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THE SUBSTANTIVE CHANGES IN THE X-11 PROCEDURE OF X-11-ARIMA

by

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I. Introduction

Many analysts at the Census Bureau have experimented with X-11-ARIMA, and have found that the results of running X-11-ARIMA without the ARIMA forecasting option are not the same as the results given by X-11. An example of this is given in Appendices A.1 and A.2 of this document. The series FTDXULAR, exports to Latin America, is taken from Sandra McKenzie's concurrent adjustment paper. This series was seasonally adjusted with X-11 and X-11-ARIMA (without the ARIMA forecasting), using identical selections for seasonal filter lengths, trading day regression, and other options. Appendix A.1 shows the seasonal factors taken from the X-11 printout (listed above) and the X-11-ARIMA printout (listed below). Individual X-11-ARIMA factors which differ from X-11 factors (when rounded to the same degree of precision as the X-11 factors) are circled. Although the differences between these factors are often small, we find large discrepancies for the months of September and October, with the projected seasonal factor for both months differing by almost two full points. This difference is also apparent in the graphs of the seasonal factors by month, shown in Appendix A.2.

This document describes three areas where X-11 and X-11-ARIMA use different techniques to seasonally adjust a series. These appear to be the only significant differences between the two "X-11" procedures. These areas are listed below.

1) Selection of Extreme Values : Both programs test the irregular component for extreme values. X-11-ARIMA has made changes which ensure that the same irregular values are selected as extremes if the data is seasonally adjusted in reverse time order. A detailed description of these differences can be found in section II.

2) Replacement of Extreme Values : After the programs select which values are extreme, X-11 and X-11-ARIMA will replace the SI ratios corresponding to the extreme irregular values. X-11-ARIMA has made changes which treat the first and last few values the same as the central values for a given month, and which change how some values close to the ends of the series are replaced in certain situations. A detailed description of this topic follows in section III.

3) Generation of Weights to Derive Seasonal Factors and Trend Cycle Estimates : Moving averages are used extensively in both programs, primarily to estimate seasonal factors and trend cycle estimates. To obtain greater precision, X-11-ARIMA calculates (rather than stores) weights for almost all the moving averages used in the program using their explicit formulae. A detailed discussion of this point can be found in section IV.

A summary of these major differences is given in Appendix A.3. Another section on other differences between the two programs and some of the distinctive features of X-11-ARIMA is also included.

II. Identification of Extreme Values

The methodology discussed in this section is used to produce the B4, B9, B17 and C17 tables in both X-11 and X-11-ARIMA. This procedure is also used in the strike adjustment option for the trend cycle.

This procedure is always applied to an estimate of the irregular. These irregular estimates are tested for extremeness by using a standard deviation computed over a moving five year period (moved a calendar year at a time, except in special cases noted below). For example, the irregular estimates for 1980 are tested against a standard deviation computed from data taken between 1978 through 1982. Note that 1980 is the central year in this span. Each moving 5-year standard deviation is used to test the irregular values in the central year of the span used to derive the standard deviation. Irregular estimates at the beginning or end of the series, those values which do not fall in the central year of any of the spans used to derive the standard deviations, are tested with the moving standard deviation from the first or last span, respectively.

X-11 and X-11-ARIMA have different methods of determining the spans which are used to calculate the moving standard deviations. In X-11, the first 5-year span begins in the first available January irregular value. The next 5-year span begins with the January irregular value of the next year, and so on. The last 5-year span ends with the final December irregular value.

X-11-ARIMA will start the first 5-year span with the first available observation, regardless of what month the irregular value happens to fall in. The next 5-year span will start with the first January after the initial observation, and the next span will begin in the next January. This continues until the last 5-year span, which will end at the last irregular value, regardless of month.

To illustrate the difference between the two programs, we will use Appendices B.1 and B.2. They contain the B3 (unmodified SI ratios) and B4 (replacement values for extreme SI ratios) tables from X-11 and X-11-ARIMA runs performed on RHARDWARE, representing retail sales from hardware stores from Sandra McKenzie's concurrent adjustment study. The values of the B3 table are used to derive a preliminary irregular series (which is not printed out). This irregular series is then tested for extremes. Also note that the B3 table for the X-11 and X-11-ARIMA programs are identical: up to this point, the programs give the same answers.

Note that the series in this table begins in July, 1967 and ends in June, 1979. This is because these SI ratios were computed by dividing the B1 table (original data or prior adjusted data) by a 2x12 moving average of the B1 table. Since a 2x12 moving average does not produce estimates for the first and last six observations of the series, the observations are taken to be missing by X-11 and X-11-ARIMA, and no effort is made to replace them.

Given the irregular derived from the B3 table, X-11 will compute its first moving 5-year standard deviation using irregular estimates from January, 1968 to December, 1972. This standard deviation will be used to test the values in the central year, 1970, as well as values for 1967 through 1969. This can be seen by examining the standard deviations listed on table B4 of Appendix B.1; notice how the first four standard deviations listed are the same.

The next moving 5-year standard deviation X-11 computes will use data from January, 1969 to December, 1973, and will be used to test the values in 1971, the central year. This will continue until the last moving standard deviation, which will be computed between January, 1974 and December, 1978. The last standard deviation will be used to test the central year, 1976, and all observations falling after 1976.

Now that we know how the standard deviations are derived, we will show how they are used in this process. Once the moving standard deviation for a span of values is derived (we will call it σ), the central values in this span are tested to see if they differ from the mean value of the irregular component (assumed to be 0 for an additive adjustment, 1.0 for a multiplicative adjustment) by more than 2.5σ (2.5 is the default upper limit, it can be changed by the user). These values are considered extreme, and are treated differently by the two seasonal adjustment programs. Both X-11 and X-11-ARIMA will give this observation a weight of 0. However, X-11 will exclude this observation from further computations of the moving standard deviation if this observation should fall in a later span. X-11-ARIMA will not exclude these extreme values. Each method, after computing the moving standard deviation for the next span, will continue in its own fashion until all the observations have been tested.

After we have identified the extreme values among the irregulars, the moving 5-year standard deviations are recalculated as before, with X-11 and X-11-ARIMA excluding those values flagged as extreme in the first iteration. After a moving standard deviation is recalculated, we give weights derived from this standard deviation to each of the irregular estimates in the central year. Let

I_t = irregular value tested at time t;

u = mean of irregular estimate (0 if additive, 1 if multiplicative);

σ = moving 5-year standard deviation used to test I_t;

S_u = upper limit for σ (default, $S_u = 2.5$);

S_ℓ = lower limit for σ (default, $S_\ell = 1.5$);

W_t = irregular weight assigned to I_t.

Now if

$$D_t = \frac{| I_t - u |}{\sigma},$$

then

$$W_t = \begin{cases} 1 & \text{if } D_t \leqslant S_\ell , \\ \dfrac{S_u - D_t}{S_u - S_\ell} & \text{if } S_\ell < D_t < S_u , \\ 0 & \text{if } D_t \geqslant S_u . \end{cases}$$

Once weights have been assigned to each irregular value, the next moving standard deviation is recomputed. However, X-11 will exclude any value found to be extreme, i.e., any value with $W_t = 0$, from the calculation of the moving standard deviation, while X-11-ARIMA will only exclude those irregular values flagged as extreme in the first iteration. Once the moving standard deviation is computed, the procedure continues until all the irregular estimates are weighted.

Let us present a hypothetical example of how this difference in excluding extreme values works to be certain that this important point is understood. A moving 5-year standard deviation is computed for observations between January of 1978 and December of 1982. None of the observations in this span has been previously classified as extreme. The central values are tested to see if they differ from the mean value by more than 2.5σ (provided the default sigma limit has been selected), and it turns out that one of the values, say December of 1980, is extreme. X-11 will exclude the December, 1980 value from the calculation of the next moving standard deviation, while X-11-ARIMA will not exclude it.

In the next iteration, let us assume that none of the observations in this span, except December, 1980 has been classified as extreme by X-11 or X-11-ARIMA. Both programs will now recompute the moving 5-year standard deviation for 1978 through 1982 without December, 1980 and will then weight all of the observations in 1980. Let us say that now two observations, June and December of 1980, are given weights equal to 0. X-11 will exclude both of these observations in computing the next moving standard deviation; X-11-ARIMA will only exclude December 1980, since this value was the only one flagged as an extreme in the first iteration.

The changes noted in this section have two consequences. First, there will be some circumstances where the values which begin and end the irregular series will be measured against different standard deviation values, depending upon when the irregular series begins or ends and the program used. Second, since X-11 will exclude extreme values from standard deviation calculations sooner than X-11-ARIMA, the X-11 moving standard deviations for the central years will tend to be smaller than those values for X-11-ARIMA, since the inclusion of extreme values will inflate the standard deviations derived for X-11-ARIMA. This can cause differences in the weights assigned to irregular values and can even cause X-11-ARIMA to not adjust values which X-11 will flag as outliers. An example of this can be seen in the B4 tables from an X-11 and X-11-ARIMA run performed on FTDXULAR, shown in Appendix B.3. Note that the X-11 moving standard deviations are almost all smaller than the X-11-ARIMA moving standard deviations. This caused X-11 to flag five more extreme values than X-11-ARIMA, and also caused differences in the replacement values, which we will discuss in detail in the next section.

Why didn't this happen for the RHARDWARE series? The sigma limits used in the adjustment performed on RHARDWARE ($S_\ell = 1.8$, $S_u = 2.8$) were different from those used in the adjustment of FTDXULAR (default limits). This, combined with the fact that RHARDWARE is a well behaved series, caused for few, if any, irregular values to be excluded from the calculation of the 5-year moving standard deviations, and therefore the two programs will give very similar, if not the same, values for the moving standard deviations.

The reason the authors of X-11-ARIMA made these changes was to make X-11-ARIMA time reversible, that is, to make it give the same seasonal adjustment with the data in reversed time order as with the data in the original order. We will pursue this matter in more detail in section V.

III. Replacement of Extreme Values

Once X-11 and X-11-ARIMA derive the weights for the irregular component, these weights are used to replace extreme SI ratios. This procedure is used in producing the B4 and B9 tables, and in the strike adjustment option for the trend cycle.

In both X-11 and X-11-ARIMA, the weights for a given month are examined to see if any of the observations in a given month have an irregular weight less than one. If so, this value is replaced, using other values from that same month for different years.

