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THE X11ARIMA/88 SEASONAL ADJUSTMENT METHOD

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BIOGRAPHICAL SKETCH

Dr. Estelle Bee Dagum is currently Director of the Time Series Research and Analysis Division of STATISTICS CANADA and Honorary Professor of the Department of Statistics and Actuarial Sciences of the Western Ontario University.

Dr. Dagum is the author of the X11ARIMA seasonal adjustment method officially adopted by the majority of the statistical bureaus of the world and also used by Central Banks, financial institutions and universities. She has published several books and over eighty papers in scientific journals in English, French, Spanish, German and Japanese.

Dr. Dagum has served as a Senior Advisor to various governments and private foreign institutions of the United States, Australia, France, Argentina, Mexico and Portugal. She was President of the International Institute of Forecasters and Guest Speaker of the Federal Reserve Board. She is a Fellow of the American Statistical Association, Elected Member of the International Institute of Statistics, First Recipient of the Julius Shiskin Award and Elected Member of the International Association on Research in Income and Wealth. She serves as Editor of the International Journal of Forecasting and Associate Editor of the Journal of Business and Economic Statistics, the Canadian Journal of Statistics and the Journal of Survey Methodology.

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PREFACE

Major institutional, technological and economic changes happening during the decade of the eighties, affected socio-economic time series in such a way, that it became necessary to modify the 1980 version of the X11ARIMA seasonal adjustment method, in order to produce reliable estimates for a large class of series.

Since the X11ARIMA method is applied worldwide by the mayority of statistical bureaus, many central banks, financial institutions, governments and universities, the changes introduced resulted from several years of research and extensive discussions with major users. The modifications were done on both parts of the program, the X11 filters and the ARIMA modelling.

Among the various new features, X11ARIMA/88 offers:

- A new set of built-in ARIMA models;
- Variable forecasting horizons;
- Estimation of Easter Effects;
- Automatic selection of the seasonal filters;
- Automatic removal of trading-day variations and Easter effects before ARIMA modelling;
- Permanent and/or temporary a-priori adjustments of original observations;
- New graphs and user-specified printouts.

The X11ARIMA/88 user-interface differs greatly from the 1980 version. The columncard orientation has been replaced by a user-friendly, free format, keyword based system. Furthermore, given the great diffusion of microcomputers, a version has been developed for IBM PC or compatible which produces the same results as the mainframe version.

Chapter I discusses the foundations of the X11ARIMA seasonal adjustment method main advantages over the Old U.S. Bureau of Census Method II-X11 variant. Chapter II introduces the seasonal adjustment of composite series. Chapter III deals with the new features of X11ARIMA/88 and finally, Chapter IV analyses the seasonal adjustment of the Index of Industrial Production of the Basque Country.

1. FOUNDATIONS OF THE X11ARIMA SEASONAL ADJUSTMENT METHOD

Section 1.1. Introduction

The majority of the seasonal adjustment methods so far developed are based on univariate time series models. They are selected mainly for their simplicity and can be applied without specialized knowledge in a subject matter field.

A few attempts have been made to estimate seasonals based on causal explanations but none of them reached further than the experimental stage. Mendershausen (1939), for instance, tried to regress the seasonal for each month on a set of exogenous variables (meteorological and social variates) in order to build an explanatory model for seasonality but his empirical results were inconclusive.

Univariate time series methods of seasonal adjustment try to estimate the generating mechanism of the observations under the simple assumption that the series is composed of a systematic part which is a well determined function of time, and a random part which obeys a probability law (Anderson, 1971; Dagum, 1974). The random element is assumed to be identically distributed with constant mean, constant variance and zero autocorrelation. The feasibility of this decomposition was proven in a famous theorem by Herman Wold in 1938.

The methods of estimation of the components of a time series can be grouped into two broad categories (Dagum, 1978.b and 1979.b):

regression methods; and

moving average techniques, also called linear smoothing procedures.

The regression methods assume that the seasonals and the other systematic components, trend and cycle, are deterministic functions over the entire span of the series.

The methods based on moving averages or linear smoothing filters assume that, although the time series components are smooth functions of time, they cannot be closely approximated by simple functions over the entire range of time under consideration. The assumptions implicit in the moving average procedures are that the trend, cycle and seasonals are stochastic and not deterministic.

The majority of the seasonal adjustment methods officially adopted by statistical agencies belong to the category of moving average techniques. They include among them, the U.S. Bureau of the Census Method II-X-11 variant; the BLS seasonal factor method; the Burman Method of the Bank of England; the Berlin Method, ASA II; the method of the Statistical Office of the European Economic Communities of Brussels; and the method of the Dutch Central Planning Bureau. These methods have often been criticized because they lack an explicit model concerning the decomposition of the original series and because their estimates for the observations of the most recent years do not have the same degree of reliability as compared to those of central observations (Kuiper, 1976 and Dagum, 1976.b).

The lack of an explicit model applies to the whole range of the series. Moving average procedures do make assumptions concerning the time series components, but the assumptions are valid only within the span of the set of weights of the moving average.

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* This chapter is reproduced from the X11ARIMA Seasonal Adjustment Method by Dagum (1980).

The second limitation is inherent in all linear smoothing procedures since the first and last observations cannot be smoothed with the same set of symmetric weights applied to central observations. Because of this, the estimates for current observations must be revised as more data is added to the original series. Frequent revisions, however, confuse the users of seasonally adjusted data, particularly if the revisions are relatively large or if they introduce changes in the direction of the general movement of the adjusted series. In fact, faced with the problem of controlling the level of the economic activity, policy makers will hardly base their decisions on seasonally adjusted data that are subject to significant revisions whenever new information is available.

The Statistics Canada X11ARIMA, as developed by Dagum (1975, and 1978.c) does not share the two common constraints of moving average procedures. It offers an ARIMA model for the series and minimizes the revision of the seasonals in mean square error.

The X11ARIMA basically consists of:

1. Modelling the original series by integrated autoregressive moving average processes (ARIMA models) of the Box and Jenkins (1970) types.

2. Extrapolating one year of unadjusted data at each end of the series from ARIMA models that fit and project the original series well. This operation, called "forecasting" and "backcasting" is designed to extend the observed series at both ends.

3. Seasonally adjusting the extended (original) series with various moving averages of Method II-X-11 variant as developed by Shiskin, Young and Musgrave (1967). In addition, the user now has the option of applying a centred 24-term filter to replace the centred 12-term moving average for the preliminary estimation of the trend-cycle. This new filter gives better results for series strongly affected by short cycles (less than three years) or sudden changes in trend.

The ARIMA part incorporated into the X-11 program plays a very important role in the estimation of seasonal factor forecasts and current seasonal factors when seasonality is moving rapidly in a stochastic manner, a phenomenon often found in key economic indicators (Dagum, 1978.a). Since the series are extended with extra data, the filters applied by the X-11 to seasonally adjust current observations and to generate the seasonal forecasts are closer to the filters used for central observations. Consequently, the degree of reliability of the extended series for current estimates is greater than that of the unextended, and the magnitude of the revisions is significantly reduced. Similar conclusions were obtained from comparisons made with other seasonal adjustment methods based on moving averages (Kuiper, 1976).

Generally, a reduction of about 30% in the bias and of 20% in the absolute values of the total error in the seasonal factor forecasts for the 12 months (four quarters) has been found for Canadian and American series (Kuiper, 1976; Farley and Zeller, 1976; and Dagum, 1978.b). The percentage reduction for those months (quarters) corresponding to peaks and troughs is larger than the average for the whole year.

Pierce (1978) shows that ARIMA extrapolation makes the X11ARIMA a minimum mean square error seasonal adjustment method and that, in fact, this type of extrapolation would minimize the revisions of any moving average seasonal adjustment procedure in the mean square error sense. Similar conclusions are obtained by Geweke (1978) who extrapolates the future values of the series using the spectrum and one ARIMA model.

For series with rather stable seasonality, a significant improvement can be obtained when the trend-cycle is growing fast or the last year of data is one with a turning point. The final weights of X11ARIMA to estimate the trend-cycle are a combination of the symmetric Henderson weights and the asymmetric weights of the ARIMA model used for the extrapolated data. Since these final weights change with the ARIMA model fitted to the series, they reflect the most recent movement of the series and, as a result, seldom miss a turning point. Better estimates of the seasonal-irregular ratios (or differences) are obtained which then are averaged to produce stable seasonals.

From the viewpoint of seasonal adjustment, another important advantage of X11ARIMA is that it offers a statistical model for the whole range of the series. The existence of a model that fits the data well, fulfils the basic underlying principle of seasonal adjustment, namely that the series is decomposable. If a series does not lend itself to the identification of an ARIMA model (here including all AR, MA and ARMA as subclasses) which simply describes the general structure of the series as a function of past values and lagged random disturbances, any further decomposition into trend, cycle, and seasonals becomes dubious. In fact, the lack of fit by an ARIMA model indicates that the series is either deterministic or is practically a purely random process, or that it is so much contaminated by the irregulars that its systematic movement is unidentifiable.

The X11ARIMA generates extrapolated values of the original data such that the one lead projected value has a minimum mean square error and thus can be used as a reference for preliminary figures. This is particularly useful to producers of original data obtained from incomplete returns, as is often the case with series that are flows.

Section 1.2. ARIMA Models and Extrapolation

A fundamental step in the improvement of the seasonal adjustment by the X-11 program (equally applicable to any seasonal adjustment method based on moving averages) is to decide what kind of extrapolation method should be used to extend the original series. For the X11ARIMA, the selection was made according to the following requirements, (Dagum, 1978.b):

The extrapolation method must belong to the "simplest" class in terms of its description of the real world. No explanatory variable must be involved; the series should be described simply by its past values and lagged random disturbances. This requirement is necessary to facilitate the incorporation of the extrapolation method into the X-11 program, since the procedure has to be automated.

The identified models must be robust to the incorporation of one or two extra years of data, and the corresponding extrapolated values should not change significantly with small variations in parameter values. This condition is necessary to avoid frequent changes of models and significant revisions that confuse the users of seasonally adjusted data.

The method must produce extrapolated values that follow the intra-year movement reasonably well although they could miss the level. This requirement reflects the fact that these projected values are not for policy or decision making but to improve current seasonal adjustment.

It must generate optimum extrapolated values in the minimum mean square error sense. This condition allows the extrapolated values, at least the one lead extrapolation, to be used as benchmarks for preliminary data coming from incomplete returns.

The method must be parsimonious in the number of parameters. The main characteristics of the series are thus summarized in a small number of parameters.

This set of conditions led to the selection of a univariate method of forecasting and, among the several well developed methods, the ARIMA models (autoregressive integrated moving averages) of the Box and Jenkins (1970) type were chosen. ARIMA models have been found to be powerful forecasting procedures for a large class of series (Newbold and Granger, 1974; Reid 1975).

ARIMA models bring together two basic concepts in extrapolating: autoregression and moving averages. ARIMA is an acronym with the first two letters, AR, standing for "Autoregressive"; the last two letters, MA, for "Moving Average" and the I, for "Integration", or summation. This part of ARIMA is indispensable since stationary models which are fitted to the differenced data have to be summed or "integrated" to provide models for the non-stationary data.

In the Box and Jenkins notation, the general multiplicative ARIMA model for a series with seasonality is expressed as $(p,d,q)(P,D,Q)_s$, where d is the order of the ordinary difference and D is the order of the seasonal differences applied to the original series to make it stationary. In other words, the statistical structure of the series must be independent of time; this implies model stability. To correct for a continuous change in level due to an upward or downward trend, a first difference (d=1) is applied to the original series Z_t; i.e., the new series is $W_t = Z_t - Z_{t-1}$. Symbolically, $W_t = (1-B)Z_t$, where B is the lag operator such that $B^n Z_t = Z_{t-n}$. For more complex cases of deterministic or stochastic instability, higher order differences are applied. To correct for a stable seasonality, the power of the seasonal difference, D, is made equal to one, and the transformed series is then $W_t = Z_t - Z_{t-s} = (1-B^s)Z_t$, where s is the seasonal periodicity, equal to 12 for monthly data and to 4 for quarterly data. Higher order seasonal differences remove other kinds of seasonal patterns.

P and p are the number of seasonal and ordinary autoregressive parameters respectively. If p=1 and the parameter is of order one, the independent variable is lagged once, i.e. we work with Z_{t-1}; similarly, if P=1 and the parameter has order s, we work with Z_{t-s}. These lagged variables are affected by autoregressive parameters ϕ and Φ respectively, which measure the impact of the previous observed value (month, quarter) and the previous year observed value for the month or quarter, on the dependent variable Z_t.

Q and q are the numbers of seasonal and ordinary moving average parameters. If q=1 and the parameter has order one, then the residuals a_t are lagged once, i.e. we work with a_{t-1}; and if Q=1 and the seasonal parameter has order s, the residuals are also lagged once, i.e. we work with a_{t-s}. The lagged residuals are affected by the parameters θ and Θ respectively, which measure the impact of the residuals of the previous value (months, quarters) and of the previous year value for the month or quarter, on the dependent variable Z_t.

Thus for ARIMA models, the variable Z_t is a function of lagged dependent variables and of lagged innovations a_t. For example, the simple ARIMA model $(0,1,1)(0,1,1)_4$ of Z_t reduces to,

$$(1-B)(1-B^4)Z_t = (1-\theta B)(1-\Theta B^4)a_t \tag{1}$$

or

$$Z_t = Z_{t-1}+Z_{t-4}-Z_{t-5}+a_t-\theta a_{t-1}-\Theta a_{t-4}+\theta\Theta a_{t-5} \tag{2}$$

(2) says that Z_t is equal to the previous quarter value Z_{t-1} plus the difference between the values for the corresponding last year quarter and previous last year quarter, plus the present innovation and lagged residuals.

For a crude approximation, θ can be interpreted as the extent to which innovations incorporate themselves in the subsequent history of the trend-cycle and Θ as the extent to which the residuals incorporate themselves in the subsequent seasonal pattern.

θ and Θ take values between -1 and 1. When both are equal to plus or minus one, the innovations have their maximum impact on the subsequent evolution of the series making the process deterministic. When both are equal to zero, the innovations have a transitory or instantaneous impact only and the process is strongly stochastic.

The procedure followed by model (1) to obtain an estimate of Z_t is not new to practising statisticians who often use a very similar approach to get a projected value to compare with a figure being checked.

The values of the autoregressive parameters ϕ and Φ, and of the moving average parameters θ and Θ, vary for each series and, therefore, the ARIMA models are very flexible and can follow well the systematic movement of a large class of series.

The ARIMA extrapolating function can be expressed in different forms but for computational purposes the difference equation form is the most useful. For a detailed discussion of the properties and basic assumptions of ARIMA models the reader is referred to Box and Jenkins (1970), and Granger and Newbold (1977).

Section 1.3. The Selection of ARIMA Models in the X11ARIMA/80 Computer Version

The ARIMA Automatic Option

The ARIMA models to be used in the context of the X11ARIMA/80 method must fulfil the double condition of fitting the data well and of generating "reasonable" projections for the last three years of observed data. By "reasonable" projections is meant projections with a mean absolute error smaller than 5% for well-behaved series (e.g., Employment adult males) and smaller than 12% for highly irregular series (e.g., Unemployment teenage males).

These guidelines have been tested with more than 250 economic time series and are rather conservative. In fact, even with larger extrapolation errors, the X11ARIMA/80 produces current and forecast seasonals more reliable than those from X-11.

If possible, the identification of the ARIMA models should be made using data previously treated for extreme values. This recommendation is even more relevant if the outliers fall in the most recent years, in order to avoid the rejection of good models simply because the outliers have inflated the absolute average extrapolation error above the acceptance level of the guidelines.

To determine whether or not a model fits the data well, the portmanteau test of fit developed by Box and Pierce (1970) with the variance correction for small samples introduced by Ljung and Box (1978) is used. The null hypothesis of randomness of the residuals is tested at a 10% level of significance and the estimated parameters are checked to avoid over-differencing.

Based on the above criteria for fitting and extrapolation, three ARIMA models were incorporated into the X-11 program in order to automate X11ARIMA/80. The user can either supply his own model or choose the automatic option. The latter can be used for series that are at least five years long and the program automatically checks whether one of the three models passes the required guidelines. For series longer than 15 years, only the last 15 years will be used in the ARIMA fit and extrapolation. In the affirmative case, the model chosen is the one that gives the smallest average extrapolation error. Then the program automatically extends the unadjusted series with one year of extrapolated data, and seasonally adjusts.

In the event that none of the three models is found acceptable, a message is given indicating that extrapolated values have not been incorporated into the unadjusted series. Particularly for flow series such as imports, retail trade and others, which can be strongly affected by strikes and trading-day variations, it is recommended that these sources of variation be removed from the series before using the automatic option or identifying the ARIMA model. The program offers an option where the extreme values of the series are replaced by the fitted values of the ARIMA model that passes the guidelines of acceptance, in a first run, and then the same model is re-submitted to the modified series to extrapolate. This option however does not modify extreme values that might be in the 2(p +Pxs + d + Dxs) observations at the beginning of the series. Thus for a $(0,1,1)(0,1,1)_{12}$ monthly model, this means that no replacement of extreme values is made in the first 26 observations.

When the three automatic models are rejected, the user should determine whether the rejection is due to an extremely large average extrapolated error for one particular year only. If such is the case, the models printed in the program can still be considered good if the year in question has been an unusual one, for example, of a strong recession. The best model should then be re-submitted using the option corresponding to user's ARIMA model identification.

The automated option for multiplicative and log additive seasonal adjustments chooses from the following three ARIMA models: log $(0,1,1)(0,1,1)_s$, log $(0,2,2)(0,1,1)_s$ and $(2,1,2)(0,1,1)_s$ and for the additive decomposition, from $(0,1,1)(0,1,1)_s$, $(0,2,2)(0,1,1)_s$ and $(2,1,2)(0,1,1)_s$.

The selection of the three first models was made from a set of 12 ARIMA models testing out of sample extrapolated values, for the four last years, on 174 economic time series of 15 years of length and of quarterly and monthly observations.

The 12 models tested were:

1. $(1,1,1)(1,1,1)_s$

2. $(2,1,2)(0,1,1)_s$

3. $(2,0,1)(0,1,2)_s$

4. $(1,1,2)(0,1,2)_s$

5. $(2,0,0)(0,1,1)_s$

6. $(1,1,2)(1,0,2)_s$

7. $(2,1,1)(0,1,2)_s$ log

8. $(0,1,2)(1,1,2)_s$ log

9. $(0,1,1)(0,1,1)_s$ log

10. $(0,1,1)(0,2,2)_s$ log

11. $(0,2,2)(0,1,1)_s$ log

12. $(2,1,1)(0,1,1)_s$ log

The 174 series were obtained from the following sectors: the System of National Accounts, Manufacturing Prices, Labour, Construction, Domestic Trade, and Finance.

Originally, the models were ranked according to how well they fitted the series and met only two of the criteria of acceptance, the χ^2 test of randomness at 1% and the absolute average forecasting error lower than 10% (Lothian and Morry, 1978.a). In further experimentations the χ^2 probability level was raised to 10% and the absolute average forecasting error for the last three years to 12% (Dagum, 1979.a).

It was found that model 2 fitted and forecast well 73% of the series. For the class of series not passed by model 2, model 11 provided acceptable results for 19% of those remaining (or 5% or the total). For the remaining series not passed by either model 2 or model 11, model 9 showed the best performance, passing an additional 2% of the total number of series. Thus models 2, 11,

and 9 jointly passed 80% of the series. An additional 1% could have been fitted by the other 9 models, while none of the 12 models tested provided acceptable results for the remaining 19% of the series.
The objective of an automatic procedure is to find adequate models for a great variety of series at minimal cost, i.e., have a small set of models that cover a large class of economic series.

The average forecast errors for each of the 174 series were ranked. It was found that when models 9 and 11 passed the guidelines, one of the two models often placed first among the 12 models. Due to this result only models 9 and 11 are fitted initially; model 2 is fitted only if neither 9 nor 11 pass the guidelines.

For a larger sample of 305 series and testing **within sample** extrapolated values for the same 12 models, it was found that the best three models were $(2,1,2)(0,1,1)_s$, $(2,0,1)(0,1,2)_s$ and $\log(2,1,2)(0,1,2)_s$ (Dagum, 1978.c). The average **out of the sample** extrapolation error for this set of three models when testing the sample of 174 series was close to the average obtained by the other three models chosen and both sets passed the guidelines of acceptance. However, models 2, 9 and 11 have been preferred because they are more parsimonious in the number of parameters. Furthermore, one of the IMA type models, the $\log(0,1,1)(0,1,1)_s$ has a system of weights similar to those of the additive standard option of the X-11 program according to Cleveland and Tiao (1976). The need for the logarithmic transformation stems from the fact that the majority of the series tested followed a multiplicative relationship among the trend, cycle, seasonal and irregulars.

