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A Guide to Seasonal Adjustment of Labor Force Data

U.S. Department of Labor
Bureau of Labor Statistics
March 1982

Bulletin 2114

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A Guide to Seasonal Adjustment of Labor Force Data

U.S. Department of Labor
Raymond J. Donovan, Secretary

Bureau of Labor Statistics
Janet L. Norwood, Commissioner
March 1982

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Preface

Each month, the Bureau of Labor Statistics issues statistics on employment and unemployment with the term "seasonally adjusted" appended to them. While there seems to be a general understanding of the meaning of employment, unemployment, and unemployment rate, the term "seasonally adjusted" may cause confusion. This publication explains what seasonal adjustment is, how it works, and why it is important. The explanation and the examples relate to labor force statistics collected for BLS by the Bureau of the Census in the monthly Current Population Survey. The basic principles, however, can help in understanding the use of seasonal adjustment for a wide variety of economic time series.

For readers interested in additional information on this subject, a bibliography has been included. An explanation of how the labor force data are collected and definitions of the terms and concepts used in the labor force data are covered in *Concepts and Methods Used in Labor Force Statistics Derived from the Current Population Survey*, BLS Report 463 (1976); H*ow the Government Measures Unemployment*, BLS Report 505 (1977); and the Explanatory Notes of the BLS publication, *Employment and Earnings*.

This bulletin was prepared in the Office of Current Employment Analysis, Division of Employment and Unemployment Analysis, by John F. Stinson, Jr., under the general direction of Gloria Peterson Green.

Unless otherwise noted, all seasonally adjusted data in this bulletin are those published at the beginning of 1981 and reflect all revisions up to that time.

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A Guide to Seasonal Adjustment of Labor Force Data

What is seasonality?

Over the course of a year, the size of the Nation's labor force and the levels of employment and unemployment exhibit sharp movements due to such seasonal events as changes in the weather, major holidays, reduced or expanded industrial production, harvests, and the opening and closing of schools. Some specific examples of these events are the increase in retail sales each December due to the Christmas buying rush, the decline in construction activity during the winter months, and the expansion in the labor force each June when schools close and many youth enter the labor market in search of jobs.

Often these seasonal fluctuations are large and thus overshadow or obscure other movements in the data. For example, typically more than 90 percent of the monthly variation in the level of unemployment results from seasonal conditions (chart 1). Because these events follow a more or less regular pattern each year, their influence on the more important, longer term trends in the data can be eliminated by adjusting the statistics over the course of a year.

What is seasonal adjustment and why is it important?

Seasonal adjustment is a statistical tool that attempts to remove, or filter out, seasonal fluctuations in a time series. Once the seasonal component has been removed, the series is said to be seasonally adjusted, and nonseasonal developments such as cyclical swings in economic activity are easier to observe. Without the use of seasonally adjusted data, observations of change for a particular pair of months could be compared properly only with those for the same pair of months in other years where the seasonal influences were the same. Consequently, it would be difficult to make accurate comparisons over time, such as for a 6-month period or an entire business cycle.

The following examples illustrate the use of seasonal adjustment as a tool in analyzing changes in labor market activity. The actual (not seasonally adjusted) data for December 1980 and January 1981 show a marked deterioration in the employment situation:

	December 1980	*January 1981*	*December-January change*
Total unemployed	7,233,000	8,543,000	1,310,000
Unemployment rate	6.9	8.2	1.3

The number of unemployed persons rose by over 1.3 million and the unemployment rate increased from 6.9 to 8.2 percent. Unemployment, however, always rises between December and January, as cold weather causes a cutback in outdoor jobs and as persons hired temporarily for the Christmas buying season are no longer needed. The important information for an economic analyst or policymaker is whether or not the increase in unemployment was greater or less than usual. Data for the same 2 months *after* seasonal adjustment give a different picture:

	December 1980	*January 1981*	*December-January change*
Total unemployed	7,785,000	7,847,000	62,000
Unemployment rate	7.4	7.4	-

Seasonally adjusted data provide a completely different perspective on the employment situation. When the normal seasonal increase in unemployment is removed, via seasonal adjustment, both the number of unemployed persons and the unemployment rate show no significant change between December and January, rather than a sharp increase as indicated by the unadjusted data. This is not to deny, however, that there were actually over 8.5 million persons unemployed in January 1981, an increase of 1.3 million from December 1980. On an individual basis, the experience of unemployment was very real. But in order to interpret the movements of the unemployment time series, aggregated over many individuals, it is essential to recognize and adjust for the seasonality; it is important to know that a particular kind of increase or decrease always takes place at a certain time in the year. Such seasonal changes may sometimes warrant special short-term programs such as those which provide summer jobs for youth; but since **the effects of such changes are transient, they do not portend any fundamental changes in the Nation's employment situation.**