In X-11, the method for replacing such a value depends on where the offending SI ratio is. If this SI ratio is in the first or last two years of data, then it is replaced by a weighted average of that SI ratio and the three nearest fully weighted SI ratios for the same calendar month. If this value does not fall within the first or last two years, then the SI ratio will be replaced by a weighted average of the (i) extreme SI ratio, (ii) the two nearest fully weighted SI ratios before the offending value for the given month, and (iii) the two nearest fully weighted SI ratios after the value for the given month. If at least two fully weighted SI ratios cannot be found either before or after the value, but the month contains at least four fully weighted SI ratios, then the nearest four fully weighted values are used in the weighted average. If less than four fully weighted SI ratios are to be found for a given month, then the mean of all the SI ratios for that month, including the extreme values, is used as a replacement value.

X-11-ARIMA's procedure differs from X-11-'s in two respects:

a) In replacing the first and last two years, the four nearest fully weighted SI ratios are used in the weighted average instead of three;

b) In replacing certain central values, if at least two fully weighted SI ratios are not found either before or after the extreme value, the extreme value is replaced by the mean of all the unmodified SI ratios for that month.

The first change was done to make the replacement process symmetric, so that the observations at either end of the series were treated the same as the central observations. The second change was done to prevent fully weighted values either before or after the replaced observation from having too much influence on the replacement value.

To see how this would affect the replacement of the SI ratios, let's look at a couple of examples. Appendices C.1 and C.2 contain sample unmodified SI-ratios and irregular weights for a given month. The replacement values for each of the extreme SI ratios were calculated as X-11 and X-11-ARIMA would perform them and were printed out. We will go through some of the calculations for both methods so you can see how each program performs the replacement procedure.

For the rest of this discussion, we will let

SI_t = unmodified SI ratio for year t;

W_t = irregular weight for year t;

R_t = replacement value at year t;

t = 1, ... , 13.

For our first example, we will use Appendix C.1. In examining the seventh year, we see that $SI_7 = 1.069$ and $W_7 = 0.359$. In order to replace this value, we use the two nearest fully weighted values before the seventh year (SI_1 and SI_3) and the two nearest fully weighted values after the seventh year (SI_8 and SI_9). The replacement value for both X-11 and X-11-ARIMA will be:

$$R_7 = \frac{(SI_1 \times W_1)+(SI_3 \times W_3)+(SI_7 \times W_7)+(SI_8 \times W_8)+(SI_9 \times W_9)}{W_1 + W_3 + W_7 + W_8 + W_9};$$

$$= \frac{(.949 \times 1)+(1.041 \times 1)+(1.069 \times .359)+(1.03 \times 1)+(1.07 \times 1)}{1 + 1 + 0.359 + 1 + 1};$$

$$= \frac{.949 + 1.041 + 0.384 + 1.03 + 1.07}{4.359};$$

$$= \frac{4.474}{4.359} = 1.026 .$$

We see that the replacement value R_2 is different for X-11 than for X-11-ARIMA.

For X-11:

$$R_2 = \frac{.949 + 1.041 + 1.030 + (.926 \times .763)}{1 + 1 + 1 + .763};$$

$$= \frac{3.020 + 0.706}{3.763} = \frac{3.726}{3.763} = 0.990 ;$$

For X-11-ARIMA :

$$R_2 = \frac{.949 + 1.041 + 1.030 + 1.070 + (.926 \times .763)}{1 + 1 + 1 + 1 + .763} ;$$

$$= \frac{4.090 + 0.706}{4.763} = \frac{4.796}{4.763} = 1.007 .$$

We will use Appendix C.2 for our second example. We see that the replacement values R_3 and R_5 are the same for X-11-ARIMA, but not for X-11. This is because in both cases there were not at least two fully weighted SI ratios before the extreme value being replaced. So the replacement value for X-11-ARIMA was the mean of the SI ratios :

$$R_3 = \frac{\sum SI_i}{13} = \frac{13.658}{13} = 1.051 = R_5 .$$

While, for X-11:

$$R_3 = \frac{1.076 + .973 + 1.073 + 1.064 + (.738 \times .276)}{1 + 1 + 1 + 1 + 0.276} ;$$

$$= \frac{4.186 + 0.204}{4.276} = \frac{4.842}{4.276} = 1.027 ;$$

and

$$R_5 = \frac{1.076 + 0.973 + 1.073 + 1.064 + (.808 + .812)}{1 + 1 + 1 + 1 + .812};$$

$$= \frac{4.186 + 0.656}{4.812} = \frac{4.842}{4.812} = 1.006 .$$

We also see that replacement values R_1, R_2 and R_{13} are not the same for X-11 and X-11-ARIMA. This is due to the difference in the way the two programs compute replacement values when an extreme value falls in either the first or last two years.

So, we have shown how the two programs differ in the way they replace SI ratios in table B4 and B9. It should also be noted that, since the moving standard deviations described in section II are often different for the two programs, the weights derived for the irregular are also going to be different. This will cause some differences between the replacement values for X-11 and X-11-ARIMA beyond those outlined in section III.

IV. Generation of weights to derive seasonal factors and trend cycle estimates

X-11 and X-11-ARIMA use moving averages to derive estimates of the seasonal factors, trend cycle, and other intermediate variables. These moving averages use weights to derive the desired estimates for each observation. How do X-11 and X-11-ARIMA get these weights?

X-11 stores the weights for both central and end values, accurate to three decimal places. X-11-ARIMA uses subroutines to derive the symmetric weights for the central values of both the seasonal factors and the trend estimates, using floating point arithmetic to achieve greater than three places of decimal accuracy. The end weights for the seasonal factors are also computed algebraically. Only the end weights of the Henderson filter are stored in X-11-ARIMA.

To see how much of a difference this really makes in the estimation of seasonal factors, the weights used by X-11 and X-11-ARIMA were applied to a sample set of modified SI ratios. The results are printed out in Appendices D.1 through D.3. The SI ratios used were taken from the series RHARDWARE, and 3x5 seasonal filters were used in every month except the last, where a 3x3 filter was used. Appendix D.1 shows the result of applying these factors to the SI ratios. We see some differences, mostly at the ends of the series. Appendix D.2 shows the result of a 2x12 moving averge of the preliminary estimate of the seasonal factors, which is used to constrain the final seasonal factors for a given year to add to twelve. The result of dividing the values of Appendix D.1 by the values of Appendix D.2 gives us our final seasonal factors, given in Appendix D.3. Note that the differences which were once apparent in the last two years of data have been practically wiped out, but there are still some small differences in a number of the seasonal factors. Although these differences are quite small, one should keep in mind that sesonal factors are not generated at only one point in the program. X-11 and X-11-ARIMA generate four sets of seasonal factors while doing the B tables, although all of these are not printed out. A sequence of small differences when computing seasonal factors can multiply when the procedure is repeated; the same applies to the generation of the trend cycle.

V. Other topics

This section will document other differences between X-11 and X-11-ARIMA, as well as some aspects of X-11-ARIMA not covered in the X-11-ARIMA manual, The X-11-ARIMA Seasonal Adjustment Method by Dr. Estella Bee Dagum. A listing of some of the other distinctive features of X-11-ARIMA is given on pages 15 through 19 of the aforementioned manual. While some of the points in this section will expand upon some of the items taken from this manual, this section is not meant to be a substitute for it.

A. Reversibility

By using a more homogeneous method for identifying extreme values, X-11-ARIMA has the property that it will give the same results when adjusting a series in reverse time order as it did when seasonally adjusting the data in its original order. Two points should be noted here:

1) This property will not hold if trading day adjustment is performed also.
2) This property will only hold if the annual and calendar month totals of the original series are preserved in the reversed time series. This ensures, for example, that the January observations in the original series will be the same (although in reversed order) as the December observations in the reversed series. This may involve a shift in the time frame of the reversed series. For example, if a series runs from January 1971 to June 1980, the reversed time series should begin in July 1971 and end in December 1980 to preserve the totals.

An example of this property is given in Appendices E.1 through E.4 . Appendix E.1 shows the series FULAR (imports from Latin American countries), pre-adjusted for trading day variation. Appendix E.2 shows the seasonal factors and adjusted data for the original time sequence, while Appendix E.3 shows the same tables for the X-11-ARIMA run on the reversed sequence. From examining them, we see that the reversibility property holds.

X-11, however, is not time reversible. Appendix E.4 shows the result of adjusting the series listed in Appendix E.1 with X-11. Note there are differences in both the seasonal factors and the adjusted data.

Why is X-11-ARIMA time reversible and X-11 not? X-11-ARIMA does not exclude extreme irregular values from the calculation of the moving 5-year standard deviation in the first iteration of the extreme identification procedure detailed in section II. This means that each of the 5-year spans used to calculate the moving 5-year standard deviations of the original series will contain exactly the same data as a 5-year span in the reversed series. This would not be the case in X-11, where different values could be considered extreme, depending on what values within the span had been declared extreme before, and thus not used in the classification of the moving standard deviation. This would give different values of the moving standard deviation for the original and time reversed series. The same holds true for the recalculation of the moving standard deviation done in the second iteration of this procedure.

B. Different Scales

The X-11-ARIMA program stores all of its variables in the original scale, while X-11 will store some variables at 100 times the value in the original scale. For example, an SI ratio stored by X-11-ARIMA as 1.053 will be stored as 105.3 by X-11. It is unclear how this affects the final adjustment, but certainly X-11 needs to do many more computations, constantly multiplying and dividing by 100.

C. Output Decimals Option

Both programs have an option to control the number of decimal places printed out on the output of the program. X-11's option refers to the number of decimals in the input data; if the user specifies that the data being input has two decimal places of accuracy, then the output will be printed to two decimal places. In X-11-ARIMA, the user can specify the number of decimals printed out by the program to be different from the number of decimals requested on input.

D. Minor corrections in X-11-ARIMA code

Some corrections have been made by the author to X-11-ARIMA code at the Census Bureau as a result of this work. The first invovles tables B8 and B9. The original X-11-ARIMA program did not print out the first six observations of these two tables because the program assumed that these observations were always missing. The second involves the output from using the special output option. This option allows the user to print out an X-11-ARIMA table to an outside file, to be examined later by the analyst (X-11 currently does not have this option). With certain print options, the user can print out a label which includes the calendar year in which the observations fall. The original X-11-ARIMA was printing out improper values for this year in certain situations, in which the first observation in the table ws not the same as the first observation in the data.

Both of these problems have been corrected. The corrections are presented in Appendices E.5 and E.6. Any user who experiences a problem with these two corrected subroutines, or any other X-11-ARIMA related problem, is asked to contact the author.

E. Seasonal factor selection for short series

X-11-ARIMA will use stable seasonal filters to adjust the series if it is less than 5 complete years long. This affects the weighting of the quality control statistics also, as M8 through M11 will not be calculated if stable seasonal filters are used.