For those series seasonally adjusted additively, the automatic selection is made from the $(0,1,1)(0,1,1)_s$, $(0,2,2)(0,1,1)_s$ and $(2,1,2)(0,1,1)_s$ non-log models. Although the first two models did not enter in the set of models originally tested, further experimentation with series that followed an additive relation among the components showed that the logarithmic transformation adversely affected both the average forecasting error and the χ^2 probability value. It is also apparent that when the additive option is used because of the presence of zeros or negative values in a series, tbe automatic option would test only the model $(2,1,2)(0,1,1)_s$ if these changes had not been made. For further details on the model selection, evidences of over-differencing, and new modifications from the first experiment, the reader is referred to Dagum (1979.a).

The extrapolation ARIMA option prints:

The tested models expressed in the classical form $(p,d,q)(P,D,Q)_s$ as described in Section 2 above.

The transformation performed on the data before testing the models.

The absolute average percentage error of the extrapolated values for each of the last three years and the average for the three years. If the average forecasting error is greater than 12%, the ARIMA automatic option rejects the model.

The χ^2 probability for testing the null hypothesis of randomness of the residuals. If the χ^2 probability is smaller than 10%, the ARIMA automatic option rejects the model.

The coefficient of determination R^2.

The values of the estimated parameters in the following order: First, the ordinary autoregressive parameters ϕ the number of which is given by p; second, the seasonal autoregressive parameter Φ, the number of which is given by P; third, the ordinary moving average parameters θ, the number of which is given by q; and fourth, the seasonal moving average parameters, Θ, the number of which is given by Q.

Evidences of over-differencing are present if the sum of the ordinary moving average parameters, or of the seasonal moving average parameters, is greater than .90. In such cases, the model is rejected.

If any of the three models of the automatic option passes the guidelines of acceptance, the program uses the best one to backcast one year. The backcasts are tested in a similar manner except that the absolute average backcasting error must be greater than 18% to reject the model. This increase in the upper bound of acceptance is due to the fact that the extrapolation errors are all expressed in percentage of the level of the series, and for most series, their level has more than doubled during the last 10 years. Furthermore, for series of 11 years or more, the influence of the backcasts in the current seasonal factors is minor.

The program has also an option by which only forecasts are generated from the ARIMA model chosen.

The Identification of ARIMA Models by the User

The guidelines for the acceptance of an ARIMA model when using the automatic option are conservative. If the series fails these guidelines "marginally", the users may still apply the best of the three models if it is considered satisfactory for the series in question. By marginally is meant here a χ^2 probability between 5% and 10%; and for highly irregular series, an average forecasting error between 12% and 15%. If none of the three selected models is marginally acceptable, the user should identify a new model. In many cases, the identification that leads to a good model requires minor changes to the automatic option's models. The following rules have been useful to improve the fitting and extrapolation for a large number of series.

Correcting for a low χ^2 probability. A low χ^2 probability indicates that the residuals of the fitted model are autocorrelated. This frequently happens because the log transformation is not needed (if applied) or vice versa. Resubmitting the model with the transformation changed may correct the low χ^2 value. In other cases this low χ^2 value is the result of over-differencing and once this is corrected, as described below, the model becomes adequate.

Correcting for evidence of overdifferencing. Evidence of overdifferencing leads to cancellation of parameters suggesting a more parsimonious model. For example, if the estimated ordinary moving average parameters of the $(0,2,2)(0,1,1)_4$ model are θ_1 = 1.3 and θ_2 = 0.3, because their sum is greater than .90, the program will reject the model on the basis of evidence of overdifferencing. In effect, the $(0,2,2)(0,1,1)_4$ model can be written as:

$$(1-B)^2(1-B^4)Z_t = (1-1.3B+.3B^2)(1-\theta B^4)a_t, \tag{3}$$

where θ is the seasonal moving average parameter and s=4 is the seasonal periodicity. The right hand member of (3) can be factored, as follows:

$$(1-1.3B+.3B^2)(1-\theta B^4) = (1-B)(1-.3B)(1-\theta B^4) \tag{4}$$

substituting (4) into (3) and simplifying, it becomes

$$(1-B)(1-B^4)Z_t = (1-0.3B)(1-\theta B^4)a_t. \tag{5}$$

The (5) is a $(0,1,1)(0,1,1)_4$ model. Because the estimation of the parameters is not exact, the model suggested by the parameter cancellation is not always the correct one. Often some modifications must be made. In our example, if the $(0,1,1)(0,1,1)_4$ model is not adequate, by simply adding an ordinary moving average parameter to compensate for the complete elimination of the ordinary differences (1-B), a good model can be obtained, e.g; $(0,1,2)(0,1,1)_4$. Another common case of overdifferencing occurs when the seasonal moving average parameter θ is > .90. In such cases, model (5) reduces to:

$(1-B)Z_t = (1-0.3B)a_t,$ (6)

that is, a (0,1,1) model. The cancellation suggests that seasonality is not present; or seasonality, if present, is mostly of a **deterministic** character. In the first case, further evidence can be obtained by looking at the tests for presence of seasonality available in the **X11ARIMA/80** program. If these tests indicate that seasonality is present, the user can try a simpler model with only a seasonal moving average parameter, say (0,1,1)(0,0,1) to generate the extrapolated value. Whether the **ARIMA** option is applied or not, it is recommended that the seasonal adjustment be made using the moving averages for stable seasonality.

Correcting for high extrapolation errors. Generally, having corrected for the low χ^2 probability and/or evidence of overdifferencing, the extrapolation errors are reduced. However, if such is not the case, users should identify their own model using any computer program for **ARIMA** model identification and estimation. The versions call **APCORR** for model identification and **TYMPAC** for model estimation can be requested from the Seasonal Adjustment and Time Series Staff at Statistics Canada.

Section 1.4. Basic Properties of the X11ARIMA Moving Averages.

Main Steps in Producing a Seasonally Adjusted Series

The main steps in producing seasonally adjusted series using the X11ARIMA method are equal to those of Method II-X-11 variant (Shiskin, Young and Musgrave, 1967) as shown in Appendix A. The main differences are: (i) the extension of the unadjusted series with one year of extrapolated values from **ARIMA** models at one or both ends of the series whenever the **ARIMA** option is used; (ii) the option of applying a centred 24-term moving average for the preliminary estimation of the trend-cycle; (iii) short series of three and four years are seasonally adjusted with the stable seasonality option only.

The X11ARIMA assumes that the main components of a time series follow a multiplicative, an additive or a log additive model, that is

1. $O_t = C_t S_t I_t$ (multiplicative model)

2. $O_t = C_t + S_t + I_t$ (additive model)

3. $\log O_t = \log C_t + \log S_t + \log I_t$ (log additive model)

where O_t stands for the unadjusted series, C_t the trend-cycle, S_t the seasonal and I_t the irregular.

The estimation is made with different kinds of moving averages that are applied sequentially in 13 steps repeated twice.

For the standard option of the computer program these 13 steps are:

1. Compute the ratios between the original series and a centred 12-term moving average (2 x 12 m.a., that is a 2-term average of a 12-term average) as a first estimate of the seasonal and irregular components (SI).

2. Apply a weighted 5-term moving average (3 x 3 m.a.) to the seasonal-irregular ratios (SI) of each month separately, to obtain a preliminary estimate of the seasonal factors.

3. Compute a centred 12-term moving average of the preliminary factors found in step 2 for the entire series. To obtain the six missing values at either end of this average, repeat the first (last) available moving average value six times. Adjust the factors to add to 12 (approximately) over any 12-month period by dividing the centred 12-term average into the factors.

4. Divide the seasonal factor estimates into the seasonal irregular (SI) ratios to obtain an estimate of the irregular component.

5. Compute a moving five-year standard deviation (σ) of the estimates of the irregular component and test the irregulars in the central year of the five-year period against 2.5σ. Remove values beyond 2.5σ as extreme and recompute the moving five-years. Assign a zero weight to irregulars beyond 2.5σ and a weight of 1 (full weight) to irregulars within 1.5σ. Assign a linearly graduated weight between 0 and 1 to irregulars between 2.5σ and 1.5σ.

6. For the first two years, the σ limits computed for the third year are used; and for the last two years, the σ limits computed for the third-from-last year are used. To replace an extreme ratio in either of the two beginning or ending years, the average of the ratio times its weight and the three nearest full-weight ratios for that month is taken.

7. Apply a weighted 5-term moving average to the SI ratios with extreme values replaced, for each month separately, to estimate preliminary seasonal factors.

8. Repeat step 3, applied to the factors found in step 7.

9. To obtain a preliminary seasonally adjusted series divide 8 into the original series.

10. Apply a 9-, 13-, or 23-term Henderson moving average to the seasonally adjusted series and divide the resulting trend-cycle into the original series to give a second estimate of the SI ratios. (In the first iteration, only the 13-term Henderson is applied.).

11. Apply a weighted 7-term moving average (3 x 5 m.a.) to each month's SI ratios separately, to obtain a second estimate of the seasonal component.

12. Repeat step 3.

13. Divide 11 into the original series to obtain the seasonally adjusted series.

Allan Young (1968), using a linear approximation of the Census Method II, arrives at the conclusion that a 145-term moving average is needed to estimate one seasonal factor with central weights if the trend-cycle component is adjusted with a 13-term Henderson moving average. The first and last 72 seasonal factors (six years) are estimated using sets of asymmetrical end weights. It is important to point out, however, that the weights given to the more distant observations are very small and, therefore, this moving average can be very well approximated by taking one half of the total number of terms plus one. So, if a 145-term moving average is used to estimate the seasonal factor of the central observation, a good approximation is obtained with only 73 terms, i.e., six years of observations. The properties of the filters used in the Method II-X-11 program are extensively discussed in Dagum (1976.a and 1978.b) and the stochastic properties for data filtering of **X11ARIMA** are analyzed in Dagum (1979.c). A brief discussion is made here for monthly series but the conclusions are also valid for quarterly series.

Basic Properties of the Two-sided Linear Smoothing Filters (Central Weights) of the X11ARIMA

The linear smoothing filters applied by Method II-X-11 and the X11ARIMA to produce seasonally adjusted data can be classified according to the distribution of their set of weights into symmetric (two-sided) and asymmetric (one-sided). The symmetric moving averages are used to estimate the component values that fall in the middle of the span of the average, say 2n+1, and the asymmetric moving averages, to the first and last n observations. The sum of the weights of both kinds of filters is one and thus the mean of the original series is unchanged in the filtering process[1].

It is very important in filter design that the filter do not displace in time the components of the output relative to those of the input.; in other words, the filter must not introduce phase shifts[2]. Symmetric moving averages introduce no time displacement for some of the components of the original series and a displacement of ± 180°, for others. A phase shift of ± 180°, is interpreted as a reverse in polarity which means that maxima are turned into minima and vice versa. In other words, peaks (troughs) in the input are changed into troughs (peaks) in the output.

For practical purposes, however, symmetric moving averages act as though the time displacement is null. This is so because the sinusoids that will have a phase shift of ± 180°, in the filtering process are cycles of short periodicity (annual or less) and moving averages tend to suppress or significantly reduce their presence in the output.

The centred 12-term moving average. The centred 12-term moving average is used for a preliminary estimate of the trend-cycle (step 1). This filter reproduces exactly the central point of a linear trend and annihilates a stable seasonality over a 12-month period in an additive model. If the relationship among the components is multiplicative, then only a constant trend multiplied by a stable seasonality will be perfectly reproduced.

The main limitation of this filter is that it misses peaks and troughs of short cycles (three or two years) and unless the irregular variations are small, it will not smooth the data successfully. If the input to this filter is a curve of three-year periodicity and amplitude 100, the output is a curve of equal periodicity but with amplitude reduced to 82.50; the amplitude of waves of two-year periodicity is reduced to 75; and only waves whose period is five years or more are passed with very small reductions in their amplitudes. However because the trend-cycle variation of most economic time series is mainly due to long cyclical variations of 40 months or more (Davis, 1941), this filter is generally good for a preliminary estimation of the trend-cycle.

The centred 24-term moving average. For series mostly dominated by short cyclical fluctuations (three or two years) or affected by sudden changes in trend level, an optional centred 24-term filter is included in X11ARIMA/80. This filter is a modified version (Cholette, 1979) of the Leser filter (1963).

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[1] The sum of the weights of a filter determines the ratio of the mean of the smoothed series to the mean of the unadjusted series assuming that these means are computed over periods long enough to ensure stable results.

[2] In spectral analysis, the phase is a dimensionless parameter that measures the displacement of the sinusoid relative to the time origin. Because of the periodic repetition of the sinusoid, the phase can be restricted to ± 180°. The phase is a function of the frequency of the sinusoid, the frequency being equal to the reciprocal of the period, or length of time required for one complete oscillation.

The amplitude of waves of three and two-year periods are reduced by only 5% and 18% respectively.

Furthermore, this filter reduces the irregular variation more than the centred 12-term filter does. Unfortunately, as we depart from the central observation, the estimation of the 12 points at each side deteriorates gradually. Because of this, in X11ARIMA the asymmetric weights that estimate only the six points at each side of the central observation are used. The first and last six observations are deleted as in the centred 12-term filter. These asymmetric weights applied to observation 7 to 12 and 14 to 19 share the same spectral properties of the centred 24-term filter except for small phase shifts.

The 9-,13- and 23-term Henderson moving averages. The Henderson moving averages were developed by summation formulae mainly used by actuaries. The basic principle for the summation formulae is the combination of operations of differencing and summation in such a manner that when differencing above a certain order is ignored, they will reproduce the functions operated on. The merit of this procedure is that the smoothed values thus obtained are functions of a large number of observed values whose errors, to a considerable extent, cancel out. These filters have the properties that, when fitted to second or third degree parabolas, their output will fall exactly on those parabolas and, when fitted to stochastic data, they will give smoother results than can be obtained from the weights which give the middle point of a second degree parabola fitted by least squares. Recognition of the fact that the smoothness of the resulting filtering depends on the smoothness of the weight diagram led Robert Henderson (1916) to develop a formula which makes the sum of squares of the third differences of the smoothed series a minimum for any number of terms.

The Henderson moving averages are applied to obtain an improved estimate of the trend-cycle (step 10). They give the same results as would be obtained by smoothing the middle values of a third degree polynomial fitted by weight least squares, where the weights given to the deviations are as smooth as possible.

The fact that the trend-cycle is assumed to follow a parabola over an interval of short duration (between one and two years approximately) makes these filters adequate for economic time series.

None of the Henderson filters used by the X11ARIMA method eliminates the seasonal component but since they are applied to data that are already seasonally adjusted, this limitation becomes irrelevant. On the other hand, they are extremely good for passing waves of any period longer than a year. Thus, the 13-month Henderson, which is the most frequently used, will not reduce the amplitude of waves of period 20 months or more, which stand for trend-cycle variations. Moreover, it eliminates almost all the irregular variations that can be represented by waves of very short periodicity, six months or less.

The weighted 5-term (3 x 3) and the weighted 7-term (3 x 5) moving averages. The weighted 5-term moving average is a 3-term moving average of a 3-term moving average (3 x 3 m.a.). Similarly, the weighted 7-term moving average is a 3-term moving average of a 5-term moving average (3 x 5 m.a.). These two filters are applied to the seasonal-irregular ratios (or differences) for each month, separately, over several years. Their weights are all positive and, consequently, they reproduce the middle value of a straight line within their spans. This property enables the X11ARIMA program to estimate a linearly moving seasonality within five and seven-year spans. Therefore, these filters can approximate quite well the gradual seasonal changes that follow non-linear patterns over the whole range of the series (more than seven years).

The weighted 5-term moving average (3 x 3 m.a.) is a very flexible filter that allows for fairly rapid changes in direction, but since the span of the filter is short, the irregulars must be small for the SI to be smoothed successfully.

The weighted 7-term moving average (3 x 5 m.a.) is less flexible and it is applied for the final estimate of the seasonal factors. For series whose irregular component is large, the program provides other optional sets of weights which are applied to longer spans and thus produce smoother seasonal factors.

Basic Properties of the one-sided Smoothing Filters (End Weights) of the X11ARIMA Method.

It is inherent in any moving-average procedure that the first and last **n** points of an unadjusted series cannot be smoothed with the same set of symmetric weights applied to middle values. In the X11ARIMA the seasonal adjustment of current years and the seasonal factor forecasts are obtained from the combination of two filters: (i) the one-sided filters used for extrapolating the unadjusted data from the ARIMA models and (ii) the filters of the X-11 program used for seasonal adjustment. The extrapolation filters of the ARIMA models change with the series and are therefore very flexible. These filters reflect the most recent movements of the series, in particular, rapidly changing seasonality.

The X-11 filters applied to the **extended** unadjusted series for the trend-cycle estimation are two-sided. Therefore they do not miss turning points and do not introduce phase shifts, which allows them to estimate the cyclical variations well.

The X-11 filters that estimate the seasonal factors are still one-sided but closer to the symmetric filters used for central observations. Thus, with one year of extrapolated data, the seasonal factor forecasts are obtained from the extrapolated data with the X-11 filters used for producing current seasonal adjustment.

It is the combination of the fixed filters from X-11 (the same for any series) with the flexible filters of the ARIMA models (changing with the series) that makes X11ARIMA a better method than X-11 for current adjustment.

Section 1.5. The Advantages of X11ARIMA/80 Computer Program Over Method II-X-11 Variant

The main advantages of X11ARIMA/80 over the X-11 variant are:

1. The availability of a statistical model that provides relevant information on the quality of the raw data. The existence of a model that fits the original series, even though it does not pass the guidelines for extrapolation, fulfils the fundamental principle of seasonal adjustment, that is, the series is decomposable. In other words, if a series does not lend itself to the identification of an ARIMA model (including any type AR, MA, ARIMA) which simply describes the series as a function of past values and lagged random disturbances, any decomposition into trend-cycle, seasonal and irregulars can be seriously criticized and of doubtful validity. In fact, the lack of fit by an ARIMA model can indicate deficiencies concerning the way in which the observations are made, e.g., improper sampling interval.

   If the series has an ARIMA model, the expected value and the variance of the original series can be calculated and thus, confidence intervals can be constructed for the observations. This permits the identification of extreme values, particularly at the end of the series.

2. The one-step extrapolation from ARIMA models is a minimum-mean-square-error extrapolation and can be used as a projected value or benchmark for preliminary figures.

3. If current seasonal factors are applied to obtain current seasonally adjusted data, there is no need to revise the series more than twice. for many series, one revision alone will give seasonal factors that are "final" in a statistical sense.

4. The total error in the seasonal factor forecasts and in the current seasonal factors is significantly reduced for all the months. Generally, a reduction of some 30% in the bias and of 20% in the absolute value of the total error has been found for Canadian and American series.

   There are several reasons for the significant reduction of the error in the seasonal factor forecasts and concurrent seasonal factors. The X11ARIMA/80 produces seasonal factor forecasts from the combination of two filters: (i) the filters of the autoregressive integrated moving averages (ARIMA) models used to extrapolate the raw data; and (ii) the filters that Method II-X-11 variant applies to obtain the first revised seasonal factors. In this manner, the seasonal factor forecasts are obtained from the extrapolated raw values with a set of moving averages whose weights, though still asymmetric, are closer to the weights applied to central observations as compared to the forecasting function of the X-11 variant.

5. Another advantage of X11ARIMA/80 is that the trend-cycle estimate for the last observation is made with the symmetric weights of the Henderson moving averages (which can reproduce a cubic in their time span) combined with the weights of the ARIMA model used for the extrapolated data. Since these latter weights change with the ARIMA model fitted to the series, they reflect the most recent movements and a better trend-cycle estimation is obtained from the combined weights. This is particularly true for years with turning points because the X-11 applies the asymmetric weights of the Henderson filters which can adequately estimate only a linear trend.

6. Finally, by adding one or two more years of extrapolated data (with no extremes, since they are mere projections) a better estimate of the variance of the irregulars is obtained. The latter allows a significant improvement in the identification and replacement of outliers which, as is well known, can severely distort the estimates obtained with linear smoothing filter. For current seasonal factors, the same observations are valid except that the seasonal filters are closer to the central filters than those corresponding to the seasonal factor forecasts. For this reason, the number of revisions in the seasonal factor estimates is also significantly reduced. It was found that one year of forecasts and backcasts is the best compromise for the majority of the series when using the automated option.

Section 1.6. Other Main Improvements Incorporated Into the Automated Version of the X11ARIMA/80

A set of new statistical tests, tables and graphs have been incorporated into the present automated version of the X11ARIMA/80 besides the automatic selection of the ARIMA models, as discussed earlier in Section 3 of this chapter. These tests are used to assess the quality of the original series and the reliability of the seasonal adjustment. A brief description of these improvements follows:

An F-Test for the Presence of Seasonality In Table B1.

This test is based on a one-way analysis of the variance on the SI ratios (differences) similar to the one already available in Method II-X-11 variant for the presence of stable seasonality in Table D8. It differs only in that the estimate of the trend-cycle is made directly from the original series by a centred 12-term moving average. The estimate of the trend-cycle is removed from the original series by division into (subtraction from) the raw data for a multiplicative (additive) model.

