

## **A Graphical Interface for Weekly Seasonal Adjustment<sup>1</sup> October 2010**

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Seasonal adjustment of monthly and quarterly data is quite prevalent in many statistical agencies. Weekly adjustment, however, is not as widespread. One reason is that weekly series are less common. Other reasons relate to the complexity of the adjustments and lack of software. Cleveland and Scott (2007) describe a seasonal adjustment method for weekly data, and Evans, Fields, and Scott (2006) present a program containing a number of diagnostics and output tables. The purpose of this paper is to illustrate the diagnostics and introduce a graphical interface that simplifies the execution of the program. Numerous tables and graphs can be viewed in the interface and stored in pdf files. The program with enhanced documentation will be available from the authors.

**Key Words:** Spectral Analysis; Outliers; Diagnostics

Methods for performing weekly seasonal adjustment with time-varying seasonal factors have been developed and made available in FORTRAN programs by William P. Cleveland (formerly of the Federal Reserve Board). These programs, although advanced in many ways, had limited documentation and were not so easy to use. Growing interest and issues in the modeling and adjustment of weekly data have encouraged statisticians at the Bureau of Labor Statistics (BLS) to enhance Cleveland's software and improve the documentation. Stuart Scott of BLS modified Cleveland's programs and added documentation. This work was later extended by Evans, Fields, and Scott (2006). The purpose of this paper is to describe the recent addition of a graphical interface to facilitate the execution of the program and to produce diagnostic graphs and tables. The layout of this paper is as follows: 1) a brief history of the program; and 2) a description of the interface and its output.

### **History**

The Federal Reserve Board originally used the X-11 approach to obtain seasonal factors for weekly series (e.g., see Simpson and Williams 1981). Since seasonal adjustment programs such as X-12-ARIMA, TRAMO/SEATS, and STAMP assume constant periodicities, it was likely clear that another method was required. The first rigorous attempt at weekly seasonal adjustment is probably by Pierce, Grupe, and Cleveland (1984) that proposes a model-based approach with deterministic seasonality. From this work, Cleveland created a FORTRAN program designed to handle weekly seasonal adjustment (Cleveland 1986). A problem with this method is that it does not allow for stochastic seasonality. Cleveland (1993) addressed this issue by adding locally weighted regressions. Examples for this approach are shown in Cleveland and Scott (2007). BLS adopted the new moving seasonality approach with much success in 2002 for weekly Unemployment Insurance (UI) Claims data. The UI data are published by the Employment and Training Administration (see [http://workforcesecurity.doleta.gov/unemploy/claims\\_arch.asp](http://workforcesecurity.doleta.gov/unemploy/claims_arch.asp)). Changes were later made to the FORTRAN code by Evans, Fields, and Scott (2006) to add diagnostics and improve the machine readability of the output files. The revised program is titled "MoveReg" which is short for "Moving Regressions." The next obvious step was to expand the documentation and