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D10. FINAL SEASONAL FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1967	92.8	92.0	100.9	106.4	103.3	102.3	102.5	102.5	98.3	98.7	99.1	101.3	100.0
1968	92.9	92.1	101.0	105.9	103.4	102.3	102.2	102.4	98.1	99.3	98.9	101.7	100.0
1969	92.9	92.0	101.3	105.6	103.5	102.5	101.7	102.1	97.9	100.1	99.0	102.2	100.0
1970	92.7	91.7	101.6	105.2	103.3	102.7	101.2	101.7	97.6	100.9	99.3	102.8	100.1
1971	92.5	91.5	101.9	104.8	103.0	103.0	100.8	101.4	97.1	101.8	99.7	103.4	100.1
1972	92.3	91.1	102.2	104.3	102.5	103.3	100.5	101.1	96.5	102.7	100.2	104.0	100.1
1973	92.3	90.7	102.7	103.5	102.0	103.7	100.2	100.9	96.0	103.4	100.7	104.8	100.1
1974	92.5	90.2	102.9	102.7	101.5	104.0	99.9	100.6	95.7	104.1	101.0	105.6	100.1
1975	92.5	89.9	102.9	102.1	100.9	104.4	99.7	100.4	95.8	104.6	101.4	106.4	100.1
1976	92.3	89.5	102.9	101.7	100.4	104.8	99.6	100.2	95.6	105.1	101.8	106.9	100.1
1977	92.1	89.1	103.0	101.5	99.8	105.2	99.6	100.1	95.4	105.3	102.3	107.3	100.0
1978	92.1	88.8	103.0	101.3	99.2	105.5	99.8	100.1	95.1	105.4	102.6	107.5	100.0
1979	92.1	88.7	102.9	101.0	98.9	105.6	100.0	100.2	95.1	105.5	102.6	107.7	100.0

TABLE TOTAL- 15607.7 MEAN- 100.0 STD. DEVIATION- 4.6

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1980	92.1	88.6	102.8	100.8	98.8	105.7	100.1	100.2	95.1	105.5	102.6	107.7	100.0

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D10. FINAL SEASONAL FACTORS
DIFFERENT MOVING AVERAGES SELECTED FOR DIFFERENT MONTHS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1967	92.81	92.22	101.12	105.66	103.07	101.96	102.39	102.30	98.09	100.72	98.68	100.92	100.00
1968	92.94	92.50	101.21	105.00	103.26	101.98	102.14	102.14	97.88	101.63	98.41	101.11	100.02
1969	92.89	92.61	101.43	104.45	103.34	102.17	101.58	101.78	97.75	102.68	98.43	101.36	100.04
1970	92.79	92.34	101.73	104.14	103.18	102.45	101.07	101.49	97.43	103.45	98.81	101.75	100.05
1971	92.58	92.06	101.99	103.78	102.92	102.80	100.72	101.19	97.03	104.07	99.25	102.35	100.06
1972	92.40	91.68	102.37	103.31	102.44	103.21	100.39	100.94	96.55	104.76	99.77	103.02	100.07
1973	92.29	91.27	102.76	102.59	101.99	103.54	100.15	100.68	96.35	105.20	100.27	103.73	100.07
1974	92.43	90.81	102.87	101.83	101.51	103.98	99.96	100.50	96.37	105.28	100.68	104.70	100.08
1975	92.36	90.43	102.88	101.31	100.94	104.42	99.77	100.26	96.66	105.23	101.12	105.53	100.07
1976	92.21	89.89	102.86	101.18	100.36	104.84	99.65	100.15	96.78	104.97	101.70	106.24	100.07
1977	91.96	89.24	102.99	101.27	99.73	105.25	99.86	100.08	96.74	104.57	102.31	106.86	100.06
1978	91.87	88.76	102.98	101.23	99.17	105.50	99.93	100.18	96.88	104.05	102.67	107.40	100.04
1979	91.82	88.65	102.86	100.96	98.88	105.63	100.20	100.26	96.85	103.76	102.63	107.74	100.02

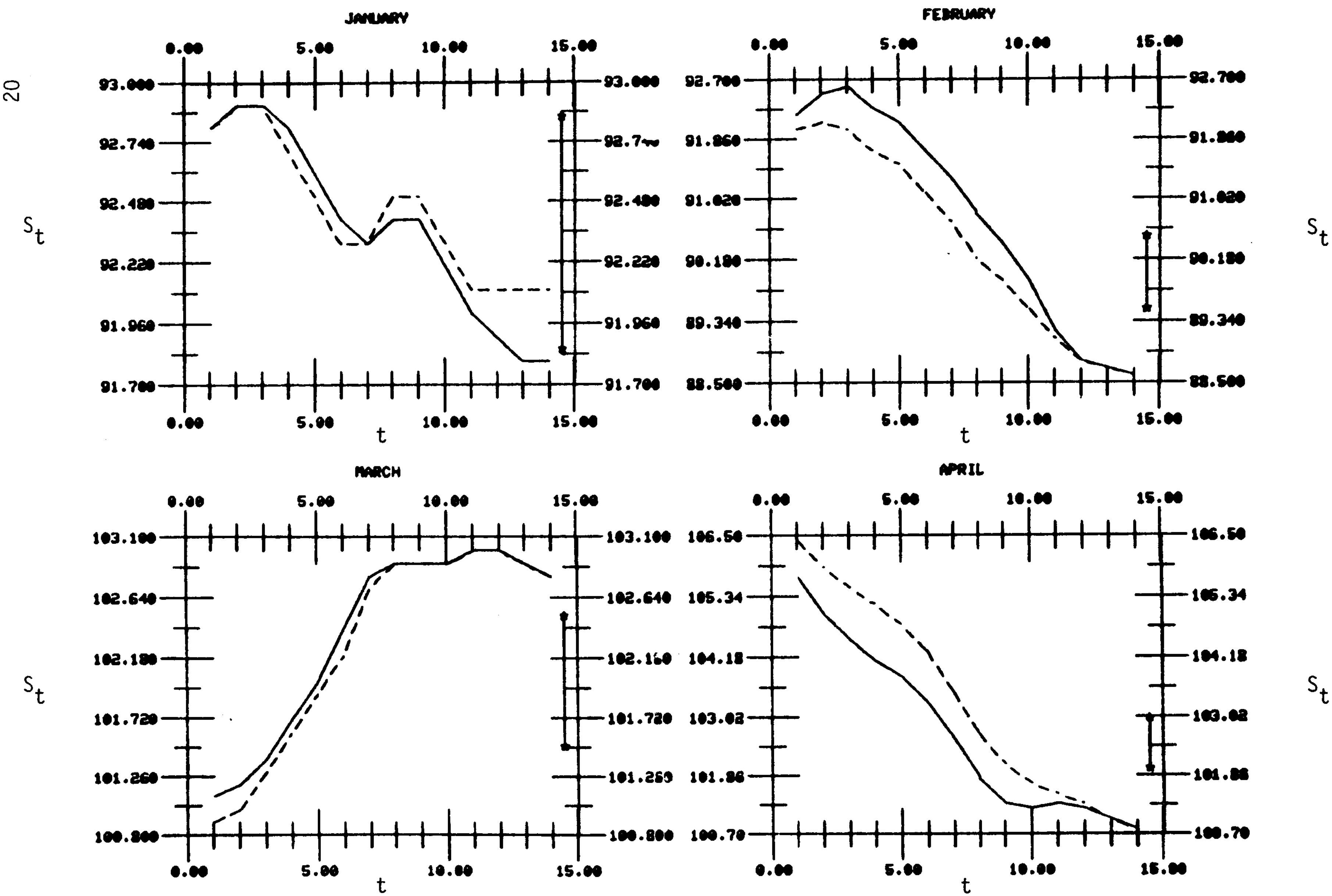
TABLE TOTAL- 15607.59 MEAN- 100.05 STD. DEVIATION- 4.39

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1980	91.80	88.60	102.80	100.82	98.73	105.69	100.33	100.30	96.94	103.62	102.61	107.90	100.01

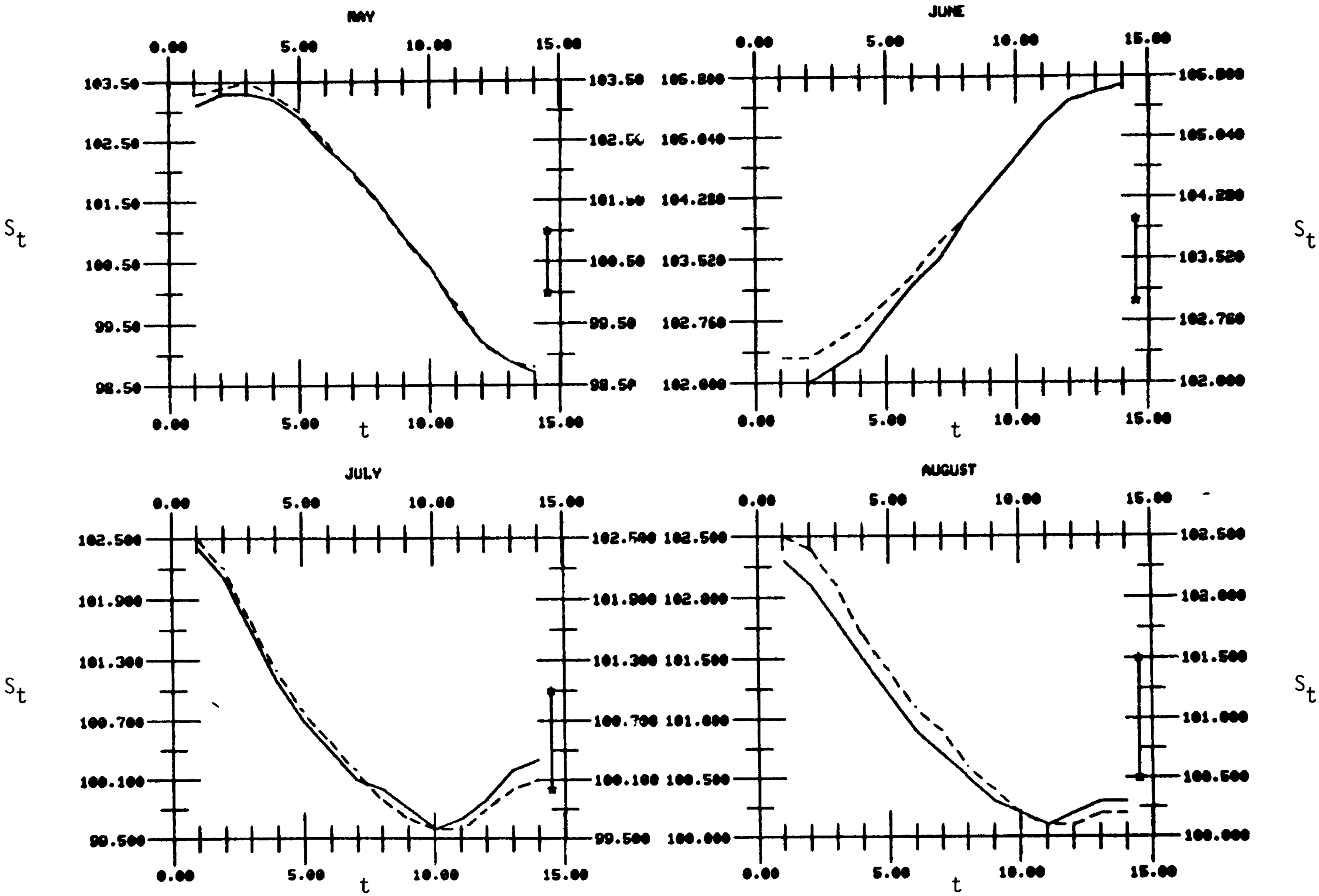
APPENDIX A.1 : Seasonal factors produced by X-11 and X-11-ARIMA for FTDXULAR

