

November 1987

**Preparing,
Documenting,
and Referencing
Lotus
Spreadsheets**

040802 / 134610

Preparation of this Information Management and Technology Division (IMTEC) Technical Guideline was undertaken by the Lotus 1-2-3¹ Users' Group. The principal authors were Richard Donaldson and Harriet Ganson of the Boston Regional office. Major contributors were Amy Tidus and Barbara House, Los Angeles Regional Office; Steve Thummel, Kansas City Regional Office; and Stewart Seman, Chicago Regional Office.

This guideline is for Lotus 1-2-3 users who are familiar with its spreadsheet, data base, and graphic capabilities. A file (TEMPLATE.WKS), which provides a template of the documentation format suggested in this guideline, can be obtained by downloading it from the End-User Systems Bulletin Board, 275-1050.

¹Lotus and Lotus 1-2-3 are registered trademarks of the Lotus Development Corporation

Preface

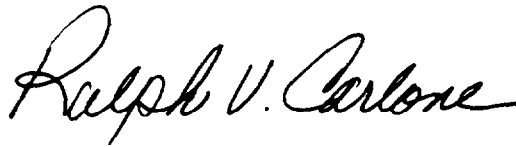
Much of the General Accounting Office's (GAO) work involves the use of spreadsheets prepared on microcomputers to analyze and develop data for use in reports and testimony. How to prepare, document, and reference spreadsheets prepared on microcomputers is a common concern throughout GAO.

This document provides guidance to Lotus users on preparing and documenting spreadsheets to meet job requirements, facilitate the referencing process, and ensure quality. In addition, it provides guidance on how to verify and reference Lotus spreadsheets provided as support for written products. Although this guidance applies specifically to Lotus 1-2-3, the principles and methodology discussed are applicable to other spreadsheets used for audit and evaluation purposes.

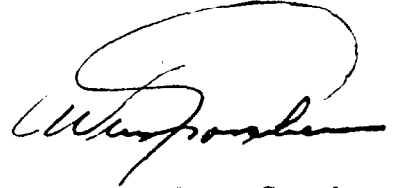
This guideline supplements and does not replace any other GAO policies or procedures. It provides additional information to that contained in IMTEC Technical Guideline 1, Using Micro Computers in GAO Audits: Improving Quality and Productivity, March 1986.

A GAO evaluator with Lotus training should be able to use Lotus to reference spreadsheets. It is important to note, however, that referencers are not required to be familiar with Lotus or other spreadsheet technology. GAO policy continues to require that if referencers encounter highly technical material or an unfamiliar methodology (econometric modeling, complex electronic spreadsheets, etc.) they are to obtain assistance. Referencers are responsible for verifying that a qualified individual from a technical assistance or economic analysis group, or other qualified person independent of the assignment, has examined and approved the manner in which data have been developed and used. These examinations should be documented and made part of the work papers, and such documentation should be acceptable to the referencer. (See the Report Manual page 7-6.)

We hope that the readers of this guideline will find the information presented here beneficial in developing, using, and referencing electronic spreadsheets.



Ralph V. Carlone
Director
Information Management and
Technology Division



Werner Grosshans
Director
Office of Policy

Contents

Preface		1
Chapter 1 Purpose of This Guideline		6
Chapter 2 Spreadsheet Development	Initial Planning Stage Data Entry and Analysis Stage Final Accuracy Check Stage	7 7 8 9
Chapter 3 Documentation Guidelines		11
Chapter 4 Referencer's Responsibilities and Duties		16
Chapter 5 Referencing Steps	Verify Supervisory Review Check Report Content for Accuracy and Support	17 17 18
Chapter 6 The Spreadsheet Auditor		23

Appendixes

Appendix I: Original Spreadsheet	24
Appendix II: Referencer-Reviewed Spreadsheet	30
Appendix III: Final Corrected Spreadsheet	36
Appendix IV: Spreadsheet Extract	42
Appendix V: Documentation Template	48
Appendix VI: Report Extract	50
Appendix VII: Referencing Review Sheet	51

Bibliography

52

Abbreviations

GAO	General Accounting Office
IMTEC	Information Management and Technology Division

Purpose of This Guideline

Appropriate quality control and documentation are essential throughout an assignment. The purpose of this paper is to provide guidance to Lotus users on how to prepare and document electronic spreadsheets that meet GAO quality assurance standards. In addition, it provides guidance on how to verify and reference Lotus spreadsheets.

This guidance is based on the following premises:

- Guidance should be consistent with all GAO rules and regulations.
- Guidance should have a minimal impact on the use of Lotus features for an evaluator's intended purpose.
- Guidance should facilitate supervisory review and the referencing process.

Evaluators should be able to use spreadsheets as direct support for checking the accuracy of report data. If Lotus spreadsheets are properly prepared and reviewed, referencers should be able to satisfy themselves as to the appropriateness and accuracy of the written product. On the other hand, since referencers are responsible for determining the accuracy of the written product, this guideline should not restrict them from doing whatever is needed to fulfill their duties.

This document offers guidance for the error-free preparation, documentation, and referencing of spreadsheets. The appendixes provide examples to assist both users (evaluators or supervisors) and referencers.

Appendixes I, II, III, and IV are examples of a spreadsheet that has gone through the progressive steps of supervisory review, referencing, and final draft. (Each spreadsheet's title is identified in cell A4.) Appendix I is the original spreadsheet with errors, prior to the referencer's review. Appendix II is the copy of the spreadsheet after the referencer has reviewed it. Appendix III is the final corrected version of the spreadsheet. Appendix IV is an extract of records from the original spreadsheet.

Appendix V provides Lotus users with a template for documenting spreadsheets according to the guidance contained in chapter 3. Appendix VI contains indexed and referenced extracts from the hypothetical report supported by the sample spreadsheets. Appendix VII is a Report Review Sheet (GAO Form 92) with sample referencer's points.

Spreadsheet Development

The following procedures and practices will facilitate the documentation and referencing process. They may be implemented during the initial planning stage, data entry and analysis stage, or during the final accuracy check stage of spreadsheet development.

Initial Planning Stage

The initial planning stage primarily involves planning activities that will result in the effective and accurate use of Lotus.

1. Mapping out the spreadsheet: Before entering any data, draw a map of what the spreadsheet should look like. For example, areas for documentation (see chapter 3), data entries, Lotus 1-2-3 macros,¹ and spreadsheet formulas should be defined. Further, it is a good idea to update the map as the spreadsheet changes or expands. A record of changes should be maintained for important data.

2. Developing an analysis plan: Develop an analysis plan for the spreadsheet before entering data to ensure that the data required for analysis are included and entered in a format amenable to the analytic techniques planned. The analysis plan should be documented and included in the work papers. If particularly complex, the plan, with risk assessment and tests of logic (including Lotus 1-2-3 functions), should be part of the planning stage of the assignment. If necessary, technical assistance should be obtained. Further, if the analysis involves using the data base functions, the requirements for using these features should be built into the spreadsheet plan.

3. Developing a validation plan: A validation plan, which includes using applicable quality controls throughout the job, will help ensure error-free spreadsheets. The most frequent errors in spreadsheets are data entry errors. One method for minimizing errors is to designate a specific area within the spreadsheet for data entry. All data should be entered in that area and verified before the data are used.

Cell references enable users to transfer the data to other areas of the worksheet without reentering the data, thus eliminating possible data entry errors. The Extract and Combine features of Lotus provide another excellent way of transferring the data to related spreadsheets without additional data entry, thus minimizing errors.

¹A macro is a set of user-defined stored keystrokes that automates Lotus 1-2-3 operations.

It is also a good idea to denote the parameters of the data entry area in the worksheet. One way of doing this is to mark the area in which data are to be entered with a repeating series of periods.

Also, the validation plan should contain steps to verify the data. Sampling and validation criteria should be established for each individual spreadsheet based primarily on sound auditing principles and professional judgment. Critical data should undergo more vigorous verification. (See page 14.) Some guidance on the minimum percentages to use in verifying data follow:

- Lotus files with less than 100 data elements:

All input items should be verified and all errors corrected.

- Lotus files with 101 to 500 data elements:

A 25-percent sample of input data should be verified. If the error rate is less than 1 percent of the sample, complete the verification by correcting the errors. If the error rate exceeds 1 percent, correct the errors and draw another 25-percent sample and repeat the procedure. If the error rate for the second sample is less than 1 percent, complete the verification by correcting the errors. If the error rate for the second sample exceeds 1 percent, correct the errors and complete a 100-percent verification of the remaining data elements.

- Lotus files with over 500 data elements:

A 10-percent sample of input data should be verified. If the error rate is less than 1 percent of the sample, complete the verification by correcting the errors. If the error rate exceeds 1 percent, correct the errors and draw another 10-percent sample and repeat the procedure. If the error rate for the second sample is less than 1 percent, complete the verification by correcting the errors. If the error rate for the second sample exceeds 1 percent, correct the errors and complete a 100-percent verification of the remaining data elements.

Data Entry and Analysis Stage

Lack of attention to data accuracy and clarity can make it difficult to understand or construct an audit trail on a spreadsheet after it is completed. The following quality assurance measures, implemented during the data entry and analysis stage, will help eliminate errors and facilitate supervisory review and referencing.

1. Minimize data entry errors by:

- using the pointer method to specify a cell or range rather than typing in cell addresses, and
- copying formulas and then using the "F2" key to edit. Take the time to verify the formula before copying it.

2. Use range names: Range names are a good way to identify cells. To facilitate the referencer's review, prepare a list of all named ranges and their locations in the spreadsheet (using "Range Name Create").

