Evaluation of X-11 and Model-based Seasonal Adjustment Methods for Economic Time Series

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1. Introduction

The U.S. Bureau of Labor Statistics is currently evaluating X11, ARIMA, and structural model approaches to seasonal adjustment of its economic time series. This paper represents "work in progress," as the project is just now entering its first evaluation phase. A disadvantage is that I do not have conclusions to report to the conference. An advantage is that feedback I receive here can still be considered during our evaluation. Those of us involved in the project hope (1) to lead BLS to consider greater use of models in seasonal adjustment when they are likely to be beneficial and (2) to serve the broader seasonal adjustment community with an up-to-date and substantive evaluation of these methods.

The next section will describe the conduct of the project and the design of the initial phase of the evaluation. Section 3 will discuss diagnostics. Section 4 contains some impressions from results at this early stage.

2. Project Management and design

2.1. "A team effort"

The project is being carried out by a team of economists and mathematical statisticians from across the Bureau, listed at the end of the document and headed by me. Eleven are official team members and another five have been participating actively. This project is part of an effort for more sharing of expertise and work across Bureau offices. We report to an Innovation Board, which charters projects like ours. We provide the Board with quarterly progress reports and send our products for review. Like most work at BLS, seasonal adjustment is decentralized. Production work is carried out within individual programs within our three largest offices, employment and unemployment statistics, prices, and wages. I am in a small central research office, with no production responsibility. I offer advice on seasonal adjustment and have participated in several projects with individual programs to address special issues. Information has been shared across programs through meetings of an informal "Seasonal Adjusters" group.

Work of the team began in Jan 2005. After initial steps in team functioning, we went through some preparatory stages.

Education
- technical presentations on methodology and diagnostics
- presentations on software (X-12-ARIMA, TRAMO/SEATS, STAMP)

Current practices
- interviewing individuals involved in seasonal adjustment for seven Bureau programs and combining information into an internal report

Computing
- creating a shared drive for project members
- developing programs for putting data into common formats

This step took nine months. The content and the extended amount of time were required because project members commit to only 5-10% of their time and meetings have been biweekly. Substantial time on education was important since most participants have limited experience with time series modeling and a few had no experience with seasonal adjustment. So, an additional goal has been to expand the knowledge base at the Bureau.

The next three months were spent on experimental design and setting up the experiment. Out of seven programs considered, three were selected for the initial evaluation phase: Current Employment Statistics (CES), Consumer Price Indexes (CPI), and Producer Price Indexes (PPI). CES is a very large establishment survey collecting industry employment statistics. More than 200 national series are seasonally adjusted. The CPI seasonally adjusts more than 350 series, with indexes for detailed items and many large metropolitan areas. PPI seasonally adjusts hundreds of detailed items which are aggregated into three stages of processing, Crude, Intermediate, and Finished Goods. Its press release features Finished Goods, seasonally adjusted. Staff from these programs helped select series: 25 for CES, 35 for CPI, and 22 for PPI. Most of the first four months of this year have been spent on the initial set of runs, plus preparation of graphs and summary tables. As described further in Sec. 2.2, the first set of runs have been carried out with X-13-SEATS, or X13 for short, with STAMP, and with a specialized program SSMB (State Space Model Based adjustment), the last two both working with structural models. The X13 automatic runs made a lot of demands on the software. Carrying out these runs was an iterative process, as we worked to simplify execution of the runs, learn new features in the software, and deal with some bugs. Brian Monsell, Census, was helpful in updating the software when difficulties arose. Also, STAMP is not very suited to production and automatic features are limited.

By late March, we began analysis. At this point, we have tailored SAS programs which compute diagnostics, summarize diagnostics in tables, and prepare graphs, all of which will be illustrated in Sec. 4. A subteam has been formed for evaluation of each of the three programs. With this approach, each project member has the opportunity to consider all three methods, an appealing feature.

Obviously, this has been an inefficient process. A team of 5 or 6 with strong backgrounds in seasonal adjustment and the software could have accomplished this in half the time or less, provided they could devote more than 10% of their time to it. However, I believe the process has been fruitful. There has been a lot of sharing of knowledge. While I had worked on projects in all three of these programs, no one else on the team had crossed office lines to any extent. Practitioners have received exposure to methodology in more depth. All of us are learning about the new SEATS part of X13. The current version even contains the new diagnostics for ARIMA-based seasonal adjustment based on papers of Findley and McElroy and Maravall, which Findley is presenting at this conference. The review of diagnostics has led to useful discussions on diagnostics which go across methods. Four project members have had limited experience with seasonal adjustment; I believe the next couple of months will determine how successful this has been for them.

2.2. Evaluation experiment

Phase 1

Our first evaluations involves three stages:

(1) "automatic" seasonal adjustment,

(2) seasonal adjustment with analyst selection of models and interventions, and

(3) direct and indirect adjustment of aggregates.

The X13 runs for (1) allow automatic selection of X11 filters, ARIMA models, outliers, and adjustment mode. There are some exceptions. Known calendar effects are included in the case of several employment series. For difficult price series, such as energy-related series, interventions and outliers used in production are used as a starting point. Experience has shown that automatic detection is inadequate for such series; for instance, ramp interventions occur and are not part of automatic detection.

For (2), we plan to select at least six series from each program for more in-depth analysis. Sometimes, X11 quality control (QC) statistics or ARIMA model diagnostics show inadequacies which we can attempt to address. Sometimes, in order to accomplish decomposition, SEATS discards the model initially identified. Some automatic runs allow for seasonal outliers (SO). This type, new to X13, is selected for 8 of 25 employment series and a few price series. We want to check their suitability. For our automatic runs, we have used X13 for ARIMA-based seasonal adjustment, since we are more familiar with it than with TRAMO/SEATS. Some project members, however, feel that TRAMO's model identification may work better than X13's AUTOMDL. These and other issues can be examined more closely and efforts made to improve on the automatic results. We will also compare signal extraction results from the two software packages, but we expect them to agree closely. Two individuals are carrying out seasonal adjustment with structural models. STAMP Version 6 is being run on a subset of series in the project. We hope that Version 7 will be available before we complete our evaluation. The structural model approach is also used in SSMB (Jain, 2001), a program written in GAUSS which includes numerous diagnostics and graphs. Since neither STAMP nor SSMB has quite the automatic capabilities of X13 or TRAMO/SEATS, their results will fit best during this detailed modeling evaluation.

BLS uses indirect adjustment to a great extent in order to achieve consistency between components and aggregates. Our highest level labor force aggregates, including the unemployment rate, are adjusted indirectly from four employment and four unemployment series, which are adjusted directly. For the three programs in our Phase 1 evaluation, indirect adjustment is used from a fairly detailed level. Our study will examine two intermediate-level aggregates from each program.

Phase 2

This phase of the project will involve sampling error considerations. Models will be formulated which include a sampling error component. BLS in 2005 began using model-based seasonal adjustment with structural models for its state labor force statistics. Since 1992, time series models have been used to estimate state employment and unemployment rates. Viewed as a small area estimation method, this approach (Tiller, 1992) borrows strength across time, rather than the usual approach of borrowing strength across geographical area. The time series estimates, computed as the observed value minus a sampling error estimate, were then seasonally adjusted with the X11 method until 2005. Since then, seasonal adjustment has come from bivariate time series models, which allow removal of a seasonal component.

In recent years, sampling error autocovariance estimates have become available for CES series and have been improved for the Current Population Survey, which provides labor force statistics at both national and state level. Building from the work of Tiller, the team aims to compare model-based methods with sampling error components to X11, which lacks a direct means of handling sampling error. While both Tiller and Jain have used structural models with sampling error, work with ARIMA models will also be carried out. One approach is to use William Bell's REGCMPNT software (Bell, 2003) to decompose an observed series into signal and sampling error parts with specified models. The resulting signal model can then yield component models for estimating trend and seasonal components.

It is hoped that variance measures for the error in seasonal adjustment can be analyzed. Measures for the X11 method (Pfeffermann, 1994 and Scott, Sverchkov, and Pfeffermann, 2005) can also be examined.

3. Diagnostics

X11 has a battery of diagnostics developed by Lothian and Morry (1978) at Statistics Canada under the direction of Estella Dagum and building in part from ideas of Julius Shiskin. Time series models have numerous diagnostics, with the advantage that they typically permit formal testing or interval estimation. Still, we know that diagnostics of seasonal adjustment are not entirely satisfactory, including comparisons across different methods. Here I will present diagnostics that we are using to compare across methods.

The first step is to assess presence of seasonality. Our principal test is to look for peaks at the seasonal frequencies in the spectrum of the differenced observed series. After seasonal adjustment, we can check for residual seasonality using the spectra of the differenced seasonally adjusted series, the irregular, and, especially important for SEATS, the ARIMA residuals. McElroy and Holan (2005) suggest formal statistical tests for significance of spectral peaks in recent work to be presented at the August statistical meetings in Seattle. Here, significance is based on the criterion of X13. Lag 12 autocorrelation in the residuals can also be examined.

Stability in estimation of the seasonal component or of other products of seasonal adjustment is another desirable property. For this, we use sliding spans and revisions statistics. In this paper, we focus on (1) percentiles of MPD (maximum % differences) for month-to-month change and (2) mean absolute revisions for 2- or 3-year test periods, where the "final value" is based on at least two years beyond the end of the test period.

Monthplots of seasonal factors give a strong visual impression of suitability of a seasonal adjustment. One looks for an overall pattern and for differences between the monthly means, which appear as horizontal lines in the monthly subplots, and also for within-month variability. In addition, we compute the F statistic from a one-way analysis of variance carried out on the final seasonal component. This is similar to, but not the same as X11's stable F, since the latter is carried out on a combined seasonal-irregular component at an intermediate stage. We feel this overall F statistic to some extent quantifies the visual impression from a monthplot. As illustrated in Sec. 4, the adjustment with the larger value may or may not be preferred. We also compute standard deviations of the seasonal factors by month. Overlay graphs with alternative trends and seasonally adjusted series are also valuable.