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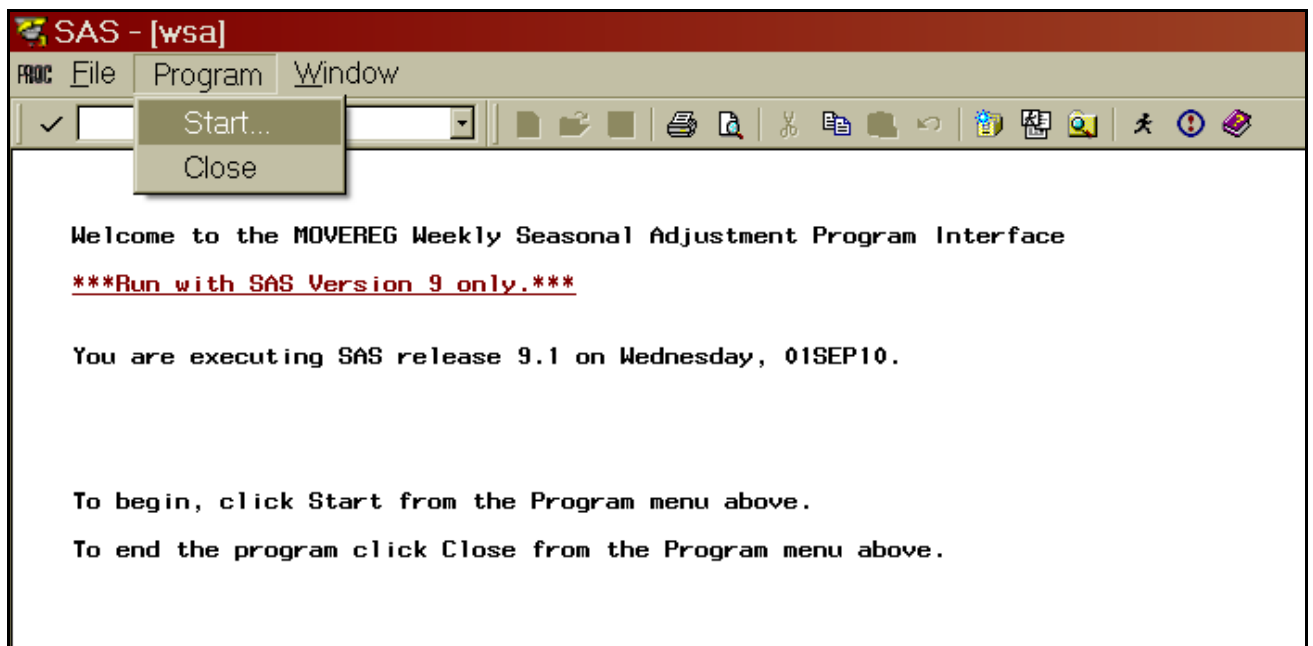
<sup>1</sup> Disclaimer: Opinions expressed in this paper are those of the authors and do not constitute policy of the Bureau of Labor Statistics.

to make the program easier to set up and execute.

### The SAS Interface

This section gives an illustration of screenshots of the SAS interface. The input control and data files are automatically created by the SAS code which can significantly reduce the possibility of errors. Note that the interface is available for both UNIX and Windows, but the FORTRAN program can also be executed without the interface at the command line. If one chooses to execute the program from the command line without the interface, control and data files need to be created with a programming language like SAS or with a text editor. Requirements and examples for setting up these files are in the MoveReg documentation.

Before starting the interface, some settings can be specified in text files. These include additive outliers and weights for the ten U.S. holidays that are built into the FORTRAN code. User-defined events can be added to the data input file by providing SAS code to create dummy variables in a text file. Once the SAS program is started, the user selects “Start” from the Program menu. This will bring up a window to specify program options that are seen in the second graphic below.



**Start** ✕

Enter the date for the beginning week to use for seasonal adjustment  
using the following numerical format: MM/DD/YYYY (2 digits each for month  
and day and 4 digits for the year)

/  /

Enter the date for the last week to use for seasonal adjustment  
using the following numerical format: MM/DD/YYYY

/  /

NOTE: When entering dates, use the date for Saturday.

Check box if output desired:  Graphs

Type in a title for graphs:

Enter the name of the input variable (max 8 chars):

If you want to change any of the parameter values, fill in the blanks below.  
If left blank, the default values shown will be used.

|  | Default | User-Specified       |
|--|---------|----------------------|
| Num of Seasonal Periods (52 or 12):            | 52      | <input type="text"/> |
| Num of Additive Outliers (70 max):             | 0       | <input type="text"/> |
| Total Num of Holidays (including user events): | 0       | <input type="text"/> |
| Width of Detrending Filter:                    | 2       | <input type="text"/> |
| AR Parameter:                                  | 0.4     | <input type="text"/> |
| Variance Ratio:                                | 16      | <input type="text"/> |
| Num of Seasonal Frequencies:                   | 60      | <input type="text"/> |
| Num of Forecasts for Seasonal Factors:         | 104     | <input type="text"/> |