3. Protect formulas and key data: One of the most common errors is writing over a formula or key data. Using the Range Protect command will ensure that this will not happen.

4. Test the model: Test the spreadsheet's features, including its formulas and macros, with a small part of the data base to ensure that the spreadsheet works as planned. Using a partial data base rather than a complete spreadsheet saves time and makes it easier to identify errors in logic.

5. Correct mistakes as soon as they are identified: If an error is not corrected immediately, the task of locating the cell or cells causing the error message becomes more difficult as the spreadsheet becomes larger. This is especially true for circular references.

6. Format cells using two decimals: Lotus automatically rounds numbers to the next highest whole number. Using at least two decimals generally eliminates those cases where the total would exceed 100 percent.

Caution: This will not totally eliminate the possibility of generating totals exceeding 100 percent.

7. Write out macros: In the cells adjacent to macros, spell out what each macro command means (for example, "/wcs2 " would be written out as Worksheet, Column Width, Set, 2).

Final Accuracy Check Stage

Once you have completed data entry and verified its accuracy, there are several additional steps that may be taken to clarify the spreadsheet as well as ensure accuracy prior to printing. They are:

1. **Use foots and cross foots:** By adding an extra row and column of formulas that bracket the totals, the accuracy of the preliminary results can be checked.
2. **Use hash totals:** To verify that all records are included in the spreadsheet, various hash totals (a total arrived at by adding up the data elements to be used in the subsequent analysis) can be used.
3. **Use Automatic Recalculation:** Each spreadsheet should be set on Automatic Recalculation for a final recalculation before the information is used in the report and the spreadsheet is given to a referencer to be used as support for a statement of fact.
4. **Protect your spreadsheet:** After verification, when no further changes are anticipated to the spreadsheet, the entire spreadsheet should be protected using the Global Protect feature.
5. **Print out spreadsheet formulas:** Printing the formulas facilitates spreadsheet review. The formulas can be printed in two ways under Lotus:
 - In the Print command (using Options Other), select Cell Formulas. The contents of the cells in the print range will be printed one cell per line. The text of the formulas, not their values will be printed.
 - Using the Worksheet Global Format command (or the Range Format command), set the numerical format at "Text." Ensure that the column widths are wide enough to accommodate the longest formula. The spreadsheet can then be printed and the formulas will be located as they appear in the spreadsheet (as opposed to the one line per cell printing approach discussed above).

Another way to print out the spreadsheet formulas is to use a program like The Spreadsheet Auditor.² (See chapter 6).

This program has features that identify circular references and print formula reports that help identify logic errors in a spreadsheet. If such programs are available, they should be used by the preparer and supervisor. Supervisors will find The Spreadsheet Auditor particularly helpful when reviewing the spreadsheets and should use The Spreadsheet Auditor prior to referencing.

²The Spreadsheet Auditor is a registered trademark of Consumers Software, Inc.

Documentation Guidelines

Documenting spreadsheets helps ensure accuracy and provides supervisors and the referencer with essential audit trail information. This guideline should facilitate quality assurance. It does not preclude the use of any other GAO guidelines. Rather, this guideline suggests some approaches that have worked and that meet the needs of referencing. The use of supervisory checklists, cross-indexed tables of contents, and other processes or procedures needed or desired that help ensure quality, is encouraged.

Documentation requirements should not override the operational requirements of the spreadsheet. Some minimal documentation is required and should be on the disk, but this should not adversely affect the use of the spreadsheet. As much documentation as possible should be done during the development of the spreadsheet. However, some of the more detailed documentation steps can be entered after the spreadsheet layout, formulas, etc. have been finalized, thus minimizing the impact on the operation of the spreadsheet. The location of the documentation on the spreadsheet should be established first, however, even if some of the information is not entered until the end of the assignment.

This guideline suggests that the left side of the spreadsheet, columns A through I, be used to document the contents of the spreadsheet. Under this approach, documentation is recorded beginning in cell A2. Data, formulas, and all use of the spreadsheet can then start in column J. To facilitate review and referencing, row 1 and column I should be used for row and column coordinates. (See appendix I.) The Spreadsheet Auditor will print row and column coordinates automatically, thus eliminating the need to enter spreadsheet row and column coordinates. Such a layout generally permits the operation of the spreadsheet without preparation of the documentation adversely affecting the data and formulas or their presentation. For example, column widths or formatting columns for data presentation can be set without altering the documentation.

Caution: Users must be careful when inserting or deleting rows in the spreadsheet. Such actions could adversely alter the documentation.

In small spreadsheets where memory is not a problem, a “step down” approach can be used. For example, the worksheet part of the spreadsheet would start in column J in the row immediately following the documentation. This approach eliminates all problems related to adding or deleting both columns and rows in either the worksheet or the documentation area. In large spreadsheets, where memory is a problem, documentation can be done externally using the word processing program

WordPerfect.¹ For example, the same areas in columns A through I are set aside for the documentation. After the spreadsheet is complete, the WordPerfect documentation can be merged into the documentation area. This also provides a hard copy of the documentation as a backup.

In all cases, a final check should be made to validate the integrity of the documentation, including the labels for worksheet row and column coordinates.

In the example spreadsheets used with this guideline (see appendixes I, II, III, and IV), the documentation is recorded in cells A2 to H138. Also, key items such as job title, code, filename, and source are located in specific cells. If key items are always placed in the same location, it makes it easier for reviewers and referencers to locate them. Also, macros and templates can be used to create pro forma spreadsheets or operate on the cells containing this documentation information. (See appendix V.)

Some spreadsheets may require more extensive documentation than is practical to place within the spreadsheet itself. In such instances, external documentation can be used for detailed explanation of the spreadsheet. The internal documentation would still contain the elements listed below, with keys to the external documentation.

Computer-generated spreadsheets must meet all the quality assurance standards required by GAO. The procedures followed in describing a Lotus spreadsheet are similar to those followed in describing any work paper. The following discussion highlights critical documentation items. A cell reference, in parentheses, indicating where the information is located on the sample spreadsheets, is provided at the end of each item. (See appendix III for examples of each item.)

1. Job title and code: The job title and code should be entered just after the spreadsheet layout. (A22..D23)
2. Title of the spreadsheet: The title should be concise and convey the primary focus of the information included in the spreadsheet. (A25)
3. Work-paper index: The work-paper index title, similar to the indexing system used in paper files, will allow the reader to determine the exact location of the data and how it relates to other work papers. The file name should be used as the work-paper index; if a title other than the

¹WordPerfect is a registered trademark of the WordPerfect Corporation.

file name is used, the file name should be included elsewhere in the title screen area. The index should be in cell B2. Also, the name of the person who last updated the spreadsheet and the date this was done should be entered in this area. (A2..H2)

Every printed spreadsheet must also have a footer that incorporates the disk title/reference number, file name, page number, and job code. This can be done by selecting Footer under Options and entering the following:

Disk: XYZ, File Name: ABCDE.WKS | Page # | Job Code: 123456

4. Purpose: The purpose of the spreadsheet should be described briefly, including whether the spreadsheet represents a specific audit step in the assignment. (A27..B28)

5. Preparer and date: The name of the individual preparing the spreadsheet and the date of preparation/update should be noted in this area. (A129..B132) The date and preparer's name, as well as the job title, must also be included at the top of each printed spreadsheet. This can be done by selecting Header under Printer Options and entering the following:

@ | Job Title: ABCDEF REVIEW | Preparer: Joe Preparer

6. Reviewer and date: The name of the reviewer and the date of the most recent review should be entered. Subsequently, the referencer may confirm that no changes were made to the spreadsheet after the date noted by the reviewer by returning to the Disk Operating System and using the Directory command. The date listed in the directory, signifying when the file was last modified, can be compared to the reviewer's date on the spreadsheet. (E129..F132)

7. Description: The description of the spreadsheet, like a work-paper summary, provides the reviewer with an understanding of the major topics covered in the spreadsheet, how it fits into the overall job, and the logic and assumptions underlying spreadsheet development. (A30..A35)

8. Source: A critical component of spreadsheet documentation is identifying the sources of data entered. If all the data were extracted from a single source, this source should be included in the title area (A37).

However, if there are multiple sources, they should be identified in conjunction with the data. For example, if all the data in that column and row are from the same source, the source could be listed immediately under the related column or row heading. If the sources are cell specific, a column could be inserted, with the corresponding sources next to the cells. (See appendix III, column K.) In some cases, the source of the spreadsheet could be another spreadsheet. For example, if a data query were done and the results of the query were saved as a separate file, this spreadsheet would have as its source the file name of the spreadsheet with the source data. Cell B41 of the sample spreadsheet (appendix IV) shows how this is done.

9. Data verification: This indicates data entry verification and control procedures. For example, if 10 percent of the data items have been verified, describe the process used and the results. (A39..A40)

The extent of data verification can vary depending on the nature of the data and how critical the data is to a finding. If it is considered very important, 100-percent verification may be necessary.

10. Spreadsheet Layout: Use this space to document the cell addresses for each component of the spreadsheet—data entry, formula explanations, macro explanations and purpose, and range names and their cell addresses, for example. (A11..F20)

11. Printing: Wide carriage printers and compressed print are recommended for printing the spreadsheet(s). Using the Borders Rows Option with a cell in column A as the borders range will print the column coordinates at the top of each page. (See appendixes I, II, III, and IV.)

The topics listed above are not meant to be all-inclusive. Depending on the complexity of your spreadsheet, more sophisticated documentation procedures may be required. We recommend including the documentation in the spreadsheet as soon as possible. If this creates an obstacle for the efficient use of a spreadsheet, the documentation could be temporarily placed in another part of the spreadsheet or completed at the end of the assignment. If this latter approach is used, some detailed external notes on the operation of the spreadsheet should be maintained to facilitate the final documentation process.

