z/OS
Version 2 Release 4

DFSORT: Getting Started

IBM
Note

Before using this information and the product it supports, read the information in “Notices” on page 183.
| Figures | ix |
| Tables | xi |

**About this document**

- How to use this document: xv
- Required product knowledge: xv

**How to send your comments to IBM**

- If you have a technical problem: xvii

**Summary of changes**

- z/OS Version 2 Release 4 summary of changes: xix
- New information: xix
- Summary of changes for z/OS Version 2 Release 3: xx
- New information: xx
- Summary of changes for SC23-6880-01 z/OS Version 2 Release 2: xxi
- New information: xxi

**Part 1. Introduction**

- Chapter 1. What is DFSORT?: 3
- DFSORT on the World Wide Web: 3
- DFSORT FTP site: 3
- Data sets, records and fields: 3
- Sorting data sets: 4
- Merging data sets: 4
- Copying data sets: 5
- Joining data sets: 5
- What else can you do with DFSORT?: 5
- Creating and running DFSORT jobs: 6
  - Writing jobs: 6
  - Summary of DFSORT control statements: 6
  - Running jobs: 7
- Creating and using the sample data sets: 7

**Part 2. Learning to write JCL and DFSORT control statements**

- Chapter 2. Sorting, merging, and copying data sets: 11
  - Sorting data sets: 11
  - Sorting by multiple fields: 13
  - FIELDS: 15
  - Example: Sorting Character data and ASCII Unsigned free format numeric data: 15
  - Example: Merging ASCII Signed free format numeric data: 15
  - Continuing a statement: 15
  - Comment statements: 15
  - JCL for sorting data sets directly: 16
  - Merging data sets: 17
  - Writing the MERGE control statement: 18
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>JCL for copying data sets directly</td>
<td>21</td>
</tr>
<tr>
<td>FIELDS</td>
<td>20</td>
</tr>
<tr>
<td>FORMAT</td>
<td>20</td>
</tr>
<tr>
<td>VB data set considerations</td>
<td>20</td>
</tr>
<tr>
<td>Starting positions</td>
<td>20</td>
</tr>
<tr>
<td>Short control fields</td>
<td>20</td>
</tr>
<tr>
<td>Copying data sets</td>
<td>21</td>
</tr>
<tr>
<td>Specifying COPY on the SORT, MERGE, or OPTION statement</td>
<td>21</td>
</tr>
<tr>
<td>JCL for copying data sets directly</td>
<td>21</td>
</tr>
<tr>
<td>Chapter 3. Including or omitting records</td>
<td>23</td>
</tr>
<tr>
<td>Writing the INCLUDE statement</td>
<td>23</td>
</tr>
<tr>
<td>Writing the OMIT statement</td>
<td>26</td>
</tr>
<tr>
<td>Allowable comparisons for INCLUDE and OMIT</td>
<td>26</td>
</tr>
<tr>
<td>Writing constants</td>
<td>28</td>
</tr>
<tr>
<td>Character strings</td>
<td>28</td>
</tr>
<tr>
<td>Hexadecimal strings</td>
<td>28</td>
</tr>
<tr>
<td>Decimal numbers</td>
<td>28</td>
</tr>
<tr>
<td>Numeric tests for INCLUDE and OMIT</td>
<td>29</td>
</tr>
<tr>
<td>Alphanumeric Tests for INCLUDE and OMIT</td>
<td>29</td>
</tr>
<tr>
<td>Substring search for INCLUDE and OMIT</td>
<td>30</td>
</tr>
<tr>
<td>Regular expressions</td>
<td>30</td>
</tr>
<tr>
<td>Unicode comparisons</td>
<td>31</td>
</tr>
<tr>
<td>VB data set considerations</td>
<td>32</td>
</tr>
<tr>
<td>Starting positions</td>
<td>32</td>
</tr>
<tr>
<td>Short control fields</td>
<td>32</td>
</tr>
<tr>
<td>Summary</td>
<td>32</td>
</tr>
<tr>
<td>Chapter 4. Summing records</td>
<td>33</td>
</tr>
<tr>
<td>Writing the SUM statement</td>
<td>33</td>
</tr>
<tr>
<td>Suppressing records with duplicate control fields</td>
<td>35</td>
</tr>
<tr>
<td>Handling overflow</td>
<td>36</td>
</tr>
<tr>
<td>VB data set considerations</td>
<td>36</td>
</tr>
<tr>
<td>Starting positions</td>
<td>36</td>
</tr>
<tr>
<td>Short summary fields</td>
<td>36</td>
</tr>
<tr>
<td>Chapter 5. Reformatting records with fixed fields</td>
<td>37</td>
</tr>
<tr>
<td>Reformatting records after sorting with BUILD or FIELDS</td>
<td>38</td>
</tr>
<tr>
<td>Reordering fields to reserve space</td>
<td>39</td>
</tr>
<tr>
<td>Inserting binary zeros</td>
<td>39</td>
</tr>
<tr>
<td>Inserting blanks</td>
<td>40</td>
</tr>
<tr>
<td>Inserting strings</td>
<td>41</td>
</tr>
<tr>
<td>Character strings</td>
<td>41</td>
</tr>
<tr>
<td>Hexadecimal strings</td>
<td>42</td>
</tr>
<tr>
<td>Setting up a basic report</td>
<td>42</td>
</tr>
<tr>
<td>Translating uppercase to lowercase, EBCDIC to ASCII, and more</td>
<td>43</td>
</tr>
<tr>
<td>Converting numeric fields to different formats</td>
<td>44</td>
</tr>
<tr>
<td>Editing numeric fields</td>
<td>45</td>
</tr>
<tr>
<td>Displaying data in hexadecimal</td>
<td>48</td>
</tr>
<tr>
<td>Displaying data as bits</td>
<td>48</td>
</tr>
<tr>
<td>Performing arithmetic with numeric fields and constants</td>
<td>48</td>
</tr>
<tr>
<td>Converting date fields</td>
<td>49</td>
</tr>
<tr>
<td>Performing arithmetic with date fields</td>
<td>50</td>
</tr>
<tr>
<td>Doing lookup and change</td>
<td>51</td>
</tr>
<tr>
<td>Left-justifying and right-justifying data</td>
<td>52</td>
</tr>
<tr>
<td>Left-squeezing and right-squeezing data</td>
<td>54</td>
</tr>
<tr>
<td>Reformatting records with OVERLAY</td>
<td>58</td>
</tr>
<tr>
<td>Extending records with OVERLAY</td>
<td>59</td>
</tr>
</tbody>
</table>
Consolidate records with SUM.................................................................118
Create multiple output data sets with OUTFIL.......................................119
Replace program logic with DFSORT control statements.....................119
Use FASTSRT with COBOL.................................................................119
Avoid options that might degrade performance.....................................119

Part 3. Learning to use ICETOOL.............................................................121

Chapter 12. Using the ICETOOL utility........................................................123
ICETOOL operators.................................................................................123
Sample input data sets..........................................................................124
Writing required JCL statements..............................................................124
ICETOOL comment and blank statements............................................125
Printing statistics for numeric fields......................................................126
  Continuing an operator statement......................................................127
  Statistics for VB data set record lengths...........................................127
Creating identical sorted data sets.......................................................128
Creating different subsets of a sorted data set......................................130
Creating multiple unsorted data sets....................................................133
Counting values in a range.................................................................133
Printing simple reports........................................................................135
Printing tailored reports.......................................................................136
Using formatting items........................................................................138
  Edit masks......................................................................................138
  Number of digits............................................................................140
  Leading zeros................................................................................140
  Edit patterns..................................................................................140
  No statistics..................................................................................141
  Division.........................................................................................141
  Leading, floating and trailing characters........................................142
Printing sectioned reports..................................................................142
Printing how many times fields occur................................................144
Selecting records by field occurrences................................................147
Joining fields from different data sets..................................................150
Matching records from different data sets..........................................152
Sorting records between headers and trailers.....................................155
Keeping or removing headers, trailers and relative records.................156
Merging previously sorted data sets....................................................157
Complete ICETOOL job and TOOLMSG output..................................157

Part 4. Learning to use symbols.............................................................163

Chapter 13. Defining and using symbols..................................................165
Creating the SYMNAMES data set.......................................................165
Defining symbols for fields..................................................................165
Using symbols for fields in DFSORT statements.................................166
Using symbols for fields in ICETOOL operators..................................167
Defining and using symbols for constants..........................................168

Appendix A. Creating the sample data sets..........................................171
Appendix B. Descriptions of the sample data sets.................................173
Appendix C. Processing order of control statements.............................177
Appendix D. Accessibility.....................................................................179
Figures

1. Comparison Operators................................................................................................................................ 24
2. Sample COBOL Program with MERGE Commands.................................................................................. 112
3. Sample PL/I Program with SORT Commands.......................................................................................... 114
4. Complete TOOLMSG Data Set. (Part 1 of 2)............................................................................................. 160
5. Complete TOOLMSG Data Set. (Part 2 of 2)............................................................................................. 161
6. Processing Order of Control Statements................................................................................................. 177
Tables

1. Related documents............................................................................................................................................ xvi
2. DFSORT Arranges Information in Ascending and Descending Order.......................................................... 4
3. Commonly Used Data Formats.......................................................................................................................... 4
4. DFSORT Merges Two Data Sets into One Data Set........................................................................................ 5
5. Sample Bookstore Data Set Sorted by Course Department in Ascending Order........................................ 8
6. Steps to Create the SORT Statement to Sort by Department..................................................................... 11
7. Sample Bookstore Data Set Sorted by Course Department in Ascending Order........................................ 12
8. Sample Bookstore Data Set Sorted by Price in Descending Order............................................................... 12
9. Sample Bookstore Data Set Sorted by Multiple Fields............................................................................... 14
10. Sample Bookstore Data Set Sorted by Course Department and Book Title................................................ 17
11. Five New Records Sorted by Course Department and Book Title............................................................ 17
12. Sample Bookstore Data Set Merged with Five New Records..................................................................... 18
13. Steps to Create the INCLUDE Statement for Books You Need to Order.................................................. 24
14. Books for which Number Sold is greater than Number in Stock.............................................................. 25
15. COR Books for which Number Sold is greater than Number in Stock...................................................... 25
16. Sorted Data Set without Books Not Required for Classes.......................................................................... 26
17. Allowable Field-to-Field Comparisons......................................................................................................... 27
18. Allowable Field-to-Constant Comparisons................................................................................................. 27
19. Steps to Create the SUM Statement for Prices.......................................................................................... 33
20. Sum of Prices for English Department.......................................................................................................... 34
21. Sum of Prices for English Department.......................................................................................................... 34
22. Sum of Number in Stock and Number Sold for Each Publisher................................................................ 35
23. List of Publishers, Deleting Duplicates........................................................................................................ 35
24. Steps to Create the OUTREC Statement for Reformatting Records........................................................ 38
25. Writing Only Publisher, Number In Stock, and Number Sold Fields....................................................... 38
26. Reordering the Fields................................................................................................................................39
27. Inserting Binary Zeros.............................................................................................................................. 40
28. Output After Inserting Blanks...................................................................................................................40
29. Output of a Report.....................................................................................................................................43
30. Converting from BI to ZD.......................................................................................................................... 44
31. Converting from BI to FS...........................................................................................................................45
32. Input records with PD values....................................................................................................................45
33. Edit Mask Patterns.................................................................................................................................... 46
34. Books with Course Department and Price Changes................................................................................ 58
35. New and Old Prices................................................................................................................................... 59
36. Proposed discounts for books.................................................................................................................. 62
37. Using INREC to Write Only Publisher, Number in Stock, and Number Sold............................................65
38. Padding Summary Fields.......................................................................................................................... 66
39. Padding Summary Fields.......................................................................................................................... 67
40. Total book prices by course......................................................................................................................67
41. Total Book Prices by Course with Sequence Numbers............................................................................68
42. Creating the OUTFIL Statement for the Multiple Output Data Set Job................................................... 80
43. Relative Records Numbers for Copy........................................................................................................ 81
44. Relative Records Numbers for Sort.......................................................................................................... 81
45. Output records in ENGLOUT data set.......................................................................................................82
46. Output records in HISTOUT data set.........................................................................................................83
47. Output records in PSYCHOUT data set.......................................................................................................83
48. Output records in RESTOUT data set.......................................................................................................83
49. REGION.IN1 data set for JOINKEYS application ................................................................. 101
50. REGION.IN2 data set for JOINKEYS application ................................................................. 101
51. REGION.OUT data set for JOINKEYS application ............................................................... 101
52. REGION.OUT data set Sorted by Headquarters and Office .................................................. 103
53. CITIES.IN1 data set ............................................................................................................. 103
54. CITIES.IN2 data set ............................................................................................................. 104
55. CITIES.OUT data set ......................................................................................................... 104
56. Joined City records ............................................................................................................ 105
57. BOTH.OUT data set ........................................................................................................... 106
58. F1ONLY.OUT data set ....................................................................................................... 107
59. F2ONLY.OUT data set ....................................................................................................... 107
60. Control Statement and Corresponding Records with INREC ............................................ 118
61. Steps to Create a Blank Statement and a Comment Statement ........................................ 125
62. Steps to Create the STATS Operator ................................................................................ 126
63. Steps to Create the SORT Operator .................................................................................. 128
64. Steps to Create JCL Statements for the SORT Operator .................................................... 129
65. Books from publishers VALD and WETH ................................................................……. 130
66. Steps to Create the SORT Operator .................................................................................. 131
67. Steps to Create JCL Statements for the SORT Operator .................................................... 131
68. Records for California Sorted by City .............................................................................. 132
69. Records for Colorado Sorted by City ............................................................................... 132
70. Edit Mask Patterns .......................................................................................................... 138
71. Books from Publishers with More than Four Books in Use .............................................. 148
72. REGION.IN1 data set for join .......................................................................................... 150
73. REGION.IN2 data set for join .......................................................................................... 150
About this document

*z/OS DFSORT: Getting Started* is a user’s guide and tutorial for DFSORT (Data Facility Sort). You should read it if you are not familiar with DFSORT and would like to learn the many ways you can use DFSORT and DFSORT’s ICETOOL utility to process data sets. Both new and experienced DFSORT users can use this document as a general guide to the many features available with DFSORT and ICETOOL. This document introduces you to the JCL, control statements and features of DFSORT and ICETOOL with numerous examples. *z/OS DFSORT: Getting Started* can help you get the most out of *z/OS DFSORT Application Programming Guide*, which has the complete details on all of the topics introduced in this document.

The chapters in this document assume that you have used job control language (JCL) and understand how to work with data sets. You should also know what data sets are available at your site.

How to use this document

This document gives you all of the information and instructions you need to build and submit DFSORT jobs. You use DFSORT by writing JCL and DFSORT program control statements.

New users should work through *z/OS DFSORT: Getting Started* from cover to cover. Each task explained in this document builds on knowledge gained in previous tasks. The Table of Contents lists the main tasks, and summaries are included in the chapters. If you have previous experience with these tasks, you can proceed from here directly to the tutorials that begin in Chapter 2, “Sorting, merging, and copying data sets,” on page 11.

Chapter 1, “What is DFSORT?” on page 3 is an overview of the basic principles of sorting, merging, and copying, and explains how to create and use the sample data sets for the examples in this document.

Chapter 2, “Sorting, merging, and copying data sets,” on page 11 through Chapter 11, “Using DFSORT efficiently,” show you how to create and process DFSORT jobs by writing JCL and DFSORT program control statements (for example, SORT, MERGE, OPTION, INCLUDE, OMIT, INREC, OUTREC, SUM, OUTFIL, JOINKEYS, JOIN and REFORMAT) to create sorted, merged or copied output data sets while performing various operations on records such as subsetting, reformatting, summing, reporting, and joining.

Chapter 12, “Using the ICETOOL utility,” on page 123 shows you how to create and process ICETOOL jobs by writing JCL and ICETOOL statements. ICETOOL is a multipurpose DFSORT utility that uses the capabilities of DFSORT to perform multiple operations on one or more data sets in a single step. ICETOOL’s 17 operators (COPY, COUNT, DATASORT, DEFAULTS, DISPLAY, MERGE, MODE, OCCUR, RANGE, RESIZE, SELECT, SORT, SPLICE, STATS, SUBSET, UNIQUE and VERIFY) expand DFSORT’s capabilities significantly.

Chapter 13, “Defining and using symbols,” on page 165 shows you how to define symbols for fields and constants and use them in your DFSORT control statements and ICETOOL operators.

Several appendixes and an index follow the chapters.

Required product knowledge

To use this document effectively, you should be familiar with the following information:

- Job control language (JCL)
- Data management

You should also be familiar with the information presented in the following related documents:
### Table 1. Related documents

<table>
<thead>
<tr>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>z/OS DFSORT Application Programming Guide</td>
</tr>
<tr>
<td>z/OS MVS JCL Reference</td>
</tr>
<tr>
<td>z/OS MVS JCL User's Guide</td>
</tr>
<tr>
<td>z/OS DFSMS Using Data Sets</td>
</tr>
</tbody>
</table>

*z/OS DFSORT: Getting Started* is a part of a more extensive DFSORT library. These documents can help you work with DFSORT more effectively.

These documents can help you work with DFSORT more effectively.

<table>
<thead>
<tr>
<th>Task</th>
<th>Publication Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Programming</td>
<td>z/OS DFSORT Application Programming Guide</td>
</tr>
<tr>
<td>Planning For and Customizing DFSORT</td>
<td>z/OS DFSORT Installation and Customization</td>
</tr>
<tr>
<td>Diagnosing Failures and Interpreting Messages</td>
<td>z/OS DFSORT Messages, Codes and Diagnosis Guide</td>
</tr>
<tr>
<td>Tuning DFSORT</td>
<td>z/OS DFSORT Tuning Guide</td>
</tr>
</tbody>
</table>
How to send your comments to IBM

We invite you to submit comments about the z/OS® product documentation. Your valuable feedback helps to ensure accurate and high-quality information.

**Important:** If your comment regards a technical question or problem, see instead “If you have a technical problem” on page xvii.

Submit your feedback by using the appropriate method for your type of comment or question:

**Feedback on z/OS function**
If your comment or question is about z/OS itself, submit a request through the IBM RFE Community (www.ibm.com/developerworks/rfe/).

**Feedback on IBM® Knowledge Center function**
If your comment or question is about the IBM Knowledge Center functionality, for example search capabilities or how to arrange the browser view, send a detailed email to IBM Knowledge Center Support at ibmkc@us.ibm.com.

**Feedback on the z/OS product documentation and content**
If your comment is about the information that is provided in the z/OS product documentation library, send a detailed email to mhvrcfs@us.ibm.com. We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information.

To help us better process your submission, include the following information:
- Your name, company/university/institution name, and email address
- The following deliverable title and order number: z/OS DFSORT: Getting Started, SC23-6880-40
- The section title of the specific information to which your comment relates
- The text of your comment.

When you send comments to IBM, you grant IBM a nonexclusive authority to use or distribute the comments in any way appropriate without incurring any obligation to you.

IBM or any other organizations use the personal information that you supply to contact you only about the issues that you submit.

**If you have a technical problem**
If you have a technical problem or question, do not use the feedback methods that are provided for sending documentation comments. Instead, take one or more of the following actions:
- Go to the IBM Support Portal (support.ibm.com).
- Contact your IBM service representative.
- Call IBM technical support.
Summary of changes

z/OS Version 2 Release 4 summary of changes

This document contains information that was previously presented in z/OS DFSORT Getting Started, SC23-6880-30, which supported z/OS Version 2 Release 3.

The messages ICE027A, ICE114A and ICE161A will be issued for the following additional error situation:

Invalid use of Regular expressions.

Any automated actions based on the presence of this message should be evaluated.

The following sections summarize the changes to that information.

New information

This edition includes the following new enhancements:

Regular expressions

DFSORT now supports Regular expressions in the following DFSORT comparison operands: COND, INCLUDE, OMIT, BEGIN, END, WHEN and TRLID. This support allows DFSORT users to use Regular expressions in their batch jobs for additional filtering capabilities. Regular expressions contain a series of characters that define a pattern of text to be matched, which allows for more robust filtering capabilities.

Unicode comparisons

DFSORT now supports the usage of Unicode data formats (UTF-8, UTF-16 and UTF-32) in the following comparison operands: COND, INCLUDE and OMIT.

ASCII free format numeric

DFSORT now supports two new ASCII free format numeric data formats (AUF and ASF) in SORT and MERGE operands. The new ASCII free format numeric data formats (AUF and ASF) are also now supported in the following comparison operands: COND, INCLUDE and OMIT.

Encryption support

DFSORT now supports reading and writing to sequential extended format data sets, VSAM extended format data sets (KSDS, ESDS, RRDS, VRRDS) and PDSE data sets.

Message changes

The following changes are made to z/OS Version 2 Release 4 (V2R4).

The following messages are new, changed, or no longer issued for z/OS DFSORT Installation and Customization in z/OS V2R4.

The text for existing DFSORT messages has been changed. Any automated actions based on the presence of these messages should be evaluated.

ICE000I
ICE201I

New

The following message is new.

ICE167A
New Reserved Words for Symbols

The following are new DFSORT/ICETOOL reserved words which are no longer allowed as symbols: AUF and ASF. If you used any of these words as a symbol previously, you must change them. For example, if you used ASF, you can change it to asf.

Summary of changes for z/OS Version 2 Release 3

This document contains information that was previously presented in z/OS DFSORT Getting Started, SC23-6880-01, which supported z/OS Version 2 Release 2.

The following sections summarize the changes to that information.

The message ICE290A is will be issued for the following additional situation:

• The E15 or E35 exit was specified with block support, but the required address of the user block list parameter area was not present in the 64-bit invocation parameter list or the block list type is invalid in the user block list parameter area.

Exploit zHPF for DFSORT work data sets (November 2018):

• Enable DFSORT to create channel programs that exploit System z High Performance FICON (zHPF) with DFSORT work data sets to provide I/O performance improvements without the need for application changes.

Any automated actions based on the presence of this message should be evaluated.

New information

This edition includes the following new enhancements:

Sort/Merge of Unicode data:
DFSORT now supports the Sorting and Merging of Unicode data. This support allows users to:

• SORT/MERGE Unicode Data with control field length of 1 to 450 Unicode characters for UTF-8 format data.
• SORT/MERGE Unicode Data with control field length of 1 to 450 Unicode characters for UTF-16 format data.
• SORT/MERGE Unicode Data with control field length of 1 to 450 Unicode characters for UTF-32 format data.

E15/E35 Block support

E15/E35 exits have been enhanced to support the transfer of block of records between DFSORT and the E15/E35 exits.

Performance Improvements

DFSORT is enhanced to provide performance improvements for several DFSORT functions that generate code at run time. The enhancements will improve performance in both CPU and elapsed times. The design of performance improvements are based on the concept of storing data into the "256 byte area for the Instruction Cache". DFSORT's design has the ability to write data directly into the instruction cache stream. Modern processors can also access a portion of this cache and may invalidate the instructions stored by DFSORT. In the modern processors like z13, the instruction cache stream is considered to be any location within the same 256-byte block of storage where an instruction resides, regardless of whether that location contains an actual instruction. This means that storing data into the same 256 byte block of an instruction can cause an impact on performance.

The following functions will see improvements in both CPU and elapsed times.

• INCLUDE COND Processing
• OMIT COND processing
• SORT statement with more than 5 keys
Message changes
The following changes are made to z/OS Version 2 Release 3 (V2R3).

The following messages are new, changed, or no longer issued for z/OS DFSORT Application Programming Guide in z/OS V2R3.

New
The following messages are new.

ICE292A
ICE500A
ICE501A
ICE502A
ICE503A
ICE504A
ICE505A
ICE506I

New Reserved Words for Symbols
The following are new DFSORT/ICETOOL reserved words which are no longer allowed as symbols: UTF8, UTF16, UTF32, and COLLKEY. If you used any of these words as a symbol previously, you must change them. For example, if you used UTF8, you can change it to utf8.

Summary of changes for SC23-6880-01 z/OS Version 2 Release 2
This document contains information that was previously presented in z/OS DFSORT Getting Started, SC28-6880-00, which supported z/OS Version 2 Release 1.

The following sections summarize the changes to that information.

The message ICE099A is enhanced to list the failing member name in case of an error. Any automated actions based on the presence of this message should be evaluated.

The text for existing DFSORT messages ICE000I and ICE288I has been changed. Any automated actions based on the presence of these messages should be evaluated.

New information
This edition includes the following new enhancements:

High Performance Ficon (HPF) Exploitation
A program that invokes DFSORT, ICETOOL or ICEGENER will now be able to exploit the High Performance Ficon (zHPF) hardware. When zHPF is available, DFSORT SORT or MERGE applications will use BSAM for SORTIN, SORTOUT, and OUTFIL data sets.

Date functions
Two new date functions to calculate the week number of a given date and Age as date duration are added.

WEEKNUM function converts a given Julian/Gregorian date to number of week. There are 2 versions of this function, the standard USA format and the ISO format.

WEEKNUM=USA function returns an integer in the range of 1 to 54 that represents the week of the year. The week starts with Sunday, and January 1 is always in the first week.

WEEKNUM=ISO function returns an integer in the range of 1 to 53 that represents the week of the year. The week starts with Monday and includes 7 days. Week 1 is the first week of the year to contain a Thursday, which is equivalent to the first week containing January 4.

AGE function returns a date duration that specifies the number of years, months, and days between an input date and current date.
Age=YMD produces an 8-byte result which has duration in years (0-9999), months (00-12), and days (00-31).
Age=YM produces a 6-byte result which has duration in years (0-9999), months (00-12).
Age=YD produces a 7-byte result which has duration in years (0-9999), days (00-366).

**Message changes**

The text for existing DFSORT messages has been changed. Any automated actions based on the presence of these messages should be evaluated.

ICE000I
ICE099A
ICE121A
ICE288I
Part 1. Introduction
Chapter 1. What is DFSORT?

DFSORT is IBM’s high-performance sort, merge, copy, analysis, and reporting product for z/OS.

With DFSORT, you can sort, merge, and copy data sets. You can use DFSORT to do simple tasks such as alphabetizing a list of names, or you can use it to aid complex tasks such as taking inventory or running a billing system. DFSORT gives you versatile data handling capabilities at the record, field and bit level.

DFSORT on the World Wide Web

For articles, online documents, news, tips, techniques, examples, and more, visit the DFSORT Home Page (www.ibm.com/storage/dfsort).

DFSORT FTP site

You can obtain DFSORT articles and examples by anonymous FTP to:


Data sets, records and fields

The information you manipulate with DFSORT is contained in data sets. The term data set refers to a file that contains one or more records. Any named group of records is called a data set. The terms data set and file are synonymous, and are used interchangeably in this document.

A data set contains the information that you want to sort, copy, or merge. For most of the processing done by DFSORT, the whole data set is affected. However, some forms of DFSORT processing involve only certain individual records in that data set.

Data sets can be cataloged, which permits the data set to be referred to by name without specifying where the data set is stored. A cataloged data set should not be confused with a cataloged procedure. A cataloged procedure is a named collection of JCL stored in a data set, and a cataloged data set is a data set whose name is recorded by the system.

Throughout this document, the term record refers to a collection of related information used as a unit, such as one item in a data base or personnel data about one member of a department. The term field refers to a specific portion of a record used for a particular category of data, such as an employee’s name or department.

DFSORT can sort, copy or merge fixed-length or variable-length records. The type and length of a data set is defined by its record format (RECFM) and logical record length (LRECL). Fixed-length data sets have a RECFM of F, FB, FBS, and so on. Variable-length data sets have a RECFM of V, VB, VBS, and so on. For simplicity in this document, the terms “FB data set” and “FB records” are used as short-hand for fixed-length data sets and records, respectively, and the terms “VB data set” and “VB records” are used as short-hand for variable-length record data sets and variable-length records, respectively.

A data set with RECFM=FB and LRECL=25 is a fixed-length (FB) data set with a record length of 25-bytes (the B is for blocked). For an FB data set, the LRECL tells you the length of each record in the data set; all of the records are the same length. A record in an FB data set with LRECL=25 might look like this:

| Positions 1-3:  | Country Code = 'USA' |
| Positions 4-5:  | State Code = 'CA'   |
| Positions 6-25: | City = 'San Jose' padded with 12 blanks on the right |

A data set with RECFM=VB and LRECL=25 is a variable-length (VB) data set with a maximum record length of 25-bytes. For a VB data set, different records can have different lengths. The first four bytes of each record contain the Record Descriptor Word or RDW, and the first two bytes of the RDW contain the
length of that record (in binary). The first data byte of a VB record is in position 5, after the 4-byte RDW in positions 1-4. A record in a VB data set with LRECL=25 might look like this:

| Positions 1-2: | Length in RDW = hex 000E = decimal 14 |
| Positions 3-4: | Zeros in RDW = hex 0000 = decimal 0   |
| Positions 5-7: | Country Code = 'USA'                   |
| Positions 8-9: | State Code = 'CA'                      |
| Positions 10-17:| City = 'San Jose'                     |

Unless otherwise noted, the examples in this document process FB data sets, which are easier to work with and describe. However, special considerations for processing VB data sets are discussed throughout this document whenever appropriate.

## Sorting data sets

You can use DFSORT to rearrange the records in your data sets. Sorting is arranging records in either ascending or descending order within a file. Table 2 on page 4 shows a sample data set of names, first sorted in ascending order, then in descending order.

Table 2. DFSORT Arranges Information in Ascending and Descending Order

<table>
<thead>
<tr>
<th>Unsor ted Data Set</th>
<th>Sorted Ascending</th>
<th>Sorted Descending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td>Andy</td>
<td>Edward</td>
</tr>
<tr>
<td>Edward</td>
<td>Betty</td>
<td>Dan</td>
</tr>
<tr>
<td>Carol</td>
<td>Carol</td>
<td>Carol</td>
</tr>
<tr>
<td>Dan</td>
<td>Dan</td>
<td>Betty</td>
</tr>
<tr>
<td>Betty</td>
<td>Edward</td>
<td>Andy</td>
</tr>
</tbody>
</table>

You can sort data in many different formats. Table 3 on page 4 shows the most commonly used DFSORT data formats and the format identifiers you use to specify them.

Table 3. Commonly Used Data Formats

<table>
<thead>
<tr>
<th>Data Format</th>
<th>Format Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBCDIC (Character)</td>
<td>CH</td>
</tr>
<tr>
<td>Binary (Unsigned Numeric)</td>
<td>BI</td>
</tr>
<tr>
<td>Fixed-point (Signed Numeric)</td>
<td>FI</td>
</tr>
<tr>
<td>Zoned Decimal (Signed Numeric)</td>
<td>ZD</td>
</tr>
<tr>
<td>Packed Decimal (Signed Numeric)</td>
<td>PD</td>
</tr>
<tr>
<td>Floating Sign (Signed Numeric)</td>
<td>FS</td>
</tr>
<tr>
<td>Free Form (Unsigned Numeric)</td>
<td>UFF</td>
</tr>
<tr>
<td>Free Form (Signed Numeric)</td>
<td>SFF</td>
</tr>
</tbody>
</table>

Refer to z/OS DFSORT Application Programming Guide for complete details of the available formats.

## Merging data sets

You can also use DFSORT to merge data sets. DFSORT merges data sets by combining two or more files of sorted records to form a single data set of sorted records.
Table 4. DFSORT Merges Two Data Sets into One Data Set

<table>
<thead>
<tr>
<th>Data Set 1</th>
<th>Data Set 2</th>
<th>Merged Data Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td>Amy</td>
<td>Amy</td>
</tr>
<tr>
<td>Betty</td>
<td>Chris</td>
<td>Andy</td>
</tr>
<tr>
<td>Carol</td>
<td>Sue</td>
<td>Betty</td>
</tr>
<tr>
<td>Dan</td>
<td>Chris</td>
<td>Carol</td>
</tr>
<tr>
<td>Edward</td>
<td>Dan</td>
<td>Chris</td>
</tr>
<tr>
<td></td>
<td>Sue</td>
<td>Dan</td>
</tr>
</tbody>
</table>

The data sets you merge must be previously sorted into the same order (ascending or descending).

Copying data sets

DFSORT can also copy data sets without any sorting or merging taking place. You copy data sets in much the same way that you sort or merge them.

Joining data sets

DFSORT can perform various "join" operations on two data sets by one or more keys. You can create joined records in a variety of ways including inner join, full outer join, left outer join, right outer join and unpaired combinations. The two input data sets can be of different types (fixed, variable, VSAM, and so on) and have keys in different locations. The records from the two input files can be processed in a variety of ways before and after they are joined.

What else can you do with DFSORT?

While sorting, merging, or copying data sets, you can also perform other tasks such as the following:

- Select a subset of records from an input data set. You can include or omit records that meet specified criteria. For example, when sorting an input data set containing records of course documents from many different school departments, you can sort the documents for only one department.
- Reformat records in a variety of ways. You can build your records one item at a time, only overlay specific columns, or reformat different records in different ways. You can edit, change, add or delete fields. You can convert date fields of one type to another type and perform date field arithmetic. You can perform find and replace operations on your records. You can perform various operations on groups of records. You can work with fixed position/length fields directly or convert variable position/length fields (such as comma separated values) to fixed parsed fields for further processing. You can also insert blanks, zeros, strings, current date, future date, past date, current time, sequence numbers, decimal constants, and the results of arithmetic instructions before, between, and after input fields. For example, you can create an output data set that contains character strings and only certain edited fields from the input data set, arranged differently.
- Sum the values in selected records while sorting or merging (but not while copying). In the example of a data set containing records of course books, you can use DFSORT to add up the dollar amounts of books for one school department.
- Create multiple output data sets and simple or complex reports from a single pass over an input data set. For example, you can create a different output data set for the records of each department.
- Convert VB data sets to FB data sets, or convert FB data sets to VB data sets.
- Sample or repeat records.
- Sort, merge, include or omit records according to the collating rules defined in a selected locale.
- Alter the collating sequence when sorting or merging records (but not while copying). For example, you can have the lowercase letters collate after the uppercase letters.
Creating and running DFSORT jobs

Processing data sets with DFSORT involves two steps:

1. Creating a DFSORT job
2. Running a DFSORT job

You can run a DFSORT job by invoking processing in a number of ways:

- With a JCL EXEC statement, using the name of the program or the name of the cataloged procedure
- Within programs written in COBOL, PL/I, or basic Assembler language

In this document, the phrases directly or JCL-invoked mean that the DFSORT program is initiated by a JCL EXEC statement with PGM=SORT or PGM=ICEMAN. The phrases called by a program or dynamically invoked mean that the DFSORT program is initiated from another program.

Writing jobs

You can use DFSORT by writing JCL and DFSORT control statements no matter how your site has installed DFSORT. Part 1 contains instructions on writing JCL and DFSORT program control statements.

You must prepare JCL statements and DFSORT program control statements to invoke DFSORT processing. JCL statements are processed by your operating system. They describe your data sets to the operating system, and initiate DFSORT processing. DFSORT program control statements are processed by DFSORT. They describe and initiate the processing you want to do.

Summary of DFSORT control statements

The functions of the most important DFSORT control statements can be summarized briefly as follows:

SORT
Describes the fields for a sort application, or requests a copy application.

MERGE
Describes the fields for a merge application, or requests a copy application.

OPTION
Overrides installation defaults, or requests optional features or a copy application.

INCLUDE
Describes the criteria to be used to include records before they are sorted, copied or merged.

OMIT
Describes the criteria to be used to omit records before they are sorted, copied or merged.

INREC
Describes how records are to be reformatted before they are sorted, copied or merged.

OUTREC
Describes how records are to be reformatted after they are sorted, copied or merged.

SUM
Describes how fields are to be summed after sorting or merging.

OUTFIL
Describes various types of processing to be performed for one or more output data sets after sorting, copying or merging.

JOINKEYS, JOIN, REFORMAT
Describes a "joinkeys" application for joining two files on one or more keys.
The functions of the less important DFSORT control statements can be summarized briefly as follows:

**ALTSEQ**
- Describes changes to the normal translation table.

**MODS**
- Describes user exit routines.

**RECORD**
- Supplies data set record type and length information when needed.

**DEBUG**
- Requests diagnostic features.

**END**
- Marks the end of the control statements.

**Running jobs**

You can run DFSORT jobs directly with a JCL EXEC statement that uses PGM=SORT or PGM=ICEMAN. Or, you can call DFSORT dynamically from a COBOL, Assembler, PL/I, or other type of program.

**Creating and using the sample data sets**

Many of the examples in this document refer to the sample data sets SORT.SAMPIN, SORT.SAMPADD, SORT.BRANCH and SORT.SAMPOUT. Appendix A, "Creating the Sample Data Sets" shows you how to create your own copies of these data sets, using a program called ICESAMP shipped with DFSORT, if you want to try the examples in this document that use them.

**Note:** Some of the examples use data sets other than SORT.SAMPIN, SORT.SAMPADD, SORT.SAMPOUT, SORT.SAMPADD, and SORT.BRANCH. You can either create data sets from scratch to match the ones used in the text, or else perform a similar exercise on data sets you already have.

Before you begin, turn to Appendix B, “Descriptions of the sample data sets,” on page 173. Many of the examples in this document refer to the sample bookstore data sets as the input data sets, so you should become familiar with them. The input data sets contain the data that you want arranged or sorted. You must specify an input data set for every DFSORT job you run. The sample bookstore data set is named SORT.SAMPIN and the additional bookstore data set is named SORT.SAMPOUT.

Each record in the bookstore data sets has 12 fields (book title, author’s last name, and so on). A record can be represented by one horizontal row on the page. A field can be represented by one vertical column on the page.

To sort a data set, you choose one or more fields that you want to use to order the records (arrange in ascending or descending order). These fields are called control fields (or, in COBOL, keys).

As you work through the exercises on the following pages, remember that each entire record is sorted, not just the control field. However, for the sake of simplicity, the figures in the text show only the control fields being discussed. The sorted records actually contain all of the fields, but one page is not wide enough to show them. Appendix B, “Descriptions of the sample data sets,” on page 173, shows all of the fields in each record. It is also arranged with headings and numbers that show the byte positions of each field. The numeric fields are in binary format (see Table 3 on page 4) and therefore will not appear on most displays as they do in this document. Methods you can use to arrange and view the data are explained in the chapters on DFSORT functions that follow.

Table 5 on page 8 shows an example of sorted fields. Notice the line of numbers above the sorted fields. These numbers represent the byte positions of those fields. You use byte positions to identify fields to DFSORT. The examples show the byte positions to help you while you are learning to use DFSORT. The byte positions do not actually appear in any of your processed data sets.

In Table 5 on page 8, the first two records, which show nothing in the course department fields, are general purpose books not required for a particular course. For this example, the control field is the Course Department field.
Table 5. Sample Bookstore Data Set Sorted by Course Department in Ascending Order

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>110 114</td>
<td>170 173</td>
</tr>
<tr>
<td>PICK'S POCKET DICTIONARY</td>
<td>BioL</td>
<td>9900</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>BioL</td>
<td>2350</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>BusIn</td>
<td>1925</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>BusIn</td>
<td>2350</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>Comp</td>
<td>2600</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>Comp</td>
<td>2199</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>Comp</td>
<td>1899</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>Comp</td>
<td>360</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>Comp</td>
<td>3195</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>EngL</td>
<td>595</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>EngL</td>
<td>1450</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>EngL</td>
<td>450</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>EngL</td>
<td>625</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>EngL</td>
<td>1520</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>Hist</td>
<td>795</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>Hist</td>
<td>1790</td>
</tr>
<tr>
<td>CRISIS OF THE MIDDLE AGES</td>
<td>Hist</td>
<td>1200</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>Psych</td>
<td>2200</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>Psych</td>
<td>2600</td>
</tr>
</tbody>
</table>

Also notice that records in Table 5 on page 8 with equally collating control fields (in this case, the same department) appear in their original order. For example, within the Computer Science department (COMP), the title *Video Game Design* still appears before *Computers: An Introduction*.

You can control whether records with equally collating control fields appear in their original order or whether DFSORT orders them randomly. The system programmer sets defaults at installation time that you can change with some DFSORT options at run time. The examples in this document assume that the default is for records with equally collating control fields to appear in their original order.

Summary

So far in Getting Started you covered the following concepts:

- You can sort, copy, or merge data sets using DFSORT.
- You can write JCL and DFSORT program control statements to create and process DFSORT jobs.
- You can run DFSORT jobs directly or call DFSORT from a program.

In addition, this chapter covered how to use and read the sample data sets provided with DFSORT. Now continue with tutorials on how to write DFSORT control statements.
Part 2. Learning to write JCL and DFSORT control statements
Chapter 2. Sorting, merging, and copying data sets

This tutorial shows you how to sort, merge, and copy data sets by writing DFSORT program control statements that are processed with JCL.

DFSORT program control statements are input in the JCL used to run DFSORT. To keep the instructions simple, the program control statements are covered first and the related JCL statements are explained afterward. For most of the tutorials you will concentrate on JCL-invoked DFSORT, that is, running DFSORT with JCL. Information on calling DFSORT from a program (dynamic invocation) is presented in Chapter 9, “Calling DFSORT from a program,” on page 109.

Sorting data sets

To use DFSORT directly (JCL-invoked), write a SORT control statement to describe the control fields, and the order in which you want them sorted. The control statements you write are part of the SYSIN data set in the JCL. The SYSIN data set is typically specified as //SYSIN DD * followed by “inline” control statements (as shown in the examples in this document). However, a sequential data set, or a member of a partitioned data set, with the control statements as records can also be used for the SYSIN data set.

You can use SORT with all of the other DFSORT control statements.

A SORT statement that sorts the bookstore records by the course department field (as shown in Table 7 on page 12) looks like this:

```
SORT FIELDS=(110,5,CH,A)
```

Make sure that the statement is coded between columns 2 and 71.

Here are the steps for writing this SORT statement:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leave at least one blank, and type SORT</td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank and type FIELDS=</td>
</tr>
<tr>
<td>3</td>
<td>Type, in parenthesis and separated by commas:</td>
</tr>
<tr>
<td></td>
<td>1. Where the course department field begins, relative to the beginning of the record in the bookstore data set (the first position is byte 1). The course department field begins at byte 110.</td>
</tr>
<tr>
<td></td>
<td>2. The length of the department field in bytes. The department field is 5 bytes long.</td>
</tr>
<tr>
<td></td>
<td>3. A format identifier for the data format. The department field contains character data, which you specify as CH. (Table 3 on page 4 shows the codes for the most commonly used data formats.)</td>
</tr>
<tr>
<td></td>
<td>4. The letter A, for ascending order.</td>
</tr>
</tbody>
</table>
Remember that although Table 7 on page 12 shows only certain fields, the displayed fields are not the only ones in the output data set. Your output data set will more closely resemble the fold-out of the sample bookstore data set.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>BIOL</td>
</tr>
<tr>
<td>PICK'S POCKET DICTIONARY</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>BUSIN</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>COMP</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>COMP</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>COMP</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>COMP</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>COMP</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>HIST</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>PSYCH</td>
</tr>
</tbody>
</table>

To sort the records in descending order, specify D instead of A. For example, to sort the prices for each book in descending order, type:

\[
\text{SORT FIELDS=(170,4,BL,D)}
\]

The sort order is bytes 170 through 173 as binary data in descending sequence. Table 8 on page 12 shows the results of the sort in descending order.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>170 173</td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Sample Bookstore Data Set Sorted by Price in Descending Order (continued)

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>9900</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>3195</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>2600</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>2600</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>2350</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>2350</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>2200</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>2199</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>1925</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>1899</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>1790</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>1520</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>1450</td>
</tr>
<tr>
<td>CRISSES OF THE MIDDLE AGES</td>
<td>1200</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>795</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>625</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>595</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>450</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>360</td>
</tr>
<tr>
<td>PICK'S POCKET DICTIONARY</td>
<td>295</td>
</tr>
</tbody>
</table>

Sorting by multiple fields

You can further sort the records in the bookstore data set by specifying multiple control fields. When you specify two or more control fields, you specify them in the order of greater to lesser priority. Note that control fields might overlap or be contained within other control fields.

Table 9 on page 14 shows how the records would be sorted if you specified the following control fields in the order they are listed:

1. Course department
2. Course number
3. Instructor’s last name
4. Instructor’s initials

So, if two records have the same department, they are sorted by course number. If they also have the same course number, they are sorted by instructor’s last name. If they also have the same last name, they are sorted by initials. Finally, if they also have the same initials, they are sorted by title.

Specify the location, length, data format, and order for each of the control fields, as follows:

SORT FIELDS=(110,5,CH,A,115,5,CH,A,145,15,CH,A,160,2,CH,A,1,75,CH,A)
The records are sorted as shown in Table 9 on page 14.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
<th>Course Number</th>
<th>Instructor's Last Name</th>
<th>Instructor's Initials</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>BIOL</td>
<td>80521</td>
<td>GREENBERG</td>
<td>HC</td>
</tr>
<tr>
<td>PICK'S POCKET DICTION</td>
<td>BUSIN</td>
<td>70124</td>
<td>LORCH</td>
<td>HH</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>BUSIN</td>
<td>70251</td>
<td>MAXWELL</td>
<td>RF</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>COMP</td>
<td>00032</td>
<td>CHATTERJEE</td>
<td>AN</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>COMP</td>
<td>00032</td>
<td>CHATTERJEE</td>
<td>CL</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>COMP</td>
<td>00032</td>
<td>CHATTERJEE</td>
<td>CL</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>COMP</td>
<td>00103</td>
<td>SMITH</td>
<td>DC</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>COMP</td>
<td>00205</td>
<td>NEUMANN</td>
<td>LB</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
<td>10054</td>
<td>BUCK</td>
<td>GR</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
<td>10347</td>
<td>MADRID</td>
<td>MM</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
<td>10347</td>
<td>MADRID</td>
<td>MM</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
<td>10856</td>
<td>FRIEDMAN</td>
<td>KR</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
<td>10856</td>
<td>FRIEDMAN</td>
<td>KR</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
<td>50420</td>
<td>GOODMAN</td>
<td>ST</td>
</tr>
<tr>
<td>CRISSES OF THE MIDDLE AGES</td>
<td>HIST</td>
<td>50521</td>
<td>WILLERTON</td>
<td>DW</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
<td>50632</td>
<td>BISCARDI</td>
<td>HR</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
<td>30016</td>
<td>ZABOSKI</td>
<td>RL</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>PSYCH</td>
<td>30975</td>
<td>NAKATSU</td>
<td>FL</td>
</tr>
</tbody>
</table>

You can often shorten the length of control statements. You can specify fields together whenever they are next to each other in the record and have the same data format and order. You can shorten this last statement by specifying the department and course number together as one field, and the instructor's last name and initials together as one field.

```
SORT FIELDS=(110,10,CH,A,145,17,CH,A,1,75,CH,A)
```

Also, if all of the control fields have the same data format, you can specify the data format just once, using the FORMAT=f parameter. For example:

```
SORT FORMAT=CH,FIELDS=(110,10,A,145,17,A,1,75,A)
```

If some of the control fields have the same data format, but others don't, you can specify the FORMAT=f parameter along with the individual data formats. For example:

```
SORT FORMAT=CH,FIELDS=(110,10,A,179,4,BI,D,145,17,A,1,75,A)
```

is equivalent to:

```
SORT FIELDS=(110,10,CH,A,179,4,BI,D,145,17,CH,A,1,75,CH,A)
```

example: Sorting UTF16 data and Character data
FIELDS

The first four values describe the major control field. It begins on byte 5 of each record, is 4 bytes long, and contains fixed point data, and is to be sorted in ascending order.

The next four values describe the second control field. It begins on byte 345, is 400 bytes long, contains a 16-bit encoding Unicode Transformation Format (UTF16) data, and is to be sorted in descending order.

The third control field begins on byte 13, is 2 bytes long, and contains character (EBCDIC) data. It is to be sorted in ascending order.

Example: Sorting Character data and ASCII Unsigned free format numeric data

SORT FIELDS=(10, 16, CH, A, 40, 8, AUF, D)

FIELDS

The first four values describe the major control field. It begins on byte 10 of each record, is 16 bytes long, contains character (EBCDIC) data, and is to be sorted in ascending order.

The next four values describe the second control field. It begins on byte 40, is 8 bytes long, contains an ASCII Unsigned free numeric format (AUF), and is to be sorted in descending order.

Example: Merging ASCII Signed free format numeric data

MERGE FIELDS=(31, 24, A), FORMAT=ASF

FIELDS

The first three values describe the major control field. It begins on byte 31 of each record, is 24 bytes long, and is to be merged in ascending order.

FORMAT

FORMAT=ASF is used to supply an ASCII signed free format numeric data format for the p,m,s fields and is equivalent to specifying p,m,ASF,s for these fields.

Continuing a statement

If you cannot fit your SORT statement (or any other DFSORT control statement) between columns 2 through 71, you can continue it on the next line. If you end a line with a comma followed by a blank, DFSORT treats the next line as a continuation. The continuation can begin anywhere between columns 2 through 71.

For example:

SORT FORMAT=CH,FIELDS=(110, 10, A, 145, 17, A, 1, 75, A)

Comment statements

You can mix comment statements with your control statements by starting them with an asterisk (*) in column 1. DFSORT prints comment statements, but otherwise ignores them.

For example:

* Sort by department and course number
SORT FIELDS=(110, 10, CH, A)
JCL for sorting data sets directly

The job control language (JCL) you need to do a sort depends on whether you run DFSORT directly or call DFSORT from a program. For now, concentrate on running DFSORT directly. Information on calling DFSORT from a program is presented in Chapter 9, “Calling DFSORT from a program,” on page 109.

Your operating system uses the JCL you supply with your DFSORT program control statements to:

• Identify you as an authorized user
• Allocate the necessary resources to run your job
• Run your job
• Return information to you about the results
• Terminate your job

You must supply JCL with every DFSORT job you submit.

Required JCL includes a JOB statement, an EXEC statement, and several DD statements. The statements you need and their exact form depend upon whether you:

• Invoke DFSORT with an EXEC statement in the input job stream, or with a system macro instruction within another program
• Choose to use EXEC statement cataloged procedures to invoke DFSORT
• Choose to specify PARM options on the EXEC statement
• Choose to specify PARM options or control statements in a DFSPARM data set
• Choose to specify control statements in a SYSIN data set
• Want to use program exits to activate routines of your own

Information on when you would choose each of the previous options is explained in z/OS DFSORT Application Programming Guide.

The JCL statements you need for most jobs are as follows.

//jobname JOB
Signals the beginning of a job. At your site, you might be required to specify information such as your name and account number on the JOB statement.

//stepname EXEC
Signals the beginning of a job step and tells the operating system what program to run. To run DFSORT, write the EXEC statement like this:

//stepname EXEC PGM=SORT

//STEPLIB DD
The DFSORT program would typically be in a library known to the system, so the //STEPLIB DD statement would not be needed. However, if DFSORT is not in a library known to the system, the //STEPLIB DD statement defines the library containing the DFSORT program

//SYSOUT DD
Defines the data set in which DFSORT messages and control statements are listed.

//SORTIN DD
Defines the input data set or concatenated input data sets.

//SORTWKdd DD
Defines a work data set for a sort. Typically not needed, because DFSORT can allocate work data sets for a sort dynamically.

//SORTOUT DD
Defines the output data set.

//SYSIN DD
Precedes or contains the DFSORT program control statements.
The following is a typical example of JCL to run DFSORT.

```
//EXAMP    JOB  A492,PROGRAMMER
//SORT     EXEC PGM=SORT
//SYSOUT   DD   SYSOUT=A
//SORTIN   DD   DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT  DD   DSN=A123456.SORT.SAMPOUT,DISP=OLD
//SYSIN    DD   *
SORT FORMAT=CH,
   FIELDS=(110,10,A,145,17,A,1,75,A)
/*
```

z/OS DFSORT Application Programming Guide contains additional information about running DFSORT directly.

**So far**

So far in this chapter you covered how to write a SORT program control statement and how to run that sort with JCL statements. The next tutorial explains how to use the MERGE program control statement to merge two data sets.

**Merging data sets**

Generally, the reason for merging data sets is to add more records to a data set that is already sorted.