Again borrowing from traditional X12 diagnostics, we compute the relative contribution of components to change in the observed series. For a component *X* and a lag *d*, we compute

$$\bar{X}_d = \frac{1}{n-d}\sum_{t=d+1}^{n}\left|\frac{X_t}{X_{t-d}} - 1\right| \qquad \text{(multiplicative case)}$$

for $X = O, T, S, \text{and } I$ and for *d*=1,3,12, and 24. Simple absolute change is used in the additive case. The relative contribution of the irregular I at lag d is $100\% \times \bar{I}_d^2 / \bar{O}_d'^2$, where $\bar{O}_d'^2 = \bar{T}_d^2 + \bar{S}_d^2 + \bar{I}_d^2$. While these statistics don't directly assess quality of seasonal adjustment, they help quantify what is accomplished by a given method. All these statistics can be computed for all three seasonal adjustment approached considered.

Before making comparisons across methods, it seems important to

(1) test presence of seasonality in the observed series

and

(2) test acceptability of seasonal adjustment with each individual method, using the usual diagnostics for that method.

4. Results

The evaluation teams are currently meeting and just beginning to share their analyses. What I present are some early personal impressions, not necessarily the views of the team or even my final views. They do give some sense of the cross-method diagnostics we are using and illustrate features of the experimental X13 software. Our experiment also allows us to consider connections between X11 filter choices and ARIMA models, a topic explored by Depoutot and Planas (1998) at another Eurostat conference on seasonality. Recall that so far we are considering only “automatic” results. As we move into the next stage of the evaluation, there will be scope for using the automatic results to improve adjustments with one or more of the methods. Much of the time we can expect similar results: similar adjustments or similar indications that seasonal adjustment is unacceptable.

So far, I personally have focused mostly on analyzing PPI series, listed in Table 1. The top half of Table 2 summarizes X11 Quality Control (QC) statistics, along with information on input spans, X11 options, and spectral peaks. The bottom half contains ARIMA model diagnostics. Now I will discuss a few examples.

PMEAT (PPI for Meats)

The single identified outlier, a temporary change (TC) at Oct 03, is quite prominent in the series graph (p. 12). Seasonality is not pronounced. The spectrum of the differenced observed series on p. 14 has peaks at seasonal frequencies 1 and 6, with a lesser peak at the fifth, which does affirm presence of seasonality.

SEATS appears to give an acceptable adjustment. An airline model provides an adequate fit, according to the Ljung-Box statistics. While the spectra of the seasonally adjusted series, the irregular, and the model residuals all have a peak at the sixth seasonal frequency, in no case is that peak a dominant feature. The monthplot of seasonal factors on p. 13 has a simple pattern, with limited within-month variability.

X11’s monthplot on p. 15 has a similar overall pattern, but much more within-month variation. Half the months change between positive and negative seasonality across time. Its QC statistics are marginal: FS=5.8, M7=1.1, Q2=0.96. Large values of M10 and M11 are consistent with the highly variable monthplot. Examining decomposition of one-month change, X11 assigns a larger proportion to the seasonal, 33%, compared to 25% for SEATS. The overall F statistic provides more confirmation, with a value near 1100 for SEATS, compared to 30 for X11. The spectrum of X11’s seasonally adjusted series also has a peak at the sixth seasonal frequency, so the more variable seasonal doesn’t show an advantage with respect to residual seasonality. In summary, SEATS provides an acceptable seasonal adjustment, while X11’s is quite marginal.

SEATS’ airline model parameters are -.19 and .88. Depoutot and Planas suggest that a 3x15 seasonal filter and a 9-point Henderson filter correspond most closely to this model, while X11’s automatic choices are the 3x5 and 13-point Henderson.

Interestingly, X11 provides a smoother trend, since it allocates only 13% of its change at a one-month lag to the trend, while the figure for SEATS is 50%. This is consistent with the component disturbance variances from the SEATS decomposition, with the trend disturbance more than twice that of the irregular.

PPUBL (PPI for Publications and Printed Matter)

The observed spectrum on p. 16 gives strong evidence for seasonality. SEATS fits a (111,011) model with barely passing Ljung-Box statistics. The seasonal MA parameter is 1, so the seasonal component is deterministic. The spectrum of residuals has no seasonal peaks, but the seasonally adjusted and irregular spectra have a minor peak at the second frequency.

X11 has positive QC statistics: FS=57, M7=0.3, Q2=.25. Its spectra on p. 17 show no seasonal peaks. The monthplot on p. 18 from X11 shows a simple seasonal pattern: prices jump in January and decline through the year; the monthly factors are reasonably stable.

This series is dominated by a simple, largely linear trend. Seasonal adjustment lends a small amount of smoothing. The possibility of residual seasonality crops up in SEATS’ adjustment, but not X11’s. X11 appears to have a slight edge: we prefer to allow for moving seasonality, which X11 gives, without undue instability. This series illustrates caution in using the overall F statistic. With a deterministic seasonal, this statistic becomes infinite, since there is no within-month variation. So, the overall F rewards the more stable seasonal; sometimes this is desirable, sometimes not.

SCENTRAN (Employment in Scenic and Sightseeing Transportation)

The graph on p. 19 contains the observed series. Seasonality dominates, but drastic changes in recent years suggest difficulties for seasonal adjustment. From the graph, one would prefer to divide the series into two pieces, but the time span is limited, only 12 years in all. X13 has an option which looks appropriate here: a change-of-regime option which can estimate distinct deterministic seasonals before and after a specified date. The abrupt change is largely due to changes in survey methods, rather than the industry itself. It coincides with the introduction of new industry coding, namely the North America Industrial Classification System. Earlier data come from a reconstruction using data collected on the old coding system, which does not appear to have worked well for this series.

For now, I analyze our automatic runs, which illustrate a couple of features of the software. Twelve outliers were automatically identified, with t-statistics ranging from 4.8 to 28 in magnitude. Among them are 2 seasonal outliers (SO's). X13 uses an outlier variable definition appearing in Bell (1983), which takes the value 1 for earlier occurrences of the given month and compensating values -1/11 for the other months earlier in the series. It is satisfying that the automatic outlier procedure has found SO's for Jul 01 and Sep 01. Among the other outliers are a negative TC at Nov 01 and a negative LS in Jan 02, a period when the travel industry was contracting in the wake of the 9/11 attacks. Even this large outlier set does not fully capture the changes that occur, but they point in the right direction.

Given the drastic change in the series behavior, both methods cope fairly well by finding appropriate outliers and by estimating rapidly changing seasonality. With SEATS, the identified (301,011) model has no acceptable decomposition. Two other complicated models also fail in decomposition, so an airline model is used. With MA(1) parameter 0.99 and MA(12) parameter 0, SEATS is putting about as much variability into the seasonal as possible. The great movement in its monthplot illustrates this (p. 20). The table below shows that SEATS has put more variability into the seasonal than X11, which seems helpful.

Decomposition Statistics (%)	Trend	Seasonal	Irregular
X11	2.4	91.2	6.4
SEATS	0.8	97.9	1.3

X11 has chosen the 3x3 seasonal filter and the 9-point Henderson. According to Depoutot and Planas (1998), the 23-point Henderson would be more appropriate.

PDIE2 (PPI for #2 Diesel Fuel)

SEATS identifies a nonseasonal (011) model. Of course, X11 dutifully estimates a seasonal component. Its QC statistics are marginal: FS=7.6, M7=0.8, and Q2=0.78. M10 and M11 indicate substantial variability in the seasonal, which is also seen in the monthplot on p. 21. This plot does show a seasonal pattern which price analysts believe has some validity. The observed spectrum on p. 22 has a peak at the second seasonal frequency which is eliminated with X11 seasonal adjustment. Given the importance of this and other energy price series, BLS puts considerable effort into modeling interventions and outliers in order to carry out acceptable adjustments. The X11 decomposition statistics place about 25% of the variation in both seasonal and trend, with 50% going to the irregular.

This example shows that X11 may give evidence that seasonal adjustment is possible, even when seasonality is weak, compared to other components.

PPI series with weak indications of seasonality

Seven of 22 PPI series either have no seasonal peak deemed significant by X13 or only one of the higher frequencies 4, 5, or 6, which is somewhat less convincing. The table below shows that SEATS finds a seasonal model for only 2 of the 7. These are 2 of 3 series for which X11 reports an acceptable Q2 statistic. SEATS and X11 find a similar seasonal pattern for PEQSW, with very small seasonal factors. SEATS's model has an MA(12) parameter close to 1, yielding a highly stable seasonal and, perhaps, providing a small amount of smoothing for the observed series. In the case of PFERT, a peak at the first seasonal frequency is prominent but not sufficiently isolated in the spectrum to be rated significant. Thus, the positive indications from X11 and SEATS may be justified for these two series. The signals are mixed for one series, PALM2. Neither supports adjustment for the remaining 4, although PGASP may merit further consideration, similar to PDIE2 above. Overall, for these weaker series, there is considerable agreement between the two methods.

Series	Observed spectral peaks	X11			SEATS		
		FS	M7	Q2	Model	LB(24) p-value	θ_{12}
palm2	-	13.1	0.8	0.56	011	.06	-
pbeef	6	1.8	2.1	1.59	011	.05	-
peqsw	-	6.9	0.9	0.66	011,011	.28	.92
pfert	5	22.7	0.6	0.47	011,011	.18	1.00
pgasp	6	6.6	1.0	0.93	011	.03	-
plamb	4	6.4	1.3	1.14	011	.03	-
pplas	4	2.2	1.5	0.92	011	.77	-

Sliding spans and revisions statistics

For the PPI series, the sliding spans and revisions statistics appear to favor SEATS. The table contains the number of series for which SEATS has lower statistics. C60 and CMAX are the 60th percentile and maximum of the MPD distribution for one-month change in the seasonally adjusted series. R75 and RMAX are the 75th percentile and maximum of revisions in the seasonally adjusted series. Only 4 of 16 series have lower C60 statistics with SEATS, but the situation is reversed for the three others. (Here, we are restricting attention to the 16 series for which SEATS identifies a seasonal model.) Still, change MPD's and revisions are mostly below 1%, so the differences are mostly rather small.