The value of the F ratio is printed in Table B1. The F is a quotient of two variances: (i) the "between months or quarters" variance which is mainly due to the seasonals and (ii) the "residual" variance which is mainly due to the irregulars.

Since several of the basic assumptions in the F-test are probably violated, the value of the F ratio to be used for rejecting the null hypothesis, i.e., no significant seasonality present, is tested at the one per thousand probability level.

A Test for the Presence of Moving Seasonality in Table D8

The moving seasonality test is based on a two-way analysis of variance performed on the SI ratios (differences) from Table D8 (Higginson, 1975). It tests for the presence of moving seasonality characterized by gradual changes in the seasonal amplitude but not in the phase.

The total variance of the SI ratios (differences) is considered as the sum of the:

1. σ^2_m, the "between months or quarters" variance which primarily measures the magnitude of the seasonality. It is equal to the sum of squares of the difference between the average for each month of the SI and the total average, corrected by the corresponding degrees of freedom.

2. σ^2_y, the "between years" variance which primarily measures the year-to-year movement of seasonality. It is equal to the sum of squares of the differences between the annual average of the SI for each year and the total average of the SI for the whole table corrected by the corresponding degrees of freedom.

3. σ^2_r, the "residual" variance which is equal to the total variance minus the "between months or quarters" variance and the "between years" variance.

The F ratio for the presence of moving seasonality is the quotient between the "between years" variance and the "residual" variance.

To calculate the variance in an additive model the absolute values of S+I are used, otherwise the annual average is always equal to zero. For a multiplicative model, the SI ratios are replaced by absolute deviations from 100, i.e., by $|SI-100|$. Contrary to the previous test, for which a high value of F is a good indication of the presence of measurable seasonality a high value of F corresponding to moving seasonality reduces the probability of a reliable estimate of the seasonal factors. The F test is printed in Table D8 indicating whether moving seasonality is present or not.

A Combined Test for the Presence of Identifiable seasonality in Table D8

This test combines the previous test for the presence of moving seasonality with the F test for the presence of stable seasonality and the Kruskal-Wallis Chi-squared test (another non-parametric test for the presence of stable seasonality).

The main purpose of this test is to determine whether the seasonality of the series is "identifiable" or not. For example, if there is little stable seasonality and most of the process is dominated by rapidly moving seasonals, chances are that the seasonals will not be accurately estimated for they will not be properly identified by the X11ARIMA/80 method.

The test basically consists of combining the F values obtained from the three previously prescribed tests as follows:

1. If the F_S-test for the presence of stable seasonality at the 0.1% level of significance fails, the null hypothesis, i.e., seasonality is not identifiable, is accepted.

2. If (1) passes but the F_M test for the presence of moving seasonality at the 5% level of significance fails, then this F_M value is combined with the F_S value from (1) to give

$$T_1 = \frac{7}{F_M - F_S} \quad \text{and} \quad T_2 = \frac{3F_M}{F_s}$$

a simple average of the two T's is calculated. If this average is greater than or equal to one, the null hypothesis, i.e., identifiable seasonality not present, is accepted.

3. If (1) passes and the F_M test passes but one of the two T's statistics fails, or the Kruskal-Wallis test fails at the 1% level, then the program prints "identifiable seasonality probably present".

4. If the F_S, F_M and the Kruskal-Wallis chi-squared values pass, then the null hypothesis (of identifiable seasonality not present) is rejected. The program prints "identifiable seasonality present".

The messages are printed at the end of Table D8.

For further details, the reader is referred to Lothian and Morry (1978 b.)

A Test for the Presence of Residual Seasonality In Table D11

This is an F-test applied to the values of Table D11 and calculated for the whole length of the series as well as for the last three years. The effect of the trend is removed by a first-order difference of lag three for monthly series and lag one for quarterly series, that is $\hat{O}_t - \hat{O}_{t-s/4}$ where $\hat{O}_t$ are the values of Table D11. Two F ratios are printed at the end of the table as well as a message indicating the presence or absence of residual seasonality for the last three years and the whole length of the series (Higginson, 1976).

The Normalized Cumulative Periodogram Test for the Randomness of the Residuals

The Method II-X-11 variant uses the Average Duration of Run (ADR) statistic to test for autocorrelation in the final estimated residuals obtained from Table D13. This non-parametric test was developed by W.A. Wallis and G.H. Moore (1941), and is constructed on the basis of the number of turning points. It is efficient for testing the randomness of the residuals only against the alternative hypothesis that the errors, I_t, follow a first-order autoregressive process of the form $I_t = \rho I_{t-1} + e_t$ where ρ is the autocorrelation coefficient and e_t is a purely random process.

If a process is purely random and we have an infinite series, the ADR statistic is equal to 1.50. For a series of 120 observations, the ADR will fall within the range 1.36 and 1.75 with a 95% confidence level. Values greater than 1.75 indicate positive autocorrelation and values smaller than 1.36 indicate negative autocorrelation.

This test, however, is not efficient for detecting the existence of periodic components in the residuals, which can happen when relatively long series are seasonally adjusted or when the relative variation of the seasonal component is small with respect to that of the irregular. To test independence of the residuals against the alternative hypothesis implying periodic processes, the normalized cumulative periodogram has been incorporated in the X11ARIMA/80 program.

The normalized cumulative periodogram values are given in a table and also in a graph. By visual inspection it is possible to determine if components with certain periodicity are present or not in the irregulars.

If the residuals are the estimates of a sample realization of a purely random process, and if the size of the sample tends to infinity, then the normalized cumulative periodogram tends to coincide with the diagonal of the square in which it is drawn.

Deviations of the periodogram from the line expected if the residuals were purely random can be assessed by use of the Kolmogorov-Smirnov test. This test is useful to determine the nature of hidden periodicities left in the irregulars, whether of seasonal or cyclical character and complements the information provided by the test for the presence of residual seasonality. (A simple explanation of this test is given in Dagum, Lothian and Morry, 1975).

A New Table D11A Where the Annual Totals of the Seasonally Adjusted Values are Equal to the Annual Totals of the Raw Data

This new Table D11A produces a modified seasonally adjusted series where the annual totals of the seasonally adjusted values and the raw data are made equal.

The discrepancy between both annual totals is distributed over the seasonally adjusted values of Table D11 in a way that preserves the month-to-month or quarter-to-quarter movements of the unmodified seasonally adjusted series. The procedure is based on a quadratic minimization of the first differences of the annual discrepancies expressed as differences or ratios. For further details the reader is referred to Huot (1975) and Cholette (1978).

A Set of Quality Control Statistics

The Statistics Canada X-11 version developed in 1975 had two statistics called Q_1 and Q_2 that provided an indication of the amount and nature of the irregulars and the seasonal components respectively. These statistics and their basic assumptions are discussed by Huot and De Fontenay (1973).

Considerable research has been carried out since the first set of guidelines was developed and they are now reduced to only one Q statistic which results from the combination of several other measures (Lothian and Morry, 1978.c). Most of them are obtained from the summary measures of Table F2. Their values vary between 0 and 3, and only values less than one are considered acceptable. The statistics that are combined to produce the final Q-statistic follow:

1. The relative contribution of the irregulars over three-month spans as obtained from Table F2B denoted by M_1.

2. The relative contribution of the irregular component to the stationary portion of the variance as obtained from Table F2F; denoted by M_2.

3. The value of the I/C ratio (the ratio of the average absolute month-to-month or quarter-to-quarter percent change in the irregular to that in the trend-cycle) for the selection of the Henderson moving averages in Table D7 printed in Table F2E; denoted by M_3.

4. The value of the average duration of run for the irregulars from Table F2D denoted by M_4.

5. The MCD or QCD (the number of months or quarters it takes the average absolute change in the trend-cycle to dominate the average absolute change in the irregular) from Table F2E denoted by M_5.

6. The total I/S moving seasonality ratio obtained as an average of the monthly moving seasonality ratios from Table D9 denoted by M_6. (It is the ratio of the average absolute year-to-year percent change in the irregulars to that in the seasonals).

7. The amount of stable seasonality in relation to the amount of moving seasonality, from the tests of Table D8, printed in Table F2I; denoted by M_7.

8. A measure of the year-to-year variation of the seasonal component for the whole series from Table D10 denoted by M_8.

9. The average linear movement of the seasonal component for the whole series from table D10 denoted by M_9.

10. Same as 8 but calculated for recent years only; denoted by M_{10}.

11. Same as 9 but calculated for recent years only; denoted by M_{11}.

New Tables

Two Tables, B20 and C20, produce the extreme values from the decomposition of the irregulars I' of Table B13 and Table C13 respectively. For additive models the extreme values are equal to I(1-W) and for multiplicative models they are equal to I/(1+W(I'-1)).

A new Table D16 gives the total effect due to both the trading-day factors and the seasonal factors.

New Charts

The following new charts are available:

G1 chart that plots the values of the original series as in A1 or, in B1 if prior modifications are made, together with the backcasts and forecasts generated from the ARIMA option. It also plots the values of the original series as modified for extreme values from Table E1.

G6 graph corresponding to the Cumulative Periodogram test for the randomness of the residuals.

A Logarithmic Model

A new option allows the user to decompose the original series in an additive relation using the logarithms of the components. It is the additive equivalent of the multiplicative model (Lothian, 1978).

Other Features of X11ARIMA/80

1. In Method II-X-11 variant the end of the series is not treated in the same manner as the beginning, and seasonally adjusting the data in reverse time order does not give the same results as the original series. This is due to a non-homogenous effect in the identification of the extremes. This effect is not present in the X11ARIMA/80 program.

2. A new F3 table is introduced containing the new monitoring and quality control statistics.

3. Images of the main control and ARIMA cards are printed on the title page.

4. In the F2 table, several new summary measures statistics are introduced. For monthly series the first 14 autocorrelations of the final irregular are calculated (the first six for quarterly series). The approximate contribution of the components to the stationary portion of the variance is given. (The series is made stationary by removing a linear trend for additive models and an exponential trend for multiplicative models.) The results of all the analysis-of-variance tests in the program are printed with their associated probability values. The I/C ratio from Table D12 is printed.

5. The probability values for the normal, chi-squared, F, and t values are printed.

6. A variable trend-cycle routine that includes the 5 and 7-term Henderson filter and prior adjustment are available in the quarterly program.

7. If there is prior adjustment, except by trading-day factors, the D11 table equals Table A1 divided by Table D10 for the multiplicative version and equals A1 minus D10 for the additive version.

8. If the MCD (or QCD) is an even number, the MCD moving average is centred by taking an average of two MCD moving averages.

9. Two new printout options. These are a brief printout which prints only three to five tables and an analysis printout.

10. The quality control statistics for each series adjusted are collected and printed at the end of the printout. This allows users to quickly judge the acceptability of all series adjusted.

11. New input and output data formats were added. New formats for the prior adjustment factors were added.

12. The number of decimals of the input data no longer controls the number of decimals on the printout. The decimals on the printout are controlled by a separate option.

13. If the data is read from tape (or disk), the user can select an option which allows the program to search the tape for the series with the required series identifier. Another option will rewind the tape and search.

14. All weights for the moving averages (except the end weights for the Henderson) are calculated using their explicit formulae.

2. THE SEASONAL ADJUSTMENT OF COMPOSITE SERIES

By composite series is here understood a series that results from the addition, subtraction, multiplication and/or division of several components. These components series can enter into the composite with equal or different weights. Because of non-linearities involved in the process of composing the series by multiplication and division and in their seasonal adjustment method, the direct and indirect seasonally adjusted composites are usually different. The direct seasonal adjustment consists of making the composite of the unadjusted components, and then seasonally adjusting the composite series. The indirect seasonal adjustment consists of first seasonally adjusting the component series and then the seasonally adjusted composite series is obtained by implication. In order to decide whether the composite series should be seasonally adjusted using the direct or the indirect procedure the criterion of smoothness is often used. A classical measure of the degree of roughness or lack of smoothness in a seasonally adjusted composite series is the sum of squares of the first difference of the series. That is:

$$R_1 = \Sigma_t (\hat{X}_t - \hat{X}_{t-1})^2 \qquad (7)$$

where $\hat{X}_t$ is the series in question. The larger R_1 the rougher the series $\hat{X}$ or, equivalently the less smooth.

The rationale of this measure is that the first difference filter removes most of the variations of long periodicities (trend and cycle). Lothian and Morry (1977) have found that the R_1 measure is related to the magnitude of the revisions in the seasonally adjusted series. The implicit definition of smoothness of R_1, however, excludes cycles of short periodicities and to compensate for this a new measure of roughness R_2 based on the 13-term Henderson filter is given in Dagum (1979). The R_2 measure is:

$$R_2 = \Sigma_t(\hat{X}_t - H\hat{X}_t)^2 = \Sigma_t [(I - H)\hat{X}_t]^2 \qquad (8)$$

where I-H is the complement of the Henderson filter.

These two measures, expressed as averages and, in percentages when the composition is multiplicative, have been incorporated in the X11ARIMA/80 program used for the direct and the indirect seasonal adjustment of composite series. Generally, both measures give consistent results in favouring one procedure over the other from the viewpoint of smoothness. However, this consistency is not present when the composite series are strongly affected by cyclical variations of short periodicity and, in such cases, R_2 should be preferred in deciding which of the two procedures gives the smoothest seasonally adjusted data.

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* This chapter is reproduced from the X11ARIMA Seasonal Adjustment Method by Dagum (1980).

3. NEW FEATURES OF THE X11ARIMA/88 SEASONAL ADJUSTMENT METHOD

Section 3.1. Introduction

In the decade of the eighties, several economic and institutional events have affected the pattern of the time series components, consequently, new problems on the accuracy and usefulness of the seasonally adjusted data emerged. Among these events, notable ones are the deep recession of 1981 - 82; the introduction of new government regulations that enable business stores to be open longer hours and/or Sunday, and the early arrival of Easter (1980, 1983, 1985, 1986 and 1988). To cope with these problems, a significant amount of research was carried out at the Time Series Research and Analysis Division, that led to new developments and their implementation in X11ARIMA/88.

The X11ARIMA/88 as the X11ARIMA developed by Dagum (1980) (here described in Chapters II and III) performs three basic functions: (1) Forecasting; (2) Seasonal adjustment; and (3) Composition of original and seasonally adjusted data. The new developments concerns the first two key functions.

The new features of X11ARIMA/88 for its forecasting function are: 1) A new set of built-in ARIMA models; 2) Variable forecast horizons; 3) Backcasts only for series shorter than 7 years; 4) New levels of acceptance for the fitting and extrapolation criteria; 5) Printing the autocorrelations of the residuals from the built-in ARIMA models; 6) Zero iteration for the parameter estimation of user-supplied models; and 7) Automatic removal of trading-day variations and Easter effect (if present) before ARIMA modelling.

The seasonal adjustment function of X11ARIMA/88 offers: (1) Estimation of Easter effects; (2) Increased accuracy of the asymmetric Henderson trend-cycle filters; (3) Selection of the seasonal filters by the default option based on a global seasonal irregular I/S ratio; (4) Re-scale of the original series; (5) Temporary and permanent a-priori adjustment of original values; (6) Graphs of the trading-day and irregulars by type of month; and (7) User-specified printouts.

Similarly to X11ARIMA/80, this new 1988 series can be applied in two different modes, namely, (1) with ARIMA extrapolations (which is now the default option) and (2) without ARIMA extrapolations. In the latter case, the estimates of the various time series components are close but not necessarily equal to those obtained with the Method II - X-11 Variant (Shiskin, Young and Musgrave, 1967). The discrepancies are due mainly to differences in the identification and replacement of extreme values and in the increased accuracy in the seasonal and trend-cycle asymmetric filters.

Section 3.2. New Features in the Forecasting Function

A New Set of Built-in ARIMA Models

The major social and economic events of the early 80's made it necessary to assess the adequacy of the built-in models in X11ARIMA/80. A study by Chiu, Higginson and Huot (1985) was conducted on a sample of 190 seasonal series ending in 1983 and representing eleven sectors of the Canadian economy.

These authors evaluated the performance of a set of seven ARIMA models (including the three available in X11ARIMA/80) according to the following eight criteria: mean absolute percentage error of the forecasts for the last three years, the chi-square statistics for the randomness of the residuals, under differencing, overdifferencing, stability, invertibility, correlation between parameters and the presence of small parameter values. Although not mutually independent, these criteria were useful to evaluate the goodness of fit and the forecasting performance for each model.

The study ranked the four first models as follows:

1 - (0,1,1) (0,1,1)s
2 - (0,1,2) (0,1,1)s
3 - (2,1,0) (0,1,1)s
4 - (0,2,2) (0,1,1)s

These models are here expressed in the classical Box and Jenkins (1970) symbolic notation, where p and P denote the number of the ordinary and seasonal autoregressive parameters, respectively; q and Q denote the number of the ordinary and seasonal moving average respectively; d and D denote the degree of the ordinary and seasonal differences, respectively.

The combined rate of success for the first three models varied from 97% for labour series to 21% for external trade series. The rate was considered good, in general, given the fact that during two of the three years tested, Canada suffered a severe recession. Furthermore, it was evident that the rate of success of model (1) was much smaller than the rate obtained by Lothian and Morry (1978) with series ending in 1977. The fourth model (0,2,2) (0,1,1) was found to fit well an important class of series (series with a steep change in trend) that all the other models fit poorly (similar conclusions were reached by Lothian and Morry, 1978).

The new experiment detected two other models, the (0,1,2) (0,1,1)s and the (2,1,0) (0,1,1)s as good for extrapolation and fitting a large class of series. It was then decided to keep the currently available three ARIMA models and add the two new models. The reason for keeping the (2,1,2) (0,1,1)s model was its excellent performance for forecasting the data.

The availability of five models instead of three does not increase the cost of running X11ARIMA/88 because these models are tested sequentially in the order shown above being the (2,1,2) (0,1,1) the last. In other words, if model (1) passes, then the program does not try the others, but if model (1) fails, it tries model (2) and so on.

For the micro-computer version of X11ARIMA/88 the (2,1,2) (0,1,1) model is not automatically tested because it augments too much the time taken by the other four models. It can always be requested with the user-supplied model option if desired.

Variable Forecasting Horizon

This subroutine enables the user to select the lengths of the forecast horizon up to three years (36 months or 12 quarters), the default option being one year. The length of the forecast horizon is strongly tied to the problem of minimization of revisions due to filter changes which has been extensively discussed by Dagum (1982.a, 1982.b) and Dagum and Laniel (1987).

A study by Dagum (1982.c) addressed the problem of revisions of the concurrent and other non-symmetric filters when one, two and three years of data are extrapolated from the three built-in ARIMA models in X11ARIMA/80, namely, (0,1,1) $(0,1,1)_{12}$; (0,2,2) $(0,1,1)_{12}$ and (2,1,2) $(0,1,1)_{12}$ with several combinations of parameter values. She showed that the largest gain was obtained with one year of extrapolated values; there was a small incremental gain if two years were used and finally there was no gain going from two to three years. This study was extended for the concurrent filter by Huot et als (1986) using four models, namely, (0,1,1) $(0,1,1)_{12}$, (2,1,0) $(0,1,1)_{12}$, (0,1,2) $(0,1,1)_{12}$ and (0,2,2) $(0,1,1)_{12}$. These authors investigated the effect of various forecast horizons on the total revisions for selected parameter values. Their results showed that the optimal forecast horizon that minimizes filter revisions changes with the parameter values of the model. Thus for the (0,1,1) $(0,1,1)_{12}$ where θ=0.50 and Θ=0.90, the filter revisions are minimized for a forecast horizon of 24 months. On the other hand, for small values of Θ (say Θ=0.40) the forecast horizon should be shorter than a year. These results are in agreement with the fact that the larger the value of Θ the more stable the seasonal pattern is assumed to be and, consequently, a longer forecast horizon is feasible.

Backcasting

Another modification introduced into the automatic ARIMA extrapolation option concerns backcasting. The X11ARIMA/80 enabled the user to backcast one year of data for all series shorter than 15 years. Backcasting improves the seasonal adjustment, in general, but introduces permanent revisions of the estimated components at the beginning year of the series. Backcasting also introduces revisions of current seasonally adjusted values for series of 8, 9 and 10 years. This is due to the fact that the backcast values will change whenever the parameter values of the ARIMA models change. An optimal trade-off in the sense that the advantages of backcasting dominate the disadvantages was found for series shorter than 7 years where the use of backcasting enables the application of symmetric filters to observations in the middle.

New Levels of Acceptance for the Criteria of Fitting and Forecasting

The criteria of fitting and extrapolation for the built-in ARIMA models introduced by Dagum (1981) have been relaxed. The mean absolute percentage forecast error (M.A.P.E) has been raised to 15% from 12% and the level of significance of the chi-squared distribution of the Ljung and Box (1978) test for the randomness of the residuals is 5% instead of 10%. These changes in the level of the acceptance criteria do not affect the advantages of using the ARIMA extrapolations but enable a more frequent application of the automatic ARIMA options.

Autocorrelation Values of the Residuals

The autocorrelation values of the residuals from the ARIMA models of the automatic option are printed up to a lag of two years.