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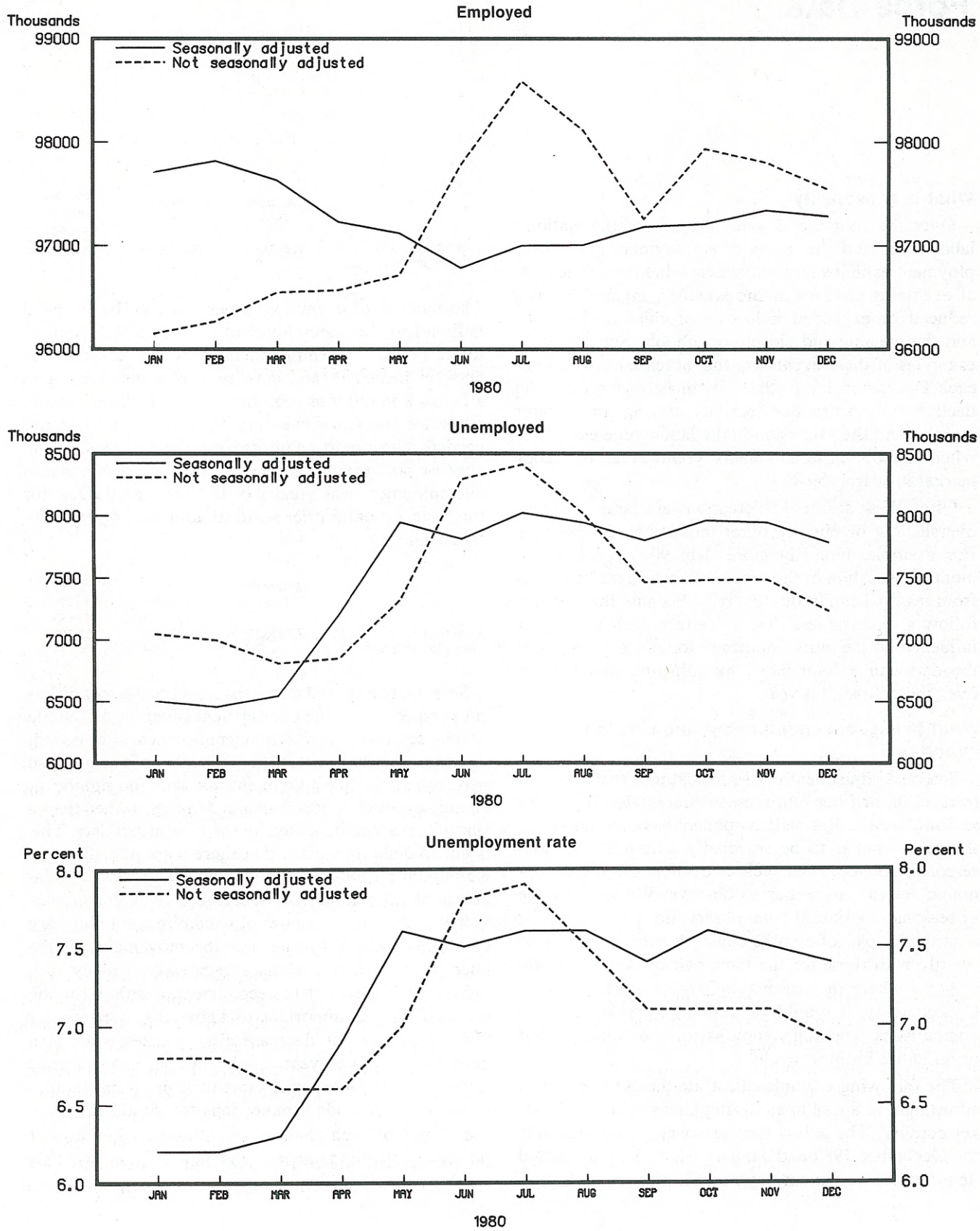
Chart 1. Employment status of all civilian workers—seasonally adjusted and unadjusted, 1980



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The following data on the total unemployment rate for February, March, April, and May of 1980 also show how important it is to use seasonally adjusted data to interpret trends:

	February 1980	*March 1980*	*April 1980*	*May 1980*
Total unemployment rate, not seasonally adjusted	6.8	6.6	6.6	7.0
Total unemployment rate, seasonally adjusted	6.2	6.3	6.9	7.6

The unadjusted data indicate that, between February and April, there was a very slight improvement in the economic situation, as the jobless rate edged down from 6.8 to 6.6 percent. Unemployment, however, always declines between February and April as the weather improves and outdoor work activity increases. Once more, the important question is: Was the decline in unemployment greater or less than what usually occurs? The seasonally adjusted data reveal that the decline was much less than usual; the seasonally adjusted unemployment rate increased sharply between February and April, rising from 6.2 to 6.9 percent. Extending this analysis through May, there was a very small increase from February to May in the unadjusted data, from 6.8 to 7.0 percent, versus a very large increase—1.4 percentage points— in the seasonally adjusted rates. The unadjusted unemployment rate in May was much higher than would have been expected, given the unadjusted rate in February, and, in reality, there was a sharp upward trend in unemployment as a recession set in. The only way to know how much higher the rate was in May, and how severe that sharp upward trend was, is to have reliable estimates of the normal seasonal movements over those months. The seasonally adjusted series clearly identified what was going on; looking at the unadjusted series alone without knowledge of the seasonality would have been misleading.