The sample spreadsheets used with this guideline contain the documentation information in specific locations in the spreadsheet. We recommend that these locations always be used unless they interfere with the

use of the spreadsheet. By reserving the same location on each spreadsheet, users and reviewers will always know where to locate the documentation. This will also facilitate the use of the features of the computer to help us in our work. This approach also allows the development of templates to help the documentation and referencing process. Appendix V contains an example of such a template.

Referencer's Responsibilities and Duties

Referencing is an internal quality control procedure that helps ensure that GAO's written products are accurate, adequately supported, and logical. Referencers are responsible for the factual accuracy of the product and, as such, will be responsible for determining the

- correctness and consistency of figures or statements of facts with the support provided;
- accuracy of computations within the document;
- agreement with earlier reports cited;
- adequacy of supporting sources; and
- logical soundness of the facts and evidence provided.

The use of microcomputers does not lessen the referencer's responsibility. The Assistant Comptroller General for Operations, in a July 23, 1984, memorandum to the heads of all divisions and offices regarding quality in microcomputer-generated material stated:

"GAO's referencing and report review activities will be the primary mechanism for assuring quality and accuracy."

The referencer's responsibility remains the same regardless of how the support for a report was acquired or analyzed. Most standard referencing procedures still apply. Consequently, an audit trail must be provided so that report data can be traced back through the various processing steps and intermediate files to the source data. The work papers should also fully document the procedures used to process the data (for example, Lotus macros and data queries).

Although it is not required, it is preferable for a referencer to understand how to use the Lotus spreadsheet package if the job being referenced relies extensively on Lotus spreadsheets for analysis. If the spreadsheets are too complex, however, an expert in Lotus should be asked to reference the section of the report supported by the spreadsheets. (See the GAO Report Manual page 7-6.) The referencing process is not a substitute for proper quality control checks throughout the job, however. These checks include a supervisory review of work papers, management reviews, and a detailed line edit of the product. Others are responsible for these functions.

Referencing Steps

A referencer's involvement with Lotus spreadsheets begins when the written product is indexed to an analysis that was done using Lotus. If the analysis is simple enough, adequate support may be limited to a printout of the spreadsheet and the formulas along with the appropriate documentation. In these cases, a referencer may not have to use a computer for additional analysis. The key factor, however, is that the material provided to the referencer must adequately support the facts in the written product.

In most cases, however, the referencing process should be done with a computer. The use of a computer is required because printed copies of spreadsheets do not display error messages, such as ERR and CIRC, which inform the reader that errors have occurred. (See page 19, paragraph c.) Furthermore, all electronically-stored data needed in the referencing process must also be provided to the referencer in the form of hard copy products. The referencer should also be supplied with a disk containing the Lotus files that produced the hard copy so that he/she can analyze the Lotus material directly or with the Spreadsheet Auditor package. (See chapter 6).

Verify Supervisory Review

Before staff can expect a referencer to evaluate the adequacy of spreadsheet evidence, the supervisor must ensure that the supporting spreadsheets are in proper condition for examination. Thus, the first step in the referencing process is to verify that the spreadsheet has received proper supervisory review. These reviews assist referencers in determining that the logic implied or stated in the report is consistent with the analysis that generated the results. Referencers must determine that this logic is correct within the Lotus spreadsheets when they are used as the supporting analysis. Although it would be too time consuming for a referencer to review an entire spreadsheet for correctness of logic, someone on the job should do it, usually the supervisor of the person who prepared the spreadsheet. When dealing with Lotus spreadsheets, the steps needed to verify supervisory review are as follows:

- Check the internal documentation part of the spreadsheet for evidence of supervisory review, such as a supervisor's name and the date of the review entered in the spaces provided. Hard copy backup must include the supervisor's signature. (See appendixes I, II, III, and IV.)
- Compare the review date entered in the spreadsheet to the date on the directory of the disk on which the spreadsheet is stored. If they are different, obtain some explanation. A directory date after the date in the

spreadsheet may mean that the spreadsheet was changed after supervisory review.

Check Report Content for Accuracy and Support

The referencer is responsible for ensuring that proper quality control procedures were used and all points of fact in a written product are accurate. Thus, if the report index for a fact or figure is a Lotus spreadsheet, the referencer must trace those figures to the supporting spreadsheet. Some of the specific steps a referencer may follow are listed below.

1. Review the spreadsheet documentation, both internal and external, to become familiar with the purpose of the spreadsheet and the way it was designed. The spreadsheets used as examples with this guideline use columns A to I for documentation. (See chapter 3 for guidance on documenting the spreadsheet.)

2. Verify the formulas used to calculate report items or determine that verification has been performed. Verifying formulas involves checking ranges, the logic of the formulas, spreadsheet messages, and conducting tests—it does not require using a calculator to check the accuracy of the Lotus mathematics. This step is not a substitute for supervisory review of the soundness of the analytical approach and formulas used. However, because a referencer is responsible for the accuracy of all facts in a report, additional verification steps may be followed when referencing important facts and figures. For example, using a computer or a printout of the formulas used to complete appendix I would disclose that the formula in cell U2 does not agree with the explanation shown in cell A109. Specifically, the referencer would note that the range of values included in the formula is U5..U78 instead of U5..U77.

a. Check the range of the formula used to calculate the numbers in the report. For example, in appendix I, there is a formula (cell U82) that calculates the number of hours the agency's computer was down. A referencer must ensure that the range specified in this formula is correct. That is, only the items that should be in the range are included. As noted above, the range specified in cell U82 includes an extra cell that inflates the down time hours. Thus, if the report states that in January 1986 there were 73 instances of down time during business hours for a total of 491 hours, then the statement is wrong. The report should state that there were 69 instances of down time during business hours with a total down time of 245 hours. There are 69 instances because four instances resulted in no down time during business hours. The total hours of down

time are 245, not 491, because of the error in cell U82. (See appendix VI for the original and revised draft of the report which shows the preparer's indexing notes and the referencer's referencing points.) This error is noted in the referencer's review of the spreadsheet, appendix II, cells A116..H121, and corrected in the final version, appendix III, cells D121..U82.

b. Check the logic of the formula. An @SUM is straightforward, but other formulas, @IF functions for example, may be more difficult to understand. For example, columns Q and R of the sample spreadsheets (appendixes I, II, III, and IV), contain @IF functions to ensure that events only refer to down time during business hours, and thus would have had an impact on office operations. A referencer should determine if the formula has the correct logic, that is, that it agrees with statements in the report. If the formula is designed to identify the instances of down time outside normal business hours, but the report states the number of instances within normal business hours, the referencer should make a point of this fact on GAO Form 92. (See appendix VII.) An examination of the formulas in appendix I, cells A53 through A110 in the spreadsheet layout discloses the logic of all formulas and would reveal this error.

To facilitate the review of formula logic, the referencer should be provided with a printout of the spreadsheet formulas. The ideal way of presenting formulas is in the same grid structure as the spreadsheet. This can be done with software such as The Spreadsheet Auditor. (See chapter 6.) Otherwise, the spreadsheet and its formulas can be printed by invoking the Range Format Text Option. This option displays the actual content of each cell. Thus, formulas are displayed as formulas, not as results. The Lotus option of printing cell formulas in a list format can also be used. This may be a better option if the formulas are too long to be displayed in a grid format. Whatever method is used, it should be adequate to permit a referencer to follow the logic of the formulas used. Complex formula logic should be written out. (See appendix I, cells A53..A110.)

c. Check for Lotus messages. Lotus displays messages at the bottom of a spreadsheet which do not show on printed copies of the spreadsheet. For example, if Manual Recalculation is on and the spreadsheet has not been recalculated since the last data change, the message CALC will be displayed on the monitor. The CALC message could be an indication that

a problem exists with the results presented. If the CALC message is displayed, the referencer should inform the staff so that they can recalculate the spreadsheet before reporting any information from it.

Lotus also gives ERR and CIRC messages when there are problems with formulas. If either of these appear in the spreadsheet provided for support, the referencer should not accept the output as support without a documented explanation. The referencer should make a point of this on GAO Form 92 (see appendix VII) and inform the preparer so that he/she can correct the problem.

d. Test selected critical items. A referencer should test and verify selected critical items of information from lead schedules to the indicated sources. This should be done to insure that supervisory reviews are effective and that cross-indexing is accurate. The referencer can also request source documentation when he/she finds errors in lead and back-up schedules. Some specific tests are outlined in chapter II.

Tested items should be marked to indicate that they have been verified. When using paper documents, such as a printed copy of the spreadsheet, use a red T (for traced). If done on the computer, a T in a particular column reserved for the referencer can be used. This kind of a system was used in the sample of the referencer's review of the spreadsheet included with this paper. (See appendix II, column V.) When a referencer verifies items, he/she should describe the testing done and the marking system used. The referencer should enter his/her name and the date on the spreadsheet as an indication that the referencer entered these marks.

If no additional changes are requested by the referencer, no further updating of this file should be done. If additional changes are needed, the referencer should review the changes. This review is probably necessary since changes to the report have to be re-referenced.