APPENDIX A.2 : Graphs for the seasonal factors, X-11 and X-11-ARIMA



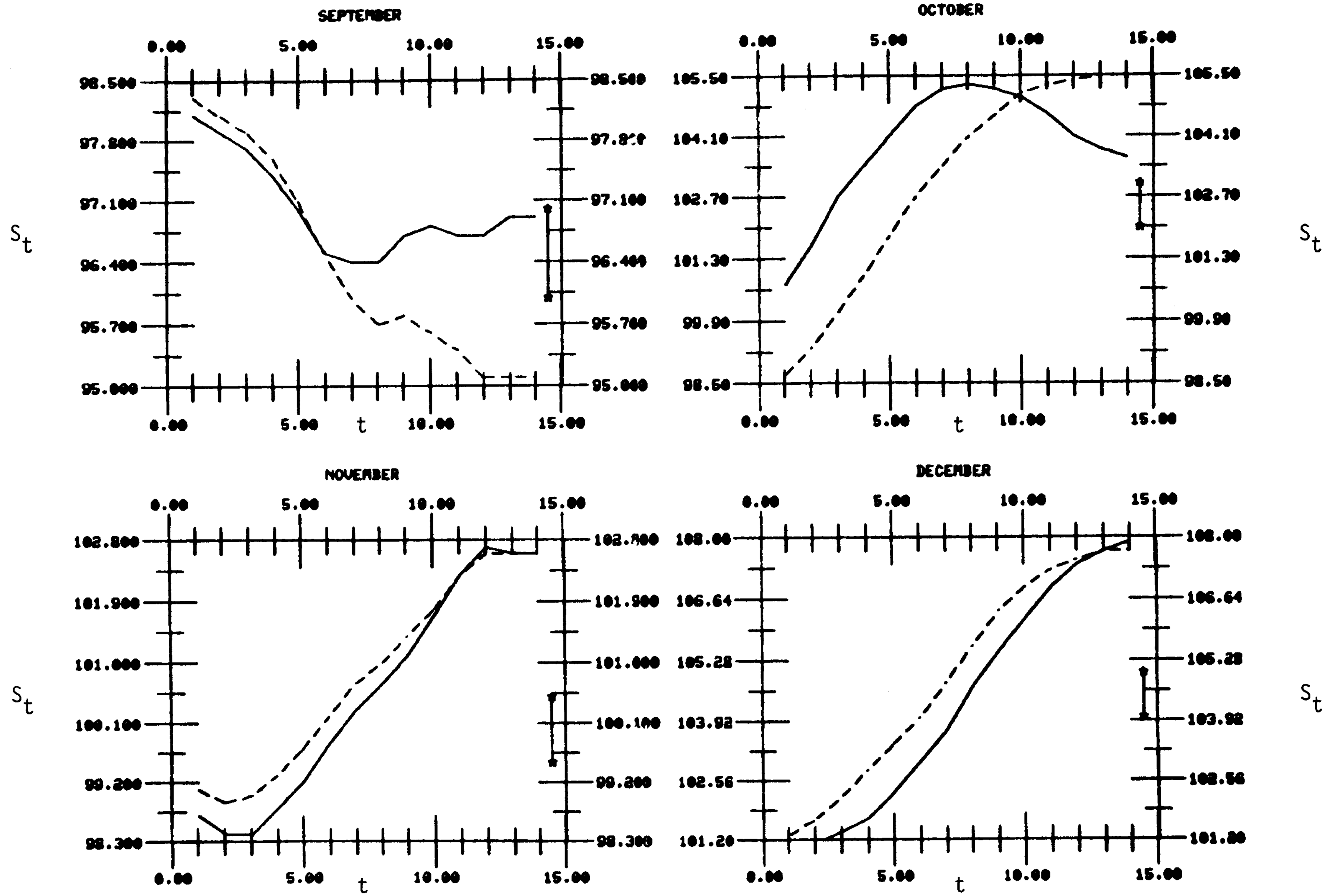
Dashed line - X-11 seasonal factors and projected seasonal for FTDXULAR
Solid line - X-11-ARIMA seasonal factors and projected seasonal for FTDXULAR
—— - represents the same distance (1 unit) on each graph

APPENDIX A.2



Dashed line - X-11 seasonal factors and projected seasonal for FTDXULAR
Solid line - X-11-ARIMA seasonal factors and projected seasonal for FTDXULAR
——— - represents the same distance (1 unit) on each graph

APPENDIX A.2



Dashed line - X-11 seasonal factors and projected seasonal for FTDXULAR
Solid line - X-11-ARIMA seasonal factors and projected seasonal for FTDXULAR
——— - represents the same distance (1 unit) on each graph

APPENDIX A.3 : Summary of differences between X-11 and X-11-ARIMA

	X-11	X-11-ARIMA
A. Identification of Extremes		
1) Where does the first 5-year span for calculating σ, the 5-year moving standard deviation, start?	first available January	first available observation
2) Where does the last 5-year span for calculating σ end?	last available December	last available observation
3) How are the extreme values excluded in the calculation?	all observations with weight = 0 excluded in all calculations of σ	on second calculation of σ, values with weights = 0 from the first iteration are excluded
B. Replacement of Extremes		
1) How many fully weighted SI ratios are used to replace the first or last two SI ratios for a given calendar month?	the 3 nearest fully weighted SI ratios	the 4 nearest fully weighted SI ratios
2) What is used to replace a central SI ratio if at least two full SI ratios are not either before or after the replaced value, but the number of fully weighted SI ratios in the calendar month was greater than or equal to four?	use weighted mean of extreme SI ratio, four nearest fully weighted SI ratios in the given calendar month	use arithmetic mean of all SI ratios for a given calendar month
C. Weights for moving averages		
1) How are the weights for the moving averages used by the program derived?	stored in the program to 3 decimal places	derived from explicit formulae (except end weights for Henderson filter)

B 3. UNMODIFIED SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1967	*******	*******	*******	*******	*******	*******	103.4	101.0	99.8	99.0	99.0	138.5	106.8
1968	67.8	73.2	85.7	103.7	109.8	107.1	106.9	104.2	96.6	102.4	106.7	134.5	99.9
1969	76.8	73.2	83.9	105.1	113.0	108.4	108.9	102.5	96.8	101.9	99.1	138.8	100.7
1970	75.0	68.7	75.7	94.3	111.7	117.4	113.0	104.0	101.5	105.1	96.2	130.9	99.5
1971	70.3	71.3	80.3	100.2	110.1	116.6	112.0	100.3	98.1	103.5	101.9	128.7	99.4
1972	74.0	74.2	87.8	95.3	111.5	112.3	108.9	105.8	99.6	103.4	103.8	128.5	100.4
1973	70.4	70.7	85.1	96.2	112.7	122.5	104.4	103.2	99.7	104.5	101.5	118.6	99.1
1974	73.2	76.1	88.1	98.8	115.0	115.1	108.8	102.3	98.1	105.0	99.7	115.3	99.6
1975	76.0	75.6	85.0	98.5	120.8	113.7	108.5	100.1	100.3	103.2	98.4	118.2	99.9
1976	76.3	79.8	92.0	105.4	110.6	114.3	107.3	95.2	97.5	102.1	100.9	118.1	100.0
1977	73.1	73.3	93.2	106.9	111.7	111.7	105.9	101.7	100.5	104.0	101.7	118.7	100.2
1978	71.2	70.8	91.6	103.0	111.8	111.1	101.7	100.2	101.9	104.0	102.8	118.5	99.1
1979	76.8	68.5	95.8	103.7	116.5	113.7	*******	*******	*******	*******	*******	*******	95.8
AVGE	73.4	73.0	87.0	100.9	112.9	113.7	107.5	101.7	99.2	103.2	101.0	125.6	

TABLE TOTAL- 14388.4

APR 1984 RHARDWARE P. 4, SERIES RHARDW

B 4. REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1967	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	2.6
1968	73.0	*******	*******	*******	*******	*******	*******	*******	*******	*******	100.1	*******	2.6
1969	74.0	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	2.6
1970	*******	*******	83.3	99.8	*******	*******	*******	*******	*******	*******	*******	*******	2.6
1971	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	2.4
1972	*******	*******	85.0	*******	*******	*******	*******	*******	*******	*******	*******	*******	2.2
1973	*******	73.6	*******	*******	*******	115.2	*******	*******	*******	*******	*******	*******	1.9
1974	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	2.1
1975	*******	*******	88.8	*******	113.1	*******	*******	*******	*******	*******	*******	*******	1.9
1976	*******	74.0	*******	*******	*******	*******	*******	100.5	*******	*******	*******	*******	1.8
1977	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	1.8
1978	74.4	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	1.8
1979	75.4	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	1.8

APPENDIX B.1 : Tables B.3 and B.4 from X-11 run of RHARDWARE

B 3. UNMODIFIED SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1967	**********	********	********	********	********	********	103.4	101.0	99.8	99.0	99.0	138.5	106.8
1968	67.8	73.2	85.7	103.7	109.8	107.1	106.9	104.2	96.6	102.4	106.7	134.5	99.9
1969	76.8	73.2	83.9	105.1	113.0	108.4	108.9	102.5	96.8	101.9	99.1	138.8	100.7
1970	75.0	68.7	75.7	94.3	111.7	117.4	113.0	104.0	101.5	105.1	96.2	130.9	99.5
1971	70.3	71.3	80.3	100.2	110.1	116.6	112.0	100.3	98.1	103.5	101.9	128.7	99.4
1972	74.0	74.2	87.8	96.3	111.5	112.3	108.9	105.8	99.6	103.4	103.8	128.5	100.4
1973	70.4	70.7	85.1	96.2	112.7	122.5	104.4	103.2	99.7	104.5	101.5	118.6	99.1
1974	73.2	76.1	88.1	98.8	115.0	115.1	108.8	102.3	98.1	105.0	99.7	115.3	99.6
1975	76.0	75.6	85.0	98.5	120.8	113.7	108.5	100.1	100.3	103.2	98.4	118.2	99.9
1976	76.3	79.8	92.0	105.4	110.6	114.3	107.3	95.2	97.5	102.1	100.9	118.1	100.0
1977	73.1	73.3	93.2	106.9	111.7	111.7	105.9	101.7	100.5	104.0	101.7	118.7	100.2
1978	71.2	70.8	91.6	103.0	111.8	111.1	101.7	100.2	101.9	104.0	102.8	118.5	99.1
1979	76.8	68.5	95.8	103.7	116.5	113.7	********	********	********	********	********	********	95.8
AVGE	73.4	73.0	87.0	100.9	112.9	113.7	107.5	101.7	99.2	103.2	101.0	125.6	