The following data on employment, from May to June of 1979, are a further example of the importance of using seasonally adjusted data when making month-to-month comparisons:

	May 1979	*June 1979*	*May-June change*
Total employment, not seasonally adjusted	96,220,000	97,917,000	1,697,000
Total employment, seasonally adjusted	96,590,000	96,838,000	248,000

The data, unadjusted for seasonality, give the impression that the economy was doing extremely well, with total employment increasing by almost 1.7 million. Employment, however, *always* rises sharply between May and June, as large numbers of school-age youth enter the labor market. For policymaking and analytical purposes, the important thing to know is whether or not the increase was consistent with that which normally occurs in June. This can be determined by examining the seasonally adjusted data, from which the usual increase caused by the influx of students into the labor market has been removed. The seasonally adjusted data reveal that the increase in employment between May and June was only a little greater than normal, about 250,000.

Each of these examples illustrates the importance of using seasonally adjusted data in the analysis of labor market statistics. Without such data, it would be extremely difficult to determine how much of a change in a data series was due to normal seasonal patterns and how much was due to an actual change in the underlying economic conditions. Additionally, it is of crucial importance that economic policymakers, who use the employment and unemployment statistics as a guide to the health of the economy, have statistics which can be compared directly from 1 month to the next so that they can accurately follow trends in the labor market and implement the proper economic policies.

How are data seasonally adjusted?

Underlying the process of seasonal adjustment is the basic assumption that an economic time series can be broken down into four distinct components: The trend (T), the cyclical (C), the seasonal (S), and the irregular (I).

The *trend* component is defined as that part of a time series which shows a smooth or regular movement over a long period of time. The *cyclical* component is that part which displays periodic fluctuations of a reasonably long-term nature (generally 2 to 5 years) around the trend in response to the ups and downs in business conditions. For seasonal adjustment purposes, the trend and cyclical components are often treated together as a single, *trend-cycle* (TC) component. The *seasonal* component is that part of a time series which features the repetitive pattern of ups and downs over the course of a year caused by regular events such as changing seasons, holidays, and school enrollment patterns. It is this component that the seasonal adjustment process is designed to isolate and remove from a time series. The final component, the *irregular*, is made up of the fluctuations in a time series that are random, unusual movements caused by a variety of factors. These factors would include such things as extremely adverse weather conditions, natural disasters, labor-management disputes, civil disturbances, and other unpredictable, nonregularly recurring phenomena. Another likely source of the irregular component, however, is simply statistical or sampling errors, differences that occur principally because the data are derived from a sample survey rather than from a complete census each month.

Each of these concepts can be illustrated by breaking down the monthly time series on total employment in the United States into the four components. The trend component of total employment is the long-term

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growth in employment that has occurred as the population has expanded and as a greater proportion of the population, particularly women, have entered the labor force and found jobs. The cyclical component is represented by the periodic expansions and contractions of employment (around the long-term, upward trend) caused by swings in business activity. The seasonal component is comprised of the predictable monthly changes in the number of jobs which tend to occur each year. Finally, the irregular component is made up of the shifts in employment caused by random, unpredictable events or by sampling errors that may be present in the data.

The relationship between the original time series, (0), and its four components depends on the statistical model that best represents the interaction of the four components. Two of the most common models used are the multiplicative and additive models.

In the multiplicative model, the original series is assumed to be the *product* of the trend, cyclical, seasonal, and irregular components. Seasonal changes in the model are assumed to be *proportional* to changes in the level of the series. The multiplicative model can be expressed as:

$$0 = T \times C \times S \times I$$

In the additive model, the original series is assumed to be the *sum* of the trend, cyclical, seasonal, and irregular components. In additive models, seasonal changes are assumed to be *constant* in magnitude. The additive model can be expressed as:

$$0 = T + C + S + I$$

The fundamental premise of seasonal adjustment is that the seasonal component of a time series can be measured and separated from the trend, cyclical, and irregular components. While there are a number of statistical techniques available for isolating the seasonal component of a time series, the most commonly used is probably the ratio-to-moving average method. The Bureau of the Census X-11 seasonal adjustment program, a widely used computer program for seasonally adjusting time series data, is a variation of the basic ratio-to-moving-average technique. The following discussion of this technique assumes a basic multiplicative model, but the procedure is similar for the basic additive and other models.

The seasonal adjustment process starts with the original series:

$$0 = TC \times S \times I$$

The first step is to obtain a measure of the trend-cycle component by calculating a centered 12-month moving average of the original data for each month.[1] This average, which provides an approximation of the trend-cycle component, is then divided into the original time series to remove the trend-cycle component, leaving only the seasonal and irregular components which are expressed in percentage terms:

$$\frac{0}{TC} = \frac{TC \times S \times I}{TC} = S \times I$$

The next step is to remove the irregular component by averaging the S x I ratio for each month over a number of years to get a mean value of the S x I ratio for that particular month. Since the averaging process is assumed to remove most of the irregular component, the mean values of the S x I ratio represent an estimate of the isolated seasonal component. This seasonal component, or seasonal factor, is then divided back into the original time series to remove the seasonal component and yield seasonally adjusted data. The final relationship can be expressed as:

$$\frac{0}{S} = \frac{TC \times S \times I}{S} = TC \times I = \text{Seasonally adjusted data}$$

This description of the seasonal adjustment process has been simplified to illustrate the basic principles of the procedure. Although most of the seasonal adjustment methods are more complex and utilize a number of statistical techniques to smooth the data and produce reliable seasonal factors, they build on these basic principles.