3. If Lotus data base features are used, additional documentation should be provided to the referencer.

a. A referencer should verify a sample of the ranges used in data base functions. Any data base function requires that a criterion range and an input range be specified in order to tell Lotus what to look for. In addition, if the selected items are to be copied to another section of the spreadsheet using the Extract or Unique options, an output range must be specified. All of these ranges must be noted in the documentation

part of the spreadsheet. The referencer must review these ranges to determine if the items selected agree with those presented in the report. An example of the documentation required when using Lotus 1-2-3 data base functions is contained in appendix IV.

b. Each data query must be documented. If multiple data queries are made there may be multiple output and criterion ranges. If so, each range must be documented in such a way that referencers can follow the logic used to select the items that appear in the report. If the number of queries becomes sufficiently large, the staff should consider extracting the items selected and creating separate spreadsheets. The extracted spreadsheets must have the same level of documentation as the source. It may also help the referencer if some record counts and identification numbers are included in the extracted and source spreadsheet to verify record accuracy. (See discussion on File Combines and Extracts, number 6 below.)

4. If macros are used to perform any functions on the data that will have an impact on critical information presented in a report, the referencer should check the accuracy of the macro. At the very least, he/she should determine that the macro has received proper supervisory review. The macro should be described in English, either internally in the spreadsheet or externally in some other form of documentation.

5. If Lotus graphics are used in any product requiring referencing, the same attention to detail will be needed to ensure that the graphics in the written product properly depict the data in the spreadsheet. The referencer should ensure that the following verification has been done. He/she can then choose to do additional verification.

a. The data ranges. The range should include the data that the written product says it represents.

b. The axes. They should agree with the written product presentation.

c. The legends. The data the legend represents in the written product must parallel the data in the spreadsheet.

The referencer can compare source or summary data to the graphs to determine if they properly reflect the data. Also, referencers should verify that the rates of change depicted in the graphs reflect actual changes in the data. Interpretation can be a problem when bar or line graphs do

not display zero origins. In such instances, the referencer should ensure that the graphs are not misleading.

6. Use of features such as File Combine and File Extract will have a further impact on the referencing and documentation process.

a. If a spreadsheet is too large to fit on one floppy disk and is not on a hard disk, it has to be combined. If so, both internal and external documentation must specify that the spreadsheet is on two disks and the disks themselves must be labeled as such. The referencer must be assured that the complete file is available to him/her when the report is referenced.

b. Evidence of supervisory review must also be present on all files that are combined into one spreadsheet or noted in external documentation to assure that nothing was overlooked in the review process.

c. If sections of a spreadsheet were extracted and considered separate spreadsheets, these individual spreadsheets must meet all the documentation requirements described in chapter 3. The referencer must determine that these spreadsheets have received proper review. The referencer must also be able to trace the data contained in them to the sources. Thus, the extracted spreadsheets should be indexed to the original spreadsheet. For example, cell A41 of appendix IV refers the reviewer to appendix I as the source spreadsheet.

These guidelines should facilitate referencing. However, regardless of how well the spreadsheet is documented, the referencer has the final say (except when overridden by the Associate Director or his/her designee) as to what will be acceptable support for a written product or testimony. Thus, the referencer should take any steps necessary and look at whatever level of detail is needed to satisfy himself or herself as to the accuracy of the document being referenced. If a referencer believes more information is needed, he/she should ask for additional support.

The Spreadsheet Auditor

The Spreadsheet Auditor is a software package designed to serve as an aid in creating error-free spreadsheets. This package is used throughout GAO in conjunction with the Lotus spreadsheets to identify potential errors. The current version (3.0) enables the user to simply view problems without having to print out the entire spreadsheet, and it can identify potential flaws in ranges and formulas. The Spreadsheet Auditor prints out a description of ranges, a map indicating which cells contain formulas, labels, numbers or macros, and a formula report.

An interactive tutorial and two other utilities are also included in The Spreadsheet Auditor. One of the utilities prints the spreadsheet sideways for extra-wide spreadsheets that will not fit across the printer page. The other utility attaches notes to cells in a spreadsheet to help document the assumptions that went into the spreadsheet, for the referencer or others who will review the work.

The Spreadsheet Auditor is a useful tool for Lotus users, reviewers, and referencers. Users can use it to create well-documented and error-free spreadsheets. Supervisors reviewing spreadsheets and referencers can use it to understand spreadsheet design and methodology or find errors. Copies of The Spreadsheet Auditor have been distributed GAO-wide. Individuals interested in using it should check with their respective Microcomputer Focal Points.

**Appendix I
Original Spreadsheet**

N	O	P	Q	R	S	T	U	V
Time Down (24 Hr. Clock)	Date Up (24 Hr. Clock)	Time Up (24 Hr. Clock)	Time-down Bus Hours (D)	Time-up Bus Hours (U)	-----Interim calculation----- Hours convrt to minutes (H)	Minutes convrt to minutes (M)	Number of minutes down dur bus hrs	REF CHK NRK
610	03-Jan-86	1052	800	1052	120	52	172	
730	03-Jan-86	930	800	930	60	30	90	
515	03-Jan-86	1030	800	1030	120	30	150	
610	03-Jan-86	900	800	900	0	0	0	
415	03-Jan-86	900	800	900	60	0	60	
830	03-Jan-86	1052	930	1052	120	22	142	
700	03-Jan-86	930	800	930	60	30	90	
755	03-Jan-86	930	800	930	60	30	90	
845	03-Jan-86	930	845	930	60	-15	45	
936	03-Jan-86	1000	936	1000	60	-36	24	
410	03-Jan-86	800	900	900	0	0	0	
1125	03-Jan-86	1700	1125	1630	300	5	305	
610	03-Jan-86	2200	800	1630	480	30	510	
720	03-Jan-86	1100	800	1100	180	0	180	
720	03-Jan-86	1204	800	1204	240	4	244	
722	03-Jan-86	1235	800	1235	240	35	275	
935	03-Jan-86	940	935	940	0	5	5	
935	03-Jan-86	2300	935	1630	420	-5	415	
1105	03-Jan-86	1123	1105	1123	0	18	18	
715	03-Jan-86	800	800	800	0	0	0	
900	03-Jan-86	1634	900	1630	420	30	450	
1445	03-Jan-86	1830	1445	1630	120	-15	105	
815	03-Jan-86	850	815	850	0	35	35	
610	06-Jan-86	955	800	955	60	55	115	
610	06-Jan-86	1655	800	1630	480	30	510	
615	06-Jan-86	845	800	845	0	45	45	
755	06-Jan-86	1032	800	1032	120	32	152	
755	06-Jan-86	807	800	807	0	7	7	
1444	06-Jan-86	2130	1444	1630	120	-14	106	
1015	06-Jan-86	1700	1015	1630	360	15	375	
1135	07-Jan-86	1158	1135	1158	0	23	23	
810	07-Jan-86	1230	810	1230	240	20	260	
630	08-Jan-86	800	800	800	0	0	0	
850	08-Jan-86	857	850	857	0	7	7	
955	08-Jan-86	2200	955	1630	420	-25	395	
1000	08-Jan-86	1755	1000	1630	360	30	390	
1113	09-Jan-86	1150	1113	1150	0	37	37	
715	09-Jan-86	1220	800	1220	240	20	260	
720	09-Jan-86	1130	800	1130	180	30	210	
1055	10-Jan-86	1600	1055	1600	360	-55	305	
715	10-Jan-86	1800	800	1630	480	30	510	
730	10-Jan-86	1605	800	1605	480	5	485	
1112	10-Jan-86	2100	1112	1630	300	18	318	
912	13-Jan-86	1353	912	1353	240	41	281	
655	13-Jan-86	1700	800	1630	480	30	510	
630	14-Jan-86	805	800	805	0	5	5	
645	14-Jan-86	1130	800	1130	180	30	210	
645	14-Jan-86	1350	800	1350	300	50	350	
1142	14-Jan-86	1150	1142	1150	0	8	8	
642	14-Jan-86	1445	800	1445	360	45	405	
855	14-Jan-86	2031	855	1630	480	-25	455	
915	14-Jan-86	945	915	945	0	30	30	

**Appendix I
Original Spreadsheet**

A	B	C	D	E	F	G	H	I	J	K	L	M
								57	53	SC-88	SCRS	14-Jan-86
								58	54	AC-102	ACTRA	15-Jan-86
								59	55	ERS-121	ERS	15-Jan-86
								60	56	P-57	9040	15-Jan-86
								61	57	ERS-128	ERS	16-Jan-86
								62	58	P-62	9040	16-Jan-86
								63	59	G-37	Restrict GUF	17-Jan-86
								64	60	SC-91	SCRS	20-Jan-86
								65	61	SC-93	SCRS	21-Jan-86
								66	62	SC-96	SCRS	21-Jan-86
								67	63	SC-99	SCRS	23-Jan-86
								68	64	AC-114	ACTRA	23-Jan-86
								69	65	P-71	9040	23-Jan-86
								70	66	SC-138	SCRS	24-Jan-86
								71	67	SC-140	SCRS	24-Jan-86
								72	68	SC-142	SCRS	24-Jan-86
								73	69	SC-147	SCRS	24-Jan-86
								74	70	AC-128	ACTRA	24-Jan-86
								75	71	SC-150	SCRS	27-Jan-86
								76	72	AC-136	ACTRA	28-Jan-86
								77	73	AC-139	ACTRA	29-Jan-86
								78				
								79				
								80				
								81				
								82				
								83				
								84				
								85				
								86				
								87				
								88				
								89				
								90				
								91				
								92				
								93				
								94				
								95				
								96				
								97				
								98				
								99				
								100				
								101				
								102				
								103				
								104				
								105				
								106				
								107				
								108				
								109				
								110				
								111				

