

To: Research Staff

December 21, 1962

From: Emil Melichar

System for processing monthly data

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The attached document outlines the capabilities of the system I have put together to perform statistical and numerical operations on monthly time series data. It is probably one of the more complete and powerful general purpose systems that exists in the world for this kind of data. If additional needs that turn up through experience are programmed in the future, it can remain the best. Subsequently, the programming of similar systems for annual and weekly data would give the Department tremendous all-around processing capability.

This entire system for monthly data was planned with one top-priority goal in mind-- to give high-powered results without requiring repunching or shuffling of the data to accomplish the different operations. Thus, when a time series is punched into standard format, all of the operations can be performed just by specifying the program to be used, and, in those very few cases where it could not be avoided, by specifying the contents of a control card.

To make it pay to use electronic data processing, the volume and quality of the results must more than compensate for the work of preparing the data cards. With this system of programs which all use data prepared in the same way, there is no doubt at all about the answer to this question about the benefit-cost ratio.

Each Research Assistant and Associate is being supplied with detailed information about each program, and also with a sample of the output of each program. A class is being held to make sure that each girl can get started in using the system.

Finally, although I obviously have not had any more experience in using this brand-new thing than any of you, I'd like to hazard a few observations that are likely to prove correct:

- 1) The way for a Research Assistant to develop a high degree of capability in using this system is by employing it on routine work. Although one of the advantages of the system is the ability to turn out a lot of work in a short time, it would be well to develop this ability and the confidence in it prior to getting the work and the deadline.
- 2) There appear to be great possibilities in using the system to put together a volume of background information on each of the series used in current routine work, and on its relationship to other series. There is also a great deal of inertia to overcome to do this sort of thing, and it is probably almost essential that the Research Assistants carry the ball on this phase of operations by showing the Economists the output that can be obtained. I obviously believe that the rewards in terms of easier and better analysis of current events can be very great.

- 3) Those with imagination and initiative will find that this system can do things that couldn't be advertised. For instance, the machine won't know that you are giving it weekly or annual data for a particular computing chore; only you will know that you have crossed out the names of the months and substituted other dates on the output. Also, you will find that it won't do some things that it should. The solution in this case is to agitate to get the program changed to do it.

- 4) Some kind of coordination probably ought to be set up to keep track of what data has been punched in the standard format, and to make this knowledge generally available. The validity of this advice depends on the coordinating system being less trouble than the duplication of effort that might otherwise result, but a try at it seems to be in order.

Standard Format for Monthly Data

The first card in the deck is the control card:

Columns

1	Always a "C"
2-73	Name of the series
74-76	Code number of the series
77-78	Last two digits of the first year of the data
79-80	Number of data cards (same as number of years covered by the data)

Next come the data cards, in order by date:

Columns

1-3	Blank
4-6	Code number of the series
7-8	Last two digits of the year of the data on that card
9-14	Data for January
15-20	Data for February
21-26	Data for March
27-32	Data for April
33-38	Data for May
39-44	Data for June
45-50	Data for July
51-56	Data for August
57-62	Data for September
63-68	Data for October
69-74	Data for November
75-80	Data for December

The last card is the chart control card:

Columns

1-6	Base for the scale for the chart of the series--a number that is lower than any of the monthly data--a "round number" is usually used.
7-12	Range for the scale for the chart of the series--a number that, when added to the Base, yields a number higher than any of the monthly data. However, it <u>must</u> be one of the following numbers:
	000100 025000
	001000 250000
	010000 000050
	100000 000500
	000025 005000
	000250 050000
	002500 500000
13-14	Last two digits of the first year of the data.
15-17	Code number of the series.
18-20	Code number of the series.

Capabilities of the Processing System for
Monthly Time Series Data in Standard Format

Federal Reserve Bank of Richmond
December 20, 1962

I. Table of the data

Program 124

II. Check on code numbers, date sequence, and chart control values for the standard format

Program 124

III. Seasonal adjustment

A. Census Method II - Program 136

B. Methods X-9, X-10

Program 168 punches cards to send to Board of Governors

Program 175 converts seasonally adjusted data received from Board of Governors into standard format for use with other programs at Richmond.