Is your input data file a SAS file or text?  
 SAS  Text

Enter input data file name:

Did specify any user-defined effects?  
 Yes  No

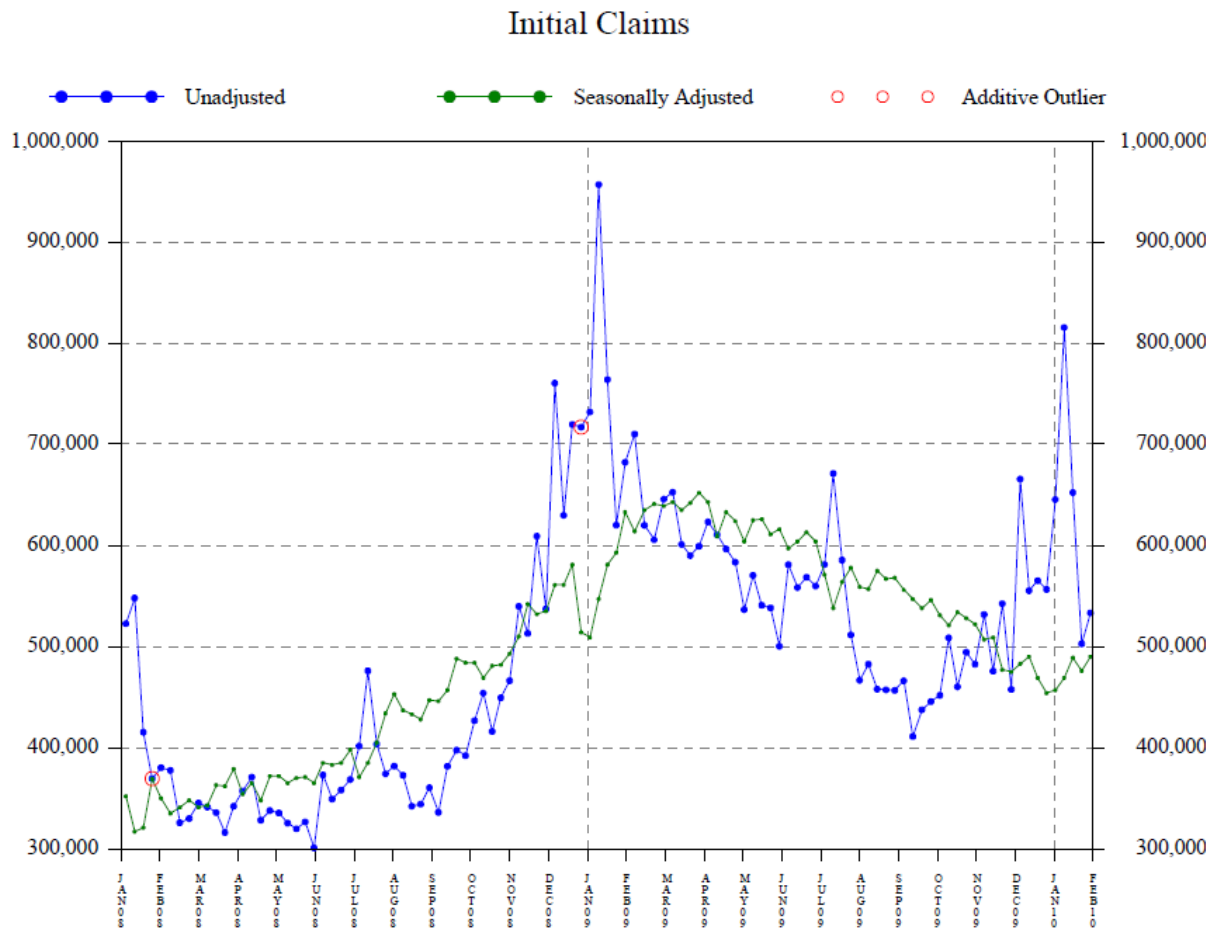
Select factor for scaling in graphs:  
 1000  100  10  None

The “Start” window shown above allows the user to specify required program parameters. All available settings can be specified with this window except for holiday weights and user-defined events as explained above.