	C60	CMAX	R75	RMAX
# of PPI series with lower SEATS values (total # = 16)	4	12	10½	11
# series with statistics exceeding 1%				
X11	2	5	3	4
SEATS	2	5	2	2

5. Closing Remarks

BLS has made substantial use of time series models for at least 20 years. However, study/application of model-based seasonal adjustment has been mostly limited to a couple of programs. The current project is the broadest exploration to date.

The team approach is working so far. There have been a sharing of knowledge of methods and software and a sharing of useful SAS programs to streamline conduct of the experiments and facilitate analysis. The next month or so will tell us how well we are able to shape our opinions into a coherent report.

Already there are indications that at least for some series model-based seasonal adjustment can bring improvement. I'm hoping that our experience with incorporating sampling error information into time series modeling will bear fruit when we study model-based seasonal adjustment with this type of model.

Project Members

Nicole Brooks, David Byun, Dan Chow, Tom Evans, Mike Giandrea, Raj Jain, Chris Manning, Jeff Medlar, Randall Powers, Stuart Scott, Eric Simants, Jeff Smith, Michael Sverchkov, Richard Tiller, Daniell Toth, Jeff Wilson

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The views expressed are those of the author and do not represent official positions of BLS.

Table 1. Series and Codes for PPI Evaluation, with Weights for Components of Aggregate Series

Commodity group		Commodity code	Series Code	Title
01 – Farm Products (1)				
		011101	PFRUT	Citrus fruits
02 – Processed Foods & Feeds (5)				
avg. wt.		0221	PMEAT	Meats (IA)
	.538	022101	PBEEF	Beef & Veal
	.005	022103	PLAMB	Lamb/Mutton
	.270	022104	PPORK	Pork Products
	.187	022105	PMOTH*	Other Meats
05 – Fuels, etc (8)				
avg. wt.		054	PELEC	Electric power (IA)
	.421	0541	PERES	Residential
	.324	0542	PECOM	Commercial
	.225	0543	PEIND	Industrial
	.030	0545	PEOTH	Other
		057103	PGASP	Unleaded premium gasoline
		057302	POILH	Home heating oil
		057303	PDIE2	#2 diesel fuel
06 – Chemicals (1)				
		065101	PFERT	Mixed fertilizers
07 – Rubber & Plastic Products (1)		072	PPLAS	Plastic products
09 – Pulp & Paper (1)				
		093	PPUBL	Publication, printed matter, and printing
10 – Metals & Metal Products (1)		102402	PALM2	Secondary aluminum
11 – Machinery & Equipment (2)		1175	PEQSW	Switchgear, switchboard etc. equipment
		1181	PEQEV	Environmental control instruments
14 –Transportation Equip (1)				
		141101	PCARS	Passenger cars
15 – Misc Products (1)				
		159101	PCASK	Caskets

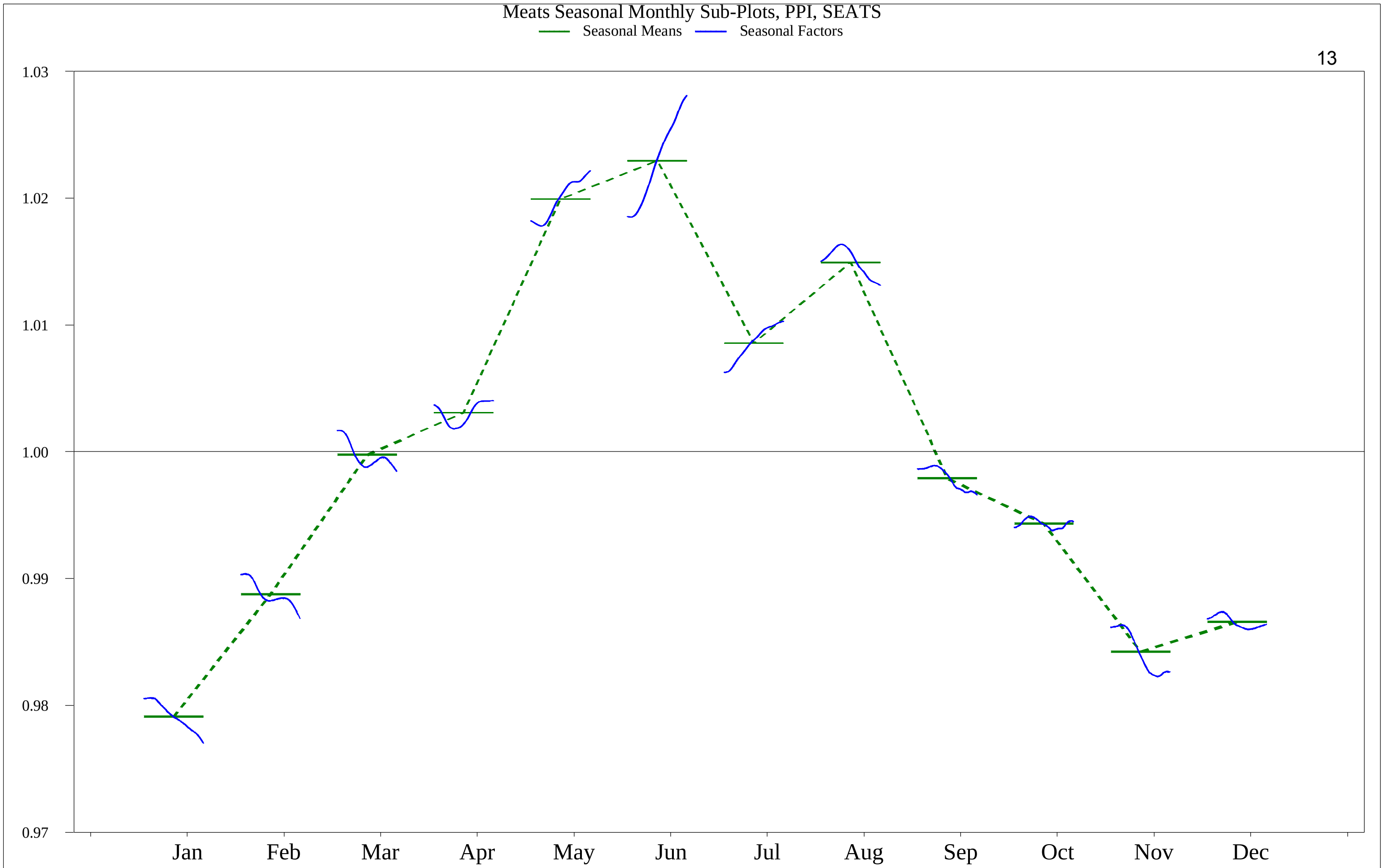
Note: Series come from 10 of 15 commodity groups.

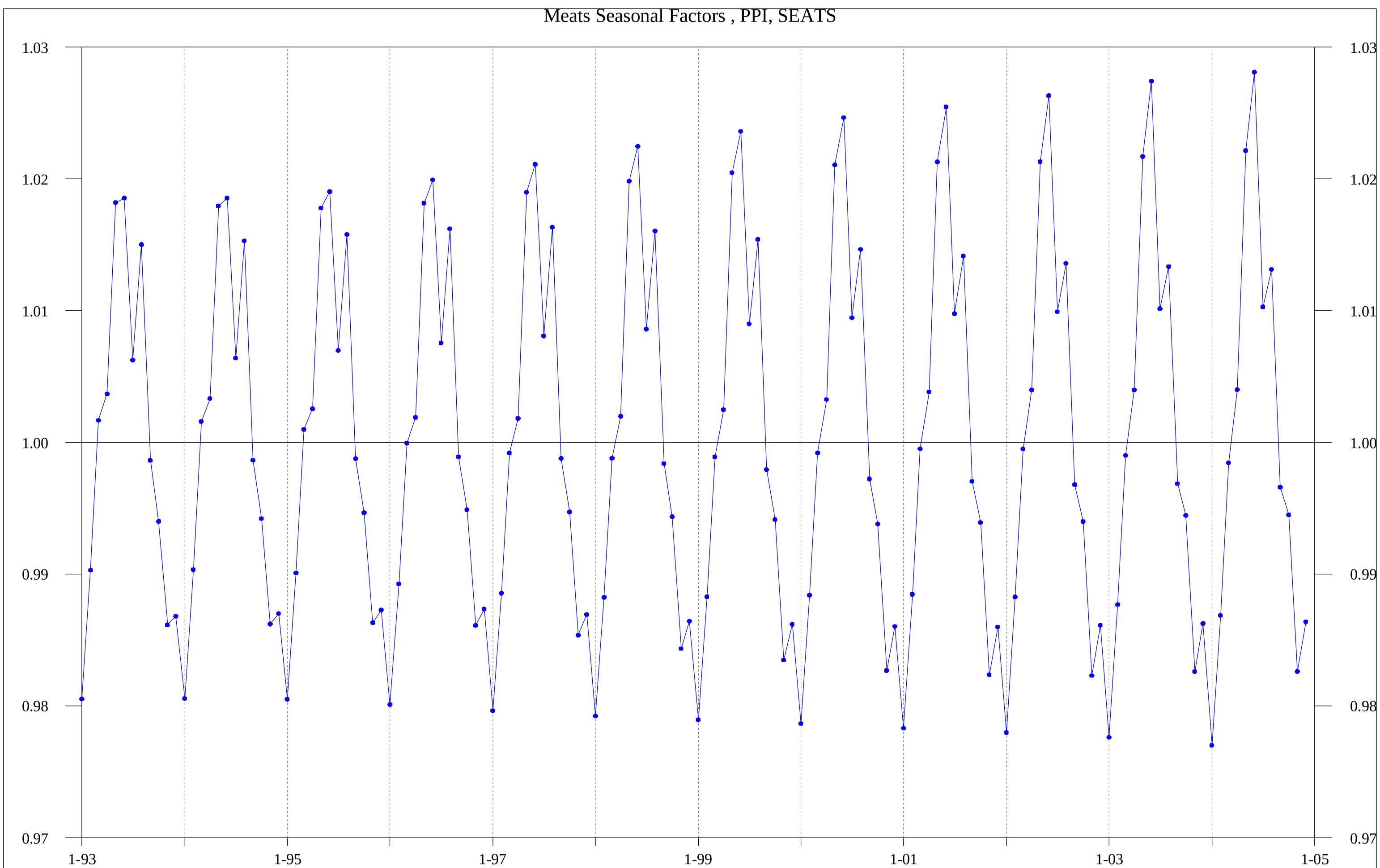
Table 2. Sample Summary Tables of Diagnostics