For example, assume that the bookstore data set is already sorted by course department and book title (as shown in Table 10 on page 17), and you want to update it by merging it with a data set that contains five new records, also sorted by course department and book title.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>BIOL</td>
</tr>
<tr>
<td>PICK’S POCKET DICTIONARY</td>
<td>BUSIN</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>BUSIN</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>COMP</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>COMP</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>COMP</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>COMP</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>COMP</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>HIST</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>PSYCH</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
</tr>
</tbody>
</table>

For this example, use a new data set such as the one shown in Table 11 on page 17.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>110</td>
<td>114</td>
</tr>
</tbody>
</table>
To merge data sets, you write a MERGE control statement and several JCL statements. Whenever you merge data sets, you must make sure that their records have the same format and that they have been previously sorted by the same control fields. You can merge up to 100 data sets at a time.

You can use MERGE with all of the other DFSORT control statements.

### Writing the MERGE control statement

The format of the MERGE statement is the same as that of the SORT statement. To merge the bookstore master data set with the data set containing the five new records, write:

```
MERGE FORMAT=CH, FIELDS=(110,5,A,1,75,A)
```

Table 12 on page 18 shows the merged output.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>110</td>
<td>114</td>
</tr>
<tr>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>
### Table 12. Sample Bookstore Data Set Merged with Five New Records (continued)

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERNATIONAL COOKBOOK</td>
<td>ART</td>
</tr>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>ART</td>
</tr>
<tr>
<td>PICK'S POCKET DICTION</td>
<td>ART</td>
</tr>
<tr>
<td>WORLD JOURNEYS BY TRAIN</td>
<td>ART</td>
</tr>
<tr>
<td>ARTS AND CRAFTS OF ASIA</td>
<td>ART</td>
</tr>
<tr>
<td>BIOCHEMISTRY</td>
<td>BIOL</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>BIOL</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>BUSIN</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>BUSIN</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>COMP</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>COMP</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>COMP</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>COMP</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>HIST</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>PSYCH</td>
</tr>
<tr>
<td>BEHAVIORAL ANALYSIS</td>
<td>PSYCH</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
</tr>
</tbody>
</table>

---

### JCL for merging data sets directly

As in a sort, the JCL you need depends on whether you run DFSORT directly or call it from a program. This chapter only discusses running DFSORT directly.

The JCL needed for a merge is the same as that for a sort, with the following exceptions:

- You do not need dynamic allocation of work data sets or SORTWKdd DD statements.

- Instead of the SORTIN DD statement, you use SORTINnn DD statements to define the input data sets. The SORTINnn DD statements name the input data sets, and tell how many data sets will be merged. You need one SORTINnn DD statement for each data set being merged. $nn$ in SORTINnn is a number from 00 to 99. Thus, if you wanted to merge 5 data sets, you would typically use DD statements for SORTIN01, SORTIN02, SORTIN03, SORTIN04 and SORTIN05.

To merge the pre-sorted bookstore data set and the data set containing the new records, code the following JCL statements for this example. The new data set is called A123456.NEW and the sorted version of the bookstore data set is called A123456.MASTER. For this example, it is assumed that the input data sets are cataloged and that the output data set will be cataloged.

```clike
//EXAMP    JOB  A492,PROGRAMMER
//MERGE  EXEC PGM=SORT
//SYSOUT   DD   SYSOUT=A
//SORTIN01 DD   DSN=A123456.MASTER,DISP=SHR
//SORTIN02 DD   DSN=A123456.NEW,DISP=SHR
//SORTOUT  DD   DSN=A123456.SORT.SAMPSET,DISP=OLD
//SYSIN    DD   *
  MERGE FIELDS=(110,5,CH,A,1,75,CH,A)
/*

example: Merging UTF16 data with format

MERGE FIELDS=(25,400,A,600,100,D),FORMAT=UTF16
```
FIELDS

The first three values describe the major control field. It begins on byte 25 of each record, is 400 bytes long, and contains a 16 bit encoding Unicode Transformation Format (UTF16) data, and is to be merged in ascending order.

The next three values describe the second control field. It begins on byte 600, is 100 bytes long, contains a 16 bit encoding Unicode Transformation Format (UTF16) data, and is to be merged in descending order.

FORMAT

FORMAT=UTF16 is used to supply UTF16 format for the p,m,s fields and is equivalent to specifying p,m,UTF16,s for these fields.

In Chapter 9, “Calling DFSORT from a program,” on page 109, you learn how to merge data sets when calling DFSORT from a program.

<table>
<thead>
<tr>
<th>So far</th>
</tr>
</thead>
<tbody>
<tr>
<td>So far in this chapter you covered how to write both the SORT and MERGE program control statements and how to process those control statements using JCL statements. Now you continue with the tutorial on COPY.</td>
</tr>
</tbody>
</table>

VB data set considerations

A record in a VB data set looks like this:

<table>
<thead>
<tr>
<th>A record in a VB data set looks like this:</th>
</tr>
</thead>
<tbody>
<tr>
<td>VB data set record</td>
</tr>
<tr>
<td>RDW</td>
</tr>
<tr>
<td>Fixed data</td>
</tr>
<tr>
<td>Variable data</td>
</tr>
</tbody>
</table>

The RDW (Record Descriptor Word) is a 4-byte binary field with the length of the record in the first two bytes. Fixed data consists of data bytes that are present in every record. Variable data consists of one or more data bytes that may or may not be present in every record, so different records can have different lengths up to the maximum logical record length (LRECL) for the data set.

Starting positions

For FB data sets, the first data byte starts in position 1. However, for VB data sets, the RDW is in positions 1-4, so the first data byte starts in position 5. So when you code your control fields for sorting or merging VB data sets, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following SORT statement specifies a CH control field in the third through fifth data bytes of a VB record:

```
SORT FIELDS=(7,3,CH,A)
```

Short control fields

Because VB records have a fixed part and a variable part, it is possible for part of a control field to be missing. Consider this SORT statement:

```
SORT FIELDS=(21,12,CH,A)
```

The control field is in positions 21-32. If your VB records have 25 fixed data bytes and LRECL=45, the records can vary in length from 29 bytes (4-byte RDW, 25 bytes of fixed data, and 0 bytes of variable data) to 45 bytes (4-byte RDW, 25 bytes of fixed data, and 16 bytes of variable data). Records 32 bytes or longer include the entire control field. But records less than 32 bytes have "short" control fields, that is, they are missing some of the bytes at the end of the control field. You cannot validly sort or merge on control fields with missing bytes because missing bytes have no values.
If you know you have VB records with short control fields, you can specify the VLSHRT option, if appropriate, to prevent DFSORT from terminating. For example:

```plaintext
OPTION VLSHRT
SORT FIELDS=(21,12,CH,A)
```

VLSHRT tells DFSORT that you want to temporarily replace any missing control field bytes with binary zeros (the zeros are not kept for the output record), thus allowing DFSORT to validly sort or merge on the short control fields.

**Attention:** If NOVLSHRT is in effect, DFSORT terminates if it finds a short control field in any VB record.

For more information on DFSORT's VLSHRT option, see [z/OS DFSORT Application Programming Guide](https://www.ibm.com/support/knowledgecenter/S5677_8.1.0/com.ibm.zos.v1r11.doc/dfs/dsranap.htm).

### Copying data sets

With DFSORT you can copy data sets directly without performing a sort or merge.

You can use COPY with all of the other DFSORT control statements except SUM. DFSORT can select and reformat the specific data sets you want to copy by using the control statements covered in later chapters.

You write a copy statement by specifying COPY on the SORT, MERGE, or OPTION statement.

#### Specifying COPY on the SORT, MERGE, or OPTION statement

The SORT and MERGE statements change very little when you specify COPY. Just replace the information you usually put in parentheses with the word COPY:

```plaintext
SORT FIELDS=COPY
MERGE FIELDS=COPY
```

You can also specify COPY on the OPTION statement:

```plaintext
OPTION COPY
```

All three of these statements have identical results.

### JCL for copying data sets directly

The JCL for a copy application is the same as for a sort, except that you do not need dynamic allocation of work data sets or SORTWKdd DD statements.

This sample JCL will copy the SORT.SAMPIN data set to a temporary output data set using the OPTION COPY statement:

```plaintext
//EXAMP JOB A492,PROGRAMMER
//COPY EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD DSN=&&TEMP,DISP=(,PASS),SPACE=(CYL,(5,5)),UNIT=SYSDA
//SYSIN DD *
//OPTION COPY
/*
```

You can use SORT FIELDS=COPY or MERGE FIELDS=COPY instead of OPTION COPY to produce the same results.

### Summary

In this chapter, you covered the following concepts:
- Writing the SORT, COPY, or MERGE program control statements
<table>
<thead>
<tr>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Using JCL statements to process your sort, copy, or merge</td>
</tr>
</tbody>
</table>

As you continue with the tutorials, you will cover two methods of obtaining subsets of your input data set for your output data set. Chapter 3, “Including or omitting records,” on page 23 covers allowable comparison operators, various types of constants, substring search, and padding and truncation rules for INCLUDE and OMIT.
Chapter 3. Including or omitting records

Often, you need only a subset of the records in a data set for an application. This chapter explains how to include or omit only specific records from the input data set for sorting, copying or merging to the output data set.

By removing unneeded records with an INCLUDE or OMIT statement before sorting, copying or merging, you can increase the speed of the sort, copy or merge. The fewer the records, the less time it takes to process them.

You select a subset of the records in an input data set by:

- Using an INCLUDE control statement to collect wanted records
- Using an OMIT control statement to exclude unwanted records
- Using an INCLUDE or OMIT parameter on an OUTFIL statement to collect wanted records or exclude unwanted records, respectively. Different INCLUDE and OMIT parameters can be used on different OUTFIL statements.

Your choice of an INCLUDE or OMIT statement depends on which is easier and more efficient to write for a given application. You cannot use both statements together.

The information presented in this chapter for the INCLUDE and OMIT statements also applies to the INCLUDE and OMIT parameters of the OUTFIL statement, except that:

- OUTFIL is processed after sorting, copying or merging
- The FORMAT=f parameter cannot be used for OUTFIL

OUTFIL is discussed later in Chapter 7, “Creating multiple output data sets and reports,” on page 79.

You select the records you want included or omitted by either:

1. Comparing the contents of a field with one of the following:
   - Another field
     For example, you can select records for which the author’s last name is the same as the instructor’s last name.
   - A constant
     The constant can be a character string, a decimal number, a hexadecimal string, or the current date, a future date or a past date. For example, you can select records that have the character string "HIST" in the department field.
   - Testing a field for "numerics", "alphanumerics", "non-numerics"or "non-alphanumerics". For example, you can select records that have non-numerics in the Employees field or Revenue field, or you can select records that have only uppercase (A-Z) and lowercase (a-z) characters in a specific field.

You can also combine two or more conditions with logical ANDs and ORs. For example, you can select records that have either "HIST" or "PSYCH" in the department field.

INCLUDE and OMIT both offer powerful substring search capabilities.

In addition, INCLUDE and OMIT allow you to select records based on the results of bit logic tests and two-digit year date comparisons. These two features are not discussed in this document, but details can be found in z/OS DFSORT Application Programming Guide.

Writing the INCLUDE statement

Suppose it is the end of the year and you want to sort, by title, only the books that you need to reorder for the coming year. If the number of copies sold this year for a particular book is greater than the number in stock, you can assume you need to order more copies.
An INCLUDE statement that selects only the books you need to order looks like this:

```
INCLUDE COND=(166,4,GT,162,4),FORMAT=BI
```

Here are the steps for writing this INCLUDE statement:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leave at least one blank and type <code>INCLUDE</code></td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank and type <code>COND=</code></td>
</tr>
<tr>
<td>3</td>
<td>Type, in parentheses, and separated by commas:</td>
</tr>
<tr>
<td></td>
<td>1. The location, length, and data format of the number sold field</td>
</tr>
<tr>
<td></td>
<td>2. The comparison operator <code>GT</code> (comparison operators are shown in Figure 1 on page 24) for greater than</td>
</tr>
<tr>
<td></td>
<td>3. The location, length, and data format of the number in stock field.</td>
</tr>
</tbody>
</table>

You can select from the following comparison operators:

<table>
<thead>
<tr>
<th>Comparison Operator</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ</td>
<td>Equal to</td>
</tr>
<tr>
<td>NE</td>
<td>Not equal to</td>
</tr>
<tr>
<td>GT</td>
<td>Greater than</td>
</tr>
<tr>
<td>GE</td>
<td>Greater than or equal to</td>
</tr>
<tr>
<td>LT</td>
<td>Less than</td>
</tr>
<tr>
<td>LE</td>
<td>Less than or equal to</td>
</tr>
<tr>
<td>RE</td>
<td>Regular expressions</td>
</tr>
<tr>
<td>REH</td>
<td>Regular expressions with hexadecimal string</td>
</tr>
</tbody>
</table>

You can place the SORT statement either before or after the INCLUDE statement. Control statements do not have to be in any specific order. However, it is good documentation practice to code them in the order...
in which they are processed. For a flowchart showing the order in which all the control statements are processed, see Appendix C, “Processing order of control statements,” on page 177.

```
INCLUDE COND=(166,4,BI,GT,162,4,BI)
SORT FIELDS=(1,75,CH,A)
```

This sorts the selected subset of the input records by title in ascending order. Table 14 on page 25 shows the sorted data set.

**Table 14. Books for which Number Sold is greater than Number in Stock**

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - ADVANCED TOPICS IN PSYCHOAANALYSIS</td>
<td>162 165</td>
<td>166 169</td>
</tr>
<tr>
<td>1 - COMPUTER LANGUAGES</td>
<td>1 12</td>
<td></td>
</tr>
<tr>
<td>1 - COMPUTERS: AN INTRODUCTION</td>
<td>5 29</td>
<td></td>
</tr>
<tr>
<td>1 - CRISES OF THE MIDDLE AGES</td>
<td>14 17</td>
<td></td>
</tr>
<tr>
<td>1 - EDITING SOFTWARE MANUALS</td>
<td>13 32</td>
<td></td>
</tr>
<tr>
<td>1 - INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>2 32</td>
<td></td>
</tr>
<tr>
<td>1 - INTRODUCTION TO BIOLOGY</td>
<td>6 11</td>
<td></td>
</tr>
<tr>
<td>1 - MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>1 26</td>
<td></td>
</tr>
<tr>
<td>1 - NUMBERING SYSTEMS</td>
<td>6 27</td>
<td></td>
</tr>
<tr>
<td>1 - STRATEGIC MARKETING</td>
<td>3 35</td>
<td></td>
</tr>
<tr>
<td>1 - SUPPLYING THE DEMAND</td>
<td>0 32</td>
<td></td>
</tr>
<tr>
<td>1 - SYSTEM PROGRAMMING</td>
<td>4 23</td>
<td></td>
</tr>
<tr>
<td>1 - THE COMPLETE PROOFREADER</td>
<td>7 19</td>
<td></td>
</tr>
</tbody>
</table>

Suppose you want to reduce the subset of input records even further, to sort only the books you need to order from COR publishers. In this case, two conditions must be true:

- The number sold is greater than the number in stock.
- The book is published by COR.

To add the second condition, expand the INCLUDE statement by adding a logical AND, and compare the contents of the publisher field to the character string "COR" (see “Writing constants” on page 28 for details how to specify constants). Because the publisher field is 4 bytes long, "COR" will be padded on the right with one blank.

```
INCLUDE COND=(166,4,BI,GT,162,4,BI,AND,106,4,CH,EQ,C'COR')
SORT FIELDS=(1,75,CH,A)
```

**Table 15 on page 25 shows the result.**

**Table 15. COR Books for which Number Sold is greater than Number in Stock**

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - ADVANCED TOPICS IN PSYCHOAANALYSIS</td>
<td>COR</td>
<td>162 165</td>
<td>166 169</td>
</tr>
<tr>
<td>1 - COMPUTER LANGUAGES</td>
<td>COR</td>
<td>14 17</td>
<td></td>
</tr>
<tr>
<td>1 - CRISES OF THE MIDDLE AGES</td>
<td>COR</td>
<td>2 32</td>
<td></td>
</tr>
<tr>
<td>1 - INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>COR</td>
<td>1 26</td>
<td></td>
</tr>
<tr>
<td>1 - MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>COR</td>
<td>0 32</td>
<td></td>
</tr>
</tbody>
</table>

As another example, you might sort only the books for courses 00032 and 10347 by writing the INCLUDE and SORT statements as follows:

```
INCLUDE COND=(115,5,CH,EQ,C'00032',OR,115,5,CH,EQ,C'10347')
SORT FIELDS=(115,5,CH,A)
```
Note: In the previous example, you cannot substitute C’32′ for C’00032’, because character constants are padded on the right with blanks. DFSORT uses the following rules for padding and truncation:

**Padding**
adds fillers in data, usually zeros or blanks

**Truncation**
deletes or omits a leading or trailing portion of a string

In comparisons, the following rules apply:

- In a field-to-field comparison, the shorter field is padded as appropriate (with blanks or zeros).
- In a field-to-constant comparison, the constant is padded or truncated to the length of the field. Decimal constants are padded or truncated on the left. Character and hexadecimal constants are padded or truncated on the right.

### Writing the OMIT statement

Suppose that you want to sort, by title, all the books used for courses but not those for general reading. In this case, you can use an OMIT statement that excludes records containing a blank in the course department field.

The format of the OMIT statement is the same as that of the INCLUDE statement. To exclude the general reading books, write:

```
OMIT COND=(110, 5, CH, EQ, C' ')
SORT FIELDS=(1, 75, CH, A)
```

Table 16 on page 26 shows the sorted data set.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 75</td>
<td>110 114</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN topCHOANALYSIS</td>
<td>PSYCH</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>COMP</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>COMP</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>HIST</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>BIOL</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>COMP</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>BUSIN</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>BUSIN</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>COMP</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>COMP</td>
</tr>
</tbody>
</table>

### Allowable comparisons for INCLUDE and OMIT

Table 17 on page 27 and Table 18 on page 27 show the allowable field-to-field and field-to-constant comparisons for the data formats most commonly used with INCLUDE and OMIT. Refer to [z/OS DFSORT Application Programming Guide](https://www.ibm.com/support/knowledgecenter/en/POWER9/zos9r10/dfs/sort/dslogre.html) for complete details of all of the data formats you can use with INCLUDE and OMIT.
### Table 17. Allowable Field-to-Field Comparisons

<table>
<thead>
<tr>
<th>Field Format</th>
<th>BI</th>
<th>FI</th>
<th>CH</th>
<th>ZD</th>
<th>PD</th>
<th>FS</th>
<th>UFF</th>
<th>SFF</th>
<th>AUF</th>
<th>ASF</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ZD</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UFF</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUF</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ASF</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

### Table 18. Allowable Field-to-Constant Comparisons

<table>
<thead>
<tr>
<th>Field Format</th>
<th>Character String</th>
<th>Hexadecimal String</th>
<th>Decimal Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>BI</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>FI</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CH</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>ZD</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>FS</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>UFF</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SFF</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

For example, if you want to sort by author’s name and include only those books whose author’s last name begins with “M,” you can compare the contents of byte 76 (the first byte of the author’s last name), which is in character format, with either a character or hexadecimal string:

```plaintext
INCLUDE COND=(76,1,CH,EQ,C'M')
SORT FIELDS=(76,15,CH,A)
```

or

```plaintext
INCLUDE COND=(76,1,CH,EQ,X'4D')
SORT FIELDS=(76,15,CH,A)
```

Also, if you want to sort by number in stock only the books for which the number in stock is less than 10, you can compare the contents of the number in stock field, which is in binary format, to a decimal constant or a hexadecimal string:
or

```
INCLUDE COND=(162,4,BI,LT,X'0000000A')
SORT FIELDS=(162,4,BI,A)
```

For the hexadecimal constant, remember the padding and truncation rules. If you specify X'0A', the string is padded on the right instead of the left. For the decimal constant, you can use 10 or +10, and you do not have to worry about padding or truncation.

**Writing constants**

The formats for writing character strings, hexadecimal strings, and decimal numbers are shown later in this section.

**Character strings**

The format for writing a character string is:

```
C'x...x'
```

where x is an EBCDIC character. For example, C'FERN'.

If you want to include a single apostrophe in the string, you must specify it as two single apostrophes. For example, O'NEILL must be specified as C'O''NEILL'.

You can use special keywords to specify a character string for the current date of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, if you want to select records in which a 10-character date in the form C'yyyy/mm/dd' starting in position 42 equals today's date, write:

```
INCLUDE COND=(42,10,CH,EQ,DATE1(/))
```

You can also use special keywords to specify a character string for a future or past date (relative to the current date of the run) in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, if you want to select records in which a 10-character date in the form C'yyyy/mm/dd' starting in position 42 is between 30 days in the past and 30 days in the future, write:

```
INCLUDE COND=(42,10,CH,GE,DATE1(/)-30,AND,42,10,CH,LE,DATE1(/)+30)
```

**Hexadecimal strings**

The format for writing a hexadecimal string is:

```
X'yy...yy'
```

where yy is a pair of hexadecimal digits. For example, X'7FB0'.

**Decimal numbers**

The format for writing a decimal number is:

```
n...n    or    ±n...n
```

where n is a decimal digit. Examples are 24, +24, and -24.

Decimal numbers must not contain commas or decimal points.

You can use special keywords to specify a decimal number for the current date of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, if you want to select...
records in which a 4-byte packed decimal date of P'yyyyddd' (hex yyyydddC) starting in position 28 equals today's date, write:

    INCLUDE COND=(28,4,PD,EQ,DATE3P)

You can use special keywords to specify a decimal number for a future or past date (relative to the current date of the run) in various forms, as detailed in z/OS DFSORT Application Programming Guide. For example, if you want to select records in which a 4-byte packed decimal date of P'yyyyddd' (hex yyyydddC) starting in position 28 is between 30 days in the past and 30 days in the future, write:

    INCLUDE COND=(28,4,PD,GE,DATE3P-30,AND,28,4,PD,LE,DATE3P+30)

### Numeric tests for INCLUDE and OMIT

Suppose you think that some of the values in the Employees field might contain invalid numeric data, and you want to select the records with those values, if any. Each byte of the 4-byte Employees field should contain '0' through '9'; you would consider any other character, such as 'A' or '.', to be invalid. '1234' is a valid numeric value; it contains all numerics. '12.3' is an invalid numeric value; it contains a non-numeric. You can use one of the numeric test capabilities of the INCLUDE statement to collect the records you want as follows:

    INCLUDE COND=(18,4,FS,NE,NUM)

If the value in the field (18,4,FS) is not equal (NE) to numerics (NUM), the record is included. The records in the output data set will be those in which the field has non-numerics (a character other than '0'-'9' appears somewhere in the field).

Use NUM to indicate a test for numerics or non-numerics.

Use EQ to test for numerics, or NE to test for non-numerics.

Use FS format for the field if you want to test for character numerics ('0'-'9' in every byte).

Use ZD format for the field if you want to test for zoned decimal numerics ('0'-'9' in all non-sign bytes; X'F0'-X'F9', X'D0'-X'D9' or X'C0'-X'C9' in the sign byte).

Use PD format for the field if you want to test for packed decimal numerics (0-9 for all digits; F, D or C for the sign).

Here's an INCLUDE statement that only includes records in which the Revenue field and Profit field have packed decimal numerics (that is, there are no invalid packed decimal values in these fields).

    INCLUDE COND=(22,6,PD,EQ,NUM,AND,28,6,PD,EQ,NUM)

### Alphanumeric Tests for INCLUDE and OMIT

Testing for alphanumerics or non-alphanumerics is similar to testing for numerics or non-numerics. Use BI for the format. Use EQ to test for alphanumerics or NE to test for non-alphanumerics. Instead of NUM, use one of the following corresponding to the set of alphanumeric characters you need:

- UC: Uppercase characters (A-Z)
- LC: Lowercase characters (a-z)
- MC: Mixed case characters (A-Z, a-z)
- UN: Uppercase and numeric characters (A-Z, 0-9)
- LN: Lowercase and numeric characters (a-z, 0-9)
- MN: Mixed case and numeric characters (A-Z, a-z, 0-9)

Here is an INCLUDE statement that only includes records which have uppercase or numeric characters in positions 11 to 15:

    INCLUDE COND=(11,5,BI,EQ,UN)
If every position from 11 to 15 in a record has A-Z or 0-9, that record is included. If any position from 11 to 15 in a record does not have A-Z or 0-9, that record is not included. So a record with 'B03RS' in 11 to 15 would be included, whereas records with 'B03rS' or 'B,ABC' would not be included.

Here's an INCLUDE statement that removes any record that has only A-Z or a-z in positions 1 to 8:

```
INCLUDE COND=(1,8,BI,NE,MC)
```

So a record with 'RsTUVxyz' in 1-8 would not be included, whereas a record with 'Rs$UVxyz' in 1-8 would be included.

**Substring search for INCLUDE and OMIT**

Suppose you want to select only the books for the Biology, History, Business and Psychology departments. Based on what you learned earlier, you can select those books using this INCLUDE statement:

```
INCLUDE COND=(106,5,CH,EQ,C'BIOL', OR,
              106,5,CH,EQ,C'HIST', OR,
              106,5,CH,EQ,C'BUSIN', OR,
              106,5,CH,EQ,C'PSYCH')
```

But the more departments you want to include, the more typing you have to do. Instead, you can use one of the substring search capabilities of INCLUDE and OMIT to write the statement in a simpler form as:

```
INCLUDE COND=(106,5,SS,EQ,C'BIOL ,HIST ,BUSIN,PSYCH')
```

With substring search (SS format), you only write the field once and write the character constant so it includes all of the strings you want to search for. If the value in the field matches any of the strings (for example, "BUSIN"), the record is included. If the value in the field does not match any of the strings, the record is omitted.

The length of each string must match the length of the field. Because the Department field is 5 characters, you must add a blank at the end of "BIOL" and "HIST", which are each four characters, but not for "BUSIN" and "PSYCH", which are each five characters.

The other way to use substring search is by searching for a constant within a field. For example, if you wanted to select only the books with "INTRODUCTION" in their Title, you could use the following INCLUDE statement:

```
INCLUDE COND=(1,75,SS,EQ,C'INTRODUCTION')
```

The books selected for output would be:

```
COMPUTERS: AN INTRODUCTION
INTRODUCTION TO PSYCHOLOGY
INTRODUCTION TO BIOLOGY
```

**Regular expressions**

A Regular expression is a pattern which specifies a string of characters used to match certain strings. By default, DFSORT treats regular expressions as case-insensitive. The input regular expression can be in any case (lowercase, uppercase or mixed case) and output results are also case-insensitive. DFSORT compares the NULL-terminated string specified by INCLUDE/OMIT field against the compiled regular expression. For comparison DFSORT internally adds NULL byte to the specified Regular expression. The specified Regular expression is then compiled and if an error is detected, DFSORT terminates with an error message.

The following patterns are given as examples, along with descriptions of what they match:

- **abc**
  Matches any record containing the three letters abc in that order.
a.c
Matches any string beginning with the letter a, followed by any character, followed by the letter c.

^.$
Matches any record containing exactly one character.

.*[a-z]+.*
Matches any record containing a word, consisting of lowercase/uppercase/mixed case alphabetic characters, delimited by at least one space on each side.

Johny.*Johny
Matches any record containing at least two occurrences of the string Johny.

^ibm
Matches records beginning with "ibm".

ibm$
Matches records ending with "ibm".

^ibm$
Matches records exactly with "ibm".

Example 1: Include all records that contain string 'ER' (case-insensitive) followed by a numeric (0-9) using Regular expressions

```ruby
//STEP0100 EXEC PGM=SORT
//SYSOUT   DD SYSOUT=*  
//SORTIN   DD *  
MORGAN STANLEY  
ERIC  
HOLMER CA 90201  
WALTER  ALBUQUERQUE NEW MEXICO  
TONY NY 10000  
JERRY 10029 NEW YORK  
SHERLOCK  
//SORTOUT  DD SYSOUT=*  
//SYSin    DD *  
OPTION COPY  
INCLUDE COND=(1,50,SS,RE,C'(ER).*[0-9]')
//*
```

This example illustrates how to include only records in which:

• ER (case-insensitive) is found somewhere within bytes 1 through 50 and have a number (0-9) following the string ER.

The output from the above job is the following:

```
HOLMER CA 90201  
JERRY 10029 NEW YORK  
```

Unicode comparisons

Compare a field in Unicode format to another field in Unicode format. For example, you can include only those records for which a UTF8 field is less than another UTF8 field. Or you can exclude those records for which a UTF16 field is equal to another UTF16 field. Or you can include only those records for which a UTF32 field is greater than another UTF32 field.

The following are examples of Unicode comparisons:

```ruby
INCLUDE FORMAT=UTF8,COND=(5,4,LT,11,4)
```

Explanation: Include the records if UTF8 format data at position 5 for 4 characters is less than UTF8 format data at position 11 for 4 characters.

```ruby
OMIT COND=(21,40,UTF16,EQ,151,40,UTF16)
```
Including or Omitting Records

Explanation: Omit the records if UTF16 format data at position 21 for 40 characters is equal to UTF16 format data at 151 for 40 characters.

```
OUTFIL INCLUDE=(21,4,UTF32,NE,31,4,UTF32)
```

Explanation: Include the records if UTF32 format data at position 21 for 4 characters is not equal to UTF32 format data at 31 for 4 characters.

VB data set considerations

The same VB data set considerations you learned about previously for the SORT and MERGE statements also apply to the INCLUDE and OMIT statements.

Starting positions

When you code your compare fields for including or omitting VB records, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following INCLUDE statement compares a PD field in the third through fifth data bytes of a VB record to a PD field in the sixth through eighth bytes of a VB record.

```
INCLUDE COND=(7,3,PD,EQ,10,3,PD)
```

Short control fields

If you know you have VB records with short compare fields, you can specify the VLSCMP option, if appropriate, to prevent DFSORT from terminating. For example:

```
OPTION COPY,VLSCMP
INCLUDE COND=(21,8,CH,EQ,C'Type 200')
```

VLSCMP tells DFSORT that you want to temporarily replace any missing compare field bytes with binary zeros, thus allowing the short fields to be validly compared (the zeros are not kept for the output records). In this example, records less than 28 bytes are not included because the binary zeros added for the missing bytes in the field prevent it from being equal to ’Type 200’.

Another way you can prevent DFSORT from terminating for VB records with short compare fields, if appropriate, is by specifying the VLSHRT option. For example:

```
OPTION COPY,VLSHRT
INCLUDE COND=(21,8,CH,EQ,C'Type 200')
```

VLSHRT tells DFSORT to treat any comparison involving a short field as false. In this example, any records less than 28 bytes are not included.

⚠️ Attention: If NOVLSCMP and NOVLSHRT are in effect, DFSORT terminates if it finds a short compare field in any VB record.

For more information on DFSORT’s VLSCMP and VLSHRT options, see z/OS DFSORT Application Programming Guide.

Summary

This chapter covered three ways to select only a subset of the input records to make processing more efficient. You wrote INCLUDE and OMIT statements and learned about allowable comparison operators, various types of constants, numeric tests, and substring search.
Chapter 4. Summing records

Suppose that the English department wants to know the total price of books for all its courses. You can include just the records for the English department by using the INCLUDE statement, and add the book prices together by using the SORT and SUM statements.

On the SUM control statement, you specify one or more numeric fields that are to be summed whenever records have equally collating control fields (control fields are specified on the SORT statement). The data formats you can specify on the SUM statement are binary (BI), fixed-point (FI), packed decimal (PD), zoned decimal (ZD) and floating-point (FL).

To sum the prices for just the records for the English department, specify the price field on the SUM statement and the department field on the SORT statement. The INCLUDE statement selects just the records for the English department before SUM and SORT are processed, making the department field equal for all of the included records, and allowing the prices to be summed. (For a flowchart showing the order in which the INCLUDE, SUM, and SORT statements are processed, see Appendix C, “Processing order of control statements,” on page 177.)

When you sum records, keep in mind that two types of fields are involved:

Control fields  specified on the SORT statement

Summary fields  specified on the SUM statement

The contents of the summary fields are summed for groups of records with the same control fields (often called "duplicate" records).

Writing the SUM statement

A SUM statement that sums the prices would look like this:

```
SUM FIELDS=(170,4,BI)
```

Here are the steps for writing this SUM statement:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leave at least one blank and type <strong>SUM</strong></td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank and type <strong>FIELDS=</strong></td>
</tr>
<tr>
<td>3</td>
<td>Type, in parentheses and separated by commas, the location, length, and data format of the price field.</td>
</tr>
</tbody>
</table>

The INCLUDE, SORT, and SUM statements are as follows:

```
INCLUDE COND=(110,5,CH,EQ,C'ENGL')
SORT FIELDS=(110,5,CH,A)
SUM FIELDS=(170,4,BI)
```
When the prices are summed, the final sum appears in the price field of one record, and the other records are deleted. Therefore, the result (shown in Table 20 on page 34) is only one record, containing the sum. You can control which record appears if you specify that records keep their original order. For the examples, the default is for records with equally collating control fields to appear in their original order (EQUALS in effect). When summing records keeping the original order, DFSORT chooses the first record to contain the sum.

Table 20. Sum of Prices for English Department

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>110 114</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
<td>46403</td>
</tr>
</tbody>
</table>

Note:
1 Some of the fields in your summation record might not be meaningful, such as the book title field in Table 20 on page 34. In the next chapter, you will learn two ways to leave out fields that are not meaningful.
2 Specified as a control field.
3 Specified as a summary field.

Suppose now that the English department wants to know the total price of books for each of its courses. In this case, you still select only the English department’s records using INCLUDE, and specify the price field on the SUM statement, but you specify the course number on the SORT statement.

Table 21 on page 34 shows the result, one record per course.

Table 21. Sum of Prices for English Department

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>115 119</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td></td>
<td>10054 1520</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td></td>
<td>10347 2075</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td></td>
<td>10856 1045</td>
</tr>
</tbody>
</table>

For an example using two summary fields, assume that for inventory purposes you want to sum separately the number of books in stock and the number sold for each of the publishers.

For this application, specify the publisher as the control field on the SORT statement and the number in stock and number sold as summary fields on the SUM statement. You want to use all of the records in the input data set this time, so you don’t need to code an INCLUDE or OMIT statement. (SORT and SUM can be used with or without an INCLUDE or OMIT statement.)
Table 22 on page 35 shows the result, one record per publisher.

Table 22. Sum of Number in Stock and Number Sold for Each Publisher

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>106 109</td>
<td>162 165</td>
</tr>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>COR</td>
<td>103</td>
<td>161</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>FERN</td>
<td>19</td>
<td>87</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>VALD</td>
<td>42</td>
<td>97</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>WETH</td>
<td>62</td>
<td>79</td>
</tr>
</tbody>
</table>

Suppressing records with duplicate control fields

Apart from summing values, you can also use SUM to delete records with duplicate control fields (often called “duplicate records”).

For example, you might want to list the publishers in ascending order, with each publisher appearing only once. If you use only the SORT statement, COR appears seven times (because seven books in the file are published by COR), FERN appears four times, VALD five times, and WETH four times.

By specifying FIELDS=NONE on the SUM statement, DFSORT writes only one record per publisher, as follows:

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,166,4),FORMAT=BI
```

Table 23 on page 35 shows the result.

Table 23. List of Publishers, Deleting Duplicates

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>1</td>
<td>106 109</td>
</tr>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>COR</td>
</tr>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>FERN</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>VALD</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>WETH</td>
</tr>
</tbody>
</table>

In Chapter 12, “Using the ICETOOL utility,” on page 123, you will learn how to use ICETOOL’s powerful SELECT, OCCUR and SPLICE operators to perform many more functions involving duplicate and non-duplicate records.
Handling overflow

When a sum becomes larger than the space available for it, overflow occurs. For example, if a 2-byte binary field (unsigned) contains X'FFFF' and you add X'0001' to it, overflow occurs, because the sum requires more than two bytes.

If overflow occurs, the summary fields in the two records involved are not added together. That is, the records are kept unchanged; neither record is deleted.

In some cases, you can correct overflow by padding the summary fields with zeros, using the INREC control statement. “Preventing overflow when summing values” on page 66 shows you how to do this.

VB data set considerations

The same VB data set considerations you learned about previously for the SORT, MERGE, INCLUDE and OMIT statements also apply to the SUM statement.

Starting positions

When you code your summary fields for VB records, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following SUM statement specifies a PD summary field in the third through fifth data bytes of a VB record:

```
SUM FIELDS=(7,3,PD)
```

Short summary fields

If you know you have VB records with short summary fields, you can specify the VLSHRT option, if appropriate, to prevent DFSORT from terminating. For example:

```
OPTION VLSHRT
SORT FIELDS=(6,2,CH,A)
SUM FIELDS=(21,8,ZD)
```

VLSHRT tells DFSORT to leave records with short summary fields unsummed. That is, when one of the two records involved in a summary operation has a short summary field, the records are kept unchanged; neither record is deleted.

⚠️ Attention: If NOVLSHRT is in effect, DFSORT terminates if it finds a short summary field in any VB record.

For more information on DFSORT's VLSHRT option, see z/OS DFSORT Application Programming Guide.

Summary

This chapter covered summing records in your data set. It explained how to use the SUM statement to sum records with equal control fields, and how to suppress any records with duplicate control fields. Now, you continue with tutorials about using OUTREC and INREC to reformat your data sets.
Chapter 5. Reformatting records with fixed fields

You can reformat records in your data sets by using the INREC, OUTREC, and OUTFIL control statements. You can use these statements separately or together.

This chapter describes how you can reformat records with fixed fields, that is, fields that start in the same position and have the same length in every record. The next chapter describes how you can reformat records in similar ways with variable fields, that is, fields that have different starting positions and lengths in different records, such as comma separated values (CSV).

With INREC, OUTREC, and OUTFIL, you can perform a wide variety of tasks while sorting, copying, or merging, including the following:

• Delete fields.
• Reorder fields.
• Insert separators (blanks, zeros, strings, current date, future date, past date, and current time).
• Translate data from uppercase to lowercase, lowercase to uppercase, EBCDIC to ASCII and ASCII to EBCDIC.
• Translate data to hexadecimal and bit representation.
• Convert numeric values to many different types of printable formats with or without thousands separators, decimal point, leading or suppressed zeros, and signs.
• Convert numeric values from one format to another format.
• Perform arithmetic using numeric values and decimal constants.
• Convert date fields from one type to another type.
• Perform arithmetic using date fields.
• Change values using a lookup table.
• Replace or remove data using find and replace operations.
• Insert sequence numbers.
• Left-justify data, right-justify data, left-squeeze data, and right-squeeze data.
• Perform various operations on groups of records.

You can reformat records in one of the following three ways:

• BUILD: Reformat each record by specifying all of its items one by one. Build gives you complete control over the items you want in your reformatted records and the order in which they appear. You can delete, rearrange and insert fields and constants.

  Note: For INREC and OUTREC, you can use either the BUILD parameter or the FIELDS parameter. For OUTFIL, you can use either the BUILD parameter or the OUTREC parameter.

• OVERLAY: Reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record.

• FINDREP: Reformat each record by doing various types of find and replace operations.

• IFTHEN clauses: Reformat different records in different ways by specifying how build, overlay, find/replace, or group operation items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted.

The INREC, OUTREC, and OUTFIL statements can all perform the same functions. However:

• The INREC statement reformats records before they are sorted, copied or merged. See “Using other statements with INREC” on page 65 for information about how INREC affects other control statements.
• The OUTREC statement reformats records after they are sorted, copied or merged.
Reformatting records after sorting with BUILD or FIELDS

In the last chapter, you used the SUM statement to sum the price of the books in stock and the books sold for each publisher. Now, using the FIELDS or BUILD parameter of the OUTREC statement, you can delete all the fields that are not needed for the application; in other words, fields whose contents are not meaningful in a summation record. Only the publisher, number-in-stock, and number-sold fields are written, reducing the output record length to 12 bytes.

The OUTREC statement looks like this:

```
OUTREC FIELDS=(106,4,162,4,166,4)
```

Here are the steps for writing this OUTREC statement:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leave at least one blank, and type OUTREC</td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank, and type FIELDS= (or BUILD=)</td>
</tr>
<tr>
<td>3</td>
<td>Type, in parentheses, and separated by commas:</td>
</tr>
<tr>
<td></td>
<td>1. The location and length of the publisher field</td>
</tr>
<tr>
<td></td>
<td>2. The location and length of the number in stock field</td>
</tr>
<tr>
<td></td>
<td>3. The location and length of the number sold field</td>
</tr>
</tbody>
</table>

The SORT, SUM and OUTREC statements are as follows:

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,BI,166,4,BI)
OUTREC FIELDS=(106,4,162,4,166,4)
```

Table 25 on page 38 shows the output.

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5 8</td>
</tr>
</tbody>
</table>
The number in stock and number sold fields are binary values which would actually be unreadable if you printed or displayed the output records shown in Table 25 on page 38. Later in this chapter, you'll learn how binary and other unreadable numeric values can be converted to various readable forms.

Suppose you use this SORTOUT DD statement for your output data set:

```
//SORTOUT DD DSN=MY.OUTPUT,DISP=(NEW,CATLG,DELETE),
   UNIT=SYSDA,SPACE=(CYL,(5,5))
```

DFSORT automatically sets the LRECL of your new output data set (MY.OUTPUT) to the reformatted output record length, so LRECL=12 would be set in this case. You do not need to specify the LRECL on your SORTOUT DD statement, because DFSORT will set it appropriately for you.

If your SORTOUT data set already has an LRECL value (OLD data set), or you choose to specify an LRECL value on the SORTOUT DD statement, that value overrides the value DFSORT would set for the LRECL. This can result, intentionally or unintentionally, in padding or truncating your output records if the calculated length of the reformatted record does not match your specified LRECL.

In general, it is best to let DFSORT set the RECFM, LRECL and BLKSIZE for your NEW SORTOUT data sets, unless you have a particular reason to override these values. For OLD SORTOUT data sets, ensure that the existing RECFM, LRECL and BLKSIZE values are appropriate for the control statements you use.

### Reordering fields to reserve space

The fields always appear in the order in which you specify them. Therefore, if you want the number sold to appear before the number in stock, as shown in Table 26 on page 39, you reverse their order on the OUTREC statement.

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,BI,166,4,BI)
OUTREC FIELDS=(106,4,166,4,162,4)
```

### Inserting binary zeros

Building on the last example, assume you want to reformat the records to include a new 4-byte binary field after the number in stock (beginning at byte 13). In this case, you can insert binary zeros as place holders for the new field (to be filled in with data at a later date). You can use Z or 1Z to specify a single binary zero. You can use nZ to specify n binary zeros.

To insert four binary zeros, write 4Z after the last field:
Table 27 on page 40 shows the result.

### Table 27. Inserting Binary Zeros

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number Sold</th>
<th>Number In Stock</th>
<th>X'0...0'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5 8</td>
<td>9 12</td>
</tr>
<tr>
<td>COR</td>
<td>161</td>
<td>103</td>
<td>0...0</td>
</tr>
<tr>
<td>FERN</td>
<td>87</td>
<td>19</td>
<td>0...0</td>
</tr>
<tr>
<td>VALD</td>
<td>97</td>
<td>42</td>
<td>0...0</td>
</tr>
<tr>
<td>WETH</td>
<td>79</td>
<td>62</td>
<td>0...0</td>
</tr>
</tbody>
</table>

**Inserting blanks**

If an output data set contains only character data, you can print it by writing the SORTOUT DD statement as follows:

```plaintext
//SORTOUT DD SYSOUT=A
```

You can make the printout more readable by using the OUTREC statement to separate the fields with blanks and to create margins. You can insert blanks before, between, or after fields. You can use X or 1X to specify a single blank. You can use nX to specify n blanks.

For example, assume you want to print just the publisher and title fields, with the publisher field appearing first. Because most of the publishers' names fill up the entire 4-byte publisher field, the publishers' names will run into the titles if you do not separate the two fields with blanks. Also, without a margin, the publishers' names will begin at the edge of the paper.

The printout can be made more readable by creating a left margin of 20 blanks and by separating the fields with 10 blanks.

To insert 20 blanks, write 20X before the first field. To insert 10 blanks, write 10X between the two fields. The SORT statement sorts the records by title in ascending order (remember that SORT, COPY, or MERGE is always required).

```plaintext
SORT FIELDS=(1,75,CH,A)
OUTREC BUILD=(20X,106,4,10X,1,75)
```

Table 28 on page 40 shows the result.

### Table 28. Output After Inserting Blanks

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Book Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>21 24</td>
</tr>
<tr>
<td></td>
<td>25 34</td>
</tr>
<tr>
<td></td>
<td>35 190</td>
</tr>
</tbody>
</table>
If you know the columns you want your fields to start in, you can specify them directly instead of figuring out how many blanks to use. For example, if you want the publisher field to start in column 21 and the title field to start in column 35, as shown previously, you can write the OUTREC statement as:

```
OUTREC BUILD=(21:106,4,35:1,75)
```

c: causes DFSORT to fill in blanks from the last field with data (or column 1) up to the column before c. So 21: puts blanks in columns 1-20 and 35: puts blanks in column 25-34.

Specifying c:X as your last field is an easy way to increase the record length of your output records to c bytes. For example, if you want to create 80-byte output records containing the first 30 bytes of your input records padded with blanks, you can use this OUTREC statement:

```
OUTREC BUILD=(1,30,80:X)
```

DFSORT automatically sets LRECL=80 for the SORTOUT data set if you do not override the LRECL.

### Inserting strings

In addition to making the printout more readable, OUTREC can also be used to set up a very basic report format by inserting strings. ICETOOL's DISPLAY operator or the OUTFIL control statement can be used to create complex reports, as you will see later in this document. The formats for writing strings are shown in the rest of this section.

#### Character strings

The format for repeating a character string is:

```
C'x...x'
```

where x is an EBCDIC character. For example, C'FERN'.

The format for repeating a character string is:

```
nC'x...x'
```
where n can be from 1 to 4095; n repetitions of the character string (C'x...x') are inserted into the reformatted records. If n is omitted, 1 is used instead.

If you want to include a single apostrophe in the string, you must specify it as two single apostrophes. For example, O'NEILL must be specified as C'O''NEILL'.

You can use special keywords to insert a character string or packed decimal constant for the current date or time of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, suppose you want to insert the following at the end of each 80 byte record:

- the string 'Timestamp: '
- the date of the run in the form C'yyyy/mm/dd',
- a blank,
- the time of the run in the form C'hh:mm'

Here's the OUTREC statement:

```plaintext
OUTREC FIELDS=(1,80,C'Timestamp: ',DATE1(/),X,TIME2())
```

You can also use special keywords to specify a character string or packed decimal constant for a future or past date (relative to the current date of the run) in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, suppose you want to insert the following at the start of each 20-byte record:

- the current date - 7 days in the form C'yyyyddd',
- a blank,
- the current date + 14 days in the form C'yyyyddd'.

Here's the OUTREC statement:

```plaintext
OUTREC FIELDS=(DATE3-7,X,DATE3+14,1,20)
```

**Hexadecimal strings**

The format for writing a hexadecimal string is:

```plaintext
X'yy...yy'
```

where `yy` is a pair of hexadecimal digits. For example, `X'7FB0'`.

The format for repeating a hexadecimal string is:

```plaintext
X'yy...yy'
```

where n can be from 1 to 4095. n repetitions of the hexadecimal string (X'yy...yy') are inserted in the reformatted records. If n is omitted, 1 is used.

**Setting up a basic report**

To produce a very basic report of the publisher’s names and author’s names from the bookstore data set, you can use the following OUTREC statement to put in "Publisher is" and "Author is" as character separators.