IV. Multiple regression and correlation

Program 147 punches cards to send to the Board of Governors

V. Simple regression and correlation of two series

Program 185

VI. Charts

A. Chart of original and seasonally adjusted time series

Part of output of Program 136

B. Charts of seasonally adjusted series, one year's data per page

Part of output of Program 136

C. Chart of one time series

Program 033

D. Chart of two time series

Program 186

E. Scatter diagram (correlation diagram) of two time series

Program 185

VII. Numerical operations

- A. Ratio of two time series, by months

Program 143

- B. Difference between two time series, by months

Program 143

- C. Annual totals for monthly time series

Program 124

- D. First differences (month-to-month change)

Program 144

- E. Second differences (change in month-to-month change)

Program 144

- F. Index numbers to any base

Program 183

adapt # 144

- G. Sum of up to six series, by months

Program 178

- H. Logarithms of the data, by months

Program 179

adapt ~~# 144~~ # 183

- I. Annual rates of change for any interval from 1 to 12 months (per cent change between first and last values divided by the number of months in the interval and then multiplied by 12)

Program 180

Annual rates of change sorted and listed from high-to-low or low-to-high

Program 181

- J. Per cent changes for any interval from 1 to 63 months

Program 182

~~*adapt # 180*~~

Per cent changes sorted and listed from high-to-low or low-to-high

Program 181

- ✓ K. Average annual rates of change for any interval in multiples of one year
Program 187 *Adjust # 180*

Average annual rates of change sorted and listed from high-to-low or low-to-high

Program 181

- L. Moving averages for any interval from 1 to 63 months

Program 184

~~*Adjust # 180 without punching*~~

VIII. Transformation of data punched in standard format for use with other programs

- A. Seasonally adjusted series

Census Method II - Program 136

Methods X-9, X-10 - Program 175

- B. Ratio of two time series

Program 143

- C. Difference between two time series

Program 143

- D. First differences (month-to-month change)

Program 144

- E. Second differences (change in month-to-month change)

Program 144

- F. Index numbers to any base

✓ Program 183

- G. Sum of up to six series

Program 178

- H. Logarithms

✓ Program 179

IX. Transformation of data for multiple regression

Most of the transformations of data commonly used in multiple regressions can be secured at the Board of Governors at the time the regression is run simply by specifying the transformation for each variable.

PROGRAM 124

Seasonal Adjustment Input Edit

Error 1 - Card treated as data control card, but having no "C" in column 1.

Error 3 - Base figure not low enough.

Error 4 - Range figure too low.

Errors 5 & 6 - Series numbers in chart control card do not compare with those of data control.

Error - Number of Data Cards - Number of data cards not the same as number in control card.. A card which does not correspond to either of the types is printed with no spacing indicating an error.

A card out of date sequence is also printed with no spacing indicating an error.

If no errors are indicated, only the totals must be checked manually against worksheets. A discrepancy indicates an error during that year.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Chart of one monthly time series in standard format
(033)

File No. 2.01.07.0

Originating Institution: Federal Reserve Bank of Richmond

Date: December 18, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

- | | |
|--|---------------------------------|
| 1. Description, function, and/or purpose | 3. Equipment required 1401 Rmac |
| 2. Methods employed | 4. Programming language Machine |

Program 033 reads up to 15 years of monthly data in standard format (defined as the format specified for the Philadelphia seasonal adjustment program, as modified for use at Richmond), and writes a table of the data, a chart of the data with no spacing between months, and a set of charts, one year's data per page, with 3 lines skipped between each month on the horizontal scale. Each page of the output is identified with the code number and name of the series.

Additional documentation for this program consists of operating instructions, sample of output, and listing of condensed object deck. This program was written by modifying Part 1 and the Graph routine of the Philadelphia seasonal adjustment program condensed deck, and thus there is no source deck.

This program requires a 1401 with Rmac and advanced programming.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Chart of two monthly time series in standard format
(186)

File No. 2.01.08.0

Originating Institution: Federal Reserve Bank of Richmond

Date: December 19, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

1. Description, function, and/or purpose
2. Methods employed
3. Equipment required 1401 Rmac
4. Programming language Machine

Program 186 reads up to 15 years of monthly data for two time series punched in standard format (defined as the format specified for the Philadelphia seasonal adjustment program, as modified for use at Richmond), and writes a table of the data in each series, a chart of the two series with no spacing between months, and a set of charts, one year's data per page, with 3 lines skipped between each month on the horizontal scale. Each page of the output is identified with the code numbers and names of the series, except the last set of charts, which is identified by the code numbers only.