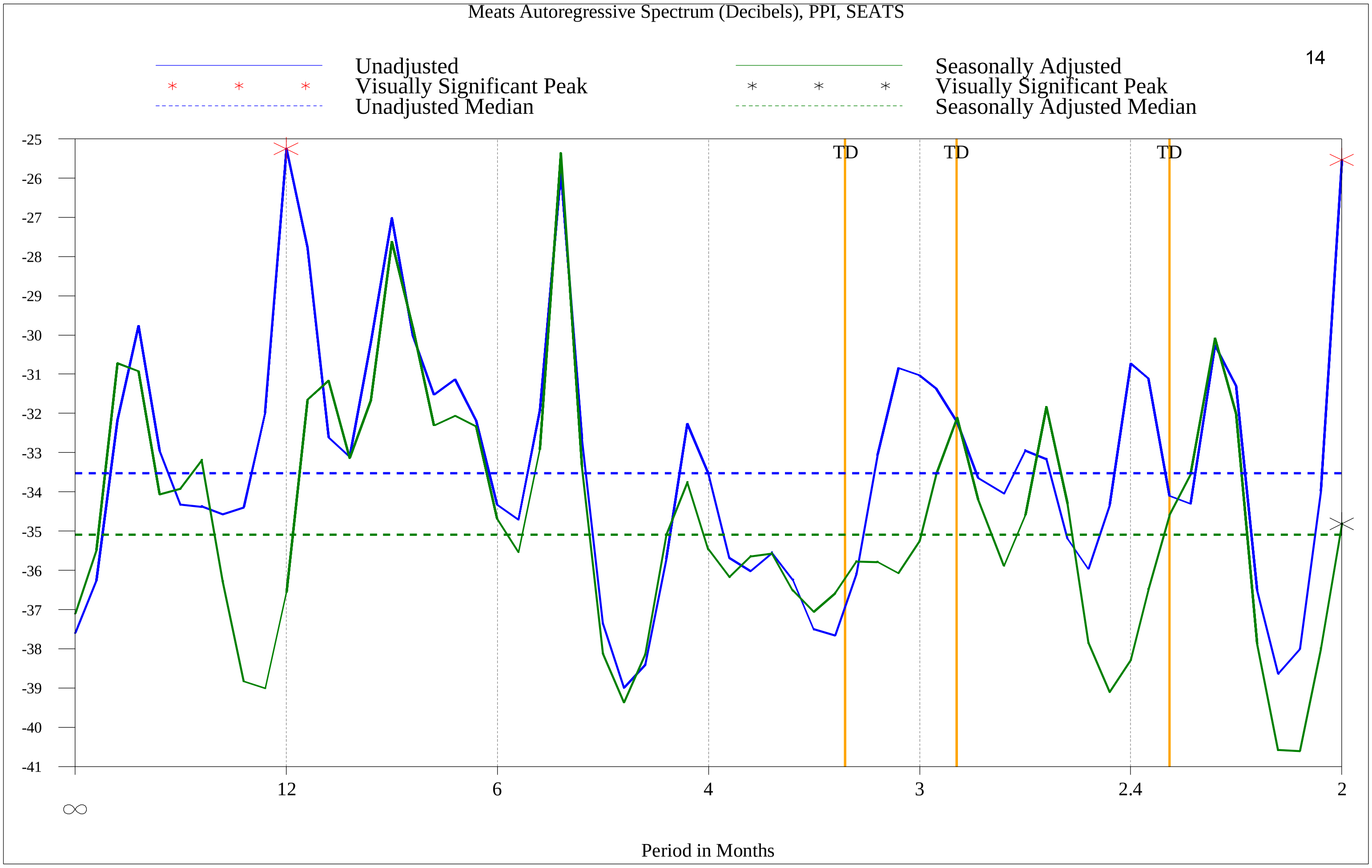
Series	BYR	EYR	Mode	Sea Fil	Trd Fil	FS	FM	M7	M10	M11	Q2	Ori Pks	SA Pks	Irr Pks
palm2	1993	2004	Mult	3x5	9	13.1	4.0	0.8	1.1	0.8	0.565			
pbeef	1993	2004	Mult	3x5	13	1.8	3.0	2.1	2.8	2.4	1.587	6		
pcars	1993	2004	Mult	3x5	13	100.3	3.2	0.2	0.5	0.4	0.416	123456		1
pcask	1993	2004	Mult	3x5	9	655.5	2.0	0.0	0.1	0.1	0.066	123456		
pdie2	1996	2004	Mult	3x5	13	7.6	1.2	0.8	1.7	1.5	0.782	2		
pecom	1993	2004	Mult	3x5	13	788.1	3.7	0.1	0.2	0.2	0.199	12345		
peind	1993	2004	Mult	3x5	13	322.4	2.4	0.1	0.1	0.1	0.203	1234		
pelec	1993	2004	Add	3x5	13	807.9	2.1	0.0	0.1	0.1	0.168	12345		
peoth	1993	2004	Mult	3x5	13	216.9	2.1	0.1	0.3	0.3	0.252	1234		
peqev	1993	2004	Add	3x5	9	7.5	2.7	1.0	2.0	2.0	0.796	1		
peqsw	1993	2004	Mult	3x5	13	6.9	1.9	0.9	1.2	1.1	0.665			
peres	1993	2004	Mult	3x9	9	1321.3	1.3	0.0	0.0	0.0	0.170	123456		
pfert	1993	2004	Add	3x5	9	22.7	4.8	0.6	0.7	0.6	0.472	5		
pfrut	1993	2004	Mult	3x5	13	52.0	2.4	0.3	0.6	0.5	0.572	123		
pgasp	1996	2004	Mult	3x5	13	6.6	2.8	1.0	1.3	1.0	0.931	6		
pmeat	1993	2004	Mult	3x5	13	5.8	3.0	1.1	1.6	1.3	0.960	16	6	
pmoth	1993	2004	Mult	3x5	9	8.8	3.4	0.9	1.3	1.0	0.629	1		
poilh	1996	2004	Mult	3x5	13	4.5	1.4	1.1	1.9	1.6	0.841	26		
ppork	1993	2004	Add	3x5	13	22.7	4.1	0.6	0.9	0.9	0.565	16		
ppubl	1993	2004	Add	3x5	9	57.3	1.4	0.3	0.9	0.9	0.246	145		