TABLE TOTAL- 14388.4 MEAN- 99.9 STD. DEVIATION- 15.5

RHARDWARE PAGE 4, SERIES RHARDW

B 4. REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1967	**********	********	********	********	********	********	********	********	********	********	********	********	2.5
1968	72.4	********	********	********	********	********	********	********	********	********	100.5	********	2.5
1969	73.2	********	********	********	********	********	********	********	********	********	********	********	2.5
1970	**********	********	83.3	99.8	********	********	********	********	********	********	********	********	2.6
1971	**********	********	********	********	********	********	********	********	********	********	********	********	2.4
1972	**********	********	85.0	********	********	********	********	********	********	********	********	********	2.2
1973	**********	73.6	********	********	********	115.2	********	********	********	********	********	********	1.9
1974	**********	********	********	********	********	********	********	********	********	********	********	********	2.1
1975	**********	********	88.8	********	113.1	********	********	********	********	********	********	********	1.9
1976	**********	74.0	********	********	********	********	********	100.5	********	********	********	********	1.8
1977	**********	********	********	********	********	********	********	********	********	********	********	********	1.8
1978	74.1	********	********	********	********	********	********	********	********	********	********	********	1.8
1979	75.0	********	********	********	********	********	********	********	********	********	********	********	1.8

APPENDIX B.2 : Tables B3 and B4 from X-11-ARIMA run of RHARDWARE

APR 1984 FTDXULAR - X-11 PRINTOUT P. 4, SERIES FTDXUL

B 4. REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1967	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	6.2
1968	*******	92.5	*******	*******	*******	*******	*******	*******	*******	*******	100.4	104.3	6.2
1969	90.8	91.0	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	6.2
1970	*******	*******	*******	*******	*******	*******	*******	*******	*******	102.3	*******	*******	6.2
1971	92.2	*******	*******	*******	*******	*******	*******	*******	95.9	102.3	98.4	*******	5.4
1972	91.1	90.1	*******	101.0	*******	*******	*******	*******	*******	*******	*******	*******	5.2
1973	*******	*******	*******	*******	*******	*******	98.7	*******	*******	107.4	*******	106.4	4.7
1974	*******	*******	*******	*******	100.3	*******	*******	*******	*******	*******	*******	*******	4.2
1975	*******	*******	*******	*******	*******	*******	*******	*******	97.4	*******	*******	*******	4.3
1976	*******	*******	*******	*******	*******	*******	*******	*******	*******	102.3	*******	106.9	4.1
1977	91.8	*******	*******	*******	*******	*******	100.3	*******	99.6	*******	*******	*******	4.1
1978	*******	87.1	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	4.1
1979	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	*******	4.1

FTDXULAR - X-11-ARIMA PRINTOUT PAGE 4, SERIES FTDXUL

B 4. REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1967	**********	********	********	********	********	********	********	********	********	********	********	********	7.1
1968	**********	********	********	********	********	********	********	********	********	********	99.9	********	7.1
1969	92.5	92.8	********	********	********	********	********	********	********	********	********	********	7.1
1970	**********	********	********	********	********	********	********	********	********	102.6	********	********	7.3
1971	**********	********	********	********	********	********	********	********	95.9	102.3	98.4	********	7.1
1972	93.8	91.4	********	********	********	********	********	********	********	********	********	********	6.9
1973	**********	********	********	********	********	********	********	********	********	108.0	********	104.6	6.5
1974	**********	********	********	********	101.0	********	********	********	********	********	********	********	5.1
1975	**********	********	********	********	********	********	********	********	97.2	********	********	********	4.6
1976	**********	********	********	********	********	********	********	********	********	102.3	********	106.9	4.1
1977	91.9	********	********	********	********	********	100.1	********	99.3	********	********	********	4.0
1978	**********	88.1	********	********	********	********	********	********	********	********	********	********	4.0
1979	**********	********	********	********	********	********	********	********	********	********	********	********	4.0

APPENDIX B.3 : Table B4 from X-11 and X-11-ARIMA runs of FTDXULAR

UNMODIFIED SI RATIOS FOR SAMPLE MONTH

.949	.926	1.041	1.060	.987	1.088	1.069	1.030	1.070	1.018	1.012	1.049	1.086

IRREGULAR WEIGHTS FOR SAMPLE MONTH

1.000	.763	1.000	.000	.000	.020	.359	1.000	1.000	.502	.172	1.000	1.000

(1)	(2)	(3)	(4)
.949	************	.949	************
1.007	1.007	.990	.990
1.041	************	1.041	************
1.022	1.022	1.022	1.022
1.022	1.022	1.022	1.022
1.023	1.023	1.023	1.023
1.026	1.026	1.026	1.026
1.030	************	1.030	************
1.070	************	1.070	************
1.054	1.054	1.054	1.054
1.057	1.057	1.057	1.057
1.049	************	1.049	************
1.086	************	1.086	************

(1) - MODIFIED SI RATIOS FOR SAMPLE MONTH (X-11-ARIMA)
(2) - REPLACEMENT VALUES FOR SAMPLE MONTH (X-11-ARIMA)
(3) - MODIFIED SI RATIOS FOR SAMPLE MONTH (X-11)
(4) - REPLACEMENT VALUES FOR SAMPLE MONTH (X-11)

APPENDIX C.1 : Replacement example # 1

UNMODIFIED SI RATIOS FOR SAMPLE MONTH

1.359	1.590	.738	1.076	.808	.973	1.073	1.064	1.238	.813	1.126	1.118	.682

IRREGULAR WEIGHTS FOR SAMPLE MONTH

.591	.000	.276	1.000	.812	1.000	1.000	1.000	.380	.777	1.000	1.000	.049

(1)	(2)	(3)	(4)
1.087	1.087	1.093	1.093
1.046	1.046	1.041	1.041
1.051	1.051	1.027	1.027
1.076	************	1.076	************
1.051	1.051	1.006	1.006
.973	************	.973	************
1.073	************	1.073	************
1.064	************	1.064	************
1.108	1.108	1.108	1.108
1.049	1.049	1.049	1.049
1.126	************	1.126	************
1.118	************	1.118	************
1.090	1.090	1.096	1.096

(1) - MODIFIED SI RATIOS FOR SAMPLE MONTH (X-11-ARIMA)
(2) - REPLACEMENT VALUES FOR SAMPLE MONTH (X-11-ARIMA)
(3) - MODIFIED SI RATIOS FOR SAMPLE MONTH (X-11)
(4) - REPLACEMENT VALUES FOR SAMPLE MONTH (X-11)

APPENDIX C.2 : Replacement value example # 2

PRELIMINARY SEASONAL FACTORS, X-11-ARIMA

73.55	76.91	82.72	104.00	107.04	112.47	105.94	100.99	100.28	99.60	102.15	135.14
73.34	76.93	82.44	103.48	107.41	112.98	106.19	101.07	100.28	99.90	102.24	134.55
73.00	77.10	82.27	102.48	108.12	113.54	106.78	101.41	100.17	100.37	102.56	132.94
72.46	77.35	82.14	101.52	108.94	114.49	107.23	101.60	100.19	101.01	102.77	130.06
72.02	77.77	82.46	100.48	109.73	115.49	107.53	101.59	100.42	101.74	102.73	126.63
71.76	78.63	82.99	100.08	110.33	116.62	107.41	101.08	100.86	102.19	102.48	123.49
71.91	79.58	84.22	100.26	110.59	117.13	107.13	100.39	101.12	102.32	102.39	120.23
72.16	80.37	85.61	101.29	110.81	117.15	106.47	99.62	101.34	102.23	102.34	117.88
72.56	80.74	87.15	102.61	111.04	116.63	105.76	99.00	101.38	102.29	102.26	116.22
72.96	80.73	88.40	104.05	111.33	115.76	104.90	98.72	101.50	102.39	102.28	115.65
73.32	80.35	89.55	105.31	111.51	114.65	104.22	98.74	101.39	102.62	102.46	115.34
73.46	79.80	90.29	106.22	111.72	113.69	103.56	98.97	101.49	102.88	102.54	114.95
73.41	79.47	90.68	106.73	111.82	113.13	103.25	99.10	101.49	103.13	102.52	114.69

PRELIMINARY SEASONAL FACTORS, X-11

73.48	76.83	82.64	103.39	106.93	112.35	105.84	100.89	100.18	99.51	102.05	135.00
73.34	76.99	82.44	103.48	107.41	112.98	106.19	101.07	100.28	99.90	102.24	134.42
73.07	77.18	82.35	102.58	108.23	113.67	106.88	101.51	100.27	100.47	102.66	132.80
72.45	77.35	82.14	101.52	108.94	114.50	107.23	101.59	100.19	101.01	102.76	129.93
72.02	77.77	82.46	100.48	109.78	115.49	107.53	101.59	100.42	101.74	102.73	126.51
71.76	78.63	82.99	100.08	110.33	116.62	107.41	101.08	100.86	102.19	102.48	123.36
71.91	79.53	84.22	100.26	110.59	117.13	107.13	100.39	101.12	102.32	102.39	120.11
72.16	80.37	85.60	101.29	110.82	117.15	106.47	99.62	101.34	102.23	102.34	117.77
72.56	80.74	87.15	102.61	111.04	116.62	105.76	99.00	101.38	102.29	102.26	116.11
72.96	80.73	88.40	104.05	111.33	115.76	104.89	98.72	101.50	102.38	102.28	115.54
73.39	80.43	89.64	105.42	111.62	114.76	104.33	98.83	101.49	102.72	102.56	115.22
73.46	79.80	90.29	106.22	111.72	113.69	103.56	98.97	101.49	102.88	102.54	114.84
73.34	79.39	90.59	106.62	111.71	113.02	103.14	99.00	101.39	103.03	102.42	114.57