Disk: XYZ, File Name: LOTUSREF.WKS

**Appendix I
Original Spreadsheet**

A	B	C	D	E	F	G	H	I	J	K	L	M
REVIEWER COMMENTS: Spreadsheet formulas, logic and documentation									112			
reviewed and found to be ok.									113			
												114
												115
REFERENCER COMMENTS:									116			
												117
												118
												119
												120
												121
												122
CONTROL TOTALS:									123			
Number of items in this selection [cell U79]:						73						124
												125
Total minutes down during bus. hours [cell U78]:						14,730						126
												127
												128
Preparer: _____				Reviewer: _____								129
												130
				Joe Evaluator						Sally Supervisor		131
Date:				May 15, 1986						Date:		132
												133
												134
Referencer: _____									135			
												136
												137
												138
												139
												140
												141
												142

Disk: IYZ, File Name: LOTUSREF.WKS

Appendix I
Original Spreadsheet

N O P Q R S T U Y

Referencer-Reviewed Spreadsheet

A	B	C	D	E	F	G	H	I	J	K	L	M																								
REPCOPY.WKS		CODE 999406		Preparer: Joe	Evaluator		6/26/86	2																												
CONTENT: This spreadsheet contains the copy of LOTUSREF.WKS after the referencer has reviewed it.								3	GAO	Source	File/																									
-----								4	I.D.	(Page #)	System Down	Date Down																								
								5	1	C-4	Restrict CAPR	03-Jan-86																								
								6	2	B-29	Restrict BAIM	03-Jan-86																								
								7	3	B-246	RMS	03-Jan-86																								
								8	4	G-20	Restrict GUP	03-Jan-86																								
								9	5	E-12	Restrict EKIP1	03-Jan-86																								
								10	6	C-56	Restrict CAPT	03-Jan-86																								
								11	7	Z-104	Restrict ZAIN	03-Jan-86																								
								12	8	I-28	Restrict IAIM2	03-Jan-86																								
								13	9	I-32	Restrict IAIM1	03-Jan-86																								
								14	10	I-37	Restrict IAIM5	03-Jan-86																								
								15	11	E-48	Restrict EKIP2	03-Jan-86																								
								16	12	I-82	Restrict IAIM3	03-Jan-86																								
								17	13	I-84	Restrict IAIM4	03-Jan-86																								
								18	14	SS-3	SSNAD	03-Jan-86																								
								19	15	RI-12	RIWAD	03-Jan-86																								
								20	16	P-40	9040	03-Jan-86																								
								21	17	AM-22	ANSTU	03-Jan-86																								
								22	18	AM-22	AMTIN	03-Jan-86																								
								23	19	ERS-31	ERS	03-Jan-86																								
								24	20	AM-23	ANLOC	03-Jan-86																								
								25	21	AMS-27	ANSOC	03-Jan-86																								
								26	22	ANP-11	ANPAR	03-Jan-86																								
								27	23	ANPE43	ANPEL	03-Jan-86																								
								28	24	NH-68	NHPEH	06-Jan-86																								
								29	25	TD-37	TDIRO	06-Jan-86																								
								30	26	Z-56	Restrict ZTIP1	06-Jan-86																								
								31	27	AMR-75	AMREP	06-Jan-86																								
								32	28	SS-25	SSNAD	06-Jan-86																								
								33	29	SC-24	SCRS	06-Jan-86																								
								34	30	ERS47	ERS	06-Jan-86																								
								35	31	AC-58	ACTRA	07-Jan-86																								
								36	32	ERS-59	ERS	07-Jan-86																								
								37	33	SC-31	SCRS	08-Jan-86																								
								38	34	AC-61	ACTRA	08-Jan-86																								
								39	35	AMR-07	AMREP	08-Jan-86																								
								40	36	ERS-65	ERS	08-Jan-86																								
								41	37	AC-67	ACTRA	09-Jan-86																								
								42	38	C-32	CIDS	09-Jan-86																								
								43	39	ERS-73	ERS	09-Jan-86																								
								44	40	SC-40	SCRS	10-Jan-86																								
								45	41	AC-78	ACTRA	10-Jan-86																								
								46	42	ERS-80	ERS	10-Jan-86																								
								47	43	P-37	9040	10-Jan-86																								
								48	44	SC-46	SCRS	13-Jan-86																								
								49	45	P-42	9040	13-Jan-86																								
								50	46	SC-50	SCRS	14-Jan-86																								
								51	47	BT-12	BTIP2	14-Jan-86																								
								52	48	BT-16	BTIP4	14-Jan-86																								
								53	49	SC-78	SCRS	14-Jan-86																								
								54	50	AC-84	ACTRA	14-Jan-86																								
								55	51	SC-86	SCRS	14-Jan-86																								
								56	52	ERS-96	ERS	14-Jan-86																								
<p>DOCUMENTATION</p> <p>SPREADSHEET LAYOUT:</p> <table border="0"> <tr> <td></td> <td>Documentation section</td> <td>A8..H138</td> </tr> <tr> <td></td> <td>Data section</td> <td>J2..P77</td> </tr> <tr> <td></td> <td>Computation and Analysis</td> <td>Q2..U88</td> </tr> <tr> <td></td> <td>Formula explanations</td> <td>A51..H110</td> </tr> <tr> <td></td> <td>Criterion range</td> <td>NONE</td> </tr> <tr> <td></td> <td>Reviewer's comments</td> <td>A112..H114</td> </tr> <tr> <td></td> <td>Referencer's comments</td> <td>A116..H121</td> </tr> <tr> <td></td> <td>Control section</td> <td>A123..H126</td> </tr> </table> <p>JOB TITLE: Lotus Referencing and Documentation Project CODE: 999406</p> <p>TITLE: Schedule of Computer System Downtime for Jan 1986</p> <p>PURPOSE: To determine the number of minutes the computer was down during business hours on a given day.</p> <p>DESCRIPTION: This is a schedule of down time and date for a large computer system. The intent of the analysis is to determine the amount of time the system was down during business hours and the impact on agency operations and other users. The data from this spreadsheet will be combined with data on agency transactions to determine the impact.</p> <p>SOURCE: Computer system logs (see page reference number in column K)</p> <p>DATA VERIFICATION: All 73 items were checked back to the system log and found to be accurate.</p> <p>CRITERIA AND ASSUMPTIONS:</p> <p>Business hours = The hours (Eastern Standard Time) between which Agency IYZ's offices are open to the general public (0800 to 1630 hours).</p> <p>Work days = Monday through Friday, except for holidays (January 1 and 20).</p> <p>FORMULA EXPLANATIONS:</p> <p>COLUMN Q: @IF(N5<800,800,N5) The purpose of this formula is to convert those instances where the computer was down prior to the start of the business day (800), to read as 800. For example, if the time down (col. N) was 0630,</p>														Documentation section	A8..H138		Data section	J2..P77		Computation and Analysis	Q2..U88		Formula explanations	A51..H110		Criterion range	NONE		Reviewer's comments	A112..H114		Referencer's comments	A116..H121		Control section	A123..H126
	Documentation section	A8..H138																																		
	Data section	J2..P77																																		
	Computation and Analysis	Q2..U88																																		
	Formula explanations	A51..H110																																		
	Criterion range	NONE																																		
	Reviewer's comments	A112..H114																																		
	Referencer's comments	A116..H121																																		
	Control section	A123..H126																																		
Disk: IYZ, File Name: REPCOPY.WKS																																				

**Appendix II
Referencer-Reviewed Spreadsheet**

N	O	P	Q	R	S	T	U	V
-----Interim calculation-----								Number of
Time Down (24 Hr. Clock)	Date Up (24 Hr. Clock)	Time Up (24 Hr. Clock)	Time-down Bus Hours (D)	Time-up Bus Hours (U)	Hours convrt to minutes (H)	Minutes convrt to minutes (M)	minutes down dur bus hrs	REP CHK
610	03-Jan-86	1052	800	1052	120	52	172	
730	03-Jan-86	930	800	930	60	30	90	
515	03-Jan-86	1030	800	1030	120	30	150	T
610	03-Jan-86	800	800	800	0	0	0	
415	03-Jan-86	900	800	900	60	0	60	
830	03-Jan-86	1052	830	1052	120	22	142	
700	03-Jan-86	930	800	930	60	30	90	T
755	03-Jan-86	930	800	930	60	30	90	
845	03-Jan-86	930	845	930	60	-15	45	
936	03-Jan-86	1000	936	1000	60	-36	24	
410	03-Jan-86	800	800	800	0	0	0	
1125	03-Jan-86	1700	1125	1630	300	5	305	
610	03-Jan-86	2200	800	1630	480	30	510	
720	03-Jan-86	1100	800	1100	180	0	180	
720	03-Jan-86	1204	800	1204	240	4	244	T
722	03-Jan-86	1235	800	1235	240	35	275	
935	03-Jan-86	940	935	940	0	5	5	
935	03-Jan-86	2300	935	1630	420	-5	415	
1105	03-Jan-86	1123	1105	1123	0	18	18	
715	03-Jan-86	800	800	800	0	0	0	
900	03-Jan-86	1634	900	1630	420	30	450	
1445	03-Jan-86	1830	1445	1630	120	-15	105	
815	03-Jan-86	850	815	850	0	35	35	
610	06-Jan-86	955	800	955	60	55	115	
610	06-Jan-86	1655	800	1630	480	30	510	
615	06-Jan-86	845	800	845	0	45	45	
755	06-Jan-86	1032	800	1032	120	32	152	T
755	06-Jan-86	807	800	807	0	7	7	
1444	06-Jan-86	2130	1444	1630	120	-14	106	
1015	06-Jan-86	1700	1015	1630	360	15	375	
1135	07-Jan-86	1158	1135	1158	0	23	23	
810	07-Jan-86	1230	810	1230	240	20	260	
630	08-Jan-86	800	800	800	0	0	0	
850	08-Jan-86	857	850	857	0	7	7	
955	08-Jan-86	2200	955	1630	420	-25	395	
1000	08-Jan-86	1755	1000	1630	360	30	390	
1113	09-Jan-86	1150	1113	1150	0	37	37	
715	09-Jan-86	1220	800	1220	240	20	260	
720	09-Jan-86	1130	800	1130	180	30	210	
1055	10-Jan-86	1600	1055	1600	360	-55	305	
715	10-Jan-86	1800	800	1630	480	30	510	T
730	10-Jan-86	1605	800	1605	480	5	485	
1112	10-Jan-86	2100	1112	1630	300	18	318	
912	13-Jan-86	1353	912	1353	240	41	281	
655	13-Jan-86	1700	800	1630	480	30	510	
630	14-Jan-86	805	800	805	0	5	5	
645	14-Jan-86	1130	800	1130	180	30	210	
645	14-Jan-86	1350	800	1350	300	50	350	
1142	14-Jan-86	1150	1142	1150	0	8	8	
642	14-Jan-86	1445	800	1445	360	45	405	
855	14-Jan-86	2031	855	1630	480	-25	455	
915	14-Jan-86	945	915	945	0	30	30	