When sending the data to the computer room, keep a rubber band around the deck for each of the two series, and then put a third band around the combined deck. The program will use the chart base and range values in the chart control card that follows the data in the deck for the first series. Make sure that the data in the second deck can be plotted with these values; if not, change the chart control values for the first series to appropriate values.

Additional documentation for this program consists of operating instructions, sample of output, and listing of condensed object deck. This program was written by modifying Part 1 and the Graph routine of the Philadelphia seasonal adjustment program condensed deck, and thus there is no source deck.

This program requires a 1401 with Rmac and advanced programming.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: 124--Seasonal Adjustment Data Edit

File No. 2.02.06.0

Originating Institution: Federal Reserve Bank of Richmond

Date: October 1, 1962

Programmers and Collaborators: Robin Cramme

Supply the following information and other pertinent data in the space below.

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|--|-----------------------------------|---------------|
| 1. Description, function, and/or purpose | 3. Equipment required programming | 1401 Advanced |
| 2. Methods employed | 4. Programming language | SPS |
-

Program 124 is designed to list and check the control card, data cards, and chart control card punched in the format required by program 136 (Seasonal Adjustment, Census Method II). The following editing checks are performed:

- 1) Checks for presence of control card and chart control card
- 2) Checks code in data cards and chart control card
- 3) Checks sequence of years in data cards
- 4) Checks for correct number of data cards
- 5) Prints 12-month total of values in each data card
- 6) Checks that all values in data cards fall within the range specified in the chart control card

The program requires a 1401 with advanced programming. It uses 1380 digits of core and is written in SPS.

Additional documentation of this program consists of:

- 1) Detailed write-up of procedure followed
- 2) Operating instructions
- 3) Instructions for persons using the program
- 4) Postlist
- 5) Sample of output
- 6) Layout of input data

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Seasonal Adjustment, Census Method II, complete program, File No. 2.02.07.0
with charts (136)

Originating Institution: Federal Reserve Bank of Richmond
(adopted from Philadelphia program)

Date: December 20, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

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|--|----------------------------------|
| 1. Description, function, and/or purpose | 3. Equipment required 1401 Ramac |
| 2. Methods employed | 4. Programming language Machine |
-

Program 136 reads up to 15 years of monthly data (minimum of 5 years) punched in standard format (defined as the format specified for the Philadelphia seasonal adjustment program, as modified for use at Richmond), and writes all of the tables in the original Census Method II seasonal adjustment procedure (reference for methods and purposes of the computations made is Julius Shiskin's work published by NBER), a chart of the original and the seasonally adjusted series plotted with no spacing between months, and a set of charts of the seasonally adjusted series, one year's data per page, with 3 lines skipped between the points plotted for each month.

Unless Switch E is on, the seasonally adjusted data are punched into cards in the standard format, including the control card and the chart control card. The data cards of this output have "12" punched into columns 1-2 to distinguish them from the original series, since the code number of the original series is punched into the output data.

This program was written by modifying the Philadelphia seasonal adjustment program, and therefore no source deck exists. The Ramac is used to eliminate intermediate punched output. Advanced programming is used, but not the multiply-divide feature.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Conversion of data from Philadelphia

Program: seasonal adjustment format to Board of Governors
seasonal adjustment format (168)

File No. 2.02.09.0

Originating Institution:
Federal Reserve Bank of Richmond

Date: November 27, 1962

Programmers and Collaborators:
Emanuel Melichar

Supply the following information and other pertinent data in the space below.

- | | |
|--|-----------------------------|
| 1. Description, function, and/or purpose | 3. Equipment required 1401 |
| 2. Methods employed | 4. Programming language SPS |
-

This program reads data cards punched in the format specified for the Philadelphia seasonal adjustment program, which has 12 months of data on one card, and punches data cards in the format specified by the Board of Governors seasonal adjustment program.

Any cards that have a C in column 1 (used to identify a control card at the Richmond Bank) or a blank in column 80 (a chart control card) are bypassed by the program. For each data card read, the program punches 2 cards. Both output cards have in columns 2-9 the information that is in columns 1-8 of the input card. The first output card has a 1 in column 10 and the first six month's data in columns 11-70. The second output card has a 2 in column 10 and the second six month's data in columns 11-70. Output cards are selected into Pocket 4, input cards into Pocket 1.