The beginning and ending dates are entered at the top of the window. In the following section, one can indicate if graphs are desired, type in the title, and specify the variable of interest. The eight small boxes that follow are for settings in the control file. The “Width of Detrending Filter” is to specify differencing; the “AR parameter” controls how fast the seasonal factors move; the “Variance Ratio” is a noise-to-signal ratio that works in a similar way to the moving averages in X-11 for the seasonal filters; the “Num of Seasonal Frequencies” indicates how many sine and cosine pairs are needed for the trig seasonal component; and the “Num of Forecasts for Seasonal Factors” is simply the number of desired

projected seasonal factors. The input data can be in either a SAS database or a text file (check the appropriate radio box), and the name of the data file is entered in the next box. Then, if user-defined events are needed for the input data file, one selects the “Yes” radio button in the next line. Finally, scaling choices are provided through radio buttons in the last line for the graphs that are output to a pdf.

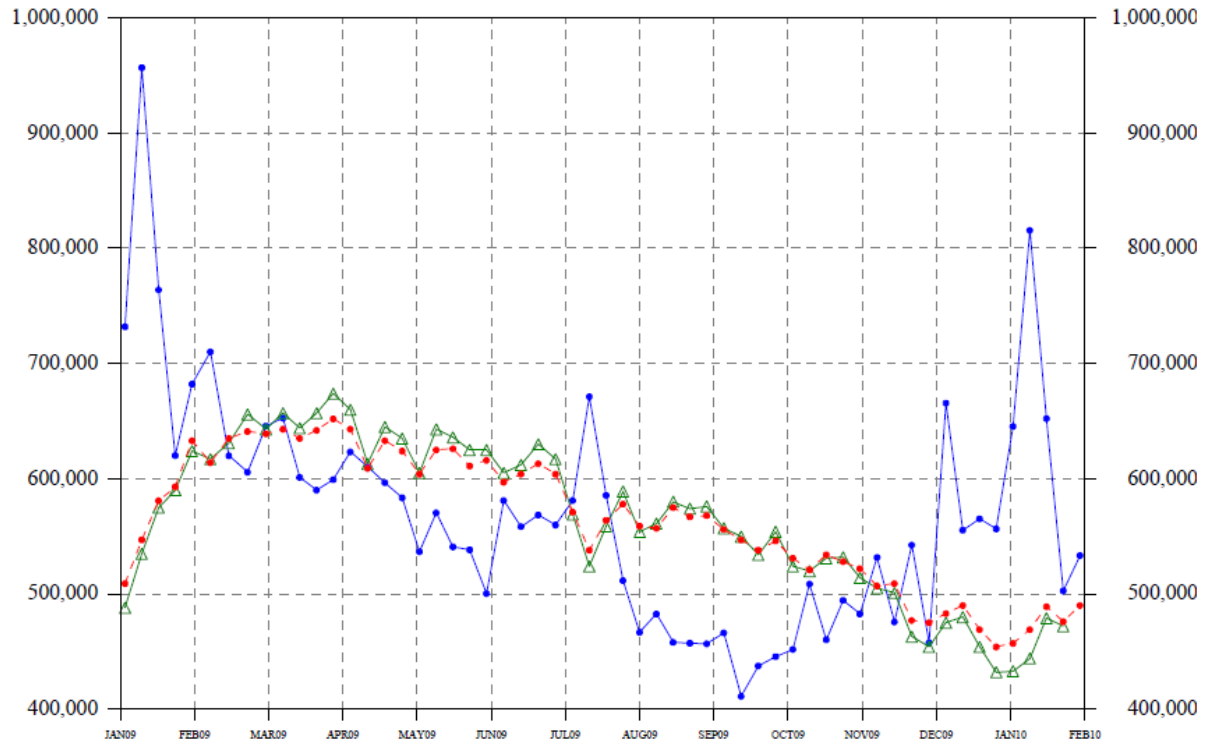
A SAS macro is provided to change the default options for the “Start” window. This macro also allows the user to select graphs for the pdf. The choices include time series plots for 1) the unadjusted series, the seasonally adjusted series, and outliers; 2) revisions for the last year; 3) average seasonal factors by week; 4) seasonal factors over time; 5) projected seasonal factors; 6) seasonal sub-plots by week, 7) trig coefficient sub-plots; and 8) a spectral plot. Two examples of graphs are below.