```plaintext
OPTION COPY
OUTREC FIELDS=(11:C'Publisher is ',106,4,31:C'Author is ',91,15,X,76,15)
```

The result is shown in *Table 29 on page 43*. 
So far this chapter has covered how the BUILD or FIELDS parameter of the OUTREC statement can reformat the records of your output data set to contain only the fields and constants you specify. This chapter also covered inserting binary zeros as place holders, and using blanks and strings to make a printout of the output data set more readable. In the following sections, you will learn how to use other reformatting features to change input fields in various ways for output.

Translating uppercase to lowercase, EBCDIC to ASCII, and more

You could use the following statements to show all of the authors for the books used in computer courses:

```plaintext
INCLUDE COND=(110,5,CH,EQ,C'COMP')
SORT FIELDS=(76,15,CH,A,91,15,CH,A)
OUTREC FIELDS=(91,15,X,76,15)
```

The results produced for these statements are:

<table>
<thead>
<tr>
<th>Author's First Name</th>
<th>Author's Last Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>WILLIAM</td>
<td>BAYLESS</td>
</tr>
<tr>
<td>RAUL</td>
<td>CAUDILLO</td>
</tr>
<tr>
<td>JOKHI</td>
<td>DINSHAW</td>
</tr>
<tr>
<td>ROBERT</td>
<td>MURRAY</td>
</tr>
<tr>
<td>LORI</td>
<td>RASMUSSEN</td>
</tr>
</tbody>
</table>

The author’s first and last names are displayed as uppercase letters, because they are stored that way in the bookstore data set. If you wanted to display these names with an initial uppercase letter and subsequent lower case letters, you could use the following OUTREC statement:

```plaintext
OUTREC FIELDS=(91,1,92,14,TRAN=UTOL,X,76,1,77,14,TRAN=UTOL)
```

The results produced for this OUTREC statement are:

<table>
<thead>
<tr>
<th>Author's First Name</th>
<th>Author's Last Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>William</td>
<td>Bayless</td>
</tr>
<tr>
<td>Raul</td>
<td>Caudillo</td>
</tr>
</tbody>
</table>
p,m,TRAN=UTOL translates uppercase letter (A-Z) in the field to the equivalent lowercase letter (a-z). In our example, p,m,TRAN=UTOL translates uppercase letters to lowercase letters starting with the second letter of the author's first name and the second letter of the author's last name. The first letter of each name is not included in the TRAN=UTOL field; these uppercase letters are moved to the output record unchanged.

In addition to TRAN=UTOL, you can also use these other TRAN=keyword functions in a similar way:

- TRAN=LTOU translates lowercase letters (a-z) in a field to the equivalent uppercase letters (A-Z)
- TRAN=ETOA translates EBCDIC characters in a field to the equivalent ASCII characters.
- TRAN=ATOE translates ASCII characters in a field to the equivalent EBCDIC characters.
- TRAN=ALTSEQ translates characters in a field to other characters as specified by an ALTSEQ statement. For example, "null" characters (hex 00) can be changed to blank characters (hex 40)
- TRAN=HEX translates binary values in a field to their equivalent EBCDIC hexadecimal values ('0'-'F'). 2 output characters are produced for each input byte.
- TRAN=BIT translates binary values in a field to their equivalent EBCDIC bit values ('0' or '1'). 8 output characters are produced for each input byte.
- TRAN=UNHEX translates EBCDIC hexadecimal values ('0'-'F') in a field to their equivalent binary values. An output byte is produced for each 2 input characters.
- TRAN=UNBIT translates EBCDIC bit values ('0' or '1') in a field to their equivalent binary values. An output byte is produced for each 8 input characters.

For detailed information on all of the available TRAN=keyword functions, see z/OS DFSORT Application Programming Guide.

Converting numeric fields to different formats

Suppose you want the summed binary values in Table 25 on page 38 be readable so you can print or display them. You can use the following statements to convert the BI values to readable ZD values:

```
OPTION COPY
OUTREC FIELDS=(1,4,X,
   5,4,BI,TO=ZD,LENGTH=6,X,
   9,4,BI,TO=ZD,LENGTH=6)
```

p,m,BI,TO=ZD converts the BI values to ZD values. By default, a 4-byte BI value produces a 10-byte ZD value, but LENGTH=6 overrides the default length to produce a 6-byte ZD value.

Table 30 on page 44 shows the output, which is readable:

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>6   11</td>
<td>13  18</td>
</tr>
<tr>
<td>COR</td>
<td>000103</td>
<td>000161</td>
</tr>
<tr>
<td>FERN</td>
<td>000019</td>
<td>000087</td>
</tr>
<tr>
<td>VALD</td>
<td>000042</td>
<td>000097</td>
</tr>
<tr>
<td>WETH</td>
<td>000062</td>
<td>000079</td>
</tr>
</tbody>
</table>

Alternatively, you can use the following OUTREC statement to convert the BI values to readable FS values:

```
OUTREC FIELDS=(1,4,X,
   5,4,BI,TO=FS,LENGTH=6,X,
   9,4,BI,TO=FS,LENGTH=6)
```
p,m,BI,TO=FS converts the BI values to FS values. By default, a 4-byte BI value produces an 11-byte FS value, but LENGTH=6 overrides the default length to produce a 6-byte FS value.

Table 31 on page 45 shows the output, which is readable:

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>COR</td>
<td>103</td>
<td>161</td>
</tr>
<tr>
<td>FERN</td>
<td>19</td>
<td>87</td>
</tr>
<tr>
<td>VALD</td>
<td>42</td>
<td>97</td>
</tr>
<tr>
<td>WETH</td>
<td>62</td>
<td>79</td>
</tr>
</tbody>
</table>

You can use p,m,f,TO=f or p,m,f,f to convert from various numeric formats to various other numeric formats. You can use LENGTH=n to override the default output length.

For detailed information on DFSORT’s numeric conversion parameters, see z/OS DFSORT Application Programming Guide.

**Editing numeric fields**

Suppose you have input records with numeric values stored in PD format that you want to display or print so they can be easily interpreted. PD values are stored as integers in a compressed internal format that is actually unreadable if you print or display the values.

However, you know that:

- The first PD field represents a number with two decimal places.
- The second PD field represents a number with three decimal places.
- The third PD field represents a date in the form mmddyyyy.

You can use the edit features of the OUTREC statement to display the digits of the PD values as readable characters. Furthermore, you can use the edit features to insert signs, commas, decimal points and hyphens, as appropriate, to make the PD values easy to interpret.

Table 32 on page 45 shows the relevant input fields in the records. The PD fields are represented as readable numbers in Table 32 on page 45, but they are really stored in an unreadable format.

<table>
<thead>
<tr>
<th>CH field</th>
<th>First PD field</th>
<th>Second PD field</th>
<th>Third PD field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>11 16</td>
<td>31 37</td>
</tr>
<tr>
<td>WEST</td>
<td>+1524900810</td>
<td>+000000020000</td>
<td>+05122003</td>
</tr>
<tr>
<td>EAST</td>
<td>-0065781053</td>
<td>+0721500532006</td>
<td>+11292003</td>
</tr>
<tr>
<td>NORTH</td>
<td>+00000000000</td>
<td>-000982630735</td>
<td>+02152004</td>
</tr>
<tr>
<td>SOUTH</td>
<td>-0000003562</td>
<td>-003826254999</td>
<td>+12032003</td>
</tr>
</tbody>
</table>

You can use the following OUTREC statement to make the PD values meaningful:

```
OUTREC FIELDS=(1,8, 5X, 11,6,PD,M4, 5X, 31,7,PD,EDIT=(SI,III,III,IIT.TT),SIGNS=(),-), 5X, 41,5,PD,EDIT=(TT-TT-TTTT))
```

M4 is one of DFSORT’s 27 pre-defined edit masks (see Table 33 on page 46). It edits a numeric field according to the pattern SI,III,III,III,IIT.TT. EDIT=(SI,III,III,IIT.TT) is a user-defined edit mask. It edits
a numeric field according to the pattern SI,III,III,IIT.TTT. EDIT=(TT-TT-TTTT) is another user-defined edit mask. It edits a numeric field according to the pattern TT-TT-TTTT.

In the patterns:

- **I** indicates a leading insignificant digit to be displayed as 1-9, or as blank for a leading 0.
- **T** indicates a significant digit to be displayed as 0-9.
- **S** before the digits indicates a leading sign. **S** after the digits indicates a trailing sign. For M4, the leading sign is to be displayed as + for a positive value or as - for a negative value. For EDIT=(SI,III,III,IIT.TTT), SIGNS=(,+,-), the leading sign is to be displayed as blank for a positive value or as - for a negative value.
- Any other character (for example, comma, decimal point or hyphen) is just displayed as appropriate.

The results produced for the OUTREC statement are:

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEST</td>
<td>+15,249,008.10</td>
<td>20.000</td>
</tr>
<tr>
<td>EAST</td>
<td>-657,810.53</td>
<td>3,721,500,532.006</td>
</tr>
<tr>
<td>NORTH</td>
<td>+0.00</td>
<td>-982,630.735</td>
</tr>
<tr>
<td>SOUTH</td>
<td>-35.62</td>
<td>-3,826,254.999</td>
</tr>
</tbody>
</table>

Pre-defined and user-defined edit masks give you a great deal of flexibility in how you format your numeric fields for output. You can use p,m,f,Mnn or p,m,f,EDIT=(pattern) to edit various numeric fields according to various output patterns. You can use SIGNS=(a,b,c,d) to override or set the output signs (leading positive, leading negative, trailing positive and trailing negative). You can use LENGTH=n to override or set the output length.

See z/OS DFSORT Application Programming Guide for complete details about DFSORT’s numeric editing parameters. For easy reference, Table 33 on page 46 shows the patterns for the 27 pre-defined edit masks (M0-M26) as well as examples of the output for each mask.
<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>Examples Value</th>
<th>Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>M8</td>
<td>IT:TT:TT</td>
<td>030553</td>
<td></td>
<td>3:05:53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>121736</td>
<td></td>
<td>12:17:36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>123004</td>
<td></td>
<td>12/30/04</td>
</tr>
<tr>
<td>M9</td>
<td>IT/TT/TT</td>
<td>083104</td>
<td></td>
<td>8/31/04</td>
</tr>
<tr>
<td>M10</td>
<td>I I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>01234</td>
<td>1234</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>00000</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>M11</td>
<td>T T T T T T T T T T T T T T T T T T T T T T T T</td>
<td>00010</td>
<td>00010</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>01234</td>
<td></td>
<td>01234</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>-12,345</td>
</tr>
<tr>
<td>M13</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+1234567</td>
<td>1 234 567</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>(12 345)</td>
</tr>
<tr>
<td>M14</td>
<td>S I I I I I I I I I I I I I I</td>
<td>+1234567</td>
<td>1 234 567</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>12 345-</td>
</tr>
<tr>
<td>M15</td>
<td>I I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+1234567</td>
<td>1 234 567</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>12 345-</td>
</tr>
<tr>
<td>M16</td>
<td>S I I I I I I I I I I I I</td>
<td>+1234567</td>
<td>1 234 567</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>-12 345</td>
</tr>
<tr>
<td>M17</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+1234567</td>
<td>1&quot;234&quot;567</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0012345</td>
<td></td>
<td>-12'345</td>
</tr>
<tr>
<td>M18</td>
<td>S I I I I I I I I I I I I I I I I I I I I T T</td>
<td>+0123456</td>
<td>1,234,56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>-12,345,67</td>
</tr>
<tr>
<td>M19</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1,234,56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>-12,345,67</td>
</tr>
<tr>
<td>M20</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1 234,56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>(12 345,67)</td>
</tr>
<tr>
<td>M21</td>
<td>I I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1 234,56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>12 345,67-</td>
</tr>
<tr>
<td>M22</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1 234,56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>-12 345,67</td>
</tr>
<tr>
<td>M23</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1&quot;234&quot;56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>-12'345,67</td>
</tr>
<tr>
<td>M24</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+0123456</td>
<td>1&quot;234&quot;56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1234567</td>
<td></td>
<td>-12'345,67</td>
</tr>
<tr>
<td>M25</td>
<td>S I I I I I I I I I I I I I I I I I I I I I I I</td>
<td>+01234</td>
<td>1234</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-00001</td>
<td></td>
<td>-1</td>
</tr>
</tbody>
</table>
### Displaying data in hexadecimal

If you are curious about how the CH and PD values in Table 32 on page 45 are actually stored, you can use this OUTREC statement to display hexadecimal representations of these fields:

```plaintext
OUTREC FIELDS=(1,8,TRAN=HEX,
               2X,
               11,6,TRAN=HEX,
               2X,
               31,7,TRAN=HEX,
               2X,
               41,5,TRAN=HEX)
```

**Note:** `p,m,TRAN=HEX` and `p,m,HEX` are equivalent.

The results produced for this OUTREC statement are:

- `E6C5E2E340404040 01524900810C 0000000020000C 005122003C`
- `C5C1E2E340404040 00065781053D 3721500532006C 011292003C`
- `D5D6D9E3C8404040 00000000000C 0000982630735D 002152004C`
- `E2D6E4E3C8404040 00000003562D 0003826254999D 012032003C`

### Displaying data as bits

You can also use OUTREC to display bit representations of data. For example, if you had the following five input records:

- A
- Z
- 0
- 9
- $

You could use this OUTREC statement to display the data in bit, hexadecimal and character form:

```plaintext
OUTREC BUILD=(1,1,TRAN=BIT,X,1,1,TRAN=HEX,X,1,1)
```

The resulting output records would be:

- `11000001 C1 A`
- `11101001 E9 Z`
- `11110000 F0 0`
- `11111001 F9 9`
- `01011011 5B $`

### Performing arithmetic with numeric fields and constants

Suppose you want to display the results of subtracting the second PD field in Table 32 on page 45 from the first PD field in Table 32 on page 45. As discussed previously, the PD fields are stored as integers, but we know that:

- The first PD field is 6 bytes and represents a signed number with 11 digits including two decimal places.
- The second PD field is 7 bytes and represents a signed number with 13 digits including three decimal places.

In order to do arithmetic on these fields, you must ensure that the integer and decimal parts of the numbers match up correctly. For example, in the first record, the first PD value is `+1524900810`
representing +15249008.10 and the second PD value is +20000 representing +20.000. In order to subtract the second PD value from the first PD value, you need to put them in the following forms:

+15249008.100
+00000020.000

You could use the following OUTREC statement to handle the subtraction correctly:

```
OUTREC FIELDS=(1,8,5X,  
  ((11,6,PD,MUL,+10),SUB,31,7,PD),  
  EDIT=(SI,III,III,IIT.TTT),SIGNS=((-))
```

11,6,PD,MUL,+10 multiples the first PD field by 10 to match up the decimal places. SUB,31,7,PD subtracts the second PD field from the results of the 11,6,PD,MUL,+10 operation.

EDIT and SIGNS are used to make the results more meaningful.

The results produced for this OUTREC statement are:

| WEST       | 15,248,988.100 |
| EAST       | -3,722,158,342.536 |
| NORTH      | 982,630.735 |
| SOUTH      | 3,826,219.379 |

You can do arithmetic with numeric fields and decimal constants (+n and -n) using the operators MIN (minimum), MAX (maximum), DIV (division), MUL (multiplication), MOD (modulus), ADD (addition) and SUB (subtraction). The order of evaluation precedence for the operators is as follows, but can be changed by using parentheses:

1. MIN and MAX
2. MUL, DIV and MOD
3. ADD and SUB

You can use p,m,f, MIN, MAX, MUL, DIV, MOD, ADD, SUB, +n, -n and parentheses to do a wide variety of arithmetic operations for various numeric formats. The result of an arithmetic operation is a 15-digit ZD value that can be converted to a different numeric format, or edited using pre-defined edit masks (M0-M26) or user-defined edit masks, as discussed earlier.

For complete details on arithmetic operations, see z/OS DFSORT Application Programming Guide.

**Converting date fields**

Suppose you had input records that looked like this:

```
03/21/2009 Sacramento
05/17/2008 Los Angeles
12/30/2008 Morgan Hill
08/13/2009 Palo Alto
```

The first field is a gregorian date in 'mmddccyy' form, but you'd actually like to reformat it into a julian date in 'ccyy/ddd' form. You can use the following statements to convert the date field to the form you want:

```
OUTREC BUILD=(1,8,Y4W,TOJUL=Y4T(/),X,10,15)
```

The results produced for this OUTREC statement are:

```
2009/080 Sacramento
2008/138 Los Angeles
2008/365 Morgan Hill
2009/225 Palo Alto
```

Y4W and Y4T are two of DFSORT’s 4-digit year date field formats. Y4W indicates a date value with the year (ccyy) last such as 'mmmdccyy' or 'ddccyy' whereas Y4T indicates a date value with the year first such as 'ccyymmdd' or 'ccyyddd'. TOJUL is one of the conversion keywords that can be used with date
You can use any of the following after p,m,Y4x or p,m,Y2x to convert a CH, ZD or PD 4-digit or 2-digit year date in one form to a corresponding CH, ZD or PD 4-digit or 2-digit year date in another form or to a corresponding day of the week:

- **TOJUL=Yaa** - converts to a julian date without a separator (for example, P'2009007').
- **TOJUL=Yaa(s)** - converts to a julian date with a separator (for example, C'325-2008').
- **TOGREG=Yaa** - converts to a gregorian date without separators (for example, Z'091121').
- **TOGREG=Yaa(s)** - converts to a gregorian date with separators (for example, C'2009.09.21').
- **WEEKDAY=CHAR3** - converts to a 3 character day of the week (for example, C'WED' for Wednesday).
- **WEEKDAY=CHAR9** - converts to a 9 character day of the week (for example, C'THURSDAY ' for Thursday).
- **WEEKDAY=DIGIT1** - converts to a 1 digit indicator for the day of the week (for example, C'2' for Monday).
- **WEEKNUM=USA** - converts to an integer in the range of 1 to 54 that represents the week of the year.
- **WEEKNUM=ISO** - converts to an integer in the range of 1 to 53 that represents the week of the year.
- **Age=YMD** – converts to a 8 byte integer which has duration in years (0-9999), months (00-12), and days (00-31).
- **Age=YM** – converts to a 6 byte integer which has duration in years (0-9999), months (00-12).
- **Age=YD** – converts to a 7 integer which has duration in years (0-9999), days (00-366).

For complete details on converting from one type of date field to another, see [z/OS DFSORT Application Programming Guide](z/OS: z/OS DFSORT: Getting Started).

### Performing arithmetic with date fields

Suppose you had an input file with gregorian input dates in ccyymmdd form like this:

<table>
<thead>
<tr>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>20070305</td>
</tr>
<tr>
<td>20071213</td>
</tr>
<tr>
<td>20080219</td>
</tr>
<tr>
<td>20080901</td>
</tr>
<tr>
<td>20091122</td>
</tr>
<tr>
<td>20100915</td>
</tr>
<tr>
<td>20100630</td>
</tr>
</tbody>
</table>

You can use these statements:

```
OUTREC BUILD=(1,8,Y4T,ADDDAYS,+50,TOGREG=Y4T(/),2X,
            1,8,Y4T,SUBMONS,+7,TOGREG=Y4T(/),2X,
            1,8,Y4T,ADDYEARS,+2,TOGREG=Y4T(/))
```

to display the original date and perform arithmetic on these dates as follows:

- **Add 50 days**
- **Subtract 7 months**
- **Add 2 years**

The results produced for this OUTREC statement are:

<table>
<thead>
<tr>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007/04/24</td>
</tr>
<tr>
<td>2008/02/01</td>
</tr>
<tr>
<td>2008/09/09</td>
</tr>
<tr>
<td>2009/10/21</td>
</tr>
<tr>
<td>2010/01/11</td>
</tr>
<tr>
<td>2010/03/06</td>
</tr>
<tr>
<td>2010/11/04</td>
</tr>
<tr>
<td>2010/08/19</td>
</tr>
<tr>
<td>2009/08/05</td>
</tr>
<tr>
<td>2009/12/13</td>
</tr>
<tr>
<td>2010/02/19</td>
</tr>
<tr>
<td>2010/09/01</td>
</tr>
<tr>
<td>2011/11/22</td>
</tr>
<tr>
<td>2011/01/15</td>
</tr>
<tr>
<td>2012/09/15</td>
</tr>
<tr>
<td>2012/06/30</td>
</tr>
</tbody>
</table>
You can perform various types of arithmetic on date fields in either julian or gregorian form, with 2-digit (Y2x) or 4-digit (Y4x) years, in CH, ZD or PD format. You can convert the result to the same form of date or another form, with or without separators.

You can use the following date arithmetic functions:

- ADDDAYS, ADDMONS and ADDYEARS can be used to add days, months or years to a date field.
- SUBDAYS, SUBMONS and SUBYEARS can be used to subtract days, months or years from a date field.
- DATEDIFF can be used to calculate the number of days between two date fields.
- NEXTDday can be used to calculate the next specified day of the week for a date field (where day can be SUN, MON, TUE, WED, THU, FRI or SAT).
- PREVDday can be used to calculate the previous specified day of the week for a date field (where day can be SUN, MON, TUE, WED, THU, FRI or SAT).
- LASTDAYW, LASTDAYM, LASTDAYQ and LASTDAYY can be used to calculate the last day of the week, month, quarter or year for a date field.

For complete details on using date field arithmetic functions, see z/OS DFSORT Application Programming Guide.

Doing lookup and change

You can use the following statements to show all of the course departments and the publishers whose books they use:

```plaintext
SORT FIELDS=(110,5,CH,A,106,4,CH,A)
SUM FIELDS=NONE
OUTREC FIELDS=(110,5,X,106,4)
```

The results produced for these statements are:

```
COR
BIOL VALD
BUSIN COR
BUSIN VALD
COMP FERN
COMP VALD
COMP WETH
ENGL COR
ENGL FERN
ENGL VALD
HIST COR
HIST WETH
PSYCH COR
PSYCH FERN
```

This list is rather cryptic as everything is abbreviated. You can use the following OUTREC statement to make the list more meaningful by substituting descriptive words for the abbreviations.

```plaintext
OUTREC FIELDS=(110,5,CHANGE=(16,
                 C'HIST',C'History',
                 C'BUSIN',C'Business',
                 C'COMP',C'Computer Science',
                 C'ENGL',C'English',
                 C'Biol',C'Biology',
                 C'PSYCH',C'Psychology'),
                 NOMATCH=(C'Unaffiliated'),
                 106,4,CHANGE=(20,
                 C'FERN',C'Fernall Brothers',
                 C'COR',C'Cornish Limited',
                 C'VALD',C'Valdern and Co.',
                 C'WETH',C'Wethman, Inc.'))
```

The results produced for this OUTREC statement are:

```
Unaffiliated | Cornish Limited
Biology     | Valdern and Co.
Business     | Cornish Limited
```
Table lookup and change allows you to find an input field value in a table of character, hexadecimal or bit constants, and set a corresponding character constant, hexadecimal constant, or input field in the output record.

You use `p, m,CHANGE=(v,find,set,...)` to give the position and length of the input field, the length of the output field, and the "table" consisting of pairs of find constants, and set constants or set fields. For example, for the first field in the previous OUTREC statement:

- The input field starts in position 110.
- The length of the input field and find constants is 5.
- The length of the output field and set constants is 16.
- The first find constant is 'HIST' (padded with a blank at the end to 5 characters).
- The first set constant is 'History' (padded with blanks at the end to 16 characters).

Whenever the course department contains 'HIST', the output field is set to 'History'. Whenever the course department contains 'BUSIN', the output field is set to 'Business', and so on.

You can use `NOMATCH=(set)` to set the output value when an input field value does not match any of the find constants. `NOMATCH=('C'string')` sets a character string constant. `NOMATCH=('X'string')` sets a hexadecimal string constant. `NOMATCH=(q,n)` sets an input field value. For example, in the previous OUTREC statement, an input field value of blanks results in an output field value of 'Unaffiliated' (padded with blanks at the end to 16 characters). If you do not specify `NOMATCH=(set)`, DFSORT terminates with an error message when an input field value does not match any of the find constants.

For complete details on lookup and change, see [z/OS DFSORT Application Programming Guide](https://www.ibm.com/support/docview.wss?rs=17&uid=swg27026284).

### Left-justifying and right-justifying data

Suppose you had input records that looked like this:

<table>
<thead>
<tr>
<th>History</th>
<th>Psychology</th>
<th>Biology</th>
<th>Business</th>
<th>Computer Science</th>
</tr>
</thead>
</table>

Since this is rather messy looking, you can use the following statements to left-justify the data to make it more presentable:

```plaintext
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=LEFT))
```

`SHIFT=LEFT` indicates that you want to left-justify. The results produced for this OUTREC statement are:

<table>
<thead>
<tr>
<th>History</th>
<th>Psychology</th>
<th>Biology</th>
<th>Business</th>
<th>Computer Science</th>
</tr>
</thead>
</table>

Alternatively, you can use the following statements to right-justify the data:

```plaintext
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=RIGHT))
```
SHIFT=RIGHT indicates that you want to right-justify. The results produced for this OUTREC statement are:

```
| History  |
| Psychology |
| Business  |
| Biology   |
| Computer Science |
```

DFSORT’s justify feature also lets you add a leading string, a trailing string, or both, to the data. For example, you can use the following statements to surround the left-justified data with ‘<’ and ‘>’:

```
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=LEFT,LEAD=C'<',TRAIL=C'>'))
```

The results produced for this OUTREC statement are:

```
<History>
<Psychology>
<Business>
<Biology>
<Computer Science>
```

LEAD=string specifies the leading string as a character or hexadecimal constant (1 to 50 bytes). TRAIL=string specifies the trailing string as a character or hexadecimal constant (1 to 50 bytes).

Notice that when you left-justify, the trailing string is placed directly to the right of the last non-blank character in your data.

If you want to right-justify instead of left-justify, you can use the following statements:

```
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=RIGHT,LEAD=C'<',TRAIL=C'>'))
```

The results produced for this OUTREC statement are:

```
<History>
<Psychology>
<Business>
<Biology>
<Computer Science>
```

Notice that when you right-justify, the leading string is placed directly to the left of the first non-blank character in your data.

If your leading or trailing string causes the output field to be longer than the input field, you will lose characters. In order to avoid that, you can increase the length of the output field with the LENGTH parameter. For example, suppose you had input records that looked like this:

```
rats
bats
cats
```

and you added a leading string with these control statements:

```
OPTION COPY
OUTREC FIELDS=(1,7,JFY=(SHIFT=LEFT,LEAD=C'*I love ',TRAIL=C'*'))
```

Since your input field is 7 bytes, your output field is also 7 bytes by default, so your output fields are truncated to:

```
*I love
*I love
*I love
```

To avoid truncation, you can use LENGTH=16 to increase the output field length by the 9 characters you added for the leading and trailing strings:
Reformatting Records

The larger output field can accommodate your leading and trailing strings so you can show your appreciation for these wonderful creatures with the following output:

*I love rats*
*I love bats*
*I love cats*

The justify feature can also be used to remove leading and trailing characters other than blanks from your data. Suppose you had input records that looked like this:

(History)
(Psychology)
(Biology)
(Business)
(Computer Science)

You can use the following statements to remove the leading '(' character and the trailing ')' character before you left-justify the data:

```plaintext
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=LEFT,PREBLANK=C'()'))
```

`PREBLANK=list` specifies a list of characters you want to replace with blanks before DFSORT starts to justify the data. You can specify the list as a character or hexadecimal constant (1 to 10 bytes). Remember that each character in the list is independent of the other characters. For example, `PREBLANK=C'*/'` replaces each leading or trailing '*' character and '/' character with a blank before justify processing begins (for example, leading and trailing character sequences of /*, //, */ and * are all replaced with blanks).

The results produced for this OUTREC statement are:

History
Psychology
Business
Biology
Computer Science

You could use the following statements to right-justify the data and replace the leading '(' character and trailing ')' character with a leading '<' character and a trailing '>' character:

```plaintext
OPTION COPY
OUTREC FIELDS=(1,30,JFY=(SHIFT=RIGHT,PREBLANK=C'()',
LEAD=C'<',TRAIL=C'>'))
```

The results produced for this OUTREC statement are:

<History>
<Psychology>
<Business>
<Biology>
<Computer Science>

For complete details on justify, see [z/OS DFSORT Application Programming Guide](https://www.ibm.com/docs/en/zos/2.4.0?topic=docref).

**Left-squeezing and right-squeezing data**

Suppose you had input records that looked like this:

```html
<tag> History </tag>
<tag> Psychology </tag>
<tag> Business </tag>
<tag>Biology</tag>
<tag> Science </tag>
```
If you want to remove the white space (blanks), you can use the following statements to left-squeeze the data:

```
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=LEFT))
```

SHIFT=LEFT indicates that you want to left-squeeze by removing all of the blanks, shifting the remaining characters to the left and padding on the right with blanks if needed. The results produced for this OUTREC statement are:

```
<tag>History</tag>  
<tag>Psychology</tag>  
<tag>Business</tag>  
<tag>Biology</tag>  
<tag>Science</tag>
```

Alternatively, you can use the following statements to right-squeeze the data:

```
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=RIGHT))
```

SHIFT=RIGHT indicates that you want to right-squeeze by removing all of the blanks, shifting the remaining characters to the right and padding on the left with blanks if needed. The results produced for this OUTREC statement are:

```
<tag>History</tag>  
<tag>Psychology</tag>  
<tag>Business</tag>  
<tag>Biology</tag>  
<tag>Science</tag>
```

DFSORT’s squeeze feature also lets you add a leading string, a trailing string, or both, to the data. For example, you can use the following statements to surround the left-squeezed data with ‘<tag1>’ and ‘</tag1>’:

```
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=LEFT,LEAD=C'<'tag1>', 
               TRAIL=C'</tag1>'))
```

The results produced for this OUTREC statement are:

```
<tag1><tag>History</tag></tag1>  
<tag1><tag>Psychology</tag></tag1>  
<tag1><tag>Business</tag></tag1>  
<tag1><tag>Biology</tag></tag1>  
<tag1><tag>Science</tag></tag1>
```

LEAD=string specifies the leading string as a character or hexadecimal constant (1 to 50 bytes).
TRAIL=string specifies the trailing string as a character or hexadecimal constant (1 to 50 bytes).

Notice that when you left-squeeze, the trailing string is placed directly to the right of the last non-blank character in your data.

If you want to right-squeeze instead of left-squeeze, you can use the following statements:

```
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=RIGHT,LEAD=C'<'tag1>', 
               TRAIL=C'</tag1>'))
```

The results produced for this OUTREC statement are:

```
<tag1><tag>History</tag></tag1>  
<tag1><tag>Psychology</tag></tag1>  
<tag1><tag>Business</tag></tag1>  
<tag1><tag>Biology</tag></tag1>  
<tag1><tag>Science</tag></tag1>
```
Notice that when you right-squeeze, the leading string is placed directly to the left of the first non-blank character in your data.

If your leading or trailing string causes the output field to be longer than the input field, you will lose characters. In order to avoid that, you can increase the length of the output field with the LENGTH parameter as discussed previously under “Left-justifying and right-justifying data” on page 52.

The squeeze feature can also be used to remove characters other than blanks from your data. Suppose you had input records that looked like this:

```text
<tag> (History) </tag>
<tag> (Psychology) </tag>
<tag> (Business) </tag>
<tag> (Biology) </tag>
<tag> (Science) </tag>
```

You can use the following statements to remove the '(' and ')' characters before you left-squeeze the data:

```text
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=LEFT,PREBLANK=C'(\')))
```

PREBLANK=list specifies a list of characters you want to replace with blanks before DFSORT starts to squeeze the data. You can specify the list as a character or hexadecimal constant (1 to 10 bytes). Remember that each character in the list is independent of the other characters. For example, PREBLANK=C'*'/ replaces each '*' character and '/' character with a blank before squeeze processing begins (for example, character sequences of /*, //, */ and * are all replaced with blanks).

The results produced for this OUTREC statement are:

```text
<tag>History</tag>
tag>Psychology</tag>
tag>Business</tag>
tag>Biology</tag>
tag>Science</tag>
```

You could use the following statements to right-squeeze the data and remove the '(' character and ')' character:

```text
OPTION COPY
OUTREC FIELDS=(1,40,SQZ=(SHIFT=RIGHT,PREBLANK=C'(\')))
```

The results produced for this OUTREC statement are:

```text
<tag>History</tag>
tag>Psychology</tag>
tag>Business</tag>
tag>Biology</tag>
tag>Science</tag>
```

The squeeze feature can be used to replace groups of blanks between the first nonblank and last nonblank with other characters. Suppose you had input records that looked like this:

<table>
<thead>
<tr>
<th>Manufacturing</th>
<th>California</th>
<th>+100000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Arizona</td>
<td>+50000</td>
</tr>
<tr>
<td>Marketing</td>
<td>Texas</td>
<td>+75000</td>
</tr>
</tbody>
</table>

You could use the following statements to create comma separated variable records:

```text
OPTION COPY
OUTREC FIELDS=(1,80,SQZ=(SHIFT=LEFT,MID=C','))
```

The results produced for this OUTREC statement are:

```text
Manufacturing,California,+100000
Research,Arizona,+50000
Marketing,Texas,+75000
```
MID=string specifies the string to replace removed blanks or PREBLANK characters as a character or hexadecimal constant (1 to 10 bytes).

If you want DFSORT to "ignore" blanks and PREBLANK characters between pairs of quotes, you can use PAIR=QUOTE with SQZ.

Suppose you had input records that looked like this:

<table>
<thead>
<tr>
<th>Input Record</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science A+</td>
<td>+123</td>
</tr>
<tr>
<td>Ancient Civilization B-</td>
<td>+521</td>
</tr>
<tr>
<td>Sanskrit A-</td>
<td>-263</td>
</tr>
</tbody>
</table>

You could use the following statements to "protect" the blanks, + and - signs inside the paired quotes while removing them outside the paired quotes, and leave only one blank between the two squeezed fields:

```
OPTION COPY
OUTREC FIELDS=(1,80,SQZ=(SHIFT=LEFT,PAIR=QUOTE,
PREBLANK=C'+-',MID=C' '))
```

The results produced for this OUTREC statement are:

<table>
<thead>
<tr>
<th>Output Record</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science A+</td>
<td>123</td>
</tr>
<tr>
<td>Ancient Civilization B-</td>
<td>521</td>
</tr>
<tr>
<td>Sanskrit A-</td>
<td>263</td>
</tr>
</tbody>
</table>

If you want DFSORT to "ignore" blanks and PREBLANK characters between pairs of apostrophes, you can use PAIR=APOST with SQZ.

Suppose you had input records that looked like this:

<table>
<thead>
<tr>
<th>Input Record</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Computer Science A+'</td>
<td>+123</td>
</tr>
<tr>
<td>'Ancient Civilization B-'</td>
<td>+521</td>
</tr>
<tr>
<td>'Sanskrit A-'</td>
<td>-263</td>
</tr>
</tbody>
</table>

You could use the following statements to "protect" the blanks, + and - signs inside the paired apostrophes while removing them outside the paired apostrophes, and leave only one blank between the two squeezed fields:

```
OPTION COPY
OUTREC FIELDS=(1,80,SQZ=(SHIFT=LEFT,PAIR=APOST,
PREBLANK=C'+-',MID=C' '))
```

The results produced for this OUTREC statement are:

<table>
<thead>
<tr>
<th>Output Record</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Computer Science A+'</td>
<td>123</td>
</tr>
<tr>
<td>'Ancient Civilization B-'</td>
<td>521</td>
</tr>
<tr>
<td>'Sanskrit A-'</td>
<td>263</td>
</tr>
</tbody>
</table>

For complete details on squeeze, see z/OS DFSORT Application Programming Guide.

---

So far

Now you know how to use the many features available with the BUILD or FIELDS parameter of the OUTREC statement to reformat your input records in many ways for output. Keep in mind that you can use all of these reformatting features with the BUILD or FIELDS parameter of the INREC statement and with the BUILD or OUTREC parameter of the OUTFIL statement, as well as with the OUTREC statement. In fact, you can use all of these statements together, when appropriate. Next, you will learn how to use the OVERLAY parameter of the OUTREC statement to change one or more fields without affecting the rest of your record.
Reformatting records with OVERLAY

With the BUILD or FIELDS parameter of the OUTREC statement, you build your reformatted output record one item at a time. You must specify each item (unedited, edited or converted input field, blanks, string, and so on) you want in the output record in the order in which you want it to appear.

But if you only want to change one or a few items and keep the rest of the record in its original form, there’s an easier way: the OVERLAY parameter of the OUTREC statement. You can use the same items with the OVERLAY parameter we discussed earlier for the BUILD or FIELDS parameter.

Suppose you want to change the course department to lowercase and discount the price of each book by 10%. You can use the following statements to create an output data set with the new price instead of the old price in each output record:

```plaintext
OPTION COPY
OUTREC OVERLAY=(110:110,5,TRAN=UTOL,
  170:170,4,BI,SUB,(170,4,BI,DIV,+10),
  TO=BI,LENGTH=4)
```

The arithmetic expression in the OUTREC parameter gives you a new 4-byte BI price as follows:

\[
\text{new price} = \text{old price} - \left(\frac{\text{old price}}{10}\right)
\]

With the BUILD parameter, you must build the entire record, so you must specify the following:

- 1,109 to keep the bytes before the course department
- 110,5,TRAN=UTOL to change the course department from uppercase to lowercase
- 115:115,55 to keep the bytes between the course department and the price
- 170:170,4,BI,SUB,(170,4,BI,DIV,+10),TO=BI,LENGTH=4 to replace price with price=price-(price/10)

But since you are not changing the bytes before the course department or between the course department and the price, it’s easier to use the OVERLAY parameter to just overlay the bytes you want to change as follows:

```plaintext
OPTION COPY
OUTREC OVERLAY=(110:110,5,TRAN=UTOL,
  170:170,4,BI,SUB,(170,4,BI,DIV,+10),
  TO=BI,LENGTH=4)
```

Table 34 on page 58 shows the copied data set.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Department</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 75</td>
<td>110 114</td>
<td>170 173</td>
</tr>
</tbody>
</table>
Table 34. Books with Course Department and Price Changes (continued)

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Department</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPUTER LANGUAGES</td>
<td>comp</td>
<td>2340</td>
</tr>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td></td>
<td>8910</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>busin</td>
<td>1733</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>comp</td>
<td>1980</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>engl</td>
<td>0536</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>comp</td>
<td>1710</td>
</tr>
<tr>
<td>PICK’S POCKET DICTIONARY</td>
<td></td>
<td>0266</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>engl</td>
<td>1305</td>
</tr>
<tr>
<td>NUMBERING SYSTEMS</td>
<td>comp</td>
<td>0324</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>busin</td>
<td>2115</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>hist</td>
<td>0716</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>engl</td>
<td>0405</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>psych</td>
<td>1980</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>engl</td>
<td>0563</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>comp</td>
<td>2876</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>engl</td>
<td>1368</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>biol</td>
<td>2115</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>psych</td>
<td>2340</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>hist</td>
<td>1611</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>hist</td>
<td>1080</td>
</tr>
</tbody>
</table>

With the OVERLAY parameter, you don't have to figure out or specify 1,109 or 115,55. Instead you just specify each output starting column (110: and 170:) and its replacement item. Any column you don't overlay remains the same. In addition, in contrast to BUILD items, OVERLAY items can overlap each other and can be specified in any order. In our case, the following OUTREC statement would give the same results as the previous OUTREC statement:

```
OPTION COPY
OUTREC OVERLAY=(170:170,4,BI,SUB,(170,4,BI,DIV,+10),
                TO=BI,LENGTH=4,
                110:110,5,TRAN=UTOL)
```

Extending records with OVERLAY

You can also use the OVERLAY parameter to extend your output record without affecting the rest of the record.

Suppose you want to replace the old price with a new price discounted by 10%, but also extend the record with a new field containing the original price. You can use the following statements:

```
OPTION COPY
OUTREC OVERLAY=(174:170,4,
                170:170,4,BI,SUB,(170,4,BI,DIV,+10),
                TO=BI,LENGTH=4)
```

Table 35 on page 59 shows the copied data set.

Table 35. New and Old Prices

<table>
<thead>
<tr>
<th>New Price</th>
<th>Old Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 173</td>
<td>174 177</td>
</tr>
</tbody>
</table>
### Table 35. New and Old Prices (continued)

<table>
<thead>
<tr>
<th>New Price</th>
<th>Old Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2340</td>
<td>2600</td>
</tr>
<tr>
<td>8910</td>
<td>9900</td>
</tr>
<tr>
<td>1733</td>
<td>1925</td>
</tr>
<tr>
<td>1980</td>
<td>2199</td>
</tr>
<tr>
<td>0536</td>
<td>0595</td>
</tr>
<tr>
<td>1710</td>
<td>1899</td>
</tr>
<tr>
<td>0266</td>
<td>0295</td>
</tr>
<tr>
<td>1305</td>
<td>1450</td>
</tr>
<tr>
<td>0324</td>
<td>0360</td>
</tr>
<tr>
<td>2115</td>
<td>2350</td>
</tr>
<tr>
<td>0716</td>
<td>0795</td>
</tr>
<tr>
<td>0405</td>
<td>0450</td>
</tr>
<tr>
<td>1980</td>
<td>2200</td>
</tr>
<tr>
<td>0563</td>
<td>0625</td>
</tr>
<tr>
<td>2876</td>
<td>3195</td>
</tr>
<tr>
<td>1368</td>
<td>1520</td>
</tr>
<tr>
<td>2115</td>
<td>2350</td>
</tr>
<tr>
<td>2340</td>
<td>2600</td>
</tr>
<tr>
<td>1611</td>
<td>1790</td>
</tr>
<tr>
<td>1080</td>
<td>1200</td>
</tr>
</tbody>
</table>

Since you added a new field at positions 174-177, DFSORT automatically increases the record length from 173 bytes to 177 bytes.

In this case, the order in which you specify the two overlay items is important because you are using the old price for both items. So you must make the copy of the old price before you modify it. Thus, in the previous OUTREC statement, the first overlay item copies the old price to the new field, and the second overlay item replaces the old price with the new price. If you used this OUTREC statement:

```
OUTREC OVERLAY=(170:170,4,BI,SUB,(170,4,BI,DIV,+10), TO=BI,LENGTH=4, 174:170,4)
```

you would inadvertently replace the old price with the new price and then copy the new price to the new field. Thus, you would have the new price in both fields instead of having the new price in one field and the old price in the other field. Since OVERLAY allows overlapping items, you must be careful not to destroy a field with an earlier overlay item that you want to use in a later overlay item.

### So far

Now you know how to use the OVERLAY parameter of the OUTREC statement to overlay specified columns with reformatting items, without affecting the rest of your reformatted record. Keep in mind that you can use all of these reformatting features with the OVERLAY parameter of the INREC statement and OUTFIL statement, as well as with the OUTREC statement. Next, you will learn how to use the FINDREP parameter of the OUTREC statement to replace or remove data anywhere in your records.

## Reformatting records with FINDREP

With the BUILD, FIELDS or OVERLAY parameter of the OUTREC statement, you reformat output records by specifying items that start at a specific position. But if you want to replace or remove data anywhere in your records, you would use the FINDREP parameter of the OUTREC statement instead.

Suppose you had input records that looked like this:

```
*"Goodbye John"*"Goodbye William"*"Goodbye Goodboy"
"Goodbye Mike"*"Good Dog"*"Goodbye Goodbye"
```
You could use the following statements to replace all instances of 'Goodbye' anywhere in the input records with 'Bye'.

```
OPTION COPY
OUTREC FINDREP=(IN=C'Goodbye',OUT=C'Bye')
```

FINDREP indicates that you want to do a find and replace operation. IN identifies the constant you are looking for (the "find" constant) and OUT identifies the constant you want instead (the "replace" constant).

The output records produced by this OUTREC statement are:

```
*"Bye John"*"Bye William"*"Bye Goodboy"*
"Bye Mike""Good Dog""Bye Bye"
```

You can use OUT=C'' (null constant) to remove identified constants. For example, you could use the following statements to remove 'bye' anywhere in the input records:

```
OPTION COPY
OUTREC FINDREP=(IN=C'bye',OUT=C'')
```

The results produced for this OUTREC statement using the input records shown previously are:

```
*"Good John"*"Good William"*"Good Goodboy"*
"Good Mike""Good Dog""Good Good"
```

You could use the following statements to change 'William' to 'Bill', 'Mike' to 'Michael', 'Dog' to 'Beagle' and '*' to '#' anywhere in the input records:

```
OPTION COPY
OUTREC FINDREP=(INOUT=(C'William',C'Bill',
C'Mike',C'Michael',C'Dog',C'Beagle',C'*',C'#'))
```

INOIT identifies pairs of find and replace constants.

The results produced for this OUTREC statement using the input records shown previously are:

```
#"Goodbye John"#"Goodbye Bill"#"Goodbye Goodboy"#
"Goodbye Michael""Good Beagle""Goodbye Goodbye"
```

For complete details on find and replace, see z/OS DFSORT Application Programming Guide.

So far

Now you know how to use the FINDREP parameter of the OUTREC statement to replace or remove data anywhere in your records. Keep in mind that you can use all of these reformatting features with the FINDREP parameter of the INREC statement and OUTFIL statement, as well as with the OUTREC statement. Next, you will learn how to use IFTHEN clauses with the OUTREC statement to reformat different records in different ways.

Reformatting records with IFTHEN

The OVERLAY, FINDREP, and BUILD or FIELDS parameters discussed in previous sections let you use the same reformatting items for every output record. IFTHEN clauses for the OUTREC statement let you select subsets of the output records and apply different BUILD, FINDREP or OVERLAY items to them. So, for example, you can apply a set of BUILD items to “type 1” records, a set of OVERLAY items to “type 2” records, do find and replace operations on “type 3” records, and apply a different set of OVERLAY items (or no items) to other types of records.

You can use five types of IFTHEN clauses as follows:

- **WHEN=INIT**: Use one or more WHEN=INIT clauses to apply BUILD, FINDREP or OVERLAY items to all of your input records. WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.
WHEN=GROUP: Use one or more WHEN=GROUP clauses to propagate fields, identifiers and sequence numbers within groups of records. You define the records that belong to a group using an appropriate combination of BEGIN=(logexp), END=(logexp), KEYBEGIN=(field) and RECORDS=n parameters.

You can use any logical expression for BEGIN=(logexp) and END=(logexp) that you can use for the COND=(logexp) parameter of an INCLUDE statement as previously discussed in Chapter 3, “Including or omitting records,” on page 23. A BEGIN=(logexp) or END=(logexp) parameter is satisfied when the logical expression evaluates as true.

A KEYBEGIN=(field) parameter is satisfied when the field value changes.

You define how the records in a group are to be changed using the PUSH parameter. You use c: (output column), p,m (field), ID=n (zoned decimal identifier of length n) and SEQ=n (zoned decimal sequence number of length n) in the PUSH parameter to specify how the records in the group are to be changed.

WHEN=INIT clauses and WHEN=GROUP clauses are processed before any of the other IFTHEN clauses.

WHEN=(logexp): Use one or more WHEN=(logexp) clauses to apply BUILD, FINDREP or OVERLAY items to the subset of your records that satisfy a specified logical expression. You can use any logical expression for WHEN=(logexp) that you can use for the COND=(logexp) parameter of an INCLUDE statement as previously discussed in Chapter 3, “Including or omitting records,” on page 23. A WHEN=(logexp) clause is satisfied when the logical expression evaluates as true.

WHEN=ANY: Use a WHEN=ANY clause after multiple WHEN=(logexp) clauses to apply additional BUILD, FINDREP or OVERLAY items to your records if they satisfied the criteria for any of the preceding WHEN=(logexp) clauses.

WHEN=NONE: Use one or more WHEN=NONE clauses to apply BUILD, FINDREP or OVERLAY items to your records that did not meet the criteria for any of the WHEN=(logexp) clauses. WHEN=NONE clauses are processed after any of the other IFTHEN clauses. If you do not specify a WHEN=NONE clause, only the WHEN=INIT changes (if any) and WHEN=GROUP changes (if any) are applied to input records that do not meet the criteria for any of the WHEN=(logexp) clauses.

Suppose you want to produce a report showing the title, publisher, edited price and % discount if you:

• discount the price of books from publisher COR that cost more than $20.00 by 20%
• discount the price of books from publisher COR that cost $20.00 or less by 10%
• discount the price of all books from publisher VALD by 25%
• discount the price of all books from the other publishers by 15%

You can use the following statements:

```
OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,
    BUILD=(1:1,40,50:106,4,60:170,4,BI,EDIT=(TT.TT),70:170,4)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C’COR’,AND,70,4,BI,GT,+2000),
        OVERLAY=(70:C’20’,X)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C’COR’,AND,70,4,BI,LE,+2000),
        OVERLAY=(70:C’10’,X)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C’VALD’),OVERLAY=(70:C’25’,X)),
    IFTHEN=(WHEN=NONE,OVERLAY=(70:C’15’,X))
```

Table 36 on page 62 shows the copied data set.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
<th>Price</th>
<th>Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 40</td>
<td>50 53</td>
<td>60 64</td>
<td>70 73</td>
</tr>
</tbody>
</table>
The first IFTHEN clause is a WHEN=INIT clause that uses BUILD to initialize every record with the title, publisher, edited price and a placeholder for the discount. Notice that the publisher field is copied to positions 50-53 and the 4-byte BI price field is copied to positions 70-73. Subsequent IFTHEN clauses are processed for all records and must refer to these fields at their new positions.

The second IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '20%' for the subset of records with 'COR ' as the publisher and more than 2000 as the price. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The third IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '10%' for the subset of records with 'COR ' as the publisher and 2000 or less as the price. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The fourth IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '25%' for the subset of records with 'VALD' as the publisher. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The fifth IFTHEN clause is a WHEN=NONE clause that uses OVERLAY to set the discount field to '15%' for the subset of records that did not satisfy the logical expression for the second, third and fourth IFTHEN clauses.

DFSORT determines an appropriate reformatted output record length from the IFTHEN clauses you specify. However, you can use the IFOUTLEN=n parameter to tell DFSORT the length you want it to use for the reformatted records. For example, suppose you had 80 byte input records, and this DFSORT statement:

```plaintext
OUTREC IFTHEN=(WHEN=INIT,OVERLAY=(81:SEQNUM,8,ZD)),
   IFTHEN=(WHEN=(81,8,ZD,EQ,+5),OVERLAY=(21:C'J82')),
   IFTHEN=(WHEN=(81,8,ZD,EQ,+10),OVERLAY=(21:C'M72'))
```

By default, DFSORT would set the reformatted output record length to 88 to accommodate the 8-byte ZD sequence number you added. If you're only using the 8-byte sequence number for the WHEN comparisons, and you don't want the sequence number as part of the reformatted output record, you
could use this statement instead to tell DFSORT to use 80 for the reformatted output record length instead of 88:

```
OUTREC IFTHEN=(WHEN=INIT,OVERLAY=(81:SEQNUM,8,ZD)),
            IFTHEN=(WHEN=(81,8,ZD,EQ,+5),OVERLAY=(21:C'J82')) ,
            IFTHEN=(WHEN=(81,8,ZD,EQ,+10),OVERLAY=(21:C'M72')) ,
            IFOUTLEN=80
```

Suppose you have the following 30-byte FB input records:

| C33 | Not in a group |
| HDR | Start Group 1  |
| A01 | Group 1 record |
| B02 | Group 1 record |
| C03 | Group 1 record |
| TRL | End Group 1    |
| R24 | Not in a group |
| T02 | Not in a group |
| HDR | Start Group 2  |
| D04 | Group 2 record |
| E05 | Group 2 record |
| TRL | End Group 2    |
| F97 | Not in a group |

In the output data set we only want to include groups of records that start with 'HDR' and end with 'TRL'. We write the following DFSORT control statements:

```
OPTION COPY
OUTREC IFTHEN=(WHEN=GROUP,BEGIN=(1,3,CH,EQ,C'HDR'),
               END=(1,3,CH,EQ,C'TRL'),PUSH=(31:ID=1))
OUTFIL INCLUDE=(31,1,CH,NE,C' '),BUILD=(1,30)
```

We use an IFTHEN WHEN=GROUP clause to put a non-blank character in each record that is part of a group. BEGIN indicates a group starts with a record that has 'HDR' in positions 1-3. END indicates a group ends with a record that has 'TRL' in positions 1-3. PUSH overlays a 1-byte ID character at position 31 in each record of a group (after the end of the record). After the IFTHEN GROUP clause is executed, the intermediate records look like this:

| C33 | Not in a group |
| HDR | Start Group 1  |
| A01 | Group 1 record |
| B02 | Group 1 record |
| C03 | Group 1 record |
| TRL | End Group 1    |
| R24 | Not in a group |
| T02 | Not in a group |
| HDR | Start Group 2  |
| D04 | Group 2 record |
| E05 | Group 2 record |
| TRL | End Group 2    |
| F97 | Not in a group |

Note that the records within a group have a non-blank character in position 31 whereas the records outside groups have a blank character in position 31. The ID starts at 1 for the first group and is incremented by 1 for each subsequent group. Since we are only allowing one character for the ID, when the ID counter gets to 10, a '0' will appear in position 31. That's fine since we are just looking for a non-blank to indicate a record within a group, or a blank to indicate a record outside of a group.

We use an OUTFIL statement to only INCLUDE records with a non-blank in position 31, and to remove the ID character so the included output records will be identical to the input records. After the OUTFIL statement is executed, the final output records look like this:

| HDR | Start Group 1 |
| A01 | Group 1 record |
| B02 | Group 1 record |
| C03 | Group 1 record |
| TRL | End Group 1    |
| HDR | Start Group 2 |
| D04 | Group 2 record |
| E05 | Group 2 record |
| TRL | End Group 2    |
For detailed information on using IFTHEN clauses and IFOUTLEN, see z/OS DFSORT Application Programming Guide.

**So far**

Now you know how to use IFTHEN clauses with the OUTREC statement to reformat different records in different ways and to perform group operations. Keep in mind that you can use IFTHEN clauses with the INREC statement and OUTFIL statement, as well as with the OUTREC statement. Next, you will learn about some special considerations for using the INREC statement.

### Reformatting records before sorting

The INREC statement has the same format as the OUTREC statement. Therefore, in the first example of “Reformatting records after sorting with BUILD or FIELDS” on page 38, where you used OUTREC to write only the publisher, number in stock, and number sold fields, you can use INREC instead.

```plaintext
INREC FIELDS=(106,4,162,4,166,4)
```

**Using other statements with INREC**

Because INREC reformats the records before they are sorted, the SORT and SUM statements must refer to the reformatted records as they will appear in the output data set.

Thus, after INREC, the input records for the control statement in the previous section are 12 bytes long (see Table 25 on page 38 for an example).

You write the SORT and SUM statements to process the byte positions in the reformatted records:

- Move input positions 106-109 to reformatted record positions 1-4.
- Move input positions 162-169 to reformatted record positions 5-12.
- Sort reformatted record positions 1-4.
- Sum reformatted record positions 5-8 and 9-12.