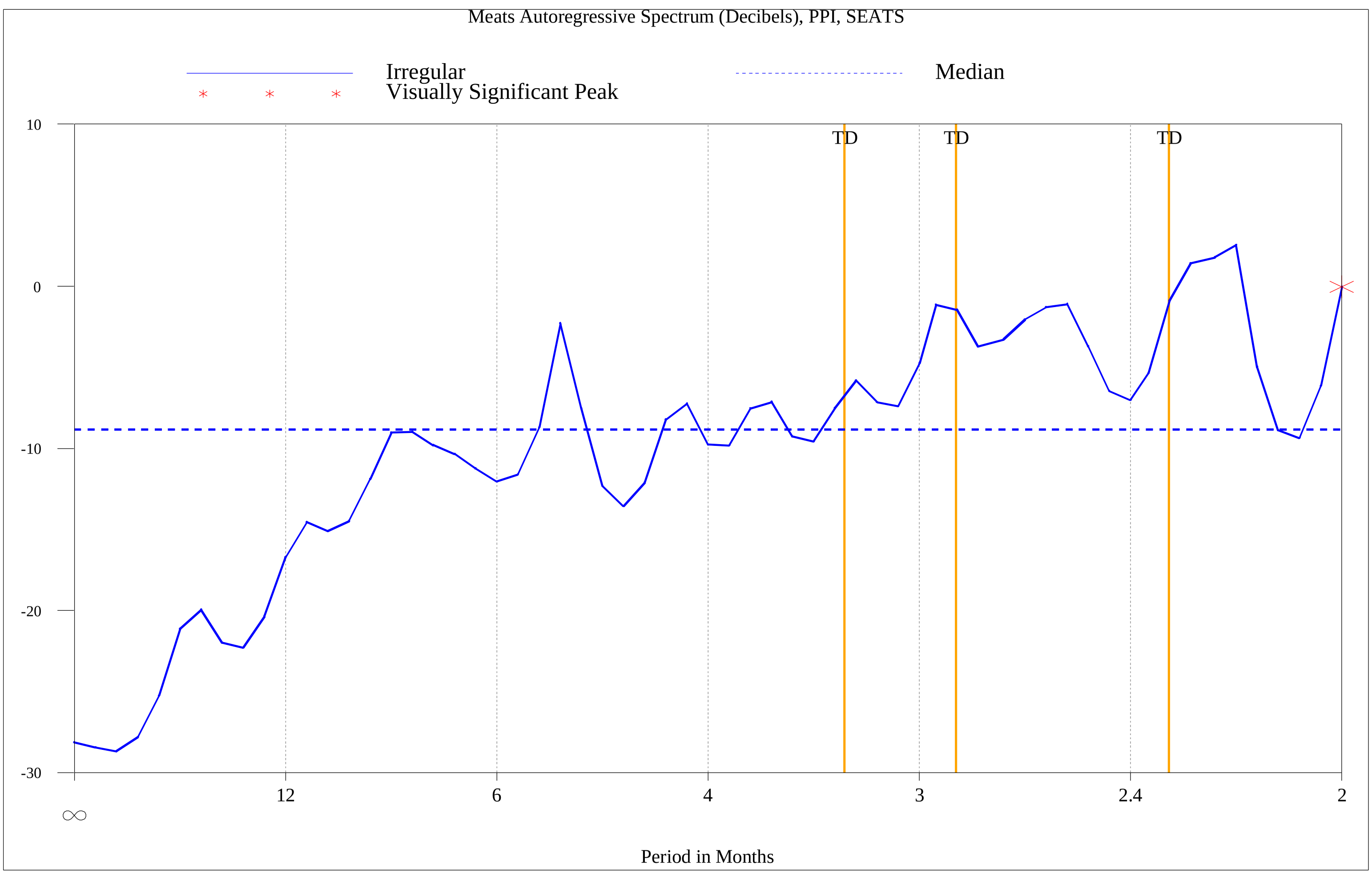
Series	Model	Log	LB12PV	BJ	BJPV	HetPV	RSDPKS
palm2	(011)	Log	0.45	0.8	0.68	*0.00	
pbeef	(011)	Log	0.16	0.8	0.68	*0.99	6
pcars	(011,011)	Log	0.76	6.3	*0.04	0.97	
pcask	(011,011)	Log	0.48	106.8	*0.00	*1.00	6
pdie2	(011)	Log	0.52	0.7	0.69	0.92	2
pecom	(011,011)	Log	*0.04	6.7	*0.03	*0.99	1
peind	(011,011)	Log	0.22	6.8	*0.03	*1.00	13
pelec	(011,011)	None	0.97	1.0	0.60	0.96	
peoth	(011,011)	Log	0.80	1.5	0.48	0.69	
peqev	(011,011)	None	0.93	10.9	*0.00	0.73	
peqsw	(011,011)	Log	0.58	4.2	0.12	0.94	6
peres	(311,011)	Log	0.07	9.9	*0.01	*1.00	
pfert	(011,011)	None	*0.03	11.5	*0.00	0.35	
pfrut	(011,011)	Log	*0.04	2.5	0.29	0.56	
pgasp	(011)	Log	0.18	10.1	*0.01	*1.00	6
pmeat	(011,011)	Log	0.14	0.2	0.89	0.96	6
pmoth	(011,011)	Log	*0.04	0.6	0.72	*1.00	
poilh	(011,011)	Log	0.15	0.1	0.97	0.97	
ppork	(011,011)	None	0.18	0.1	0.96	0.32	6
ppubl	(111,011)	None	0.09	3.3	0.19	0.04	

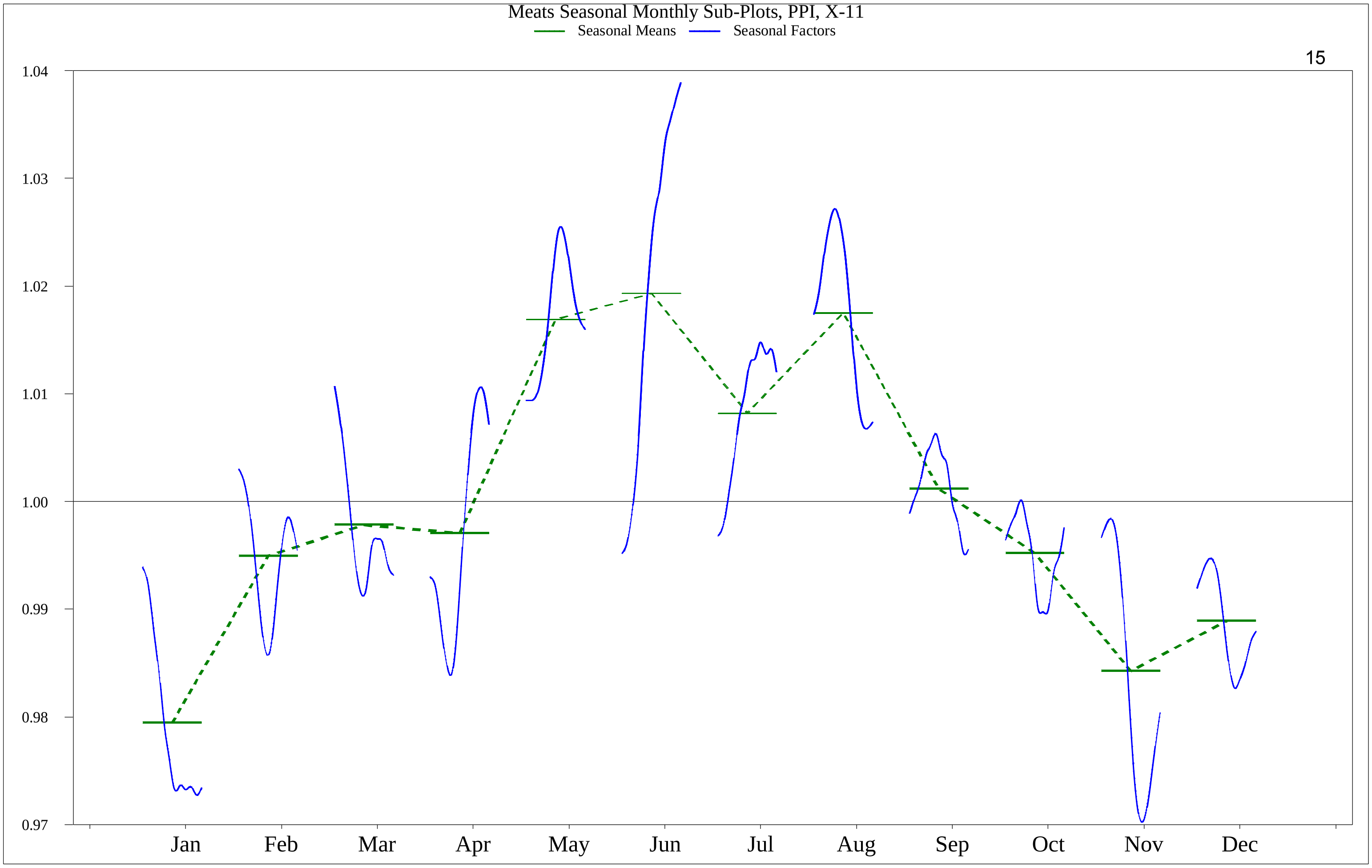
Meats, PPI, SEATS
Series pmeat
NBER Recessions in Gray
Unadjusted
Seasonally Adjusted
Trend
TC
150
140
130
120
110
100
90
1-95
1-96
1-97
1-98
1-99
1-00
1-01
1-02
1-03
1-04
1-05

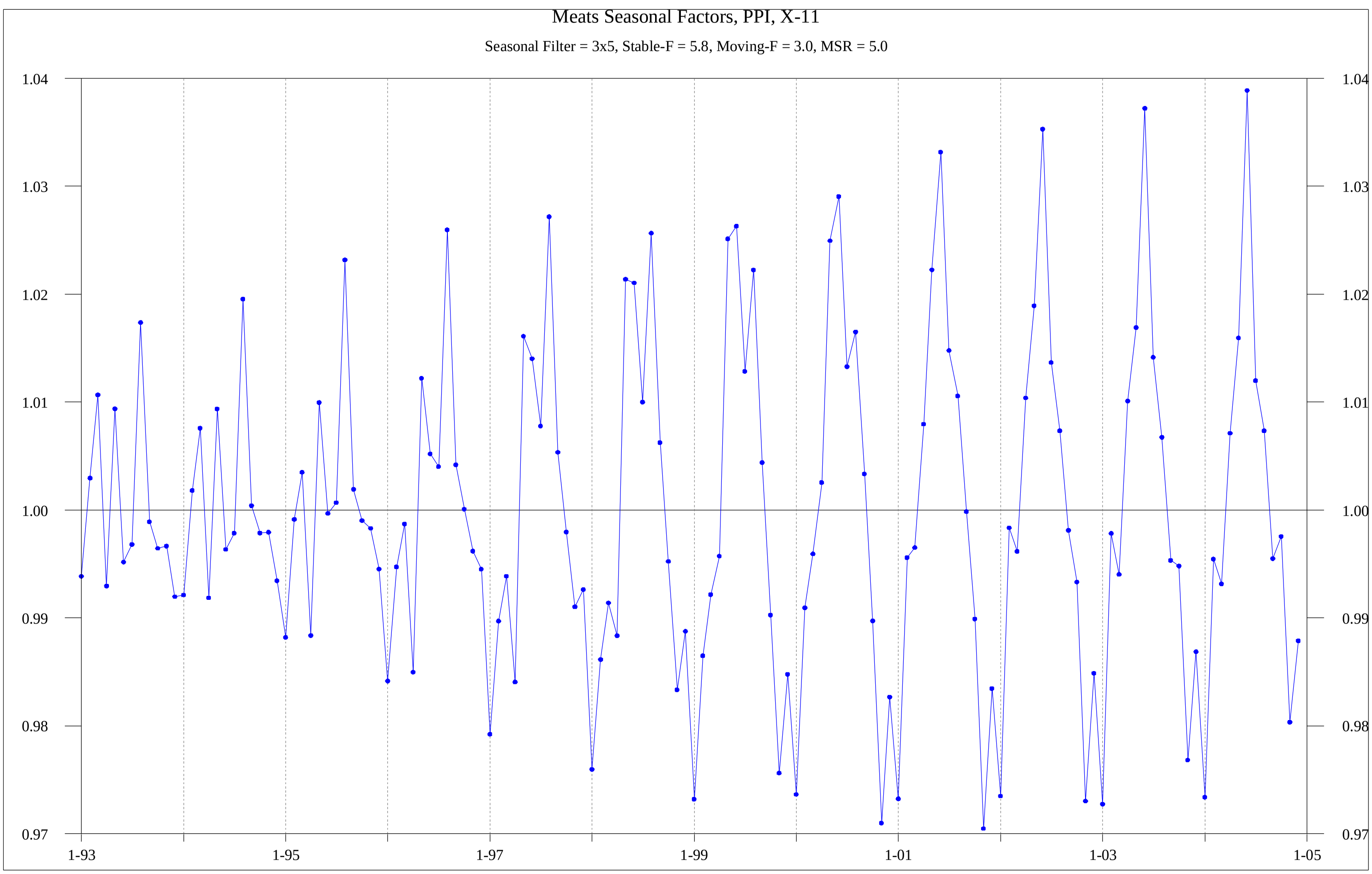

Meats Seasonal Monthly Sub-Plots, PPI, SEATS
Seasonal Means
Seasonal Factors
1.03
1.02
1.01
1.00
0.99
0.98
0.97
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