January 2009 to January 2010 IC Revisions (000s)

2009 % Revision Statistics:  
 N = 57, Mean = 0.03, Abs Mean = 1.64  
 Median = 0.52, Abs Median = 1.44, Abs Max = 3.26

●—● Unadjusted      △—△ Preliminary  
●-● Revised        ○ ○ ○ Additive Outlier



Text files with results and diagnostics are produced by the FORTRAN program (with or without the SAS interface). One of the seven text files is shown below as an example.

MoveReg Version 2.02  
 Execution at 12:21, 04-AUG-2010  
 series: ic  
 series begins: 1988 week: 05  
 series ends: 2010 week: 05  
 output file: anova.out

| COMPONENT    | DoF  | SS      | MSS    | F        | P-Value |
|--------------|------|---------|--------|----------|---------|
| Holiday      | 13   | 7.2276  | 0.5560 | 256.9495 | 0.0000  |
| Outliers     | 23   | 0.8726  | 0.0379 | 17.5339  | 0.0000  |
| Seasonal     | 60   | 8.1690  | 0.1361 | 62.9231  | 0.0000  |
| Linear trend | 2    | 0.0002  | 0.0001 | 0.0495   | 0.9517  |
| Model        | 98   | 16.6844 | 0.1702 | 78.6826  | 0.0000  |
| Error        | 1050 | 2.2719  | 0.0022 |          |         |
| Total        | 1148 | 18.9563 | 0.0165 |          |         |

R-Square= 88.01%

Box-Ljung statistic (approx. chi-square)

| DoF | Q        | P-Value |
|-----|----------|---------|
| 53  | 294.6149 | 0.0000  |
| 106 | 491.7771 | 0.0000  |

Outlier estimates

| WK | YEAR | FACTOR | STD ERR | T-Value | P-Value |
|----|------|--------|---------|---------|---------|
| 40 | 1989 | 1.1886 | 0.0341  | 5.0638  | 0.0000  |
| 30 | 1992 | 1.4044 | 0.0340  | 9.9809  | 0.0000  |
| 30 | 1993 | 1.3442 | 0.0341  | 8.6841  | 0.0000  |
| 52 | 1993 | 0.8753 | 0.0346  | -3.8534 | 0.0001  |
| 5  | 1994 | 1.1238 | 0.0340  | 3.4297  | 0.0003  |
| 3  | 1996 | 1.1684 | 0.0348  | 4.4663  | 0.0000  |
| 38 | 2001 | 1.1247 | 0.0443  | 2.6518  | 0.0041  |
| 39 | 2001 | 1.2756 | 0.0571  | 4.2683  | 0.0000  |
| 40 | 2001 | 1.1685 | 0.0626  | 2.4908  | 0.0064  |
| 41 | 2001 | 1.1574 | 0.0627  | 2.3326  | 0.0099  |
| 42 | 2001 | 1.1254 | 0.0575  | 2.0544  | 0.0201  |
| 43 | 2001 | 1.1065 | 0.0443  | 2.2843  | 0.0113  |
| 47 | 2001 | 1.1656 | 0.0392  | 3.9061  | 0.0000  |
| 48 | 2001 | 1.1626 | 0.0401  | 3.7541  | 0.0001  |
| 37 | 2005 | 1.2907 | 0.0437  | 5.8382  | 0.0000  |
| 38 | 2005 | 1.2486 | 0.0551  | 4.0328  | 0.0000  |
| 39 | 2005 | 1.0690 | 0.0585  | 1.1413  | 0.1270  |
| 40 | 2005 | 1.1274 | 0.0551  | 2.1767  | 0.0149  |
| 41 | 2005 | 1.1129 | 0.0438  | 2.4433  | 0.0074  |
| 1  | 2006 | 1.1135 | 0.0348  | 3.0918  | 0.0010  |
| 2  | 2007 | 0.8656 | 0.0348  | -4.1481 | 0.0000  |
| 4  | 2008 | 1.1107 | 0.0352  | 2.9796  | 0.0015  |
| 52 | 2008 | 0.9327 | 0.0345  | -2.0186 | 0.0219  |