```plaintext
INREC FIELDS=(106,4,162,8)
SORT FIELDS=(1,4,CH,A)
SUM FIELDS=(5,4,BI,9,4,BI)
```

Table 37 on page 65 shows the result.

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>9 12</td>
</tr>
<tr>
<td>COR</td>
<td>103</td>
<td>161</td>
</tr>
<tr>
<td>FERN</td>
<td>19</td>
<td>87</td>
</tr>
<tr>
<td>VALD</td>
<td>42</td>
<td>97</td>
</tr>
<tr>
<td>WETH</td>
<td>62</td>
<td>79</td>
</tr>
</tbody>
</table>
As the flowchart in Appendix C, “Processing order of control statements,” on page 177 shows, DFSORT processes the INREC statement before SORT, SUM, and OUTREC, but after INCLUDE and OMIT. Therefore, when used with the INREC statement, SORT, SUM, and OUTREC must refer to the reformatted records, and INCLUDE and OMIT must refer to the original records.

DFSORT processes the OUTFIL statements after the INREC and OUTREC statements. Therefore, OUTFIL must refer to the reformatted records produced by OUTREC if specified, or to the reformatted records produced by INREC if it is specified without OUTREC. You will learn about OUTFIL statements in Chapter 7, “Creating multiple output data sets and reports,” on page 79.

The following control statements illustrate how the INREC and OUTREC statements affect the positions you specify for various other statements:

```plaintext
INCLUDE COND=(110,5,CH,EQ,C'ENGL',OR,110,5,CH,EQ,C'PSYCH')
INREC FIELDS=(1:1,75,76:170,4,80:110,5)
SORT FIELDS=(76,4,BI,D)
OUTREC FIELDS=(1:1,75,85:76,4,BI,EDIT=($IT.TT),95:80,5)
OUTFIL FNAMES=ENGL,INCLUDE=(95,5,CH,EQ,C'ENGL')
OUTFIL FNAMES=PSYCH,INCLUDE=(95,5,CH,EQ,C'PSYCH')
```

The INCLUDE and INREC statements refer to fields as they appear in the input records. The SORT and OUTREC statements refer to fields as they appear in the reformatted INREC records. The OUTFIL statements refer to fields as they appear in the reformatted OUTREC records.

### Preventing overflow when summing values

In some cases, you can prevent overflow by using INREC to pad summary fields with zeros. However, this method cannot be used for negative fixed-point binary data, because padding with zeros rather than with ones would change the sign.

If the summary fields in Table 37 on page 65 were overflowing, you could pad each of them on the left with 4 bytes (binary fields must be 2, 4, or 8 bytes long), as shown in Table 38 on page 66.

#### Table 38. Padding Summary Fields

<table>
<thead>
<tr>
<th>Publisher</th>
<th>X'0...0'</th>
<th>Number In Stock</th>
<th>X'0...0'</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5 8</td>
<td>9 12</td>
<td>13 16</td>
</tr>
<tr>
<td>COR</td>
<td></td>
<td>103</td>
<td></td>
<td>161</td>
</tr>
<tr>
<td>FERN</td>
<td></td>
<td>19</td>
<td></td>
<td>87</td>
</tr>
<tr>
<td>VALD</td>
<td></td>
<td>42</td>
<td></td>
<td>97</td>
</tr>
<tr>
<td>WETH</td>
<td></td>
<td>62</td>
<td></td>
<td>79</td>
</tr>
</tbody>
</table>

INREC FIELDS=(106,4,4Z,162,4,4Z,166,4)
SORT FIELDS=(1,4,CH,A)
SUM FIELDS=(5,8,BI,13,8,BI)

- New number sold field
- New number in stock field

Table 39 on page 67 shows the output records, each 20 bytes long.
### Table 39. Padding Summary Fields

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Number In Stock</th>
<th>Number Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>COR</td>
<td>103</td>
<td>161</td>
</tr>
<tr>
<td>FERN</td>
<td>19</td>
<td>87</td>
</tr>
<tr>
<td>VALD</td>
<td>42</td>
<td>97</td>
</tr>
<tr>
<td>WETH</td>
<td>62</td>
<td>79</td>
</tr>
<tr>
<td>13</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ **Attention:** You cannot use the OUTREC statement to prevent overflow, because it is processed *after* summarization.

### Inserting sequence numbers

Suppose you want to show the total price for all of the books associated with each course department, but you need the list in its original course department order rather than sorted by course department. In order to get the totals, you need to SORT by the department field, and SUM the price field, using the following statements:

```
INREC FIELDS=(110,5,170,4)
SORT FIELDS=(1,5,CH,A)
SUM FIELDS=(6,4,BI)
```

Table 40 on page 67 shows the result of these statements.

### Table 40. Total book prices by course

<table>
<thead>
<tr>
<th>Department</th>
<th>Total Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6 9</td>
</tr>
<tr>
<td>10195</td>
<td></td>
</tr>
<tr>
<td>2350</td>
<td></td>
</tr>
<tr>
<td>4275</td>
<td></td>
</tr>
<tr>
<td>10253</td>
<td></td>
</tr>
<tr>
<td>4640</td>
<td></td>
</tr>
<tr>
<td>3785</td>
<td></td>
</tr>
<tr>
<td>4800</td>
<td></td>
</tr>
</tbody>
</table>

Because you had to SORT in order to SUM (remember that you cannot SUM with COPY), the list is in sorted order by course department instead of the original order of COMP, blank, BUSIN, ENGL, HIST, PSYCH, and BIOL you need. To get back the original order, you can add a sequence number to each record *before* the records are sorted, and use a second step to sort the records back into their original order by that sequence number. You can remove the sequence numbers at the end of the second step.

You can use the previous statements with a slightly modified INREC statement to add the sequence number for the first step:

```
INREC FIELDS=(110,5,170,4,SEQNUM,8,ZD)
SORT FIELDS=(1,5,CH,A)
SUM FIELDS=(6,4,BI)
```

The sequence numbers start at 00000001 for the first record and are incremented by 00000001 for each subsequent record. This allows you to sort the summed records back into their original course department order by the sequence number.

Table 41 on page 68 shows the result of this first step. The output records are stored in a temporary data set.
### Table 41. Total Book Prices by Course with Sequence Numbers

<table>
<thead>
<tr>
<th>Department</th>
<th>Total Price</th>
<th>Sequence Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 5</td>
<td>6 9</td>
<td>10 17</td>
</tr>
<tr>
<td>BIOL</td>
<td>10195</td>
<td>00000002</td>
</tr>
<tr>
<td>BUSIN</td>
<td>2350</td>
<td>00000017</td>
</tr>
<tr>
<td>COMP</td>
<td>4275</td>
<td>00000003</td>
</tr>
<tr>
<td>ENGL</td>
<td>10253</td>
<td>00000001</td>
</tr>
<tr>
<td>HIST</td>
<td>4640</td>
<td>00000005</td>
</tr>
<tr>
<td>PSYCH</td>
<td>3785</td>
<td>00000011</td>
</tr>
<tr>
<td>PSYCH</td>
<td>4800</td>
<td>00000013</td>
</tr>
</tbody>
</table>

You can use the following statements for the second step to sort by the sequence number, display the data in a meaningful way, and remove the sequence numbers. The input for this second step is the temporary data set you created in the first step.

```sql
SORT FIELDS=(10,8,CH,A)
OUTREC FIELDS=(1,5,CHANGE=(16,'HIST','History', 'BUSIN','Business', 'COMP','Computer Science', 'ENGL','English', 'BIOL','Biology', 'PSYCH','Psychology'), NOMATCH=('Unaffiliated'), 6,4,BI,EDIT=($III,IIT.TT))
```

The output records from this second step are:

<table>
<thead>
<tr>
<th>Department</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Science</td>
<td>$102.53</td>
</tr>
<tr>
<td>Unaffiliated</td>
<td>$101.95</td>
</tr>
<tr>
<td>Business</td>
<td>$42.75</td>
</tr>
<tr>
<td>English</td>
<td>$46.40</td>
</tr>
<tr>
<td>History</td>
<td>$37.85</td>
</tr>
<tr>
<td>Psychology</td>
<td>$48.00</td>
</tr>
<tr>
<td>Biology</td>
<td>$23.50</td>
</tr>
</tbody>
</table>

You can use SEQNUM,m,f to create sequence numbers of various lengths in various formats. You can use START=j to start the sequence numbers at j instead of 1. You can use INCR=i to increment each sequence number by i instead of 1. You can use RESTART=(p,m) to start the sequence number at the starting value again each time the value in a particular field changes.

Suppose you have the following input records:

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>Albany</td>
</tr>
<tr>
<td>California</td>
<td>Morgan Hill</td>
</tr>
<tr>
<td>New York</td>
<td>Buffalo</td>
</tr>
<tr>
<td>Arizona</td>
<td>Tuscon</td>
</tr>
<tr>
<td>California</td>
<td>San Jose</td>
</tr>
<tr>
<td>New York</td>
<td>Poughkeepsie</td>
</tr>
<tr>
<td>Arizona</td>
<td>Phoenix</td>
</tr>
<tr>
<td>California</td>
<td>Davis</td>
</tr>
<tr>
<td>New York</td>
<td>Armonk</td>
</tr>
</tbody>
</table>

If you wanted to sort the records by the State field in positions 1-15 and by the City field in positions 16-30, and add a third field with a sequence number starting from 1000 and incrementing by 10, you could use START=1000 and INCR=10 as shown in the following statements:

```sql
SORT FIELDS=(1,30,CH,A)
OUTREC OVERLAY=(32:SEQNUM,5,ZD,START=1000,INCR=10)
```

The output records would look like this:

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
<th>SEQNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>Phoenix</td>
<td>01000</td>
</tr>
<tr>
<td>Arizona</td>
<td>Tuscon</td>
<td>01010</td>
</tr>
</tbody>
</table>
Note that each record has a different sequence number.

If you wanted to start the sequence number over at 1000 again each time the State changed, you could add `RESTART=(1,15)` as shown in the following statements:

```
SORT FIELDS=(1,30,CH,A)
OUTREC OVERLAY=(32:SEQNUM,5,ZD,START=1000,INCR=10,
RESTART=(1,15))
```

The output records would look like this:

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
<th>SEQNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>Phoenix</td>
<td>01000</td>
</tr>
<tr>
<td>Arizona</td>
<td>Tucson</td>
<td>01010</td>
</tr>
<tr>
<td>California</td>
<td>Davis</td>
<td>01000</td>
</tr>
<tr>
<td>California</td>
<td>Morgan Hill</td>
<td>01010</td>
</tr>
<tr>
<td>California</td>
<td>San Jose</td>
<td>01020</td>
</tr>
<tr>
<td>New York</td>
<td>Albany</td>
<td>01000</td>
</tr>
<tr>
<td>New York</td>
<td>Armonk</td>
<td>01010</td>
</tr>
<tr>
<td>New York</td>
<td>Buffalo</td>
<td>01020</td>
</tr>
<tr>
<td>New York</td>
<td>Poughkeepsie</td>
<td>01030</td>
</tr>
</tbody>
</table>

Note that the sequence number starts over at 1000 again each time the State changes.

If you specify an IFTHEN clause with a sequence number, the sequence number is only incremented for the subset of records selected by that IFTHEN clause. For example, if you specified the following statements for the input records shown previously:

```
OPTION COPY
OUTREC IFTHEN=(WHEN=(1,15,CH,EQ,C'Arizona'),
OVERLAY=(32:SEQNUM,2,ZD)),
IFTHEN=(WHEN=(1,15,CH,EQ,C'California'),
OVERLAY=(32:SEQNUM,4,ZD)),
IFTHEN=(WHEN=(1,15,CH,EQ,C'New York'),
OVERLAY=(32:SEQNUM,3,ZD))
```

The output records would look like this:

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
<th>SEQNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>Albany</td>
<td>001</td>
</tr>
<tr>
<td>California</td>
<td>Morgan Hill</td>
<td>0001</td>
</tr>
<tr>
<td>New York</td>
<td>Buffalo</td>
<td>002</td>
</tr>
<tr>
<td>Arizona</td>
<td>Tucson</td>
<td>01</td>
</tr>
<tr>
<td>California</td>
<td>San Jose</td>
<td>0002</td>
</tr>
<tr>
<td>New York</td>
<td>Poughkeepsie</td>
<td>003</td>
</tr>
<tr>
<td>Arizona</td>
<td>Phoenix</td>
<td>02</td>
</tr>
<tr>
<td>California</td>
<td>Davis</td>
<td>0003</td>
</tr>
<tr>
<td>New York</td>
<td>Armonk</td>
<td>004</td>
</tr>
</tbody>
</table>

For complete details about creating sequence numbers with `INREC`, `OUTREC` and `OUTFIL OUTREC`, see `z/OS DFSORT Application Programming Guide`.

### VB data set considerations

Some of the same VB data set considerations you learned about previously for the `SORT`, `MERGE`, `INCLUDE`, `OMIT` and `SUM` statements also apply to the `INREC` and `OUTREC` statements, but some additional considerations apply as well.

### RDW

If you use the `BUILD`, `FIELDS`, or `IFTHEN BUILD` parameter, you must begin your `INREC` or `OUTREC` statement fields by specifying 1,4 (starting position is 1 and length is 4) to represent the RDW in your VB records. For example:
INREC FIELDS=(1,4,8,25)

If you want your first field to include input data bytes immediately after the RDW (that is, starting with position 5), you can use 1,n (starting position is 1 and length is n, with n greater than 4) instead of 1,4. For example:

OUTREC BUILD=(1,10,21,30)

If you want to display the record length (from positions 1-2 in the RDW), you can use 1,4 to represent the RDW followed by 1,2 for the record length. For example:

INREC FIELDS=(1,4,'Record length is ',1,2,BI,M11)

If you use the OVERLAY, IFTHEN OVERLAY, or IFTHEN PUSH parameter of INREC or OUTREC, you must not overlay the RDW in positions 1-4. So all of your items must start at or after position 5. For example:

INREC OVERLAY=(5:5,3,TRAN=UTOL,21:18,2,11:C'***')

converts the input field at positions 5-7 to lowercase. If you forget to specify c: for the first item, c will default to 1 which will result in an error message because you would be overlaying the RDW. For example:

INREC OVERLAY=(5,3,TRAN=UTOL)   Results in an error message

is interpreted as overlaying output positions 1-3 with the lowercase conversion of input positions 5-7. Since you cannot overlay positions 1-4, you will get an error message.

Be careful not to use 1:, 2:, 3: or 4: for any OVERLAY, IFTHEN OVERLAY, or IFTHEN PUSH item. For example, the following will also result in an error message, since the second item would overlay the RDW:

OUTREC OVERLAY=(8:5,3,TRAN=UTOL,  ok
2:18,2)      Results in an error message

Starting positions and columns

When you code your input fields for the BUILD, FIELDS, OVERLAY, IFTHEN BUILD, IFTHEN OVERLAY, or IFTHEN PUSH parameters, remember to add 4 to the starting position to account for the 4-byte RDW. Likewise, when you code your output columns. For example, the following OUTREC statement puts the field in the first through sixth data byte of the VB input record into positions 21-26 of the VB output record.

OUTREC FIELDS=(1,4,21:5,6)

Variable data

If you want to include the variable data at the end of each VB input record in the VB output record with the BUILD, FIELDS, or IFTHEN BUILD parameter, specify the starting position of the variable input data without the length. For example:

OUTREC FIELDS=(1,4,'Fixed data ','5,10,' Variable data ','15)

You can also use the following for the variable data at the end of each VB record:

p,TRAN=keyword

where keyword can be UTOL, LTOU, ETOA, ATOE, ALTSEQ, HEX, UNHEX, BIT or UNBIT.

For example, the following OUTREC statement translates all of the data bytes in each VB record from EBCDIC to ASCII:

OUTREC BUILD=(1,4,5,TRAN=ETOA)
You must not specify a starting position without a length with the OVERLAY or IFTHEN parameters. DFSORT will issue an error message if you specify any of the following with OVERLAY or IFTHEN OVERLAY:

- \( p \)
- \( p,\text{TRAN}=\text{keyword} \)
- \( p,\text{HEX} \)

For example:

```
INREC OVERLAY=(5:C'***', 21:21,TRAN=BIT)  Results in an error message
```

### Summary

This chapter covered using the BUILD, FIELDS, OVERLAY, FINDREP, and IFTHEN parameters of the OUTREC statement and INREC statement to reformat fixed position/length input records in a variety of ways for output. It explained how you can delete fields, reorder fields, overlay fields, insert separators and sequence numbers, convert character and numeric data to various forms, perform arithmetic operations, and change different records in different ways, with the OUTREC and INREC statements, as well as with the OUTFIL statement.
Chapter 6. Reformating records with variable fields

The previous chapter described how you can reformat records with fixed fields, that is, fields that start in the same position and have the same length in every record. This chapter describes how you can reformat records in similar ways with variable fields, that is, fields that have different starting positions and lengths in different records, such as comma separated values (CSV).

Using %nnn, %nn and %n Parsed Fields with BUILD and OVERLAY

There are many types of variable position/length fields such as delimited fields, comma separated values (CSV), tab separated values, blank separated values, keyword separated fields, and so on. For example, you might have four records with comma separated values as follows:

Wayne,M,-53,-1732,Gotham
Summers,F,+7258,-273,Sunnydale
Kent,M,+213,-158,Metropolis
Prince,F,-164,+1289,Gateway

Note that each record has five variable fields separated by commas. The fields do not start and end in the same position in every record and have different lengths in different records, so you could not just specify the starting position and length (p,m) for any of these fields in a BUILD (or FIELDS or OUTREC) or OVERLAY operand of the INREC, OUTREC or OUTFIL statement. But you can use the PARSE operand of an INREC, OUTREC or OUTFIL statement to define rules that tell DFSORT how to extract the relevant data from each variable input field into a fixed parsed field, and then use the fixed parsed fields in a BUILD or OVERLAY operand as you would use fixed input fields.

You define a parsed field for converting a variable field to a fixed parsed field using a %nnn name where nnn can be 000 to 999, a %nn name where nn can be 00 to 99, or a %n name where n can be 0 to 9. You can define and use up to 1000 parsed fields (%0-%999) per run. Each %nnn, %nn or %n parsed field must be defined only once. %n, %0n and %00n (for example, %1, %01 and %001) are treated as the same parsed field. Likewise, %nn and %0nn (for example, %22 and %022) are treated as the same parsed field. A %nnn, %nn or %n parsed field must be defined in a PARSE operand before it is used in a BUILD or OVERLAY operand.

Suppose you wanted to reformat the CSV records to produce these output records:

Wayne        -178.5     Gotham
Summers       698.5     Sunnydale
Kent            5.5     Metropolis
Prince        112.5     Gateway

You can use the following OUTREC statement to parse and reformat the variable fields:

```
OUTREC PARSE=(%91=(ENDBEFR=C',',FIXLEN=8),
%=(ENDBEFR=C',',)
%03=(ENDBEFR=C',',FIXLEN=5),
%04=(ENDBEFR=C',',FIXLEN=5),
%05=(FIXLEN=10)),
BUILD=(%01,14:%03,SFF,ADD,%04,SFF,EDIT=(SIIT.T),SIGNS=((-),
25:%05))
```

The PARSE operand defines how each variable field is to be extracted to a fixed parsed field as follows:

- The %01 parsed field is used to extract the first variable field into an 8-byte fixed parsed field. ENDBEFR=C,' tells DFSORT to stop extracting data at the byte before the next comma (the comma after the first variable field). FIXLEN=8 tells DFSORT that the %01 parsed field is 8 bytes long. Thus, for the first record, DFSORT extracts Wayne into the 8-byte %01 parsed field. Since Wayne is only 5 characters, but the %01 parsed field is 8 bytes long, DFSORT pads the %01 parsed field on the right with 3 blanks. ENDBEFR=C,' also tells DFSORT to skip over the comma after the first variable field before it parses the second variable field.
• The % parsed field is used to skip the second variable field without extracting anything for it. Since we don’t want this field in the output record, we can use % to ignore it. Thus, for the first record, we ignore M. ENDBEFR=C,’ tells DFSORT to skip over the comma after the second variable field before it parses the third variable field.

• The %03 parsed field is used to extract the third variable field into a 5-byte fixed parsed field. ENDBEFR=C,’ tells DFSORT to stop extracting data before the next comma (the comma after the third variable field). FIXLEN=5 tells DFSORT that the %03 parsed field is 5 bytes long. Thus, for the first record, DFSORT extracts -53 into the 5-byte %03 parsed field. Since -53 is only 3 characters, but the %03 parsed field is 5 bytes long, DFSORT pads the %03 parsed field on the right with 2 blanks. ENDBEFR=C,’ also tells DFSORT to skip over the comma after the third variable field before it parses the fourth variable field.

• The %04 parsed field is used to extract the fourth variable field into a 5-byte fixed parsed field. ENDBEFR=C,’ tells DFSORT to stop extracting data before the next comma (the comma after the fourth variable field). FIXLEN=5 tells DFSORT that the %04 parsed field is 5 bytes long. Thus, for the first record, DFSORT extracts -1732 into the 5-byte %04 parsed field. Since -1732 is 5 characters, it fills up the 5-byte %05 parsed field and padding is not needed. ENDBEFR=C,’ also tells DFSORT to skip over the comma after the fourth variable field before it parses the fifth variable field.

• The %05 parsed field is used to extract the fifth variable field into a 10-byte fixed parsed field. FIXLEN=10 tells DFSORT that the %05 parsed field is 10 bytes long. Thus, for the first record, DFSORT extracts Gotham and 4 blanks into the 10-byte %01 parsed field.

The BUILD operand uses the previously extracted fixed parsed fields to build the output record as follows:

• %01 copies the 8-byte fixed-length data extracted from the first variable field to positions 1-8 of the output record. For the first record, positions 1-8 contain 'Wayne   '.

• 14:%03,SFF,ADD,%04,SFF,EDIT=(SIIT.T),SIGNS=(,-) adds the 5-byte fixed-length data extracted from the third variable field to the 5-byte fixed-length data extracted from the fourth variable field and places the 6-byte edited result in positions 14-19 of the output record. For the first record, positions 14-19 contain -178.5 (-53 + -1732 = -1785 edited to -178.5). Note that since the %03 and %04 parsed fields may be padded on the right with blanks, we must use the SFF format to handle the sign and digits correctly.

• 25:%05 copies the 10-byte fixed-length data extracted from the fifth variable field to positions 25-34 of the output record. For the first record, positions 25-34 contain 'Gotham    '.

Using %nnn, %nn and %n Parsed Fields with IFTHEN

If you have different variable position/length fields in different types of records, you can convert them to %nnn, %nn or %n fixed parsed fields and use them in IFTHEN clauses. If you define a %nnn, %nn or %n parsed field in a WHEN=INIT clause, you can use it in the IFTHEN BUILD or IFTHEN OVERLAY suboperand of that clause as well as in any IFTHEN clause that follows. If you define a %nnn, %nn or %n parsed field in a WHEN=(logexp), WHEN=ANY or WHEN=NONE clause, you can use it in the IFTHEN BUILD or IFTHEN OVERLAY suboperand of that clause.

Suppose you have the following input records:

1/Sam/Charlie;27
2/Bill/48
1/Frank/Vicky;02
1/William/Dale;86
2/Helen/15

Note that the records that start with ‘1’ have one fixed field (‘1’) and three variable fields, whereas the records that start with ‘2’ have one fixed field (‘2’) and two variable fields. The variable fields in each type of record do not start and end in the same position in every record and have different lengths in different records.

Suppose you wanted to reformat these input records to produce these output records:
You can use the following INREC statement to parse and reformat the fixed and variable fields:

```
INREC IFOUTLEN=50,
  IFTHEN=(WHEN=INIT,
    PARSE=('%00=(ABSPOS=3,ENDBEFR=C'/',FIXLEN=8)),
    IFTHEN=(WHEN=('%1=(CH,EQ,C'1'),
      PARSE=(%01=(ABSPOS=3,STARTAFT=C'/',ENDBEFR=C';',
        FIXLEN=8)),%02=(FIXLEN=2)),
    BUILD=(1,1,4:%00,18:%01,30:%02,ZD,EDIT=(T.T))),
  IFTHEN=(WHEN=('%2=(CH,EQ,C'2'),
    PARSE=(%03=(ABSPOS=3,STARTAFT=C'/',FIXLEN=2)),
    BUILD=(1,1,4:%00,30:%03,ZD,EDIT=(T.T)))
```

The PARSE suboperand of the WHEN=INIT clause uses the %00 parsed field to extract the first variable field into an 8-byte fixed parsed field for every record. ABSPOS=3 tells DFSORT to start at position 3. ENDBEFR=C'/ tells DFSORT to stop extracting data before the next slash (the slash after the first variable field). FIXLEN=8 tells DFSORT that the %00 parsed field is 8 bytes long. Thus, for the first record, DFSORT extracts Sam into the 8-byte %00 parsed field. Since Sam is only 3 characters, but the %00 parsed field is 8 bytes long, DFSORT pads the %00 parsed field on the right with 5 blanks. The WHEN=INIT clause defines %00 so it can be used for the clauses that follow. (%00 could be used in a BUILD or OVERLAY suboperand for this WHEN=INIT clause, but in this case, it just defines %00 for the other clauses.)

The PARSE suboperand of the first WHEN=(logexp) clause uses the %01 parsed field to extract the second variable field into an 8-byte fixed parsed field, and the %02 parsed field to extract the third variable field into a 2-byte fixed parsed field, for the '1' records.

For %01, ABSPOS=3 tells DFSORT to start at position 3. STARTAFT=C'/ tells DFSORT to start extracting data after the next slash (the slash after the first variable field). ENDBEFR=C'; tells DFSORT to stop extracting data before the next semicolon (the semicolon after the second variable field). FIXLEN=8 tells DFSORT that the %01 parsed field is 8 bytes long. Thus, for the first record, DFSORT extracts Charlie into the 8-byte %01 parsed field. Since Charlie is only 7 characters, but the %01 parsed field is 8 bytes long, DFSORT pads the %01 parsed field on the right with one blank.

For %02, FIXLEN=2 tells DFSORT that the %02 parsed field is 2 bytes long. Thus, for the first record, DFSORT extracts 27 into the 2-byte %02 parsed field.

The BUILD suboperand of the first WHEN=(logexp) clause uses the %00 parsed field defined by the WHEN=INIT clause and the %01 and %02 parsed fields defined by the first WHEN=(logexp) clause to build each '1' output record.

The PARSE suboperand of the second WHEN=(logexp) clause uses the %03 parsed field to extract the second variable field into an 8-byte fixed parsed field for the '2' records.

For %03, ABSPOS=3 tells DFSORT to start at position 3. STARTAFT=C'/ tells DFSORT to start extracting data after the next slash (the slash after the first variable field). FIXLEN=2 tells DFSORT that the %03 parsed field is 2 bytes long. Thus, for the second record, DFSORT extracts 48 into the 2-byte %03 parsed field.

The BUILD suboperand of the second WHEN=(logexp) clause uses the %00 parsed field defined by the WHEN=INIT clause and the %03 parsed field defined by the second WHEN=(logexp) clause to build each '2' output record.

Where You Can Use %nnn, %nn and %n Fields in BUILD and OVERLAY

You can use a %nnn, %nn or %n parsed field in BUILD or OVERLAY in the same way you can use p.m. For simplicity, we will use %nn to represent %nnn, %nn or %n. Here is a list of the items where you can use %nn (see z/OS DFSORT Application Programming Guide for details):

- %nn
PARSE parameters

You can use the following parameters in PARSE to define the rules for extracting variable position/length data to %nnn, %nn and %n fixed parsed fields:

- **FIXLEN=m**: Specifies the length (m) of the fixed area to contain the extracted variable data for this %nnn, %nn or %n fixed parsed field.
- **ABSPOS=p**: Start extracting data at input position p.
- **ADDPOS=x**: Start extracting data at the current position + x.
- **SUBPOS=y**: Start extracting data at the current position - y.
- **STARTAFT=string**: Start extracting data at the byte after the end of the character or hexadecimal string.
- **STARTAFT=an**: Start extracting data at the byte after the first character found from a specified alphanumeric set.
- **STARTAFT=BLANKS**: Start extracting data after the end of the next group of blanks.
- **STARTAT=string**: Start extracting data at the first byte of the character or hexadecimal string.
- **STARTAT=an**: Start extracting data from the first character found from a specified alphanumeric set.
- **STARTAT=BLANKS**: Start extracting data at the start of the first group of blanks.
- **STARTAT=NONBLANK**: Start extracting data at the next nonblank.
• **ENDBEFR=string**: Stop extracting data at the byte before the start of the character or hexadecimal string.

• **ENDBEFR=an**: Stop extracting data at the byte before the first character found from a specified alphanumeric set.

• **ENDBEFR=BLANKS**: Stop extracting data at the byte before the next group of blanks.

• **ENDAT=string**: Stop extracting data at the byte before the first character found from a specified alphanumeric set.

• **ENDAT=an**: Stop extracting data at the first character found from a specified alphanumeric set.

• **ENDAT=BLANKS**: Stop extracting data at the end of the next group of blanks.

• **PAIR=APOST**: Do not search for strings or blanks between apostrophe (’) pairs.

• **PAIR=QUOTE**: Do not search for strings or blanks between quote (") pairs.

• **REPEAT=v**: Repeat this parsed field v times.

See z/OS DFSORT Application Programming Guide for complete details about defining and using %nnn, %nn and %n parsed fields, as well as more examples.

**Summary**

This chapter provided an overview of how you can use variable position/length fields as %nnn, %nn and %n fixed parsed fields in the BUILD, OVERLAY and IFTHEN parameters of the INREC, OUTREC and OUTFIL statements.
Chapter 7. Creating multiple output data sets and reports

You can create one or more output data sets and reports from a single pass over sorted, merged, or copied input using OUTFIL control statements. You can use different OUTFIL parameters on different OUTFIL statements, so the output data sets you create in a single DFSORT application can be identical or very different. You can perform a wide variety of tasks with each OUTFIL statement, including the following:

- Select a sequential subset of records with the STARTREC and ENDREC parameters.
- Select a sample of records with the SAMPLE parameter.
- Select a subset of records with the INCLUDE and OMIT parameters. These parameters have all of the capabilities of the INCLUDE and OMIT statements.
- Limit the number of records selected with the ACCEPT parameter.
- Select "discarded" records with the SAVE parameter. This parameter saves any records that are not selected as a result of STARTREC, ENDREC, SAMPLE, INCLUDE, OMIT or ACCEPT parameters.
- Reformat records with fixed position/length fields or variable position/length fields using the PARSE, BUILD, OUTREC, OVERLAY, or IFTHEN parameters. These parameters have all of the capabilities of the PARSE, BUILD, FIELDS, OVERLAY, or IFTHEN parameters on the OUTREC statement, and also allow you to create multiple output records and blank output records from each input record.
- Repeat records with the REPEAT parameter.
- Split records between output data sets using the SPLIT, SPLITBY, and SPLIT1R parameters.
- Create detailed reports with up to three levels (report, page, and section) using the BUILD, OUTREC, OVERLAY, IFTHEN, HEADERn, TRAILERn, SECTIONS, LINES, NODETAIL, BLKCCH1, BLKCCH2, BLKCCT1, and REMOVECC parameters. Your reports can contain elements such as headers, data, blank lines, trailers, statistics, sections, timestamps, page numbers, and counts.
- Update count and total values in an existing trailer (last) record, based on the current data records, with the IFTRAIL parameter.
- Convert FB records to VB records with the FTOV parameter, or convert VB records to FB records with the VTOF parameter.

You can use OUTFIL statements with any of the other DFSORT statements (for example, INCLUDE, OMIT, INREC, SORT, MERGE, OPTION, SUM and OUTREC). OUTFIL processing is performed last, after all of the processing for the other statements, as shown in Appendix C, “Processing order of control statements,” on page 177. Thus, the output records created by the processing for the other statements are the input records for OUTFIL processing. For example, OUTFIL processes the sorted records if the SORT statement is specified, or the copied records if the OPTION COPY statement is specified.

Combining the various DFSORT statements in different ways gives you a lot of flexibility. You can actually use an INREC statement, an OUTREC statement, and an OUTFIL statement to reformat your input records three times. You can also use an INCLUDE or OMIT statement to keep a subset of the input records, and use OUTFIL statements with different INCLUDE or OMIT and OUTREC, OVERLAY, or IFTHEN parameters to write different subsets of the remaining records into different OUTFIL data sets reformatted in different ways.

Creating multiple identical copies

Suppose you want to create backups for your data set; on disk for the local site and on tapes for the remote sites. You can do this by using OUTFIL and the FNAMES parameter with an OPTION COPY statement. The FNAMES parameter identifies the DD statements in your JCL for your output data sets by their DD names. Sample JCL and DFSORT control statements are as follows.
//COPY JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTO1 DD DSN=A123456 исследование.DAT,DISP=OLD
//SORTO2 DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT1
//SORTO3 DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT2
//SYSIN DD *
OPTION COPY
OUTFIL FNAMES=(BACKUP, NEWYORK, SANJOSE)
/

**Note:** The previous JCL includes two tape data sets. Substitute your own tape data set information if you want to run this example.

Here are the steps for writing the OUTFIL statement:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leave at least one blank and type <strong>OUTFIL</strong></td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank and type <strong>FNAMES=</strong></td>
</tr>
<tr>
<td>3</td>
<td>Type, in parentheses and separated by commas, each output data set DD name. In this example, they are <strong>BACKUP, NEWYORK</strong>, and <strong>SANJOSE</strong>.</td>
</tr>
</tbody>
</table>

This OUTFIL statement creates three backup copies of your data set: one on-site disk data set, and two tapes that can be sent to remote sites.

You can also complete this task using the FILES parameter of OUTFIL. With FILES, you assign SORTOFd or SORTOFdd DD statements instead of naming unique DD statements. Sample JCL and DFSORT control statements using FILES are as follows.

---

Both FNAMES and FILES create the same output, but FNAMES lets you use descriptive names of up to 8 characters for your OUTFIL DD statements instead of one or two cryptic suffix characters. FNAMES is recommended and is used in all of the multiple output examples in the rest of this chapter.

**Note:** If you do not specify a FNAMES or FILES parameter for an OUTFIL statement, the OUTFIL ddname is SORTOUT by default.

### Selecting and sampling by relative record number

When you copy, sort or merge input records, the resulting output records have implicit relative record numbers starting from 1 for the first record and ending at n (the total number of copied, sorted or merged records) for the last record.

Table 43 on page 81 shows the City field of the output records created by copying the SORT.BRANCH data set, along with the relative record number (abbreviated RRN) for each record (the relative record numbers do not actually appear in the output data set).
### Table 43. Relative Records Numbers for Copy

<table>
<thead>
<tr>
<th>City</th>
<th>RRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>1</td>
</tr>
<tr>
<td>San Francisco</td>
<td>2</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>3</td>
</tr>
<tr>
<td>Sacramento</td>
<td>4</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>5</td>
</tr>
<tr>
<td>Denver</td>
<td>6</td>
</tr>
<tr>
<td>Boulder</td>
<td>7</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>8</td>
</tr>
<tr>
<td>Vail</td>
<td>9</td>
</tr>
<tr>
<td>San Jose</td>
<td>10</td>
</tr>
<tr>
<td>San Diego</td>
<td>11</td>
</tr>
<tr>
<td>Aspen</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 44 on page 81 shows the City field of the output records created by sorting the SORT.BRANCH data set on the City field, along with the RRN for each record. Note that the RRNs for the copied output data set and the sorted output data set are different because the order of the output records is different (for example, the record containing 'Denver' has a relative record number of 6 for the copied data set and 3 for the sorted data set).

### Table 44. Relative Records Numbers for Sort

<table>
<thead>
<tr>
<th>City</th>
<th>RRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Aspen</td>
<td>1</td>
</tr>
<tr>
<td>Boulder</td>
<td>2</td>
</tr>
<tr>
<td>Denver</td>
<td>3</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>4</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>5</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>6</td>
</tr>
<tr>
<td>Sacramento</td>
<td>7</td>
</tr>
<tr>
<td>San Diego</td>
<td>8</td>
</tr>
<tr>
<td>San Francisco</td>
<td>9</td>
</tr>
<tr>
<td>San Jose</td>
<td>10</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>11</td>
</tr>
<tr>
<td>Vail</td>
<td>12</td>
</tr>
</tbody>
</table>

You can use these relative record numbers to select groups of sequential records to be written to different OUTFIL data sets. STARTREC=n tells DFSORT to start OUTFIL processing at relative record n. ENDREC=m tells DFSORT to end OUTFIL processing at relative record m. The following statements show how this works:

```plaintext
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAMES=OUT1,ENDREC=4
OUTFIL FNAMES=OUT2,STARTREC=2,ENDREC=6
OUTFIL FNAMES=OUT3,STARTREC=7,ENDREC=9
OUTFIL FNAMES=OUT4,STARTREC=10
```

Because STARTREC is not specified for OUT1, DFSORT starts at RRN 1 and ends at RRN 4. For OUT2, DFSORT starts at RRN 2 and ends at RRN 6. (Note that RRNs 2, 3 and 4 are written to both OUT1 and OUT2.) For OUT3, DFSORT starts at RRN 7 and ends at RRN 9. Because ENDREC is not specified for OUT4, DFSORT starts at RRN 10 and ends at the last record (RRN 12). The RRNs in each OUTFIL data set are as follows:
OUT1: 1, 2, 3, 4
OUT2: 2, 3, 4, 5, 6
OUT3: 7, 8, 9
OUT4: 10, 11, 12

You can also use relative record numbers to take a "sample" of your records. SAMPLE=n tells DFSORT to process every nth record, starting at the record indicated by STARTREC=x and ending at or before the record indicated by ENDREC=y. SAMPLE=(n,m) tells DFSORT to process m records every nth record, starting at the record indicated by STARTREC=x and ending at or before the record indicated by ENDREC=y. The following statements show how this works:

```
OPTION COPY
OUTFIL FNAMES=OUT1, SAMPLE=3
OUTFIL FNAMES=OUT2, STARTREC=4, SAMPLE=2, ENDREC=10
OUTFIL FNAMES=OUT3, STARTREC=2, SAMPLE=(5,3)
```

For OUT1, DFSORT starts at RRN 1 and writes every third record up to RRN 10 (RRN 13 would be the next record, but there are only 12 records). For OUT2, DFSORT starts at RRN 4 and writes every other record up to RRN 10. For OUT3, DFSORT writes 3 records starting at RRN 2, and writes three records starting at every fifth record after record 2, up to RRN 12. The records in each OUTFIL data set are as follows:

OUT1: 1, 4, 7, 10
OUT2: 4, 6, 8, 10
OUT3: 2, 3, 4, 7, 8, 9, 12

**Including, omitting, and saving discards**

In Chapter 3, “Including or omitting records,” on page 23, you learned how to use the INCLUDE and OMIT statements to select only a subset of the input records for sorting, copying or merging. You can also select subsets of records for your individual OUTFIL output data sets in the same way using the INCLUDE and OMIT parameters. Different INCLUDE or OMIT parameters can be used for different OUTFIL statements.

All of the logical expressions that are valid for the COND parameter of the INCLUDE and OMIT statements are also valid for the INCLUDE and OMIT parameters of OUTFIL. However, you cannot specify the FORMAT parameter with the OUTFIL statement as you can with the INCLUDE and OMIT statements. VB data set considerations for the INCLUDE and OMIT statements also apply to the INCLUDE and OMIT parameters.

Suppose you wanted to sort the bookstore data set by title, and create separate output data sets for the English, History and Psychology departments. You could use the following OUTFIL statements to create these three output data sets:

```
SORT FIELDS=(1,75,CH,A)
OUTFIL FNAMES=ENGLOUT, INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNAMES=HISTOUT, INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNAMES=PSYCHOUT, INCLUDE=(110,5,CH,EQ,C'PSYCH')
```

The SORT statement sorts the input records by the title field.

The first OUTFIL statement writes the records for the English department to the ENGLOUT data set. The result is shown in Table 45 on page 82.

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>ENGL</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>ENGL</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>ENGL</td>
</tr>
<tr>
<td>THE COMPLETE PROOFREADER</td>
<td>ENGL</td>
</tr>
</tbody>
</table>
The second OUTFIL statement writes the records for the History department to the HISTOUT data set. The result is shown in Table 46 on page 83.

Table 46. Output records in HISTOUT data set

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>CRISES OF THE MIDDLE AGES</td>
<td>HIST</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>HIST</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>HIST</td>
</tr>
</tbody>
</table>

The third OUTFIL statement writes the records for the Psychology department to the PSYCHOUT data set. The result is shown in Table 47 on page 83.

Table 47. Output records in PSYCHOUT data set

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td>ADVANCED TOPICS IN PSYCHOANALYSIS</td>
<td>PSYCH</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>PSYCH</td>
</tr>
</tbody>
</table>

The previous example creates output data sets for the English, History and Psychology department’s books. If you wanted to create an additional output data set (RESTOUT) containing the rest of the books, you could use the following statements:

```
SORT FIELDS=(1,75,CH,A)
OUTFIL FNAMES=ENGLOUT,INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNAMES=HISTOUT,INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNAMES=PSYCHOUT,INCLUDE=(110,5,CH,EQ,C'PSYCH')
OUTFIL FNAMES=RESTOUT,INCLUDE=(110,5,CH,NE,C'ENGL',AND,110,5,CH,NE,C'HIST',AND,110,5,CH,NE,C'PSYCH')
```

This is not too bad for only three departments, but the INCLUDE statement for RESTOUT would get more involved as the number of departments increased.

DFSORT’s SAVE parameter gives you an easy way to keep the records discarded by a group of OUTFIL statements. The SAVE parameter selects records for its OUTFIL data set that are not selected for any other OUTFIL data set as a result of the INCLUDE, OMIT, ACCEPT, STARTREC, ENDREC or SAMPLE parameters. So instead of the preceding statements, you could use the following statements to accomplish the same thing:

```
SORT FIELDS=(1,75,CH,A)
OUTFIL FNAMES=ENGLOUT,INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNAMES=HISTOUT,INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNAMES=PSYCHOUT,INCLUDE=(110,5,CH,EQ,C'PSYCH')
OUTFIL FNAMES=RESTOUT,SAVE
```

The fourth OUTFIL statement writes the records not used for English, History or Psychology to the RESTOUT data set. The result is shown in Table 48 on page 83.

Table 48. Output records in RESTOUT data set

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
</tbody>
</table>

Chapter 7. Creating multiple output data sets and reports 83
Reformatting

In Chapter 5, “Reformatting records with fixed fields,” on page 37 and Chapter 6, “Reformatting records with variable fields,” on page 73, you learned how to use the INREC and OUTREC statements to reformat your input records in various ways while sorting, copying, or merging. You can also reformat your OUTFIL output records in the same ways using the PARSE, BUILD, OUTREC, OVERLAY, FINDREP, or IFTHEN parameters. VB data set considerations for the INREC and OUTREC statements also apply to the PARSE, BUILD, OUTREC, OVERLAY and IFTHEN parameters of OUTFIL statements.

Different PARSE, BUILD, OUTREC, OVERLAY or IFTHEN parameters can be used for different OUTFIL statements. You can use these parameters to perform the same wide variety of tasks as for the INREC and OUTREC statements, as described in Chapter 5, “Reformatting records with fixed fields,” on page 37 and Chapter 6, “Reformatting records with variable fields,” on page 73.

In addition, you can use the BUILD, OUTREC, or IFTHEN BUILD parameters to create one, two or more output records from each input record, and insert blank lines before, between or after your records.

Suppose you wanted to create separate data sets for publishers FERN and WETH. For WETH, you want the number of copies sold and the instructor’s name on one line. For FERN, you want the course number on one line and the price on another line. You also want two blank lines to separate the information for each book. You can use the following statements to create these two output data sets:

```
OPTION COPY
OUTFIL FNAMES=WETHBKS,
   INCLUDE=(106,4,CH,EQ,C'WETH'),
   OUTREC=(C'Sold ',166,4,BI,EDIT=(IIT),
           C' copies of Wethman, Inc. book for instructor ',
           160,2,X,145,15)

OUTFIL FNAMES=FERNBKS,
   INCLUDE=(106,4,CH,EQ,C'FERN'),
   OUTREC=(3:C'Fernall Brothers book #',SEQNUM,2,ZD,
           C' for course ',115,5,/,
           5:C'costs ',170,4,BI,EDIT=($IIT.TT),2/)
```

The first OUTFIL statement uses an INCLUDE parameter to select the books for publisher WETH, and an OUTREC parameter to create the output records for each book with the needed information. The second OUTFIL statement uses an INCLUDE parameter to select the books for publisher FERN, and a different OUTREC parameter to create the output records for each book, with the needed information. Fields, constants, sequence numbers, and numeric editing are used in the OUTREC parameters as previously explained for the INREC and OUTREC statements.

/., n/ and /.../ can be used in the BUILD, OUTREC, or IFTHEN BUILD parameters of the OUTFIL statement, but not in the OVERLAY or IFTHEN OVERLAY parameters of the OUTFIL statement, or in any parameters
of the INREC and OUTREC statements. If \( n/ \) is used at the start or end of the BUILD, OUTREC or IFTHEN BUILD parameters, \( n \) blank lines are inserted. If \( n/ \) is used in the middle of the BUILD, OUTREC or IFTHEN parameters, \( n-1 \) blanks lines are inserted.

Thus, in the OUTREC parameter for FERNBKS, the \( / \) (0 blank lines) in the middle after 115,5 is used to create two output records from each FERN input record, and the \( 2/ \) (two blank lines) at the end is used to insert two blank lines after the information for each FERN book.

The results produced for WETHBKS are:

| Sold | 26 copies of Wethman, Inc. book for instructor CL CHATTERJEE |
| Sold | 9 copies of Wethman, Inc. book for instructor ST GOODGOLD  |
| Sold | 23 copies of Wethman, Inc. book for instructor DC SMITH     |
| Sold | 21 copies of Wethman, Inc. Book for instructor HR BISCARDI  |

The results produced for FERNBKS are:

| Fernall Brothers book #01 for course 00032 costs $26.00 |
| Fernall Brothers book #02 for course 00032 costs $3.60  |
| Fernall Brothers book #03 for course 10347 costs $6.25  |
| Fernall Brothers book #04 for course 30975 costs $26.00 |

DFSORT automatically sets the LRECL of each OUTFIL data set to the reformatted output record length. If \( n/ \) is used to create multiple output records from each input record, the LRECL is set to the longest output record.

For WETHBKS, the output record is 71 bytes long, so DFSORT sets the LRECL to 71. For FERNBKS, the first output record is 44 bytes long and the second output record is 17 bytes long, so DFSORT sets the LRECL to 44. If your reformatted length is shorter than you want for the LRECL, you can use \( c: X \) to increase the LRECL to \( c \). For example, if you want the LRECL for FERNBKS to be 80 instead of 44, you can change the last line of the OUTREC parameter for FERNBKS to:

\[
5: C'\text{costs}',170,4,BI,EDIT=($IIT.TT),80:X,2/)
\]

**Repeating**

OUTFIL’s \( \text{REPEAT}=n \) parameter lets you repeat each output record \( n \) times. If you specify the BUILD, OUTREC, OVERLAY, or IFTHEN parameters with a sequence number, the sequence numbers are incremented for each repeated record, but otherwise the repeated records are identical. For example, you could use the following statements to create two output data sets with repeated records; one with just the course name and the other with the course name and a sequence number.

\[
\text{OPTION COPY} \\
\text{INCLUDE COND=(110,5,CH,\text{EQ},C'PSYCH')} \\
\text{OUTFIL FNAMES=OUT1,} \\
\text{REPEAT=3,} \\
\text{BUILD=(120,25)} \\
\text{OUTFIL FNAMES=OUT2,} \\
\text{REPEAT=3,} \\
\text{BUILD=(120,25,X,SEQNUM,4,ZD)}
\]

The results produced for OUT1 are:

| PSYCHOLOGY I |
| PSYCHOLOGY I |
| PSYCHOLOGY I |
| PSYCHOANALYSIS |
The results produced for OUT2 are:

<table>
<thead>
<tr>
<th>Subject</th>
<th>SEQNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYCHOLOGY I</td>
<td>0001</td>
</tr>
<tr>
<td>PSYCHOLOGY I</td>
<td>0002</td>
</tr>
<tr>
<td>PSYCHOLOGY I</td>
<td>0003</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>0004</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>0005</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>0006</td>
</tr>
</tbody>
</table>

If you specify an IFTHEN clause with a sequence number, the sequence number is only incremented for the subset of records selected by the IFTHEN clause. For example, if you specified the following statements:

```plaintext
OPTION COPY
INCLUDE COND=(110,5,CH,EQ,C'PSYCH')
OUTFIL REPEAT=3,
IFTHEN=(WHEN=(120,7,CH,EQ,C'PSYCHO'),
        BUILD=(120,25,X,SEQNUM,4,ZD)),
IFTHEN=(WHEN=NONE,BUILD=(120,25,X,SEQNUM,2,ZD))
```

The results produced for SORTOUT are:

<table>
<thead>
<tr>
<th>Subject</th>
<th>SEQNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSYCHOLOGY I</td>
<td>0001</td>
</tr>
<tr>
<td>PSYCHOLOGY I</td>
<td>0002</td>
</tr>
<tr>
<td>PSYCHOLOGY I</td>
<td>0003</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>01</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>02</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>03</td>
</tr>
</tbody>
</table>

### Splitting

Suppose you don't know how many records are in a data set, but you want to divide the records as equally as possible between two output data sets. You can use OUTFIL's SPLIT parameter to put the first record into OUTPUT1, the second record into OUTPUT2, the third record into OUTPUT1, the fourth record into OUTPUT2, and so on until you run out of records. SPLIT splits the records one at a time among the data sets specified by FNAMES. The following statements split the records between two OUTFIL data sets:

```plaintext
OPTION COPY
OUTFIL FNAMES=(OUTPUT1,OUTPUT2),SPLIT
```

With 17 input records, the results produced for OUTPUT1 are:

<table>
<thead>
<tr>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
</tr>
<tr>
<td>03</td>
</tr>
<tr>
<td>05</td>
</tr>
<tr>
<td>07</td>
</tr>
<tr>
<td>09</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>15</td>
</tr>
<tr>
<td>17</td>
</tr>
</tbody>
</table>

The results produced for OUTPUT2 are:

<table>
<thead>
<tr>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
</tr>
<tr>
<td>04</td>
</tr>
<tr>
<td>06</td>
</tr>
<tr>
<td>08</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

Similarly, OUTFIL's SPLITBY=n parameter splits the records n at a time among the data sets specified by FNAMES. The following statements split the records four at a time between three OUTFIL data sets:
With 17 input records, the results produced for OUT1 are:

Record 01
Record 02
Record 03
Record 04
Record 05
Record 06
Record 07
Record 08
Record 09
Record 10
Record 11
Record 12
Record 13
Record 14
Record 15
Record 16

The results produced for OUT2 are:

Record 05
Record 06
Record 07
Record 08
Record 17

The results produced for OUT3 are:

Record 09
Record 10
Record 11
Record 12
Record 13
Record 14
Record 15
Record 16
Record 17

SPLIT and SPLITBY=n both start over with the first ddname after writing records to the last ddname. This can give you non-contiguous records in one or more of the OUTFIL data sets. For example, in the previous example with SPLITBY=4, OUT1 has records 1-4 and 13-16. If instead, you only want contiguous records in each OUTFIL data set, you can use OUTFIL's SPLIT1R=n parameter which writes n records to each OUTFIL data set and then writes the remaining records to the last OUTFIL data set. Thus, whereas SPLIT and SPLITBY=n rotate many times among the OUTFIL data sets, SPLIT1R=n only rotates once among the OUTFIL data sets.

The following statements ensure that the records are split with only contiguous records in each OUTFIL data set:

```
OPTION COPY
OUTFIL FNAMES=(OUTA,OUTB,OUTC),SPLIT1R=5
```

With 17 input records, the results produced for OUTA are:

Record 01
Record 02
Record 03
Record 04
Record 05

The results produced for OUTB are:

Record 06
Record 07
Record 08
Record 09
Record 10

The results produced for OUTC are:

Record 11
Record 12
Record 13
Record 14
Record 15
Record 16
Record 17
So far

So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; include, omit or save selected input records for output; and reformat, repeat and split input records for output. Next, you will learn about creating various types of reports.

Creating reports: OUTFIL vs ICETOOL

Both the OUTFIL statement and ICETOOL’s DISPLAY operator can be used to create reports. While each performs some reporting functions that the other does not, in general the difference between them is one of control and effort. With OUTFIL, you have more control over the appearance of reports, but considerable effort may be required on your part to specify in detail where every piece of information is to appear in the report and how it is to look. With ICETOOL, much of the work of determining where information is to appear in the report and how it is to look is done for you, but you have somewhat less control over the appearance of the reports.

ICETOOL should be your primary choice for creating reports, because it is easier to use than OUTFIL. But remember that OUTFIL is available if you need any of its specific reporting features, or more control of the appearance of reports than ICETOOL gives you. Next, you will learn about using OUTFIL to create reports. See Chapter 12, “Using the ICETOOL utility,” on page 123 for tutorials on using ICETOOL’s DISPLAY operator to create reports.

Creating reports with OUTFIL

You can use OUTFIL to create one or more detailed reports using the OUTFIL parameters BUILD, OUTREC, OVERLAY, FINDREP, IFTHEN, HEADERn, TRAILERn, SECTIONS, LINES, NODETAIL, BLKCCH1, BLKCCH2, BLKCCT1, and REMOVECC. You can include any or all of these in your reports:

- A cover sheet (report header)
- A header at the top of each page (page header)
- A trailer at the bottom of each page (page trailer)
- A header at the start of each section (section header)
- A trailer at the end of each section (section trailer)
- A summary sheet (report trailer)

Your reports can contain a variety of elements you specify such as current date, current time, edited or converted page numbers, character strings, and blank lines. Your reports can also contain a variety of elements you derive from the input records such as character fields, unedited, edited, or converted numeric input fields, edited or converted record counts, and edited or converted totals, maximums, minimums, and averages for numeric input fields.

Data

The data for your report consists of the OUTFIL output records. You can use the INCLUDE, OMIT, INREC, SUM and OUTREC statements, and the OUTFIL parameters STARTREC, SAMPLE, ENDREC, INCLUDE, OMIT, ACCEPT, SAVE, PARSE, BUILD, OUTREC, OVERLAY, FINDREP, and IFTHEN to determine which data records appear in your report and what they look like.

The following statements show the simplest possible type of OUTFIL report you can produce:

```
OPTION COPY
OUTFIL FNAMES=RPT1,LINES=10
```

LINES=10 indicates you want a report with 10 lines per page. These statements might produce the following two page result for RPT1:

```
1Data line 01
Data line 02
Data line 03
```

88 z/OS: z/OS DFSORT: Getting Started
Note: In some of the examples later in this section, small LINES values are used to illustrate a point. However, the default for LINES is 60 and you would generally want to use either that value or one close to it.

For reports, OUTFIL places an ANSI carriage control character in the first byte of each output line to tell a printer what action to take for that line. The '1' for Data line 01 and Data line 11 tells the printer that these lines each start on a new page. This is the way DFSORT translates LINES=10 into 10 lines per page for the printer. Other ANSI carriage control characters that DFSORT uses for OUTFIL reports are: blank for single space (no blank lines before the output line), '0' for double space (one blank line before the output line), and '1' for triple space (two blank lines before the output line).

When you view a report on your display, the ANSI carriage control is not meaningful, and is usually not displayed even though it's actually in the record. If you don't want ANSI carriage control characters in your output records, you can use OUTFIL's REMOVECC parameter to remove them (more on this later).

In general, you will want to use the PARSE, BUILD, OUTREC, OVERLAY, FINDREP, or IFTHEN parameters to reformat the data records for your report. Suppose you want to print a report from the SORT.BRANCH data set showing each branch's revenue and profit or loss, with 9 lines per page. You can use the following statements to show the branches in sorted order, along with their revenue and profit fields in readable form:

```
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAMES=RPT2,LINES=9,
OUTREC=(1,15,X,
22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-))
```

The two page result produced for RPT2 is the following:

<table>
<thead>
<tr>
<th>Branch</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>25,800</td>
<td>5,200</td>
</tr>
<tr>
<td>Boulder</td>
<td>33,866</td>
<td>7,351</td>
</tr>
<tr>
<td>Denver</td>
<td>31,876</td>
<td>6,288</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>12,300</td>
<td>-2,863</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>22,530</td>
<td>-4,278</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>18,200</td>
<td>3,271</td>
</tr>
<tr>
<td>Sacramento</td>
<td>42,726</td>
<td>8,276</td>
</tr>
<tr>
<td>San Diego</td>
<td>32,940</td>
<td>8,275</td>
</tr>
<tr>
<td>San Francisco</td>
<td>42,820</td>
<td>6,832</td>
</tr>
<tr>
<td>San Jose</td>
<td>27,225</td>
<td>8,264</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>16,152</td>
<td>-978</td>
</tr>
<tr>
<td>Vail</td>
<td>23,202</td>
<td>5,627</td>
</tr>
</tbody>
</table>

**Headers**

The preceding output for RPT2 does not look much like a report, but you can fix that by adding page headings with OUTFIL's HEADER2 parameter. This parameter (as well as the HEADER1 and HEADER3 parameters discussed later), lets you specify multi-line headings with character strings, hexadecimal strings, input fields, the current date, the current time, page numbers and blank lines.

The following statements create a report with page headings:

```
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAMES=RPT3,LINES=15,
HEADER2=(/3:'Branch Revenue Report',
30:'Page',PAGE,45:DATE=(MD4-),2/,
3:'Branch',25:'Revenue',50:'Profit',/,
3:'----------',25:'------',50:'------')
```

```
1Aspen             25,800    5,200
Boulder           33,866    7,351
Denver            31,876    6,288
Fort Collins      12,300   -2,863
Los Angeles       22,530   -4,278
Morgan Hill       18,200    3,271
Sacramento        42,726    8,276
San Diego         32,940    8,275
San Francisco     42,820    6,832
San Jose          27,225    8,264
Sunnyvale         16,152     -978
Vail              23,202    5,627
```
All of the elements in the HEADER2 parameter should be familiar from the previous discussions of the OUTREC statement, except for the PAGE and DATE=(MD4-) parameters.

PAGE tells DFSORT to print a 6-character page number with leading blanks starting at 1 for the first page and incrementing by 1 for each subsequent page. For page 3, PAGE would give you ' 3'. If you wanted to print a 3-character page number with leading zeros, you could use PAGE=(EDIT=(TTT)) or PAGE=(M11, LENGTH=3) or PAGE=(TO=ZD, LENGTH=3). For page 10, these would all give you '010'. See “Converting numeric fields to different formats” on page 44 and “Editing numeric fields” on page 45, for more information on conversion and editing.

DATE=(MD4-) tells DFSORT to print the date in the form mm-dd-yyyy. See z/OS DFSORT Application Programming Guide for more information on the different forms of the date you can print in headers and trailers.

You do not need to start character strings in headers (HEADERn parameters) or trailers (TRAILERn parameters) with C as you do for the BUILD, OUTREC, OVERLAY, FINDREP, or IFTHEN parameters, although you can if you want to.

If n/ is used at the start or end of a header or trailer, n blank lines are printed. If n/ is used in the middle of a header or trailer, n-1 blanks lines are printed.

The following is a two-page result produced for RPT3:

<table>
<thead>
<tr>
<th>Branch Revenue Report</th>
<th>Page</th>
<th>1</th>
<th>04-16-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch</td>
<td>Revenue</td>
<td>Profit</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Aspen</td>
<td>25,800</td>
<td>5,200</td>
<td></td>
</tr>
<tr>
<td>Boulder</td>
<td>33,866</td>
<td>7,351</td>
<td></td>
</tr>
<tr>
<td>Denver</td>
<td>31,876</td>
<td>6,288</td>
<td></td>
</tr>
<tr>
<td>Fort Collins</td>
<td>12,300</td>
<td>-2,863</td>
<td></td>
</tr>
<tr>
<td>Los Angeles</td>
<td>22,530</td>
<td>-4,278</td>
<td></td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>18,200</td>
<td>3,271</td>
<td></td>
</tr>
<tr>
<td>Sacramento</td>
<td>42,726</td>
<td>8,276</td>
<td></td>
</tr>
<tr>
<td>San Diego</td>
<td>32,940</td>
<td>8,275</td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>42,820</td>
<td>6,832</td>
<td></td>
</tr>
<tr>
<td>San Jose</td>
<td>27,225</td>
<td>8,264</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Branch Revenue Report</th>
<th>Page</th>
<th>2</th>
<th>04-16-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch</td>
<td>Revenue</td>
<td>Profit</td>
<td></td>
</tr>
<tr>
<td>------------------------</td>
<td>---------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>16,152</td>
<td>-978</td>
<td></td>
</tr>
<tr>
<td>Vail</td>
<td>23,202</td>
<td>5,027</td>
<td></td>
</tr>
</tbody>
</table>

If you print this report, the ANSI carriage control characters tell the printer to eject a page when it sees '1' in the first byte, and to insert a blank line before the lines with '0' in the first byte. So you get a blank line between the 'Branch Revenue Report' line and the "Branch" line in your headers, corresponding to the 2/ in your OUTREC parameter. However, if you view this report on a display, the ANSI carriage control characters are ignored, so the '0' line does not have a blank line before it on the display. To force the blank line to appear whether you print the report or view it on a display, you can change the second line of HEADER2 to:

38: 'Page', PAGE, 45:DATE=(MD4-), /, X, /,

This forces DFSORT to write an additional blank output line instead of using the '0' ANSI carriage control character to insert a blank line for the printer. The blank line appears on the printer or display.

OUTFIL's HEADER1 parameter is very similar to the HEADER2 parameter, except that it produces a report heading on a separate page before the first page of data. You can add the following HEADER1 parameter to your OUTFIL statement:

HEADER1=(20: 'Cover sheet for Branch Revenue Report', 3/, 28: 'Printed on ', DATE=(MD4/), ' at ', TIME),
This separate page is printed at the beginning of the report for RPT3, before the other two pages shown previously. Thus, the first two pages of the report would start like this:

```
1                   Cover sheet for Branch Revenue Report
-                   Printed on 04/16/2005 at 16:42:20
1
Branch Revenue Report       Page     1     04-16-2005
...
```

Note that the report heading only has a few lines and then we eject to a new page for the first page heading. If we wanted to start the page heading on the same page as the report heading, we could use OUTFIL's BLKCCH2 parameter. This parameter tells DFSORT to replace the '1' in the first line of the first page heading with a blank, thus avoiding the page eject. With BLKCCH2, the first page of the report would start like this:

```
1                   Cover sheet for Branch Revenue Report
-                   Printed on 04/16/2005 at 16:42:20
Branch Revenue Report       Page     1     04-16-2005
...
```

You can also use OUTFIL's BLKCCH1 parameter to tell DFSORT to replace the '1' in the first line of the report heading with a blank, thus avoiding the page eject for the report heading.

Here are sample JCL statements and control statements for the report using HEADER1, HEADER2, and BLKCCH2:

```
//HDRPT JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.BRANCH,DISP=SHR
//RPT3   DD SYSOUT=A
//SYSIN DD *
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAMES=RPT3,LINES=15,BLKCCH2,
  HEADER1=(20:'Cover sheet for Branch Revenue Report',3/, 20:'Printed on ',DATE=(MD4/),' at ',TIME),
  HEADER2=(/,'Branch Revenue Report',3:'Page',PAGE,45:DATE=(MD4-),2/,
  3:'Branch         ',25:' Revenue',50:'  Profit',/,
  3:'---------------',25:'--------',50:'--------'),
OUTREC=(3:1,15,X, 22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X, 50:28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-))
/*
```

Of course, you could use a temporary or permanent data set for RPT3 instead of SYSOUT=A. For example:

```
//RPT3 DD DSN=&MYRPT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA
```

**Trailers and statistics**

You can add trailers to your report with OUTFIL's TRAILER1 (report trailer) and TRAILER2 (page trailer) parameters. You can use any combination of headers and trailers you need.

Like the HEADERn parameters, the TRAILER1 and TRAILER2 parameters (as well as the TRAILER3 parameter discussed later), let you specify multi-line headings with character strings, hexadecimal strings, input fields, the current date, the current time, page numbers and blank lines. In addition, you can include edited or converted record counts, and edited or converted totals, maximums, minimums, and averages for numeric fields, in your trailers.

The following statements create a report with a separate report trailer page containing the overall record count and various overall statistics for the revenue brought in by the branches.

```
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAMES=RPT4,
  HEADER2=(1:'BRANCH',18:'REVENUE',28:'PROFIT'),
  OUTREC=(1,15,X, 22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
```
For OUTFIL reports, DFSORT terminates if any header or trailer record is longer than the data records. In this case, the TRAILER1 line with DATE=(MD4/) is 46 bytes long, so the data records must be at least 46 bytes long. To increase the data length set by the OUTREC parameter from 42 bytes to 50 bytes, you can put 50:X at the end of the OUTREC parameter as shown.

COUNT=(EDIT=(IIT)) shows the count of data records as three digits with leading zeros suppressed. TOT=(22,6,PD,M12,LENGTH=10) shows the total revenue as ten bytes of the M12 pattern (that is, SI,III,IIT). Similarly, AVG, MIN and MAX show the average, minimum and maximum, respectively, as ten bytes of the M12 pattern. See “Converting numeric fields to different formats” on page 44 and “Editing numeric fields” on page 45, for more information on conversion and editing.

Because LINES=n is not specified, the default of 60 lines per page is used.

The two page result produced for RPT4 is:

<table>
<thead>
<tr>
<th>1BRANCH</th>
<th>REVENUE</th>
<th>PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>25,880</td>
<td>5,280</td>
</tr>
<tr>
<td>Boulder</td>
<td>33,866</td>
<td>7,351</td>
</tr>
<tr>
<td>Denver</td>
<td>31,876</td>
<td>6,288</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>12,300</td>
<td>-2,863</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>22,530</td>
<td>-4,278</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>18,280</td>
<td>3,271</td>
</tr>
<tr>
<td>Sacramento</td>
<td>42,726</td>
<td>8,276</td>
</tr>
<tr>
<td>San Diego</td>
<td>32,940</td>
<td>8,275</td>
</tr>
<tr>
<td>San Francisco</td>
<td>42,820</td>
<td>8,276</td>
</tr>
<tr>
<td>San Jose</td>
<td>27,225</td>
<td>8,264</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>16,152</td>
<td>-978</td>
</tr>
<tr>
<td>Vail</td>
<td>23,202</td>
<td>5,027</td>
</tr>
</tbody>
</table>

0 Overall results for branches on 04/16/2005:
0 12 branches are included
0 Total revenue = 329,637
0 Average revenue = 27,469
0 Lowest revenue = 12,300
0 Highest revenue = 42,820

The second page is the report trailer page produced for TRAILER1, which normally starts on a new page. However, you can use OUTFIL's BLKCCT1 parameter to avoid forcing a new page for the report trailer. For example, if you change the first line of the OUTFIL statement to:

```
OUTFIL FNAMES=RPT4,BLKCCT1,
```

The one page result produced for RPT4 is:

<table>
<thead>
<tr>
<th>1BRANCH</th>
<th>REVENUE</th>
<th>PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>25,880</td>
<td>5,280</td>
</tr>
<tr>
<td>Boulder</td>
<td>33,866</td>
<td>7,351</td>
</tr>
<tr>
<td>Denver</td>
<td>31,876</td>
<td>6,288</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>12,300</td>
<td>-2,863</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>22,530</td>
<td>-4,278</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>18,280</td>
<td>3,271</td>
</tr>
<tr>
<td>Sacramento</td>
<td>42,726</td>
<td>8,276</td>
</tr>
<tr>
<td>San Diego</td>
<td>32,940</td>
<td>8,275</td>
</tr>
<tr>
<td>San Francisco</td>
<td>42,820</td>
<td>8,276</td>
</tr>
<tr>
<td>San Jose</td>
<td>27,225</td>
<td>8,264</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>16,152</td>
<td>-978</td>
</tr>
<tr>
<td>Vail</td>
<td>23,202</td>
<td>5,027</td>
</tr>
</tbody>
</table>

0 Overall results for branches on 04/16/2005:
0 12 branches are included
No data or carriage control characters

If you want your report to contain the overall statistics page, but not the actual data lines, you can add OUTFIL's NODETAIL parameter to your OUTFIL statement. NODETAIL tells DFSORT to process the data records in the usual way, but not to write them to the report data set.

If you do not want the ANSI carriage control characters in your report, you can add OUTFIL's REMOVECC parameter to your OUTFIL statement. REMOVECC tells DFSORT to remove the carriage control character from the first byte of each record. As a result, the data starts in column 1 of the report rather than in column 2.

Suppose you want to produce two output data sets. The first data set should have a single output record with the total count of records in your input data set. The second data set should have a single output record with today's date in the form ddmmyyyy. The following statements would produce these two output data sets:

```
OPTION COPY
OUTFIL FNAMES=BRANCHCT,NODETAIL,REMOVECC,
       TRAILER1=(COUNT=(TO=ZD,LENGTH=10))
OUTFIL FNAMES=CURDT,NODETAIL,REMOVECC,
       HEADER1=(DATENS=(DM4))
```

If the input data set has 12 records, the single record produced for BRANCHCT with the count in columns 1-10 is:

```
0000000012
```

If the job is run on July 15th, 2004, the single record produced for CURDT with the ddmmyyyy date in columns 1-8 is:

```
15072004
```

VB data set considerations for headers and trailers

When you specify an output column in a HEADERn or TRAILERn parameter, you must not add 4 for the RDW to the column, as you must for the BUILD, OUTREC, OVERLAY, IFTHEN OUTREC, IFTHEN BUILD, IFTHEN OVERLAY or IFTHEN PUSH parameters. Consider this OUTFIL statement:

```
OUTFIL REMOVECC,
       HEADER2=(1:C'PAGE HEADER'),
       OUTREC=(1,4,5:C'OUTREC FOR DATA')
```

Both the 'PAGE HEADER' string and the 'OUTREC FOR DATA' string start in position 5 of their respective output records. For HEADER2, you use 1: because 4 must not be added to the output column for the RDW, even though the RDW appears in the header record. For OUTREC, you use 5: because 4 must be added to the output column for the RDW. Just be aware of this difference and specify your output columns accordingly.

When you specify an input field in a HEADERn or TRAILERn parameter, you must add 4 for the RDW to the starting position as you do for a BUILD, OUTREC, OVERLAY, IFTHEN OUTREC, IFTHEN BUILD, IFTHEN OVERLAY or IFTHEN PUSH parameter. However, you cannot specify the variable part of the input record (that is, position without length) in a HEADERn or TRAILERn parameter, as you can for a BUILD, OUTREC, IFTHEN BUILD or IFTHEN OUTREC parameter.

Sections

Suppose you want to print one page with information about the Computer department's books, one page with information about the English department's books, and one page about the History department's...
books. For each department's books, you want to show their course numbers, number in stock, number sold year to date, and price, as well as totals by department for each of the three numeric (BI) fields. The following statements create a report with all of this information:

```
INCLUDE COND=(110,4,SS,EQ,C'COMP,ENGL,HIST')
INREC FIELDS=(1:110,4, Course Department
  CHANGE=(16, C'COMP',C'Computer Science', C'ENGL',C'English', C'HIST',C'History'),
  17:115,5, Course Number
  22:162,4, Number in Stock
  26:166,4, Number Sold Y-to-D
  30:170,4, Price
  50:X)   Ensure data length greater than header/trailer length
SORT FIELDS=(1,16,CH,A,17,5,CH,A)
OUTFIL FNAMES=RPT5,
SECTIONS=(1,16,SKIP=P,
  HEADER3=(3:X,,/
    3:'Department: ',116,/,X,,/
    3:'Number'12:'In Stock',23:'Sold YTD',34:' Price',/,X,,/
    3:'------' 12:'--------',23:'--------',34:'--------'),/
  TRAILER3=(3:'======'12:'========',23:'========',34:'=======',/
    3:'Totals',
  15:TOT=(22,4,BI,EDIT=(IIIIT)),
  26:TOT=(26,4,BI,EDIT=(IIIIT)),
  34:TOT=(30,4,BI,EDIT=(IIIT.TT)))),
OUTREC=(3:17,5,
  15:22,4,BI,EDIT=(IIIIT),
  26:26,4,BI,EDIT=(IIIIT),
  34:30,4,BI,EDIT=(IIIT.TT))
```

The INCLUDE statement and INREC statement remove the unneeded records and fields before sorting. The INREC statement also changes department identifiers (COMP, ENGL, HIST) to more readable strings. As you learned previously, the INREC statement changes the starting positions of various fields, so you must use those new positions for the statements that are processed after INREC (SORT and OUTFIL in this case).

OUTFIL's SECTION parameter is used to divide the report up into sections by the course department. 1,16 tells DFSORT to start a new section every time the department value in columns 1-16 changes. The SORT statement sorts on the department field to bring all of the records for each department value together, so only one section is produced for each department value. If your records are not already sorted by the section field, use the SORT statement to sort them that way. You can sort by other fields as well, but the first sort field must be the section field.

SKIP=P tells DFSORT to start each section on a new page. Alternatively, you can use SKIP=nL if you want your sections to appear on the same page, with n lines between them.

HEADER3 creates section headers in the same way that HEADER1 and HEADER2 create report and page headers, respectively. TRAILER3 creates section trailers in the same way that TRAILER 1 and TRAILER2 create report and page trailers, respectively.

OUTFIL's OUTREC parameter is used to reformat the data records for the report.

The three page result produced for RPT5 is:

```
Department: Computer Science

<table>
<thead>
<tr>
<th>Number</th>
<th>In Stock</th>
<th>Sold YTD</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>00032</td>
<td>5</td>
<td>29</td>
<td>26.00</td>
</tr>
<tr>
<td>00032</td>
<td>6</td>
<td>27</td>
<td>3.60</td>
</tr>
<tr>
<td>00032</td>
<td>28</td>
<td>26</td>
<td>18.99</td>
</tr>
<tr>
<td>00103</td>
<td>4</td>
<td>23</td>
<td>31.95</td>
</tr>
<tr>
<td>00205</td>
<td>10</td>
<td>10</td>
<td>21.99</td>
</tr>
<tr>
<td>Totals</td>
<td>45</td>
<td>115</td>
<td>102.53</td>
</tr>
</tbody>
</table>

Department: English

<table>
<thead>
<tr>
<th>Number</th>
<th>In Stock</th>
<th>Sold YTD</th>
<th>Price</th>
</tr>
</thead>
</table>
```

Using OUTFIL
Suppose you want to create a second report showing the totals for each department, but not the data lines. To accomplish this, you can use a second OUTFIL statement with the NODETAIL (no data), HEADER2 (page headers), SECTIONS (sections) and TRAILER3 (section trailers) parameters. In this case, because the data lines are not printed, you do not need to reformat them with the OUTREC parameter.

The JCL and control statements for the complete job to produce your two reports is:

```
//SCTNRPT JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//RPT5 DD SYSOUT=A
//RPT6 DD SYSOUT=A
//SYSIN DD *
INCLUDE COND=(110,4,SS,EQ,C'COMP,ENGL,HIST')
INREC FIELDS=(1:110,4, Course Department
CHANGE=(16,
C'COMP',C'Computer Science',
C'ENGL',C'English',
C'HIST',C'History'),
17:115,5,  Course Number
22:162,4,  Number in Stock
26:166,4,  Number Sold Y-to-D
30:170,4,  Price
50:X)  Ensure data length greater than header/trailer length
SORT FIELDS=(1,16,CH,A,17,5,CH,A)
OUTFIL FNAMES=RPT5,
SECTIONS=(1,16,SKIP=P,
HEADER3=(3:X,/,3:'Department:  ',1,16,/,X,/,3:'Number',12:'In Stock',23:'Sold YTD',34:'  Price',/,3:'------',12:'--------',23:'--------',34:'-------'),
TRAILER3=(3:'======',12:'========',23:'========',34:'=======',/,3:'Totals',
15:TOT=(22,4,BI,EDIT=(IIIIT)),
26:TOT=(26,4,BI,EDIT=(IIIIT)),
34:TOT=(30,4,BI,EDIT=(IIIT.TT)) ),
OUTREC=(3:17,5,
15:22,4,BI,EDIT=(IIIIT),
26:26,4,BI,EDIT=(IIIIT),
34:30,4,BI,EDIT=(IIIT.TT))
OUTFIL FNAMES=RPT6,
NODETAIL,
HEADER2=(3:'Department      ',22:'In Stock',
31:'Sold YTD',42:'  Price',/,3:'----------------',22:'--------',
31:'--------',42:'-------'),
SECTIONS=(1,16,SKIP=0L,
TRAILER3=(3:1,16,
25:TOT=(22,4,BI,EDIT=(IIIIT)),
34:TOT=(26,4,BI,EDIT=(IIIIT)),
42:TOT=(30,4,BI,EDIT=(IIIT.TT)) ))
/*
```

The three page report produced for RPT5 is the same as shown previously. The one page result produced for RPT6 is:

```
1  Department         In Stock   Sold YTD     Price
----------------   --------   --------   -------
Computer Science         45        115    102.53
```
So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; include, omit or save selected input records for output; reformat, repeat and split input records for output; and create various types of reports. Next, you will learn how to update counts and totals in trailer records.

Updating counts and totals in trailer with OUTFIL

You can use OUTFIL’s IFTRAIL parameter to update count and total values in an existing trailer (last) record to reflect the actual data records in the OUTFIL data set.

Suppose another process deleted 3 records from a data set that originally contained 7 records, but did not update the counts and totals in the trailer record. The modified data set looks like this:

```
1 SAN JOSE    -1.23    +0.35
1 PALO ALTO   +8.34    +1.23
1 DALLAS      -0.03    -3.41
1 MORGAN HILL -15.25   +20.21
9 COUNT=0007, TOTAL1= -12.32, TOTAL2= +26.15
```

The data records are identified by a '1' and the trailer record is identified by a '9'. Note that the count of data records is 7 even though there are now only 4 data records, and the totals are also incorrect.

You can use the following OUTFIL statement to update the trailer record with the correct count and totals:

```
OUTFIL IFTRAIL=(TRLID=(1,1,CH,EQ,C'9'),
               TRLUPD=(9:COUNT=(EDIT=(TTTT)),
                       21:TOT=(16,6,SFF,EDIT=(SIIT.TT),SIGNS=(+,-)),
                       36:TOT=(26,6,SFF,EDIT=(SIIT.TT),SIGNS=(+,-))))
```

IFTRAIL tells DFSORT to update the trailer record.

TRLID=(logexp) identifies the trailer record using the same type of logical expression you can use for INCLUDE. In this case, we identify the trailer record as having a '9' in position 1. The identified trailer record is treated as the last record; it is not treated as a data record.

TRLUPD indicates the fields in the data records to be used to update counts and totals. c:, COUNT=, COUNT+n=, COUNT-n=, TOT= and TOTAL= can be used in TRLUPD in the same way they are used in TRAILER1.

The output data set will contain these data records and a trailer record updated with the correct count and totals:

```
1 SAN JOSE    -1.23    +0.35
1 PALO ALTO   +8.34    +1.23
1 DALLAS      -0.03    -3.41
1 MORGAN HILL -15.25   +20.21
9 COUNT=0004, TOTAL1=  -8.17, TOTAL2= +18.38
```

You can also use IFTRAIL to update counts and totals as you modify a data set, such as when you use two OUTFIL statements to split a data set.

Suppose your input data set has a header, data and trailer records like this:

```
H 2010/07/06
D key1  0100
D key2  0200
D key2  0118
D key1  0150
D key1  0025
D key2  1000
D key2  0310
T X  0007  QR  001903  D52-007-321-7526
```
The header record is identified by an 'H', the data records are identified by a 'D' and the trailer record is identified by a 'T'. In the trailer record, positions 6-9 contain a count (0007) of the data records, and positions 14-19 contain a total (001903) for the amount fields in the data records.

You can use the following OUTFIL statements to split the data records by key (key1 and key2) into two output data sets each of which has the header and trailer with accurate count and total for the included data records.

```
OUTFIL FNAMES=OUT1,
  INCLUDE=(3,4,CH,EQ,C'key1'),
  IFTRAIL=(HD=YES,TRLID=(1,1,CH,EQ,C'T'),
           TRLUPD=(6:COUNT=(M11,LENGTH=4),
                  14:TOT=(10,4,ZD,TO=ZD,LENGTH=6)))
OUTFIL FNAMES=OUT2,
  INCLUDE=(3,4,CH,EQ,C'key2'),
  IFTRAIL=(HD=YES,TRLID=(1,1,CH,EQ,C'T'),
           TRLUPD=(6:COUNT=(M11,LENGTH=4),
                  14:TOT=(10,4,ZD,TO=ZD,LENGTH=6)))
```

IFTRAIL tells DFSORT to update the trailer record.

INCLUDE includes the records with key1 (for OUT1) or key2 (for OUT2).

HD=YES indicates the first record is a header record. The header record will be output without change and its fields will not be used for the count or total. If the input data set has a header, you must use HD=YES to avoid treating the header record as a data record.

TRLID=(logexp) identifies the trailer record as having a 'T' in position 1. The identified trailer record is treated as the last record; it is not treated as a data record.

TRLUPD indicates the counts and totals to be updated.

The results produced for OUT1 are:

```
H 2010/07/06
D key1   0100
D key1   0150
D key1   0025
T X  0003 QR 000275  D52-007-321-7526
```

The trailer record has a count (0003) and total (000275) for the three included data records.

The results produced for OUT2 are:

```
H 2010/07/06
D key2   0200
D key2   0118
D key2   1000
D key2   0310
T X  0004 QR 001628  D52-007-321-7526
```

The trailer record has a count (0004) and total (001628) for the four included data records.

For complete details on using IFTRAIL, see z/OS DFSORT Application Programming Guide.

### So far

So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; include, omit or save selected input records for output; reformat, repeat and split input records for output; create various types of reports and update counts and totals in trailer records. Next, you will learn about converting between fixed and variable records.

#### Converting FB to VB

You can convert an FB data set to a VB data set with OUTFIL's FTOV parameter. Each VB output record has a 4-byte RDW followed by the corresponding data from the FB input record, and the length in the RDW is the length of the FB record plus 4.
The following JCL and DFSORT control statements convert the bookstore data set records from FB to VB.

```plaintext
//FBVB JOB A92,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//VBOUT DD DSN=A123456.SORT.VSAMP,DISP=(NEW,CATLG,DELETE), 
//   UNIT=3390,SPACE=(CYL,(5,5))
//SYSIN DD *
OPTION COPY
OUTFIL FNAMES=VBOUT,FTOV
/*

Because the LRECL of SORT.SAMPIN is 173 bytes, each VB record in SORT.VSAMP is 177 bytes (the FB record length of 173 plus 4 for the RDW) and SORT.VSAMP is given an LRECL of 177.

You can also use PARSE, BUILD, OUTREC, OVERLAY, FINDREP, or IFTHEN parameters with FTOV on the OUTFIL statement. All of the reformatting features are available (input fields, strings, editing, and so on). With FTOV, you specify the input positions, and output columns as you would for an FB record (without the RDW). DFSORT adds the RDW after the FB record is reformatted.

Here is an example of using FTOV with BUILD:

```
OUTFIL FTOV,BUILD=(1:120,25,32:C'in ',110,5)
```

The VB output records look like this:

<table>
<thead>
<tr>
<th>Positions 1-2:</th>
<th>Length (in RDW) = hex Publication Number = 43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positions 3-4:</td>
<td>Zeros (in RDW) = hex Publication Number = 0</td>
</tr>
<tr>
<td>Positions 5-29:</td>
<td>Input positions 120-144</td>
</tr>
<tr>
<td>Positions 30-35:</td>
<td>Blanks</td>
</tr>
<tr>
<td>Positions 36-38:</td>
<td>'in '</td>
</tr>
<tr>
<td>Positions 39-43:</td>
<td>Input positions 110-114</td>
</tr>
</tbody>
</table>

Each VB output record is 43 bytes long and the output data set is given an LRECL of 43.

For the previous examples, the VB output records are all the same length. You can use OUTFIL'S VLTRIM parameter to create VB output records of different lengths from FB input records. Suppose you have an FB input data set with LRECL=20 and 20-byte records like this:

```
ABC
ABCD
AC
ABCDEF
```

These statements change each 20-byte FB input record to a 24-byte VB output record and set LRECL=24 for the VB output data set:

```
OPTION COPY
OUTFIL FTOV
```

The VB output records look like this:

<table>
<thead>
<tr>
<th>Length</th>
<th>X'0000'</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24</td>
<td>0</td>
<td>ABC</td>
</tr>
<tr>
<td>24</td>
<td>0</td>
<td>ABCD</td>
</tr>
<tr>
<td>24</td>
<td>0</td>
<td>AC</td>
</tr>
<tr>
<td>24</td>
<td>0</td>
<td>ABCD</td>
</tr>
</tbody>
</table>

To remove the trailing blanks from the end of each VB output record, use VLTRIM=C' ' (or VLTRIM=X'40') like this:

```
OUTFIL FTOV,VLTRIM=C' '
```
LRECL=24 is still set for the resulting VB output data set, indicating that the maximum record length is 24, but the VB output records are not padded on the right with blanks; they now have different record lengths like this.

<table>
<thead>
<tr>
<th>Length</th>
<th>X'0000'</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>ABC</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>ABCDEF</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>AC</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>ABCDEFGH</td>
</tr>
</tbody>
</table>

You can use any character or hexadecimal byte value for VLTRIM. For example, VLTRIM=C'*' removes trailing asterisks, and VLTRIM=X'00' removes trailing binary zeros.

### Converting VB to FB

You can convert a VB data set to an FB data set with OUTFIL's VTOF and BUILD or OUTREC parameters. All of the PARSE, BUILD, or OUTREC features are available (input fields, strings, editing, and so on). For VTOF, you specify the input positions of the VB input record (with the RDW), and the output columns of the FB output record (without the RDW). DFSORT does not include the RDW in the FB output records.

**Attention:** You cannot specify OVERLAY, FINDREP, or IFTHEN with VTOF.

The following JCL and DFSORT control statements convert a VB data set with LRECL=104 to an FB data set with LRECL=100:

```jcl
//VBFB   JOB   A92,PROGRAMMER
//S1     EXEC  PGM=SORT
//SYSOUT DD    SYSOUT=*  
//SORTIN DD    DSN=A123456.VBIN,DISP=SHR
//FBOUT  DD    DSN=A123456.FBOUT,DISP=(NEW,CATLG,DELETE),
//  UNIT=3390,SPACE=(CYL,(5,5))
//SYSIN  DD    *
OPTION COPY
OUTFIL FNAMES=FBOUT,VTOF,OUTREC=(5,100)
/*
```

Up to 100 bytes of data starting at position 5 (after the RDW) of the VB input record appears in the FB output record starting at position 1. The FB output records are all 100 bytes long. By default, if a VB input record has less than 100 data bytes, DFSORT pads the output data with blanks on the right to 100 bytes. However, you can change the padding character to anything you like with OUTFIL's VLFILL parameter. For example, VLFILL=C'*' pads with asterisks and VLFILL=X'00' pads with binary zeros:

```sort
SORT FIELDS=(25,10,CH,A)  
* Pad short fields on the right with blanks (default is VLFILL=C' ')  
OUTFIL FNAMES=PADB,VTOF,  
OUTREC=(41,40,C'Blank padding',11,20)  
* Pad short fields on the right with asterisks  
OUTFIL FNAMES=PADA,VTOF,  
OUTREC=(5,60,C'Asterisk padding',61,40),VLFILL=C'*'.  
* Pad short fields on the right with binary zeros  
OUTFIL FNAMES=PADZ,VTOF,  
OUTREC=(21,60,C'Binary zero padding'),VLFILL=X'00'
```

LRECL=73 is set for the PADB output data set, which has 73 byte FB records. Short input fields are padded with blanks on the right as needed.

LRECL=116 is set for the PADA output data set, which has 116 byte FB records. Short input fields are padded with asterisks on the right as needed.

LRECL=79 is set for the PADZ output data set, which has 79 byte FB records. Short input fields are padded with binary zeros on the right as needed.
### Summary

This chapter covered the many ways you can use the OUTFIL statement and its various parameters to create multiple output data sets and reports.

The next chapter will cover joining records from two data sets.
Chapter 8. Joining records

Often, you have two data sets with common key fields and different data fields, and you want to join their records, that is, for records with matching keys, you want to create output records with some fields from one data set and some fields from the other data set. You might want a one record to one record join, a one record to many records join, a many records to one record join, or even a many records to many records join.

A JOINKEYS application helps you to perform various "join" applications on two data sets by one or more keys. You can do an inner join, full outer join, left outer join, right outer join and unpaired combinations. The two data sets can be of different types (fixed, variable, VSAM, and so on) and lengths, and have keys in different locations.

The records from the input data sets can be processed in a variety of ways before and after they are joined using most of the DFSORT control statements you learned about previously including SORT or COPY, INCLUDE or OMIT, INREC, OUTREC and OUTFIL.

Suppose you have two input data sets, REGION.IN1 and REGION.IN2 as shown in Table 49 on page 101 and Table 50 on page 101. REGION.IN1 has RECFM=FB and LRECL=35 and REGION.IN2 has RECFM=FB and LRECL=27, so their LRECLs are different.

Table 49. REGION.IN1 data set for JOINKEYS application

<table>
<thead>
<tr>
<th>Region</th>
<th>Headquarters</th>
<th>Regional Director</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6 20</td>
</tr>
<tr>
<td>East</td>
<td>Philadelphia</td>
<td>C. Kent</td>
</tr>
<tr>
<td>West</td>
<td>San Jose</td>
<td>B. Wayne</td>
</tr>
<tr>
<td>North</td>
<td>Boston</td>
<td>P. Parker</td>
</tr>
<tr>
<td>South</td>
<td>Charlotte</td>
<td>D. Prince</td>
</tr>
</tbody>
</table>

Table 50. REGION.IN2 data set for JOINKEYS application

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5 9</td>
<td>10 13</td>
<td>14 23</td>
</tr>
<tr>
<td>0001</td>
<td>East</td>
<td>0050</td>
<td>Fair</td>
<td>1983</td>
</tr>
<tr>
<td>0001</td>
<td>South</td>
<td>0023</td>
<td>Good</td>
<td>1976</td>
</tr>
<tr>
<td>0002</td>
<td>South</td>
<td>0068</td>
<td>Fair</td>
<td>1978</td>
</tr>
<tr>
<td>0002</td>
<td>East</td>
<td>0125</td>
<td>Excellent</td>
<td>1986</td>
</tr>
<tr>
<td>0001</td>
<td>West</td>
<td>0052</td>
<td>Good</td>
<td>1995</td>
</tr>
<tr>
<td>0003</td>
<td>East</td>
<td>0028</td>
<td>Good</td>
<td>1994</td>
</tr>
<tr>
<td>0002</td>
<td>West</td>
<td>0105</td>
<td>Excellent</td>
<td>2001</td>
</tr>
<tr>
<td>0003</td>
<td>South</td>
<td>0054</td>
<td>Fair</td>
<td>1992</td>
</tr>
<tr>
<td>0001</td>
<td>North</td>
<td>0200</td>
<td>Fair</td>
<td>1991</td>
</tr>
<tr>
<td>0004</td>
<td>South</td>
<td>0070</td>
<td>Good</td>
<td>2002</td>
</tr>
</tbody>
</table>

From these two input data sets, you want to create an output data set, REGION.OUT. For each record in REGION.IN2, you want to look up the corresponding Region in REGION.IN1, and combine fields from the two records into one output record in REGION.OUT, as shown in Table 51 on page 101.

Table 51. REGION.OUT data set for JOINKEYS application

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Regional Director</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5 9</td>
<td>10 24</td>
<td>25 28</td>
<td>29 38</td>
</tr>
</tbody>
</table>
Write the following DFSORT JCL and control statements to use a JOINKEYS application to create REGION.OUT from REGION.IN1 and REGION.IN2.

```
//JN1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//IN1 DD DSN=DSN=A123456 REGION.IN1,DISP=SHR
//IN2 DD DSN=DSN=A123456 REGION.IN2,DISP=SHR
//SORTOUT DD DSN=A123456 REGION.OUT,DISP=(NEW,CATLG,DELETE),UNIT=3390,  
// SPACE=(CYL,(5,5))  
//SYSIN DD *
JOINKEYS F1=IN1,FIELDS=(1,5,A)  
JOINKEYS F2=IN2,FIELDS=(5,5,A)  
REFORMAT FIELDS=(F2:1,4, Office from F2)  
REFORMAT FIELDS=(F2:10,4,14,10, Employees and Evaluation from F2)  
REFORMAT FIELDS=(F1:6,15) Headquarters from F1  
OPTION COPY Copy joined records
/*
```
The resulting sorted output records in REGION.OUT are shown in Table 52 on page 103.

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Regional Director</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>5 9</td>
<td>10 24</td>
<td>25 28</td>
<td>29 38</td>
<td>39 53</td>
</tr>
</tbody>
</table>

0001 North  P. Parker  0200  Fair  Boston
0001 South  D. Prince  0023  Good  Charlotte
0002 South  D. Prince  0068  Fair  Charlotte
0003 South  D. Prince  0054  Fair  Charlotte
0004 South  D. Prince  0070  Good  Charlotte
0001 East   C. Kent    0050  Fair  Philadelphia
0002 East   C. Kent    0125  Excellent  Philadelphia
0003 East   C. Kent    0028  Good  Philadelphia
0001 West   B. Wayne   0052  Good  San Jose
0002 West   B. Wayne   0105  Excellent  San Jose

You can also use a JOINKEYS application to match records from two different input data sets in various ways. Suppose you have two input data sets, CITIES.IN1 and CITIES.IN2 as shown in Table 53 on page 103 and Table 54 on page 104.

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 20</td>
<td>21 35</td>
<td>36 37</td>
</tr>
</tbody>
</table>

GILROY  CALIFORNIA  05
GILROY  CALIFORNIA  10
MORGAN HILL  CALIFORNIA  03
PALO ALTO  CALIFORNIA  15
PALO ALTO  CALIFORNIA  08
PALO ALTO  CALIFORNIA  21
SACRAMENTO  CALIFORNIA  05
SAN JOSE  CALIFORNIA  02
SAN JOSE  CALIFORNIA  10
SAN MARTIN  CALIFORNIA  12
AUSTIN  TEXAS  21
DALLAS  TEXAS  15
DALLAS  TEXAS  25
BARRE  VERMONT  07
BARRE  VERMONT  12
STOWE  VERMONT  09
Table 54. CITIES.IN2 data set

<table>
<thead>
<tr>
<th>State</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td>TEXAS</td>
<td>AUSTIN</td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>SACRAMENTO</td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>GILROY</td>
</tr>
<tr>
<td>VERMONT</td>
<td>BURLINGTON</td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>MODESTO</td>
</tr>
<tr>
<td>TEXAS</td>
<td>LAREDO</td>
</tr>
<tr>
<td>VERMONT</td>
<td>BARRE</td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>LOS ANGELES</td>
</tr>
<tr>
<td>CALIFORNIA</td>
<td>SAN JOSE</td>
</tr>
</tbody>
</table>

From these two data sets, you want to create a CITIES.OUT data set with the records for Cities that appear in CITIES.IN1, but not in CITIES.IN2, as shown in Table 55 on page 104.

Table 55. CITIES.OUT data set

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>21 35</td>
</tr>
<tr>
<td>MORGAN HILL</td>
<td>CALIFORNIA</td>
<td>03</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>15</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>08</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>21</td>
</tr>
<tr>
<td>SAN MARTIN</td>
<td>CALIFORNIA</td>
<td>12</td>
</tr>
<tr>
<td>DALLAS</td>
<td>TEXAS</td>
<td>15</td>
</tr>
<tr>
<td>DALLAS</td>
<td>TEXAS</td>
<td>25</td>
</tr>
<tr>
<td>STOWE</td>
<td>VERMONT</td>
<td>09</td>
</tr>
</tbody>
</table>

Write the following DFSORT JCL and control statements to use a JOINKEYS application to create CITIES.OUT from CITIES.IN1 and CITIES.IN2.

```
//JN2 EXEC PGM=SORT
//SYSOUT DD SYSOUT=* 
//SORTJNF1 DD DSN=DSN=A123456.CITIES.IN1,DISP=SHR
//SORTJNF2 DD DSN=DSN=A123456.CITIES.IN2,DISP=SHR
//SORTOUT DD DSN=A123456.CITIES.OUT,DISP=OLD
//SYSIN DD *
* F1 keys are State and City - F1 is already sorted
* by those keys.
JOINKEYS FILE=F1,FIELDS=(21,15,A,1,20,A),SORTED
* F2 keys are State and City
JOINKEYS FILE=F2,FIELDS=(1,15,A,16,20,A)
* Keep the records in F1 that do not have a match in F2
* for the State and City.
JOIN UNPAIRED,F1,ONLY
OPTION COPY
/*

The first JOINKEYS statement identifies SORTJNF1 as the ddname for the F1 data set and indicates ascending keys (State and City) in positions 21-35 and 1-20 of that data set. Since the F1 records are already in order by the State and City fields, SORTED is used to do a Copy of the F1 records rather than a Sort.

The second JOINKEYS statement identifies SORTJNF2 as the ddname for the F2 data set and indicates ascending keys (State and City) in positions 1-15 and 16-35 of that data set. Since the F2 records are not already in order by the State and City fields, SORTED is not used and a Sort in performed for the F2 records on the indicated keys.

104  z/OS: z/OS DFSORT: Getting Started
JOIN UNPAIRED,F1,ONLY is used to restrict the output (SORTOUT) to the records in F1 that do not have matching keys in F2. Since we want the entire F1 record, we do not need a REFORMAT statement.

Now suppose we want to use the CITIES.IN1 and CITIES.IN2 data sets again, but this time we want to produce the following output from these two data sets:

- BOTH.OUT: CALIFORNIA and TEXAS cities that appear in both CITIES.IN1 and CITIES.IN2.
- F1ONLY.OUT: CALIFORNIA and TEXAS cities that appear in CITIES.IN1, but not in CITIES.IN2.
- F2ONLY.OUT: CALIFORNIA and TEXAS cities that appear in CITIES.IN2, but not in CITIES.IN1.

Write the following DFSORT JCL and control statements to use a JOINKEYS application to create BOTH.OUT, F1ONLY.OUT and F2ONLY.OUT from CITIES.IN1 and CITIES.IN2.

```
//JN3 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*  
//CITIES1 DD DSN=A123456.CITIES.IN1,DISP=SHR  
//CITIES2 DD DSN=A123456.CITIES.IN2,DISP=SHR  
//JNF1CNTL DD *  
OMIT COND=(21,15,CH,EQ,C'VERMONT')  
//JNF2CNTL DD *  
OMIT COND=(1,15,CH,EQ,C'VERMONT')  
//BOTH DD DSN=A123456.BOTH.OUT,DISP=OLD  
//F1ONLY DD DSN=A123456.F1ONLY.OUT,DISP=OLD  
//F2ONLY DD DSN=A123456.F2ONLY.OUT,DISP=OLD  
//SYSIN DD *  
JOINKEYS F1=CITIES1,FIELDS=(21,15,A,1,20,A),SORTED  
JOINKEYS F2=CITIES2,FIELDS=(1,15,A,16,20,A)  
JOIN UNPAIRED,F1,F2  
REFORMAT FIELDS=(?,F1:1,37,F2:1,35)  
OPTION COPY  
OUTFIL FNAMES=BOTH,INCLUDE=(1,1,CH,EQ,C'B'),BUILD=(2,37)  
OUTFIL FNAMES=F1ONLY,INCLUDE=(1,1,CH,EQ,C'1'),BUILD=(2,37)  
OUTFIL FNAMES=F2ONLY,INCLUDE=(1,1,CH,EQ,C'2'),BUILD=(54,20,39,15)  
/*  
```

The first JOINKEYS statement identifies CITIES1 as the ddname for the F1 data set and indicates ascending keys (State and City) in positions 21-35 and 1-20 of that data set. The JNF1CNTL data set contains an OMIT statement to remove the VERMONT records from the F1 data set so they will not be joined. Since the F1 records are already in order by the State and City fields, SORTED is used to do a Copy rather than a Sort for the F1 data set.

The second JOINKEYS statement identifies CITIES2 as the ddname for the F2 data set and indicates ascending keys (State and City) in positions 1-15 and 16-35 of that data set. The JNF2CNTL data set contains an OMIT statement to remove the VERMONT records from the F2 data set so they will not be joined. Since the F2 records are not already in order by the State and City fields, SORTED is not used and a Sort in performed for the F2 data set.

Since we want to separate out the BOTH, F1ONLY and F2ONLY joined records, we use a JOIN statement with UNPAIRED,F1,F2 to keep the unpaired joined records as well as the paired join records. In the REFORMAT statement, we use ? as the first field to give us an indicator of whether each key was found in both records ('B' indicator), only in F1 ('1' indicator) or only in F2 ('2' indicator). After the indicator, we put positions 1-37 (City, State, District) from F1 and 1-35 (State, City) from F2. After the records are joined, they will look as shown in Table 56 on page 105.

```
Table 56. Joined City records

<table>
<thead>
<tr>
<th>Indicator</th>
<th>F1 City</th>
<th>F1 State</th>
<th>F1 District</th>
<th>F2 State</th>
<th>F2 City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1</td>
<td>2 21</td>
<td>22 36</td>
<td>37 38</td>
<td>39 53</td>
<td>54 73</td>
</tr>
</tbody>
</table>
```

Chapter 8. Joining records 105
Now we can use OUTFIL statements to create our three different output data sets. We write positions 2-38 (F1 City, F1 State, F1 District) of the joined records with an indicator of 'B' to positions 1-37 of the BOTH.OUT data set. We write positions 2-38 (F1 City, F1 State, F1 District) of the joined records with an indicator of '1' to positions 1-37 of the F1ONLY.OUT data set. We write positions 54-73 (F2 City) and 39-53 (F2 State) of the joined records with an indicator of '2' to positions 1-35 of the F2ONLY.OUT data set. The resulting records are shown in Table 57 on page 106, Table 58 on page 107 and Table 59 on page 107.

Table 57. BOTH.OUT data set

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>21 35</td>
</tr>
<tr>
<td>GILROY</td>
<td>CALIFORNIA</td>
<td>05</td>
</tr>
<tr>
<td>GILROY</td>
<td>CALIFORNIA</td>
<td>10</td>
</tr>
<tr>
<td>SACRAMENTO</td>
<td>CALIFORNIA</td>
<td>05</td>
</tr>
<tr>
<td>SAN JOSE</td>
<td>CALIFORNIA</td>
<td>02</td>
</tr>
<tr>
<td>SAN JOSE</td>
<td>CALIFORNIA</td>
<td>10</td>
</tr>
<tr>
<td>AUSTIN</td>
<td>TEXAS</td>
<td>21</td>
</tr>
</tbody>
</table>
Table 58. F1ONLY.OUT data set

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 20</td>
<td>21 35</td>
<td>36 37</td>
</tr>
<tr>
<td>MORGAN HILL</td>
<td>CALIFORNIA</td>
<td>03</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>15</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>08</td>
</tr>
<tr>
<td>PALO ALTO</td>
<td>CALIFORNIA</td>
<td>21</td>
</tr>
<tr>
<td>SAN MARTIN</td>
<td>CALIFORNIA</td>
<td>12</td>
</tr>
<tr>
<td>DALLAS</td>
<td>TEXAS</td>
<td>15</td>
</tr>
<tr>
<td>DALLAS</td>
<td>TEXAS</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 59. F2ONLY.OUT data set

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 20</td>
<td>21 35</td>
</tr>
<tr>
<td>LOS ANGELES</td>
<td>CALIFORNIA</td>
</tr>
<tr>
<td>MODESTO</td>
<td>CALIFORNIA</td>
</tr>
<tr>
<td>LAREDO</td>
<td>TEXAS</td>
</tr>
</tbody>
</table>

These are just a few of the many types of join operations you can do with JOINKEYS. See z/OS DFSORT Application Programming Guide for complete details of using the JOINKEYS, JOIN and REFORMAT statements along with the other DFSORT statements to perform different JOINKEYS applications.

Summary

This chapter covered the use of JOINKEYS, JOIN and REFORMAT to join records from two data sets. The next chapter will cover methods of calling DFSORT from a program.
Chapter 9. Calling DFSORT from a program

This chapter contains Programming Interface information.

In addition to processing your DFSORT program control statements directly with PGM=SORT or PGM=ICEMAN, you can call DFSORT from COBOL, PL/I, Assembler, or other programs. In this chapter, you will concentrate on sorting and merging using COBOL and sorting using PL/I. The examples in this chapter assume that the COBOL environment is available.

For information on restrictions when using these languages and on calling DFSORT from an assembler program, see z/OS DFSORT Application Programming Guide.

Passing control statements

When you use COBOL or PL/I to call DFSORT, these program products create and pass a SORT or MERGE control statement and a RECORD control statement for you. You can use other DFSORT control statements, such as INCLUDE, OMIT, SUM, INREC, OUTREC and OUTFIL with your COBOL or PL/I programs. Use a SORTCNTL or DFSPARM data set for these DFSORT statements in the same way you would use a SYSIN data set. For example, you can use the SORTCNTL DD statement to pass the INCLUDE control statement that selects only the English department books:

```
//EXAMP    JOB A492,PROGRAMMER
...  
//SORTCNTL DD *
  INCLUDE COND=(110,5,CH,EQ,C'ENGL')
/*
```

Either a SYSIN data set or a DFSPARM data set, or both, can be used for DFSORT control statements when DFSORT is invoked directly, that is, by PGM=SORT or PGM=ICEMAN. Either a SORTCNTL data set or a DFSPARM data set, or both, can be used for DFSORT control statements when DFSORT is called from a program.

If you use DFSORT with COBOL, you should be familiar with the SORT-CONTROL and SORT-RETURN special registers. For complete details, see the COBOL Programmer's Guide that describes the compiler version available at your site.

Calling DFSORT from a COBOL program

To call DFSORT from a COBOL program, use the COBOL statements SORT and MERGE. This section shows sample programs that use the COBOL SORT and MERGE statements. For complete information, see the COBOL Programmer's Guide describing the compiler version available at your site.

Sorting records

The sample COBOL program shown in this section calls DFSORT to sort the bookstore master file (MASTER-FILE) by title in ascending order. The sorted master file is written to SORTED-MASTER-FILE.

Following is the JCL that calls the sample COBOL program:

```
//EXAMP    JOB A492,PROGRAMMER
//BOOKS    EXEC PGM=COBOLPGM
//STEPLIB  DD   DSN=USER.PGMLIB,DISP=SHR
//SYSOUT   DD   SYSOUT=A
//MASTIN   DD   DSN=A123456.MASTER,DISP=OLD
//MASTOUT  DD   DSN=A123456.OUTB,DISP=(NEW,CATLG,DELETE),
  SPACE=(CYL,(1,1)),UNIT=SYSDA
//PRINTFL  DD   SYSOUT=A
```
In contrast to the JCL for executing DFSORT by using a JCL EXEC statement with PGM=SORT or PGM=ICEMAN (see “JCL for sorting data sets directly” on page 16) the previous JCL has these differences:

- The program name on the EXEC statement is that of the COBOL program.
- The STEPLIB DD statement defines the library containing the COBOL program.
- The name of the DD statement for the input file need not be SORTIN.
- The name of the DD statement for the output file need not be SORTOUT.

Notice that the control field and order for the sort are specified in the COBOL program itself rather than with a SORT control statement. The following shows the sample COBOL program.