Appendix II
Referencer-Reviewed Spreadsheet

A	B	C	D	E	F	G	H	I	J	K	L	M
the formula would tell Lotus to show the time down as 800 in col.Q.								57	53	SC-88	SCRS	14-Jan-86
This would enable analysis of down time elapsed during business hours.								58	54	AC-102	ACTRA	15-Jan-86
If the time down was equal to or later than 800, the actual time down would show in column Q.								59	55	ERS-121	ERS	15-Jan-86
								60	56	P-57	9040	16-Jan-86
								61	57	ERS-128	ERS	16-Jan-86
								62	58	P-62	9040	16-Jan-86
COLUMN R: @IF(P5>1630,1630,P5)								63	59	G-37	Restrict GUP	17-Jan-86
The purpose of this formula is to convert those instances where the computer came up after the end of the business day (1630), to read as 1630. For example, if the time up (col. P) was 1800, the formula would tell Lotus to show the time up as 1630 in col. R.								64	60	SC-91	SCRS	20-Jan-86
If the time up was equal to or earlier than 1630, the actual time up would show in column R.								65	61	SC-93	SCRS	21-Jan-86
								66	62	SC-96	SCRS	21-Jan-86
								67	63	SC-99	SCRS	23-Jan-86
								68	64	AC-114	ACTRA	23-Jan-86
								69	65	P-71	9040	23-Jan-86
COLUMN S: (@INT(R5/100)-@INT(Q5/100))*60								70	66	SC-138	SCRS	24-Jan-86
This formula converts the hours of downtime into minutes down using the military time up (col.R) and the military time down (col.Q).								71	67	SC-140	SCRS	24-Jan-86
The formula takes the first 2 integers (the hour) of the time down and subtracts it from the first two integers of the time up.								72	68	SC-142	SCRS	24-Jan-86
The result is then multiplied by 60 to yield the total number of hours down, in minutes. This is an interim calculation used in col U.								73	69	SC-147	SCRS	24-Jan-86
								74	70	AC-128	ACTRA	24-Jan-86
								75	71	SC-150	SCRS	27-Jan-86
								76	72	AC-136	ACTRA	28-Jan-86
								77	73	AC-139	ACTRA	29-Jan-86
COLUMN T: ((R5-(@INT(R5/100)*100))-(Q5-(@INT(Q5/100)*100)))								78				
This formula does the same thing as the formula in column S, except that it takes the military times recorded and computes the number of minutes, the second two integers of the military time, to be able to determine the number of minutes elapsed. This is an interim calculation. Negative values are expected in some cases.								79				
								80				
								81				
								82				
								83				
								84				
COLUMN U: (S5+T5)								85				
This formula adds the minutes computed in col.S to the minutes computed in column T to arrive at the total number of minutes the computer was down.								86				
								87				
								88				
								89				
CELL U78: @SUM(U5..U77)								90				
This formula totals the down time in minutes for all of the instances where the system was down during working hours.								91				
								92				
								93				
CELL U79: @COUNT(U5..U77)								94				
This formula computes the total number of computer downtime events.								95				
								96				
								97				
								98				
								99				
								100				
								101				
								102				
								103				
								104				
								105				
								106				
								107				
								108				
CELL U82: @SUM(U5..U77)/60								109				
This formula converts minutes down to hours down.								110				
								111				

Disk: IYZ, File Name: REFCOPY.WKS

**Appendix II
Referencer-Reviewed Spreadsheet**

N	O	P	Q	R	S	T	U	V
530	14-Jan-86	2204	800	1630	480	30	510	T
855	15-Jan-86	952	855	952	60	-3	57	
900	15-Jan-86	2100	900	1630	420	30	450	
800	16-Jan-86	1635	800	1630	480	30	510	
645	16-Jan-86	1830	800	1630	480	30	510	
715	16-Jan-86	1720	800	1630	480	30	510	
615	17-Jan-86	815	800	815	0	15	15	
645	20-Jan-86	1030	800	1030	120	30	150	
630	21-Jan-86	1025	800	1025	120	25	145	
1120	21-Jan-86	1229	1120	1229	60	9	69	
630	23-Jan-86	1420	800	1420	360	20	300	T
735	23-Jan-86	1435	800	1435	360	35	395	
545	23-Jan-86	1530	800	1530	420	30	450	
843	24-Jan-86	918	843	918	60	-25	35	
928	24-Jan-86	1020	928	1020	60	-8	52	
1100	24-Jan-86	1115	1100	1115	0	15	15	
1138	24-Jan-86	1223	1138	1223	60	-15	45	
845	24-Jan-86	904	845	904	60	-4i	19	
630	27-Jan-86	1125	800	1125	180	25	205	T
810	28-Jan-86	812	810	812	0	2	2	
1013	29-Jan-86	1050	1013	1050	0	37	37	
							Total minutes down	14730
							Number of Instances	73
							Total hours down	491

**Appendix II
Referencer-Reviewed Spreadsheet**

A	B	C	D	E	F	G	H	I	J	K	L	M
REVIEWER COMMENTS: Spreadsheet formulas, logic and documentation reviewed and found to be ok.									112			
									113			
									114			
									115			
REFERENCER COMMENTS: The items identified with a F in column F were traced back to system logs and the formulas used to calculate elapsed time were checked. All were found to be ok and agree with the report presentation.									116			
									117			
									118			
									119			
									120			
									121			
									122			
CONTROL TOTALS:									123			
Number of items in this selection [cell U79]:									73	124		
										125		
Total minutes down during bus. hours [cell U78]:									14,730	126		
										127		
										128		
Preparer:									129			
-----										130		
Joe Evaluator										131		
Date: May 15, 1986										132		
										133		
										134		
Reviewer:									135			
-----										136		
Sally Supervisor										137		
Date: May 25, 1986										138		
										139		
										140		

Disk: XYZ, File Name: RECOPY.WES

Appendix II
Referencer-Reviewed Spreadsheet

N O P Q R S T U V

Final Corrected Spreadsheet

A	B	C	D	E	F	G	H	I	J	K	L	M
FINAL.WKS		CODE 999406		Preparer: Joe Evaluator			6/27/86	2				
CONTENT: This spreadsheet contains the final corrected version of LOTUSREF.WKS.								3	GAO	Source	File/	
-----								4	I.D. (Page #)		System Down	Date Down
								5	1	C-4	Restrict CAFR	03-Jan-86
								6	2	B-29	Restrict BAIM	03-Jan-86
								7	3	R-246	RMS	03-Jan-86
								8	4	G-28	Restrict GUF	03-Jan-86
								9	5	E-12	Restrict EXIF1	03-Jan-86
								10	6	C-56	Restrict CAPT	03-Jan-86
								11	7	Z-104	Restrict ZAIM	03-Jan-86
								12	8	I-28	Restrict IAIM2	03-Jan-86
								13	9	I-32	Restrict IAIM1	03-Jan-86
								14	10	I-37	Restrict IAIM5	03-Jan-86
								15	11	E-48	Restrict EXIF2	03-Jan-86
								16	12	I-82	Restrict IAIM3	03-Jan-86
								17	13	I-84	Restrict IAIM4	03-Jan-86
								18	14	SS-3	SSNAD	03-Jan-86
								19	15	EI-12	EINAD	03-Jan-86
								20	16	P-40	9040	03-Jan-86
								21	17	AM-22	AMSTU	03-Jan-86
								22	18	AM-22	AMTIM	03-Jan-86
								23	19	ERS-31	ERS	03-Jan-86
								24	20	AM-23	AMLOC	03-Jan-86
								25	21	AMS-27	AMSOC	03-Jan-86
								26	22	ANP-11	ANPAR	03-Jan-86
								27	23	ANPE43	ANPEL	03-Jan-86
								28	24	NM-68	NMPEM	06-Jan-86
								29	25	TD-37	TDIROQ	06-Jan-86
								30	26	Z-56	Restrict ZTIF1	06-Jan-86
								31	27	AMR-75	AMREP	06-Jan-86
								32	28	SS-25	SSNAD	06-Jan-86
								33	29	SC-24	SCRS	06-Jan-86
								34	30	ERS47	ERS	06-Jan-86
								35	31	AC-58	ACTRA	07-Jan-86
								36	32	ERS-59	ERS	07-Jan-86
								37	33	SC-31	SCRS	08-Jan-86
								38	34	AC-61	ACTRA	08-Jan-86
								39	35	AMR-87	AMREP	08-Jan-86
								40	36	ERS-65	ERS	08-Jan-86
								41	37	AC-67	ACTRA	09-Jan-86
								42	38	C-32	CIDS	09-Jan-86
								43	39	ERS-73	ERS	09-Jan-86
								44	40	SC-40	SCRS	10-Jan-86
								45	41	AC-78	ACTRA	10-Jan-86
								46	42	ERS-80	ERS	10-Jan-86
								47	43	P-37	9040	10-Jan-86
								48	44	SC-46	SCRS	13-Jan-86
								49	45	P-42	9040	13-Jan-86
								50	46	SC-58	SCRS	14-Jan-86
								51	47	BT-12	BTIF2	14-Jan-86
								52	48	BT-16	BTIF4	14-Jan-86
								53	49	SC-78	SCRS	14-Jan-86
								54	50	AC-84	ACTRA	14-Jan-86
								55	51	SC-86	SCRS	14-Jan-86
								56	52	ERS-96	ERS	14-Jan-86
DISK: XYZ, File Name: FINAL.WKS												