APPENDIX D.1 : Preliminary seasonal factors, X-11 and X-11-ARIMA

2 X 12 MOVING AVERAGE OF SEASONAL, X-11-ARIMA

100.06	100.06	100.06	100.06	100.06	100.06	100.06	100.05	100.04	100.01	100.00	100.04
100.07	100.09	100.09	100.10	100.12	100.10	100.06	100.05	100.05	100.00	99.99	100.04
100.09	100.13	100.14	100.15	100.18	100.13	100.04	100.03	100.03	99.99	99.98	100.05
100.11	100.14	100.15	100.18	100.21	100.10	99.96	99.96	99.99	99.96	99.95	100.03
100.08	100.10	100.11	100.15	100.18	100.03	99.88	99.90	99.96	99.96	99.97	100.04
100.03	100.06	100.05	100.09	100.10	99.96	99.83	99.88	99.97	100.03	100.05	100.08
100.09	100.05	100.03	100.04	100.05	99.91	99.78	99.83	99.92	100.02	100.07	100.08
100.05	100.00	99.97	99.98	99.97	99.87	99.79	99.82	99.90	100.02	100.09	100.07
100.02	99.97	99.94	99.95	99.95	99.87	99.82	99.84	99.89	100.00	100.07	100.05
99.93	99.93	99.92	99.93	99.94	99.91	99.90	99.90	99.93	100.03	100.09	100.06
99.93	99.95	99.95	99.96	99.97	99.97	99.96	99.94	99.95	100.02	100.07	100.04
99.97	99.95	99.96	99.98	99.99	99.98	99.96	99.95	99.95	99.99	100.01	99.99
99.96	99.95	99.96	99.97	99.98	99.96	99.96	99.96	99.96	99.96	99.96	99.96

2 X 12 MOVING AVERAGE OF SEASONAL, X-11

99.96	99.96	99.96	99.96	99.96	99.96	99.96	99.96	99.96	99.93	99.94	99.98
100.02	100.05	100.06	100.08	100.10	100.09	100.05	100.05	100.05	100.01	100.01	100.07
100.13	100.18	100.19	100.22	100.26	100.21	100.12	100.10	100.09	100.04	100.03	100.09
100.14	100.16	100.16	100.18	100.20	100.09	99.95	99.95	99.98	99.95	99.94	100.02
100.07	100.09	100.10	100.14	100.16	100.02	99.87	99.89	99.95	99.95	99.96	100.03
100.07	100.04	100.04	100.08	100.09	99.95	99.82	99.87	99.96	100.02	100.04	100.07
100.03	100.04	100.02	100.03	100.04	99.90	99.77	99.82	99.91	100.01	100.06	100.07
100.04	99.99	99.96	99.97	99.96	99.86	99.78	99.81	99.89	100.01	100.08	100.06
100.01	99.96	99.93	99.94	99.94	99.86	99.81	99.83	99.88	99.99	100.06	100.04
99.97	99.92	99.91	99.92	99.93	99.90	99.90	99.90	99.94	100.05	100.12	100.09
100.02	100.00	100.01	100.02	100.05	100.05	100.04	100.01	100.02	100.08	100.11	100.07
100.00	99.97	99.93	99.98	99.99	99.97	99.95	99.93	99.92	99.95	99.97	99.94
99.90	99.88	99.88	99.88	99.88	99.86	99.86	99.86	99.86	99.86	99.86	99.86

APPENDIX D.2 : Centered 12-term moving average of seasonal, X-11 and X-11-ARIMA

FINAL SEASONAL FACTORS, X-11-ARIMA

73.51	76.87	82.68	103.94	106.98	112.40	105.88	100.94	100.24	99.59	102.14	135.08
73.29	76.92	82.37	103.37	107.29	112.87	106.13	101.02	100.24	99.90	102.26	134.50
72.93	77.00	82.16	102.32	107.92	113.42	106.73	101.38	100.13	100.39	102.58	132.86
72.37	77.24	82.02	101.34	108.71	114.38	107.23	101.64	100.19	101.05	102.81	130.02
71.96	77.70	82.37	100.34	109.59	115.46	107.67	101.69	100.46	101.78	102.76	126.58
71.70	78.58	82.95	99.99	110.22	116.67	107.59	101.21	100.89	102.17	102.43	123.39
71.85	79.54	84.19	100.22	110.54	117.24	107.36	100.56	101.20	102.31	102.32	120.14
72.12	80.38	85.63	101.31	110.85	117.30	106.70	99.80	101.44	102.21	102.25	117.80
72.55	80.77	87.20	102.67	111.10	116.77	105.95	99.16	101.50	102.29	102.18	116.17
72.98	80.79	88.47	104.12	111.40	115.86	105.00	98.82	101.56	102.35	102.18	115.59
73.33	80.39	89.59	105.36	111.54	114.69	104.27	98.79	101.44	102.60	102.39	115.30
73.43	79.84	90.32	106.24	111.73	113.71	103.60	99.02	101.54	102.90	102.53	114.96
73.45	79.51	90.72	106.76	111.85	113.17	103.28	99.14	101.53	103.17	102.56	114.73

FINAL SEASONAL FACTORS, X-11

73.51	76.86	82.67	103.94	106.98	112.40	105.88	100.93	100.22	99.57	102.11	135.03
73.32	76.95	82.40	103.40	107.30	112.88	106.14	101.02	100.23	99.89	102.24	134.32
72.93	77.04	82.19	102.36	107.95	113.44	106.76	101.41	100.17	100.43	102.64	132.68
72.35	77.23	82.01	101.34	108.72	114.40	107.29	101.65	100.21	101.06	102.82	129.91
71.97	77.71	82.38	100.35	109.60	115.47	107.68	101.70	100.47	101.79	102.77	126.47
71.71	78.59	82.96	100.00	110.23	116.68	107.60	101.22	100.90	102.17	102.44	123.28
71.86	79.55	84.20	100.23	110.55	117.25	107.37	100.57	101.21	102.32	102.33	120.03
72.13	80.39	85.64	101.33	110.86	117.31	106.71	99.81	101.45	102.22	102.26	117.69
72.55	80.78	87.21	102.66	111.11	116.78	105.96	99.17	101.51	102.30	102.20	116.06
72.99	80.80	88.48	104.13	111.41	115.87	105.00	98.82	101.56	102.33	102.16	115.43
73.37	80.42	89.63	105.39	111.56	114.71	104.29	98.82	101.48	102.65	102.44	115.14
73.46	79.83	90.31	106.24	111.74	113.72	103.61	99.04	101.56	102.93	102.57	114.91
73.42	79.49	90.70	106.75	111.85	113.18	103.28	99.14	101.53	103.17	102.56	114.73

APPENDIX D.3 : Final seasonal factors, X-11 and X-11-ARIMA

FULAR - PROPER SEQUENCE

PAGE 1, SERIES FULAR

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	9235.	8615.	12295.	12397.	11140.	10875.	10654.	11329.	10772.	11222.	11819.	13319.	133672.
1975	11883.	8847.	8826.	11030.	9861.	9672.	10423.	9318.	10667.	9328.	8556.	9763.	118174.
1976	10000.	9178.	11254.	10264.	9173.	11812.	11507.	11089.	10606.	10696.	12624.	13691.	131894.
1977	13965.	13817.	16158.	15420.	13352.	14176.	12052.	12768.	12673.	12249.	12493.	14563.	163686.
1978	15045.	14093.	15602.	15455.	15144.	15059.	15567.	13844.	15596.	16597.	16358.	17607.	185967.
1979	18476.	17692.	18437.	19454.	20202.	20728.	19237.	20707.	22016.	22938.	22938.	24973.	247798.
1980	25269.	24956.	26320.	21870.	24862.	26258.	22929.	23912.	22576.	23696.	27332.	27650.	297630.
1981	28221.	29597.	26698.	26458.	24515.	25581.	23332.	26471.	26236.	30375.	27645.	25848.	320977.
1982	27783.	23972.	26223.	22197.	26552.	29796.	25691.	29204.	27625.	30814.	25998.	29025.	324880.
1983	29187.	24298.	28138.	29784.	35826.	27309.	29145.	29684.	31076.	34622.	29255.	29074.	357398.
AVGE	18906.	17507.	18995.	18433.	19063.	19127.	18054.	18833.	18984.	20254.	19502.	20551.	

TABLE TOTAL- 2281976. MEAN- 19016. STD. DEVIATION- 7488.

FULAR - REVERSED SEQUENCE

PAGE 1, SERIES FULAR

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	29074.	29255.	34622.	31076.	29684.	29145.	27309.	35826.	29784.	28138.	24298.	29187.	357398.
1975	29025.	25998.	30814.	27625.	29204.	25691.	29796.	26552.	22197.	26223.	23972.	27783.	324880.
1976	25848.	27645.	30375.	26236.	26471.	23332.	25581.	24515.	26458.	26698.	29597.	28221.	320977.
1977	27650.	27332.	23696.	22576.	23912.	22929.	26258.	24862.	21870.	26320.	24956.	25269.	297630.
1978	24973.	22938.	22938.	22016.	20707.	19237.	20728.	20202.	19454.	18437.	17692.	18476.	247798.
1979	17607.	16358.	16597.	15596.	13844.	15567.	15059.	15144.	15455.	15602.	14093.	15045.	185967.
1980	14563.	12493.	12249.	12673.	12768.	12052.	14176.	13352.	15420.	16158.	13817.	13965.	163686.
1981	13691.	12624.	10696.	10606.	11089.	11507.	11812.	9173.	10264.	11254.	9178.	10000.	131894.
1982	9763.	8556.	9328.	10667.	9318.	10423.	9672.	9861.	11030.	8826.	8847.	11883.	118174.
1983	13319.	11819.	11222.	10772.	11329.	10654.	10875.	11140.	12397.	12295.	8615.	9235.	133672.
AVGE	20551.	19502.	20254.	18984.	18833.	18054.	19127.	19063.	18433.	18995.	17507.	18906.	

TABLE TOTAL- 2281976. MEAN- 19016. STD. DEVIATION- 7488.