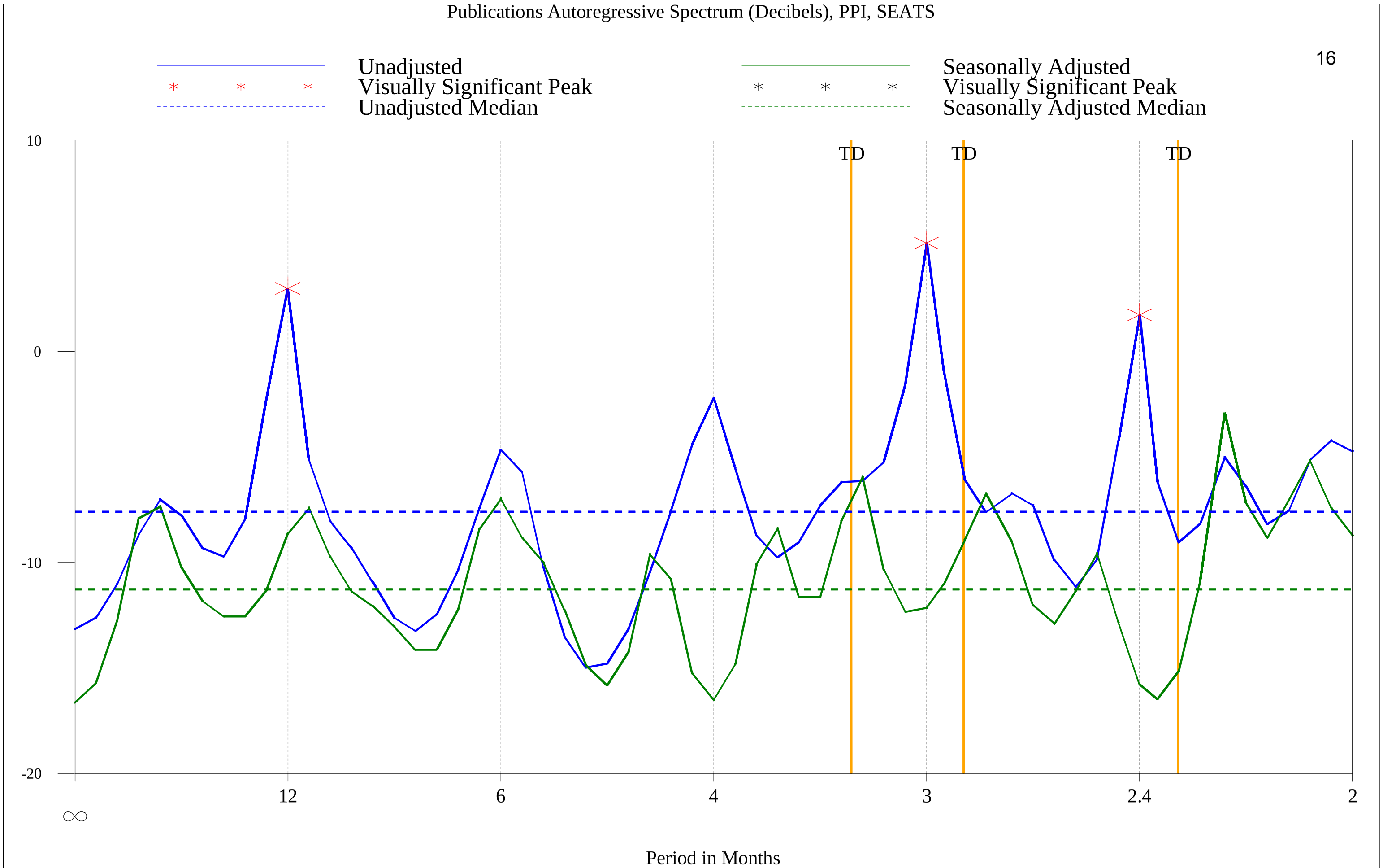

Meats Seasonal Factors , PPI, SEATS
1.03
1.02
1.01
1.00
0.99
0.98
0.97
1-93
1-95
1-97
1-99
1-01
1-03
1-05

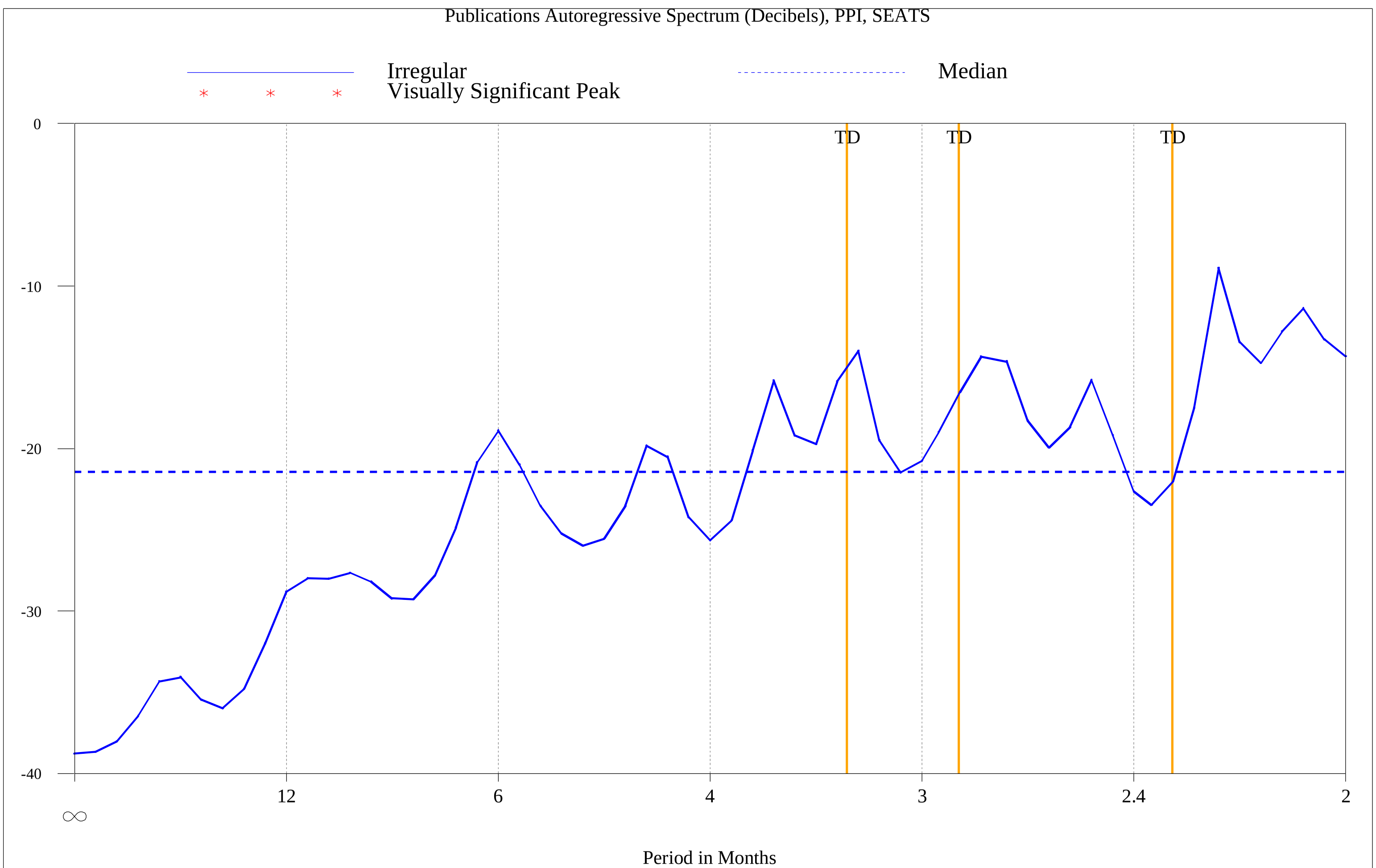

Meats Autoregressive Spectrum (Decibels), PPI, SEATS
Unadjusted
Visually Significant Peak
Unadjusted Median
Seasonally Adjusted
Visually Significant Peak
Seasonally Adjusted Median
-25
-26
-27
-28
-29
-30
-31
-32
-33
-34
-35
-36
-37
-38
-39
-40
-41
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months