The program uses 541 digits of core and is written in SPS. Additional documentation consists of postlist and operating instructions.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Conversion of data from Board of Governors to Philadelphia (standard) seasonal adjustment format (175) File No. 2.02.10.0

Originating Institution: Federal Reserve Bank of Richmond

Date: December 12, 1963

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

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|--|-----------------------------|
| 1. Description, function, and/or purpose | 3. Equipment required 1401 |
| 2. Methods employed | 4. Programming language SPS |
-

Program 175 converts data from the 2-cards-per-year format used by the Board of Governors seasonal adjustment program into the 1-card-per-year format used by the Philadelphia seasonal adjustment program. The primary purpose of the program is to make the output of the Board's seasonal adjustment program useable by other Richmond programs which use data in the Philadelphia format. Program 175 is thus the direct opposite of Program 168 (File No. 2.02.09.0). Any number of series can be processed in one run.

The following error conditions will cause a halt with the specified indicator appearing in the A-address register:

- 111--Card should have had a 1 or A punch in column 10.
- 222--The last card processed did not have a 2 or B punch in column 10.
- 333--Card should have had a 2 or B punch in column 10.
- 444--Card should have had the same code number in columns 5-7 as the preceding card.
- 555--Card does not have the correct date sequence in columns 8-9.
- 666--Card does not have the correct date sequence in columns 8-9.

The program uses 614 digits of core and is written in SPS. Additional documentation consists of postlist and operating instructions.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Conversion of data from standard format to Board of
Governors multiple regression format (147)
Originating Institution: Federal Reserve Bank of Richmond

File No. 2.03.08.0

Date: December 12, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

1. Description, function, and/or purpose
2. Methods employed
3. Equipment required 1401 Rmac
4. Programming language SPS

Program 147 reads up to 6 series of monthly data punched in standard format (defined as the format required by the Philadelphia seasonal adjustment program, as modified for use at Richmond) and punches a deck of cards in the format specified for the multiple regression and correlation program used at the Board of Governors.

The series must be arranged in the order they are to appear in the output. The first series read will be punched as X_1 , the second as X_2 , etc. The data cards for each of the series must be preceded by the control card for the series. It does not matter whether or not the chart control card is in its usual place behind the data cards; if it is present, it will be bypassed.

The input deck thus arranged must be preceded by a card which contains in columns 1-10 the information that is to appear in columns 1-10 of the first output card. The correct date sequence is automatically punched into the subsequent output cards.

The program prints a list of the names of the series in the input data and shows which is being punched as X_1 , as X_2 , etc. It also prints a table showing the contents of the output cards as they are being punched.

To meet the requirement that the input data for the multiple regression program must not exceed 5 significant digits, any or all of the series can be reduced from 6-digit numbers to 5-digit numbers by setting the appropriate switches, as follows:

Switch	
B	First series (X_1)
C	Second series (X_2)
D	Third series (X_3)
E	Fourth series (X_4)
F	Fifth series (X_5)
G	Sixth series (X_6)

Program 147 requires a 1401 with Rmac and advanced programming. It is written in SPS. Additional documentation consists of postlist, operating instructions, and sample of printed output.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: 144-First and Second Differences of Data in
Seasonal Adjustment Format

File No. 2.07.04.0

Originating Institution: Federal Reserve Bank of Richmond

Date: September 27, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

1. Description, function, and/or purpose

1401
3. Equipment required Advanced programming

2. Methods employed

4. Programming language SPS

Program 144 computes the first and second differences, or month-to-month change and change in the month-to-month change, of data punched into cards in standard format (defined as the format specified for the Philadelphia seasonal adjustment program, as modified for use at Richmond).

The first and second differences are printed in two columns, double-spaced, one year per page. Each page is numbered and is identified by the code number and name of the series. The year and the name of the month are printed on each line to the left of the first difference. The contents of the first two columns of each data card (see format of output of program 136) are printed to the left of the year. This distinguishes a seasonally adjusted series from the unadjusted series with the same name and code number. Any number of series may be processed in the same run.

The program requires a 1401 with advanced programming, and uses less than 1,000 digits of core. It is written in SPS.

Unless Switch F is on, the first differences are also punched into cards in the standard format. These cards are selected into Pocket 4. The differences are punched into the fields for the second month of interval. Columns 9-14 of the first data card are thus blank and may be filled in by manual calculation of the difference from the preceding December.