APPENDIX E.1 : Proper and reversed sequence for FULAR

D10. FINAL SEASONAL FACTORS
DIFFERENT MOVING AVERAGES SELECTED FOR DIFFERENT MONTHS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1974	103.33	90.26	113.78	108.23	98.33	100.11	99.00	96.44	92.90	93.42	97.39	106.42	99.97
1975	103.56	91.25	113.34	107.98	98.27	100.12	98.58	96.19	93.08	93.72	97.12	106.19	99.96
1976	104.45	93.16	111.80	106.96	98.38	100.44	98.00	95.78	93.75	94.40	96.70	105.56	99.95
1977	105.18	95.70	109.97	106.39	98.64	101.04	96.98	95.55	94.04	96.64	96.85	105.05	100.00
1978	105.66	98.00	107.76	104.19	98.61	101.51	95.14	95.75	94.76	98.07	97.15	104.33	100.08
1979	105.78	99.01	105.81	103.14	98.60	101.84	93.32	96.49	95.07	101.25	97.62	103.89	100.15
1980	105.94	98.81	103.51	102.38	98.50	102.08	92.02	97.11	95.91	104.78	97.74	102.94	100.15
1981	105.91	98.10	101.97	101.36	98.23	102.82	91.60	97.77	96.18	107.41	97.70	102.23	100.11
1982	105.69	97.56	101.02	100.93	97.74	103.33	91.27	98.17	96.73	109.22	97.59	101.35	100.05
1983	105.66	97.11	100.72	100.77	97.38	103.44	91.23	98.47	96.88	110.11	97.47	100.78	100.00
AVGE	105.12	95.90	106.97	104.13	98.27	101.67	94.71	96.77	94.93	100.80	97.33	103.87	

TABLE TOTAL- 12004.79 MEAN- 100.04 STD. DEVIATION- 4.99

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1984	105.64	96.89	100.58	100.68	97.20	103.49	91.21	98.62	96.95	110.55	97.40	100.49	99.98

FULAR - PROPER SEQUENCE PAGE 6, SERIES FULAR

D11. FINAL SEASONALLY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	8938.	9545.	10806.	11454.	11329.	10863.	10762.	11747.	11595.	12013.	12136.	12515.	133701.
1975	11474.	9695.	7787.	10215.	10034.	9660.	10573.	9687.	11459.	9954.	8810.	9194.	118544.
1976	9574.	9852.	10066.	9596.	9325.	11760.	11742.	11577.	11313.	11330.	13065.	12970.	132161.
1977	13277.	14438.	14693.	14632.	13434.	14030.	12428.	13363.	13476.	12807.	12899.	13863.	163338.
1978	14239.	14380.	14479.	14834.	15358.	14835.	16363.	14458.	16458.	16924.	16837.	16877.	186041.
1979	17466.	17870.	17425.	18862.	20489.	20354.	20614.	21461.	23158.	22656.	23497.	24038.	247890.
1980	23853.	25258.	25427.	21361.	26239.	26723.	24916.	24622.	23539.	28615.	27983.	28860.	297375.
1981	26646.	30170.	26183.	26104.	24956.	24878.	25471.	27074.	27278.	28280.	28296.	25883.	308621.
1982	26286.	24571.	25959.	21993.	27166.	28834.	28150.	29748.	28560.	28213.	28630.	28639.	324780.
1983	27624.	25020.	27936.	29558.	36790.	26401.	31946.	30145.	30078.	31443.	30015.	28850.	357807.
AVGE	17938.	18080.	18076.	17861.	19412.	18734.	19296.	19388.	19891.	19623.	20015.	19080.	

TABLE TOTAL- 2282236. MEAN- 19019. STD. DEVIATION- 7459.

APPENDIX E.2 : Tables D10 and D11 from X-11-ARIMA run, proper sequence

D10. FINAL SEASONAL FACTORS
DIFFERENT MOVING AVERAGES SELECTED FOR DIFFERENT MONTHS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1974	100.78	97.47	110.11	96.88	98.47	91.23	103.44	97.38	100.77	100.72	97.11	105.06	100.00
1975	101.36	97.59	109.22	96.73	98.17	91.27	103.33	97.74	100.93	101.02	97.56	105.69	100.05
1976	102.23	97.70	107.41	96.18	97.77	91.60	102.82	98.23	101.36	101.97	98.10	105.91	100.11
1977	102.94	97.74	104.78	96.91	97.11	92.02	102.08	98.50	102.38	103.51	98.81	105.94	100.15
1978	103.89	97.62	101.25	95.87	96.49	93.32	101.84	98.60	103.14	105.81	99.01	105.78	100.15
1979	104.33	97.15	98.07	94.76	95.75	95.14	101.51	98.61	104.19	107.76	98.00	105.66	100.08
1980	105.06	96.85	95.64	94.04	95.55	96.98	101.04	98.64	105.39	109.97	96.70	105.18	100.00
1981	105.56	96.70	94.40	93.75	95.78	98.00	100.44	98.36	106.96	111.80	93.16	104.45	99.95
1982	106.19	97.12	93.72	93.08	96.19	98.58	100.12	98.27	107.98	113.34	91.25	103.56	99.95
1983	106.42	97.39	93.42	92.90	96.44	99.00	100.11	98.33	108.23	113.78	90.26	103.33	99.97
AVGE	103.87	97.33	100.80	94.93	96.77	94.71	101.67	98.27	104.13	106.97	96.90	105.12	

TABLE TOTAL- 12004.79 MEAN- 100.04 STD. DEVIATION- 4.99

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1984	106.54	97.53	93.27	92.81	96.56	99.21	100.11	98.36	108.36	114.00	89.76	103.21	99.98

FULAR - REVERSED SEQUENCE PAGE 6, SERIES FULAR

D11. FINAL SEASONALLY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	28850.	30015.	31443.	32078.	30145.	31946.	26401.	36790.	29658.	27936.	25020.	27624.	357807.
1975	28639.	26639.	28213.	28560.	29748.	28150.	28834.	27166.	21993.	25969.	24571.	28208.	324759.
1976	25283.	28296.	28280.	27278.	27074.	25471.	24878.	24956.	28104.	26183.	30170.	26646.	320621.
1977	26860.	27963.	22615.	23539.	24622.	24916.	25723.	25239.	21361.	25427.	25258.	23853.	297376.
1978	24038.	23497.	22656.	23158.	21461.	20614.	20354.	20489.	18862.	17425.	17870.	17466.	247890.
1979	16877.	16837.	16924.	16468.	14458.	16363.	14835.	15368.	14834.	14479.	14380.	14239.	186041.
1980	13863.	12899.	12807.	13476.	13363.	12488.	14030.	13434.	14632.	14693.	14438.	13277.	163338.
1981	12970.	13055.	11330.	11313.	11577.	11742.	11760.	9325.	9598.	10068.	9852.	9574.	138181.
1982	9194.	8810.	9954.	11459.	9687.	10573.	9860.	10034.	10215.	7787.	9695.	11474.	118544.
1983	12515.	12136.	12013.	11595.	11747.	10762.	10863.	11329.	11454.	10806.	9545.	8938.	133701.
AVGE	19909.	20015.	19623.	19891.	19388.	19296.	18734.	19412.	17861.	18076.	18080.	17938.	

TABLE TOTAL- 2282236. MEAN- 19019. STD. DEVIATION- 7459.

APPENDIX E.3 : Tables D10 and D11 from X-11-ARIMA run, reversed sequence

D10. FINAL SEASONAL FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1974	103.4	90.1	113.8	108.2	98.4	99.9	99.4	96.5	92.9	93.4	97.5	106.0	100.0
1975	103.7	91.2	113.4	107.9	98.3	99.9	99.1	96.2	93.0	93.7	97.2	105.8	100.0
1976	104.5	93.1	111.9	106.9	98.4	100.2	98.5	95.9	93.7	94.4	96.8	105.4	100.0
1977	105.1	95.6	110.0	105.3	98.7	100.8	97.5	95.7	94.0	95.6	96.9	104.9	100.0
1978	105.6	98.0	107.7	104.1	98.6	101.3	96.6	95.9	94.7	98.0	97.1	104.3	100.1
1979	105.7	99.1	105.8	103.1	98.6	101.7	93.6	96.6	95.0	101.1	97.5	103.8	100.1
1980	105.9	99.0	103.5	102.3	98.5	102.1	92.2	97.2	95.9	104.6	97.6	102.8	100.1
1981	105.9	98.4	102.0	101.3	98.3	102.9	91.6	97.9	96.2	107.3	97.6	102.2	100.1
1982	105.6	97.9	101.0	100.8	97.7	103.4	91.3	98.2	96.7	109.2	97.5	101.3	100.0
1983	105.6	97.5	100.7	100.6	97.4	103.5	91.2	98.5	96.8	110.0	97.4	100.7	100.0

TABLE TOTAL- 12004.6 MEAN- 100.0 STD. DEVIATION- 5.0

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1984	105.5	97.3	100.5	100.5	97.2	103.6	91.2	98.6	96.9	110.4	97.3	100.4	100.0

APR 1984 FULAR - PROPER SEQUENCE P. 7, SERIES FULAR

D11. FINAL SEASONALLY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	8931.	9562.	10804.	11457.	11321.	10886.	10718.	11740.	11595.	12015.	12122.	12585.	133717.
1975	11459.	9701.	7783.	10222.	10032.	9682.	10518.	9686.	11470.	9955.	8802.	9228.	118537.
1976	9569.	9858.	10057.	9601.	9322.	11788.	11682.	11563.	11319.	11331.	13041.	12900.	132123.
1977	13287.	14453.	14689.	14644.	13427.	14063.	12361.	13342.	13482.	12813.	12893.	13883.	163336.
1978	14247.	14381.	14487.	14846.	15359.	14866.	16283.	14436.	16469.	16936.	16847.	16881.	186037.
1979	17480.	17853.	17426.	18869.	20489.	20382.	20552.	21436.	23175.	22688.	23626.	24059.	247934.
1980	23861.	25208.	25430.	21378.	25241.	25718.	24869.	24601.	23541.	22654.	28004.	26897.	297402.
1981	26649.	30078.	26175.	26118.	24939.	24860.	25472.	27039.	27272.	28308.	28325.	25292.	320527.
1982	26310.	24486.	25963.	22021.	27177.	28816.	28139.	29739.	28568.	28218.	26665.	28653.	324755.
1983	27639.	24921.	27942.	29606.	36782.	26306.	31967.	30136.	32103.	31475.	30036.	28872.	357856.