Holiday estimates

| HOLIDAY      | FACTOR | STD ERR | T-Value  | P-Value |
|--------------|--------|---------|----------|---------|
| User         | 1.1179 | 0.0210  | 5.3137   | 0.0000  |
| User         | 1.0517 | 0.0197  | 2.5545   | 0.0054  |
| User         | 0.8998 | 0.0219  | -4.8240  | 0.0000  |
| New Years    | 1.0835 | 0.0098  | 8.1904   | 0.0000  |
| MLK Day      | 0.8364 | 0.0153  | -11.6711 | 0.0000  |
| Presidential | 0.9430 | 0.0148  | -3.9562  | 0.0000  |
| Easter       | 0.9519 | 0.0072  | -6.8450  | 0.0000  |
| Memorial Day | 0.8895 | 0.0146  | -7.9957  | 0.0000  |
| 4th of July  | 0.9614 | 0.0147  | -2.6756  | 0.0038  |
| Labor Day    | 0.8931 | 0.0149  | -7.6049  | 0.0000  |
| Columbus Day | 0.9629 | 0.0155  | -2.4471  | 0.0073  |
| Veterans Day | 0.8713 | 0.0144  | -9.5525  | 0.0000  |
| Thanksgiving | 0.7996 | 0.0155  | -14.4212 | 0.0000  |

Seasonal estimates

| TERM | FACTOR | STD ERR | T-Value | P-Value |
|------|--------|---------|---------|---------|
| 1    | 0.3240 | 0.1619  | 2.0015  | 0.0228  |