How has the seasonal adjustment process been developed?

The theoretical foundation of modern seasonal adjustment techniques was developed in the first several decades of this century. Warren Persons of Harvard University is credited with being the first to decompose

[1] A moving average is also a time series. The values for a 12-month moving average are calculated by taking the average value of each possible set of 12 consecutive observations from the original series. For example, in computing a 12-month moving average based on a monthly time series starting in January of some year, the first value for the moving average series would be computed by averaging the values for January through December of that year, the second value would be computed by averaging the data for February of that year through January of the following year, and so forth. A centered 12-month moving average is then calculated by computing a 2-month moving average of the values in the 12-month moving average series, placing (centering) each result in the middle month of the 13 months originally participating in each calculation. For example, the first result would involve data for January of the first year through January of the following year and would be placed in July of the first year.

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time series into their four component parts, in 1919.[2] The standard ratio-to-moving-average technique was developed in the 1920's by Frederick Macaulay at the National Bureau of Economic Research.[3] The early seasonal adjustment procedures, however, were cumbersome and required numerous, lengthy manual calculations. It was only with the introduction of high-speed electronic computers in the 1950's that the seasonal adjustment of a large number of time series in a short period of time became feasible.

Research conducted by Julius Shiskin at the Bureau of the Census led to the introduction in 1954 of a computer program for seasonal adjustment entitled the Census Method I, which was essentially a refinement of the standard ratio-to-moving-average technique. This program greatly expedited the seasonal adjustment process, permitting the wider use of seasonally adjusted data in the statistical analysis of the economy. In 1955, this original program was replaced with a revised procedure, the Census Method II. The X-11 variant of the Census Method II, introduced in 1965, is at present probably the most widely used seasonal adjustment program.[4]

The seasonal adjustment of labor force data has changed considerably over the years, keeping pace with improvements in methodology. Seasonally adjusted labor force data were first published in the mid-1950's and were adjusted using the Census Methods I and II. In 1960, the BLS Seasonal Factor Method,[5] similar in most respects to the Census technique, was adopted as the official BLS procedure for seasonally adjusting the labor force data and was used until 1973, when a shift was made in the seasonal adjustment methodology. In 1973, data prior to 1967 that had already been seasonally adjusted by the BLS Seasonal Factor Method were "frozen" and were subject to no further revision. Data for 1967 and later years, however, were now adjusted by the X-11 Variant of the Census Method II, which was capable of adjusting shorter time series than the BLS method. Use of the standard X-11 method continued through 1979.

In January 1980, the BLS adopted the X-11 ARIMA (Auto-Regressive Integrated Moving Average) technique as its official method for seasonally adjusting national employment and unemployment data. The X-11 ARIMA method (developed under the direction of Estela Dagum at the Canadian national statistical agency, Statistics Canada) is a modified version of the standard X-11 procedure.[6] The ARIMA method adds 1 year of forecasted data to the time series being adjusted and then seasonally adjusts the enlarged time series with the standard X-11 method. The forecasted data are projected through the use of ARIMA statistical models which have been fitted to the individual series. By including the year of forecasted data, the X-11 ARIMA procedure is able to provide better seasonal adjustment factors for the year being currently adjusted than the standard X-11 procedure can; that is, the size of the revisions in the seasonally adjusted data is expected to be somewhat less when the statistics are updated and new seasonal factors are calculated at the end of each year. At present, ARIMA models have been identified for about 75 percent of the major labor force series that are directly seasonally adjusted. The remaining series are still adjusted with the standard X-11 method.

How are the seasonally adjusted labor force data updated each year?

Twice each year, in January and July, the seasonal adjustment factors used in adjusting labor force data are updated with the X-11 ARIMA program. Each January, the original (not seasonally adjusted) data through December of the year just completed are added to the data previously used in the seasonal adjustment process and are run through the X-11 ARIMA computer program, generating revised seasonally adjusted data for the previous 5 years and seasonal factors for the next 6 months. Each month, the seasonal factors for that month are applied to the newly collected original estimates to derive the seasonally adjusted figures for the various labor force series. When a multiplicative seasonal adjustment method is used, the unadjusted data are divided by a seasonal factor to calculate the seasonally adjusted figure. When an additive seasonal adjustment method is used, the seasonal factor is subtracted from the unadjusted level to calculate the seasonally adjusted level. Then in July, the not seasonally adjusted data from January to June are incorporated into the historical data base and the data are rerun through the X-11 ARIMA seasonal adjustment procedure. At this time, however, only new seasonal factors for the July-December period are produced, and no revisions are made in the historical data. Updating of the seasonal factors on a 6-month basis is a relatively new practice that was initiated in 1980 at the same time the X-11 ARIMA seasonal adjustment method was adopted. Previously, seasonal adjustment of the data was carried out once a year, in January, and seasonal factors for all 12 months of the coming year were created. The reason for the change in procedure was that, in the past,

[2] Warren M. Persons, "Indices of Business Conditions," *Review of Economics and Statistics*, Vol. 1, 1919, pp. 5-107; and "An Index of General Business Conditions," *Review of Economics and Statistics*, Vol. 1, 1919, pp. 111-205.