This information is critical for the user who wishes to modify the ARIMA models that failed because of a very low X^2 probability value or the presence of overdifferencing.

Zero Iteration for the Parameter Estimations of User-supplied Models

This option enables users to maintain the parameter values of their ARIMA models as estimated by other computer programmes.

Automatic Removal of Trading-Day and Easter Effects Before the ARIMA Modelling

The estimations of trading-day variations by the X11ARIMA/88 program as described in Chapter 4 is based on a regression model developed by Young (1965) and is the same as that used by X11ARIMA/80 and by Method II-X11 variant. Trading-day variations cannot be picked up by the usual ARIMA models. Similarly, the estimation of Easter effects assumes a deterministic behaviour that cannot be reflected by the ARIMA models. Consequently, these two sources of variations are automatically removed from the original series before the ARIMA modelling (when applicable).

Estimation of Easter Effects

X11ARIMA/80 does not provide an estimation of the effect of Easter on series affected by this type of variation. Easter is a moving holiday associated with the calendar that can cause serious distortions in month to month (also quarter to quarter) changes when it occurs in March or at the very beginning of April. During this decade, Easter fell in March or during the first week of April in 1980, 1983, 1985, 1986 and 1988. The very early arrival of Easter in March 1986, seriously affected international trade series, particularly, imports where a large drop in March was followed by an increase in April. This was caused by the fact that custom forms at the end of March were processed in April because of the Easter closing of custom offices. The impact of Easter in this case is immediate in the sense that only the holiday period displays a change of activity. To take into account this type of effect the following model has been introduced in X11ARIMA/88.

$$E_i = 1/2\ f(Z_i)\ \left[\frac{\sum_{i \epsilon M} (I_{i,j+1} - I_{i,j})}{n_M} - \frac{\sum_{i \epsilon A} (I_{i,j+1} - I_{i,j})}{n_A} \right] \qquad (3.1)$$

where

Z_i = number of days between Easter Sunday in year i and March 22 (the earliest possible Easter date)

$f(Z_i)$ = 1 if $Z_i \leq 9$ (Easter falls in March)

$f(Z_i)$ = 0 if $Z_i > 9$ (Easter falls in April)

I_{ij} = residuals estimated in first iteration of X11ARIMA/88 and assumed to be affected by Easter effect (E_i); i denotes year and j month of March (consequently j+l denotes April)

n_M = number of years when Easter fell in March;

n_A = number of years when Easter fell in April.

There is another type of Easter effect which affects not only the holiday period but days (sometimes weeks) before it. This type of gradual impact can occur in retail trade series such as chocolates, flowers, women's clothing.

A model has been developed for this kind of Easter effect but is not yet incorporated in X11ARIMA/88 (see Dagum, Huot and Morry, 1988).

Increased Accuracy of the Asymmetric Henderson Filters

The weights of all asymmetric trend-cycle filters in X11ARIMA/80 are those of the Method II - X-11-Variant. These weights are given with three digits only and, thus, the degree of accuracy of the estimates is limited. The reason for not using higher precision was the lack of documentation on how these weights were derived by Shiskin, Young and Musgrave (1967).

A study by Laniel (1985) gives a formula that enables us to reproduce exactly the end-weights of the 13-term Henderson filter as in the X-11-Variant and consequently, they can now be calculated to any degree of precision. The formula used to obtain these weights is based on the minimization of the mean squared revision (MSR) between the final estimate (obtained by the application of a symmetric filter) and the preliminary estimate (obtained by the application of an asymmetric filter) subject to the constraint that the sum of the weights is equal to one. The assumption made is that at the end of the series the seasonally adjusted values are equal to a linear trend-cycle plus a purely random irregular NID~$(0,\sigma^2_a)$. The equation used by Laniel (1985) is,

$$E[r_t^{(i,m)}]^2 = c_1^2 \left(t - \sum_{j=-i}^{m} h_{ij}(t-j)\right)^2 + \sigma^2_a \sum_{j=-m}^{m} (h_{mj}-h_{ij})^2 \qquad (3.2.1)$$

where h_{mj} and h_{ij} are the weights of the symmetric (central) filter and the asymmetric filters, respectively; $h_{ij}=0$ for $j=-m,\ldots,-i-1$, c_1 is the slope of the line and σ^2_a denotes the noise variance.

There is a relation between c_1 and σ^2_a such that,

$$\frac{I}{C} = \frac{(4\sigma^2_a/\pi)^{1/2}}{|c_1|} \qquad (3.2.2)$$

The I/C noise to signal ratio in the Census X11 Variant and X11ARIMA/88 as well, determines the length of the Henderson trend-cycle filter to be applied. Thus, setting t=0 and m=6 for the end weights of the 13-term Henderson, we have,

$$\frac{E\, r_0^{(i,6)}}{\sigma^2_a} = \frac{4}{\pi(I/C)^2}\left[\left(\sum_{j=-i}^{6} h_{ij}\right)^2 + \sum_{j=-6}^{6} (h_{6j}-h_{ij})^2\right] \qquad (3.2.3)$$

Making I/C=3.5 (the most noisy situation where the 13-term Henderson is applied), Laniel (1985) obtained the same set of end weights as those of Census X-11 variant. These end weights have been calculated for the remaining Henderson filters using, for quarterly series I/C=3.5 for the 5-term filter and I/C=7 for the 7-term filter; for monthly series I/C=.99 for the 9-term filter and I/C=7 for the 23-term filter. These weights are now incorporated in the X11ARIMA/88 program.

Automatic Selection of the Default Seasonal Filters Based on the Global I/S Ratio

The X11ARIMA/80 computer program automatically selects a 5-term and a 7-term weighted moving average (3X3m.a and 3X5m.a, respectively) as seasonal filters whenever the default option is applied. However, Lothian (1984) has shown that depending on the moving seasonality ratio (MSR) given by the global irregular-seasonal ratio value (I/S) printed in Table F-2, other seasonal moving averages may be more appropriate for a given series. Lothian (1984) gives the following ranges"

Average	Range of the MSR(I/S) for series shorter than 15 yrs.	Range of the MSR(I/S) for series longer than 15 yrs.
3-term	0-2.3	0-2.1
3x3	2.3-4.1	2.1-3.8
3x5	4.1-5.2	3.8-5.0
3x9	5.2-6.5	5.0-6.9
Simple N-Term	6.5-7.1	6.9-7.1

The problem of incorporating the above ranges in an automatic option is that of getting unnecessary extra revisions for values near the boundaries. It suffices to have a few extreme values not well identified and/or replaced to obtain I/S values that change significantly in very short periods of time. In order to avoid this, the automatic selection of the seasonal moving average is done as follows:

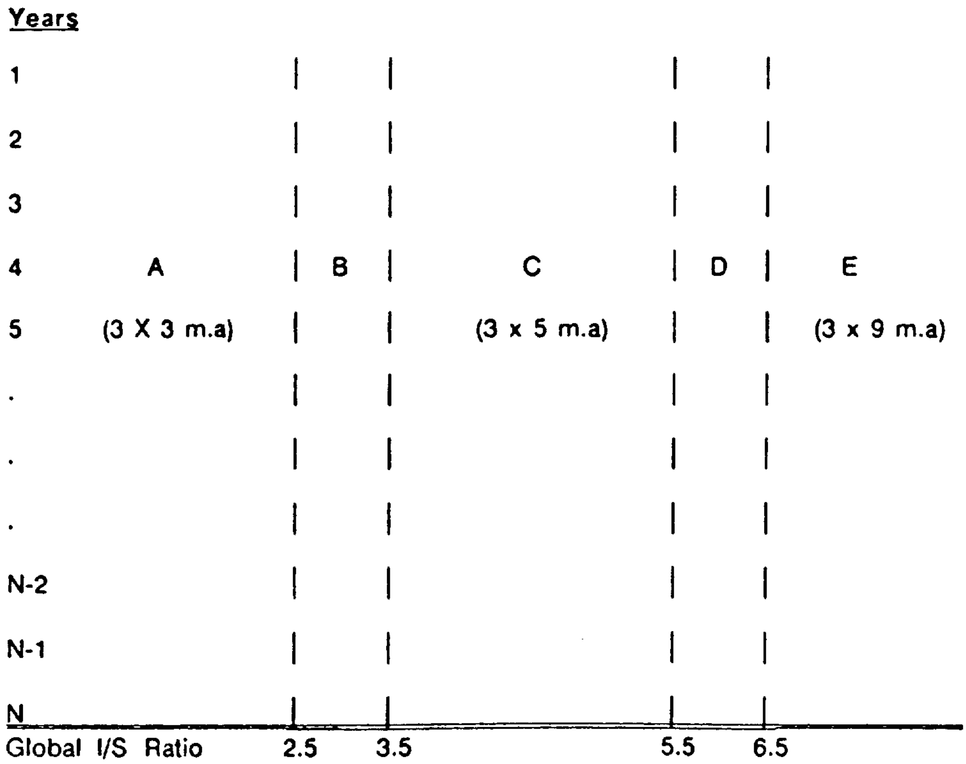
(1) The global I/S ratio is calculated using data that ends in the last full calendar year available. This implies that the I/S ratio will not be changed when new observations are added until a full year of data is completed.

(2) Bandwidths are used instead of the cut-off points given by Lothian (1984). Looking at Figure I below the selection process is done as follows:

(a) If the global I/S ratio for the entire series up to and including the last whole year N, falls in set A (I/S $\leq$ 2.5) then a 3 X 3 m.a is applied; if in set C (3.5 $\leq$ I/S $\leq$5.5) then a 3 X 5 ma is applied and if in set E (I/S $\geq$ 6.5) then a 3 X 9 m.a is used.

(b) If the global I/S ratio for the entire series up to and including the last whole year falls either in set B or D the last year of data is dropped and the I/S ratio is calculated again to see whether it now falls in A, C or E. If the I/S ratio still falls in the sets B or D, another year of data is dropped and I/S ratio is recalculated. This process is done for the last five years and if the I/S ratio does not fall in A, C or E then the 3X5 m.a is used.

Figure 1 - Criteria for the selection of the seasonal moving average by the default option



Similarly to the variable trend-cycle subroutine the automatic selection of the seasonal filters of the default option operates only in Part D of the program. For Part B and C the same steps as in 11ARIMA/80 are followed. Furthermore, this new option does not apply for series shorter than five full years.

Re-scale of the Original Series

This option enables one to re-scale the values of the original series if they are too big or too small.

Temporary and Permanent a-Priori Adjustments of Original Values

The X11ARIMA/80 enabled only temporary a priori adjustment of original values in the sense that these adjustments were reintroduced in the final seasonally adjusted data. The major purpose for having temporary a-priori replacement of original values is to provide a smoother input for the estimation of the components.

There are cases, however, where it is convenient to have permanent a-priori adjustments of the original values, for such cases, the permanent adjustments are not reintroduced in the final output. This option enables one to keep a record of the permanent adjustments done to the original series. It is very useful for series affected by Easter and other moving holidays, the effects of which one does not want to appear in the final adjusted series.

The new X11ARIMA/88 enables the use of each kind of a-priori modification.

Graphs of Trading-day and Irregular Variations by Type of Months

Optional graphs (G8) that plot the trading-day and irregulars for the 22 types of months are incorporated in X11ARIMA/88. These graphs permit one to evaluate the adequacy of the daily weights estimated by the program to produce reasonable trading-day variations for each month. They also facilitate the detection of breaks in the pattern of the trading-day variations.

This option is not available in the microcomputer version of X11ARIMA/88.

User-Specified Printouts

This new option in X11ARIMA/88 enables the user to select the tables he/she wants to have printed out with a maximum of twenty (20).

4. EXAMPLE: SEASONAL ADJUSTMENT OF THE INDUSTRIAL PRODUCTION INDEX OF THE BASQUE COUNTRY

The Industrial Production Index(IPI) is one of the most important leading economic indicator of the Basque country.It represents the evolution of the industrial sector of the Gross Domestic Product.The total index results from the aggregation of various Laspeyres indices calculated for different industrial products based on the industrial classification standards.

The IPI series covers the period January 1985-April 1990 as shown in Table A.1.Because this series is an index ,its seasonal adjustment is done using a multiplicative decomposition model.Furthermore,given that the phenomenon under question is the volume of industrial activities,we requested the estimation of trading-day variations and their removal from the original series,if present. The corresponding Table A7 indicates that the presence of trading-day variations is significant.The daily weights are given in Table A 8A which shows that the days of higher industrial activities are Wednesday,Friday and Sunday,being Monday the one with lowest activity.The estimated trading-day factors for each month and each year are shown in Table A 8B.

Because we have requested the default option for seasonal adjustment together with trading-day variations,the program automatically estimates and removes the latter before trying to test the five built-in ARIMA models.The program has selected the (0,1,1)(0,1,1) model with the log transformation.The chi-squared probability value is 99.65% accepting the null hypothesis of randomness of the residuals.The mean absolute forecasting error, in percentage, is 2.52 for the last three years .The values of the estimated parameters are 0.770 for the small theta,indicating that the trend-cycle component is not strongly affected by the innovations;and similarly,0.675 for capital theta,indicating that the seasonal variations are rather stable.All the above information is given in Table A15 and is based on data that ended in December 1989.Based on information up to and including April 1990,the re-estimated parameters changed very little.

The F statistic for presence of seasonality printed in Table B 1 has a high value indicating that stable seasonality is present.This is confirmed ,later on, by the values printed at the bottom of Table D8.

Table C 17 shows that years 1986 and 1989 have been most affected by extreme values, in particular, the month of August has been hit in such a way that its values have been given zero weight.The extreme values are given in Table C 20. Based on the global I/S ratio that is equal to 5.64,as shown in Table D 10,the program automatically selected the 3x5 seasonal moving average to estimate the final seasonal factors.The series adjusted for seasonal vsariations and trading-day variations is given in Table D 11 and the corresponding F values for presence of residual seasonality accepts the null hypothesis.

Table D 12 shows the final trend-cycle estimates calculated with the 13-term Henderson filter,automatically chosen by the program, based on the I/C ratio. Table E 4 shows that the ratios of the annual totals between tha original and seasonally adjusted series are near to 100 as should be when seasonality is rather stable.Tables E 5 and E 6 give the month-to month changes in the original and seasonally adjusted series.As expected,there is strong permanence of sign for certain months in Table E 5, an indication that seasonality is present,whereas the signs are more randomly behaved in the seasonally adjusted series.

Table F 2 gives the summary measures and Table F 3 shows the monitoring and quality assessment statistics.In F 2.A,we can see that the average percent change without regard to sign for one month span of the original series O is 25.01 and it is reduced to 2.30 after seasonally adjusting the series.This indicates that the seasonal adjustment has significantly reduced the variation of the data. Table F 2B shows that the greatest contribution to the month to month percent change in the original series is given by the seasonal variations with 98.88,there is very little due to the irregulars (0.82) and even less to the trend-cycle (0.03).

The month for cyclical dominance (MCD) is equal to 5,but this high value is due to the slow accumulation of the trend-cycle more than to the contribution of the irregulars.

Except for M3,all the remaining monitoring measures are indicative of a good seasonal adjustment.Once again,the failure of M3 is due to the slow change in the trend-cycle component and should not be a matter of concern.Finally the overall Q statistic is accepted at the level of 0.29.

G 1 shows the graph of the original series and one year of extrapolated values.Graph G 2 gives the seasonally adjusted values and the corresponding trend cycle.The IPI seems to have been strongly affected by short business cycles from 1985 till the end of 1987 when it increased sharply untill the beginning of 1989 .G 3 shows the seasonal factors for each month over all the years.

```
                  J E S 2   J O B   L O G  --  S Y S T E M   S Y S A  --  N O D E   J E S 2

13.38.53 JOB 6654  IEF196I IEF237I F2F  ALLOCATED TO SYS17682
13.38.54 JOB 6654  IEF196I IEF285I   ICFCTLG.VSCG310                              KEPT
13.38.54 JOB 6654  IEF196I IEF285I   VOL SER NOS= SCG310.
13.39.35 JOB 6654  $HASP373 CAPV     STARTED - INIT  3 - CLASS D - SYS SYSA
13.39.40 JOB 6654  +------------------------------------------------------------------------------------+
13.39.40 JOB 6654  | STATISTICS CANADA JOB ACCOUNTING REPORT                                            |
13.39.40 JOB 6654  +------------------------------------------------------------------------------------+
13.39.40 JOB 6654  | JOBNAME  STEPNAME PROCSTEP    TIME       RC    EXCPS    CPU        SRB     SERVICE MOUNTS |
13.39.40 JOB 6654  |                            (HH:MM:SS)          (I/O) (HH:MM:SS) (HH:MM:SS)  UNITS        |
13.39.40 JOB 6654  | -------- -------- -------- ----------   ---  ------- ---------- ---------- -------  ---- |
13.39.40 JOB 6654  | CAPV     *AWAITING EXEC*    13:38:53                                                  |
13.39.40 JOB 6654  | CAPV     S1                 13:39:35    00       70  00:00:00   00:00:00    2,064      0 |
13.39.40 JOB 6654  | CAPV     S2                 13:39:37    00      111  00:00:00   00:00:00    9,740      0 |
13.39.40 JOB 6654  | CAPV     *AWAITING PRINT*   13:39:40                                                  |
13.39.40 JOB 6654  | CAPV     *TURNAROUND*       00:00:47 TOTALS     181  00:00:00   00:00:00   11,804      0 |
13.39.40 JOB 6654  +------------------------------------------------------------------------------------+
13.39.40 JOB 6654  | EXECUTION CLASS = D        SERVICE FACTOR =    2.0                                  |
13.39.40 JOB 6654  +------------------------------------------------------------------------------------+
13.39.40 JOB 6654  | SERVICE UNITS / 10000          = MCUS CONSUMED =         1.1                        |
13.39.40 JOB 6654  | MCUS CONSUMED X SERVICE FACTOR = MCUS CHARGED  =         2.2 IF THE SERVICE LEVEL IS MET. |
13.39.40 JOB 6654  | PLEASE SEE THE CARS II DATABASE FOR THE ACTUAL CHARGE.                              |
13.39.40 JOB 6654  +------------------------------------------------------------------------------------+
13.39.40 JOB 6654  $HASP395 CAPV     ENDED

------ JES2 JOB STATISTICS ------

    17 JUL 90 JOB EXECUTION DATE

           12 CARDS READ

        1,785 SYSOUT PRINT RECORDS

            0 SYSOUT PUNCH RECORDS

          128 SYSOUT SPOOL KBYTES

         0.09 MINUTES EXECUTION TIME
```

```
 1 //CAPV JOB (2152,CO23,,10),WONGPAU,CLASS=D,MSGLEVEL=(1,1),              JOB 6654
   //  TIME=(,10),MSGCLASS=T,NOTIFY=WONGPAU
   *** $ACFJ219 ACF2 ACTIVE JES2                                                ACF2
 2 //PROCLIB DD DSN=TISE.PUBLIC.PROCLIB,DISP=SHR
 3 // EXEC X11ARIMA
 4 XXX11ARIMA PROC                                                          00000010
 5 XXS1    EXEC  PGM=X11AR,REGION=400K                                      00000020
 6 XXSTEPLIB  DD  DSN=TISE.PUBLIC.LOADMOD,DISP=SHR                          00000030
 7 XXFT03F001  DD  SYSOUT=*                                                 00000040
 8 XXFT06F001  DD SYSOUT=*,DCB=RECFM=UA                                     00000050
 9 XXFT07F001  DD  DSN=&&A,DISP=(,PASS),UNIT=DISK,SPACE=(TRK,(10,4)),       00000060
   XX            DCB=(LRECL=80,BLKSIZE=6400,RECFM=FB)                       00000070
10 XXFT22F001  DD  DSN=ECAN.CEA.ARHELP,DISP=SHR,LABEL=(,,,IN)               00000080
11 XXFT25F001  DD  DSN=ECAN.CEA.DUMMY,DISP=SHR                              00000090
12 XXFT05F001  DD  DDNAME=SYSIN                                             00000100
13 //FT10F001 DD DISP=SHR,DSN=TISE.PUBLIC.WONGPAU.ESTELLA.CAEIPI.DATA
14 //SYSIN DD *
15 XXS2    EXEC PGM=XA88,REGION=200K,COND=(4,LT,S1)
16 XXSTEPLIB DD DSN=TISE.PUBLIC.X11A.LOADMOD,DISP=SHR                       00000120
17 XXFT03F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=5320)            00000130
18 XXFT09F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=5320)            00000140
19 XXFT11F001 DD DUMMY       --- SPECIAL (PUNCH) FILE                       00000150
20 XXFT15F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=5320)            00000160
21 XXFT16F001 DD SYSOUT=*,DCB=(RECFM=FBA,LRECL=133,BLKSIZE=5320)            00000170
22 XXFT01F001  DD  DSN=&&A,DISP=(OLD,DELETE)                                 00000180
```

```
IEF236I ALLOC. FOR CAPV S1
IEF237I A46  ALLOCATED TO STEPLIB
IEF237I F2F  ALLOCATED TO SYS07538
IEF237I JES2 ALLOCATED TO FT03F001
IEF237I JES2 ALLOCATED TO FT06F001
IEF237I C44  ALLOCATED TO FT07F001
IEF237I 66B  ALLOCATED TO FT22F001
IEF237I 66B  ALLOCATED TO SYS07540
IEF237I 66B  ALLOCATED TO FT25F001
IEF237I JES2 ALLOCATED TO FT05F001
IEF237I A46  ALLOCATED TO FT10F001
SC0002I FT07F001 C44 WORK04      2 PS  FB     80  6400 SYS90198.T133935.RA000.CAPV.A
SC0002I FT22F001 66B SCC310      4 DA  F    1024  1024 ECAN.CEA.ARHELP
SC0002I FT25F001 66B SCC310      1 DA  F    1024  1024 ECAN.CEA.DUMMY
SC0002I FT10F001 A46 SCG311      2 PS  FB     80  6400 TISE.PUBLIC.WONGPAU.ESTELLA.CAEIPI.DATA
SC0002I STEPLIB  A46 SCG311     18 PO  U       0 32760 TISE.PUBLIC.LOADMOD
IEF142I CAPV S1 - STEP WAS EXECUTED - COND CODE 0000
IEF285I   TISE.PUBLIC.LOADMOD                          KEPT
IEF285I   VOL SER NOS= SCG311.
IEF285I   ICFCTLG.VSCG310                              KEPT
IEF285I   VOL SER NOS= SCG310.
IEF285I   JES2.JOB06654.S0000102                       SYSOUT
IEF285I   JES2.JOB06654.S0000103                       SYSOUT
IEF285I   SYS90198.T133935.RA000.CAPV.A                PASSED
IEF285I   VOL SER NOS= WORK04.
IEF285I   ECAN.CEA.ARHELP                              KEPT
IEF285I   VOL SER NOS= SCC310.
IEF285I   ICFCTLG.VSCC310                              KEPT
IEF285I   VOL SER NOS= SCC310.
IEF285I   ECAN.CEA.DUMMY                               KEPT
IEF285I   VOL SER NOS= SCC310.
IEF285I   JES2.JOB06654.SI000101                       SYSIN
IEF285I   TISE.PUBLIC.WONGPAU.ESTELLA.CAEIPI.DATA      KEPT
IEF285I   VOL SER NOS= SCG311.
IEF373I STEP /S1      / START 90198.1339
IEF374I STEP /S1      / STOP  90198.1339 CPU    0MIN 00.07SEC SRB    0MIN 00.01SEC VIRT   328K SYS   276K EXT      92K SYS    9072K
IEF236I ALLOC. FOR CAPV S2
IEF237I E4A  ALLOCATED TO STEPLIB
IEF237I F2F  ALLOCATED TO SYS07542
IEF237I JES2 ALLOCATED TO FT03F001
IEF237I JES2 ALLOCATED TO FT09F001
IEF237I DMY  ALLOCATED TO FT11F001
IEF237I JES2 ALLOCATED TO FT15F001
IEF237I JES2 ALLOCATED TO FT16F001
IEF237I C44  ALLOCATED TO FT01F001
SC0002I FT01F001 C44 WORK04      2 PS  FB     80  6400 SYS90198.T133935.RA000.CAPV.A
SC0002I STEPLIB  E4A SCG312     36 PO  U       0 32760 TISE.PUBLIC.X11A.LOADMOD
IEF142I CAPV S2 - STEP WAS EXECUTED - COND CODE 0000
IEF285I   TISE.PUBLIC.X11A.LOADMOD                     KEPT
IEF285I   VOL SER NOS= SCG312.
IEF285I   ICFCTLG.VSCG310                              KEPT
IEF285I   VOL SER NOS= SCG310.
IEF285I   JES2.JOB06654.S0000104                       SYSOUT
IEF285I   JES2.JOB06654.S0000105                       SYSOUT
IEF285I   JES2.JOB06654.S0000106                       SYSOUT
IEF285I   JES2.JOB06654.S0000107                       SYSOUT
IEF285I   SYS90198.T133935.RA000.CAPV.A                DELETED
IEF285I   VOL SER NOS= WORK04.
IEF373I STEP /S2      / START 90198.1339
IEF374I STEP /S2      / STOP  90198.1339 CPU    0MIN 00.31SEC SRB    0MIN 00.01SEC VIRT   368K SYS   352K EXT      92K SYS    9072K
IEF375I  JOB /CAPV    / START 90198.1339
IEF376I  JOB /CAPV    / STOP  90198.1339 CPU    0MIN 00.38SEC SRB    0MIN 00.02SEC
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 THE X11ARIMA/88 PREPROCESSOR

             BY

       ESTELA BEE DAGUM


 TIME SERIES RESEARCH AND ANALYSIS DIVISION

 STATISTICS CANADA  - OTTAWA - CANADA -  K1A OT6
 NOVEMBER, 1988
COMMAND:

   RANGE 12 85 1 90 4;
COMMAND:

   X11ARDATA FORMAT(F8.1) CAPV;
CAPV      AVAILABLE RANGE :    12    85     1    90     4
COMMAND:

   T CAPV ;
COMMAND:

   SA (CAPV,0,0) PRTDEC 1  TDR 3 PRINT 4 CHART 2;
FINISHED PROCESSING CAPV
COMMAND:

   END;
```

