A Graphical Interface for Weekly Seasonal Adjustment[1] 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). 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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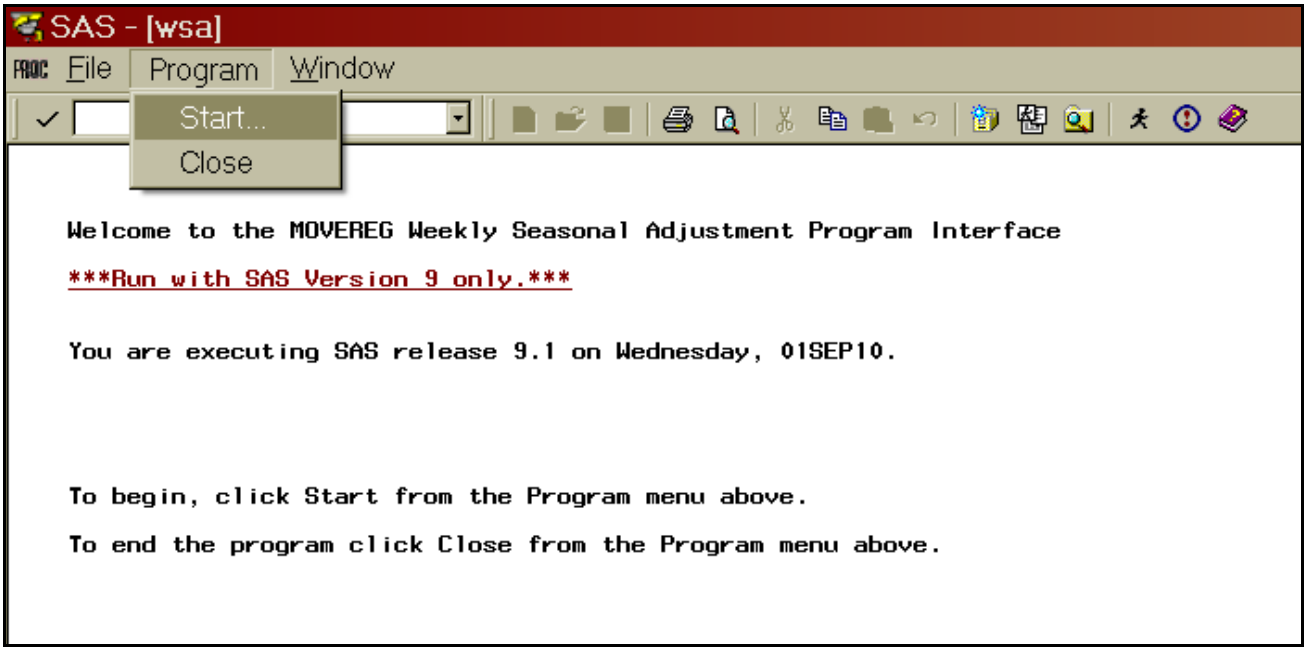
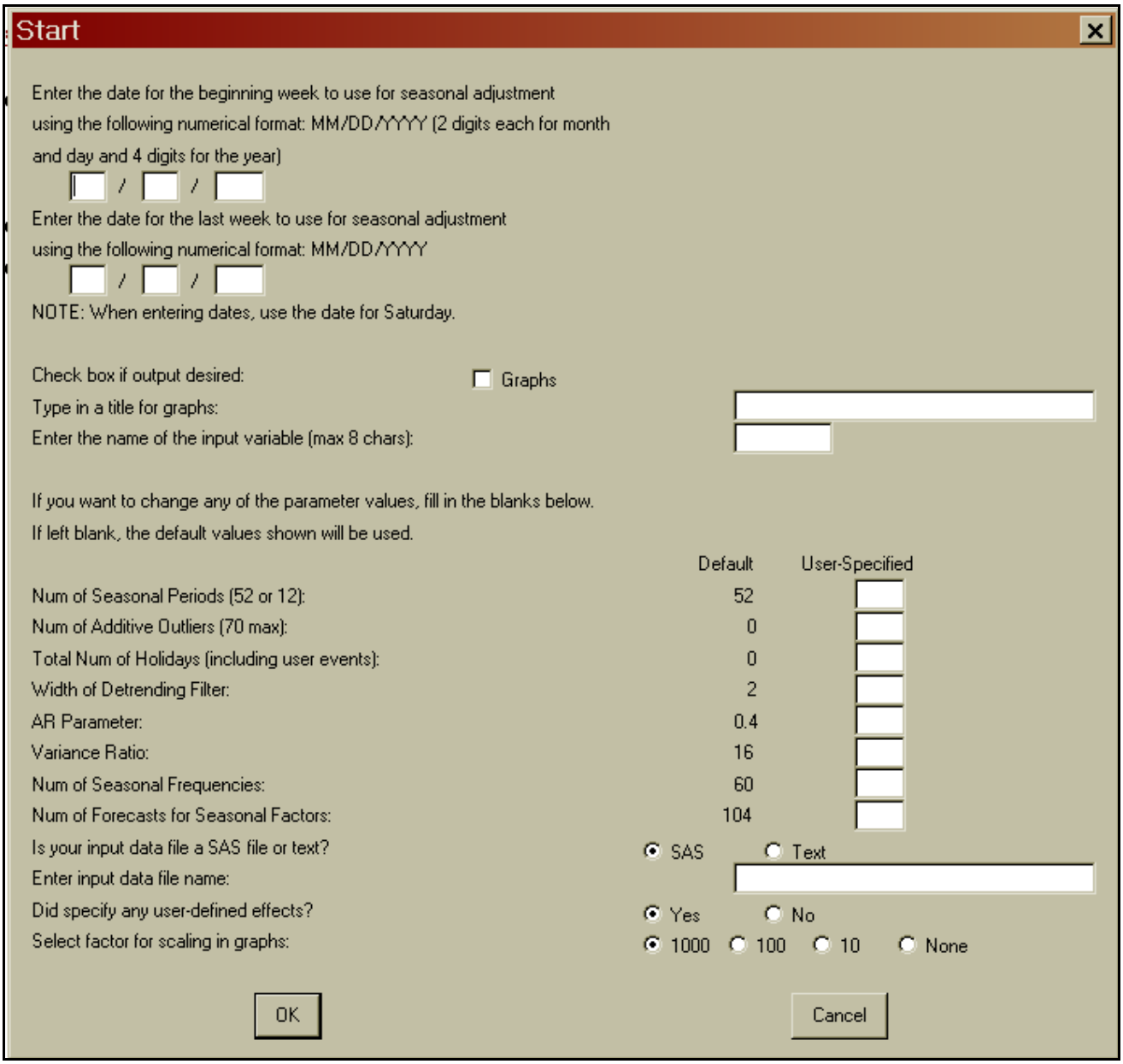
to make the program easier to set up and execute.