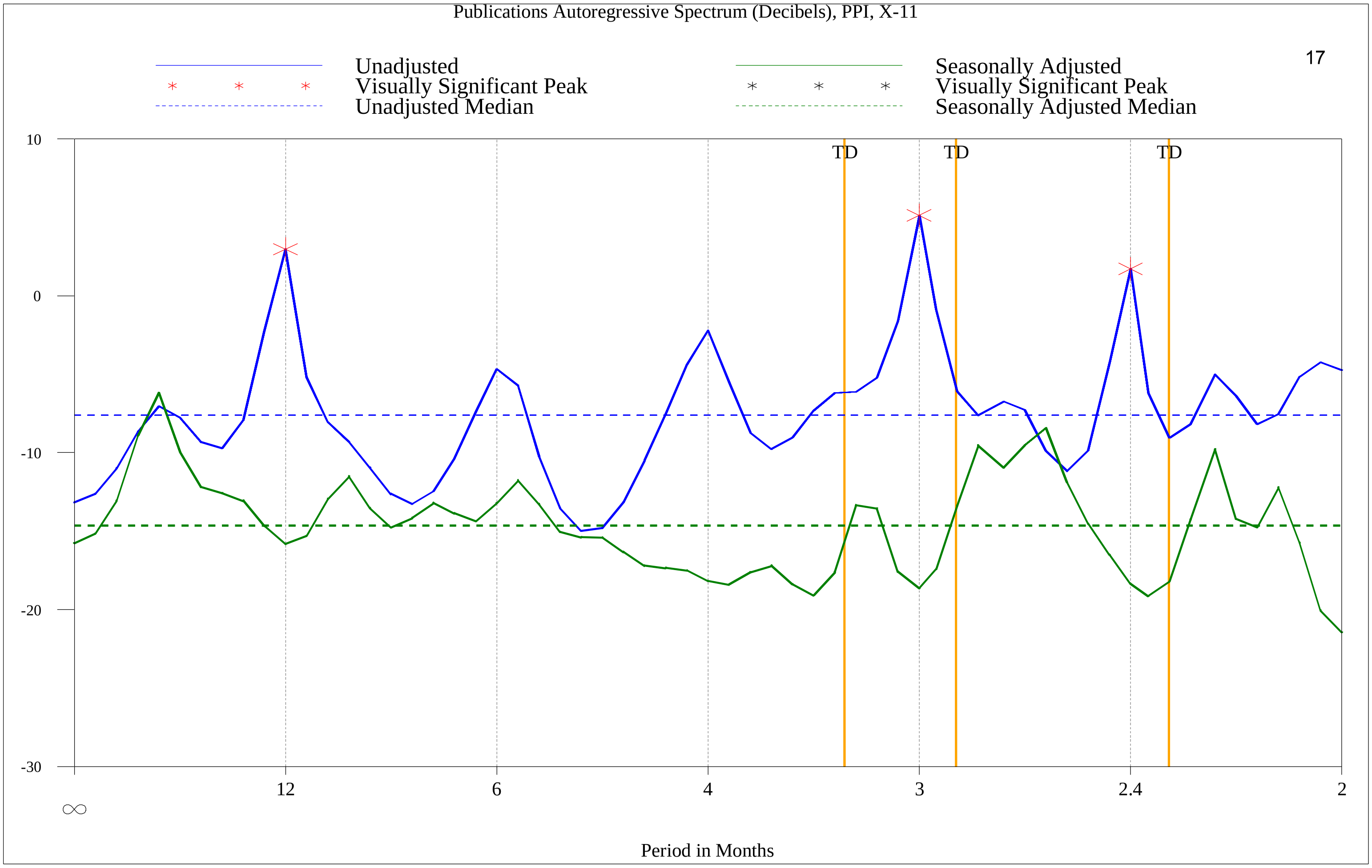

Meats Autoregressive Spectrum (Decibels), PPI, SEATS
Irregular
Visually Significant Peak
Median
10
0
-10
-20
-30
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months


Meats Seasonal Monthly Sub-Plots, PPI, X-11
Seasonal Means
Seasonal Factors
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

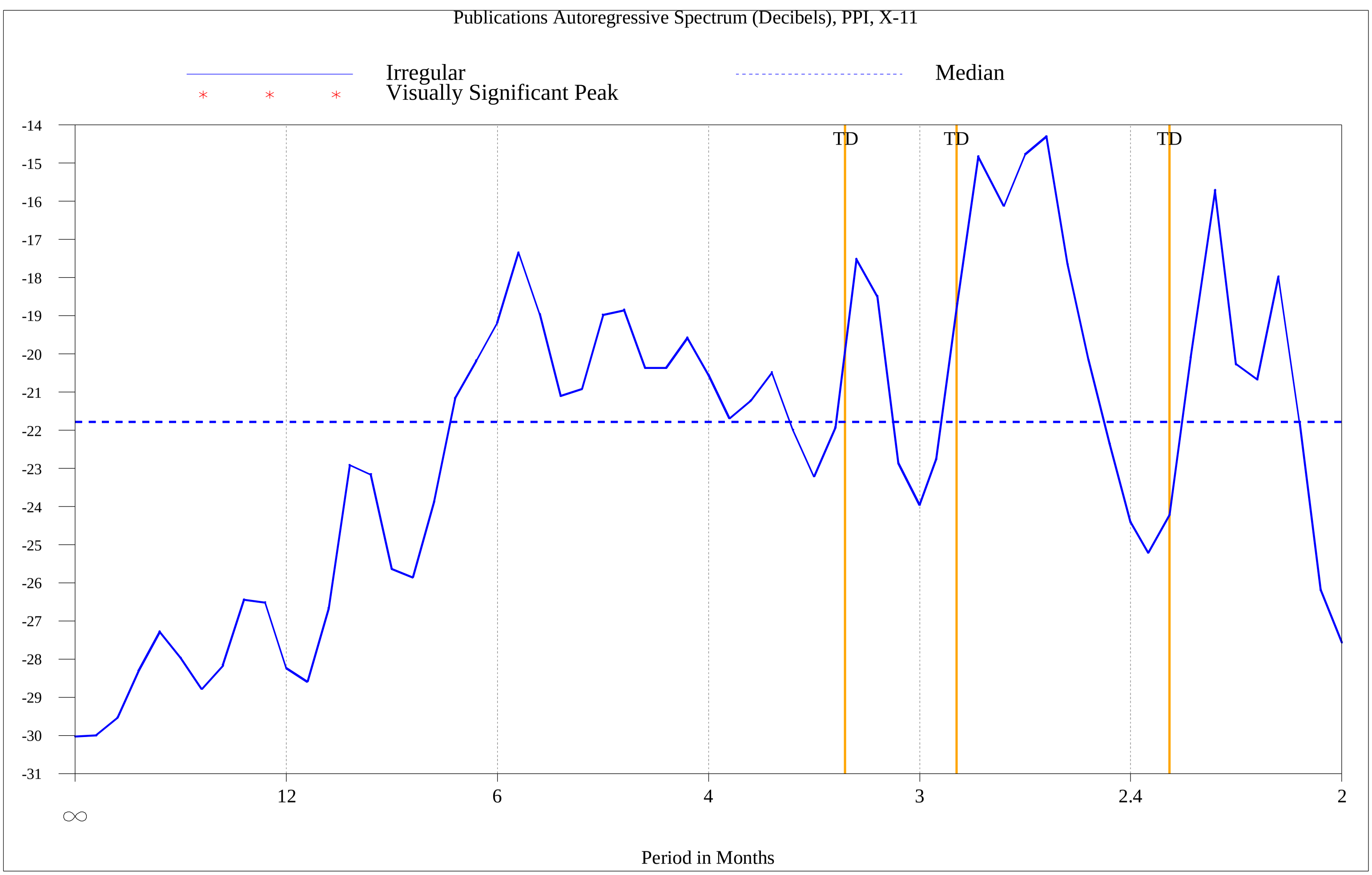

Meats Seasonal Factors, PPI, X-11
Seasonal Filter = 3x5, Stable-F = 5.8, Moving-F = 3.0, MSR = 5.0
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
1-93
1-95
1-97
1-99
1-01
1-03
1-05


Publications Autoregressive Spectrum (Decibels), PPI, SEATS
Unadjusted
Visually Significant Peak
Unadjusted Median
Seasonally Adjusted
Visually Significant Peak
Seasonally Adjusted Median
10
0
-10
-20
TD
TD
TD
12
6
4
3
2.4
2
Period in Months