[3] Frederick R. Macaulay, *The Smoothing of Time Series* (New York, National Bureau of Economic Research, 1931).

[4] Julius Shiskin, Allan H. Young, and John C. Musgrave, *The X-11 Variant of the Census Method II Seasonal Adjustment Program*, Technical Paper No. 15 (Bureau of the Census, 1967).

[5] *The BLS Seasonal Factor Method (1966)* (Bureau of Labor Statistics, 1966).

[6] Estella Bee Dagum, *The X-11 ARIMA Seasonal Adjustment Method* (Statistics Canada, February 1980).

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Table 1. Seasonally adjusted unemployment rates as originally published and as revised in subseqent years, 1977-80

Month	1977					1978				1979			1980	
	Originally published	1978 revision	1979 revision	1980 revision	1981 revision	Originally published	1979 revision	1980 revision	1981 revision	Originally published	1980 revision	1981 revision	Originally published	1981 revision
January	7.3	7.4	7.4	7.4	7.5	6.3	6.3	6.4	6.4	5.8	5.8	5.8	6.2	6.2
February	7.5	7.6	7.5	7.6	7.6	6.1	6.1	6.1	6.2	5.7	5.7	5.9	6.0	6.2
March	7.3	7.4	7.4	7.4	7.4	6.2	6.2	6.2	6.2	5.7	5.7	5.8	6.2	6.3
April	7.0	7.1	7.2	7.2	7.2	6.0	6.1	6.1	6.1	5.8	5.8	5.8	7.0	6.9
May	6.9	7.1	7.1	7.1	7.0	6.1	6.1	6.1	6.0	5.8	5.8	5.6	7.8	7.6
June	7.1	7.1	7.2	7.2	7.2	5.7	5.8	5.9	5.8	5.6	5.7	5.6	7.7	7.5
July	6.9	6.9	6.9	6.9	6.9	6.2	6.1	6.2	6.1	5.7	5.7	5.6	7.8	7.6
August	7.1	7.0	7.0	7.0	6.9	5.9	5.9	5.9	5.8	6.0	5.9	5.9	7.6	7.6
September	6.9	6.8	6.8	6.8	6.8	6.0	5.9	5.9	5.9	5.8	5.8	5.8	7.5	7.4
October	7.0	6.8	6.8	6.7	6.8	5.8	5.8	5.7	5.7	6.0	5.9	5.9	7.6	7.6
November	6.9	6.7	6.7	6.7	6.7	5.8	5.8	5.8	5.8	5.8	5.8	5.9	7.5	7.5
December	6.4	6.4	6.3	6.2	6.3	[1] 6.0	5.9	5.9	6.0	[1] 5.9	5.9	6.0	[1] 7.3	7.4

[1] Never published

when the seasonal factors were updated only in January, sizable revisions sometimes occurred in the data for the last half of the previous year. More reliable seasonal factors for those last 6 months can be produced when they are updated at midyear through the incorporation of data for the first 6 months of the year.

The revisions in the data, typically small even for the year just completed, generally get progressively smaller over the 5-year revision span. An indication of how small the revisions can sometimes be is shown in table 1. After being revised in January 1980, the seasonally adjusted monthly total unemployment rates for 1979 were not affected at all in 9 months and changed by only 0.1 percentage point in the other 3 months. Revisions were more extensive in 1977 and 1980, years when more sizable cyclical shifts occurred in the unemployment data.

It would be possible to update the seasonal adjustment of the labor force data each month when the new data became available rather than wait for the accumulation of 6 months of new data. In fact, the National Commission on Employment and Unemployment Statistics recently recommended that the BLS consider using this technique, known as the concurrent method of seasonal adjustment, for the principal labor force series such as total employment and unemployment.[7] Under this procedure, however, the seasonal factors could not be published in advance because new seasonal factors would be created each month when a new month's data became available and were added to the data base for the seasonal adjustment process. BLS felt that any technical advantages gained through monthly updating might be outweighed by the possible erosion of public confidence resulting from the cessation of prior publication of the factors to be used. Therefore, it was decided only to update the seasonal factors every 6 months, a procedure which improves the data for the second half of the year while still enabling the seasonal factors to be published in advance. The BLS, however, maintains and makes available to interested data users several unofficial monthly data series for the total unemployment rate seasonally adjusted by alternative methods, including the concurrent method. These alternative methods, which represent slight variations of one aspect or another of the official adjustment method, produce a range of unemployment rates that usually do not vary much from the official rate in any 1 month (typically 0.2 percentage point or less).