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                         LOG FOR X-11-ARIMA MONTHLY AND QUARTERLY SEASONAL ADJUSTMENT PROGRAM
                        *-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*-*

  CAPV      1ST/85 -  4TH/90  MULTIPLICATIVE SEASONAL ADJUSTMENT ,     LONG PRINTOUT,  MONTHLY  PROGRAM.
END OF X-11 ARIMA
```

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                              STATISTICS CANADA

                  X11ARIMA/88  MONTHLY  SEASONAL ADJUSTMENT METHOD


                 THIS METHOD MODIFIES THE 1980 VERSION OF X11-ARIMA.
                 THE MODIFICATIONS WERE INTRODUCED BY THE TIME
                 SERIES RESEARCH AND ANALYSIS DIVISION OF STATISTICS
                 CANADA. UNDER THE DIRECTION OF ESTELA BEE DAGUM.


SERIES TITLE-   CAPV                                                        SERIES NO. CAPV

                                               JULY  17, 1990

  -PERIOD COVERED-  1ST   MONTH,1985 TO  4TH   MONTH,1990
  -TYPE OF RUN - MULTIPLICATIVE SEASONAL ADJUSTMENT
  -    LONG PRINTOUT. EXPANDED CHARTS.
  -SIGMA LIMITS FOR GRADUATING EXTREME VALUES ARE 1.5 AND 2.5 .
  -SEASONAL MOVING AVERAGE SELECTED BY THE PROGRAM BASED ON THE GLOBAL I/S RATIO.
  -12 MONTHS   OF FORECASTS FROM ARIMA MODEL SELECTED BY THE PROGRAM.
  -TRADING DAY REGRESSION COMPUTED STARTING 1985 EXCLUDING IRREGULAR VALUES OUTSIDE 2.5-SIGMA LIMITS.
  -TRADING DAY REGRESSION ESTIMATES APPLIED STARTING 1985 IF SIGNIFICANT.
  -TRADING-DAY REGRESSION WEIGHTS USED AS PRIOR WEIGHTS


--------------------------------------------------------------------------------------------------------------------

                                        1         2         3         4         5         6         7         8
 COLUMN NUMBER                 : 12345678901234567890123456789012345678901234567890123456789012345678901234567890

 IMAGE OF THE MAIN OPTION CARD: M1CAPV     01850490   1   42                                                 3
IMAGE OF THE INPUT FORMAT CARD: (4F18.6)
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A 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	96.3	107.3	107.8	109.2	104.6	103.5	102.6	34.0	101.7	113.1	112.7	98.1	1190.9
1986	102.4	110.1	110.4	105.7	104.2	110.8	111.4	33.5	104.5	108.8	113.5	97.2	1212.5
1987	98.3	109.6	107.7	112.3	115.9	110.5	115.7	37.0	110.4	118.4	120.2	103.1	1259.1
1988	112.6	115.9	113.8	118.9	117.8	118.1	120.8	37.2	111.7	123.8	127.9	111.0	1329.5
1989	120.2	129.1	123.9	124.6	125.8	124.8	121.6	42.6	119.9	128.4	132.1	119.6	1412.6
1990	119.9	127.2	127.5	127.6	********	********	********	********	********	********	********	********	502.2
AVGE	108.3	116.5	115.2	116.4	113.7	113.5	114.4	36.9	109.6	118.5	121.3	105.8	

TABLE TOTAL- 6906.8 MEAN- 107.9 STD. DEVIATION- 22.4

A 7 . TRADING-DAY REGRESSION FROM FIRST PASS.

	COMBINED WEIGHT	PRIOR WEIGHT	REGRESSION COEFF.	ST.ERROR (COMB.WT.)	T (1)	T (PRIOR WT.)
MONDAY	0.751	1.000	-0.249	0.159	-1.563	-1.563
TUESDAY	0.916	1.000	-0.084	0.157	-0.536	-0.536
WEDNESDAY	1.179	1.000	0.179	0.157	1.141	1.141
THURSDAY	0.641	1.000	-0.359	0.157	-2.283*	-2.283*
FRIDAY	1.126	1.000	0.126	0.157	0.804	0.804
SATURDAY	0.922	1.000	-0.078	0.157	-0.499	-0.499
SUNDAY	1.465	1.000	0.465	0.151	3.068**	3.068**

THE STARS INDICATE THE COMBINED WT. IS SIGNIFICANTLY DIFFERENT FROM 1 OR THE PRIOR WT. THE SIGNIFICANCE LEVELS ARE 3 STARS (0.1 PERCENT), 2 STARS (1 PERCENT), 1 STAR (5 PERCENT), AND NO STARS INDICATES NOT SIGNIFICANT AT THE 5 PERCENT LEVEL

SOURCE OF VARIANCE	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F
REGRESSION	3.546	6	0.591	3.475**
ERROR	8.333	49	0.170	
TOTAL	11.879	55		

** RESIDUAL TRADING DAY VARIATION PRESENT AT THE 1 PER CENT LEVEL

STANDARD ERRORS OF TRADING DAY ADJUSTMENT FACTORS DERIVED FROM REGRESSION COEFFICIENTS

31-DAY MONTHS-	0.47
30-DAY MONTHS-	0.47
29-DAY MONTHS-	0.55
28-DAY MONTHS-	.00

A 8 . REGRESSION TRADING DAY ADJUSTMENT

A 8A. FINAL DAILY WEIGHTS

MON	TUE	WED	THU	FRI	SAT	SUN
0.751	0.916	1.179	0.641	1.126	0.922	1.465

A 8B. FINAL TRADING-DAY FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	99.15	99.12	101.65	98.89	99.83	101.29	99.50	99.00	100.72	99.15	100.16	100.43	99.91
1986	99.83	99.12	100.44	100.32	99.00	100.72	99.15	101.65	98.89	99.83	101.29	99.50	99.98
1987	99.00	99.12	100.43	99.40	101.65	98.89	99.83	100.44	100.32	99.00	100.72	99.15	99.83
1988	101.65	101.77	99.15	100.16	100.43	99.40	101.65	99.50	99.23	100.44	100.32	99.00	100.22
1989	100.43	99.12	99.83	101.29	99.50	99.23	100.44	99.15	100.16	100.43	99.40	101.65	100.05
1990	99.50	99.12	99.00	100.72	********	********	********	********	********	********	********	********	99.58
AVGE	99.93	99.56	100.08	100.13	100.08	99.90	100.12	99.95	99.86	99.77	100.38	99.95	

TABLE TOTAL- 6398.19 MEAN- 99.97 STD. DEVIATION- 0.89

A 8C. FINAL TRADING-DAY FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1990	**********	********	********	********	99.15	100.16	100.43	99.83	101.29	99.50	99.23	100.44	100.00
1991	99.15	99.12	101.65	98.89	********	********	********	********	********	********	********	********	99.70

A 9 . FINAL TRADING-DAY ADJUSTED SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.1	108.3	106.0	110.4	104.8	102.2	103.1	34.3	101.0	114.1	112.5	97.7	1191.5
1986	102.6	111.1	109.9	105.4	105.3	110.0	112.4	33.0	105.7	109.0	112.1	97.7	1213.9
1987	99.3	110.6	107.2	113.0	114.0	111.7	115.9	36.8	110.1	119.6	119.3	104.0	1261.6
1988	110.8	113.9	114.8	118.7	117.3	118.8	118.8	37.4	112.6	123.3	127.5	112.1	1325.9
1989	119.7	130.3	124.1	123.0	126.4	125.8	121.1	43.0	119.7	127.9	132.9	117.7	1411.4
1990	120.5	128.3	128.8	126.7	********	********	********	********	********	********	********	********	504.3
AVGE	108.3	117.1	115.1	116.2	113.6	113.7	114.3	36.9	109.8	118.8	120.9	105.8	

TABLE TOTAL- 6908.7 MEAN- 107.9 STD. DEVIATION- 22.4

AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) EXTRAPOLATION PROGRAM

A15. ARIMA EXTRAPOLATION MODEL (FORECAST)

THIS PROGRAM HAS DEVELOPED FOLLOWING THE PROCEDURES OUTLINED IN 'TIME SERIES ANALYSIS' BY G. E. P. BOX AND G. M. JENKINS.

MODEL	TRAN.	ADDITIVE CONSTANT	AVERAGE PERCENTAGE STANDARD ERROR IN FORECASTS: LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS	
(0,1,1)(0,1,1)	LOG	0.000E+00	2.52	2.75	1.91	2.89	99.65%	0.9870	0.770	0.675

THE MODEL CHOSEN IS (0,1,1)(0,1,1)0 WITH TRANSFORMATION - LOG

THE CHOSEN MODEL IS FITTED TO THE DATA INCLUDING PARTIAL YEAR.

MODEL	TRAN.	ADDITIVE CONSTANT	LAST 3 YEARS	LAST YEAR	LAST-1 YEAR	LAST-2 YEAR	CHI-SQ. PROB.	R-SQUARED VALUE	ESTIMATED PARAMETERS	
(0,1,1)(0,1,1)	LOG	0.000E+00	2.98	2.49	2.39	4.05	99.77%	0.9869	0.753	0.656

HERE ARE THE AUTOCORRELATIONS OF THE MODEL(S)

MODEL 1	0.041	0.004	0.025	-0.084	-0.065	0.105	-0.015	-0.091	-0.111	-0.003	0.045	-0.016
	0.022	-0.004	-0.176	0.006	-0.014	0.104	0.120	-0.031	-0.040	-0.005	-0.017	0.039

THE MAXIMUM NUMBER OF ITERATIONS IS 30

B 1. ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.1	108.3	106.0	110.4	104.8	102.2	103.1	34.3	101.0	114.1	112.5	97.7	1191.5
1986	102.6	111.1	109.9	105.4	105.3	110.0	112.4	33.0	105.7	109.0	112.1	97.7	1213.9
1987	99.3	110.6	107.2	113.0	114.0	111.7	115.9	36.8	110.1	119.6	119.3	104.0	1261.6
1988	110.8	113.9	114.8	118.7	117.3	118.8	118.8	37.4	112.6	123.3	127.5	112.1	1325.9
1989	119.7	130.3	124.1	123.0	126.4	125.8	121.1	43.0	119.7	127.9	132.9	117.7	1411.4
1990	120.5	128.3	128.8	126.7	********	********	********	********	********	********	********	********	504.3
AVGE	108.3	117.1	115.1	116.2	113.6	113.7	114.3	36.9	109.8	118.8	120.9	105.8	

TABLE TOTAL- 6908.7 MEAN- 107.9 STD. DEVIATION- 22.4

ORIGINAL SERIES EXTRAPOLATED 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1990	**********	********	********	********	129.2	129.0	128.4	42.3	124.2	134.7	137.5	120.6	946.0
1991	125.9	135.6	133.6	134.2	********	********	********	********	********	********	********	********	529.3

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	23933.9221	11	2175.81110	399.512**
RESIDUAL	217.8470	40	5.44617	
TOTAL	24151.7691	51		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

B 2. TREND CYCLE- CENTERED 12-TERM MOVING AVERAGE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	**********	********	********	********	********	********	99.5	99.9	100.1	100.1	99.9	100.2	599.8
1986	101.0	101.3	101.4	101.4	101.2	101.2	101.0	100.9	100.7	100.9	101.6	102.1	1214.7
1987	102.3	102.6	102.9	103.6	104.3	104.9	105.6	106.2	106.7	107.2	107.6	108.0	1261.9
1988	108.5	108.6	108.7	109.0	109.5	110.2	110.9	111.9	113.0	113.6	114.1	114.8	1332.6
1989	115.2	115.5	116.0	116.5	116.9	117.4	117.7	117.6	117.7	118.1	118.3	118.6	1405.5
1990	119.0	119.3	119.5	119.9	********	********	********	********	********	********	********	********	477.8
AVGE	109.2	109.5	109.7	110.1	108.0	108.4	106.9	107.3	107.7	108.0	108.3	108.7	

TABLE TOTAL- 6292.2 MEAN- 108.5 STD. DEVIATION- 6.9

B 3. UNMODIFIED SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	**********	********	********	********	********	********	103.6	34.4	100.8	114.0	112.6	97.4	93.8
1986	101.6	109.7	108.4	103.9	104.0	108.7	111.2	32.7	104.9	108.0	110.3	95.7	99.9
1987	97.1	107.8	104.2	109.1	109.3	106.6	109.7	34.7	103.2	111.5	110.9	96.3	100.0
1988	102.1	104.9	105.6	108.9	107.1	107.9	107.2	33.4	99.6	108.5	111.7	97.7	99.6
1989	103.9	112.8	107.0	105.6	108.1	107.1	102.9	36.5	101.7	108.3	112.3	99.2	100.5
1990	101.2	107.6	107.8	105.6	********	********	********	********	********	********	********	********	105.6
AVGE	101.2	108.5	106.6	106.6	107.2	107.6	106.9	34.3	102.0	110.1	111.6	97.3	

TABLE TOTAL- 5784.6 MEAN- 99.7 STD. DEVIATION- 20.6

B 7. TREND CYCLE - HENDERSON CURVE
13-TERM MOVING AVERAGE SELECTED. I/C RATIO IS 4.41

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	99.5	99.5	99.4	99.0	98.2	97.6	97.5	98.2	99.4	100.8	101.9	102.4	1193.4
1986	102.2	101.8	101.3	100.8	100.5	100.3	100.3	100.4	100.5	100.4	100.2	100.3	1209.0
1987	100.8	101.5	102.4	103.6	104.8	105.8	106.6	107.3	107.8	108.0	107.9	107.7	1264.2
1988	107.6	107.8	108.3	108.9	109.4	109.7	110.1	110.5	111.3	112.6	114.2	115.7	1325.9
1989	116.8	117.2	117.1	116.9	117.0	117.3	117.9	118.5	118.9	118.9	118.8	118.6	1413.9
1990	118.6	118.8	119.2	119.6	********	********	********	********	********	********	********	********	476.2
AVGE	107.6	107.8	107.9	108.1	106.0	106.1	106.5	107.0	107.6	108.1	108.6	108.9	

TABLE TOTAL- 6882.6 MEAN- 107.5 STD. DEVIATION- 7.4

SERIES CAPV   CAPV   DATE: JULY 17, 1990 PAGE 10

B10. SEASONAL FACTORS
3X5 MOVING AVERAGE SELECTED.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	99.5	109.0	106.6	108.3	106.9	107.0	107.8	34.4	101.9	110.7	111.1	96.6	100.0
1986	99.9	108.9	106.5	108.1	107.0	107.1	107.7	34.3	101.7	110.4	111.2	96.7	100.0
1987	100.5	108.8	106.5	107.8	107.2	107.3	107.6	34.3	101.6	109.9	111.3	97.1	100.0
1988	101.0	108.8	106.5	107.4	107.5	107.2	107.4	34.3	101.4	109.5	111.4	97.4	100.0
1989	101.6	108.7	106.6	107.1	107.7	107.2	107.2	34.3	101.3	109.2	111.5	97.6	100.0
1990	101.9	108.7	106.6	106.8	********	********	********	********	********	********	********	********	106.0
AVGE	100.7	108.8	106.6	107.6	107.3	107.2	107.5	34.3	101.6	109.9	111.3	97.1	

TABLE TOTAL- 6423.2   MEAN- 100.4   STD. DEVIATION- 19.6

SERIES CAPV CAPV DATE: JULY 17, 1990 PAGE 11

B13. IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	98.0	99.9	100.0	103.1	99.8	97.9	98.1	101.8	99.7	102.2	99.3	98.8	1.6
1986	100.5	100.2	101.8	96.6	97.8	102.4	104.0	95.6	103.4	98.3	100.6	100.7	2.5
1987	98.0	100.1	98.3	101.1	101.6	98.4	101.0	100.0	100.5	100.8	99.3	99.4	1.1
1988	101.9	97.1	99.6	101.5	99.8	101.0	100.5	98.6	99.8	100.0	100.2	99.5	1.2
1989	100.9	102.3	99.5	98.2	100.4	100.0	95.8	105.6	99.4	98.5	100.3	101.6	2.3
1990	99.7	99.4	101.3	99.2	********	********	********	********	********	********	********	********	0.8
S.D.	1.4	1.5	1.2	2.2	1.2	1.7	2.8	3.3	1.4	1.5	0.5	1.0	

TABLE TOTAL- 6400.8 MEAN- 100.0 STD. DEVIATION- 1.8

B17. PRELIM WEIGHTS FOR IRREGULAR COMPONENT
GRADUATION RANGE FROM 1.5 TO 2.5 SIGMA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	100.0	100.0	100.0	63.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.6
1986	100.0	100.0	100.0	45.5	100.0	100.0	6.6	0.0	45.6	100.0	100.0	100.0	1.6
1987	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.6
1988	100.0	57.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.5
1989	100.0	92.7	100.0	100.0	100.0	100.0	0.0	0.0	100.0	100.0	100.0	100.0	1.5
1990	100.0	100.0	100.0	100.0	********	********	********	********	********	********	********	********	1.5

B20. EXTREME VALUES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	100.0	100.0	100.0	101.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.3
1986	100.0	100.0	100.0	98.1	100.0	100.0	103.7	95.6	101.8	100.0	100.0	100.0	1.8
1987	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
1988	100.0	98.7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.3
1989	100.0	100.2	100.0	100.0	100.0	100.0	95.8	105.6	100.0	100.0	100.0	100.0	2.0
1990	100.0	100.0	100.0	100.0	********	********	********	********	********	********	********	********	0.0
S.D.	0.0	0.5	0.0	0.9	0.0	0.0	2.5	3.2	0.7	0.0	0.0	0.0	

TABLE TOTAL- 6400.6 MEAN- 100.0 STD. DEVIATION- 1.2

C 1. ADJUSTED* ORIGINAL SERIES MODIFIED BY PRELIM WEIGHTS
*ADJUSTED BY...TRADING DAY ADJUSTMENT FACTORS DERIVED FROM REGRESSION COEFFICIENTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.1	108.3	106.0	109.2	104.8	102.2	103.1	34.3	101.0	114.1	112.5	97.7	1190.3
1986	102.6	111.1	109.9	107.4	105.3	110.0	108.3	34.5	103.8	109.0	112.1	97.7	1211.5
1987	99.3	110.6	107.2	113.0	114.0	111.7	115.9	36.8	110.1	119.6	119.3	104.0	1261.6
1988	110.8	115.3	114.8	118.7	117.3	118.8	118.8	37.4	112.6	123.3	127.5	112.1	1327.4
1989	119.7	130.0	124.1	123.0	126.4	125.8	126.4	40.7	119.7	127.9	132.9	117.7	1414.3
1990	120.5	128.3	128.8	126.7	********	********	********	********	********	********	********	********	504.3
AVGE	108.3	117.3	115.1	116.3	113.6	113.7	114.5	36.7	109.4	118.8	120.9	105.8	

TABLE TOTAL- 6909.4 MEAN- 108.0 STD. DEVIATION- 22.5

C 2. TREND CYCLE- CENTERED 12-TERM MOVING AVERAGE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	**********	********	********	********	********	********	99.4	99.8	100.0	100.1	100.1	100.4	599.9
1986	101.0	101.2	101.3	101.2	101.0	101.0	100.8	100.7	100.5	100.7	101.3	101.7	1212.2
1987	102.1	102.5	102.9	103.6	104.3	104.9	105.6	106.3	106.8	107.3	107.7	108.2	1262.1
1988	108.6	108.7	108.8	109.1	109.6	110.3	111.0	112.0	113.0	113.5	114.1	114.8	1333.4
1989	115.4	115.8	116.3	116.8	117.2	117.6	117.9	117.9	118.0	118.3	118.6	118.8	1408.5
1990	119.1	119.2	119.5	119.9	********	********	********	********	********	********	********	********	477.7
AVGE	109.2	109.5	109.7	110.1	108.0	108.4	106.9	107.3	107.7	108.0	108.3	108.8	

TABLE TOTAL- 6293.8 MEAN- 108.5 STD. DEVIATION- 7.0

C 7. TREND CYCLE - HENDERSON CURVE
13-TERM MOVING AVERAGE SELECTED. I/C RATIO IS 2.99

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	99.4	99.3	99.1	98.7	98.2	97.8	97.8	98.4	99.4	100.6	101.6	102.1	1192.5
1986	102.2	102.0	101.5	101.1	100.8	100.6	100.5	100.5	100.5	100.3	100.0	100.1	1210.0
1987	100.6	101.4	102.5	103.6	104.8	106.0	106.8	107.4	107.9	108.0	108.0	107.9	1264.8
1988	107.9	108.1	108.6	109.1	109.5	109.8	110.2	110.6	111.5	112.8	114.3	115.7	1327.9
1989	116.7	117.1	117.2	117.2	117.2	117.4	117.7	118.1	118.4	118.5	118.6	118.6	1412.6
1990	118.7	118.9	119.2	119.5	********	********	********	********	********	********	********	********	476.3
AVGE	107.6	107.8	108.0	108.2	106.1	106.3	106.6	107.0	107.5	108.0	108.5	108.9	

TABLE TOTAL- 6884.2 MEAN- 107.6 STD. DEVIATION- 7.4

C10. SEASONAL FACTORS
3X5 MOVING AVERAGE SELECTED.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	99.6	108.7	106.6	108.7	106.8	106.8	107.4	34.4	102.2	110.8	111.3	96.7	100.0
1986	99.9	108.8	106.5	108.5	106.9	106.9	107.4	34.4	102.0	110.5	111.3	96.8	100.0
1987	100.5	108.7	106.4	107.9	107.1	107.1	107.4	34.3	101.8	109.9	111.4	97.1	100.0
1988	101.0	108.8	106.4	107.4	107.4	107.1	107.4	34.3	101.6	109.5	111.5	97.4	100.0
1989	101.6	108.7	106.5	107.0	107.6	107.2	107.3	34.3	101.4	109.2	111.5	97.6	100.0
1990	101.8	108.8	106.6	106.7	********	********	********	********	********	********	********	********	106.0
AVGE	100.7	108.8	106.5	107.7	107.2	107.0	107.4	34.3	101.8	110.0	111.4	97.1	

TABLE TOTAL- 6423.1 MEAN- 100.4 STD. DEVIATION- 19.6

C13. IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	98.1	100.3	100.4	102.9	99.9	97.9	98.2	101.4	99.4	102.4	99.6	99.0	1.6
1986	100.5	100.2	101.7	96.0	97.7	102.3	104.1	95.4	103.1	98.4	100.7	100.8	2.6
1987	98.2	100.3	98.3	101.0	101.6	98.4	101.0	99.9	100.2	100.7	99.2	99.3	1.1
1988	101.7	96.8	99.4	101.3	99.8	101.0	100.4	98.5	99.4	99.8	100.1	99.5	1.3
1989	101.0	102.3	99.5	98.1	100.2	100.0	95.8	106.1	99.7	98.8	100.5	101.6	2.4
1990	99.7	99.2	101.4	99.3	********	********	********	********	********	********	********	********	0.9
S.D.	1.3	1.6	1.2	2.2	1.3	1.6	2.8	3.5	1.4	1.4	0.6	1.0	

TABLE TOTAL- 6399.3 MEAN- 100.0 STD. DEVIATION- 1.8

C17. FINAL WEIGHTS FOR IRREGULAR COMPONENT
GRADUATION RANGE FROM 1.5 TO 2.5 SIGMA

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	100.0	100.0	100.0	84.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.7
1986	100.0	100.0	100.0	21.3	100.0	100.0	14.2	0.0	69.0	100.0	100.0	100.0	1.7
1987	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.7
1988	100.0	51.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	1.6
1989	100.0	100.0	100.0	100.0	100.0	100.0	0.0	0.0	100.0	100.0	100.0	100.0	1.6
1990	100.0	100.0	100.0	100.0	********	********	********	********	********	********	********	********	1.6

C20. EXTREME VALUES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	100.0	100.0	100.0	100.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.1
1986	100.0	100.0	100.0	96.9	100.0	100.0	103.5	95.4	100.9	100.0	100.0	100.0	1.9
1987	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0
1988	100.0	98.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.4
1989	100.0	100.0	100.0	100.0	100.0	100.0	95.8	106.1	100.0	100.0	100.0	100.0	2.1
1990	100.0	100.0	100.0	100.0	********	********	********	********	********	********	********	********	0.0
S.D.	0.0	0.6	0.0	1.2	0.0	0.0	2.4	3.4	0.4	0.0	0.0	0.0	

TABLE TOTAL- 6397.4 MEAN- 100.0 STD. DEVIATION- 1.3

D 1. ADJUSTED* ORIGINAL SERIES MODIFIED BY FINAL WEIGHTS
