Environmental Monitoring Data Entry and Data Quality Application

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ABSTRACT

Data entry with data quality checks used in a "user-friendly" menu-driven environment is a vital database management tool. This poster presents an environmental monitoring database application using SAS/AF, SAS/FS, and Screen Control Language (SCL) commands on a VAX/VMS mainframe. The application offers data entry, double data entry, and data quality checks through a "user-friendly" menu-driven system. Quality checks consist of placing value limitations on entered values and comparing the data entry dataset with the double data entry dataset for identical matches or error conditions. Both entry datasets are built through data entry screens accessed from the same menu system. The data entry dataset is used as the master dataset and the double data entry dataset is used for backup and quality control. The easy-to-follow menu-driven system allows data entry and access by an experienced programmer or a computer user. This application was designed and is currently used for field data in environmental monitoring projects, but the application is a versatile tool that can be customized uniquely to meet different requirements.

INTRODUCTION

A database with the capabilities of data entry, data retrieval, and comparison checking is ideal for a field sampling database. The database allows for data entry, data retrieval, data revisions, and data quality checking through a single "user-friendly" menu-driven system. This application has value limitations incorporated into the data quality checks. Entries are checked against ranges for numeric values, and selection lists of valid entries for character values. When a value outside the limitations is entered, the user is notified that there is a problem. With this capability, the user is immediately aware of a value exceedence or invalid entry and is able to resolve the problem in a timely manner. The ability to manage field data through one menu-driven system allows an effective and secured application. There is less chance of error when the database has data quality checking and double data entry combined under one application. The example provided in this outline illustrates an environmental monitoring "field sampling database" containing the set up, management, and cleanup of a data entry and retrieval system. The data entry dataset is referenced as ENTRY1 and the double data entry dataset is referenced as ENTRY2.

A. FIELD LOGSHEETS

When field measurements and samples are collected, associated information is recorded on data forms called field logsheets (Display 1). Field logsheets are designed to assist and ensure that the sampling technicians collect and record all required samples. Data from the logsheets are entered into a database management system designed to verify and quality check the results. Each field logsheet is represented by a computerized data entry screen which is a duplication of the field logsheet. All data from the field logsheets are entered twice (double data entry) for data quality control.

B. DATA ENTRY SCREENS

Data entry screens are designed and implemented as computerized copies of the field logsheets. Each entry screen represents one individual field logsheet. The entry screen is a computerized match of the field logsheets. Entry screens are designed using PROC FSEDIT with the SCREEN= option. Data requirements and limitations are built into the data entry screens using the modify option. When the data is entered, the data is checked for entries that do not meet the specified limitations. Selection lists for some location variables are created to ensure the correct location entry. If an incorrect entry is made, the selection list is displayed and allows the user to enter or choose a valid response. All data is entered twice for quality control. The data screens for the data entry and double data entry are identical with identical specifications. See Display 2.

C. MENU-DRIVEN SYSTEM

Menu-driven system is designed and implemented as a "user-friendly" entry system. The menus are created with PROC BUILD and the program entries are accessed by CALL FSEDIT. Data entry, the double data entry, data adjustments, and/or corrections are all processed through options in the main menu. Each menu is specific to an environmental monitoring project. Each menu has attributes that list each menu and its associated program names and links. Selection lists are created for location sites on some menus. When an invalid location is entered, the selection list appears with a list of the valid responses. The menu-driven system allows all data entry processing to be done as one application. The user accesses the menu system and chooses to do either the data entry or the double data entry. After the selection is made, a menu with a list of environmental monitoring projects is displayed. Next, the program entries under that project are listed. An exit option is available at any point in the menu system. The data entry and double data entry options are identical processes; the data is entered twice for quality control and documentation. The menu system is executed by one command "@FIELD", which executes all the filenames and locations, then initiates the main menu system. See Displays 3-6.

D. QC COMPARISON

After the data is entered twice, the user executes a compare program to check that the datasets match exactly. The compare programs are designed for quality checking both entry datasets. A compare program is designed for each environmental monitoring project. Working with one compare program at a time greatly reduces errors and time. The compare program sorts the data by sampling site and location, then compares each variable and displays a brief summary of the findings. The variable from the data entry dataset must match the same variable from the double data entry dataset exactly in order for zero findings to occur. Data entry dataset is noted as the master dataset and is the dataset used by the computer programmers for information, while the double data entry dataset is used for backup and quality control. See Display 7.
CONCLUSION

Upon completion of the data entry and compare application, a "CLEANUP" command is executed to purge unneeded datasets and to delete log and listing files. The cleanup procedure eliminates multiple versions of the datasets and reduces disk space. This data entry application has been used with great success for two years. As an environmental section, we must meet regulatory requirements for all field data. The design of the "Field Sampling Database" allows an effective, data quality, compliance, and cost efficient system of field data entry. This data entry system is a versatile data management tool that can be used as a model for a variety of data applications.