[7] National Commission on Employment and Unemployment Statistics, *Counting the Labor Force* (Washington, D.C., 1979), pp. 223-25.

Aggregation of labor force series

Many labor force series are not directly seasonally adjusted but are summed or aggregated from other series that are directly adjusted. This aggregation process is used to calculate the seasonally adjusted estimates for the overall civilian labor force, total employment, total unemployment, and the unemployment rate. The civilian labor force, for example, represents the sum of eight individually seasonally adjusted employment series and four individually adjusted unemployment series. The eight employment series are those for men and women 16-19 years of age and men and women 20 years and over employed, respectively, in agricultural and nonagricultural industries. The four unemployment series are the number of unemployed men and women 16-19 years and 20 years and over. Examples of monthly seasonal adjustment factors for each of these 12 series, covering the period of July to December 1981, are shown in table 2.

Each month, the eight individual employment series are seasonally adjusted and then summed to arrive at the seasonally adjusted level of total employment; the same is done with the four unemployment series. The seasonally adjusted total employment and unemploy-

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ment series are then summed to arrive at the seasonally adjusted civilian labor force. The seasonally adjusted total unemployment rate is calculated by dividing the seasonally adjusted level of unemployment by the seasonally adjusted civilian labor force.

This process of directly seasonally adjusting components and then aggregating these to arrive at seasonally adjusted totals is used because individual components often have widely differing seasonal patterns. For example, the seasonal employment pattern of 16- to 19-year-old men in agriculture is very different from that of men 20 years and older in nonagricultural industries because of the influence of the school year and crop cycles.

Because the official seasonally adjusted employment and unemployment totals are produced by the addition of eight employment series and four unemployment series, they will not agree with the totals produced by summing other independently seasonally adjusted series, such as the number of employed and unemployed broken down by race, occupation, or the various age categories. The differences between the official seasonally adjusted employment and unemployment totals and those derived by the addition of other labor force series, however, are usually not substantial. The process does assure that the seasonally adjusted labor force level for a given group will always be the sum of its employment and unemployment components.

The total employment and unemployment series are not the only ones produced by aggregating component series. While more than 200 labor force time series are directly adjusted by BLS each year, hundreds of other seasonally adjusted series are derived from these component series by the addition or subtraction of one or more series, dividing one series into another, or averaging monthly data over 3-month spans to produce quarterly averages.

Which labor force series are seasonally adjusted and published by the BLS?

Each month, BLS receives hundreds of thousands of individual data items collected in the Current Population Survey. It is not technically feasible to publish each of these series, nor is it possible to seasonally adjust more than a small proportion of the total. Only the most important indicators of labor market activity are selected for seasonal adjustment. These include, in addition to the highly publicized data on the civilian labor force, total employment, and total unemployment, breakdowns of these totals by important demographic characteristics such as sex, age, race, Hispanic ethnicity, and marital status as well as by full- or part-time status, occupation, industry, class of worker, and the reasons for and duration of unemployment. Numerous rates are calculated: Labor force participation rates, employment-population ratios, and, of course, rates of unemployment. In addition, selected quarterly data on persons not in the labor force are published in seasonally adjusted form. A total of about 1,800 monthly and quarterly labor force series are adjusted either directly or derived from other seasonally adjusted series. Out of this total, about 500 of the principal series are published

Table 2. Current seasonal adjustment factors for the 12 major labor force components, July-December 1981

Procedure and series	July	August	September	October	November	December
Multiplicative Adjustment[1]						
Agricultural employment:						
Males, 20 years and over	1.073	1.063	1.057	1.045	1.001	0.954
Females, 20 years and over	1.268	1.173	1.128	1.134	.928	.831
Males, 16-19 years	1.600	1.448	1.097	1.010	.803	.695
Females, 16-19 years	1.982	1.779	1.010	.883	.656	.592
Nonagricultural employment:						
Males, 20 years and over	1.007	1.007	1.003	1.006	1.003	1.001
Females, 20 years and over	.974	.976	1.002	1.012	1.015	1.016
Unemployment:						
Males, 20 years and over	.996	.963	.883	.883	.907	.943
Females, 20 years and over	1.024	1.075	1.061	1.022	.977	.929
Additive Adjustment[1]						
Nonagricultural employment:						
Males, 16-19 years	928	723	-257	-186	-214	-179
Females, 16-19 years	677	481	-203	-68	-19	70
Unemployment:						
Males, 16-19 years	185	-29	-68	-73	-25	-46
Females, 16-19 years	192	50	21	-46	-62	-130

[1] When the multiplicative seasonal adjustment method is used, seasonally adjusted data are calculated by dividing the seasonal factors into the original, or not seasonally adjusted data; when the additive seasonal adjustment method is used, seasonally adjusted data are calculated by subtracting the seasonal factors from the original data.

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regularly on either a monthly or quarterly basis in *Employment and Earnings.*

At the beginning of each year, when the seasonally adjusted data are revised, 5 years of the revised data for a few hundred of the monthly series are published in the February issue of *Employment and Earnings.* Also, seasonal adjustment factors for the forthcoming 6 months for the 12 labor force series used in computing the total unemployment rate are published in the January and July issues of *Employment and Earnings.* Additionally, packages of summary sheets showing recent years of original, or not seasonally adjusted, data and the entire span of seasonally adjusted data for each of the approximately 1,800 seasonally adjusted labor force time series are made available in January of each year to interested data users.