```
IDENTIFICATION DIVISION.
PROGRAM-ID.
COBOLPGM.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
  SELECT SD-FILE ASSIGN TO DUMMYNM.
  SELECT MASTER-FILE ASSIGN TO MASTIN.
  SELECT SORTED-MASTER-FILE ASSIGN TO MASTOUT.
  SELECT PRINT-FILE ASSIGN TO PRINTFL.
DATA DIVISION.
FILE SECTION.
SD  SD-FILE
  DATA RECORD IS SD-RECORD.
  01  SD-RECORD.
   05 TITLE-IN PICTURE X(75).
   05 AUTH-LN-IN PICTURE X(15).
   05 AUTH-FN-IN PICTURE X(15).
   05 PUB-IN PICTURE X(4).
   05 COUR-DEPT-IN PICTURE X(5).
   05 COUR-NO-IN PICTURE X(5).
   05 COUR-NAM-IN PICTURE X(25).
   05 INST-LN-IN PICTURE X(15).
   05 INST-INIT-IN PICTURE X(2).
   05 NO-STOCK-IN PICTURE 9(8) BINARY.
   05 NO-SOLD-IN PICTURE 9(8) BINARY.
   05 PRICE-IN PICTURE 9(8) BINARY.
FD  MASTER-FILE
  DATA RECORD IS MASTER-RECORD.
  01  MASTER-RECORD.
   05 FILLER PICTURE X(173).
FD  SORTED-MASTER-FILE
  DATA RECORD IS SORTED-MASTER-RECORD.
  01  SORTED-MASTER-RECORD.
   05 FILLER PICTURE X(173).
FD  PRINT-FILE
  DATA RECORD IS OUTPUT-REPORT-RECORD.
  01  OUTPUT-REPORT-RECORD.
   05 REPORT-OUT PICTURE X(120).
   .
   .
PROCEDURE DIVISION.
   .
   .
SORT-Routine SECTION.
  SORT SD-FILE
  ASCENDING KEY TITLE-IN
  USING MASTER-FILE
  GIVING SORTED-MASTER-FILE.
  IF SORT-RETURN > 0
  DISPLAY "SORT FAILED".
  .
  .
SORT-Report SECTION.
  print a report on PRINT-FILE using SORTED-MASTER-FILE.
```
Merging records

The sample COBOL program in Figure 2 on page 112 calls DFSORT to merge the presorted bookstore master file (MASTER-FILE) with another presorted file (NEW-BOOKS-FILE) to create a new master file (MERGED-FILE).

The JCL for the program is as follows:

```
//EXAMP    JOB  A492,PROGRAMMER
//BOOKS    EXEC PGM=COBOLP
//STEPLIB  DD   DSN=USER.PGMLIB,DISP=SHR
//SYSOUT   DD   SYSOUT=A
//MASTERFL DD   DSN=A123456.MASTER,DISP=OLD
//NEWBOOKS DD   DSN=A123456.NEW,DISP=OLD
//MERGEDFL DD   DSN=A123456.OUTC,DISP=(NEW,CATLG,DELETE),
//           SPACE=(CYL,(1,1)),UNIT=SYSDA
```

Figure 2 on page 112 shows the sample COBOL program.
IDENTIFICATION DIVISION.
PROGRAM-ID.
   COBOLP.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
   SELECT SD-FILE ASSIGN TO DUMMYNM.
   SELECT MASTER-FILE ASSIGN TO MASTERFL.
   SELECT NEW-BOOKS-FILE ASSIGN TO NEWBOOKS.
   SELECT MERGED-FILE ASSIGN TO MERGEDFL.
DATA DIVISION.
FILE SECTION.
SD  SD-FILE
   DATA RECORD IS SD-RECORD.
   01  SD-RECORD.
      05 TITLE-KEY  PICTURE X(75).
      05 FILLER     PICTURE X(98).
FD  MASTER-FILE
   DATA RECORD IS MASTER-RECORD.
   01  MASTER-RECORD.
      05 FILLER     PICTURE X(173).
FD  NEW-BOOKS-FILE
   DATA RECORD IS NEW-BOOKS-RECORD.
   01  NEW-BOOKS-RECORD.
      05 FILLER    PICTURE X(173).
FD  MERGED-FILE
   DATA RECORD IS MERGED-RECORD.
   01  MERGED-RECORD.
      05 FILLER    PICTURE X(173).
.
PROCEDURE DIVISION.
.
MERGE-Routine SECTION.
   MERGE SD-FILE
      ASCENDING KEY TITLE-KEY
      USING MASTER-FILE NEW-BOOKS-FILE
      GIVING MERGED-FILE.
      IF SORT-RETURN > 0
         DISPLAY "MERGE FAILED".
      STOP RUN.

Figure 2. Sample COBOL Program with MERGE Commands

Sorting with COBOL FASTSRT

With the COBOL program for sorting records in “Sorting records” on page 109, the input (from MASTER-FILE) and the output (to SORTED-MASTER-FILE) qualify for the COBOL FASTSRT option. With this compile-time FASTSRT option, your sort runs considerably faster, because DFSORT does the input and output processing, rather than COBOL. For complete details on FASTSRT, refer to z/OS DFSORT Application Programming Guide and the COBOL Programmer's Guide that describes the compiler version available at your site.

Note: COBOL evaluates sort input and output independently to see if it qualifies for FASTSRT. If either the input or the output of your sort does not qualify because of the presence of an input or output procedure, you might be able to replace such a procedure and use DFSORT control statements to accomplish the...
same thing. For example, you can use a control statement (OUTREC) to indicate how records will be reformatted before being written to the output data set.

### Calling DFSORT from a PL/I program

When calling DFSORT, a PL/I program must pass a SORT control statement, a RECORD control statement, and the amount of main storage to be available to DFSORT. On the RECORD control statement, you specify the record type and length for the input data set. Following the RECORD control statement, you specify the main storage value for DFSORT either as MAX, or as a value in bytes. (DFSORT performs best when MAX is specified as the main storage value.)

You can also specify DFSORT control statements in a SORTCNTL or DFSPARM data set.

This JCL is for the program shown in Figure 3 on page 114. A SORTCNTL data set is used to specify an INCLUDE control statement that selects only the English department books.

```plaintext
//EXAMP    JOB    A492,PROGRAMMER
//BOOKS    EXEC    PGM=PLIPGM
//STEPLIB  DD    DSN=USER.PGMLIB,DISP=SHR
//SYSOUT   DD    SYSOUT=A
//SORTIN   DD    DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT  DD    DSN=A123456.SORT.SAMPOUT,DISP=OLD
//SORTCNTL DD    *  INCLUDE  COND=(110,5,CH,EQ,C'ENGL')
/*
//SYSPRINT DD    SYSOUT=A
```

The sample PL/I program shown in Figure 3 on page 114 calls DFSORT to sort the bookstore file by title. It specifies appropriate SORT and RECORD control statements, and a DFSORT main storage value of MAX.
Calling DFSORT from a Program

Figure 3. Sample PL/I Program with SORT Commands

<table>
<thead>
<tr>
<th>Sumary</th>
</tr>
</thead>
<tbody>
<tr>
<td>This chapter covered methods of calling DFSORT from COBOL, and PL/I.</td>
</tr>
</tbody>
</table>
Chapter 10. Overriding installation defaults

IBM ships DFSORT with pre-set defaults. During installation, your system programmer can change these defaults. For example, one IBM-supplied default is to list DFSORT control statements in the DFSORT message data set. However, at your site, the default might be to not list DFSORT control statements.

Furthermore, your system programmer can establish separate defaults for jobs with DFSORT executed directly and for jobs with DFSORT called from a program. So, when you execute DFSORT directly, the default might be to list DFSORT control statements, and when you call DFSORT from a program, the default might be to not list DFSORT control statements.

In many cases, if a particular installation default is not appropriate for your job, you can temporarily override it in one of several ways:

- as a PARM parameter in a DFSPARM data set
- as an OPTION, ALTSEQ or DEBUG parameter in a DFSPARM data set
- as a PARM parameter on the JCL EXEC statement
- as an OPTION, ALTSEQ or DEBUG parameter in a SYSIN or SORTCNTL data set
- as an OPTION, ALTSEQ or DEBUG parameter in a parameter list passed from a calling program

OPTION, ALTSEQ and DEBUG parameters in a DFSPARM data set are a good way to override installation defaults regardless of whether you execute DFSORT directly or call it from a program.

In this chapter, you will learn how to override some of the many available defaults, concentrating on PARM parameters in the JCL EXEC statement, and the OPTION control statement in a DFSPARM data set.

You can list all of the installation defaults selected at your site using an ICETOOL DEFAULTS job like the following:

```
//S1  EXEC  PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//DFLTS DD SYSOUT=A
//TOOLIN DD *
DEFAULTS LIST(DFLTS)
/*
```

You'll learn more about ICETOOL in Chapter 12, “Using the ICETOOL utility,” on page 123.

For detailed information on all of the parameters you can override and the various ways in which you can override them, see z/OS DFSORT Application Programming Guide. In particular, see Appendix C, “Specification/Override of DFSORT Options”.

Specifying PARM parameters on a JCL EXEC statement

When you execute DFSORT directly, you can use the PARM parameter in the JCL EXEC statement to override certain defaults for your job. For example, if the default at your site is to list DFSORT statements (installation parameter LIST=YES), but you do not want them listed for your job, you can specify NOLIST in the PARM field:

```
//S1  EXEC  PGM=SORT,PARM='NOLIST'
```

On the other hand, if the default is not to list the DFSORT statements (installation parameter LIST=NO), but you do want them listed, you can specify LIST in the PARM field:

```
//S1  EXEC  PGM=SORT,PARM='LIST'
```

You can also specify more than one PARM parameter. For example, if you want to list the DFSORT statements, have DFSORT set a return code of 4 if SUM fields overflow, use six dynamically allocated SYSDA work data sets, and have DFSORT ABEND if it detects an error, you can specify:
Specifying an OPTION control statement in DFSPARM

Whether you execute DFSORT directly or call it from a program, you can use an OPTION statement in a DFSPARM data set to override certain defaults for your job. To do so, you can place the OPTION statement after a //DFSPARM DD * statement, either by itself or with other DFSORT control statements.

A particular default that you may want to override with the OPTION statement is the EQUALS=NO installation option that specifies whether equally collating records are to be written in their original order.

If your site has EQUALS=NO as the default (recommended) and you want to temporarily override it (so that equally collating records are written in their original order for your job), you can specify EQUALS on the OPTION statement:

```
//DFSPARM DD *
OPTION EQUALS
/*
```

Or, if your site has established EQUALS=YES as the installation default and you want to temporarily override it (so that equally collating records can be written in random order for your job), you can specify NOEQUALS on the OPTION statement:

```
//DFSPARM DD *
OPTION NOEQUALS
/*
```

You can also specify more than one parameter on the OPTION statement, as well as additional control statements, in a DFSPARM data set. For example, if you want to list the DFSORT statements, have DFSORT set a return code of 4 if SUM fields overflow, use six dynamically allocated SYSDA work data sets, and have DFSORT ABEND if it detects an error, you can specify:

```
//DFSPARM DD *
OPTION LIST,OVFLO=RC4,DYNALLOC=(SYSDA,6)
DEBUG ABEND
/*
```

**Summary**

This chapter covered methods of overriding selected DFSORT installation defaults using PARM parameters on the JCL EXEC statement, or an OPTION control statement.
You will get the best performance from DFSORT if you follow these guidelines:

- Be generous with main storage.
- Allow memory object sorting, hipersorting and dataspace sorting.
- Use high-speed disks for work space.
- Eliminate unnecessary fields with INREC.
- Eliminate unnecessary records with INCLUDE or OMIT.
- Eliminate unnecessary records with STOPAFT and SKIPREC.
- Consolidate records with SUM.
- Create multiple output data sets with OUTFIL.
- Replace program logic with DFSORT control statements.
- Use FASTSRT with COBOL.
- Avoid options that might degrade performance.

Additional suggestions can be found in z/OS DFSORT Application Programming Guide and z/OS DFSORT Tuning Guide.

**Be generous with main storage**

By default, DFSORT can use 6 megabytes of main memory for sort, merge and copy applications, or even more when appropriate. If your site does not have an installation default of SIZE=MAX, we recommend setting the MAINSIZE=MAX parameter for your job. As an example, you can set MAINSIZE=MAX like this:

```plaintext
//DFSPARM DD *
OPTION MAINSIZE=MAX
/*
```

Alternatively, you can specify the MAINSIZE=nM parameter (n megabytes) to give DFSORT more or less storage for your job, but we do not recommend this unless you have a specific reason for using MAINSIZE=nM rather than MAINSIZE=MAX. As an example, you can set MAINSIZE=2M like this:

```plaintext
//DFSPARM DD *
OPTION MAINSIZE=2M
/*
```

**Allow memory object sorting, Hipersorting and dataspace sorting**

By default, DFSORT can use memory objects, hiperspaces or data spaces, when appropriate, instead of or along with disk work data sets, to improve the performance of sort applications. If your site has an installation default of MOSIZE=0, HIPRMAX=0 or DSPSIZE=0, you might want to specify the MOSIZE=MAX, HIPRMAX=OPTIMAL and DSPSIZE=MAX parameters when you sort large data sets. As an example, you can set these parameters like this:

```plaintext
//DFSPARM DD *
OPTION MOSIZE=MAX,HIPRMAX=OPTIMAL,DSPSIZE=MAX
/*
```

**Use high-speed disks for work data sets**

Using high-speed disks, such as IBM's Enterprise Storage Server subsystems, offers the best performance for work data sets. Throughput can be further improved by leveraging high speed channels such as IBM's FICON connectivity solutions. DFSORT is optimized to leverage the high speed data...
transfer capabilities offered by these technologies. You should avoid using tapes for work data sets whenever possible.

**Eliminate unnecessary fields with INREC**

If you need to reformat your records, using INREC to significantly shorten them can result in faster processing.

Remember that INREC reformats records before they are processed, and OUTREC reformats them after they are processed. Therefore, you should use INREC to shorten records and OUTREC to lengthen records. For a summary of the control statements and the corresponding record positions to refer to when using INREC, see Table 60 on page 118.

<table>
<thead>
<tr>
<th>Control Statement</th>
<th>Original Records</th>
<th>Reformatted Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>SORT</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>MERGE</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SUM</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>OUTREC</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>OUTFIL</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>INCLUDE</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>OMIT</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

For details on INREC, see Chapter 5, “Reformatting records with fixed fields,” on page 37.

**Eliminate unnecessary records with INCLUDE or OMIT**

Naturally, the number of input records affects the amount of time processing will take. The fewer the records, the faster the DFSORT application. You can improve performance by using INCLUDE or OMIT whenever possible to select only the records pertaining to your application.

For details on INCLUDE and OMIT, see Chapter 3, “Including or omitting records,” on page 23.

**Eliminate unnecessary records with STOPAFT and SKIPREC**

You can also use the STOPAFT and SKIPREC options to reduce the number of input records you process.

- Use STOPAFT to specify the maximum number of records to be accepted for sorting or copying.
- Use SKIPREC to specify the number of records to be skipped before sorting or copying begins.

For information on how to use these options, see *z/OS DFSORT Application Programming Guide*.

**Consolidate records with SUM**

You can improve performance for sorting or merging by using the SUM statement, if appropriate for your job, to:

- add the contents of fields whenever two records with equal control fields are found. DFSORT places the result in one record and deletes the other, reducing the number of output records, or
- delete records with duplicate control fields by specifying FIELDS=NONE.

For details on SUM, see Chapter 4, “Summing records,” on page 33.
Create multiple output data sets with OUTFIL

If you need to create multiple output data sets from the same input data set, you can use OUTFIL to read the input data set only once, thus improving performance. OUTFIL can be used for sort, merge, and copy applications to provide sophisticated filtering, editing, conversion, lookup and replace, and report features.

For details on OUTFIL, see Chapter 7, “Creating multiple output data sets and reports,” on page 79.

Replace program logic with DFSORT control statements

As a rule, using appropriate DFSORT control statements is more efficient than program logic. Whenever possible, use DFSORT control statements INCLUDE, OMIT, INREC, OUTREC, SUM and OUTFIL instead of doing the same functions with program code.

Use FASTSRT with COBOL

With COBOL, you can enhance DFSORT performance by using the FASTSRT compile-time option. With FASTSRT, DFSORT does the input and output processing, rather than COBOL. For more information on the FASTSRT option, see the COBOL Programmer's Guide that describes the compiler version available at your site.

Avoid options that might degrade performance

This chapter covered methods for improving DFSORT performance, including the effective use of various control statements and parameters.

The following parameters and options might adversely affect DFSORT performance. Use them only when necessary. For a complete description of what these parameters and options are and how they affect performance, see z/OS DFSORT Application Programming Guide and z/OS DFSORT Tuning Guide.

- VERIFY parameter
- EQUALS parameter
- NOBLKSET parameter
- CKPT parameter
- EQUCOUNT parameter
- NOCINV parameter
- LOCALE parameter
- BSAM parameter
- NOASSIST parameter
- NOCFW parameter
- Tape work data sets
- User exit routines
- EFS program
- Dynamic link-edit of user exit routines
- Small values for the MOSIZE, HIPRMAX, DSPSIZE, or MAINSIZE parameters
- Processing Unicode data formats
Part 3. Learning to use ICETOOL
Chapter 12. Using the ICETOOL utility

ICETOOL is a multipurpose DFSORT utility that uses the capabilities of DFSORT to perform multiple operations on one or more data sets in a single step.

This chapter introduces you to ICETOOL's 17 "operators", which allow you to do a wide variety of tasks. You will learn about ICETOOL's JCL and control statements while writing a large "main" ICETOOL job that uses many of the ICETOOL operators, as well as several additional smaller ICETOOL jobs that illustrate specific points. To fully use the capabilities of ICETOOL, you should become familiar with all of its operators, operands, and methods of invocation, as described in z/OS DFSORT Application Programming Guide.

Note: Most likely, you would do unrelated tasks in different ICETOOL jobs. But you can do unrelated tasks in the same ICETOOL job. The ICETOOL jobs constructed in this chapter take both approaches as a convenient way to illustrate the use of various ICETOOL operators.

ICETOOL operators

The following 17 ICETOOL operators can be used to perform a variety of functions. By using various combinations of the 17 ICETOOL operators, you can easily create applications that perform many complex tasks.

COPY
Copies a data set to one or more output data sets.

COUNT
Prints a message containing the count of records in a data set. COUNT can also be used to create an output data set containing text and the count, or to set RC=12, RC=8, RC=4, or RC=0 based on meeting criteria for the number of records in a data set (for example, empty, not empty, less than, equal to, or greater than 5000 records, and so on).

DATASORT
Sorts data records between header and trailer records in a data set to an output data set.

DEFAULTS
Prints the DFSORT installation defaults in a separate list data set.

DISPLAY
Prints the values or characters of specified numeric or character fields in a separate list data set. Simple, tailored, or sectioned reports can be produced. Maximums, minimums, totals, averages and counts can be produced.

MERGE
Merges one or more data sets to one or more output data sets.

MODE
Three modes are available, which can be set or reset for groups of operators:

• STOP mode (the default) stops subsequent operations if an error is detected.
• CONTINUE mode continues with subsequent operations if an error is detected.
• SCAN mode allows ICETOOL statement checking without actually performing any operations.

OCCUR
Prints each unique value for specified numeric or character fields and how many times it occurs in a separate list data set. Simple or tailored reports can be produced. The values printed can be limited to those for which the value count meets specified criteria (for example, only duplicate values or only non-duplicate values).

RANGE
Prints a message containing the count of values in a specified range for a specified numeric field in a data set.
RESIZE
Creates a larger record from multiple shorter records, or creates multiple shorter records from a
larger record, that is, resizes fixed length records.

SELECT
Selects records from a data set for inclusion in an output data set based on meeting criteria for the
number of times specified numeric or character field values occur (for example, only duplicate values
or only non-duplicate values). Records that are not selected can be saved in a separate output data
set.

SORT
Sorts a data set to one or more output data sets.

SPLICE
Splices together specified fields from records that have the same specified numeric or character field
values (that is, duplicate values), but different information. Specified fields from two or more records
can be combined to create an output record. The fields to be spliced can originate from records in
different data sets, so you can use SPLICE to do various "join" and "match" operations.

STATS
Prints messages containing the minimum, maximum, average, and total for specified numeric fields in
a data set.

SUBSET
Selects records from a data set based on keeping or removing header records, relative records or
trailer records. Records that are not selected can be saved in a separate output data set.

UNIQUE
Prints a message containing the count of unique values for a specified numeric or character field.

VERIFY
Examines specified decimal fields in a data set and prints a message identifying each invalid value
found for each field.

Sample input data sets
Each ICETOOL operator (except DEFAULTS and MODE) requires an input data set. The input data set used
by one operator can be the same or different from the input data set used by another operator. Thus,
ICETOOL can process many data sets in a single step.

This chapter uses the branch data set SORT.BRANCH, the bookstore data set SORT.SAMPIN, and the
additional bookstore data set SORT.SAMPADD as input data sets. See Appendix A, “Creating the sample
data sets,” on page 171 and Appendix B, “Descriptions of the sample data sets,” on page 173 for
additional information about these sample data sets. Two temporary data sets created by ICETOOL from
SORT.BRANCH are also used as input.

Note: This chapter also uses data sets other than SORT.BRANCH, SORT.SAMPIN and SORT.SAMPADD.
You can either create data sets from scratch to match the ones used in the text, or else perform a similar
exercise on data sets you already have.

Writing required JCL statements
An ICETOOL job consists of:

1. The JCL statements that are required for every ICETOOL job.
2. The operator statements indicating the operations to be performed by the ICETOOL job.
3. The JCL statements that are required as a result of the specified operator statements.

The first step in creating any ICETOOL job is to write the JCL that is always required. Here is a skeleton of
the JCL for an ICETOOL job:
• The JOB statement signals the beginning of the job.
• The EXEC statement signals the beginning of the job step and tells the operating system to run the ICETOOL program.
• The TOOLMSG statement defines the output data set for ICETOOL messages.
• The DFSMSG statement defines the output data set for DFSORT messages.
• The TOOLIN statement precedes the ICETOOL statements (comment, blank, and operator statements). The ICETOOL statements you write must appear after TOOLIN. The additional JCL statements you write can appear before the TOOLIN statement or after the ICETOOL statements. In the main ICETOOL job, the additional JCL statements will be placed after the ICETOOL statements.

**ICETOOL comment and blank statements**

Comment statements and blank statements can be placed anywhere among the ICETOOL operator statements.

• Comment statements start with an asterisk (*) in column 1 and are printed along with the ICETOOL operator statements.
• Blank statements contain blanks in columns 1-72 and are ignored because ICETOOL prints blank lines where appropriate.

A blank statement and a comment statement for our example looks like this:

```
* Statistics from all branches
```

Here are the steps for writing these statements:

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>After the TOOLIN DD statement, skip one line.</td>
</tr>
<tr>
<td>2</td>
<td>Type an asterisk (*) in column 1 followed by the comment.</td>
</tr>
</tbody>
</table>

When complete, the TOOLIN statements look like this:

```
//TOOLIN DD *
* Statistics from all branches
/*
```

For the main ICETOOL job, a comment statement will be placed before each operator to describe its function. Although not required, this is a good practice to follow.

**So far**

So far, you have been introduced to the basics of the ICETOOL utility. Now, using the following tutorials, you can learn about many of the ICETOOL operators. The following sections contain parts of the main ICETOOL job, so that by the end of the chapter, you will have created the complete main ICETOOL job. At the end of the chapter, there is a section that contains the complete main ICETOOL job and its resulting messages.
Printing statistics for numeric fields

When working with data sets containing numeric fields, you may want statistical information about one or more of those fields. You can use the STATS operator to find the minimum, maximum, average, and total values of up to 10 specific numeric fields.

A STATS operator that prints statistics for the employees, profit, and revenue fields of the branch office data set looks like this:

```plaintext
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
```

Here are the steps for writing this STATS operator.

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type <code>STATS</code> after the comment statement (you can leave one or more blanks before <code>STATS</code> if you like).</td>
</tr>
<tr>
<td>2</td>
<td>Leave at least one blank and type <code>FROM(ALL)</code>. FROM specifies the ddname (that is, the name of the DD statement) for the input data set from which you want to print statistics. In this case <code>ALL</code> is the ddname chosen, but you can use any valid 1-8 character ddname you like.</td>
</tr>
<tr>
<td>3</td>
<td>Leave at least one blank and type <code>ON</code>. ON defines a field for which you want to print statistics.</td>
</tr>
<tr>
<td>4</td>
<td>Type in parentheses, and separated by commas: 1. Where the employees field begins relative to the beginning of the input record (the first position is byte 1). The employees field begins at byte 18. 2. The length of the employees field in bytes. The employees field is 4 bytes long. 3. A code for the data format. The employees field contains zoned decimal data, which you specify as ZD.</td>
</tr>
<tr>
<td>5</td>
<td>Leave at least one blank and type <code>ON</code>. ON defines another field for which you want to print statistics. You can print statistics for up to 10 fields with one STATS statement. Specify the ON fields in the same order in which you want their statistics to be printed.</td>
</tr>
<tr>
<td>6</td>
<td>Type in parentheses, and separated by commas the location (28), length (6), and format (PD for packed decimal) of the profit field.</td>
</tr>
<tr>
<td>7</td>
<td>Leave at least one blank and type <code>ON</code>. Type in parentheses and separated by commas, the location (22), length (6), and format (PD) of the revenue field. Make sure that the statement is coded between columns 1 and 72.</td>
</tr>
</tbody>
</table>

You must also write a DD statement for the A123456.SORT.BRANCH data set using the ddname ALL and place it at the end of the job:

```plaintext
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
```
When complete the TOOLIN statements and ALL statement look like this:

```plaintext
//TOOLIN DD *
* Statistics from all branches
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
/*
//ALL DD DSN=A123456 SORT.BRANCH, DISP=SHR
```

When this STATS operation is run, the results are placed in the TOOLMSG data set. If you ran the ICETOOL job you created so far, the TOOLMSG output would look like this:

```
ICE600I 0 DFSORT ICETOOL UTILITY RUN STARTED
ICE650I 0 VISIT http://www.ibm.com/storage/dfs for ICETOOL PAPERS, EXAMPLES AND MORE
ICE632I 0 SOURCE FOR ICETOOL STATEMENTS: TOOLIN
ICE630I 0 MODE IN EFFECT: STOP
  * Statistics from all branches
  STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
ICE627I 0 DFSORT CALL 0001 FOR COPY FROM ALL TO E35 EXIT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000012
ICE607I 0 STATISTICS FOR (18,4,ZD):
ICE608I 0   MINIMUM: +000000000000015, MAXIMUM: +000000000000035
ICE609I 0   AVERAGE: +000000000000024, TOTAL: +000000000000298
ICE607I 0 STATISTICS FOR (28,6,PD):
ICE608I 0   MINIMUM: -000000000004278, MAXIMUM: +000000000008276
ICE609I 0   AVERAGE: +000000000004222, TOTAL: +000000000050665
ICE607I 0 STATISTICS FOR (22,6,PD):
ICE608I 0   MINIMUM: +000000000012300, MAXIMUM: +000000000042820
ICE609I 0   AVERAGE: +000000000027469, TOTAL: +000000000329637
ICE602I 0 OPERATION RETURN CODE: 00
ICE601I 0 DFSORT ICETOOL UTILITY RUN ENDED - RETURN CODE: 00
```

Looking at the output, you will notice that:

- Message ICE628I gives the count of records processed.
- Messages ICE607I, ICE608I, and ICE609I give the numerical statistics for each ON field specified in the order in which they were specified.
- A return code for each operator is given in message ICE602I and the highest operator return code is given in message ICE601I.

### Continuing an operator statement

If you cannot fit your STATS statement (or any other ICETOOL operator statement) between columns 1 and 72 of a single line, you can continue it across multiple lines. If you end a line with a hyphen (-) after the operator or any operand, the next line is treated as a continuation. Any characters specified after the hyphen are ignored.

Note that the operator and each operand must be completely specified on one line (between columns 1 and 72).

For example:

```plaintext
STATS
  FROM(ALL) - this is the operator
  ALL is the ddname for SORT.BRANCH
  ON(18,4,ZD)
  ON(28,6,PD)
  ON(22,6,PD)
```

### Statistics for VB data set record lengths

When working with variable length record data sets, you can use the STATS operator to easily obtain the following information:

- The shortest record in the data set (minimum)
- The longest record in the data set (maximum)
- The average length of records in the data set (average)
• The total number of bytes in the data set (total)

ICETOOL provides the special ON(VLEN) field for printing these statistics. Specify ON(VLEN) as you would any other ON field.

When you code ON(p,m,f) fields for VB records, remember to add 4 to the starting position to account for the 4-byte RDW, in the same way discussed earlier for DFSORT control statement fields.

The following STATS operator reports the minimum, maximum, total and average values for the record length and for a PD field in the first two data bytes:

```
STATS FROM(VBIN) ON(VLEN) ON(5,2,PD)
```

<table>
<thead>
<tr>
<th>So far</th>
</tr>
</thead>
<tbody>
<tr>
<td>Now you know how to use ICETOOL's STATS operator to print statistics for numeric fields and VB record lengths. In the next section, you will learn how to use ICETOOL's SORT operator.</td>
</tr>
</tbody>
</table>

### Creating identical sorted data sets

You can use ICETOOL's SORT operator to create sorted output data sets. A single SORT operator can be used to create one output data set or up to 10 identical output data sets. Using INCLUDE or OMIT statements, you can select a subset of the input records. Using INREC or OUTREC statements, you can rearrange the fields of the input records. Using OUTFIL statements, you can create any number of output data sets with different subsets of records or arrangements of fields.

For this example, we will use both the sample bookstore data set (SORT.SAMPIN) and the additional bookstore data set (SORT.SAMPADD) as input.

A SORT operator that selects the books from publishers VALD and WETH, sorts them by publisher and title, and writes them to disk and print data sets, looks like this:

```
SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB)
```

Here are the steps for writing this SORT operator:

<table>
<thead>
<tr>
<th>Table 63. Steps to Create the SORT Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step</strong></td>
</tr>
</tbody>
</table>
| 1 | Write a comment statement (optional):
AXBK  Books from VALD and WETH |
| 2 | Type **SORT** after the comment statement |
| 3 | Leave at least one blank and type **FROM(BKS)**

BKS specifies the ddname for the input data sets you want to sort.
Table 63. Steps to Create the SORT Operator (continued)

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 4    | Leave at least one blank and type **TO(DAPUBS,PRPUBS)**  
**TO** specifies the ddnames for the output data sets to contain the sorted subset of records. You can create up to 10 identical output data sets of any type that DFSORT allows (permanent, temporary, disk, tape, print, etc).  
In this case, DAPUBS is the ddname chosen for the temporary disk data set and PRPUBS is the ddname chosen for the print data set. You can use any valid 1-8 character ddnames you like.  
ICETOOL will automatically use OUTFIL to create both output data sets from a single pass over the input data set. |
| 5    | Leave at least one blank and type **USING(SPUB)**  
**USING** specifies the first four characters of the ddname for the data set containing the DFSORT control statements. In this case, the four characters chosen are SPUB, but you can use any four characters you like as long as they are valid for a ddname. The last four characters of the ddname are always CNTL, so in this case the full ddname is SPUBCNTL.  
For the SORT operator, you must specify a SORT control statement in the DFSORT control statement data set (SPUBCNTL) in order to tell DFSORT how to sort the input data set. You can also specify additional DFSORT control statements, like INCLUDE, OMIT, INREC, OUTREC and OUTFIL, as appropriate. |

To write the JCL statements that go with the SORT operator:

Table 64. Steps to Create JCL Statements for the SORT Operator

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Write DD statements for the input data sets and place them at the end of the job. In order to "concatenate" the two input data sets together, you must leave the ddname field blank in the second DD statement:  
```plaintext  
//BKS    DD DSN=A123456.SORT.SAMPIN,DISP=SHR  
//       DD DSN=A123456.SORT.SAMPADD,DISP=SHR  
```
| 2    | Write DD statements for the disk and print output data sets and place them at the end of the job:  
```plaintext  
//DAPUBS DD  DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA  
//PRPUBS DD  SYSOUT=A  
```
| 3    | Write a DD statement for the DFSORT control statement data set and place it at the end of the job:  
```plaintext  
//SPUBCNTL DD  *  
```
| 4    | Write the SORT control statement to sort the input data sets by publisher and title, and the INCLUDE statement to select only the books by publishers VALD and WETH, and place them after the SPUBCNTL statement:  
```plaintext  
SORT  FIELDS=(106,4,A,1,75,A),FORMAT=CH  
INCLUDE  COND=(106,4,EQ,C 'VALD'),OR,(106,4,EQ,C 'WETH'),   
FORM=CH  
```

When complete, the TOOLIN statements and DD statements for this SORT operator look like this:
Books from VALD and WETH

SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB)
/

Books from VALD and WETH

SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB)
/

```*
//BKS DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//       DD DSN=A123456.SORT.SAMPADD,DISP=SHR
//DAPUBS DD DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA
//PRPUBS DD SYSOUT=A
//SPUBCNTL DD *
SORT FIELDS=(106,4,A,1,75,A),FORMAT=CH
 INCLUDE COND=(106,4,EQ,C'VALD',OR,106,4,EQ,C'WETH'),
                FORMAT=CH
/*

Tip: Instead of writing the previous INCLUDE statement using two conditions joined by OR, you could write it with one condition using INCLUDE’s substring search feature, as you learned in “Substring search for INCLUDE and OMIT” on page 30, like this:

```
INCLUDE COND=(106,4,SS,EQ,C'VALD,WETH')
```

Table 65 on page 130 shows the Book Title and Publisher fields for the records as they would appear in the resulting output data sets. The actual records contain all of the fields.

Table 65. Books from publishers VALD and WETH

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>106 109</td>
</tr>
<tr>
<td>CELLS AND HOW THEY WORK</td>
<td>VALD</td>
</tr>
<tr>
<td>COMPLETE SPANISH DICTIONARY</td>
<td>VALD</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>VALD</td>
</tr>
<tr>
<td>FREUD'S THEORIES</td>
<td>VALD</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>VALD</td>
</tr>
<tr>
<td>NOVEL IDEAS</td>
<td>VALD</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>VALD</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>VALD</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>VALD</td>
</tr>
<tr>
<td>ZEN BUSINESS</td>
<td>VALD</td>
</tr>
<tr>
<td>ANTICIPATING THE MARKET</td>
<td>WETH</td>
</tr>
<tr>
<td>CIVILIZATION SINCE ROME FELL</td>
<td>WETH</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>WETH</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>WETH</td>
</tr>
<tr>
<td>GUIDE TO COLLEGE LIFE</td>
<td>WETH</td>
</tr>
<tr>
<td>GUNTHER'S GERMAN DICTIONARY</td>
<td>WETH</td>
</tr>
<tr>
<td>REBIRTH FROM ITALY</td>
<td>WETH</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>WETH</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>WETH</td>
</tr>
</tbody>
</table>

Creating different subsets of a sorted data set

If you want to create subsets of records from the same input data set, you can use OUTFIL statements with a SORT or COPY operator. The OUTFIL statements specify the ddnames of the output data sets, so the TO operand is not needed. All of the features of OUTFIL are available through the SORT and COPY operators.
A SORT operator that creates separate disk and tape data sets for the branch offices in California, and those in Colorado, sorted by city looks like this:

```
SORT FROM(ALL) USING(CACO)
```

First four chars of ddname of DFSORT control data set

ddname of input data set

Here are the steps for writing this SORT operator:

### Table 66. Steps to Create the SORT Operator

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write a comment statement (optional):</td>
</tr>
<tr>
<td></td>
<td>* Separate output for California and Colorado branches</td>
</tr>
<tr>
<td>2</td>
<td>Type <code>SORT</code> after the comment statement</td>
</tr>
<tr>
<td>3</td>
<td>Leave at least one blank and type <code>FROM(ALL)</code></td>
</tr>
<tr>
<td></td>
<td>ALL specifies the ddname for the input data set you want to sort. You can use the same ddname that you used for A123456.SORT.BRANCH in the STATS operator.</td>
</tr>
<tr>
<td>4</td>
<td>Leave at least one blank and type <code>USING(CACO)</code></td>
</tr>
<tr>
<td></td>
<td>The CACOCNTL data set contains the SORT and OUTFIL statements.</td>
</tr>
</tbody>
</table>

To write the JCL statements that go with the SORT operator follow these steps:

### Table 67. Steps to Create JCL Statements for the SORT Operator

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write a DD statement for the DFSORT control statement data set and place it at the end of the job:</td>
</tr>
<tr>
<td></td>
<td>//CACOCNTL DD *</td>
</tr>
<tr>
<td>2</td>
<td>Write the SORT control statement to sort the input data set by city, and the OUTFIL statement to select only the California branches, and the OUTFIL statement to select only the Colorado branches, and place them after the CACOCNTL statement:</td>
</tr>
<tr>
<td></td>
<td>SORT FIELDS=(1,15,CH,A)</td>
</tr>
<tr>
<td></td>
<td>OUTFIL FNAMES=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA')</td>
</tr>
<tr>
<td></td>
<td>OUTFIL FNAMES=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO')</td>
</tr>
<tr>
<td>3</td>
<td>Write DD statements for the disk and tape output data sets and place them at the end of the job:</td>
</tr>
<tr>
<td></td>
<td>//CADASD DD DSN=&amp;&amp;CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390</td>
</tr>
<tr>
<td></td>
<td>//CATAPE DD DSN=CA.BRANCH,UNIT=3480,VOL=SER=111111,</td>
</tr>
<tr>
<td></td>
<td>// DISP=(NEW,KEEP),LABEL=(,SL)</td>
</tr>
<tr>
<td></td>
<td>//CODASD DD DSN=&amp;&amp; CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390</td>
</tr>
<tr>
<td></td>
<td>//COTAPE DD DSN=CO.BRANCH,UNIT=3480,VOL=SER=222222,</td>
</tr>
<tr>
<td></td>
<td>// DISP=(NEW,KEEP),LABEL=(,SL)</td>
</tr>
</tbody>
</table>

When complete, the TOOLIN statements and DD statements for this SORT operator look like this:
Separate output for California and Colorado branches
SORT FROM(ALL) USING(CACO)

/*
CACOCNTL DD *
SORT FIELDS=(1,15,CH,A)
OUTFIL FNAME=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA')
OUTFIL FNAME=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO')
*/

//CADASD DD DSN=&&CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//CATAPE DD DSN=CA.BRANCH,UNIT=3480,VOL=SER=111111,
//  DISP=(NEW,KEEP),LABEL=(,SL)
//CODASD DD DSN=&&CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//COTAPE DD DSN=CO.BRANCH,UNIT=3480,VOL=SER=222222,
//  DISP=(NEW,KEEP),LABEL=(,SL)

Table 68 on page 132 shows the records as they would appear in the CADASD data set (&&CA) and the CATAPE data set (CA.BRANCH) as a result of using the first OUTFIL statement.

Table 68. Records for California Sorted by City

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>Employees</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 15</td>
<td>16 17</td>
<td>18 21</td>
<td>22 27</td>
<td>28 33</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>CA</td>
<td>32</td>
<td>22530</td>
<td>-4278</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>CA</td>
<td>15</td>
<td>18200</td>
<td>3271</td>
</tr>
<tr>
<td>Sacramento</td>
<td>CA</td>
<td>29</td>
<td>42726</td>
<td>8276</td>
</tr>
<tr>
<td>San Diego</td>
<td>CA</td>
<td>22</td>
<td>32940</td>
<td>8275</td>
</tr>
<tr>
<td>San Francisco</td>
<td>CA</td>
<td>35</td>
<td>42820</td>
<td>6832</td>
</tr>
<tr>
<td>San Jose</td>
<td>CA</td>
<td>21</td>
<td>27225</td>
<td>8264</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>CA</td>
<td>18</td>
<td>16152</td>
<td>-978</td>
</tr>
</tbody>
</table>

Table 69 on page 132 shows the records as they would appear in the CODASD data set (&&CO) and the COTAPE data set (CO.BRANCH) as a result of using the second OUTFIL statement.

Table 69. Records for Colorado Sorted by City

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>Employees</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 15</td>
<td>16 17</td>
<td>18 21</td>
<td>22 27</td>
<td>28 33</td>
</tr>
<tr>
<td>Aspen</td>
<td>CO</td>
<td>20</td>
<td>25800</td>
<td>5200</td>
</tr>
<tr>
<td>Boulder</td>
<td>CO</td>
<td>32</td>
<td>33866</td>
<td>7351</td>
</tr>
<tr>
<td>Denver</td>
<td>CO</td>
<td>33</td>
<td>31876</td>
<td>6288</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>CO</td>
<td>22</td>
<td>12300</td>
<td>-2863</td>
</tr>
<tr>
<td>Vail</td>
<td>CO</td>
<td>19</td>
<td>23202</td>
<td>5027</td>
</tr>
</tbody>
</table>

Figure 4 on page 160 shows the complete TOOLMSG output.

So far

So far in this tutorial, you have learned how to print statistics for numeric fields using ICETOOL's STATS operator, and how to sort an input data set and create multiple output data sets using ICETOOL's SORT operator. Next, you will learn about ICETOOL's COPY operator.
Creating multiple unsorted data sets

If you want to create unsorted copies of an input data set, you can use ICETOOL's COPY operator. The COPY operator does not require any DFSORT statements. However, you can supply DFSORT statements (for example, INCLUDE, OMIT, INREC, OUTREC, or OUTFIL) if appropriate.

Here are a couple of examples of COPY operator statements with their accompanying JCL statements:

```bash
//TOOLIN DD *
COPY FROM(ALL) TO(D1,D2,D3)
COPY FROM(ALL) TO(P1) USING(COPY)
/*
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
//D1 DD DSN=A123456.SORT.COPY1,DISP=OLD
//D2 DD DSN=A123456.SORT.COPY2,DISP=OLD
//D3 DD DSN=A123456.SORT.COPY3,DISP=OLD
//P1 DD SYSOUT=* 
//COPYCNTL DD *
  INCLUDE COND=(16,2,CH,EQ,C'CA')
/*
```

The first COPY operator creates identical copies of A123456.SORT.BRANCH in A123456.SORT.COPY1, A123456.SORT.COPY2, and A123456.SORT.COPY3.

The second COPY operator prints the A123456.SORT.BRANCH records for the branches in California. Note that only the character fields in the resulting printed output will be readable. You will learn how to display numeric fields in readable format later in this chapter.

Because copying is more efficient than sorting, you should use the COPY operator rather than the SORT operator when possible.

---

**So far**

So far in this chapter you have learned about STATS, SORT, and COPY, three important ICETOOL operators. The next tutorial shows you how to use ICETOOL's RANGE operator.

---

Counting values in a range

You can use ICETOOL's RANGE operator to count the number of values for a particular numeric field that fall within a range you define. The range can be defined with:

- **Operand**
- **Comparison**

  **EQUAL (u)**
  - Equal to u

  **NOTEQUAL (v)**
  - Not equal to v

  **LOWER (w)**
  - Less than w

  **HIGHER (x)**
  - Greater than x

  **HIGHER (x) and LOWER (w)**
  - Greater than x, but less than w
To print a count of the number of California branches with profit greater than -1500, but less than +8000, write the following RANGE statement:

```
RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
```

The input data set defined by CADASD is the same data set you created earlier (with the SORT operator) for the California branches. HIGHER(-1500) indicates that you want to count values in the profit field that are greater than -1500, while LOWER(+8000) indicates that you want to count values in the profit field that are less than +8000. For a negative limit, you must specify a minus (-) sign before the number. For a positive limit, you either specify a plus (+) sign before the number or leave it out, therefore, HIGHER(8000) is the same as HIGHER(+8000).

To print a count of the number of branches (in California and Colorado) with less than 32 employees, write the following RANGE statement:

```
RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
```

Because CADASD and ALL were previously defined, you don’t need to add any new JCL statements to the ICETOOL job.

When these RANGE operators are run, the results are placed in the TOOLMSG data set. The TOOLMSG output produced for these RANGE operators would look like this:

```
* California branches profit analysis
  RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
  ICE627I 0 DFSORT CALL 0004 FOR COPY FROM CADASD TO E35 EXIT COMPLETED
  ICE628I 0 RECORD COUNT: 000000000000007
  ICE631I 0 NUMBER OF VALUES IN RANGE FOR (28,6,PD) : 000000000000003
  ICE602I 0 OPERATION RETURN CODE: 00

* Branches with less than 32 employees
  RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
  ICE627I 0 DFSORT CALL 0005 FOR COPY FROM ALL TO E35 EXIT COMPLETED
  ICE628I 0 RECORD COUNT: 000000000000012
  ICE631I 0 NUMBER OF VALUES IN RANGE FOR (18,4,ZD) : 000000000000008
  ICE602I 0 OPERATION RETURN CODE: 00
```

Looking at the output, you will notice that:

- Message ICE628I gives the count of records processed.
- Message ICE631I gives the count of values in the specified range. There were 3 California branches with profit greater than -1500, but less than +8000, and 8 branches in all with less than 32 employees.
- A return code for each operator is given in message ICE602I.
So far

You have now learned how to count the number of values in a range for a particular field using ICETOOL’s RANGE operator. Next, you will learn about ICETOOL’s DISPLAY operator.

Printing simple reports

Numeric fields are often in a format (binary, fixed-point, or decimal) that is not readable when printed. You can use ICETOOL’s DISPLAY operator to print simple reports showing up to 50 numeric and character fields from an input data set in readable form. The specified fields are printed in a list data set that you define. For numeric fields, appropriate plus (+) and minus (-) signs are printed along with the decimal value of each number.

To print a list data set showing the profit, employees, and city fields for the Colorado branches, write the following DISPLAY operator:

```
DISPLAY FROM(CODASD) LIST(OUT) ON(28,6,PD) ON(18,4,ZD) ON(1,15,CH)
```

The input data set defined by CODASD is the same data set you created earlier (with the SORT operator) for the Colorado branches. LIST specifies the ddname for the list data set you want the fields to be printed in. In this case, OUT is the ddname chosen for the list data set, but you can use any valid 1-8 character ddname you like. Specify the ON fields in the same order in which you want their values to be printed in the list data set.

Because OUT has not been defined previously, you must add a JCL statement for it to the end of the job:

```
//OUT DD SYSOUT=A
```

When this DISPLAY operator is run, the OUT data set looks like this:

```
(28,6,PD)          (18,4,ZD)          (1,15,CH)
+0000000000000002863 +00000000000000032 +00000000000000033 +00000000000000022 +00000000000000019 
Apache          Aspen          Boulder         Denver          Fort Collins      Vail
```

**Note:** The output actually contains ANSI carriage control characters in the first byte of the report, as explained previously in “Creating reports with OUTFIL” on page 88. However, ICETOOL always inserts actual blank lines in your report rather than using the '0' and '-' ANSI carriage control characters to print blank lines. So you do not have to do anything to force blank lines to be displayed when you view an ICETOOL report, as you do for an OUTFIL report. The ANSI carriage control characters are not shown in this section, although they are present in the reports.

If you don’t want ANSI carriage control characters in your output records, you can use DISPLAY’s NOCC operand to suppress them.

The values for profit, employees, and city are printed in separate columns across the page with a header for each column at the top. If more than one page is printed, DISPLAY puts the header at the top of each page. If you do not want the header printed, you can use DISPLAY’s NOHEADER operand to suppress it.
DISPLAY also has two special ON fields you can use:

- **ON(VLEN)** can be used for variable length record data sets to print the length of each record.
- **ON(NUM)** can be used to print a relative record number for each record (starting with 1).

Use the ON(VLEN) or ON(NUM) field just as you would any other ON field.

### Printing tailored reports

The previous tutorial showed you how to print a simple listing of numeric and character fields using the DISPLAY operator. By using additional operands of DISPLAY, you can create list data sets showing character and numeric fields in a variety of tailored report formats. You can specify:

- title strings in up to three title lines (TITLE operands), other title elements for the first title line (DATE, PAGE, and TIME operands) spacing between title elements (TBETWEEN operand), left alignment of title strings instead of center alignment (TLEFT operand) and title lines only on the first page instead of on every page (TFIRST operand)
- one, two or three line field headings (HEADER operand)
- spacing for columns (INDENT, BETWEEN, and STATLEFT operands)
- field formatting (BLANK and PLUS operands), and formatting items for individual ON fields
- statistics (TOTAL, AVERAGE, MAXIMUM, MINIMUM, and COUNT operands)
- lines per page (LINES operand)
- suppression of ANSI carriage control characters (NOCC operand)

Refer to *z/OS DFSORT Application Programming Guide* for complete details on these and other operands you can use with DISPLAY.

To print a report for the Colorado branches showing the city, profit and employee fields with a title line, field headings, totals, averages, minimums, and counts, write the following DISPLAY operator:
* Print a report for the Colorado branches
DISPLAY FROM(CODASD) LIST(RPT) -

DATE TITLE('Colorado Branches Report') PAGE -

HEADER('City') HEADER('Profit') HEADER('Employees') -

ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(5) -

TOTAL('Total') AVERAGE('Average')-

MINIMUM('Lowest') COUNT('Number of cities')

CODASD is the ddname for the previously created Colorado branches data set. RPT is the ddname for the
list data set in which you want the report to be printed.

DATE, TITLE and PAGE indicate the elements to be included in the title line and their placement. Specify
these operands in the same order in which you want them to be printed in the list data set.

Each HEADER indicates a heading to be used for the corresponding field. Specify the ON fields and their
corresponding HEADER strings in the same order in which you want their values to be printed in the list
data set.

BLANK specifies that numeric values are printed with blank for plus sign, - for minus sign and no leading
zeros. BETWEEN specifies the number of spaces between columns (overriding the default of 3). HEADER,
BLANK and BETWEEN change the justification and column width for the fields, and the spacing between
them, to produce a more report-like format.

TOTAL, AVERAGE, MINIMUM, and COUNT cause the indicated statistics to be produced at the end of the
report, identified by the specified strings.

Because RPT has not been defined previously, you must add a JCL statement for it at the end of the job:

//RPT DD SYSOUT=A

When this DISPLAY operator is run, the RPT data set that results looks like:

<table>
<thead>
<tr>
<th>City</th>
<th>Profit</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspen</td>
<td>5200</td>
<td>20</td>
</tr>
<tr>
<td>Boulder</td>
<td>7351</td>
<td>32</td>
</tr>
<tr>
<td>Denver</td>
<td>6288</td>
<td>33</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>-2863</td>
<td>22</td>
</tr>
<tr>
<td>Vail</td>
<td>5027</td>
<td>19</td>
</tr>
</tbody>
</table>
The title line and heading line are printed at the top of each page. The character data is left-justified and the numeric data is right-justified with zeros suppressed. The statistics are printed after the columns of data.

**Using formatting items**

The previous tutorial used the BLANK operand to change the way all numeric values in the report are displayed. You can use formatting items to change the appearance of individual numeric fields and their related statistics in the report, with respect to separators, number of digits, decimal point, decimal places, signs, leading zeros, division, leading strings, floating strings, and trailing strings. Formatting items can also be used to insert leading strings or trailing strings for character fields.