*ADJUSTED BY...TRADING DAY ADJUSTMENT FACTORS DERIVED FROM REGRESSION COEFFICIENTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.1	108.3	106.0	109.9	104.8	102.2	103.1	34.3	101.0	114.1	112.5	97.7	1191.0
1986	102.6	111.1	109.9	108.8	105.3	110.0	108.6	34.5	104.7	109.0	112.1	97.7	1214.2
1987	99.3	110.6	107.2	113.0	114.0	111.7	115.9	36.8	110.1	119.6	119.3	104.0	1261.6
1988	110.8	115.7	114.8	118.7	117.3	118.8	118.8	37.4	112.6	123.3	127.5	112.1	1327.8
1989	119.7	130.3	124.1	123.0	126.4	125.8	126.3	40.5	119.7	127.9	132.9	117.7	1414.2
1990	120.5	128.3	128.8	126.7	********	********	********	********	********	********	********	********	504.3
AVGE	108.3	117.4	115.1	116.7	113.6	113.7	114.5	36.7	109.6	118.8	120.9	105.8	

TABLE TOTAL- 6913.0 MEAN- 108.0 STD. DEVIATION- 22.5

D 2. TREND CYCLE- CENTERED 12-TERM MOVING AVERAGE

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	**********	********	********	********	********	********	99.5	99.8	100.1	100.2	100.2	100.5	600.3
1986	101.1	101.3	101.5	101.4	101.2	101.2	101.0	100.9	100.8	100.8	101.4	101.8	1214.4
1987	102.2	102.6	102.9	103.6	104.3	104.9	105.6	106.3	106.8	107.4	107.8	108.2	1262.4
1988	108.6	108.8	108.9	109.1	109.6	110.3	111.0	112.0	113.0	113.6	114.1	114.8	1333.8
1989	115.4	115.8	116.3	116.7	117.2	117.6	117.9	117.8	118.0	118.3	118.6	118.8	1408.4
1990	119.0	119.2	119.5	119.9	********	********	********	********	********	********	********	********	477.7
AVGE	109.3	109.5	109.8	110.2	108.1	108.5	107.0	107.4	107.7	108.1	108.4	108.8	

TABLE TOTAL- 6296.9 MEAN- 108.6 STD. DEVIATION- 7.0

D 7. TREND CYCLE - HENDERSON CURVE
13-TERM MOVING AVERAGE SELECTED. I/C RATIO IS 3.03

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	99.5	99.4	99.3	98.8	98.3	97.8	97.8	98.4	99.4	100.6	101.6	102.2	1193.1
1986	102.3	102.1	101.8	101.4	101.1	100.9	100.8	100.8	100.7	100.5	100.2	100.2	1212.7
1987	100.6	101.4	102.4	103.6	104.8	106.0	106.8	107.5	107.9	108.0	108.0	107.9	1264.9
1988	107.9	108.2	108.6	109.1	109.5	109.8	110.2	110.7	111.5	112.8	114.3	115.7	1328.3
1989	116.7	117.1	117.2	117.2	117.2	117.3	117.6	118.0	118.4	118.5	118.5	118.6	1412.3
1990	118.7	118.9	119.1	119.5	********	********	********	********	********	********	********	********	476.2
AVGE	107.6	107.9	108.1	108.3	106.2	106.4	106.7	107.1	107.6	108.1	108.5	108.9	

TABLE TOTAL- 6887.6 MEAN- 107.6 STD. DEVIATION- 7.3

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D 8. FINAL UNMODIFIED SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	97.6	108.9	106.8	111.7	106.6	104.5	105.4	34.9	101.6	113.4	110.8	95.6	99.8
1986	100.3	108.8	108.0	103.9	104.1	109.1	111.4	32.7	104.9	108.5	111.9	97.5	100.1
1987	98.7	109.1	104.7	109.1	108.8	105.5	108.5	34.3	102.0	110.7	110.5	96.3	99.8
1988	102.6	105.2	105.7	108.8	107.2	108.2	107.9	33.8	101.0	109.3	111.5	96.9	99.8
1989	102.6	111.2	105.9	105.0	107.9	107.2	103.0	36.4	101.1	107.9	112.1	99.2	100.0
1990	101.5	108.0	108.1	106.0	********	********	********	********	********	********	********	********	105.9
AVGE	100.5	108.5	106.5	107.4	106.9	106.9	107.2	34.4	102.1	110.0	111.3	97.1	

TABLE TOTAL- 6418.0 MEAN- 100.3 STD. DEVIATION- · 19.6

TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN MONTHS	24470.8022	11	2224.61838	557.099**
RESIDUAL	207.6472	52	3.99322	
TOTAL	24678.4494	63		

**SEASONALITY PRESENT AT THE 0.1 PER CENT LEVEL

NONPARAMETRIC TEST FOR THE PRESENCE OF SEASONALITY ASSUMING STABILITY

KRUSKAL-WALLIS STATISTIC	DEGREES OF FREEDOM	PROBABILITY LEVEL
50.6531	11	0.000%

SEASONALITY PRESENT AT THE ONE PERCENT LEVEL

MOVING SEASONALITY TEST

	SUM OF SQUARES	DGRS.OF FREEDOM	MEAN SQUARE	F-VALUE
BETWEEN YEARS	9.7100	4	2.427508	0.610
ERROR	175.0968	44	3.979474	

NO EVIDENCE OF MOVING SEASONALITY AT THE FIVE PERCENT LEVEL

COMBINED TEST FOR THE PRESENCE OF IDENTIFIABLE SEASONALITY

IDENTIFIABLE SEASONALITY PRESENT

D 9. FINAL REPLACEMENT VALUES FOR EXTREME SI RATIOS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1985	**********	********	********	111.2	********	********	********	********	********	********	********	********
1986	**********	********	********	107.3	********	********	107.7	34.3	103.9	********	********	********
1987	**********	********	********	********	********	********	********	********	********	********	********	********
1988	**********	106.9	********	********	********	********	********	********	********	********	********	********
1989	**********	********	********	********	********	********	107.4	34.3	********	********	********	********
1990	**********	********	********	********	********	********	********	********	********	********	********	********

D 9A. YEAR TO YEAR CHANGE IN IRREGULAR AND SEASONAL COMPONENTS AND MOVING SEASONALITY RATIO

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
I	1.937	1.958	1.603	1.890	2.277	2.880	1.060	1.312	1.344	2.098	0.884	1.371
S	0.603	0.127	0.140	0.528	0.287	0.244	0.217	0.267	0.207	0.517	0.119	0.376
RATIO	3.21	15.44	11.46	3.58	7.95	11.81	4.89	4.91	6.48	4.06	7.41	3.64

D10. FINAL SEASONAL FACTORS
3X5 MOVING AVERGE SELECTED AND I/S RATIO IS 5.64

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	99.48	108.69	106.47	109.21	106.69	106.68	107.36	34.39	102.32	110.70	111.18	96.60	99.98
1986	99.84	108.76	106.39	108.93	106.82	106.80	107.37	34.35	102.14	110.42	111.25	96.77	99.99
1987	100.44	108.75	106.37	108.27	106.99	107.06	107.41	34.29	101.95	109.87	111.36	97.08	99.99
1988	100.97	108.87	106.34	107.61	107.36	107.08	107.38	34.27	101.67	109.47	111.42	97.38	99.98
1989	101.54	108.79	106.47	107.07	107.59	107.17	107.30	34.25	101.42	109.15	111.48	97.59	99.99
1990	101.83	108.92	106.60	106.74	********	********	********	********	********	********	********	********	106.02
AVGE	100.68	108.80	106.44	107.97	107.09	106.96	107.37	34.31	101.90	109.92	111.34	97.09	

TABLE TOTAL- 6423.18 MEAN- 100.36 STD. DEVIATION- 19.62

D10A. SEASONAL FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1990	**********	********	********	********	107.75	107.11	107.20	34.25	101.20	109.10	111.50	97.67	96.97
1991	102.01	109.00	106.77	106.40	********	********	********	********	********	********	********	********	106.05

D11. SERIES FINALLY ADJUSTED FOR SEASONALITY AND WHEN APPLICABLE FOR TRADING-DAY AND EASTER EFFECTS.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.6	99.6	99.6	101.1	98.2	95.8	96.0	99.9	98.7	103.0	101.2	101.1	1191.9
1986	102.7	102.1	103.3	96.7	98.5	103.0	104.6	96.0	103.5	98.7	100.7	100.9	1210.9
1987	98.9	101.7	100.8	104.3	106.6	104.4	107.9	107.4	107.9	108.9	107.2	107.1	1263.1
1988	109.7	104.6	107.9	110.3	109.3	111.0	110.7	109.1	110.7	112.6	114.4	115.1	1325.4
1989	117.9	119.7	116.6	114.9	117.5	117.4	112.8	125.5	118.0	117.1	119.2	120.6	1417.1
1990	118.3	117.8	120.8	118.7	********	********	********	********	********	********	********	********	475.7
AVGE	107.5	107.6	108.2	107.7	106.0	106.3	106.4	107.6	107.8	108.1	108.5	109.0	

TABLE TOTAL- 6884.1 MEAN- 107.6 STD. DEVIATION- 7.7

TEST FOR THE PRESENCE OF RESIDUAL SEASONALITY

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE ENTIRE SERIES AT THE 1 PER CENT LEVEL. F = 0.09

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 1 PER CENT LEVEL. F = 0.44

NO EVIDENCE OF RESIDUAL SEASONALITY IN THE LAST 3 YEARS AT THE 5 PER CENT LEVEL.

NOTE: SUDDEN LARGE CHANGES IN THE LEVEL OF THE SEASONALLY ADJUSTED SERIES WILL INVALIDATE THE RESULTS OF THIS TEST FOR THE LAST THREE YEAR PERIOD.

D12. FINAL TREND CYCLE - HENDERSON CURVE
13-TERM MOVING AVERAGE SELECTED. I/C RATIO IS 3.31

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	99.4	99.2	99.1	98.7	98.1	97.8	97.9	98.5	99.6	100.7	101.7	102.2	1192.9
1986	102.2	101.9	101.6	101.2	101.1	101.0	101.0	101.0	100.9	100.5	100.1	100.1	1212.5
1987	100.4	101.1	102.3	103.6	104.9	106.1	107.0	107.6	107.9	108.0	107.9	107.8	1264.7
1988	107.8	108.1	108.6	109.1	109.6	109.9	110.2	110.6	111.3	112.6	114.3	115.8	1327.8
1989	116.8	117.3	117.3	117.2	117.1	117.1	117.4	117.8	118.2	118.5	118.7	118.9	1412.4
1990	119.1	119.2	119.2	119.4	********	********	********	********	********	********	********	********	476.9
AVGE	107.6	107.8	108.0	108.2	106.2	106.4	106.7	107.1	107.6	108.1	108.5	108.9	

TABLE TOTAL- 6887.1 MEAN- 107.6 STD. DEVIATION- 7.3

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D13. FINAL IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	98.2	100.4	100.5	102.5	100.1	98.0	98.1	101.4	99.1	102.3	99.5	99.0	1.5
1986	100.5	100.2	101.7	95.5	97.5	102.0	103.6	95.0	102.6	98.2	100.6	100.9	2.6
1987	98.5	100.5	98.6	100.7	101.6	98.3	100.8	99.9	100.0	100.8	99.3	99.3	1.0
1988	101.8	96.8	99.4	101.1	99.7	101.0	100.4	98.7	99.5	100.0	100.1	99.5	1.2
1989	100.9	102.1	99.4	98.0	100.3	100.2	96.1	106.5	99.8	98.9	100.4	101.4	2.4
1990	99.4	98.9	101.3	99.4	********	********	********	********	********	********	********	********	0.9
S.D.	1.3	1.6	1.1	2.3	1.3	1.5	2.6	3.7	1.2	1.5	0.5	1.0	

TABLE TOTAL- 6396.7 MEAN- 99.9 STD. DEVIATION- 1.8

D16. COMBINED SEASONAL, TRADING DAY (IF PRESENT), AND EASTER (IF PRESENT) FACTORS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	98.64	107.73	108.23	108.00	106.50	108.05	106.83	34.05	103.06	109.76	111.36	97.01	99.93
1986	99.67	107.80	106.86	109.28	105.75	107.57	106.45	34.91	101.01	110.23	112.68	96.29	99.88
1987	99.44	107.79	106.82	107.62	108.75	105.88	107.22	34.44	102.27	108.77	112.16	96.25	99.78
1988	102.64	110.80	105.43	107.78	107.82	106.44	109.16	34.10	100.89	109.95	111.77	96.40	100.26
1989	101.97	107.83	106.29	108.45	107.05	106.34	107.78	33.96	101.59	109.61	110.81	99.20	100.07
1990	101.32	107.95	105.53	107.51	********	********	********	********	********	********	********	********	105.58
AVGE	100.61	108.32	106.53	108.11	107.17	106.86	107.49	34.29	101.76	109.66	111.76	97.03	

TABLE TOTAL- 6421.50 MEAN- 100.34 STD. DEVIATION- 19.64

D16A. COMBINED SEASONAL, TRADING DAY (IF PRESENT), AND EASTER (IF PRESENT) FACTORS, 12 MONTHS AHEAD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1990	**********	********	********	********	106.83	107.28	107.66	34.19	102.50	108.56	110.64	98.10	96.97
1991	101.14	108.04	108.53	105.22	********	********	********	********	********	********	********	********	105.73

E 1. ORIGINAL SERIES MODIFIED FOR EXTREMES WITH ZERO FINAL WEIGHTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	96.3	107.3	107.8	109.2	104.6	103.5	102.6	34.0	101.7	113.1	112.7	98.1	1190.9
1986	102.4	110.1	110.4	105.7	104.2	110.8	111.4	35.3	104.5	108.8	113.5	97.2	1214.3
1987	98.3	109.6	107.7	112.3	115.9	110.5	115.7	37.0	110.4	118.4	120.2	103.1	1259.1
1988	112.6	115.9	113.8	118.9	117.8	118.1	120.8	37.2	111.7	123.8	127.9	111.0	1329.5
1989	120.2	129.1	123.9	124.6	125.8	124.8	126.5	40.0	119.9	128.4	132.1	119.6	1414.9
1990	119.9	127.2	127.5	127.6	********	********	********	********	********	********	********	********	502.2
AVGE	108.3	116.5	115.2	116.4	113.7	113.5	115.4	36.7	109.6	118.5	121.3	105.8	

TABLE TOTAL- 6910.9 MEAN- 108.0 STD. DEVIATION- 22.5

E 2. FINAL SEASONALLY ADJUSTED SERIES MODIFIED FOR EXTREMES WITH ZERO WEIGHTS

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	97.6	99.6	99.6	101.1	98.2	95.8	96.0	99.9	98.7	103.0	101.2	101.1	1191.9
1986	102.7	102.1	103.3	96.7	98.5	103.0	104.6	101.0	103.5	98.7	100.7	100.9	1215.9
1987	98.9	101.7	100.8	104.3	106.6	104.4	107.9	107.4	107.9	108.9	107.2	107.1	1263.1
1988	109.7	104.6	107.9	110.3	109.3	111.0	110.7	109.1	110.7	112.6	114.4	115.1	1325.4
1989	117.9	119.7	116.6	114.9	117.5	117.4	117.4	117.8	118.0	117.1	119.2	120.6	1414.1
1990	118.3	117.8	120.8	118.7	********	********	********	********	********	********	********	********	475.7
AVGE	107.5	107.6	108.2	107.7	106.0	106.3	107.3	107.0	107.8	108.1	108.5	109.0	

TABLE TOTAL- 6886.1 MEAN- 107.6 STD. DEVIATION- 7.5

E 3. MODIFIED IRREGULAR SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	S.D.
1985	98.2	100.4	100.5	102.5	100.1	98.0	98.1	101.4	99.1	102.3	99.5	99.0	1.5
1986	100.5	100.2	101.7	95.5	97.5	102.0	103.6	100.0	102.6	98.2	100.6	100.9	2.2
1987	98.5	100.5	98.6	100.7	101.6	98.3	100.8	99.9	100.0	100.8	99.3	99.3	1.0
1988	101.8	96.8	99.4	101.1	99.7	101.0	100.4	98.7	99.5	100.0	100.1	99.5	1.2
1989	100.9	102.1	99.4	98.0	100.3	100.2	100.0	100.0	99.8	98.9	100.4	101.4	1.0
1990	99.4	98.9	101.3	99.4	********	********	********	********	********	********	********	********	0.9
S.D.	1.3	1.6	1.1	2.3	1.3	1.5	1.8	0.8	1.2	1.5	0.5	1.0	

TABLE TOTAL- 6399.1 MEAN- 100.0 STD. DEVIATION- 1.4

E 4. RATIOS OF ANNUAL TOTALS, ORIGINAL AND ADJUSTED SERIES

YEAR	UNMODIFIED	MODIFIED
1985	99.92	99.92
1986	100.13	99.86
1987	99.69	99.69
1988	100.31	100.31
1989	99.68	100.06

E 5. MONTH-TO- MONTH CHANGES IN THE ORIGINAL SERIES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	**********	11.4	0.5	1.3	-4.2	-1.1	-0.9	-66.9	199.1	11.2	-0.4	-13.0	12.5
1986	4.4	7.5	0.3	-4.3	-1.4	6.3	0.5	-69.9	211.9	4.1	4.3	-14.4	12.5
1987	1.1	11.5	-1.7	4.3	3.2	-4.7	4.7	-68.0	198.4	7.2	1.5	-14.2	11.9
1988	9.2	2.9	-1.8	4.5	-0.9	0.3	2.3	-69.2	200.3	10.8	3.3	-13.2	12.4
1989	8.3	7.4	-4.0	0.6	1.0	-0.8	-2.6	-65.0	181.5	7.1	2.9	-9.5	10.6
1990	0.3	6.1	0.2	0.1	********	********	********	********	********	********	********	********	1.7
AVGE	4.7	7.8	-1.1	1.1	-0.5	0.0	0.8	-67.8	198.2	8.1	2.3	-12.8	

TABLE TOTAL- 711.9 MEAN- 11.3 STD. DEVIATION- 58.3

E 6. MONTH-TO- MONTH CHANGES IN THE FINAL SEASONALLY ADJUSTED SERIES (D11.)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
1985	**********	2.0	0.0	1.5	-2.9	-2.5	0.3	4.0	-1.2	4.4	-1.8	-0.1	0.3
1986	1.6	-0.6	1.2	-6.4	1.9	4.5	1.6	-8.3	7.8	-4.6	2.0	0.2	0.1
1987	-2.1	2.9	-0.8	3.5	2.1	-2.1	3.4	-0.4	0.5	0.8	-1.5	-0.1	0.5
1988	2.4	-4.7	3.2	2.2	-1.0	1.5	-0.3	-1.4	1.5	1.7	1.6	0.6	0.6
1989	2.4	1.6	-2.6	-1.4	2.3	-0.1	-3.9	11.2	-5.9	-0.8	1.8	1.1	0.5
1990	-1.8	-0.4	2.5	-1.8	********	********	********	********	********	********	********	********	-0.4
AVGE	0.5	0.1	0.6	-0.4	0.5	0.3	0.2	1.0	0.5	0.3	0.4	0.4	

TABLE TOTAL- 22.5 MEAN- 0.4 STD. DEVIATION- 3.1

F 1. MCD MOVING AVERAGE
MCD IS 5

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1985	**********	********	99.2	98.9	98.2	98.2	97.7	98.7	99.8	100.8	101.4	102.0	994.8
1986	102.1	101.2	100.7	100.7	101.2	99.8	101.1	101.2	100.7	100.0	100.5	100.2	1209.4
1987	100.6	101.3	102.5	103.6	104.8	106.1	106.8	107.3	107.9	107.7	108.2	107.5	1264.2
1988	107.3	107.9	108.4	108.6	109.8	110.1	110.1	110.8	111.5	112.4	114.2	116.0	1327.1
1989	116.7	116.8	117.3	117.2	115.8	117.6	118.2	118.2	118.5	120.1	118.7	118.6	1413.8
1990	119.4	119.2	********	********	********	********	********	********	********	********	********	********	238.6
AVGE	109.2	109.3	105.6	105.8	106.0	106.4	106.8	107.2	107.7	108.2	108.6	108.9	

TABLE TOTAL- 6447.9 MEAN- 107.5 STD. DEVIATION- 7.2

F 2. SUMMARY MEASURES

F 2.A: AVERAGE PER CENT CHANGE WITHOUT REGARD TO SIGN OVER THE INDICATED SPAN

SPAN IN MONTHS	B1 O	D11 CI	D13 I	D12 C	D10 S	A2 P	C18 TD	F1 MCD	E1 MOD.O	E2 MOD.CI	E3 MOD.I
1	25.01	2.30	2.22	0.42	24.34	0.00	1.25	0.64	25.06	1.82	1.73
2	28.78	2.61	2.22	0.85	27.90	0.00	1.09	1.04	28.86	2.19	1.80
3	28.50	2.51	1.83	1.25	27.54	0.00	0.87	1.37	28.48	2.21	1.53
4	25.36	2.88	2.15	1.63	24.10	0.00	1.12	1.72	25.36	2.61	1.85
5	27.57	3.22	1.95	1.99	26.57	0.00	1.02	2.04	27.64	2.79	1.49
6	29.71	3.44	1.92	2.33	28.90	0.00	0.76	2.35	29.91	2.96	1.49
7	29.65	3.70	2.20	2.67	28.46	0.00	1.22	2.75	29.73	3.32	1.85
8	28.22	3.80	2.03	3.02	26.84	0.00	0.96	3.13	28.13	3.35	1.52
9	26.55	3.99	2.07	3.39	24.11	0.00	0.70	3.45	26.18	3.68	1.67
10	28.11	4.14	1.72	3.74	25.50	0.00	1.27	3.80	27.90	3.90	1.42
11	26.96	4.45	1.77	4.07	24.38	0.00	0.95	4.17	26.90	4.28	1.46
12	4.99	5.10	2.42	4.40	0.21	0.00	1.03	4.56	4.87	4.88	2.03

F 2.B: RELATIVE CONTRIBUTIONS TO THE VARIANCE OF THE PER CENT CHANGE IN THE COMPONENTS OF THE ORIGINAL SERIES

SPAN IN MONTHS	D13 I	D12 C	D10 S	A2 P	C18 TD	TOTAL	RATIO (X100)
1	0.82	0.03	98.88	0.00	0.26	100.00	95.82
2	0.63	0.09	99.13	0.00	0.15	100.00	94.84
3	0.44	0.20	99.26	0.00	0.10	100.00	94.09
4	0.78	0.45	98.56	0.00	0.21	100.00	91.67
5	0.53	0.55	98.77	0.00	0.15	100.00	94.00
6	0.44	0.64	98.85	0.00	0.07	100.00	95.71
7	0.59	0.86	98.37	0.00	0.18	100.00	93.61
8	0.56	1.24	98.07	0.00	0.13	100.00	92.29
9	0.72	1.92	97.28	0.00	0.08	100.00	84.75
10	0.44	2.09	97.23	0.00	0.24	100.00	84.59
11	0.51	2.70	96.64	0.00	0.15	100.00	84.59
12	22.21	73.56	0.16	0.00	4.07	100.00	105.64

F 2.C: AVERAGE PER CENT CHANGE WITH REGARD TO SIGN AND STANDARD DEVIATION OVER INDICATED SPAN

SPAN IN	B1 O		D13 I		D12 C		D10 S		D11 CI		F1 MCD	
MONTHS	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.
1	11.30	58.28	0.06	3.02	0.29	0.50	10.90	57.93	0.36	3.09	0.31	0.71
2	13.12	65.14	0.08	2.85	0.60	0.98	12.37	64.64	0.68	3.10	0.65	1.09
3	13.92	67.47	0.04	2.56	0.92	1.41	12.75	66.12	0.96	3.09	1.00	1.40
4	11.95	56.57	-0.01	2.68	1.25	1.77	10.56	55.56	1.25	3.44	1.36	1.72
5	13.12	60.71	0.02	2.67	1.61	2.04	11.16	59.07	1.63	3.57	1.77	1.95
6	15.08	66.94	0.06	2.57	1.98	2.24	12.89	65.82	2.04	3.53	2.15	2.09
7	14.99	65.90	0.07	2.66	2.36	2.37	12.26	64.31	2.44	3.59	2.52	2.21
8	16.68	66.27	0.05	2.72	2.74	2.46	13.68	64.95	2.79	3.72	2.89	2.36
9	14.63	62.81	0.17	2.59	3.11	2.55	10.74	59.45	3.29	3.66	3.25	2.48
10	15.05	63.42	0.05	2.33	3.46	2.64	10.90	60.01	3.52	3.62	3.58	2.61
11	15.24	64.74	0.07	2.37	3.80	2.72	10.61	60.55	3.88	3.80	3.95	2.73
12	4.27	4.35	0.11	3.07	4.15	2.78	0.00	0.27	4.28	4.37	4.36	2.81

F 2.D: AVERAGE DURATION OF RUN

CI	I	C	MCD
1.57	1.50	6.30	2.57

F 2.E: I/C RATIO FOR MONTHS SPAN

1	2	3	4	5	6	7	8	9	10	11	12
5.25	2.61	1.46	1.32	0.98	0.83	0.82	0.67	0.61	0.46	0.43	0.55

MONTHS FOR CYCLICAL DOMINANCE: 5

F 2.F: RELATIVE CONTRIBUTION OF THE COMPONENTS TO THE STATIONARY PORTION OF THE VARIANCE IN THE ORIGINAL SERIES

I	C	S	P	TD	TOTAL
0.36	0.32	100.31	0.00	0.08	101.07

F 2.G: THE AUTOCORRELATION OF THE IRREGULARS FOR SPANS 1 TO 14

1	2	3	4	5	6	7	8	9	10	11	12	13	14
-0.35	-0.20	0.06	-0.02	-0.02	0.05	0.01	-0.03	-0.01	0.13	0.13	-0.42	0.10	0.13

F 2.H: THE FINAL I/C RATIO FROM TABLE D12: 3.31
THE FINAL I/S RATIO FROM TABLE D10: 5.64

F 2.I:

		STATISTIC	PROBABILITY LEVEL
F-TEST FOR STABLE SEASONALITY FROM TABLE B 1.	:	399.512	0.00%
F-TEST FOR THE TRADING DAY REGESSION IN TABLE C15.	:	3.475	0.61%
F-TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	557.099	0.00%
KRUSKAL-WALLIS CHI SQUARED TEST FOR STABLE SEASONALITY FROM TABLE D 8.	:	50.653	0.00%
F-TEST FOR MOVING SEASONALITY FROM TABLE D 8.	:	0.610	65.76%