Not only have the techniques of seasonal adjustment changed over time, but the quantity of seasonally adjusted data that is published and the role that these data play in the analysis of the labor market situation have been greatly expanded. The first seasonally adjusted labor force data series to be published was an index of the level of unemployment that appeared in the *Monthly Report on the Labor Force* from January 1955 to December 1956. Regular publication of the seasonally adjusted total unemployment rate began in June 1957, together with a chart showing historical data on the seasonally adjusted levels of employment and unemployment. Seasonally adjusted data on the unemployment rates of men and women were added to the regularly published data in 1958, and a growing number of other time series were seasonally adjusted and published at the beginning of each year when the data were revised. The quantity of seasonally adjusted data published on a regular monthly basis, however, was not expanded until February 1963, when, on the recommendation of the President's Committee to Appraise Employment and Unemployment Statistics, BLS began publishing 5 new statistical tables containing a total of 34 seasonally adjusted data series. Since then, the quantity of regularly published seasonally adjusted data has expanded steadily, to the point where *Employment and Earnings* currently has 10 monthly tables containing a total of 227 seasonally adjusted series and an additional 10 tables with 279 series on a quarterly basis. At the same time, the role of seasonally adjusted data in labor market analysis has expanded from a secondary position to where it now forms the keystone of the monthly analysis of the Nation's employment situation.

Limitations of the seasonal adjustment process

It should be realized that the seasonal adjustment process has its limitations. One problem lies in the basic nature of seasonal adjustment. By necessity, current seasonal adjustment is an approximation based on the average seasonal movements of a particular time series over previous years. When the seasonal pattern of the current year deviates from the average seasonal pattern of earlier years as a consequence of such factors as extremes of climate and shifting dates of holidays, the seasonal adjustment process will fail to capture and remove all of the seasonal movements of the time series in question, or it may remove more of the seasonal movements than is warranted. As a result, the seasonally adjusted data may, at certain times, exhibit erratic behavior or lack of smoothness. These rough points are often smoothed over in subsequent years when the seasonal adjustment program is rerun to incorporate the latest available data.

An example of a problem in seasonally adjusting labor force data caused by a possible shift in the seasonal pattern is illustrated below based on initial (unrevised) seasonal adjustments:

	April 1980	*May 1980*	*June 1980*
		(in thousands)	
Civilian labor force, total 16 years and over, seasonally adjusted	104,419	105,142	104,542
Over-the-month change	–	723	–600
Civilian labor force, total 16 to 24 years, seasonally adjusted	24,541	24,986	24,471
Over-the-month change	–	445	–515

The seasonally adjusted civilian labor force for persons 16 years and over increased by 723,000 between April and May 1980 and then declined by 600,000 in June. A substantial portion of these changes occurred among persons 16 to 24 years of age, as a larger than usual number of school-age youth began searching for jobs in May, somewhat earlier than normal. Because the seasonal adjustment process normally adjusts for this increase of young people in June, the adjustment was thrown off by the unusual change in May. If these shifts do in fact represent a change in the seasonal pattern (similar movements did occur in 1981) subsequent seasonal adjustments should reflect the changes more accurately.

The fact that the data will be smoothed in future years is not much help to policymakers who have to make decisions based on the data currently available and cannot wait a year until the data are revised. Consequently, much of the research in the area of seasonal adjustment of labor force data has focused on improving the quality of the current seasonally adjusted data. The changes made in the seasonal adjustment process in 1980, specifically, the adoption of the X-11 ARIMA seasonal adjustment procedure and the 6-month updating of the seasonal adjustment factors, should help eliminate some of the problems of erratic movements in the current data.

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A second problem in the seasonal adjustment process concerns sampling variability of the seasonally adjusted labor force data. Because all of the labor force data are gathered through a sample survey, they are subject to a degree of sampling variability, which is measured in terms of standard errors, or variations that occur by chance because a sample rather than the entire population is surveyed. To cite an example, it has been determined that the standard error of the month-to-month change in the total unemployment rate is 0.19 percentage point at the 90-percent level of confidence. This means that the chances are 9 out of 10 that monthly changes in the unemployment rate of less than this magnitude could be due entirely to sampling error and may not represent an actual change in labor market conditions. Standard errors for major labor force series together with tables that provide the information needed to calculate standard errors for other labor force series are published monthly in the Explanatory Notes of *Employment and Earnings*.