D10. FINAL SEASONAL FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1974	100.7	97.3	110.0	96.8	98.4	91.2	103.5	97.3	100.5	100.6	97.9	105.5	100.0
1975	101.3	97.5	109.1	96.7	98.1	91.2	103.4	97.7	100.7	100.9	98.2	105.6	100.0
1976	102.2	97.6	107.3	96.2	97.8	91.6	102.9	98.2	101.2	102.0	98.7	105.9	100.1
1977	102.8	97.6	104.6	95.8	97.2	92.1	102.1	98.5	102.2	103.5	99.2	105.9	100.1
1978	103.8	97.5	101.1	95.0	96.6	93.5	101.7	98.6	103.1	105.8	99.2	105.7	100.1
1979	104.3	97.1	98.0	94.7	95.9	95.4	101.3	98.6	104.2	107.8	98.1	105.6	100.1
1980	104.9	96.9	95.6	94.0	95.7	97.2	100.7	98.7	105.4	110.0	95.7	105.2	100.0
1981	105.3	97.0	94.4	93.7	95.9	98.3	100.1	98.4	107.0	111.9	93.2	104.6	100.0
1982	105.6	97.4	93.7	93.0	96.2	98.8	99.8	98.4	108.1	113.4	91.3	103.8	100.0
1983	106.8	97.7	93.4	92.9	96.5	99.2	99.7	98.4	108.3	113.8	90.3	103.5	100.0

TABLE TOTAL- 12004.7 MEAN- 100.0 STD. DEVIATION- 5.0

D10A. SEASONAL FACTORS, ONE YEAR AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1984	105.9	97.8	93.3	92.8	96.6	99.4	99.7	98.5	108.4	114.1	89.7	103.4	100.0

APR 1984 FULAR - REVERSED SEQUENCE P. 7, SERIES FULAR

D11. FINAL SEASONALLY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1974	28872.	30067.	31475.	32103.	30167.	31967.	26388.	36820.	29636.	27970.	24819.	27685.	357937.
1975	28653.	26665.	28244.	28568.	29770.	28170.	28816.	27177.	22043.	25989.	24411.	26310.	324814.
1976	25292.	28325.	28308.	27272.	27066.	25472.	24860.	24964.	26144.	28175.	29987.	26649.	320514.
1977	26897.	28004.	22654.	23566.	24601.	24896.	25718.	25241.	21399.	25430.	25157.	23861.	297423.
1978	24059.	23526.	22688.	23175.	21436.	20674.	20382.	20489.	18869.	17426.	17836.	17480.	247938.
1979	16881.	16847.	16936.	16469.	14436.	16318.	14866.	15359.	14832.	14473.	14366.	14847.	186029.
1980	13883.	12893.	12813.	13482.	13342.	12399.	14077.	13427.	14630.	14689.	14438.	13275.	163347.
1981	13002.	13014.	11331.	11319.	11563.	11706.	11800.	9322.	9593.	10057.	9848.	9560.	132115.
1982	9245.	8784.	9956.	11470.	9686.	10650.	9691.	10021.	10204.	7783.	9690.	11448.	118528.
1983	12589.	12007.	12015.	11596.	11740.	10740.	10908.	11381.	11447.	10804.	9540.	8983.	133719.

APPENDIX E.4 : Tables D10 and D11 from X-11 runs, proper and reversed sequence

APPENDIX E.5 : Corrections in SI subroutine

```
      SUBROUTINE SI(KSECT,KFDA,KLDA,NYR,KPROPT,IFORC,LFD1,LLD1)
C --- THIS SUBROUTINE CALCULATES THE SEASONALS FROM THE SI ESTIMATES
C --- FOR PART B.
      COMMON /WORK / TEMP(372)
      COMMON /MQ1  / STS(372),STSI(372)
      COMMON /MQ6  / STWT(372),STDEV(35)
      COMMON /MQ7  / STI(372)
      COMMON /OPT9 / IDUM(19),KEBACK
      LFD=LFD1+(NYR/2)
      LLD=LLD1-(NYR/2)
      L=LLD1-LFD1+1
      LLDA = KLDA
      IF (IFORC.NE.0.AND.KSECT.EQ.1) LLDA = KLDA-NYR
      IF (KSECT.EQ.1) GO TO 1
      CALL VSFA(KFDA,LLDA,NYR)
    1 CALL VSFB(KFDA,KLDA,NYR)
      K = KSECT * 5 - 2
      IFTNY=15*NYR
      IF (KPROPT.EQ.1) GO TO 3
      IF (KPROPT.NE.2) GO TO 4
      IF (KSECT.EQ.2) GO TO 4
    3 IF (IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.0) CALL TABLE(STSI,LFD
     11,LLD1,K,1,1,0.0)
C  *****  CODE CHANGE - BRIAN C. MONSELL - 5-84
      IF (KSECT.EQ.2) GO TO 2
C  *****  CODE CHANGE ENDS
      IF(IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.1)CALL TABLE(STSI,LFD,
     1LLD1,K,1,1,0.0)
      IF (IFORC.EQ.0) CALL TABLE(STSI,LFD,LLD,K,1,1,0.0)
      IF (IFORC.NE.0.AND.L.GT.IFTNY) CALL TABLE(STSI,LFD,LLD1,K,1,1,0.0)
C  *****  CODE CHANGE - BRIAN C. MONSELL - 5-84
      GO TO 4
    2 IF(IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.1)CALL TABLE(STSI,LFD1,
     1LLD1,K,1,1,0.0)
      IF (IFORC.EQ.0) CALL TABLE(STSI,LFD1,LLD1,K,1,1,0.0)
      IF (IFORC.NE.0.AND.L.GT.IFTNY) CALL TABLE(STSI,LFD1,LLD1,K,1,1,0.)
C  *****  CODE CHANGE ENDS
```

```
    4 CALL DIVSUB(STI,STSI,STS,KFDA,KLDA)
      CALL XTRM(STI,KFDA,KLDA,NYR)
      CALL REPLAC(STSI,TEMP,STWT,KFDA,KLDA,NYR)
      IF (KPROPT.NE.1) GO TO 5
      K = K + 1
      IF(IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.0)CALL TABLE(TEMP,LFD1,
     1LLD1,K,1,4,STDEV)
C  *****  CODE CHANGE - BRIAN C. MONSELL - 5-84
      IF (KSECT.EQ.2) GO TO 6
C  *****  CODE CHANGE ENDS
      IF(IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.1)CALL TABLE(TEMP,LFD,L
     1LD1,K,1,4,STDEV)
      IF (IFORC.EQ.0) CALL TABLE(TEMP,LFD,LLD,K,1,4,STDEV)
      IF(IFORC.NE.0.AND.L.GT.IFTNY)CALL TABLE(TEMP,LFD,LLD1,K,1,4,STDEV)
C  *****  CODE CHANGE - BRIAN C. MONSELL - 5-84
      GO TO 5
    6 IF(IFORC.NE.0.AND.L.LE.IFTNY.AND.KEBACK.EQ.1)CALL TABLE(TEMP,LFD1,
     1LLD1,K,1,4,STDEV)
      IF (IFORC.EQ.0) CALL TABLE(TEMP,LFD1,LLD1,K,1,4,STDEV)
      IF(IFORC.NE.0.AND.L.GT.IFTNY)CALL TABLE(TEMP,LFD1,LLD1,K,1,4,
     1   STDEV)
C  *****  CODE CHANGE ENDS
    5 CALL VSFB(KFDA,KLDA,NYR)
      RETURN
      END
```

APPENDIX E.6 : Corrections in PUNCH subroutine

```
      SUBROUTINE PUNCH(X,MFDA,MLDA,J,IPOW)
C --- THIS SUBROUTINE OUTPUTS SERIES ON FILE MP.
      DOUBLE PRECISION IDNT
      COMMON /UNITS/ MT,MT2,MT1,MP,NG,NF
      COMMON /WORK2/ TMP(12),ITMP(12),TMP2(24),TEMP(60)
      COMMON /OPT3 / IDNT(9),LDEC(9),JFORM(20),JFMT
      COMMON /OPT4 / NUMB(9),IHOLD(9),NOP
      COMMON /OPT9 / LFDA,LYR,LSTMO,LSTYR,LLDA,IDUM(4),NY,IFORC,LLDAF,
     1               LLAF
      DIMENSION X(1)
      IHOLD(J) = 1
      CALL IFMTS(JFORM,JFMT,LDEC(J),NY)
      KFMT = JFMT+1
      IF (LDEC(J).EQ.0.AND.JFMT.NE.1) KFMT = KFMT+10
      IC = 1
      NY1 = NY
      IF (JFMT.NE.4.OR.NY.EQ.12) GO TO 1
      IC = 12/NY
      NY1 = 12
    1 NYR = LYR
C  *****  CODE CHANGES - BRIAN C. MONSELL - 5/84
      ML = MFDA - LFDA
      IF (ML.EQ.0) GO TO 24
      IF (ML.GE.NY) GO TO 25
      ML = MOD(LFDA,NY) + ML
      IF (ML.LE.NY) GO TO 24
   25 NYR = NYR + 1
   24 KLDA = MLDA
C  *****  CODE CHANGES END
      IF (JFMT.GT.2) GO TO 3
      IF (JFMT.EQ.1) GO TO 3
      KLDA = ((MLDA-1)/NY+1)*NY
      IF (KLDA.EQ.MLDA) GO TO 3
      KFDA = MLDA+1
      DO 2 I = KFDA,KLDA
```

```
    2 X(I) = 0.0
    3 M = 1
      IF (MFDA.GT.NY) M = (MFDA-1)/NY*NY+1
      KHCM=M
      N = M+NY1-1
      L = NY1
      K = MFDA-1
      KK = MFDA-M
      IF (KK.EQ.0) GO TO  5
      DO 4 I = 1,K
      TMP2(I) = X(I)
    4 X(I) = 0.0
    5 IF (N.LT.KLDA) GO TO 6
      N = KLDA
      L = N-M+1
    6 DO 7 I = M,N
    7 TMP(I-M+1) = X(I)
      IF (IPOW.EQ.0) GO TO 9
      DO 8 I = 1,L
    8 TMP(I) = 100.0*TMP(I)
    9 IF (LDEC(J).NE.0) GO TO 11
      DO 10 I = 1,L
      TP = TMP(I)
   10 ITMP(I) = TP+SIGN(0.5,TP)
   11 GO TO (12,13,12,17,17,17,12,17,23,23,18,13,18,19,17,19,12,17,23,
     1 23),KFMT
   12 WRITE(MP,JFORM) (TMP(I),I = 1,L),NYR,IDNT(J)
      GO TO 20
   13 IF (IPOW.EQ.0) GO TO 15
      DO 14 I = 1,KLDA
   14 X(I) = 100.0*X(I)
   15 WRITE(MP,JFORM) (X(I),I = KHCM,KLDA)
      IF (IPOW.EQ.0) GO TO 21
      DO 16 I = 1,KLDA
   16 X(I) = X(I)/100.0
```

```
      GO TO 21
   17 WRITE(MP,JFORM) IDNT(J),NYR,(TMP(1),I = 1,L)
      GO TO 20
   18 WRITE(MP,JFORM) (ITMP(I),I = 1,L),NYR,IDNT(J)
      GO TO 20
   19 WRITE(MP,JFORM) IDNT(J),NYR,(ITMP(I),I = 1,L)
   20 IF (N.EQ.KLDA) GO TO 21
      M = M+NY1
      N = N+NY1
      NYR = NYR+IC
      GO TO 5
   21 IF (KK.EQ.0) GO TO 23
      DO 22 I = 1,K
   22 X(I) = TMP2(I)
   23 RETURN
      END
```