Formatting items are written as part of the ON operand, separated by commas, as follows: ON(p,m,f,formatting), ON(VLEN,formatting) and ON(NUM,formatting). EDCOUNT(formatting) can be used to specify formatting items for the count.

**Edit masks**

You can select from thirty-three pre-defined edit masks. The following table describes the available masks and shows how the values 12345678 and -1234567 would be printed for each mask. In the pattern:

- **d** is used to represent a decimal digit (0-9)
- **w** is used to represent a leading sign that will be blank for a positive value or - for a negative value
- **x** is used to represent a trailing sign that will be blank for a positive value or - for a negative value
- **y** is used to represent a leading sign that will be blank for a positive value or ( for a negative value
- **z** is used to represent a trailing sign that will be blank for a positive value or ) for a negative value

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>12345678</th>
<th>-1234567</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>wddddddddddddddddddddddddddd</td>
<td>12345678</td>
<td>-1234567</td>
</tr>
<tr>
<td>A1</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>-1,234,567</td>
</tr>
<tr>
<td>A2</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12.345,678</td>
<td>-1.234,567</td>
</tr>
<tr>
<td>A3</td>
<td>wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd</td>
<td>12'345'678</td>
<td>-1'234'567</td>
</tr>
<tr>
<td>A4</td>
<td>d ddd ddd ddd ddd ddd ddd ddd ddd ddd</td>
<td>12 345 678</td>
<td>-1 234 567</td>
</tr>
<tr>
<td>A5</td>
<td>wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>1,234,567.8</td>
<td>-123,456.7</td>
</tr>
<tr>
<td>B1</td>
<td>wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>1234 567.8</td>
<td>-1234 567.7</td>
</tr>
<tr>
<td>B2</td>
<td>wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>1 234 567.8</td>
<td>-123 456.7</td>
</tr>
<tr>
<td>B3</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd</td>
<td>1 234 567.8</td>
<td>-123 456.7</td>
</tr>
<tr>
<td>B4</td>
<td>wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd</td>
<td>1'234'567.8</td>
<td>-123'456.7</td>
</tr>
<tr>
<td>B5</td>
<td>wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd</td>
<td>1'234'567.8</td>
<td>-123'456.7</td>
</tr>
<tr>
<td>B6</td>
<td>ddd ddd ddd ddd ddd ddd ddd ddd ddd,ddd,ddd</td>
<td>1 234 567.8</td>
<td>123 456.7</td>
</tr>
<tr>
<td>C1</td>
<td>wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>123,456.78</td>
<td>-12,345.67</td>
</tr>
</tbody>
</table>
### Table 70. Edit Mask Patterns (continued)

<table>
<thead>
<tr>
<th>Mask</th>
<th>Pattern</th>
<th>12345678</th>
<th>-1234567</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>wdd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.dd</td>
<td>123.456,78</td>
<td>-12.345,67</td>
</tr>
<tr>
<td>C3</td>
<td>wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd,dd</td>
<td>123 456,78</td>
<td>-12 345,67</td>
</tr>
<tr>
<td>C4</td>
<td>wdd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd.dd</td>
<td>123'456,78</td>
<td>-12'345,67</td>
</tr>
<tr>
<td>C5</td>
<td>wdd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd.dd</td>
<td>123 456,78</td>
<td>-12 345,67</td>
</tr>
<tr>
<td>C6</td>
<td>dd ddd ddd ddd ddd d d d d d d d d d d d d,dd</td>
<td>123 456,78</td>
<td>123 456,78</td>
</tr>
<tr>
<td>D1</td>
<td>wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd</td>
<td>12,345,678</td>
<td>(1,234,567)</td>
</tr>
<tr>
<td>D2</td>
<td>wd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,ddd</td>
<td>12.345,678</td>
<td>(1.234,567)</td>
</tr>
<tr>
<td>D3</td>
<td>wd ddd ddd ddd ddd ddd ddd ddd ddd ddd,ddd</td>
<td>12 345,678</td>
<td>(1 234,567)</td>
</tr>
<tr>
<td>D4</td>
<td>wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd.dd</td>
<td>12'345,678</td>
<td>(12'345,67)</td>
</tr>
<tr>
<td>D5</td>
<td>wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddd</td>
<td>12'345,678</td>
<td>(12'345,67)</td>
</tr>
<tr>
<td>D6</td>
<td>d d d d d d d d d d d d d d d d d,dddx</td>
<td>123 456,78</td>
<td>123 456,78</td>
</tr>
<tr>
<td>E1</td>
<td>yd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,dddz</td>
<td>12,345,678</td>
<td>(1,234,567)</td>
</tr>
<tr>
<td>E2</td>
<td>yd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,ddz</td>
<td>12.345,678</td>
<td>(1.234,567)</td>
</tr>
<tr>
<td>E3</td>
<td>yd ddd ddd ddd ddd ddd ddd ddd ddd ddd,ddz</td>
<td>123 456,78</td>
<td>(123 456,78)</td>
</tr>
<tr>
<td>E4</td>
<td>yd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'dddz</td>
<td>12'345,678</td>
<td>(1'234,567)</td>
</tr>
<tr>
<td>F1</td>
<td>ydd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddzz</td>
<td>12,345,678</td>
<td>(12,345,67)</td>
</tr>
<tr>
<td>F2</td>
<td>ydd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,ddzz</td>
<td>12.345,678</td>
<td>(12.345,67)</td>
</tr>
<tr>
<td>F3</td>
<td>ydd ddd ddd ddd ddd ddd ddd ddd ddd ddd,ddzz</td>
<td>123 456,78</td>
<td>(123 456,78)</td>
</tr>
<tr>
<td>F4</td>
<td>ydd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'dddzz</td>
<td>123'456,78</td>
<td>(123'456,78)</td>
</tr>
<tr>
<td>F5</td>
<td>ydd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddzz</td>
<td>123'456,78</td>
<td>(123'456,78)</td>
</tr>
<tr>
<td>G1</td>
<td>wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddddd</td>
<td>1,234,5678</td>
<td>-123 456,78</td>
</tr>
<tr>
<td>G2</td>
<td>wddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,ddddd</td>
<td>1,234,5678</td>
<td>-123 456,78</td>
</tr>
<tr>
<td>G3</td>
<td>wddd ddd ddd ddd ddd ddd ddd ddd ddd dddd</td>
<td>1,234,5678</td>
<td>-123 456,78</td>
</tr>
<tr>
<td>G4</td>
<td>wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddddd</td>
<td>1'234,5678</td>
<td>-123 456,78</td>
</tr>
<tr>
<td>G5</td>
<td>wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddddd</td>
<td>1'234,5678</td>
<td>-123 456,78</td>
</tr>
<tr>
<td>G6</td>
<td>d d d d d d d d d d d d d d d d d,dddx</td>
<td>123,456,78</td>
<td>123,456,78</td>
</tr>
</tbody>
</table>

To use the E1 edit mask for the Profit field in the previous report, just change ON(28,6,PD) to ON(28,6,PD,E1). The RPT data set looks like this:

```
07/22/08      Colorado Branches Report      - 1 -
City          Profit     Employees
---------------     ---------------------     ----------------
Aspen          5,200     20
Boulder        7,351     32
Denver         6,288     33
Fort Collins (2,863) 22
Vail           5,027     19
Total          21,003    126
Average        4,200     25
```
Number of digits

The default number of digits for a numeric field varies according to the type of field or statistic. You can change the number of digits for a numeric field by adding Udd to your formatting items where dd is the number of digits you want. To use 5 digits for the count value in the report, instead of the default of 15 digits, just add EDCOUNT(U05). The RPT data set looks like this:

07/22/08        Colorado Branches Report        - 1 -
City                               Profit            Employees
---------------     ---------------------     ----------------
Aspen                              5,200                    20
Boulder                            7,351                    32
Denver                             6,288                    33
Fort Collins                      (2,863)                   22
Vail                               5,027                    19
Total                             21,003                   126
Average                           4,200                    25
Lowest                            (2,863)                   19
Number of cities       5

Leading zeros

By default, leading zeros are not displayed when you use an edit mask, but you can change that by adding LZ to your formatting items as in the second ON field, as follows:

HEADER('No leading zeros','(without LZ)') ON(28,6,PD,E1) -
HEADER('Leading zeros','(with LZ)') ON(28,6,PD,E1,LZ)

The resulting report shows the difference in the way the Profit values from SORT.BRANCH are displayed with the E1 edit mask and without and with LZ. Note the use of HEADER('string1','string2') to produce a two line heading.

<table>
<thead>
<tr>
<th>No leading zeros (without LZ)</th>
<th>Leading zeros (with LZ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,832</td>
<td>00,000,006,832</td>
</tr>
<tr>
<td>(2,863)</td>
<td>00,000,002,863</td>
</tr>
<tr>
<td>8,276</td>
<td>00,000,008,276</td>
</tr>
<tr>
<td>(978)</td>
<td>00,000,000,978</td>
</tr>
<tr>
<td>6,288</td>
<td>00,000,006,288</td>
</tr>
<tr>
<td>7,351</td>
<td>00,000,007,351</td>
</tr>
<tr>
<td>3,271</td>
<td>00,000,003,271</td>
</tr>
<tr>
<td>5,027</td>
<td>00,000,005,027</td>
</tr>
<tr>
<td>8,264</td>
<td>00,000,008,264</td>
</tr>
<tr>
<td>8,275</td>
<td>00,000,008,275</td>
</tr>
<tr>
<td>5,208</td>
<td>00,000,005,200</td>
</tr>
</tbody>
</table>

Edit patterns

The edit masks are not particularly useful for unsigned numeric data such as telephone numbers, dates, time-of-day, identification numbers, and so on. Instead, you can use edit patterns to change the way these types of numeric values are displayed in your report. E'pattern' is used to specify an edit pattern. You use a 9 in the pattern where you want a digit (0-9) from the numeric value to appear, and any other characters anywhere you want them to appear.

If you have an 8-byte ZD date in the form mmddyyyy in positions 21-28, you can display it as mm/dd/yyyy using ON(21,8,ZD,E'99/99/9999'). An 8-byte value of 03122004 is displayed as 03/12/2004.
If you have a 10-byte ZD telephone number in the form aaapppnnnn in positions 31-40, you can display it as (aaa)-ppp-nnnn using ON(31,10,ZD, E'(999)-999-9999'). A 10-byte value of 0123456789 is displayed as (012)-345-6789.

No statistics

By default, any statistics you request using TOTAL, MAXIMUM, MINIMUM, and AVERAGE (as well as BTOTAL, BMINIMUM, BMAXIMUM and BVERAGE, which you will learn about later) are displayed for every numeric ON field. You can use the NOST formatting item to suppress statistics for numeric fields, such as telephone numbers, for which they are meaningless. The following DISPLAY operator prints a report from the SORT.BRANCH data set with totals for the Revenue and Profit fields, but not for the Employees field.

```
DISPLAY FROM(IN) LIST(RPT3) -
  HEADER('City') ON(1,15,CH) -
  HEADER('Employees') ON(18,4,ZD,NOST) -
  HEADER('Revenue') ON(22,6,PD) -
  HEADER('Profit') ON(28,6,PD) -
  TOTAL('Totals')
```

The RPT3 data set looks like this:

```
<table>
<thead>
<tr>
<th>City</th>
<th>Employees</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles</td>
<td>32</td>
<td>22530</td>
<td>-4278</td>
</tr>
<tr>
<td>San Francisco</td>
<td>35</td>
<td>42820</td>
<td>6832</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>22</td>
<td>12300</td>
<td>-2863</td>
</tr>
<tr>
<td>Sacramento</td>
<td>29</td>
<td>42726</td>
<td>8276</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>18</td>
<td>16152</td>
<td>-978</td>
</tr>
<tr>
<td>Denver</td>
<td>33</td>
<td>31876</td>
<td>6288</td>
</tr>
<tr>
<td>Boulder</td>
<td>32</td>
<td>33866</td>
<td>7351</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>15</td>
<td>18200</td>
<td>3271</td>
</tr>
<tr>
<td>Vail</td>
<td>19</td>
<td>23202</td>
<td>5627</td>
</tr>
<tr>
<td>San Jose</td>
<td>21</td>
<td>27225</td>
<td>8264</td>
</tr>
<tr>
<td>San Diego</td>
<td>22</td>
<td>32940</td>
<td>8275</td>
</tr>
<tr>
<td>Aspen</td>
<td>20</td>
<td>25800</td>
<td>5290</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>329637</td>
<td>50665</td>
</tr>
</tbody>
</table>
```

Division

You can select from ten division items as follows:

- /D - divide by 10
- /C - divide by 100
- /K - divide by 1000
- /DK - divide by 10000 (10*1000)
- /CK - divide by 100000 (100*1000)
- /M - divide by 1000000 (1000*1000)
- /G - divide by 100000000 (1000*1000*1000)
- /MB - divide by 1024
- /KB - divide by 1048576 (1024*1024)
- /GB - divide by 1073741824 (1024*1024*1024)

The Profit values from SORT.BRANCH look as follows with HEADER('Profit/(Loss) in K$') and ON(28,6,PD,E1,/K):

```
<table>
<thead>
<tr>
<th>Profit/(Loss) in K$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4)</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>(2)</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>(6)</td>
</tr>
</tbody>
</table>
```

Chapter 12. Using the ICETOOL utility 141
Leading, floating and trailing characters

You can add floating characters to your numeric fields and add leading and trailing characters to your numeric and character fields as follows:

- **F'string** - a floating string to appear to the left of the first non-blank character of the formatted numeric data.
- **L'string** - a leading string to appear at the beginning of the character or numeric data column.
- **T'string** - a trailing string to appear at the end of the character or numeric data column.

The Profit values from SORT.BRANCH look as follows with HEADER('Profit') and ON(28,6,PD,A1,F'$',T'**'):

<table>
<thead>
<tr>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-4,278**</td>
</tr>
<tr>
<td>$6,832**</td>
</tr>
<tr>
<td>$-2,863**</td>
</tr>
<tr>
<td>$8,276**</td>
</tr>
<tr>
<td>$-978**</td>
</tr>
<tr>
<td>$6,288**</td>
</tr>
<tr>
<td>$7,351**</td>
</tr>
<tr>
<td>$3,271**</td>
</tr>
<tr>
<td>$5,927**</td>
</tr>
<tr>
<td>$8,264**</td>
</tr>
<tr>
<td>$8,275**</td>
</tr>
<tr>
<td>$5,200**</td>
</tr>
</tbody>
</table>

Printing sectioned reports

The previous tutorial showed you how to print tailored reports using the DISPLAY operator. By using the BREAK operand of DISPLAY, you can create reports divided into sections by a character or numeric break field on which you have previously sorted. You can use formatting items with BREAK(p,m,f,formatting) in the same way you can use them with ON(p,m,f,formatting). You can also specify a string for the break title (BTITLE operand) and statistics for the individual sections (BTOTAL, BAVEGAGE, BMAXIMUM, BMINIMUM and BCOUNT operands). EDBCOUNT(formatting) can be used to specify formatting items for BCOUNT.

For this example, we will use the data set with books from publishers VALD and WETH, sorted by publisher and title, that we created previously. To print a report with sections by publisher showing the title and price fields with a title line, field headings, break title, break averages and totals, and overall
averages and totals, write the following DISPLAY operator:

* Print a report of books for individual publishers

\[
\text{DISPLAY FROM(DAPUBS) LIST(SECTIONS) -} \\
\text{TITLE('BOOKS FOR INDIVIDUAL PUBLISHERS') PAGE -} \\
\text{HEADER('TITLE OF BOOK') ON(1,35,CH) -} \\
\text{HEADER('PRICE OF BOOK') ON(170,4,BL,C1,F'$') -} \\
\text{BTITLE('PUBLISHER:') BREAK(106,4,CH) -} \\
\text{BAVERAGE('AVERAGE FOR THIS PUBLISHER') -} \\
\text{BTOTAL('TOTAL FOR THIS PUBLISHER') -} \\
\text{AVERAGE('AVERAGE FOR ALL PUBLISHERS') -} \\
\text{TOTAL('TOTAL FOR ALL PUBLISHERS') -} \\
\]

DAPUBS is the ddname for the previously created VALD and WETH data set. SECTIONS is the ddname for the list data set in which you want the report to be printed.

TITLE and PAGE indicate the elements to be included in the title line and their placement.

Each HEADER and ON pair indicate a field to be included in the report and the heading to be used for it.

BTITLE indicates a string to be used for the break title and its placement (before or after the break field).

BREAK indicates the break field to be used to create sections. BAVERAGE and BTOTAL indicate section statistics to be produced at the end of each section.
AVERAGE and TOTAL indicate overall statistics to be produced at the end of the report.

Because SECTIONS has not been defined previously, you must add a JCL statement for it at the end of the job:

```
//SECTIONS DD SYSOUT=A
```

When this DISPLAY operator is run, it produces a three-page report for the SECTIONS data set that looks like this:

```
BOOKS FOR INDIVIDUAL PUBLISHERS        - 1 -
PUBLISHER:  VALD

<table>
<thead>
<tr>
<th>TITLE OF BOOK</th>
<th>PRICE OF BOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>CELLS AND HOW THEY WORK</td>
<td>$24.95</td>
</tr>
<tr>
<td>COMPLETE SPANISH DICTIONARY</td>
<td>$6.50</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>$14.50</td>
</tr>
<tr>
<td>FREUD'S THEORIES</td>
<td>$12.50</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>$23.50</td>
</tr>
<tr>
<td>NOVEL IDEAS</td>
<td>$24.50</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>$15.20</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>$23.50</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>$21.99</td>
</tr>
<tr>
<td>ZEN BUSINESS</td>
<td>$12.00</td>
</tr>
<tr>
<td>AVERAGE FOR THIS PUBLISHER</td>
<td>$17.91</td>
</tr>
<tr>
<td>TOTAL FOR THIS PUBLISHER</td>
<td>$179.14</td>
</tr>
</tbody>
</table>

BOOKS FOR INDIVIDUAL PUBLISHERS        - 2 -
PUBLISHER:  WETH

<table>
<thead>
<tr>
<th>TITLE OF BOOK</th>
<th>PRICE OF BOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTICIPATING THE MARKET</td>
<td>$20.00</td>
</tr>
<tr>
<td>CIVILIZATION SINCE ROME FELL</td>
<td>$13.50</td>
</tr>
<tr>
<td>COMPUTERS: AN INTRODUCTION</td>
<td>$18.99</td>
</tr>
<tr>
<td>EIGHTEENTH CENTURY EUROPE</td>
<td>$17.90</td>
</tr>
<tr>
<td>GUIDE TO COLLEGE LIFE</td>
<td>$20.00</td>
</tr>
<tr>
<td>GUNTHER'S GERMAN DICTIONARY</td>
<td>$10.88</td>
</tr>
<tr>
<td>REBIRTH FROM ITALY</td>
<td>$25.60</td>
</tr>
<tr>
<td>SYSTEM PROGRAMMING</td>
<td>$31.95</td>
</tr>
<tr>
<td>THE INDUSTRIAL REVOLUTION</td>
<td>$7.95</td>
</tr>
<tr>
<td>AVERAGE FOR THIS PUBLISHER</td>
<td>$18.53</td>
</tr>
<tr>
<td>TOTAL FOR THIS PUBLISHER</td>
<td>$166.77</td>
</tr>
</tbody>
</table>

BOOKS FOR INDIVIDUAL PUBLISHERS        - 3 -

<table>
<thead>
<tr>
<th>TITLE OF BOOK</th>
<th>PRICE OF BOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE FOR ALL PUBLISHERS</td>
<td>$18.20</td>
</tr>
<tr>
<td>TOTAL FOR ALL PUBLISHERS</td>
<td>$345.91</td>
</tr>
</tbody>
</table>

So far

You have now learned how to print simple, tailored and sectioned reports using ICETOOL's DISPLAY operator. Next, you will learn about ICETOOL's OCCUR operator.

**Printing how many times fields occur**

You can use ICETOOL's OCCUR operator to print a simple or tailored report showing how many times different ON field values occur, sorted by those ON field values. Values that occur only once are called "non-duplicate" values. Values that occur more than once are called "duplicate" values.
You can list all of the values in the data set, or list different combinations of duplicate and non-duplicate values, using the following operands:

- **ALLDUPS** - only list duplicate values
- **NODUPS** - only list non-duplicate values
- **EQUAL(n)** - only list values that occur n times
- **HIGHER(n)** - only list values that occur more than n times
- **LOWER(n)** - only list values that occur less than n times

Setting up an OCCUR report is similar to setting up a DISPLAY report. Specify ON fields for OCCUR in the same order you want their values to be printed in the list data set. OCCUR also has two special ON fields you can use:

- **ON(VALCNT)** can be used to print the number of times each field value occurs.
- **ON(VLEN)** can be used for the record length of variable length records.

You can use up to 10 ON fields; all of the ON field values, except ON(VALCNT) and ON(VLEN), are used for sorting and counting occurrences. For example, if you use ON(1,4,CH), 'ABCD+01' and 'ABCD-01' are sorted in that order (by 1,4,CH) and counted as two occurrences of 'ABCD'. However, if you use ON(1,4,CH) and ON(5,3,FS), 'ABCD-01' is sorted before 'ABCD+01' (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of 'ABCD-01' and one occurrence of 'ABCD+01'.

You can use the following for an OCCUR report in the same way you use them for a DISPLAY report:

- title strings in up to three title lines (TITLE operands), other title elements for the first title line (DATE, PAGE, and TIME operands), spacing between title elements (TBETWEEN operand), left alignment of title strings instead of center alignment (TLEFT operand) and title lines only on the first page instead of on every page (TFIRST operand).
- field headings (HEADER operand)
- spacing for columns (INDENT and BETWEEN operands)
- field formatting (BLANK and PLUS operands), and formatting items for individual ON fields as follows: ON(p,m,f,formatting), ON(VALCNT,formatting) and ON(VLEN,formatting)
- lines per page (LINES operand)
- Suppression of ANSI carriage control characters (NOCC operand)

Refer to *z/OS DFSORT Application Programming Guide* for complete details about these and other operands you can use with OCCUR.

For this example, we will use the sample bookstore data set as input. To print a report showing the number of different books in use from each publisher, write the following OCCUR statement:
* Print the count of books in use from each publisher

**OCCUR** FROM(BKIN) LIST(PUBCT) BLANK -

- Alternate print format
- ddnames of data sets

**TITLE('Books from Publishers') DATE(DMY.)** -

- Title line elements

**HEADER('Publisher') HEADER('Books Used')** -

- Field headings

**ON(106,4,CH) ON(VA**LC**N**T,N05)**

- Publisher and Count

BKin is the ddname for the sample bookstore data set. PUBCT is the ddname for the list data set in which you want the report to be printed. BLANK specifies the field format to be used.

**TITLE** indicates the title string to appear in the title line. **DATE** indicates the format in which the date is to appear in the title line (dd.mm.yy where dd is the two-digit day, mm is the two-digit month and yy is the last two digits of the year).

The **HEADER** strings correspond to the **ON** fields. **ON(VA**LC**N**T,N05)** is a special **ON** field used with **OCCUR** to print the count of occurrences. N05 is a formatting item used to set the number of digits for the count to 5, overriding the default of 15 digits for VA**LC**N**T**.

Write DD statements for the A123456.SORT.SAMPIN and PUBCT data sets and place them at the end of the job:

```plaintext
//BKIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//PUBCT DD SYSOUT=A
```

When this **OCCUR** operator is run, the PUBCT data set looks like this:

<table>
<thead>
<tr>
<th>Books from Publishers</th>
<th>21.10.03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publisher</td>
<td>Books Used</td>
</tr>
<tr>
<td>COR</td>
<td>7</td>
</tr>
<tr>
<td>FERN</td>
<td>4</td>
</tr>
<tr>
<td>VALD</td>
<td>5</td>
</tr>
<tr>
<td>WETH</td>
<td>4</td>
</tr>
</tbody>
</table>

The name of each publisher is printed along with the number of times that publisher appeared in the sample bookstore data set, which is equivalent to the number of different books from that publisher.

**So far**

You have now learned how use ICETOOL’s **OCCUR** operator to print a simple or tailored report showing how many times different field values occur. Next, you will learn how to use ICETOOL's **SELECT** operator.
Selecting records by field occurrences

You can use ICETOOL’s SELECT operator to create an output data set with records selected according to how many times different ON field values occur, sorted by those ON field values. As with the OCCUR operator, values that occur only once are called non-duplicate values, and values that occur more than once are called duplicate values.

You can use up to 10 ON fields; all of the ON field values are used for sorting and counting occurrences. For example, if you use ON(1,4,CH), ‘ABCD+01’ and ‘ABCD-01’ are sorted in that order (by 1,4,CH,A) and counted two occurrences of ‘ABCD’. However, if you use ON(1,4,CH) and ON(5,3,FS), ‘ABCD-01’ is sorted before ‘ABCD+01’ (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of ‘ABCD-01’ and one occurrence of ‘ABCD+01’.

You can select different combinations of records with duplicate and non-duplicate values using the following operands:

- **FIRST** - keep only the first record for each value (that is, records with non-duplicate values, and the first record for duplicate values)
- **FIRST(n)** - keep only the first n records for each value (that is, records with non-duplicate values, and the first n records for duplicate values)
- **LAST** - keep only the last record for each value (that is, records with non-duplicate values, and the last record for duplicate values)
- **FIRSTDUP** - only keep the first record for duplicate values
- **FIRSTDUP(n)** - only keep the first n records for duplicate values
- **LASTDUP** - only keep the last record for duplicate values
- **ALLDUPS** - only keep records with duplicate values
- **NODUPS** - only keep records with non-duplicate values
- **EQUAL(n)** - only keep records with values that occur n times
- **HIGHER(n)** - only keep records with values that occur more than n times
- **LOWER(n)** - only keep records with values that occur less than n times

The selected records are written to the output data set identified by the TO operand. If appropriate, you can use the DISCARD operand with any of the other operands shown previously to save the records that are not selected in a separate output data set identified by the DISCARD operand. You can create just the TO data set, just the DISCARD data set, or both.

You can use a USING data set to specify DFSORT INCLUDE, OMIT, INREC, and OUTFIL statements for your SELECT operation. INCLUDE or OMIT and INREC statement processing is performed before SELECT processing. OUTFIL statement processing is performed after SELECT processing.

To create an output data set containing records for publishers with more than four different books in use, write the following SELECT statement:

```
SELECT FROM(BKIN) TO(BKOUT) ON(106,4,CH) HIGHER(4)
```

* Separate output containing records for publishers
* with more than 4 books in use
BKIN is the ddname for the sample bookstore data set. BKOUT is the ddname of the output data set that will contain the records for each publisher field value that occurs more than 4 times (all of the records for COR and VALD in this case).

Write a DD statement for the A123456.BOOKS1 data sets and place it at the end of the job:

```
//BKOUT DD DSN=A123456.BOOKS1,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(3,3)),UNIT=3390
```

Table 71 on page 148 shows the Book Title and Publisher fields for the records in the resulting output data set. The actual records contain all of the fields.

Table 71. Books from Publishers with More than Four Books in Use

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIVING WELL ON A SMALL BUDGET</td>
<td>COR</td>
</tr>
<tr>
<td>SUPPLYING THE DEMAND</td>
<td>COR</td>
</tr>
<tr>
<td>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</td>
<td>COR</td>
</tr>
<tr>
<td>PICK'S POCKET DICTIONARY</td>
<td>COR</td>
</tr>
<tr>
<td>MODERN ANTHOLOGY OF WOMEN POETS</td>
<td>COR</td>
</tr>
<tr>
<td>INTRODUCTION TO PSYCHOLOGY</td>
<td>COR</td>
</tr>
<tr>
<td>CRISSES OF THE MIDDLE AGES</td>
<td>COR</td>
</tr>
<tr>
<td>VIDEO GAME DESIGN</td>
<td>VALD</td>
</tr>
<tr>
<td>EDITING SOFTWARE MANUALS</td>
<td>VALD</td>
</tr>
<tr>
<td>STRATEGIC MARKETING</td>
<td>VALD</td>
</tr>
<tr>
<td>SHORT STORIES AND TALL TALES</td>
<td>VALD</td>
</tr>
<tr>
<td>INTRODUCTION TO BIOLOGY</td>
<td>VALD</td>
</tr>
</tbody>
</table>

To create separate output data sets containing records with only the course name and author’s last name, both for courses that use more than one book, and for courses that use only one book, write the following SELECT statement:

```
* Course name and author’s last name for courses with more than one book
* and only one book
SELECT FROM(BKIN) TO(DUP) DISCARD(NODUP)

ON(120,25,CH) ALLDUPS USING(CTL1)
```

BKIN is the ddname for the sample bookstore data set. DUP is the ddname of the output data set to contain the records for courses with more than one book. NODUP is the ddname of the output data set to contain the records for courses with only one book.

Here is the complete JCL for the job, including control statements:

```
//SEL2 JOB A492,PROGRAMMER
//EXTRACT EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*
//DFSMSG DD SYSOUT=*
```
The OMIT statement removes records with a blank course name before SELECT processing. The OUTFIL statement for DUP reformatsthe selected records for courses with more than one book to have just the course name and author's last name. The OUTFIL statement for NODUP reformatsthe selected records for courses with only one book to have just the course name and author's last name.

Here are the DUP records exactly as they would appear:

<table>
<thead>
<tr>
<th>Course</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
</tr>
<tr>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
</tr>
<tr>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
</tr>
<tr>
<td>MODERN POETRY</td>
<td>FRIEDMAN</td>
</tr>
<tr>
<td>MODERN POETRY</td>
<td>FRIEDMAN</td>
</tr>
<tr>
<td>WORLD HISTORY</td>
<td>GOODGOLD</td>
</tr>
<tr>
<td>WORLD HISTORY</td>
<td>WILLERTON</td>
</tr>
</tbody>
</table>

Here are the NODUP records exactly as they would appear:

<table>
<thead>
<tr>
<th>Course</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCED MARKETING</td>
<td>LORCH</td>
</tr>
<tr>
<td>BIOLOGY I</td>
<td>GREENBERG</td>
</tr>
<tr>
<td>DATA MANAGEMENT</td>
<td>SMITH</td>
</tr>
<tr>
<td>EUROPEAN HISTORY</td>
<td>BISCARDI</td>
</tr>
<tr>
<td>FICTION WRITING</td>
<td>BUCK</td>
</tr>
<tr>
<td>MARKETING</td>
<td>MAXWELL</td>
</tr>
<tr>
<td>PSYCHOANALYSIS</td>
<td>NAKATSU</td>
</tr>
<tr>
<td>PSYCHOLOGY I</td>
<td>ZABOSKI</td>
</tr>
<tr>
<td>TECHNICAL EDITING</td>
<td>MADRID</td>
</tr>
<tr>
<td>TECHNICAL EDITING</td>
<td>MADRID</td>
</tr>
<tr>
<td>VIDEO GAMES</td>
<td>NEUMANN</td>
</tr>
</tbody>
</table>

Note that "TECHNICAL EDITING" and "TECHINCAL EDITING" are both included in the NODUP data set because they are different ("TECHINCAL" is spelled incorrectly).

Suppose you want to use the SORT.BRANCH data set to display the three branches in each state with the highest number of employees. Write the following ICETOOL statement:

```
SELECT FROM(BRANCH) TO(HIGH3) ON(16,2,CH) FIRST(3) USING(HIGH)
```

Include the following DFSORT statements in HIGHCNTL:

```
SORT FIELDS=(16,2,CH,A,18,4,ZD,D)
OUTFIL FNAMES=BRANCH,
    BUILD=(16,2,2X,18,4,ZD,EDIT=(IIT))
```

The SORT statement orders the records ascending by state and descending by number of employees. This brings the records for each state with the highest number of employees to the top. The intermediate result would be:

<table>
<thead>
<tr>
<th>State</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>35</td>
</tr>
<tr>
<td>CA</td>
<td>32</td>
</tr>
<tr>
<td>CA</td>
<td>29</td>
</tr>
<tr>
<td>CA</td>
<td>22</td>
</tr>
<tr>
<td>CA</td>
<td>21</td>
</tr>
<tr>
<td>CA</td>
<td>18</td>
</tr>
<tr>
<td>CA</td>
<td>15</td>
</tr>
<tr>
<td>CO</td>
<td>33</td>
</tr>
<tr>
<td>CO</td>
<td>32</td>
</tr>
<tr>
<td>CO</td>
<td>22</td>
</tr>
</tbody>
</table>
The FIRST(3) operand tells SELECT to keep the first 3 records for each ON field (the state). Finally, the OUTFIL statement extracts the state and employees values from the selected records. The output records would look like this:

<table>
<thead>
<tr>
<th>State</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA</td>
<td>35</td>
</tr>
<tr>
<td>CA</td>
<td>32</td>
</tr>
<tr>
<td>CA</td>
<td>29</td>
</tr>
<tr>
<td>CO</td>
<td>33</td>
</tr>
<tr>
<td>CO</td>
<td>32</td>
</tr>
<tr>
<td>CO</td>
<td>22</td>
</tr>
</tbody>
</table>

So far in this chapter you have learned how to print statistics for numeric fields, create sorted and unsorted data sets, obtain a count of numeric fields in a range for a particular field, print fields from an input data set, print reports, print a count of field occurrences and select output records based on field occurrences. Next, you will learn how to use ICETOOL's SPLICE operator.

## Joining fields from different data sets

You can use ICETOOL's SPLICE operator to create output records in a variety of ways by splicing together up to 50 fields from records that have the same ON field values, but different information. The output records are sorted by the ON field values. The records to be spliced can originate from different input data sets, making it possible to perform various "join" and "match" operations.

You can use up to 10 ON fields; all of the ON field values are used for sorting and splicing. For example, if you use ON(1,4,CH), 'ABCD+01' and 'ABCD-01' are sorted in that order (by 1,4,CH,A) and counted as two occurrences of 'ABCD'. However, if you use ON(1,4,CH) and ON(5,3,FS), 'ABCD-01' is sorted before 'ABCD+01' (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of 'ABCD-01' and one occurrence of 'ABCD+01'.

To do a join or match operation on two input data sets, you need to have the fields aligned appropriately for each pair of records to be spliced. Typically, you accomplish that by copying and reformattting one or both input data sets to temporary data sets, so you can splice the temporary data sets together.

Suppose you have two input data sets, REGION.IN1 and REGION.IN2, as shown in Table 72 on page 150 and Table 73 on page 150.

### Table 72. REGION.IN1 data set for join

<table>
<thead>
<tr>
<th>Region</th>
<th>Headquarters</th>
<th>Regional Director</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6 20</td>
</tr>
<tr>
<td>East</td>
<td>Philadelphia</td>
<td>C. Kent</td>
</tr>
<tr>
<td>West</td>
<td>San Jose</td>
<td>B. Wayne</td>
</tr>
<tr>
<td>North</td>
<td>Boston</td>
<td>P. Parker</td>
</tr>
<tr>
<td>South</td>
<td>Charlotte</td>
<td>D. Prince</td>
</tr>
</tbody>
</table>

### Table 73. REGION.IN2 data set for join

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>5 9</td>
<td>10 13</td>
<td>14 23</td>
<td>24 27</td>
</tr>
</tbody>
</table>
Table 73. REGION.IN2 data set for join (continued)

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>East</td>
<td>0050</td>
<td>Fair</td>
<td>1983</td>
</tr>
<tr>
<td>0001</td>
<td>South</td>
<td>0023</td>
<td>Good</td>
<td>1976</td>
</tr>
<tr>
<td>0002</td>
<td>South</td>
<td>0068</td>
<td>Fair</td>
<td>1978</td>
</tr>
<tr>
<td>0002</td>
<td>East</td>
<td>0125</td>
<td>Excellent</td>
<td>1986</td>
</tr>
<tr>
<td>0001</td>
<td>West</td>
<td>0052</td>
<td>Good</td>
<td>1995</td>
</tr>
<tr>
<td>0003</td>
<td>East</td>
<td>0028</td>
<td>Good</td>
<td>1994</td>
</tr>
<tr>
<td>0002</td>
<td>West</td>
<td>0105</td>
<td>Excellent</td>
<td>2001</td>
</tr>
<tr>
<td>0003</td>
<td>South</td>
<td>0054</td>
<td>Fair</td>
<td>1992</td>
</tr>
<tr>
<td>0001</td>
<td>North</td>
<td>0200</td>
<td>Fair</td>
<td>1991</td>
</tr>
<tr>
<td>0004</td>
<td>South</td>
<td>0070</td>
<td>Good</td>
<td>2002</td>
</tr>
</tbody>
</table>

From these two input data sets, you want to create an output data set, REGION.OUT. For each record in REGION.IN2, you want to look up the corresponding Region in REGION.IN1, and combine fields from the two records into one output record in REGION.OUT, as shown in Table 74 on page 151.

Table 74. REGION.OUT data set for join

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Regional Director</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>24</td>
<td>25 28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Regional Director</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001</td>
<td>East</td>
<td>C. Kent</td>
<td>0050</td>
<td>Fair</td>
<td>Philadelphia</td>
</tr>
<tr>
<td>0002</td>
<td>East</td>
<td>C. Kent</td>
<td>0125</td>
<td>Excellent</td>
<td>Philadelphia</td>
</tr>
<tr>
<td>0003</td>
<td>East</td>
<td>C. Kent</td>
<td>0028</td>
<td>Good</td>
<td>Philadelphia</td>
</tr>
<tr>
<td>0001</td>
<td>North</td>
<td>P. Parker</td>
<td>0200</td>
<td>Fair</td>
<td>Boston</td>
</tr>
<tr>
<td>0001</td>
<td>South</td>
<td>D. Prince</td>
<td>0023</td>
<td>Good</td>
<td>Charlotte</td>
</tr>
<tr>
<td>0002</td>
<td>South</td>
<td>D. Prince</td>
<td>0068</td>
<td>Fair</td>
<td>Charlotte</td>
</tr>
<tr>
<td>0003</td>
<td>South</td>
<td>D. Prince</td>
<td>0054</td>
<td>Fair</td>
<td>Charlotte</td>
</tr>
<tr>
<td>0004</td>
<td>South</td>
<td>D. Prince</td>
<td>0070</td>
<td>Good</td>
<td>Charlotte</td>
</tr>
<tr>
<td>0001</td>
<td>West</td>
<td>B. Wayne</td>
<td>0052</td>
<td>Good</td>
<td>San Jose</td>
</tr>
<tr>
<td>0002</td>
<td>West</td>
<td>B. Wayne</td>
<td>0105</td>
<td>Excellent</td>
<td>San Jose</td>
</tr>
</tbody>
</table>

Write the following ICETOOL statements and JCL statements to create REGION.OUT from REGION.IN1 and REGION.IN2:

```plaintext
* Reformat REGION.IN1 to T1 so it can be spliced
COPY FROM(REGNIN1) TO(T1) USING(CTL1)
* Reformat REGION.IN2 to T1 so it can be spliced
COPY FROM(REGNIN2) TO(T1) USING(CTL2)
* Splice records in T1 with matching ON fields
SPlice FROM(T1) WITHALL -
  ON(5,5,CH) - Region
  WITH(1,4) - Office
  WITH(25,4) - Employees
  WITH(29,10) - Evaluation
TO(REGNOUT)
/*
//REGNIN1 DD DSN=A123456.REGION.IN1,DISP=SHR
//REGNIN2 DD DSN=A123456.REGION.IN2,DISP=SHR
//T1 DD DSN=66&T1,UNIT=3390,SPACE=(CYL,(5,5)),DISP=(MOD,PASS)
//REGNOUT DD DSN=A123456.REGION.OUT,DISP=(NEW,CATLG,DELETE),UNIT=3390,
// SPACE=(CYL,(5,5))
//CTL1CNTL DD *
* Move REGION.IN1 fields to their locations for the
* output data set
OUTREC FIELDS=(5:1,5, Region
  10:21,15, Regional Director
  39:6,15) Headquarters
/*
//CTL2CNTL DD *
* Move REGION.IN2 fields to their locations for the
* output data set
OUTREC FIELDS=(1:1,4, Office
  5:5,5, Region
  25:18,4, Employees
```

Chapter 12. Using the ICETOOL utility 151
The first COPY operator writes records to temporary data set T1 with the fields from REGION.IN1 as shown in Table 75 on page 152.

**Table 75. T1 data set fields from REGION.IN1**

<table>
<thead>
<tr>
<th>Blanks</th>
<th>Region</th>
<th>Regional Director</th>
<th>Blanks</th>
<th>Blanks</th>
<th>Headquarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>5 9</td>
<td>10 24</td>
<td>25 28</td>
<td>29 38</td>
<td>39 53</td>
</tr>
</tbody>
</table>

The second COPY operator writes records at the end (MOD) of temporary data set T1 with the fields from REGION.IN2 as shown in Table 76 on page 152.

**Table 76. T1 data set fields from REGION.IN2**

<table>
<thead>
<tr>
<th>Office</th>
<th>Region</th>
<th>Blanks</th>
<th>Employees</th>
<th>Evaluation</th>
<th>Blanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 4</td>
<td>5 9</td>
<td>10 24</td>
<td>25 28</td>
<td>29 38</td>
<td>39 53</td>
</tr>
</tbody>
</table>

Because the Region field is the ON field you want SPLICE to use to match your records, you must move it to the same location in both types of reformatted records (positions 5-9). You must move all of the other fields that you want in your output records to the locations in which you want them to appear in the combined record. Put blanks in each record for the corresponding fields in the other type of record. For example, the Regional Director field appears in positions 10-24 of the reformatted REGION.IN1 records while blanks appear in the corresponding positions 10-24 of the reformatted REGION.IN2 records, and the Office field appears in positions 1-4 of the reformatted REGION.IN2 records, while blanks appear in the corresponding positions 1-4 of the reformatted REGION.IN1 records.

The FROM(T1) operand tells DFSORT that the input for the SPLICE operation is the T1 data set, which contains the reformatted REGION.IN1 and REGION.IN2 records, in that order. The order of the input records is important, because the first record for each matching ON field acts as the base record on to which the second or subsequent record is spliced.

In this case, all of the reformatted REGION.IN1 records come before all of the reformatted REGION.IN2 records, so the SPLICE operator splices the WITH fields from the reformatted REGION.IN2 records to the reformatted REGION.IN1 record whenever their ON fields match. WITHALL tells SPLICE to splice the first record with every other record for which the ON fields match. Without WITHALL, only the first and last records are spliced.

This is just one example of the many types of join operations you can do with SPLICE, using some of its available operands.

You can also use a USING data set to specify DFSORT INCLUDE, OMIT, INREC, and OUTFIL statements for your SPLICE operation. INCLUDE or OMIT and INREC statement processing is performed before SPLICE processing. OUTFIL statement processing is performed after SPLICE processing.

For complete details of all of the operands you can use with SPLICE, as well as many more examples of join operations, see *z/OS DFSORT Application Programming Guide*.

**Matching records from different data sets**

SPLICE can be used for match operations as well as join operations. Suppose you want to look at the courses in SORT.SAMPIN and SORT.SAMPADD and produce three output data sets as follows:

- COURSE.MATCH to show the courses that appear in both SORT.SAMPIN and SORT.SAMPADD
- COURSE.INONLY to show the courses that appear only in SORT.SAMPIN
- COURSE.ADDONLY to show the courses that appear only in SORT.SAMPADD

The following JCL and ICETOOL statements create these three data sets:
//S1  EXEC PGM=ICETOOL  
//TOOLMSG  DD SYSOUT=*  
//DFSMSG  DD SYSOUT=*  
//F1IN  DD DSN=A123456.SORT.SAMPIN,DISP=SHR  
//F2IN  DD DSN=A123456.SORT.SAMPADD,DISP=SHR  
//F1ONLY DD DSN=&&&T1,DISP=(MOD,PASS),UNIT=SYSDA,SPACE=(CYL,(5,5),RLSE)  
//F2ONLY DD DSN=COURSE.INONLY,DISP=(NEW,CATLG,DELETE),UNIT=3390  
//MATCH DD DSN=COURSE.MATCH,DISP=(NEW,CATLG,DELETE),SPACE=(CYL,(5,5)),UNIT=3390  
//TOOLIN DD *  
* Copy needed File1 fields to T1 and add '11' id  
COPY FROM(F1IN) TO(T1) USING(MATA)  
* Copy needed File2 fields to T1 and add '22' id  
COPY FROM(F2IN) TO(T1) USING(MATB)  
* Splice second id character from overlay to base for  
* matching course numbers. Use resulting spliced or  
* unspliced id to write records to MATCH, F1ONLY  
* or F2ONLY as appropriate.  
SPLICE FROM(T1) TO(MATCH) ON(1,5,CH) -  
WITH(32,1) KEEPNODUPS USING(MATC)  
/*  
//MATACNTL DD *  
* Extract needed File1 fields and add '11' id  
OUTREC FIELDS=(1:115,5, Course number  
6:120,25, Course name  
31:C'11') '11' id for File1 records  
/*  
//MATBCNTL DD *  
* Extract needed File2 fields and add '22' id  
OUTREC FIELDS=(1:115,5, Course number  
6:120,25, Course name  
31:C'22') '22' id for File2 records  
/*  
//MATCCNTL DD *  
* A '12' id indicates a match between File1 and File2.  
* Remove the '12' id and write the records to MATCH.  
OUTFIL FNAMES=MATCH,INCLUDE=(31,2,CH,EQ,C'12'),OUTREC=(1,30)  
* A '11' id indicates a record in File1 only.  
* Remove the '11' id and write the records to F1ONLY.  
OUTFIL FNAMES=F1ONLY,INCLUDE=(31,2,CH,EQ,C'11'),OUTREC=(1,30)  
* A '22' id indicates a record in File2 only.  
* Remove the '22' id and write the records to F2ONLY.  
OUTFIL FNAMES=F2ONLY,INCLUDE=(31,2,CH,EQ,C'22'),OUTREC=(1,30)  
/*

The first COPY operator writes records to temporary data set T1 consisting of the course number and course name fields from SORT.SAMPIN, and an id of '11', as shown in Table 77 on page 153.

Table 77. T1 data set fields from SORT.SAMPIN

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>'11'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

The second COPY operator writes records at the end (MOD) of temporary data set T1 consisting of the course number and course name fields from SORT.SAMPADD, and an id of '22', as shown in Table 78 on page 153.

Table 78. T1 data set fields from SORT.SAMPADD

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>'22'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

The SPLICE operator matches the course numbers (ON field). When a match is found, the second id character is spliced into the base record. Because WITHALL is not specified, only the last record for each match is spliced with the first record for each match. KEEPNODUPS tells DFSORT to keep records that are not spliced. Without KEEPNODUPS, records for course numbers that appear once in one data set, but not

Chapter 12. Using the ICETOOL utility 153
in the other data set, would be deleted instead of being written to COURSE.INONLY or COURSE.ADDONLY.

Here's what happens for all of the possible types of matches and non-matches:

- For a course number that appears one or more times with id '11' and one or more times with id '22', the second '2' from the last '22' record is spliced into the first '11' record to get an id of '12'. Thus, an id of '12' represents a course number that appears in both SORT.SAMPIN and SORT.SAMPADD.

- For a course number that appears only once with id '11' (and not with id '22') the id of '11' is not changed. For a course number that appears more than once with id '11' (and not with id '22') the second '1' from the last '11' record is spliced into the first '11' record to get an id of '11'. Thus, an id of '11' represents a course number that only appears in SORTIN.SAMPIN.

- For a course number that appears only once with an id of '22' (and not with an id of '11') the id of '22' is not changed. For a course number that appears more than once in with an id of '22' (and not with an id of '11') the second '2' from the last '22' record is spliced into the first '22' record to get an id of '22'. Thus, an id of '22' represents a course number that only appears in SORTIN.SAMPADD.

The output created for COURSE.MATCH containing the information for course numbers that appear in both SORT.SAMPIN and SORT.SAMPADD is shown in Table 79 on page 154.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>00103</td>
<td>DATA MANAGEMENT</td>
</tr>
<tr>
<td>00205</td>
<td>VIDEO GAMES</td>
</tr>
<tr>
<td>10054</td>
<td>FICTION WRITING</td>
</tr>
<tr>
<td>30016</td>
<td>PSYCHOLOGY I</td>
</tr>
<tr>
<td>30975</td>
<td>PSYCHOANALYSIS</td>
</tr>
<tr>
<td>50420</td>
<td>WORLD HISTORY</td>
</tr>
<tr>
<td>50521</td>
<td>WORLD HISTORY</td>
</tr>
<tr>
<td>50632</td>
<td>EUROPEAN HISTORY</td>
</tr>
<tr>
<td>70124</td>
<td>ADVANCED MARKETING</td>
</tr>
<tr>
<td>70251</td>
<td>MARKETING</td>
</tr>
</tbody>
</table>

The output created for COURSE.INONLY containing the information for course numbers that appear only in SORT.SAMPIN is shown in Table 80 on page 154.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>00032</td>
<td>INTRO TO COMPUTERS</td>
</tr>
<tr>
<td>10347</td>
<td>TECHNICAL EDITING</td>
</tr>
<tr>
<td>10856</td>
<td>MODERN POETRY</td>
</tr>
<tr>
<td>80521</td>
<td>BIOLOGY I</td>
</tr>
</tbody>
</table>

The output created for COURSE.ADDONLY containing the information for course numbers that appear only in SORT.SAMPADD is shown in Table 81 on page 154.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 5</td>
<td>6 30</td>
</tr>
</tbody>
</table>
### Table 81. COURSE.ADDONLY output (continued)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>70255</td>
<td>BUSINESS THEORY</td>
</tr>
<tr>
<td>80522</td>
<td>BIOLOGY II</td>
</tr>
<tr>
<td>80523</td>
<td>INTRO TO GENETICS</td>
</tr>
</tbody>
</table>

### Sorting records between headers and trailers

You can use ICETOOL’s DATASORT operator to sort the data records in a data set without sorting the header or trailer records. You use the following operands to tell DATASORT the number of header records, trailer records, or header and trailer records in your data set:

- **HEADER** or **FIRST** - the first record is a header record
- **HEADER(x)** or **FIRST(x)** - the first x records are header records
- **TRAILER** or **LAST** - the last record is a trailer record
- **TRAILER(y)** or **LAST(y)** - the last y records are trailer records

DATASORT does not require an “identifier” in the header or trailer records; it can treat the first x records as header records and the last y records as trailer records.

You must specify a USING data set to specify a DFSORT SORT statement that tells DATASORT the fields you want to use to sort your data records. You can use various other DFSORT statements as well; see *z/OS DFSORT Application Programming Guide* for details.

DATASORT sorts the data records between your header records (first x records of the data set) and trailer records (last y records of the data set) while keeping the header and trailer records in place.

Suppose you have input records that look like this:

```
2008/04/23
Geometry
Algebra
Trigonometry
Calculus
0004
End of data set
```

The first record is a header record containing a date, the last two records are trailer records containing a count and an end indicator, respectively, and the records between the header and trailer records are data records containing Subject names. You want to create an output data set with the Subject names sorted but the header and trailer records in their original places. Write the following ICETOOL statement:

```
DATASORT FROM(IN) TO(OUT) HEADER TRAILER(2) USING(CTL1)
```

Include the following DFSORT SORT statement in CTL1CNTL:

```
SORT FIELDS=(1,16,CH,A)
```

The output records would look like this:

```
2008/04/23
Algebra
Geometry
Trigonometry
0004
End of data set
```

For complete details of DATASORT, as well as more examples, see *z/OS DFSORT Application Programming Guide*.  

---

Chapter 12. Using the ICETOOL utility 155
Keeping or removing headers, trailers and relative records

You can use ICETOOL's SUBSET operator to create a subset of the input or output records with or without specific header, trailer or relative records. You use the following operands to tell SUBSET which records you want to keep or remove:

- **KEEP** - keep the specified records
- **REMOVE** - remove the specified records
- **INPUT** - keep or remove input records
- **OUTPUT** - keep or remove output records
- **HEADER** or **FIRST** - keep or remove the first record (header record)
- **HEADER(x)** or **FIRST(x)** - keep or remove the first x records (header records)
- **RRN(u)** - keep or remove relative record u
- **RRN(u,v)** - keep or remove relative records u through v
- **RRN(u,*)** - keep or remove relative records u through the last record
- **TRAILER** or **LAST** - keep or remove the last record (trailer record)
- **TRAILER(y)** or **LAST(y)** - keep or remove the last y records (trailer records)

The records that are selected (that is, kept or not removed) are written to the output data set identified by the TO operand. If appropriate, you can use the DISCARD operand to save the records that are not selected to a separate output data set identified by the DISCARD operand. You can create just the TO data set, just the DISCARD data set, or both.

You can use a USING data set to specify various DFSORT statements with SUBSET; see *z/OS DFSORT Application Programming Guide* for details.

Suppose you have input records that look like this:

```
MASTER03.IN
2008/04/23
Vicky
Frank
Regina
Viet
David
Dave
Carrie
Sam
Sri Hari
Martin
UPDATE03.OUT
```

You want to create an output data set with the the first two input records, the fifth through seventh input records, the eleventh input record, and the last input record. Write the following ICETOOL statement:

```
SUBSET FROM(INPUT) TO(OUTPUT) KEEP INPUT-FIRST(2) RRN(5,7) RRN(11) LAST
```

The output records would look like this:

```
MASTER03.IN
2008/04/23
Regina
Viet
David
Sri Hari
UPDATE03.OUT
```

For complete details of SUBSET, as well as more examples, see *z/OS DFSORT Application Programming Guide*.
Merging previously sorted data sets

You can use DFSORT's MERGE operator to create merged output data sets. A single MERGE operator can be used to merge up to 50 input data sets which were previously sorted by the same fields in the same locations. MERGE can create one output data set or up to 10 identical output data sets. Using INCLUDE or OMIT statements, you can select a subset of the input records. Using INREC or OUTREC statements, you can rearrange the fields of the input records. Using OUTFIL statements, you can create any number of output data sets with different subsets of records or arrangements of fields.

You can use up to 10 FROM operands to specify up to 50 input data sets. You must specify a USING data set to specify a DFSORT MERGE statement that tells MERGE the fields your input data sets are already sorted on. You can use various other DFSORT statements as well; see z/OS DFSORT Application Programming Guide for details.

Suppose you have two input data sets previously sorted by Branch Number as follows:

Input file1

0003 Sacramento
0005 Palo Alto
0008 Morgan Hill

Input file2

0002 Los Angeles
0006 Modesto
0009 San Jose

The following JCL and ICETOOL statements would merge the two input data sets on the Branch Number:

```
//MRG EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=* 
//DFSMSG DD SYSOUT=* 
//IN1 DD DSN=INPUT.FILE1,DISP=SHR 
//IN2 DD DSN=INPUT.FILE2,DISP=SHR 
//OUT DD DSN=OUTPUT.FILE,DISP=(NEW,CATLG,DELETE), 
// UNIT=SYSDA,SPACE=(CYL,(5,5)) 
//TOOLIN DD * 
//MERGE FROM(IN1,IN2) TO(OUT) USING(CTL1) 
/*
//CTL1CNTL DD *
//MERGE FIELDS=(1,4,ZD,A) 
/*
```

The output data set would have these merged records:

0002 Los Angeles
0003 Sacramento
0005 Palo Alto
0006 Modesto
0008 Morgan Hill
0009 San Jose

So far

So far in this chapter you have learned how to print statistics for numeric fields, create sorted and unsorted data sets, obtain a count of numeric fields in a range for a particular field, print fields from an input data set, print reports, print a count of field occurrences, select output records based on field occurrences, join fields from different data sets, match records from different data sets, sort records between headers and trailers, keep or remove headers, trailers or relative records, and merge previously sorted data sets. The last part of this chapter shows the complete main ICETOOL job and its resulting TOOLMSG output.

Complete ICETOOL job and TOOLMSG output

Here is the complete ICETOOL job you created in this chapter:
/* Statistics from all branches 
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD) 
* Books from VALD and WETH 
SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB) 
* Separate output for California and Colorado branches 
SORT FROM(ALL) USING(CACO) 
* California branches profit analysis 
RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000) 
* Branches with less than 32 employees 
RANGE FROM(ALL) ON(18,4,ZD) LOWER(32) 
* Print profit, employees, and city for each Colorado branch 
DISPLAY FROM(CODASD) LIST(OUT) ON(28,6,PD) ON(18,4,ZD) ON(1,15,CH) 
* Print a report for the Colorado branches 
DISPLAY FROM(CODASD) LIST(RPT) - 
DATE TITLE('Colorado Branches Report') PAGE - 
HEADER('City') HEADER('Profit') HEADER('Employees') - 
ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(5) - 
TOTAL('Total') AVERAGE('Average') - 
MINIMUM('Lowest') COUNT('Number of cities') 
* Print a report of books for individual publishers 
DISPLAY FROM(DAPUBS) LIST(SECTIONS) - 
TITLE('Books for Individual Publishers') PAGE - 
HEADER('Title of Book') ON(1,35,CH) - 
HEADER('Price of Book') ON(170,4,BI,C1,F'$') - 
BTITLE('Publisher:') BREAK(106,4,CH) - 
BAVERAGE('Average for This Publisher') - 
BTOTAL('Total for This Publisher') - 
AVERAGE('Average for All Publishers') - 
TOTAL('Total for All Publishers') 
* Print the count of books in use from each publisher 
OCCUR FROM(BKIN) LIST(PUBCT) BLANK - 
TITLE('Books from Publishers') DATE(DMY.) - 
HEADER('Publisher') HEADER('Books Used') - 
ON(106,4,CH) ON(VALCNT,N05) 
* Separate output containing records for publishers 
* with more than 4 books in use 
SELECT FROM(BKIN) TO(BKOUT) ON(106,4,CH) HIGHER(4) 
COPY FROM(REGNIN1) TO(T1) USING(CTL1) 
* Reformate REGION.IN1 to T1 so it can be spliced 
COPY FROM(REGNIN2) TO(T1) USING(CTL2) 
* Splice records in T1 with matching ON fields 
SPlice FROM(T1) WITHALL - 
ON(5,5,CH) - Region 
WITH(1,4) - Office 
WITH(25,4) - Employees 
WITH(29,10) - Evaluation 
TO(REGNOUT) */ 

/* ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR 
BKS DD DSN=A123456.SORT.SAMPIN,DISP=SHR 
DD DSN=A123456.SORT.SAMPADD,DISP=SHR 
DAPUBS DD DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA 
PRPUBS DD SYSOUT=A 
SPUBCNTL DD * 
SORT FIELDS=(106,4,A,1,75,A),FORMAT=CH 
INCLUDE COND=(106,4,EQ,C'VALD',OR,106,4,EQ,C'WETH'), 
FORMAT=CH 
*/ 

/* CACOCNTL DD * 
SORT FIELDS=(1,15,CH,A) 
OUTFIL FNAME=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA') 
OUTFIL FNAME=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO') 
*/ 

/* 
CACADASD DD DSN=&&CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390 
CATAPE DD DSN=CA.BRANCH,UNIT=3480,DISP=(NEW,KEEP) 
*/ 

/* 
CODASD DD DSN=&&CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390 
COTAPE DD DSN=CO.BRANCH,UNIT=3480,DISP=(NEW,KEEP) 
*/
Here is the complete TOOLMSG data set produced by running this job:
ICE6001  DFSORT IECETOOL UTILITY RUN STARTED
ICE6501  VISIT http://www.ibm.com/storage/dfsort FOR IECETOOL PAPERS, EXAMPLES AND MORE
ICE6321  SOURCE FOR IECETOOL STATEMENTS: TOOLIN

ICE6301  MODE IN EFFECT:  STOP

* Statistics from all branches
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)

ICE6271  DFSORT CALL 0001 FOR COPY FROM ALL TO E35 EXIT COMPLETED
ICE6281  RECORD COUNT: 000000000000012

ICE6071  STATISTICS FOR (18,4,ZD):
ICE6081  MINIMUM: +000000000000015, MAXIMUM: +000000000000035
ICE6091  AVERAGE: +000000000000024, TOTAL: +000000000000298

ICE6071  STATISTICS FOR (28,6,PD):
ICE6081  MINIMUM: -000000000004278, MAXIMUM: +000000000008276
ICE6091  AVERAGE: +000000000004222, TOTAL: +000000000050665

ICE6071  STATISTICS FOR (22,6,PD):
ICE6081  MINIMUM: +000000000012300, MAXIMUM: +000000000042820
ICE6091  AVERAGE: +000000000027469, TOTAL: +000000000329637

ICE6021  OPERATION RETURN CODE: 00

* Books from VALD and WETH
SORT FROM(ALL) TO(DAPUBS,PRPUBS) USING(SPUB)

ICE6061  DFSORT CALL 0002 FOR SORT FROM ALL TO OUTFIL USING SPUBCNTL COMPLETED
ICE6021  OPERATION RETURN CODE: 00

* Separate output for California and Colorado branches
SORT FROM(ALL) USING(CACO)

ICE6061  DFSORT CALL 0003 FOR SORT FROM ALL TO OUTFIL USING CACOCNTL COMPLETED
ICE6021  OPERATION RETURN CODE: 00

* California branches profit analysis
RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)

ICE6271  DFSORT CALL 0004 FOR COPY FROM CADASD TO E35 EXIT COMPLETED
ICE6281  RECORD COUNT: 000000000000007
ICE6311  NUMBER OF VALUES IN RANGE FOR (28,6,PD): 000000000000003
ICE6021  OPERATION RETURN CODE: 00

* Branches with less than 32 employees
RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)

ICE6271  DFSORT CALL 0005 FOR COPY FROM ALL TO E35 EXIT COMPLETED
ICE6281  RECORD COUNT: 000000000000012
ICE6311  NUMBER OF VALUES IN RANGE FOR (18,4,ZD): 000000000000008
ICE6021  OPERATION RETURN CODE: 00

* Print profit, employees, and city for each Colorado branch
DISPLAY FROM(CODASD) LIST(OUT) ON(28,6,PD) ON(18,4,ZD) ON(1,15,CH)

ICE6431  WIDTH OF REPORT IS 0121 BYTES
ICE6271  DFSORT CALL 0006 FOR COPY FROM CODASD TO E35 EXIT COMPLETED
ICE6031  INFORMATION PRINTED IN OUT DATA SET
ICE6281  RECORD COUNT: 000000000000005
ICE6021  OPERATION RETURN CODE: 00

* Print a report for the Colorado branches
DISPLAY FROM(CODASD) LIST(RPT) -
  DATE TITLE('Colorado Branches Report') PAGE -
  HEADER('City') HEADER('Profit') HEADER('Employees') -
  ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(S) -
  TOTAL('Total') AVERAGE('Average') -
  MINIMUM('Lowest') COUNT('Number of cities')

ICE6431  WIDTH OF REPORT IS 0121 BYTES
ICE6271  DFSORT CALL 0007 FOR COPY FROM CODASD TO E35 EXIT COMPLETED
ICE6031  INFORMATION PRINTED IN RPT DATA SET
ICE6281  RECORD COUNT: 000000000000005
ICE6021  OPERATION RETURN CODE: 00

Figure 4. Complete TOOLMSG Data Set. (Part 1 of 2)
* Print a report of books for individual publishers

DISPLAY FROM(DAPUBS) LIST(SECTIONS)
- TITLE('BOOKS FOR INDIVIDUAL PUBLISHERS') PAGE -
  HEADER('TITLE OF BOOK') ON(1,35,CH) -
  HEADER('PRICE OF BOOK') ON(170,4,BI,C1,F'$') -
  BTITLE('PUBLISHER:') BREAK(106,4,CH) -
  BAVVERAGE('AVERAGE FOR THIS PUBLISHER') -
  BTOTAL('TOTAL FOR THIS PUBLISHER') -
  AVERAGE('AVERAGE FOR ALL PUBLISHERS') -
  TOTAL('TOTAL FOR ALL PUBLISHERS')

Figure 5. Complete TOOLMSG Data Set. (Part 2 of 2)

Summary

This chapter introduced the 17 ICETOOL operators, and showed some of the ways you can use them to perform various tasks. For complete information on DFSORT's ICETOOL, refer to z/OS DFSORT Application Programming Guide.
Part 4. Learning to use symbols
Chapter 13. Defining and using symbols

A symbol is a name (preferably something meaningful) you can use to represent a field or a constant. Sets of symbols, also called mappings, can be used to describe a group of related fields and constants such as the information in a particular type of record. Such mappings allow you to refer to fields, constants, and output columns by their symbols, freeing you from having to know the position, length and format of fields, the values of constants or the position of the output column you want to use.

DFSORT's symbol processing feature allows you or your site to create symbols for the fields in your own records and for constants associated with those fields. You can then use those symbols in DFSORT control statements and ICETOOL operators.

In addition, you can obtain predefined sets of symbols to use for the records created by other products such as RACF®, DCOLLECT and DFSMSrmm. Visit the DFSORT Home Page (www.ibm.com/storage/dfsort) for information about obtaining DFSORT symbol mappings for records produced by other products, and examples that use these symbols.

The chapter in this section explains how to define symbols for the bookstore data set and use them in several DFSORT control statements and ICETOOL operators.

Although not described in this book, you can also use:

- System symbols (for example, &SYSPLEX. and &JOBNAME.) in your symbol constants. For a full description of how symbols (including system symbols) can be used with DFSORT and ICETOOL, see z/OS DFSORT Application Programming Guide.
- SET and PROC symbols included in the DFSORT and ICETOOL EXEC PARM string. For a full description of how SET and PROC symbols can be used with DFSORT and ICETOOL, see z/OS DFSORT Application Programming Guide.

Creating the SYMNAMES data set

DFSORT and ICETOOL obtain the symbols to be used from the data set specified in a SYMNAMES DD statement. Create the SYMNAMES data set you want to use with RECFM=FB and LRECL=80 in the same way you would create a data set containing DFSORT JCL and control statements. Then use an editor, such as ISPF EDIT, to write the SYMNAMES statements defining your symbols, as described later in this section.

After you create the SYMNAMES data set, you can use it in any DFSORT or ICETOOL application for which you want to use the symbols you defined. You can add, delete and change SYMNAMES statements in the SYMNAMES data set at any time using the editor.

For this chapter, we will assume you have created a data set called SORT.SYMBOLS to put your SYMNAMES statements in.

Defining symbols for fields

Appendix B, “Descriptions of the sample data sets,” on page 173 shows the fields of the bookstore data set. To define the symbols for these fields, write a SYMNAMES statement for each one in SORT.SYMBOLS. The SYMNAMES statements for the symbols Title and Author_Last_Name look like this:

```
* Symbols for fields
Title,1,75,CH
Author_Last_Name,*,15,CH
```

To write these SYMNAMES statements that define the symbol Title for the Title field and the symbol Author_Last_Name for the Author's Last Name field, follow these steps:
<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write a comment statement (optional): * Symbols for fields</td>
</tr>
<tr>
<td>2</td>
<td>Type <strong>Title</strong> followed by a comma. This is the symbol you will use for the Title field. A symbol can be 1 to 50 characters consisting of uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), the number sign (#), the dollar sign ($), the commercial at sign (@), the underscore (_), and the hyphen (-). However, the first character must not be a number. Title, TITLE, and title are three different symbols.</td>
</tr>
<tr>
<td>3</td>
<td>Type the position of the Title field followed by a comma. The position of the Title field is <strong>1</strong>.</td>
</tr>
<tr>
<td>4</td>
<td>Type the length of the Title field followed by a comma. The length of the Title field is <strong>75</strong>.</td>
</tr>
<tr>
<td>5</td>
<td>Type the format of the Title field followed by a blank. The format of the Title field is <strong>CH</strong>.</td>
</tr>
<tr>
<td>6</td>
<td>Type <strong>Author_Last_Name</strong> followed by a comma. This is the symbol you will use for the Author’s Last Name field.</td>
</tr>
<tr>
<td>7</td>
<td>Type * for the position followed by a comma. An asterisk (*) for the position shows that this field immediately follows the previous field. The * here will automatically assign <strong>76</strong> as the position of the Author_Last_Name symbol. You could specify 76 instead of *, but * is preferable when fields are adjacent. * allows symbols for fields to be inserted without changes to symbols for other fields.</td>
</tr>
<tr>
<td>8</td>
<td>Type the length of the Author’s Last Name field followed by a comma. The length of the Author’s Last Name field is <strong>15</strong>.</td>
</tr>
<tr>
<td>9</td>
<td>Type the format of the Author’s Last Name field followed by a blank. The format of the Author’s Last Name field is <strong>CH</strong>.</td>
</tr>
</tbody>
</table>

The SYMNAMES statements to define the symbols for the other fields in the bookstore data set look like this:

```
Author_First_Name,*,15,CH
Publisher,*,4,CH
Course_Department,*,5,CH
Course_Number,*,5,CH
Course_Name,*,25,CH
Instructor_Last_Name,*,15,CH
Instructor_Initials,*,2,CH
Number_in_Stock,*,4,BI
Number_Sold_YTD,*,4,BI
Price,*,4,BI
```

**So far**

So far, you have learned how to create a SYMNAMES data set and use it to define symbols for your fields. Now you will learn how to use the symbols for the fields you defined.

**Using symbols for fields in DFSORT statements**

Now that you have your symbols for the bookstore data set defined in SORT.SYMBOLS, you can use those symbols in DFSORT control statements wherever fields can appear.
Here's an example of a DFSORT application that uses symbols. It selects the books for courses 00032 and 10347 from SORT.SAMPIN and sorts them by title, instructor and price:

```plaintext
//SYM1   JOB  A492,PROGRAMMER
//SORTIT EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SYMNAMES DD DSN=A123456.SORT.SYMBOLS,DISP=SHR
//SYMNOUT DD SYSOUT=* 
//SORTIT DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD DSN=A123456.SORT.SAMPOUT,DISP=SHR
//SYSIN DD *
INCLUDE COND=(Course_Number,EQ,C'00032',OR, Course_Number,EQ,C'10347')
SORT FIELDS=(Title,A,
Instructor_Last_Name,A,Instructor_Initials,A,
Price,A)
/*

The SYMNAMES DD statement specifies the SYMNAMES data set to be used for this application.

The SYMNOUT DD statement specifies a data set in which you want DFSORT to list your original SYMNAMES statements and the symbol table constructed from them. You can omit the SYMNOUT data set if you don’t want to see that information. For this SYMNAMES data set, the SYMNOUT listing looks like this:

```
------- ORIGINAL STATEMENTS FROM SYMNAMES -------
* Symbols for fields
Title,1,75,CH
Author_Last_Name,*,15,CH
Author_First_Name,*,15,CH
Publisher,*,4,CH
Course_Department,*,5,CH
Course_Number,*,5,CH
Course_Name,*,25,CH
Instructor_Last_Name,*,15,CH
Instructor_Initials,*,2,CH
Number_in_Stock,*,4,BI
Number_Sold_YTD,*,4,BI
Price,*,4,BI
------------------ SYMBOL TABLE -----------------
Title,1,75,CH
Author_Last_Name,76,15,CH
Author_First_Name,91,15,CH
Publisher,106,4,CH
Course_Department,110,5,CH
Course_Number,115,5,CH
Course_Name,120,25,CH
Instructor_Last_Name,145,15,CH
Instructor_Initials,160,2,CH
Number_in_Stock,162,4,BI
Number_Sold_YTD,166,4,BI
Price,170,4,BI
```

The INCLUDE and SORT statements use symbols for the fields instead of position, length and format.

You can define symbols for any %n%nn, %nn or %n parsed fields you use. For example, you could specify these SYMNAMES statements to define symbols for %01 and %02:

```
First_name,%01
Last_name,%02
```

and then use these symbols in the following OUTREC statement:

```
OUTREC PARSE=(First_name=(ABSPOS=9,FIXLEN=12,ENDBEFR=C','),
Last_name=(FIXLEN=15,ENDBEFR=C',')),
BUILD=(First_name,15:Last_name)
```

**Using symbols for fields in ICETOOL operators**

You can also use the symbols from SORT.SYMBOLS in ICETOOL operators and their associated DFSORT control statements wherever fields can appear. Here's an example of an ICETOOL application that uses
symbols for fields. It does what the DFSORT example in “Using symbols for fields in DFSORT statements” on page 166 does, but also shows the number of selected books priced below 7 dollars and the number priced above 20 dollars:

```
//SYM2 JOB A492,PROGRAMMER
//TOOL EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//SYMNAMES DD DSN=A123456.SORT.SYMBOLS,DISP=SHR
//SYMNOUT DD SYSOUT=*
//IN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//OUT DD DSN=A123456.SORT.SAMPOUT,DISP=OLD
//TOOLIN *
  SORT FROM(IN) TO(OUT) USING(CTL1)
  RANGE FROM(OUT) ON(Price) LOWER(+700)
  RANGE FROM(OUT) ON(Price) HIGHER(+2000)
//CTL1CNTL DD *
  INCLUDE COND=(Course_Number,EQ,C'00032',OR,
                Course_Number,EQ,C'10347')
  SORT FIELDS=(Title,A,
                Instructor_Last_Name,A,Instructor_Initials,A,
                Price,A)
/*
```

The SYMNAMES DD statement specifies the SYMNAMES data set to be used for this application.

The SYMNOUT DD statement specifies a data set in which you want ICETOOL to list your original SYMNAMES statements and the symbol table constructed from them. Because the SYMNAMES data set is the same as for the DFSORT application shown in “Using symbols for fields in DFSORT statements” on page 166, the SYMNOUT listing will be the same as well.

The RANGE operators and the INCLUDE and SORT statements use symbols for the fields instead of position, length and format.

```
So far
```

You have now learned how to use symbols for fields in DFSORT control statements and ICETOOL operators. Next, you will learn how to define and use symbols for your constants.

### Defining and using symbols for constants

You can use symbols wherever decimal constants, character constants, hexadecimal constants or bit constants can appear in DFSORT control statements and ICETOOL operators.

The ICETOOL example in “Using symbols for fields in ICETOOL operators” on page 167 uses the following RANGE operators:

```
RANGE FROM(OUT) ON(Price) LOWER(+700)
RANGE FROM(OUT) ON(Price) HIGHER(+2000)
```

and the following INCLUDE statement:

```
INCLUDE COND=(Course_Number,EQ,C'00032',OR,
             Course_Number,EQ,C'10347')
```

+700 and +2000 are decimal constants. C'00032' and C'10347' are character constants. You can use symbols for these constants to make them more understandable in the ICETOOL operators and DFSORT control statements you write. The SYMNAMES statements for these constants look like this:

```
* Symbols for constants
Discount,+700
Premium,+2000
Beginning_Economics,C'00032'
Advanced_Sociology,C'10347'
```

To add these symbols for the four constants to the SORT.SYMBOLS data set, follow these steps:
### Table 83. Steps to Define Symbols for Constants

<table>
<thead>
<tr>
<th>Step</th>
<th>Action</th>
</tr>
</thead>
</table>
| 1    | Write a comment statement (optional):  *
|      | Symbols for constants |
| 2    | Type `Discount` followed by a comma.  
|      | This is the symbol you will use for the decimal constant +700. |
| 3    | Type the constant followed by a blank.  
|      | The constant is +700. You can also use 700, but we recommend using a + sign for positive decimal constants. |
| 4    | Type `Premium` followed by a comma.  
|      | This is the symbol you will use for the decimal constant +2000. |
| 5    | Type the constant followed by a blank.  
|      | The constant is +2000. You can also use 2000, but we recommend using a + sign for positive decimal constants. |
| 6    | Type `Beginning_Economics` followed by a comma.  
|      | This is the symbol you will use for the character constant C'00032'. |
| 7    | Type the constant followed by a blank.  
|      | The constant is C'00032'. You can also use '00032' or c'00032'. |
| 8    | Type `Advanced_Sociology` followed by a comma.  
|      | This is the symbol you will use for the character constant C'10347'. |
| 9    | Type the constant followed by a blank.  
|      | The constant is C'10347'. You can also use '10347' or c'10347'. |

The RANGE operators can now be written as:

```plaintext
RANGE FROM(OUT) ON(Price) LOWER(Discount)
RANGE FROM(OUT) ON(Price) HIGHER(Premium)
```

The INCLUDE statement can now be written as:

```plaintext
INCLUDE COND=(Course_Number,EQ,Beginning_Economics,OR,
           Course_Number,EQ,Advanced_Sociology)
```

### Summary

This chapter covered how to define and use symbols for fields and constants in DFSORT control statements and ICETOOL operators. For more information on DFSORT symbols, see *z/OS DFSORT Application Programming Guide*.

This completes the *z/OS DFSORT: Getting Started* tutorials. The appendixes that follow contain important information about the Sample Data Sets and the order in which DFSORT processes its various control statements.
Appendix A. Creating the sample data sets

Many of the examples in this document use A123456.SORT.SAMPIN, A123456.SORT.SAMPADD, and A123456.SORT.BRANCH as input data sets, and A123456.SORT.SAMPOUT as an output data set. If you want to try the examples in this document that use these data sets, create your own userid.SORT.SAMPIN, userid.SORT.SAMPADD, userid.SORT.BRANCH and userid.SORT.SAMPOUT data sets with your own userid by running the ICEDCRE job that follows.

Substitute your own JOB statement for the ICEDCRE JOB statement. Substitute your own userid for 'userid' in the four DD statements.

If you use a JOBLIB or STEPLIB to run DFSORT jobs, add it to the ICEDCRE job. If you prefer a value for UNIT other than SYSALLDA, change that parameter in the DD statements. Add a VOL=SER=vvvvv parameter to the DD statements, if appropriate.

Once you run this job successfully, you can substitute your userid for A123456 in the data set names of these four data sets. For example, if you see a DD statement like this:

```
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
```

you can use your own DD statement like this:

```
//SORTIN DD DSN=userid.SORT.SAMPIN,DISP=SHR
```

**Note:** Some of the examples use data sets other than A123456.SORT.SAMPIN, A123456.SORT.SAMPOUT, A123456.SORT.SAMPADD, and A123456.SORT.BRANCH. You can either create data sets from scratch to match the ones used in the text, or else perform a similar exercise on data sets you already have.
Appendix B. Descriptions of the sample data sets

The fields in the records of the sample data sets SORT.SAMPIN, SORT.SAMPADD and SORT.BRANCH are described on this page, and the contents of the records are described on the following pages.

Table 84 on page 173 shows the length and data format of each field in the sample bookstore data set SORT.SAMPIN, and in the additional bookstore data set SORT.SAMPADD. Both of these data sets have fixed-length records (RECFM=FB) that are 173 bytes long (LRECL=173).

Table 84. SORT.SAMPIN and SORT.SAMPADD Field Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Length</th>
<th>Data Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>75</td>
<td>CH</td>
</tr>
<tr>
<td>Author's Last Name</td>
<td>15</td>
<td>CH</td>
</tr>
<tr>
<td>Author's First Name</td>
<td>15</td>
<td>CH</td>
</tr>
<tr>
<td>Publisher</td>
<td>4</td>
<td>CH</td>
</tr>
<tr>
<td>Course Department</td>
<td>5</td>
<td>CH</td>
</tr>
<tr>
<td>Course Number</td>
<td>5</td>
<td>CH</td>
</tr>
<tr>
<td>Course Name</td>
<td>25</td>
<td>CH</td>
</tr>
<tr>
<td>Instructor's Last Name</td>
<td>15</td>
<td>CH</td>
</tr>
<tr>
<td>Instructor's Initials</td>
<td>2</td>
<td>CH</td>
</tr>
<tr>
<td>Number In Stock</td>
<td>4</td>
<td>BI</td>
</tr>
<tr>
<td>Number Sold Y-to-D</td>
<td>4</td>
<td>BI</td>
</tr>
<tr>
<td>Price</td>
<td>4</td>
<td>BI</td>
</tr>
</tbody>
</table>

Table 85 on page 173 shows the length and data format of each field in the sample branch data set SORT.BRANCH. This data set has fixed-length records (RECFM=FB) that are 33 bytes long (LRECL=33).

Table 85. SORT.BRANCH Field Descriptions

<table>
<thead>
<tr>
<th>Field</th>
<th>Length</th>
<th>Data Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>15</td>
<td>CH</td>
</tr>
<tr>
<td>State</td>
<td>2</td>
<td>CH</td>
</tr>
<tr>
<td>Employees</td>
<td>4</td>
<td>ZD</td>
</tr>
<tr>
<td>Revenue</td>
<td>6</td>
<td>PD</td>
</tr>
<tr>
<td>Profit</td>
<td>6</td>
<td>PD</td>
</tr>
</tbody>
</table>

The contents of the records in the sample data sets are shown on the following pages. Each horizontal line represents a record, and each column represents a field. Headings show the field names and the starting and ending position of each field. Of course, these headings do not actually appear in the data sets. Numeric fields (BI, ZD, PD) would not actually be readable if displayed, but are shown as their equivalent readable values.

Sample Data Set - SORT.SAMPIN
## Sample Bookstore Data Sets

### Sample Data Set - SORT.SAMPIN

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Author's Last Name</th>
<th>Author's First Name</th>
<th>Publisher</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>155747</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sample Data Set - SORT.SAMPADD

<table>
<thead>
<tr>
<th>Book Title</th>
<th>Author's Last Name</th>
<th>Author's First Name</th>
<th>Publisher</th>
<th>Course Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>155747</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sample Data Set - SORT.SAMPIN (continued)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Instructor's Last Name</th>
<th>Instructor's Initials</th>
<th>Number In Stock</th>
<th>Number Sold Year-to-Date</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>119</td>
<td></td>
<td></td>
<td>145 159</td>
<td>160 161 162 165</td>
<td>166 169 170 173</td>
</tr>
</tbody>
</table>
### Sample Data Set - SORT.SAMPIN (continued)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Instructor's Last Name</th>
<th>Instructor's Initials</th>
<th>Number In Stock</th>
<th>Number Sold Year-to-Date</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>00032</td>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
<td>CL</td>
<td>5</td>
<td>29</td>
<td>2600</td>
</tr>
<tr>
<td>70251</td>
<td>MARKETING</td>
<td>MAXWELL</td>
<td>RF</td>
<td>0</td>
<td>32</td>
<td>1925</td>
</tr>
<tr>
<td>00205</td>
<td>VIDEO GAMES</td>
<td>NEUMANN</td>
<td>LB</td>
<td>10</td>
<td>10</td>
<td>2199</td>
</tr>
<tr>
<td>10856</td>
<td>MODERN POETRY</td>
<td>FRIEDMAN</td>
<td>KR</td>
<td>2</td>
<td>32</td>
<td>595</td>
</tr>
<tr>
<td>00032</td>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
<td>CL</td>
<td>20</td>
<td>26</td>
<td>1899</td>
</tr>
<tr>
<td>10347</td>
<td>TECHNICAL EDITING</td>
<td>MADRID</td>
<td>MM</td>
<td>46</td>
<td>38</td>
<td>295</td>
</tr>
<tr>
<td>00032</td>
<td>INTRO TO COMPUTERS</td>
<td>CHATTERJEE</td>
<td>AN</td>
<td>6</td>
<td>27</td>
<td>360</td>
</tr>
<tr>
<td>70124</td>
<td>ADVANCED MARKETING</td>
<td>LORCH</td>
<td>MH</td>
<td>3</td>
<td>35</td>
<td>2350</td>
</tr>
<tr>
<td>50420</td>
<td>WORLD HISTORY</td>
<td>GOODGOLD</td>
<td>ST</td>
<td>15</td>
<td>9</td>
<td>795</td>
</tr>
<tr>
<td>10856</td>
<td>MODERN POETRY</td>
<td>FRIEDMAN</td>
<td>KR</td>
<td>1</td>
<td>26</td>
<td>450</td>
</tr>
<tr>
<td>30016</td>
<td>PSYCHOLOGY I</td>
<td>ZABOSKI</td>
<td>RL</td>
<td>26</td>
<td>15</td>
<td>2200</td>
</tr>
<tr>
<td>10347</td>
<td>TECHNICAL EDITING</td>
<td>MADRID</td>
<td>MM</td>
<td>7</td>
<td>19</td>
<td>625</td>
</tr>
<tr>
<td>00103</td>
<td>DATA MANAGEMENT</td>
<td>SMITH</td>
<td>DC</td>
<td>13</td>
<td>32</td>
<td>1450</td>
</tr>
<tr>
<td>10054</td>
<td>FICTION WRITING</td>
<td>BUCK</td>
<td>GR</td>
<td>13</td>
<td>46</td>
<td>3195</td>
</tr>
<tr>
<td>80521</td>
<td>BIOLOGY I</td>
<td>GREENBERG</td>
<td>HC</td>
<td>6</td>
<td>11</td>
<td>2350</td>
</tr>
<tr>
<td>30975</td>
<td>PSYCHOANALYSIS</td>
<td>NAKATSU</td>
<td>FL</td>
<td>1</td>
<td>12</td>
<td>2800</td>
</tr>
<tr>
<td>50632</td>
<td>EUROPEAN HISTORY</td>
<td>BISCARDI</td>
<td>HR</td>
<td>23</td>
<td>21</td>
<td>1790</td>
</tr>
<tr>
<td>50521</td>
<td>WORLD HISTORY</td>
<td>WILLERTON</td>
<td>DW</td>
<td>14</td>
<td>17</td>
<td>1200</td>
</tr>
</tbody>
</table>

### Sample Data Set - SORT.SAMPADD (continued)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Instructor's Last Name</th>
<th>Instructor's Initials</th>
<th>Number In Stock</th>
<th>Number Sold Year-to-Date</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 119</td>
<td>120 144</td>
<td>145 159</td>
<td>160 161</td>
<td>162 165</td>
<td>166 169</td>
<td>170 173</td>
</tr>
<tr>
<td>80522</td>
<td>BIOLOGY II</td>
<td>HAROLD</td>
<td>LM</td>
<td>2</td>
<td>3</td>
<td>1088</td>
</tr>
<tr>
<td>80522</td>
<td>BIOLOGY II</td>
<td>HAROLD</td>
<td>LM</td>
<td>9</td>
<td>4</td>
<td>650</td>
</tr>
<tr>
<td>80523</td>
<td>INTRO TO GENETICS</td>
<td>ABRAHAM</td>
<td>NG</td>
<td>15</td>
<td>6</td>
<td>925</td>
</tr>
<tr>
<td>80523</td>
<td>INTRO TO GENETICS</td>
<td>ABRAHAM</td>
<td>NG</td>
<td>8</td>
<td>17</td>
<td>1100</td>
</tr>
<tr>
<td>70251</td>
<td>MARKETING</td>
<td>MAXWELL</td>
<td>RF</td>
<td>16</td>
<td>20</td>
<td>2000</td>
</tr>
<tr>
<td>70124</td>
<td>ADVANCED MARKETING</td>
<td>LORCH</td>
<td>MH</td>
<td>20</td>
<td>25</td>
<td>2000</td>
</tr>
<tr>
<td>70255</td>
<td>BUSINESS THEORY</td>
<td>SCHOFFE</td>
<td>KN</td>
<td>12</td>
<td>12</td>
<td>1200</td>
</tr>
<tr>
<td>70255</td>
<td>BUSINESS THEORY</td>
<td>SCHOFFE</td>
<td>KN</td>
<td>17</td>
<td>15</td>
<td>615</td>
</tr>
<tr>
<td>00205</td>
<td>VIDEO GAMES</td>
<td>NEUMANN</td>
<td>LB</td>
<td>15</td>
<td>12</td>
<td>2600</td>
</tr>
<tr>
<td>10054</td>
<td>FICTION WRITING</td>
<td>BUCK</td>
<td>GR</td>
<td>11</td>
<td>25</td>
<td>2450</td>
</tr>
<tr>
<td>50521</td>
<td>WORLD HISTORY</td>
<td>WILLERTON</td>
<td>DW</td>
<td>3</td>
<td>17</td>
<td>995</td>
</tr>
<tr>
<td>50420</td>
<td>WORLD HISTORY</td>
<td>GOODGOLD</td>
<td>ST</td>
<td>6</td>
<td>15</td>
<td>1350</td>
</tr>
<tr>
<td>50632</td>
<td>EUROPEAN HISTORY</td>
<td>BISCARDI</td>
<td>HR</td>
<td>10</td>
<td>20</td>
<td>2560</td>
</tr>
<tr>
<td>30975</td>
<td>PSYCHOANALYSIS</td>
<td>NAKATSU</td>
<td>FL</td>
<td>12</td>
<td>15</td>
<td>1250</td>
</tr>
<tr>
<td>30016</td>
<td>PSYCHOLOGY I</td>
<td>ZABOSKI</td>
<td>RL</td>
<td>6</td>
<td>9</td>
<td>895</td>
</tr>
<tr>
<td>70255</td>
<td>BUSINESS THEORY</td>
<td>SCHOFFE</td>
<td>KN</td>
<td>2</td>
<td>20</td>
<td>1500</td>
</tr>
<tr>
<td>00103</td>
<td>DATA MANAGEMENT</td>
<td>SMITH</td>
<td>DC</td>
<td>7</td>
<td>15</td>
<td>1435</td>
</tr>
</tbody>
</table>

### Sample Data Set - SORT.BRANCH

<table>
<thead>
<tr>
<th>City</th>
<th>State</th>
<th>Employees</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>16 17</td>
<td>22 27</td>
<td>28 33</td>
</tr>
<tr>
<td>City</td>
<td>State</td>
<td>Employees</td>
<td>Revenue</td>
<td>Profit</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>CA</td>
<td>32</td>
<td>22530</td>
<td>-4278</td>
</tr>
<tr>
<td>San Francisco</td>
<td>CA</td>
<td>35</td>
<td>42820</td>
<td>6832</td>
</tr>
<tr>
<td>Fort Collins</td>
<td>CO</td>
<td>22</td>
<td>12300</td>
<td>-2863</td>
</tr>
<tr>
<td>Sacramento</td>
<td>CA</td>
<td>29</td>
<td>42726</td>
<td>8276</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>CA</td>
<td>18</td>
<td>16152</td>
<td>-978</td>
</tr>
<tr>
<td>Denver</td>
<td>CO</td>
<td>33</td>
<td>31876</td>
<td>6288</td>
</tr>
<tr>
<td>Boulder</td>
<td>CO</td>
<td>32</td>
<td>33866</td>
<td>7351</td>
</tr>
<tr>
<td>Morgan Hill</td>
<td>CA</td>
<td>15</td>
<td>18200</td>
<td>3271</td>
</tr>
<tr>
<td>Vail</td>
<td>CO</td>
<td>19</td>
<td>23202</td>
<td>5027</td>
</tr>
<tr>
<td>San Jose</td>
<td>CA</td>
<td>21</td>
<td>27225</td>
<td>8264</td>
</tr>
<tr>
<td>San Diego</td>
<td>CA</td>
<td>22</td>
<td>32940</td>
<td>8275</td>
</tr>
<tr>
<td>Aspen</td>
<td>CO</td>
<td>20</td>
<td>25800</td>
<td>5200</td>
</tr>
</tbody>
</table>
Appendix C. Processing order of control statements

The following flowchart shows the order in which control statements are processed. (SUM is processed at the same time as SORT or MERGE. It is not used with COPY.)

Although you can write the statements in any order, DFSORT always processes the statements in the following order.

Figure 6. Processing Order of Control Statements
Appendix D. Accessibility

Accessible publications for this product are offered through IBM Knowledge Center (www.ibm.com/support/knowledgecenter/SSLTBW/welcome).

If you experience difficulty with the accessibility of any z/OS information, send a detailed message to the Contact the z/OS team web page (www.ibm.com/systems/campaignmail/z/zos/contact_z) or use the following mailing address.

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
United States

Accessibility features

Accessibility features help users who have physical disabilities such as restricted mobility or limited vision use software products successfully. The accessibility features in z/OS can help users do the following tasks:

• Run assistive technology such as screen readers and screen magnifier software.
• Operate specific or equivalent features by using the keyboard.
• Customize display attributes such as color, contrast, and font size.

Consult assistive technologies

Assistive technology products such as screen readers function with the user interfaces found in z/OS. Consult the product information for the specific assistive technology product that is used to access z/OS interfaces.

Keyboard navigation of the user interface

You can access z/OS user interfaces with TSO/E or ISPF. The following information describes how to use TSO/E and ISPF, including the use of keyboard shortcuts and function keys (PF keys). Each guide includes the default settings for the PF keys.

• z/OS TSO/E Primer
• z/OS TSO/E User's Guide
• z/OS ISPF User's Guide Vol I

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users who access IBM Knowledge Center with a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line because they are considered a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that the screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, your syntax can include either USERID or SYSTEMID, but not both.
The dotted decimal numbering level denotes the level of nesting. For example, if a syntax element with dotted decimal number 3 is followed by a series of syntax elements with dotted decimal number 3.1, all the syntax elements numbered 3.1 are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add information about the syntax elements. Occasionally, these words and symbols might occur at the beginning of the element itself. For ease of identification, if the word or symbol is a part of the syntax element, it is preceded by the backslash (\) character. The * symbol is placed next to a dotted decimal number to indicate that the syntax element repeats. For example, syntax element *FILE with dotted decimal number 3 is given the format 3 \* FILE. Format 3* FILE indicates that syntax element FILE repeats. Format 3* \* FILE indicates that syntax element * FILE repeats.

Characters such as commas, which are used to separate a string of syntax elements, are shown in the syntax just before the items they separate. These characters can appear on the same line as each item, or on a separate line with the same dotted decimal number as the relevant items. The line can also show another symbol to provide information about the syntax elements. For example, the lines 5.1*, 5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the LASTRUN and DELETE syntax elements, the elements must be separated by a comma. If no separator is given, assume that you use a blank to separate each syntax element.

If a syntax element is preceded by the % symbol, it indicates a reference that is defined elsewhere. The string that follows the % symbol is the name of a syntax fragment rather than a literal. For example, the line 2.1 %OP1 means that you must refer to separate syntax fragment OP1.

The following symbols are used next to the dotted decimal numbers.

? indicates an optional syntax element
The question mark (?) symbol indicates an optional syntax element. A dotted decimal number followed by the question mark symbol (?) indicates that all the syntax elements with a corresponding dotted decimal number, and any subordinate syntax elements, are optional. If there is only one syntax element with a dotted decimal number, the ? symbol is displayed on the same line as the syntax element, (for example 5? NOTIFY). If there is more than one syntax element with a dotted decimal number, the ? symbol is displayed on a line by itself, followed by the syntax elements that are optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you know that the syntax elements NOTIFY and UPDATE are optional. That is, you can choose one or none of them.

! indicates a default syntax element
The exclamation mark (!) symbol indicates a default syntax element. A dotted decimal number followed by the ! symbol and a syntax element indicate that the syntax element is the default option for all syntax elements that share the same dotted decimal number. Only one of the syntax elements that share the dotted decimal number can specify the ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and 2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword. In the example, if you include the FILE keyword, but do not specify an option, the default option KEEP is applied. A default option also applies to the next higher dotted decimal number. In this example, if the FILE keyword is omitted, the default FILE (KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1! (KEEP), and 2.1.1 (DELETE), the default option KEEP applies only to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

* indicates an optional syntax element that is repeatable
The asterisk or glyph (*) symbol indicates a syntax element that can be repeated zero or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3* , 3 HOST, 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

Notes:
1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you can write HOST STATE, but you cannot write HOST HOST.

3. The * symbol is equivalent to a loopback line in a railroad syntax diagram.

**+ indicates a syntax element that must be included**

The plus (+) symbol indicates a syntax element that must be included at least once. A dotted decimal number followed by the + symbol indicates that the syntax element must be included one or more times. That is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the * symbol, the + symbol can repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loopback line in a railroad syntax diagram.
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Index

A

accessibility
contact IBM 179
features 179
allowable comparisons 26
Arithmetic 48
ascending order
example 4
sorting 11
ASCII data format code 4
assistive technologies 179

B

BI format 4
binary data 4
binary display 48
binary zeros 39
blanks 40

C
calling DFSORT
COBOL program 109
PL/I program 113
carriage control, ANSI 88, 89, 93
CH format 4
character data 4
character strings, format 41
COBOL
calling DFSORT 109
FASTSRT compile-time option 119
MERGE statement 109
passing DFSORT statements 109
sample program 110, 111
SORT statement 109
comparison
allowable 26
field-to-constant 23, 26
field-to-field 23, 26
numeric 29
operators 23
constant
comparisons 28
reformatting 41
contact
z/OS 179
continuing a statement
DFSORT 15
ICETOOL 127
control fields
combining 14
deleting duplicate records 35
duplicate 33
equally collating 8, 33
general information 7
count
comparisons 28
reformatting 41
data set
copying
definition 5
with DFSORT 21
with ICETOOL 133
joining
definition 5
making multiple copies 79, 80
merging
definition 4
with DFSORT 17
sorting
ascending order 11
by multiple control fields 13
definition 4
descending order 11
with DFSORT 11
with ICETOOL 128
DATASORT operator (ICETOOL) 123
dataspace sorting 117
defaults
order of equal records 8
overriding
using OPTION statement 116
using PARM parameter 115
DEFAULTS operator (ICETOOL) 123
deleting fields 38
deleting records 33
descending order
example 4
sorting 11
DFSORT FTP site 3
DFSORT web site 3
DFSPARM 16
discards, saving 82
DISPLAY operator (ICETOOL) 135
duplicate fields
OCCUR operator (ICETOOL) 144
control fields (continued)
multiple 13
overlapping 13
reordering 39
summing 33
control statements
DFSORT 6
ordering 24
processing order flowchart 177
converting numeric fields 44
COPY operator (ICETOOL) 133
COPY option 21
copying records 21
COUNT operator (ICETOOL) 123
creating a DFSORT job 6
duplicate fields (continued)
  SELECT operator (ICETOOL) 147
  SPLICE operator (ICETOOL) 150
  SUM statement 112
  UNIQUE operator (ICETOOL) 124

E
EBCDIC data format code 4
edit masks
  ICETOOL 138
  OUTFIL 46–48
editing fields 37, 138
equal control fields 8
excluding records 26

F
FASTSRT
  COBOL 112
  compile-time option 119
FB to VB 97
feedback xvii
FI format 5
field-to-constant comparison 23, 26
field-to-field comparison 23, 26
fields
  character and numeric, printing 135
deleting unnecessary fields 38
ing 39, 138
  printing statistics for numeric 126
reformatting 39
fixed fields 37
Fixed-point data 5
Floating sign data 5
format 20
formats 5
formats for writing constants 28
reformatting fields 37, 138
FS format 5
FTP site 3

H
headers
  sorting records between 155
hexadecimal display 48
hexadecimal strings, format 41
high-speed disk 117
Hipersorting 117

I
ICETOOL
  complete sample job 157
  COPY operator 133
  COUNT operator 123
  creating a job 124
  DATASORT operator 123
  DEFAULTS operator 123
definition 123
  DISPLAY operator 135
  JCL statements 125

ICETOOL (continued)
  job
    elements 124
    sample 157
    MERGE operator 123
    MODE operator 123
    OCCUR operator 144
    operator summary 123
    RANGE operator 123, 133
  requirements
    input data sets 124
    JCL 124
    RESIZE operator 124
    SELECT operator 147
    SPLICE operator 150
  statements
    blank 125
    comment 125
    operator, continuing 127
    STATS operator 126
    SUBSET operator 124
    symbols 167
    TOOLMSG output, sample 157
    UNIQUE operator 124
    VERIFY operator 124
  improving performance
    allocating main storage 117
    FASTSRT compile-time option 119
    high-speed disk 117
    Hiperspace 117
    INCLUDE statement 118
    INREC statement 118
    JCL (job control language) 119
    OMIT statement 118
    options to avoid 119
    SKIPREC option 118
    STOPAFT option 118
    SUM statement 118
    INCLUDE statement 23
    INREC statement 37
  installation defaults, overriding 115

J
JCL (job control language)
  calling DFSORT from a program 109, 111, 113
  executing a copy 21
  executing a merge 19
  executing a sort 16
general information 16
  ICETOOL 125
  selecting input data sets 16
  selecting output data sets 16
  statements 16
  JOB statement 16
  joining 150
  justifying data 52

K
keyboard
  navigation 179
  PF keys 179
keyboard (continued)
  shortcut keys 179

L
lookup and change 51
lowercase to uppercase 43

M
main storage, allocating 117
making multiple data set copies 79
mapping
  symbols 165
matching 152
MERGE operator (ICETOOL) 123
MERGE statement 18
MERGE statement, COBOL 109
merging records 17
messages
  z/OS DFSORT Application Programming Guide xxix
  z/OS DFSORT Installation and Customization xix
MODE operator (ICETOOL) 123
multiple control fields 13
multiple data sets 79

N
navigation
  keyboard 179
non-duplicate fields
  OCCUR operator (ICETOOL) 144
  SELECT operator (ICETOOL) 147
  SPLICE operator (ICETOOL) 150
  SUM statement 112
  UNIQUE operator (ICETOOL) 124
number of digits
  ICETOOL 140
numeric tests 29

O
OCCUR operator (ICETOOL) 144
occurrences
  OCCUR operator (ICETOOL) 144
  SELECT operator (ICETOOL) 147
  SPLICE operator (ICETOOL) 150
OMIT statement 23
OPTION COPY 21
OPTION statement 21, 116
order of control statements 24
ordering
  ascending order 4
  control statements 24
  descending order 4
  DFSORT defaults 8
OUTFIL
  edit mask patterns 46–48
  OUTFIL statement 79
output records, reformattign 37
OUTREC statement 37
overflow (continued)
  explanation 36
  preventing 66
  overriding installation defaults 115

P
packed decimal data 4
PARM parameter 115
 parsing records 73
passing DFSORT statements
  from a COBOL program 109
  from a PL/I program 109
PD format 4
PL/I
  calling DFSORT 113
  passing DFSORT statements 109
  sample program 113
printing reports
  DISPLAY operator (ICETOOL) 135
  OUTFIL statement 88
processing order
  differences between INREC and OUTREC 37
  flowchart 177
  special considerations for INREC 65, 66

R
RANGE operator (ICETOOL) 123, 133
record length, changing 38
RECORD statement 113
records
  considerations when reordering with INREC and
  OUTREC 65, 66
  copying
    definition 5
    writing the COPY statement 21
  joining
    definition 5
  merging
    definition 4
    using program control statements 17
  reformatting with OUTFIL 23
  reordering and reformatting with OUTFIL 39
  reordering with OUTREC 23
  selecting by occurrences 147
  sorting
    ascending order 11
    between headers and trailers 155
    by multiple control fields 13
    definition 4
    descending order 11
    writing the SORT statement 11
  summing 33
  reformatting records 37, 73
  regular expressions 30
  reordering fields 39
  repeating 85
  reports
    DISPLAY operator (ICETOOL) 135
    OUTFIL statement 88
RESIZE operator (ICETOOL) 124
running a DFSORT job 6
S
sample data sets 7, 80, 124, 171, 173
sampling 80
saving discards 82
search
substring 30
sections 93, 142
SELECT operator (ICETOOL) 147
selecting records 147
sending to IBM
reader comments xvii
sequence numbers 67
SFF format 4
short fields 20, 32, 36
shortcut keys 179
SKIPREC option 118
SORT operator (ICETOOL) 128
SORT statement 11
SORT statement, COBOL 109
SORT-CONTROL special register (COBOL) 110
SORT-RETURN special register (COBOL) 110
sorting records
DFSORT 11
ICETOOL 128, 155
specifying COPY
COPY operator (ICETOOL) 133
MERGE statement 21
OPTION statement 21
SORT statement 21
SPLICE operator (ICETOOL) 150
splitting 86
squeezing data 54
statistics, printing for numeric fields 91, 126, 136
STATS operator (ICETOOL) 126
STOPAFT option 118
SUBSET operator (ICETOOL) 124
substring search 30
SUM statement 33
summary fields 33
symbols 165

T
trailers
sorting records between 155

U
UFF format 4
Unicode comparisons 31
UNIQUE operator (ICETOOL) 124
uppercase to lowercase 43
user interface
ISPF 179
TSO/E 179

V
variable fields 73
VB data sets 20, 32, 36, 69, 93, 97, 99, 127
VB to FB 99
VERIFY operator (ICETOOL) 124

W
web site 3
work storage data sets
devices for efficient use 117
number needed 16

Z
z/OS DFSORT Application Programming Guide
messages xxi
messages, new xxi
z/OS DFSORT Installation and Customization
messages xix
messages, new xix
ZD format 4
zeros 39
zoned decimal data 4