Unless Switch G is on, the second differences are also punched into cards in the standard format. These cards are selected into Pocket 8/2. Columns 9-20 of the first data card will be blank and may be filled in through manual calculation.

When cards are to be punched, a card must be put in front of the input series which has in columns 1-8 the code number and date information which is to be punched into the first data card of the output series. The rest of the data cards punched will have the correct date sequence automatically punched into them. If both first and second differences are to be punched, put 2 cards in front of the input series, the first containing the code for the first differences, the second containing the code for the second differences.

Additional documentation for this program consists of:

- 1) Postlist
- 2) Sample of written output
- 3) Operating instructions

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Ratio of and difference between two monthly
Program: time series in standard format (143)

File No. 2.07.06.0

Originating Institution: Federal Reserve Bank of Richmond

Date: December 11, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

1. Description, function, and/or purpose
2. Methods employed
3. Equipment required 1401 Ramac
4. Programming language SPS

Program 143 reads 2 series of monthly data punched in standard format, which is defined as the format specified by the Philadelphia seasonal adjustment program as modified for use at Richmond. The data cards for each series must be preceded by the control card for that series. The chart control card for the series should be present in its usual place behind the data cards.

The program calculates and prints the ratio of each month's data for the two series. The first series read is taken as the numerator, the second as the denominator. The program also calculates and prints the difference between the series obtained by subtracting the first series from the second series.

In calculation of the ratio, the values of the two series are treated as whole numbers and the ratio may be calculated and printed with anywhere from 0 to 15 decimal places. The desired number of decimal places is obtained by specifying the combination of Switches B through E which adds up to the desired number, in accordance with the following table of values:

Switch B - .1	Switch D - 4
Switch C - 2	Switch E - 8

Unless Switch F is on, the calculated ratio is punched into data cards in the standard format. If these cards are punched, it is important not to specify a number of decimal places which will result in more than 6 significant figures in the ratio, as in that case only the 6 least significant figures would be punched into the cards, which is an error.

Unless Switch G is on, the difference between the two series is also punched into data cards in the standard format.

The program prints the values for each year on a separate page. The original values of the two series are also printed, and each page contains complete identification of the name of the series and the year of the data. There is no limit on the number of years of data that can be processed.

The program is written in SPS and requires a 4K 1401 with Ramac, advanced programming, and multiply-divide features. It is programmed to use Disk Face 48 of the Ramac for temporary storage of data.

Additional documentation for Program 143 consists of postlist, operating instructions, and sample of printed output.

FEDERAL RESERVE SYSTEM RESEARCH PROGRAM LIBRARY ABSTRACT

Program: Summation of monthly series (178)

File No. 2.07.07.0

Originating Institution: Federal Reserve Bank of Richmond

Date: December 15, 1962

Programmers and Collaborators: Emanuel Melichar

Supply the following information and other pertinent data in the space below.

1. Description, function, and/or purpose
2. Methods employed
3. Equipment required 1401 Ramac
4. Programming language SPS

Program 178 reads up to 6 series of monthly data punched in standard format (defined as the format required by the Philadelphia seasonal adjustment program, as modified for use at Richmond) and punches a deck of cards containing, in standard format, the sum, by months, of the series read.

The data cards for each of the input series must be preceded by the control card for the series. It does not matter whether or not the chart control card is in its usual place behind the data cards; if it is present, it will be bypassed.

The input deck thus arranged must be preceded by a card which contains, in columns 1-8, the information that is to appear in columns 1-8 of the first output card. The correct date sequence is automatically punched into the subsequent output cards.

The program prints a list of the names of the series in the input data. It also prints a table, one year per page, showing the values of the input and output date, by months.

To meet the requirement that the data in standard format must not exceed 6 significant digits, any or all of the input series can be reduced from 6-digit numbers to 5-digit numbers by setting the appropriate switches, as follows:

<u>Switch</u>	
B	First series
C	Second series
D	Third series
E	Fourth series
F	Fifth series
G	Sixth series

If switches are set, the input data will be printed as reduced, thus providing a check on whether the correct switches were used. It will be recognized that this procedure enables the program to be used to round off the data of a single series by one decimal place, by running the series alone with Switch B on. Also, within limits, series punched with a different number of decimal places can be added together by setting the appropriate switches.

Program 147 requires a 4K 1401 with Ramac and advanced programming, and is written in SPS. Additional documentation consists of postlist, operating instructions, and sample of printed output.