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.



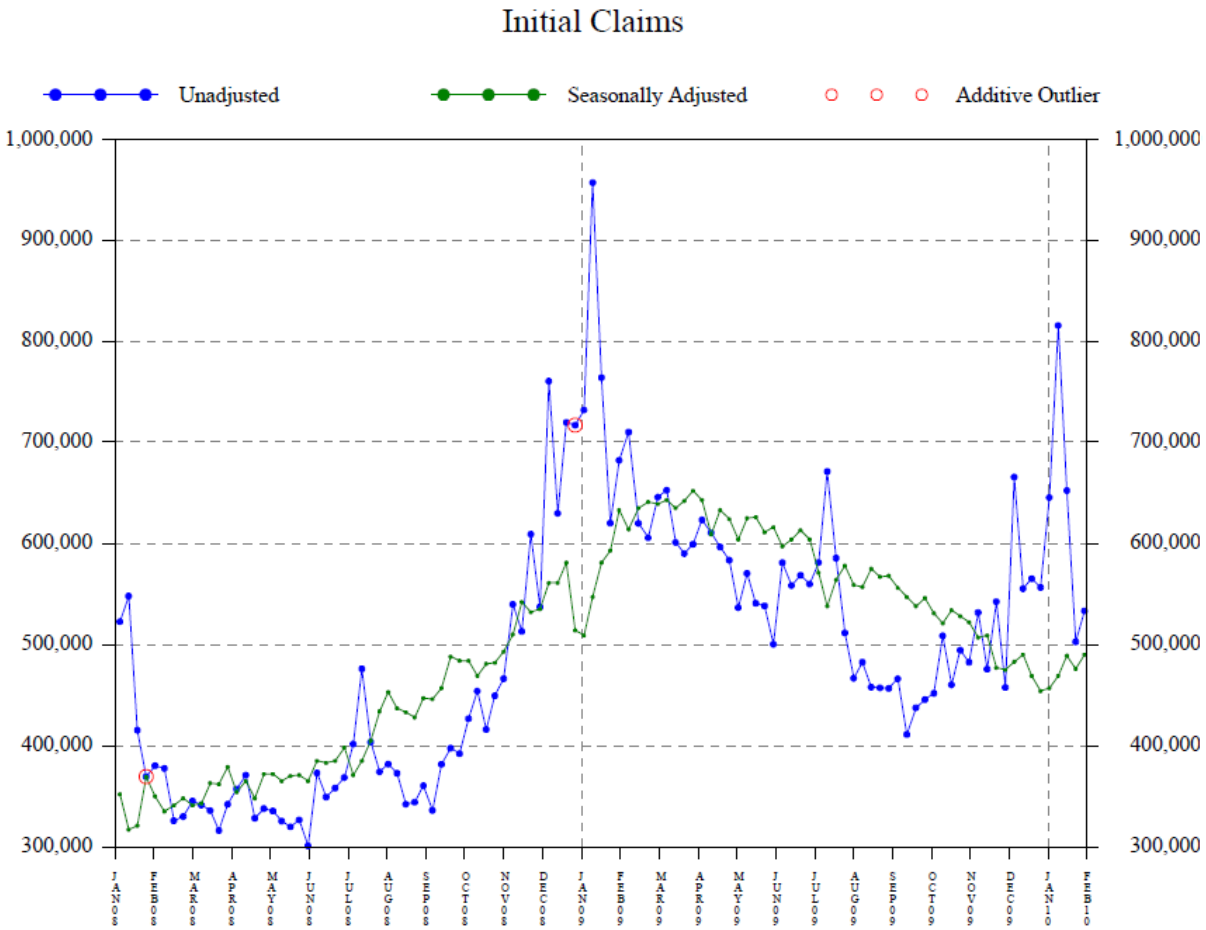


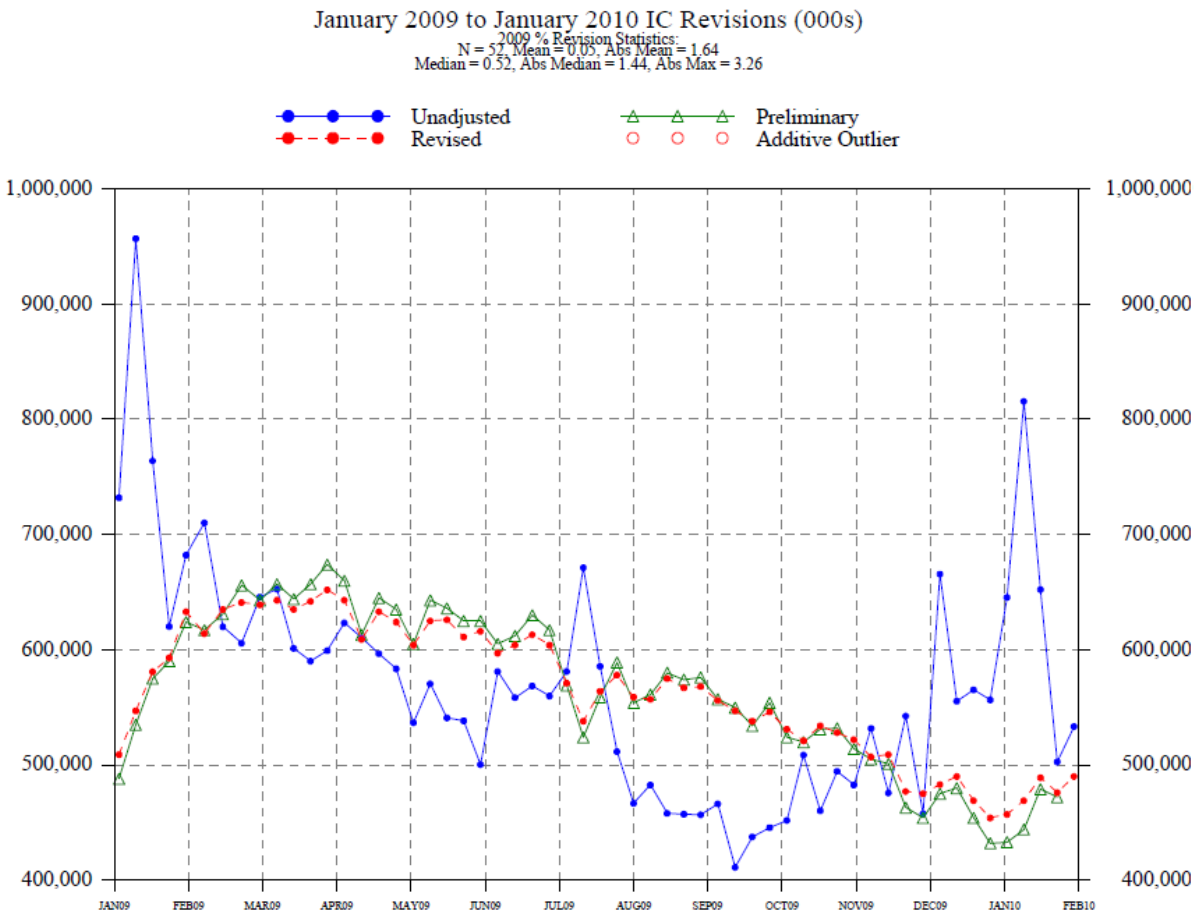
The "Start" window shown above allows the user to specify required program parameters. All available settings can be specified with this window except for holiday weights and user-defined events as explained above.

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.





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

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 or byun.david@bls.gov.

References

Cleveland, W.P. (1986), "Calendar Adjustment and Time Series," Special Studies Paper, no 198, Division of Research and Statistics, Federal Reserve Board, Washington, DC.

Cleveland, W.P. (1993), "A Time-Varying Least Squares Approach to Seasonal Adjustment of Weekly Time Series," unpublished paper.

Cleveland, W.P., and Scott, S. (2007), "Seasonal Adjustment of Weekly Time Series with Application to Unemployment Insurance Claims and Steel Production," *Journal of Official Statistics*, 23, 209-221.

Evans, T.D., Fields, J.L., and Scott, S. (2006), "Developing and Improving a Moving Regression Weekly Seasonal Adjustment Program," presented at EUROSTAT conference on seasonal adjustment in Luxembourg.

Pierce, D.A., Grupe, M.R., and Cleveland, W.P. (1984), "Seasonal Adjustment of Weekly Monetary Aggregates: A Model-Based Approach," *Journal of Business & Economics Statistics*, 2, 260-270.

Simpson, T.D., and Williams, J.R. (1981), "Recent Revisions in the Money Stock," *Federal Reserve Bulletin*, 67, 539-542.