```
                                   1         2         3         4         5         6         7         8
COLUMN NUMBER              : 12345678901234567890123456789012345678901234567890123456789012345678901234567890

IMAGE OF THE MAIN OPTION CARD: M1CAPV     01850490    1    42                                          3
IMAGE OF THE INPUT FORMAT CARD: (4F18.6)
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F 3. MONITORING AND QUALITY ASSESSMENT STATISTICS

ALL THE MEASURES BELOW ARE IN THE RANGE FROM 0 TO 3 WITH AN ACCEPTANCE REGION FROM 0 TO 1.

1. THE RELATIVE CONTRIBUTION OF THE IRREGULAR OVER THREE MONTHS SPAN (FROM TABLE F 2.B). M1 = 0.044

2. THE RELATIVE CONTRIBUTION OF THE IRREGULAR COMPONENT TO THE STATIONARY PORTION OF THE VARIANCE (FROM TABLE F 2.F). M2 = 0.036

3. THE AMOUNT OF MONTH TO MONTH CHANGE IN THE IRREGULAR COMPONENT AS COMPARED TO THE AMOUNT OF MONTH TO MONTH CHANGE IN THE TREND-CYCLE (FROM TABLE F2.H). M3 = 1.156

4. THE AMOUNT OF AUTOCORRELATION IN THE IRREGULAR AS DESCRIBED BY THE AVERAGE DURATION OF RUN (TABLE F 2.D). M4 = 0.039

5. THE NUMBER OF MONTHS IT TAKES THE CHANGE IN THE TREND-CYCLE TO SURPASS THE AMOUNT OF CHANGE IN THE IRREGULAR (FROM TABLE F 2.E). M5 = 0.891

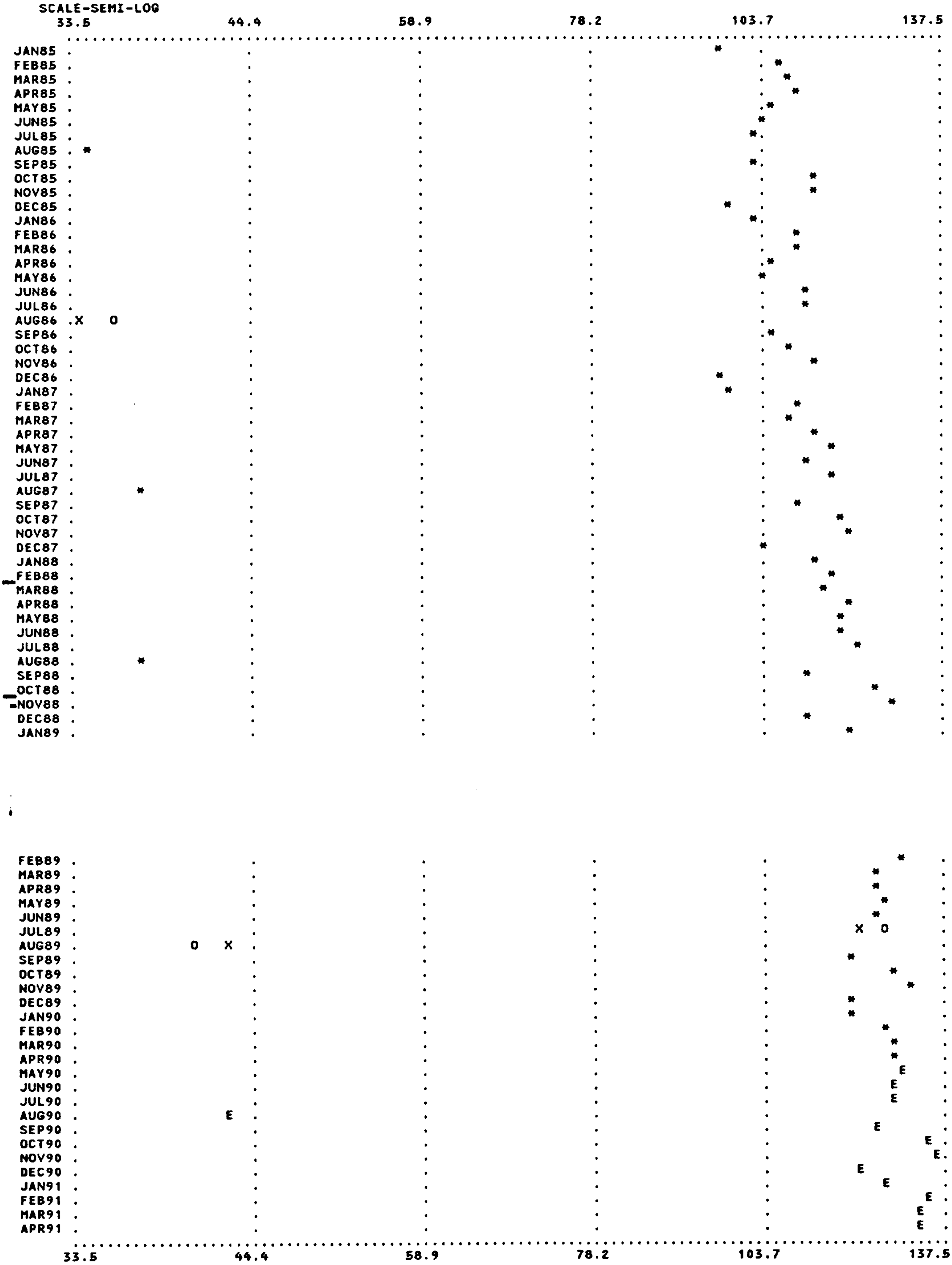
6. THE AMOUNT OF YEAR TO YEAR CHANGE IN THE IRREGULAR AS COMPARED TO THE AMOUNT OF YEAR TO YEAR CHANGE IN THE SEASONAL (FROM TABLE F 2.H). M6 = 0.657