**Appendix III
Final Corrected Spreadsheet**

N	O	P	Q	R	S	T	U	V	
Time Down (24 Hr.Clock)		Time Up (24 Hr. Clock)	Time-down Bus Hours (D)	Time-up Bus Hours (U)	-----Interim calculaion----- Hours convrt to minutes (H)		Minutes convrt to minutes (M)	Number of minutes down dur bus hrs	REP CHK MRK
610	03-Jan-86	1052	800	1052	120	52	172		
730	03-Jan-86	930	800	930	60	30	90		
515	03-Jan-86	1030	800	1030	120	30	150	T	
610	03-Jan-86	800	800	800	0	0	0		
415	03-Jan-86	900	800	900	60	0	60		
830	03-Jan-86	1052	830	1052	120	22	142		
700	03-Jan-86	930	800	930	60	30	90	T	
755	03-Jan-86	930	800	930	60	30	90		
845	03-Jan-86	930	845	930	60	-15	45		
936	03-Jan-86	1000	936	1000	60	-36	24		
410	03-Jan-86	800	800	800	0	0	0		
1125	03-Jan-86	1700	1125	1630	300	5	305		
610	03-Jan-86	2200	800	1630	480	30	510		
720	03-Jan-86	1100	800	1100	180	0	180		
720	03-Jan-86	1204	800	1204	240	4	244	T	
722	03-Jan-86	1235	800	1235	240	35	275		
935	03-Jan-86	940	935	940	0	5	5		
935	03-Jan-86	2300	935	1630	420	-5	415		
1105	03-Jan-86	1123	1105	1123	0	18	18		
715	03-Jan-86	800	800	800	0	0	0		
900	03-Jan-86	1634	900	1630	420	30	450		
1445	03-Jan-86	1830	1445	1630	120	-15	105		
815	03-Jan-86	850	815	850	0	35	35		
610	06-Jan-86	955	800	955	60	55	115		
610	06-Jan-86	1655	800	1630	480	30	510		
615	06-Jan-86	845	800	845	0	45	45		
755	06-Jan-86	1032	800	1032	120	32	152	T	
755	06-Jan-86	807	800	807	0	7	7		
1444	06-Jan-86	2130	1444	1630	120	-14	106		
1015	06-Jan-86	1700	1015	1630	360	15	375		
1135	07-Jan-86	1158	1135	1158	0	23	23		
810	07-Jan-86	1230	810	1230	240	20	260		
630	08-Jan-86	800	800	800	0	0	0		
850	08-Jan-86	857	850	857	0	7	7		
955	08-Jan-86	2200	955	1630	420	-25	395		
1000	08-Jan-86	1755	1000	1630	360	30	390		
1113	09-Jan-86	1150	1113	1150	0	37	37		
715	09-Jan-86	1220	800	1220	240	20	260		
720	09-Jan-86	1130	800	1130	180	30	210		
1055	10-Jan-86	1600	1055	1600	360	-55	305		
715	10-Jan-86	1800	800	1630	480	30	510	T	
730	10-Jan-86	1605	800	1605	480	5	485		
1112	10-Jan-86	2100	1112	1630	300	18	318		
912	13-Jan-86	1353	912	1353	240	41	281		
655	13-Jan-86	1700	800	1630	480	30	510		
630	14-Jan-86	805	800	805	0	5	5		
645	14-Jan-86	1130	800	1130	180	30	210		
645	14-Jan-86	1350	800	1350	300	50	350		
1142	14-Jan-86	1150	1142	1150	0	8	8		
642	14-Jan-86	1445	800	1445	360	45	405		
855	14-Jan-86	2031	855	1630	480	-25	455		
915	14-Jan-86	945	915	945	0	30	30		

Appendix III
Final Corrected Spreadsheet

A	B	C	D	E	F	G	H	I	J	K	L	M
the formula would tell Lotus to show the time down as 900 in col.Q.								57	53	SC-88	SCRS	14-Jan-86
This would enable analysis of down time elapsed during business hours.								58	54	AC-102	ACTRA	15-Jan-86
If the time down was equal to or later than 800, the actual time down								59	55	ERS-121	ERS	15-Jan-86
would show in column Q.								60	56	P-57	9040	16-Jan-86
								61	57	ERS-128	ERS	16-Jan-86
COLUMN R: @IF(P5>1630,1630,P5)								62	58	P-62	9040	16-Jan-86
The purpose of this formula is to convert those instances where the								63	59	G-37	Restrict GUP	17-Jan-86
computer came up after the end of the business day (1630),								64	60	SC-91	SCRS	20-Jan-86
to read as 1630. For example, if the time up (col. P) was 1800,								65	61	SC-93	SCRS	21-Jan-86
the formula would tell Lotus to show the time up as 1630 in col. R.								66	62	SC-96	SCRS	21-Jan-86
If the time up was equal to or earlier than 1630, the actual time up								67	63	SC-99	SCRS	23-Jan-86
would show in column R.								68	64	AC-114	ACTRA	23-Jan-86
								69	65	P-71	9040	23-Jan-86
COLUMN S: (@INT(R5/100)-@INT(Q5/100))*60								70	66	SC-138	SCRS	24-Jan-86
This formula converts the hours of downtime into minutes down using								71	67	SC-140	SCRS	24-Jan-86
the military time up (col.R) and the military time down (col.Q).								72	68	SC-142	SCRS	24-Jan-86
The formula takes the first 2 integers (the hour) of the time down								73	69	SC-147	SCRS	24-Jan-86
and subtracts it from the first two integers of the time up.								74	70	AC-128	ACTRA	24-Jan-86
The result is then multiplied by 60 to yield the total number of								75	71	SC-150	SCRS	27-Jan-86
hours down, in minutes. This is an interim calculation used in col U.								76	72	AC-136	ACTRA	28-Jan-86
								77	73	AC-139	ACTRA	29-Jan-86
COLUMN T: ((R5-(@INT(R5/100)*100))-(Q5-(@INT(Q5/100)*100)))								78				
This formula does the same thing as the formula in column S, except that								79				
it takes the military times recorded and computes the number of minutes,								80				
the second two integers of the military time, to be able to determine								81				
the number of minutes elapsed. This is an interim calculation. Negative								82				
values are expected in some cases.								83				
								84				
COLUMN U: (S5+T5)								85				
This formula adds the minutes computed in col.S to the minutes computed								86				
in column T to arrive at the total number of minutes the computer was								87				
down.								88				
								89				
CELL U78: #SUM(U5..U77)								90				
This formula totals the down time in minutes for all of the instances								91				
where the system was down during business hours.								92				
								93				
CELL U79: #COUNT(U5..U77)								94				
This formula computes the total number of computer downtime events.								95				
								96				
CELL U80: (@DCOUNT(U4..U77,0,R87..R88))								97				
The purpose of this formula is to count all of the cells in column U								98				
that have a value of zero, i.e. the number of instances where there								99				
was no down time during business hours. The criterion range for this								100				
data base function is located in cells R87..R88.								101				
								102				
CELL U81: (U79-U80)								103				
The purpose of this formula is to compute the total number of downtime								104				
events that resulted in minutes down during business hours.								105				
The number of events with no downtime during business hours (cell U80)								106				
is subtracted from the total number of downtime events (cell U79).								107				
								108				
CELL U82: #SUM(U5..U77)/60								109				
This formula converts the minutes down to hours down.								110				
								111				

Disk: IYZ, File Name: FINAL.WKS

**Appendix III
Final Corrected Spreadsheet**

N	O	P	Q	R	S	T	U	V
530	14-Jan-06	2204	800	1630	480	30	510	T
855	15-Jan-06	952	855	952	60	-3	57	
900	15-Jan-06	2100	900	1630	420	30	450	
800	16-Jan-06	1635	800	1630	480	30	510	
645	16-Jan-06	1030	800	1630	480	30	510	
715	16-Jan-06	1720	800	1630	480	30	510	
615	17-Jan-06	815	800	815	0	15	15	
645	20-Jan-06	1030	800	1030	120	30	150	
630	21-Jan-06	1025	800	1025	120	25	145	
1120	21-Jan-06	1229	1120	1229	60	9	69	
630	23-Jan-06	1420	800	1420	360	20	380	T
735	23-Jan-06	1435	800	1435	360	35	395	
545	23-Jan-06	1530	800	1530	420	30	450	
843	24-Jan-06	918	843	918	60	-25	35	
928	24-Jan-06	1020	928	1020	60	-8	52	
1100	24-Jan-06	1115	1100	1115	0	15	15	
1138	24-Jan-06	1223	1138	1223	60	-15	45	
845	24-Jan-06	904	845	904	60	-41	19	
630	27-Jan-06	1125	800	1125	180	25	205	T
810	28-Jan-06	812	810	812	0	2	2	
1013	29-Jan-06	1050	1013	1050	0	37	37	
					Total minutes down		14730	
					Number of Instances		73	
					Number with 0 downtime		4	
					Number with non zero downtime		69	
					Total hours down		245.5	