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|    |         |        |          |        |
|----|---------|--------|----------|--------|
| 2  | 1.6780  | 0.1620 | 10.3602  | 0.0000 |
| 3  | -0.0234 | 0.0818 | -0.2854  | 0.3877 |
| 4  | 1.5972  | 0.0818 | 19.5164  | 0.0000 |
| 5  | -0.2326 | 0.0558 | -4.1709  | 0.0000 |
| 6  | 0.0322  | 0.0558 | 0.5768   | 0.2821 |
| 7  | 0.4229  | 0.0428 | 9.8729   | 0.0000 |
| 8  | 0.5483  | 0.0430 | 12.7384  | 0.0000 |
| 9  | 0.0114  | 0.0348 | 0.3284   | 0.3714 |
| 10 | -0.1131 | 0.0357 | -3.1736  | 0.0008 |
| 11 | 0.3553  | 0.0299 | 11.8764  | 0.0000 |
| 12 | 0.1250  | 0.0303 | 4.1300   | 0.0000 |
| 13 | 0.0401  | 0.0261 | 1.5338   | 0.0627 |
| 14 | 0.0950  | 0.0273 | 3.4741   | 0.0003 |
| 15 | 0.4968  | 0.0245 | 20.3092  | 0.0000 |
| 16 | -0.0020 | 0.0241 | -0.0812  | 0.4677 |
| 17 | -0.0440 | 0.0233 | -1.8877  | 0.0297 |
| 18 | 0.0547  | 0.0212 | 2.5846   | 0.0049 |
| 19 | 0.1392  | 0.0212 | 6.5573   | 0.0000 |
| 20 | 0.0432  | 0.0207 | 2.0933   | 0.0183 |
| 21 | -0.1061 | 0.0203 | -5.2294  | 0.0000 |
| 22 | 0.0899  | 0.0197 | 4.5537   | 0.0000 |
| 23 | 0.4046  | 0.0199 | 20.3641  | 0.0000 |
| 24 | -0.0119 | 0.0184 | -0.6469  | 0.2590 |
| 25 | -0.0746 | 0.0194 | -3.8503  | 0.0001 |
| 26 | 0.1261  | 0.0168 | 7.4868   | 0.0000 |
| 27 | -0.0628 | 0.0177 | -3.5396  | 0.0002 |
| 28 | 0.0053  | 0.0171 | 0.3081   | 0.3791 |
| 29 | -0.0846 | 0.0170 | -4.9860  | 0.0000 |
| 30 | 0.0453  | 0.0167 | 2.7054   | 0.0035 |
| 31 | -0.0460 | 0.0155 | -2.9603  | 0.0016 |
| 32 | -0.1118 | 0.0171 | -6.5482  | 0.0000 |
| 33 | -0.0844 | 0.0150 | -5.6288  | 0.0000 |
| 34 | 0.0601  | 0.0164 | 3.6609   | 0.0001 |
| 35 | -0.1201 | 0.0153 | -7.8670  | 0.0000 |
| 36 | -0.0105 | 0.0154 | -0.6859  | 0.2465 |
| 37 | -0.0119 | 0.0143 | -0.8330  | 0.2026 |
| 38 | 0.0006  | 0.0154 | 0.0378   | 0.4849 |
| 39 | 0.0360  | 0.0145 | 2.4807   | 0.0066 |
| 40 | -0.0963 | 0.0141 | -6.8192  | 0.0000 |
| 41 | 0.0262  | 0.0142 | 1.8536   | 0.0320 |
| 42 | -0.0239 | 0.0150 | -1.5892  | 0.0562 |
| 43 | -0.0087 | 0.0148 | -0.5859  | 0.2791 |
| 44 | -0.0139 | 0.0135 | -1.0244  | 0.1530 |
| 45 | 0.0104  | 0.0137 | 0.7599   | 0.2238 |
| 46 | -0.0257 | 0.0134 | -1.9202  | 0.0276 |
| 47 | 0.0919  | 0.0125 | 7.3646   | 0.0000 |
| 48 | -0.1794 | 0.0140 | -12.8131 | 0.0000 |
| 49 | -0.0339 | 0.0138 | -2.4642  | 0.0069 |
| 50 | -0.0086 | 0.0121 | -0.7139  | 0.2378 |
| 51 | -0.0454 | 0.0126 | -3.6072  | 0.0002 |
| 52 | 0.0567  | 0.0130 | 4.3495   | 0.0000 |
| 53 | -0.0382 | 0.0127 | -3.0156  | 0.0013 |
| 54 | 0.0208  | 0.0128 | 1.6222   | 0.0526 |
| 55 | -0.0839 | 0.0137 | -6.1481  | 0.0000 |
| 56 | -0.0383 | 0.0114 | -3.3458  | 0.0004 |
| 57 | -0.0308 | 0.0135 | -2.2729  | 0.0116 |
| 58 | -0.0154 | 0.0118 | -1.3008  | 0.0968 |
| 59 | 0.0365  | 0.0130 | 2.8062   | 0.0026 |
| 60 | 0.0295  | 0.0120 | 2.4653   | 0.0069 |

Trend estimates

| DEGREE    | FACTOR | STD ERR | T-Value | P-Value |
|-----------|--------|---------|---------|---------|
| intercept | 0.0003 | 0.0014  | 0.1909  | 0.4243  |
| slope     | 0.0000 | 0.0000  | 0.2496  | 0.4015  |

The MoveReg FORTRAN program, SAS interface, and documentation will be available from the authors by e-mail: [evans.thomas@bls.gov](mailto:evans.thomas@bls.gov) or [byun.david@bls.gov](mailto:byun.david@bls.gov).

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