7. THE AMOUNT OF MOVING SEASONALITY PRESENT RELATIVE TO THE AMOUNT OF STABLE SEASONALITY (FROM TABLE F 2.I). M7 = 0.089

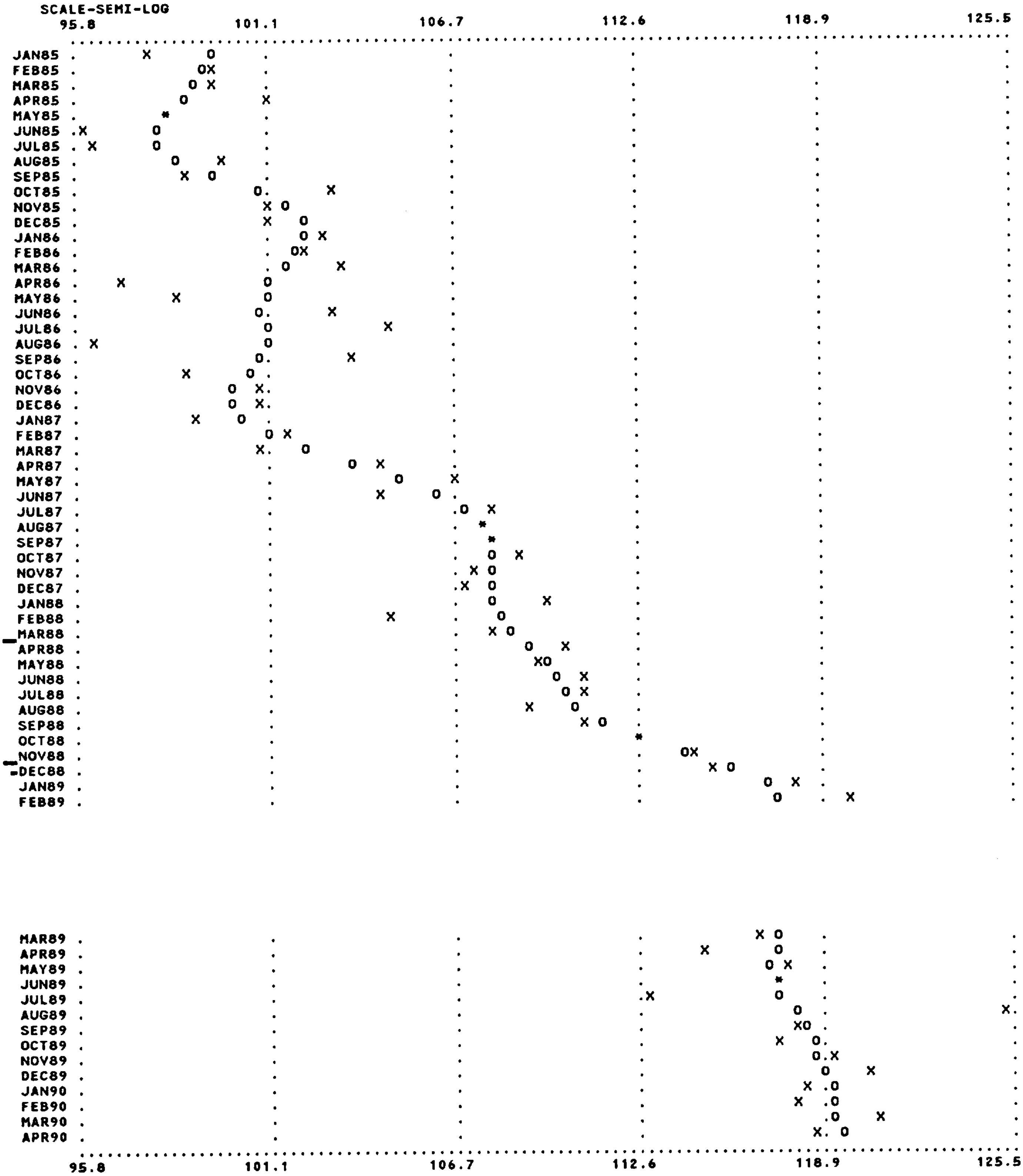
*** ACCEPTED *** AT THE LEVEL 0.29

*** CHECK THE 1 ABOVE MEASURES WHICH FAILED.

G 1. CHART
(X) - B 1. ORIGINAL SERIES
(O) - E 1. ORIGINAL SERIES MODIFIED FOR EXTREMES WITH ZERO FINAL WEIGHTS
(*) - COINCIDENCE OF POINTS
(E) - ARIMA EXTRAPOLATION
SCALE-SEMI-LOG



G 2. CHART
(X) - D11. FINAL SEASONALLY ADJUSTED SERIES
(O) - D12. FINAL TREND CYCLE
(*) - COINCIDENCE OF POINTS
SCALE-SEMI-LOG



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G 3. CHART
       (X) - D10. FINAL SEASONAL FACTORS
       (O) - D 8. FINAL UNMODIFIED SI RATIOS
       (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
       (*) - COINCIDENCE OF POINTS
       (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7            48.8            65.0            81.1            97.3            113.4
     ...................................................................................
JANUARY
 1985 .               .               .               .              *  X              .
 1986 .               .               .               .              .  X*             .
 1987 .               .               .               .              . * X             .
 1988 .               .               .               .              .   X *           .
 1989 .               .               .               .              .   X *           .
 1990 .               .               .               .              .   *X            .
 1991 .               .               .               .              .    E            .
     ...................................................................................
     32.7            48.8            65.0            81.1            97.3            113.4
```

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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
     .........................................................................................................
FEBRUARY
 1985 .                   .                   .                   .                   .              *       .
 1986 .                   .                   .                   .                   .              *       .
 1987 .                   .                   .                   .                   .              X*      .
 1988 .                   .                   .                   .                   .          O + X       .
 1989 .                   .                   .                   .                   .              X  *    .
 1990 .                   .                   .                   .                   .             *X       .
 1991 .                   .                   .                   .                   .               E      .
     .........................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4
```

```
G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS       MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
      ...........................................................................................................
MARCH
 1985 .                    .                   .                   .                   .        X*          .
 1986 .                    .                   .                   .                   .        X *         .
 1987 .                    .                   .                   .                   .      * X           .
 1988 .                    .                   .                   .                   .       *X           .
 1989 .                    .                   .                   .                   .        *           .
 1990 .                    .                   .                   .                   .         X*         .
 1991 .                    .                   .                   .                   .         E          .
      ...........................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4
```

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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7              48.8              65.0              81.1              97.3              113.4
      ...................................................................................................
APRIL
 1985 .                   .                 .                 .                 .           X +O   .
 1986 .                   .                 .                 .                 .      O   + X     .
 1987 .                   .                 .                 .                 .            X*    .
 1988 .                   .                 .                 .                 .           X*     .
 1989 .                   .                 .                 .                 .         * X      .
 1990 .                   .                 .                 .                 .          *X      .
 1991 .                   .                 .                 .                 .          E       .
      ...................................................................................................
     32.7              48.8              65.0              81.1              97.3              113.4
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G 3. CHART
      (X) - D10. FINAL SEASONAL FACTORS
      (O) - D 8. FINAL UNMODIFIED SI RATIOS
      (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
      (*) - COINCIDENCE OF POINTS
      (E) - EXTRAPOLATED SEASONAL FACTORS
  SCALE-ARITHMETIC
    32.7           48.8           65.0           81.1           97.3           113.4
     .........................................................................
MAY
 1985 .              .              .              .              .      *      .
 1986 .              .              .              .              .   *  X      .
 1987 .              .              .              .              .      X *    .
 1988 .              .              .              .              .      *      .
 1989 .              .              .              .              .       *     .
 1990 .              .              .              .              .       E     .
     .........................................................................
    32.7           48.8           65.0           81.1           97.3           113.4
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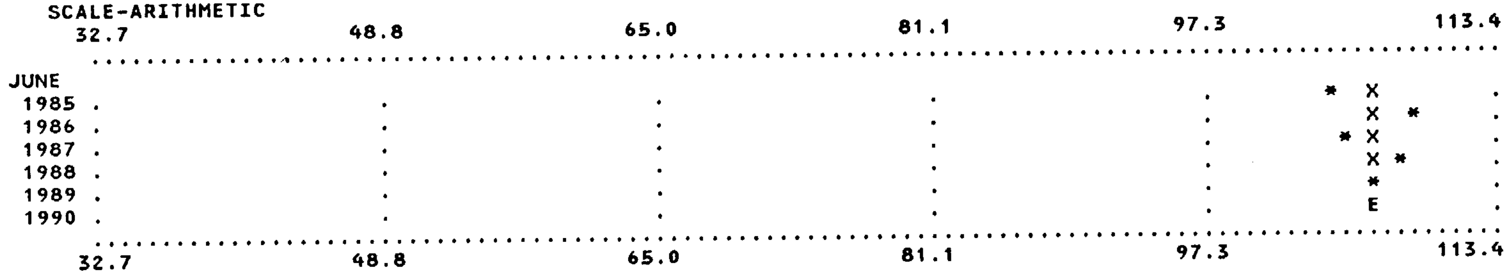
SERIES CAPV CAPV DATE: JULY 17, 1990 PAGE 49

G 3. CHART

(X) - D10. FINAL SEASONAL FACTORS
(O) - D 8. FINAL UNMODIFIED SI RATIOS
(+) - D 9. FINAL RATIOS MODIFIED FOR EXTREMES
(*) - COINCIDENCE OF POINTS
(E) - EXTRAPOLATED SEASONAL FACTORS

SCALE-ARITHMETIC



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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
     .........................................................................................................
JULY
 1985 .                    .                   .                   .                   .          * X       .
 1986 .                    .                   .                   .                   .            X+    O .
 1987 .                    .                   .                   .                   .             X*     .
 1988 .                    .                   .                   .                   .              *     .
 1989 .                    .                   .                   .                   .      O     X+      .
 1990 .                    .                   .                   .                   .            E       .
     .........................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4
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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
      ......................................................................................................
AUGUST
 1985 .  X*                .                   .                   .                   .                     .
 1986 .O *                 .                   .                   .                   .                     .
 1987 .  *                 .                   .                   .                   .                     .
 1988 . *X                 .                   .                   .                   .                     .
 1989 .  *  O              .                   .                   .                   .                     .
 1990 .  E                 .                   .                   .                   .                     .
      ......................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4
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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3               113.4
       .......................................................................................................
SEPTEMBER
 1985 .                   .                   .                   .                   .    *X             .
 1986 .                   .                   .                   .                   .     X +O          .
 1987 .                   .                   .                   .                   .     *             .
 1988 .                   .                   .                   .                   .    *              .
 1989 .                   .                   .                   .                   .    *              .
 1990 .                   .                   .                   .                   .    E              .
       .......................................................................................................
     32.7                48.8                65.0                81.1                97.3               113.4
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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
     .......................................................................................................
OCTOBER                                                                                          X   *.
 1985 .                   .                   .                   .                   .        * X      .
 1986 .                   .                   .                   .                   .          X*     .
 1987 .                   .                   .                   .                   .         *       .
 1988 .                   .                   .                   .                   .       * X       .
 1989 .                   .                   .                   .                   .         E       .
 1990 .                   .                   .                   .                   .                 .
     .......................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4
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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7               48.8               65.0               81.1               97.3              113.4
      ...................................................................................................
NOVEMBER
 1985 .                    .                  .                  .                  .                *   .
 1986 .                    .                  .                  .                  .                X*  .
 1987 .                    .                  .                  .                  .               *X   .
 1988 .                    .                  .                  .                  .                 *  .
 1989 .                    .                  .                  .                  .                 *  .
 1990 .                    .                  .                  .                  .                 E  .
      ...................................................................................................
     32.7               48.8               65.0               81.1               97.3              113.4
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G 3. CHART
        (X) - D10. FINAL SEASONAL FACTORS
        (O) - D 8. FINAL UNMODIFIED SI RATIOS
        (+) - D 9. FINAL RATIOS      MODIFIED FOR EXTREMES
        (*) - COINCIDENCE OF POINTS
        (E) - EXTRAPOLATED SEASONAL FACTORS
   SCALE-ARITHMETIC
     32.7                48.8                65.0                81.1                97.3                113.4
     ...................................................................................................
DECEMBER
 1985 .                   .                   .                   .                  *X.                   .
 1986 .                   .                   .                   .                   X*                   .
 1987 .                   .                   .                   .                   *X                   .
 1988 .                   .                   .                   .                    *                   .
 1989 .                   .                   .                   .                    X *                 .
 1990 .                   .                   .                   .                    E                   .
     ...................................................................................................
     32.7                48.8                65.0                81.1                97.3                113.4

  END OF X-11 ARIMA
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TYPE OF ADJUST.	SERIES IDENT.	ADDITIONAL IDENTIFIERS			SERIES TITLE	QUALITY CONTROL FAILED	STATISTICS PASSED	CHECK IF PUBLISHED
M-MLT	CAPV	--------	--------	CAPV			0.29	---

F 2. SUMMARY MEASURES

F 2.A: AVERAGE PER CENT CHANGE WITHOUT REGARD TO SIGN OVER THE INDICATED SPAN

SPAN IN MONTHS	B1 O	D11 CI	D13 I	D12 C	D10 S	A2 P	C18 TD	F1 MCD	E1 MOD.O	E2 MOD.CI	E3 MOD.I
1	25.01	2.30	2.22	0.42	24.34	0.00	1.25	0.64	25.06	1.82	1.73
2	28.78	2.61	2.22	0.85	27.90	0.00	1.09	1.04	28.86	2.19	1.80
3	28.50	2.51	1.83	1.25	27.54	0.00	0.87	1.37	28.48	2.21	1.53
4	25.36	2.88	2.15	1.63	24.10	0.00	1.12	1.72	25.36	2.61	1.85
5	27.57	3.22	1.95	1.99	26.57	0.00	1.02	2.04	27.64	2.79	1.49
6	29.71	3.44	1.92	2.33	28.90	0.00	0.76	2.35	29.91	2.96	1.49
7	29.65	3.70	2.20	2.67	28.46	0.00	1.22	2.75	29.73	3.32	1.85
8	28.22	3.80	2.03	3.02	26.84	0.00	0.96	3.13	28.13	3.35	1.52
9	26.55	3.99	2.07	3.39	24.11	0.00	0.70	3.45	26.18	3.68	1.67
10	28.11	4.14	1.72	3.74	25.50	0.00	1.27	3.80	27.90	3.90	1.42
11	26.96	4.45	1.77	4.07	24.38	0.00	0.95	4.17	26.90	4.28	1.46
12	4.99	5.10	2.42	4.40	0.21	0.00	1.03	4.56	4.87	4.88	2.03

F 2.B: RELATIVE CONTRIBUTIONS TO THE VARIANCE OF THE PER CENT CHANGE IN THE COMPONENTS OF THE ORIGINAL SERIES

SPAN IN MONTHS	D13 I	D12 C	D10 S	A2 P	C18 TD	TOTAL	RATIO (X100)
1	0.82	0.03	98.88	0.00	0.26	100.00	95.82
2	0.63	0.09	99.13	0.00	0.15	100.00	94.84
3	0.44	0.20	99.26	0.00	0.10	100.00	94.09
4	0.78	0.45	98.56	0.00	0.21	100.00	91.67
5	0.53	0.55	98.77	0.00	0.15	100.00	94.00
6	0.44	0.64	98.85	0.00	0.07	100.00	95.71
7	0.59	0.86	98.37	0.00	0.18	100.00	93.61
8	0.56	1.24	98.07	0.00	0.13	100.00	92.29
9	0.72	1.92	97.28	0.00	0.08	100.00	84.75
10	0.44	2.09	97.23	0.00	0.24	100.00	84.59
11	0.51	2.70	96.64	0.00	0.15	100.00	84.59
12	22.21	73.56	0.16	0.00	4.07	100.00	105.64

F 2.C: AVERAGE PER CENT CHANGE WITH REGARD TO SIGN AND STANDARD DEVIATION OVER INDICATED SPAN

SPAN IN	B1 O		D13 I		D12 C		D10 S		D11 CI		F1 MCD	
MONTHS	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.	AVGE	S.D.
1	11.30	58.28	0.06	3.02	0.29	0.50	10.90	57.93	0.36	3.09	0.31	0.71
2	13.12	65.14	0.08	2.85	0.60	0.98	12.37	64.64	0.68	3.10	0.65	1.09
3	13.92	67.47	0.04	2.56	0.92	1.41	12.75	66.12	0.96	3.09	1.00	1.40
4	11.95	56.57	-0.01	2.68	1.25	1.77	10.56	55.56	1.25	3.44	1.36	1.72
5	13.12	60.71	0.02	2.67	1.61	2.04	11.16	59.07	1.63	3.57	1.77	1.95
6	15.08	66.94	0.06	2.57	1.98	2.24	12.89	65.82	2.04	3.53	2.15	2.09
7	14.99	65.90	0.07	2.66	2.36	2.37	12.26	64.31	2.44	3.59	2.52	2.21
8	16.68	66.27	0.05	2.72	2.74	2.46	13.68	64.95	2.79	3.72	2.89	2.36
9	14.63	62.81	0.17	2.59	3.11	2.55	10.74	59.45	3.29	3.66	3.25	2.48
10	15.05	63.42	0.05	2.33	3.46	2.64	10.90	60.01	3.52	3.62	3.58	2.61
11	15.24	64.74	0.07	2.37	3.80	2.72	10.61	60.55	3.88	3.80	3.95	2.73
12	4.27	4.35	0.11	3.07	4.15	2.78	0.00	0.27	4.28	4.37	4.36	2.81

F 2.D: AVERAGE DURATION OF RUN

CI	I	C	MCD
1.57	1.50	6.30	2.57

F 2.E: I/C RATIO FOR MONTHS SPAN

```
        1       2       3       4       5       6       7       8       9      10      11      12
     5.25    2.61    1.46    1.32    0.98    0.83    0.82    0.67    0.61    0.46    0.43    0.55

 MONTHS FOR CYCLICAL DOMINANCE:       5

F 2.F: RELATIVE CONTRIBUTION OF THE COMPONENTS TO THE STATIONARY PORTION OF THE VARIANCE IN THE ORIGINAL SERIES
                I       C       S       P      TD    TOTAL
             0.36    0.32  100.31    0.00    0.08   101.07

F 2.G: THE AUTOCORRELATION OF THE IRREGULARS FOR SPANS 1 TO 14
                1       2       3       4       5       6       7       8       9      10      11      12      13      14
            -0.35   -0.20    0.06   -0.02   -0.02    0.05    0.01   -0.03   -0.01    0.13    0.13   -0.42    0.10    0.13

F 2.H: THE FINAL I/C RATIO FROM TABLE D12:        3.31
       THE FINAL I/S RATIO FROM TABLE D10:        5.64

F 2.I:                                                                        STATISTIC PROBABILITY
                                                                                         LEVEL
       F-TEST FOR STABLE SEASONALITY FROM TABLE B 1.                        :    399.512   0.00%
       F-TEST FOR THE TRADING DAY REGESSION IN TABLE C15.                   :      3.475   0.61%
       F-TEST FOR STABLE SEASONALITY FROM TABLE D 8.                        :    557.099   0.00%
       KRUSKAL-WALLIS CHI SQUARED TEST FOR STABLE SEASONALITY FROM TABLE D 8. :   50.653   0.00%
       F-TEST FOR MOVING SEASONALITY FROM TABLE D 8.                        :      0.610  65.76%

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                                         1         2         3         4         5         6         7         8
  COLUMN NUMBER               : 12345678901234567890123456789012345678901234567890123456789012345678901234567890

  IMAGE OF THE MAIN OPTION CARD: M1CAPV     01850490    1    42                                       3
 IMAGE OF THE INPUT FORMAT CARD: (4F18.6)
```

F 3. MONITORING AND QUALITY ASSESSMENT STATISTICS

ALL THE MEASURES BELOW ARE IN THE RANGE FROM 0 TO 3 WITH AN ACCEPTANCE REGION FROM 0 TO 1.

1. THE RELATIVE CONTRIBUTION OF THE IRREGULAR OVER THREE MONTHS SPAN (FROM TABLE F 2.B).	M1	= 0.044
2. THE RELATIVE CONTRIBUTION OF THE IRREGULAR COMPONENT TO THE STATIONARY PORTION OF THE VARIANCE (FROM TABLE F 2.F).	M2	= 0.036
3. THE AMOUNT OF MONTH TO MONTH CHANGE IN THE IRREGULAR COMPONENT AS COMPARED TO THE AMOUNT OF MONTH TO MONTH CHANGE IN THE TREND-CYCLE (FROM TABLE F2.H).	M3	= 1.156
4. THE AMOUNT OF AUTOCORRELATION IN THE IRREGULAR AS DESCRIBED BY THE AVERAGE DURATION OF RUN (TABLE F 2.D).	M4	= 0.039
5. THE NUMBER OF MONTHS IT TAKES THE CHANGE IN THE TREND-CYCLE TO SURPASS THE AMOUNT OF CHANGE IN THE IRREGULAR (FROM TABLE F 2.E).	M5	= 0.891
6. THE AMOUNT OF YEAR TO YEAR CHANGE IN THE IRREGULAR AS COMPARED TO THE AMOUNT OF YEAR TO YEAR CHANGE IN THE SEASONAL (FROM TABLE F 2.H).	M6	= 0.657
7. THE AMOUNT OF MOVING SEASONALITY PRESENT RELATIVE TO THE AMOUNT OF STABLE SEASONALITY (FROM TABLE F 2.I).	M7	= 0.089

*** ACCEPTED *** AT THE LEVEL 0.29

*** CHECK THE 1 ABOVE MEASURES WHICH FAILED.

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