CRITERION RANGE
dur bus hrs
0

**Appendix III
Final Corrected Spreadsheet**

A	B	C	D	E	F	G	H	I	J	K	L	M
REVIEWER COMMENTS:	Spreadsheet formulas, logic and documentation											112
	reviewed and found to be ok.											113
	Errors in cell U82 corrected.											114
												115
REFERENCER COMMENTS:	The items identified with a T in column V were											116
	traced back to system logs and the formulas used											117
	to calculate elapsed time were checked. All were											118
	found to be ok and agree with the report											119
	presentation.											120
	Errors in cell U82 corrected.											121
												122
CONTROL TOTALS:												123
	Number of items in this selection [cell U79]:					73						124
	No. of instances down during bus. hours [cell U81]:					69						125
	Total minutes down during bus. hours [cell U78]:					14,730						126
												127
												128
Preparer:	-----						Reviewer:	-----				129
	Joe Evaluator							Sally Supervisor				131
Date:	May 15, 1986						Date:	June 26, 1986				132
												133
												134
Referencer:	-----											135
	Chuck Checker											136
Date:	June 27, 1986											137
												138

Disk: IYZ, File Name: FINAL.WKS

**Appendix III
Final Corrected Spreadsheet**

N O P Q R S T U V

**Appendix IV
Spreadsheet Extract**

N	O	P	Q	R	S	T	U
Time Down	Time Up	Time-down	Time-up	-----Internal calculation-----		Number of	
24 Hr. Clock	Date Up	(24 Hr. Clock)	Bus Hours (D)	Bus Hours (U)	Hours convert to minutes (H)	Minutes convert to minutes (M)	minutes dur bus h
1135	07-Jan-86	1158	1135	1158	0	0	22
859	08-Jan-86	957	850	857	0	7	7
1112	09-Jan-86	1150	1112	1150	0	37	37
715	10-Jan-86	1900	800	1620	480	30	510
842	14-Jan-86	1445	800	1445	360	45	405
955	15-Jan-86	952	855	952	60	-3	57
735	23-Jan-86	1435	800	1435	360	35	395
945	24-Jan-86	904	945	904	60	-41	19
810	28-Jan-86	812	810	812	0	2	2
1013	29-Jan-86	1050	1013	1050	0	37	37
						TOTAL MINUTES DOWN	1492
						TOTAL HOURS DOWN	24.87

**Appendix IV
Spreadsheet Extract**

A	B	C	D	E	F	G	H	I	J	K	L	M
COLUMN Q: @IF(M5<800,800,M5)												57
The purpose of this formula is to convert those instances where the												58
computer was down prior to the start of the business day (800),												59
to read as 800. For example, if the time down (col. N) was 0630,												60
the formula would tell Lotus to show the time down as 800 in col. Q.												61
This would enable analysis of down time elapsed during business hours.												62
If the time down was equal to or later than 800, the actual time down												63
would show in column Q.												64
												65
COLUMN R: @IF(P5>1630,1630,P5)												66
The purpose of this formula is to convert those instances where the												67
computer came up after the end of the business day (1630),												68
to read as 1630. For example, if the time up (col. P) was 1800,												69
the formula would tell Lotus to show the time up as 1630 in col. R.												70
If the time up was equal to or earlier than 1630, the actual time up												71
would show in column R.												72
												73
COLUMN S: (@INT(R5/100)-@INT(Q5/100))*60												74
This formula converts the hours of downtime into minutes down using												75
the military time up (col. R) and the military time down (col. Q).												76
The formula takes the first 2 integers (the hour) of the time down												77
and subtracts it from the first two integers of the time up.												78
The result is then multiplied by 60 to yield the total number of												79
hours down, in minutes. This is an interim calculation used in col U.												80
												81
COLUMN T: ((R5-(@INT(R5/100)*100))-(Q5-(@INT(Q5/100)*100)))												82
This formula does the same thing as the formula in column S, except that												83
it takes the military times recorded and computes the number of minutes,												84
the second two integers of the military time, to be able to determine												85
the number of minutes elapsed. This is an interim calculation. Negative												86
values are expected in some cases.												87
												88
COLUMN U: (S5+T5)												89
This formula adds the minutes computed in col. S to the minutes computed												90
in column T to arrive at the total number of minutes the computer was												91
down.												92
												93
-----FORMULA'S IN THIS SPREADSHEET-----												94
												95
												96
CELL U15: @SUM(U5..U14)												97
This formula totals the down time in minutes for all of the instances												98
where the system was down during business hours.												99
												100
CELL U16: U15/60												101
This formula converts the minutes of down time to hours of down time.												102
												103
												104
												105
												106
												107
												108
												109
												110
												111

Disk: IYZ, File Name: ACTRA.WES

**Appendix IV
Spreadsheet Extract**

N O P Q R S T U

**Appendix IV
Spreadsheet Extract**

A	B	C	D	E	F	G	H	I	J	K	L	M
												112
												113
												114
												115
												116
												117
												118
												119
												120
												121
												122
												123
												124
												125
												126
												127
												128
												129
												130
												131
												132
												133
												134
												135
												136
												137
												138
												139
												140
												141
												142

Disk: XYZ. File Name: ACTRA.WKS

**Appendix IV
Spreadsheet Extract**

N O P Q R S T U

Documentation Template

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FILENAME.WKS		JOB CODE		PREPARER:		DATE LAST UPDATE		2					
								3					
CONTENT:								4					
								5					
								6					
								7					
								8					
								9					
								10					
								11					
SPREADSHEET LAYOUT:						Cell Ref.		12					
								13					
								14					
								15					
								16					
								17					
								18					
								19					
								20					
								21					
JOB TITLE:		Short Title						22					
CODE:		Job Code						23					
								24					
TITLE:		Title of the spreadsheet						25					
								26					
PURPOSE:		Purpose of the spreadsheet						27					
								28					
								29					
DESCRIPTION:		What the spreadsheet contains						30					
								31					
								32					
								33					
								34					
								35					
								36					
								37					
								38					
								39					
								40					
								41					
								42					
								43					
								44					
								45					
								46					
								47					
								48					
								49					
								50					
								51					
								52					
								53					
								54					
								55					
								56					

**Appendix V
Documentation Template**

A	B	C	D	E	F	G	H	I	J	K	L	M	N
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							57					
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							58					
	{RIGHT}PREPARER: {RIGHT}							59					
	ENTER YOUR NAME: (?) {EDIT}{HOME}{RIGHT}{DEL}{DEL}							60					
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							61					
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							62					
	{GOTO}M2							63					
	ENTER TODAYS DATE: (?) {EDIT}{HOME}{RIGHT}{DEL}							64					
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							65					
	{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}{DEL}							66					
	/MDOC^A4							67					
	{GOTO}A2							68					
	/RENACRO							69					
								70					
								71					
	CONTENT:							72					
								73					
	-----							74					
								75					
								76					
								77					
								78					
								79					
	SPREADSHEET LAYOUT:							80					
								81					
	Documentation section							82					
	Data section							83					
	Computation and Analysis							84					
	Formula explanations							85					
	Criterion range							86					
	Reviewer's comments							87					
	Referencer's comments							88					
	Control section							89					
	JOB TITLE:							90					
	CODE:							91					
								92					
	TITLE:							93					
								94					
	PURPOSE:							95					
								96					
								97					
	DESCRIPTION:							98					
								99					
								100					
								101					
								102					
								103					
								104					
								105					
								106					
								107					
								108					
								109					
								110					
								111					

Report Extract

ORIGINAL DRAFT

Lotusref. wKS
cells T77, T81

①

The systems were down 73 times during business hours in January 1986 for a total of 491 hours.

②

REVISED DRAFT

Final wKS
C41, T80, T81

The systems were down 69 times during business hours in January 1986 for a total of 245 hours.

Bibliography

Dooley, Kevin. "Guidelines for Preparing Schedules Using Lotus 1-2-3." HRD Microcomputer Bulletin. No. 1, 1986.

Grupe, Fritz. "Tips for Better Worksheet Documentation." Lotus Magazine. Vol. 1, No. 4, 1985. pp. 69-70.

Gruschcow, Jack. "Avoid These Common Spreadsheet Errors." Lotus Magazine. Vol. 1, No. 3, 1985. pp. 59-62.

Seman, Stewart O. "Controlling the Quality of Electric Work Papers." The GAO Review. Volume 21, No. 4, Fall 1986. pp.11-14 and 33.

U.S. General Accounting Office. Project Manual. Washington D.C., 1983. Chapters 15 and 18.

U.S. General Accounting Office. Report Manual. Washington D.C., 1985. Chapter 7.

U.S. General Accounting Office, Information Management and Technology Division. Technical Guideline 1. Using Micro Computers in GAO Audits: Improving Quality and Productivity. Washington D.C., 1986.

U.S. General Accounting Office, Office of Organization and Human Development. Preparing GAO Workpapers. Washington D.C., 1986.

Requests for copies of GAO publications should be sent to:

U.S. General Accounting Office
Post Office Box 6015
Gaithersburg, Maryland 20877

Telephone 202-275-6241

The first five copies of each publication are free. Additional copies are \$2.00 each.

There is a 25% discount on orders for 100 or more copies mailed to a single address.

Orders must be prepaid by cash or by check or money order made out to the Superintendent of Documents.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use \$300

Address Correction Requested

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100