However, the standard errors presently reported for the employment and unemployment statistics apply to the data prior to seasonal adjustment. Applying these standard errors to the seasonally adjusted data assumes that the seasonal adjustment process does not affect the accuracy of the estimates, an assumption that may not be correct. Despite its smoothing effect, the seasonal adjustment process probably adds to the errors associated with the unadjusted statistics. Thus, if standard errors were available for the seasonally adjusted current data, they might exceed the standard errors published for the unadjusted data by as much as 10 to 20 percent.[8]

The reports of both the President's Committee to Appraise Employment and Unemployment Statistics in 1962 and the National Commission on Employment and Unemployment Statistics in 1979 urged the Bureau of the Census, the agency responsible for computing standard errors for CPS labor force data, to undertake the research necessary to calculate errors for the seasonally adjusted statistics. To date, techniques have not been devised to take seasonal adjustment into account in the estimation of standard errors.[9]

While the seasonal adjustment process has limitations, it does, with rare exceptions, adequately remove the normal seasonal fluctuations from the labor force data. The process is constantly monitored to make sure it continues to perform adequately. And, as improvements are made in the techniques of seasonal adjustment, these new methods are routinely tested on the labor force data to determine if they increase the quality of the seasonal adjustments.[10] If they meet this test, they are incorporated into the official seasonal adjustment methodology.

[8] Ibid., p. 227.

[9] For an attempt at such a calculation, see Lawrence H. Summers, "Unemployment in the 1980 Recession," an unpublished paper presented at the October 2, 1980, meeting of the Brookings Panel on Economic Activity.

[10] The principal criterion that BLS uses to evaluate the quality of alternative seasonal adjustment methods is revision error; i.e., how close do the initial seasonally adjusted estimates come to later revisions? The method which produces smaller revision errors is deemed to be better.

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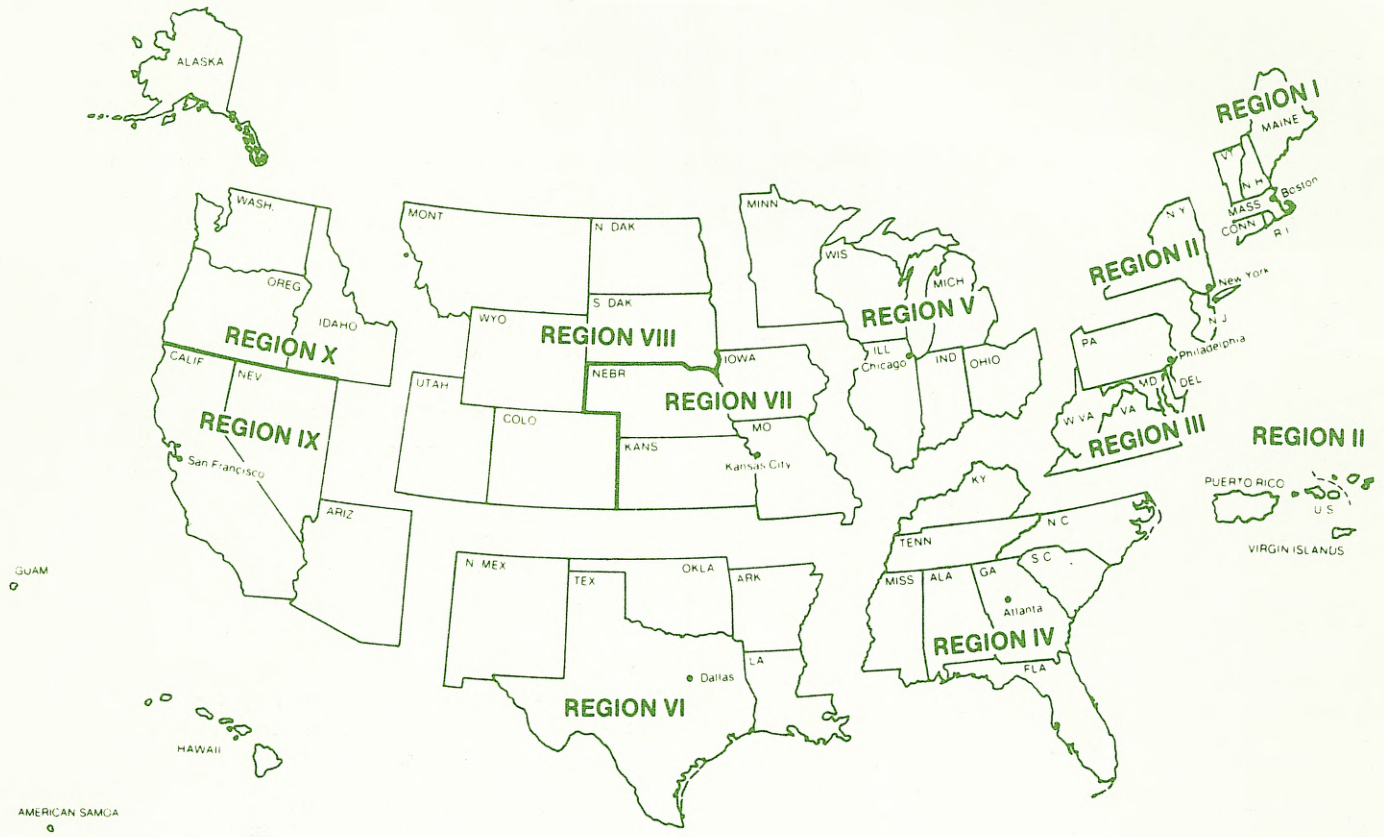

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