DISPLAY 1

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Samples</th>
<th>CK</th>
<th>Initials</th>
<th>Time</th>
<th>Measurement/Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melton Branch (X13)</td>
<td>OIL AND GREASE</td>
<td>NONE</td>
<td>Diss. Oxygen ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Oak Creek (X14)</td>
<td>OIL AND GREASE</td>
<td>NONE</td>
<td>Diss. Oxygen ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White Oak Dam (X15)</td>
<td>OIL AND GREASE</td>
<td>NONE</td>
<td>Diss. Oxygen ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewage Treatment Plant (X01)</td>
<td>OIL AND GREASE</td>
<td>NONE</td>
<td>pH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Limits: Minimum -- pH (6.0), DspH (6.0), Diss. Oxygen (6.0)  
Maximum -- pH (9.0), DspH (9.0), Diss. Oxygen (14.0)
FSEDIT Attribute: MAXIMUM

Command ==> 

NPDES WEEKLY FIELD LOG

DATE: 31DEC93

Mellon Branch (X13)
- Dissolved Oxygen 14.0
- Chlorine
- Temperature

White Oak Creek (X14)
- Dissolved Oxygen 14.0
- Chlorine
- Temperature

White Oak Dam (X15)
- Dissolved Oxygen 14.0
- Chlorine
- Temperature

Sewage Treatment Plant (X01)
- pH 9.0
- Temperature
- Downstream pH
- Downstream Temperature

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DISPLAY 2

BUILD: DISPLAY MAIN.MENU (E)
Command ==> 1

WATER MONITORING AND ANALYSIS
FIELD DATA ENTRY SYSTEM

Main Menu
1. Data Entry
2. Double Data Entry

Enter END to Exit the system

Enter your selection at the Command ==> 

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BUILD: DISPLAY MAIN.MENU (E)
Command ==> 

BUILD: ATTR MAIN.MENU (E)
Command ==> 

<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Type</th>
<th>Libref</th>
<th>Catalog</th>
<th>Menu-Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENTRY1</td>
<td>MENU</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ENTRY2</td>
<td>MENU</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>END</td>
<td>EXIT</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

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WATER MONITORING AND ANALYSIS
FIELD DATA ENTRY SYSTEM

Data Entry Menu
1. EMP
2. Groundwater
3. NPDES
4. Offsite
5. Water
6. Return to Main Menu

Enter your selection at the Command ===>

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Option Name Type Libref Catalog Menu-Link
1 EMP MENU * *
2 GRWATER MENU * *
3 NPDES MENU * *
4 OFFSITE MENU * *
5 WATER MENU * *
6 MAIN MENU * *

BUILD: ATTRIBUTE ENTRY1.MENU (E)
Command ===>

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WATER MONITORING AND ANALYSIS
FIELD DATA ENTRY SYSTEM

NPDES Data Entry Menu

1. Daily Entry
2. Weekly Entry
3. 3XWeek Entry
4. Monthly Entry
5. Category I Entry
6. Category II Entry
7. Category III Entry
8. Cooling Systems Entry
9. Special Project Entry
10. 1504 Backwash Filters
11. Return To Entry1 Menu

Enter your selection at the Command ===> 

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<table>
<thead>
<tr>
<th>Option</th>
<th>Name</th>
<th>Type</th>
<th>Libref</th>
<th>Catalog</th>
<th>Menu-Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DAILY</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>WEEKLY</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>WEEK3X</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>MONTHLY</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CAT1</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CAT2</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CAT3</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>COOLS</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>SPECIAL</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>FILTER</td>
<td>PROGRAM</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>ENTRY1</td>
<td>MENU</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>.......</td>
<td>............</td>
<td>..........</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>.......</td>
<td>............</td>
<td>..........</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>
DISPLAY 6

BUILD: DISPLAY WEEKLY.PROGRAM (E)
Command ==> 

BUILD: SOURCE WEEKLY.PROGRAM (E)
Command ==> 

00001 INIT:
00002 CALL FSEDIT('NPDES.WEEKLY','NPDES.WEEKLY.SCREEN');
00003 RETURN;
00004
00005
00006
00007
00008

DISPLAY 7

OPTIONS NOCENTER;

LIBNAME NPDES1 'PG3DSK:[PG3.YEAR93.FIELD.NPDES]';
LIBNAME NPDES2 'PG3DSK:[PG3.YEAR93.FIELD_DIFF.NPDES_DIFF]';

*******************************
* SORT THE NPDES DATABASES *
*******************************

DATA NPDES1.WEEKLY; SET NPDES1.WEEKLY;
PROC SORT; BY DATE;

DATA NPDES2.WEEKLY; SET NPDES2.WEEKLY;
PROC SORT; BY DATE;

*******************************
* COMPARE THE NPDES DATABASES *
*******************************

DATA THREE;
PROC COMPARE BASE=NPDES1.WEEKLY COMPARE=NPDES2.WEEKLY BRIEFSUMMARY;

VAR DATE X13DO X13CL X13TEMP X14DO X14CL X14TEMP X15DO X15CL X15TEMP
    X01PH X01TEMP X01DSPH X01DSTMP;
WITH DATE X13DO X13CL X13TEMP X14DO X14CL X14TEMP X15DO X15CL X15TEMP
    X01PH X01TEMP X01DSPH X01DSTMP;

TITLE 'Comparing NPDES Monthly Datasets';