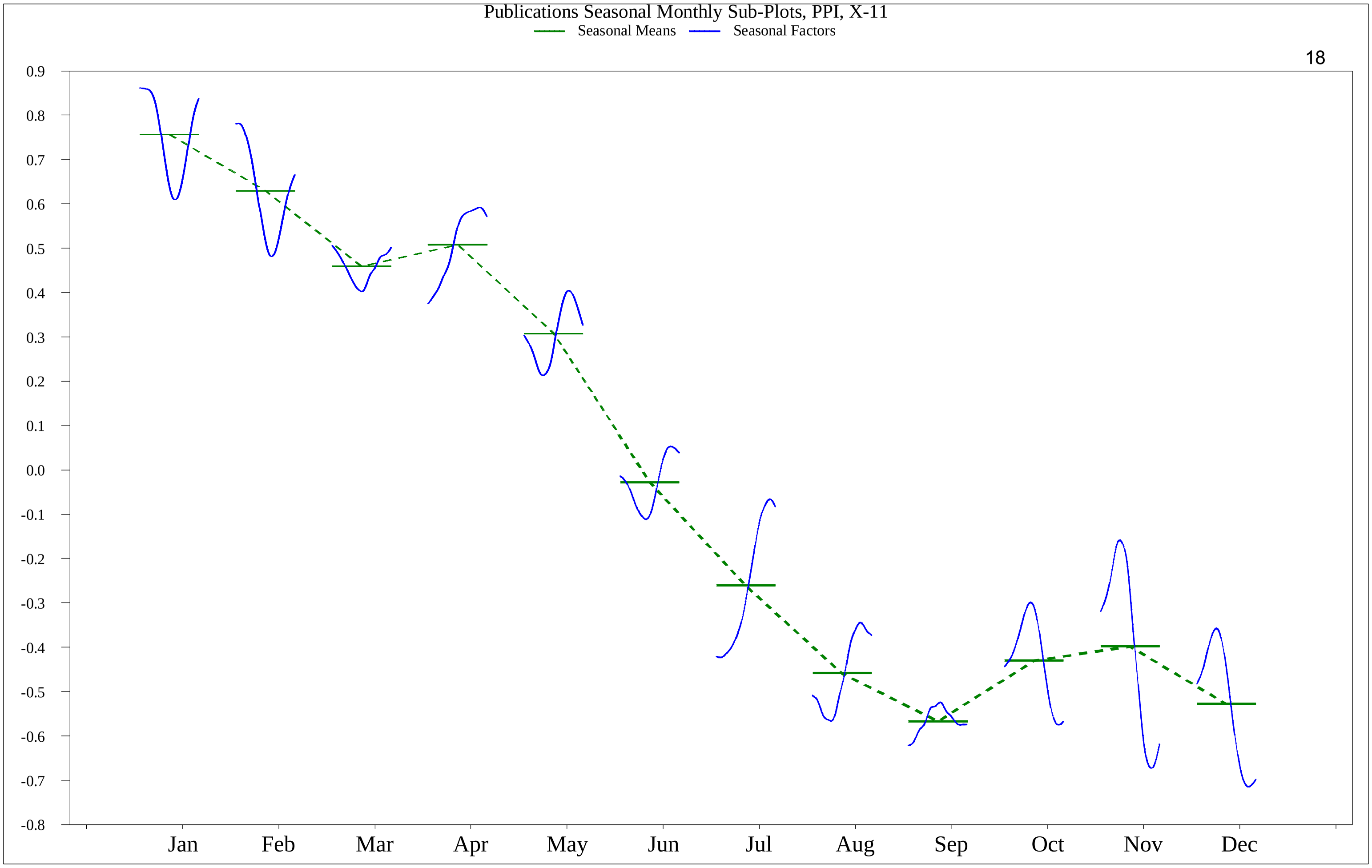

Publications Autoregressive Spectrum (Decibels), PPI, SEATS
Irregular
Visually Significant Peak
Median
0
-10
-20
-30
-40
TD
TD
TD
12
6
4
3
2.4
2
Period in Months

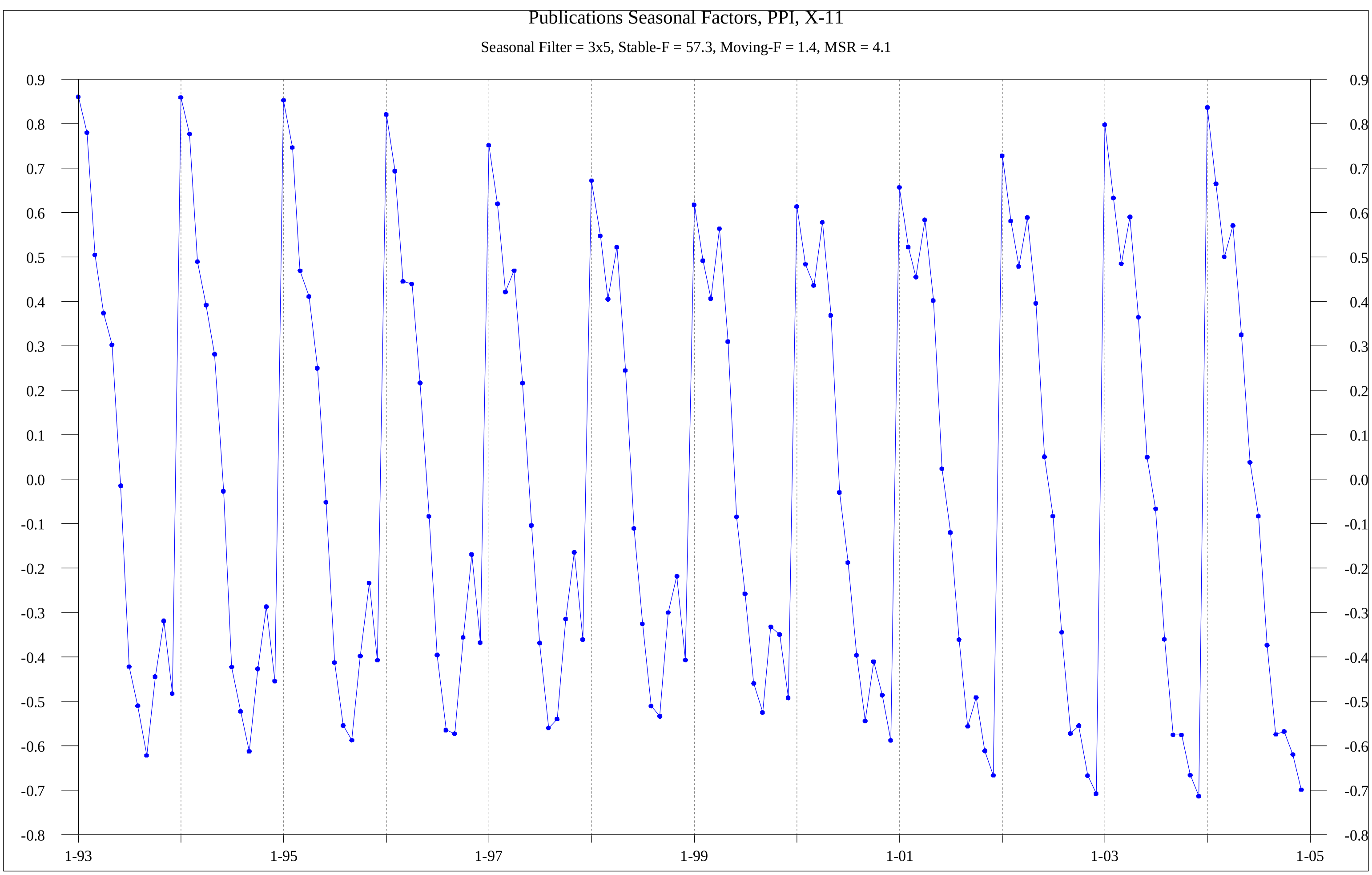


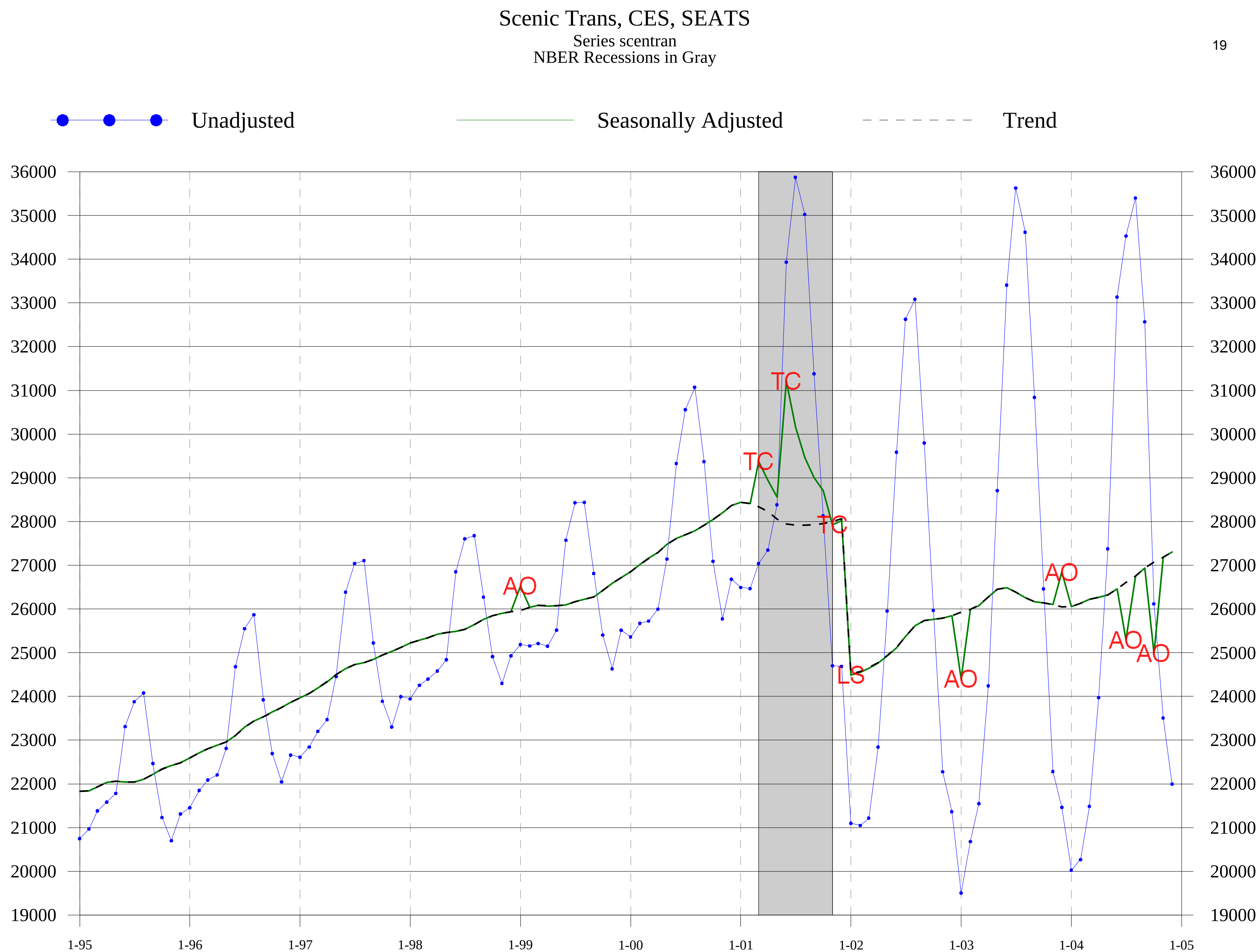
Publications Autoregressive Spectrum (Decibels), PPI, X-11
Unadjusted
Visually Significant Peak
Unadjusted Median
Seasonally Adjusted
Visually Significant Peak
Seasonally Adjusted Median
10
0
-10
-20
-30
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months

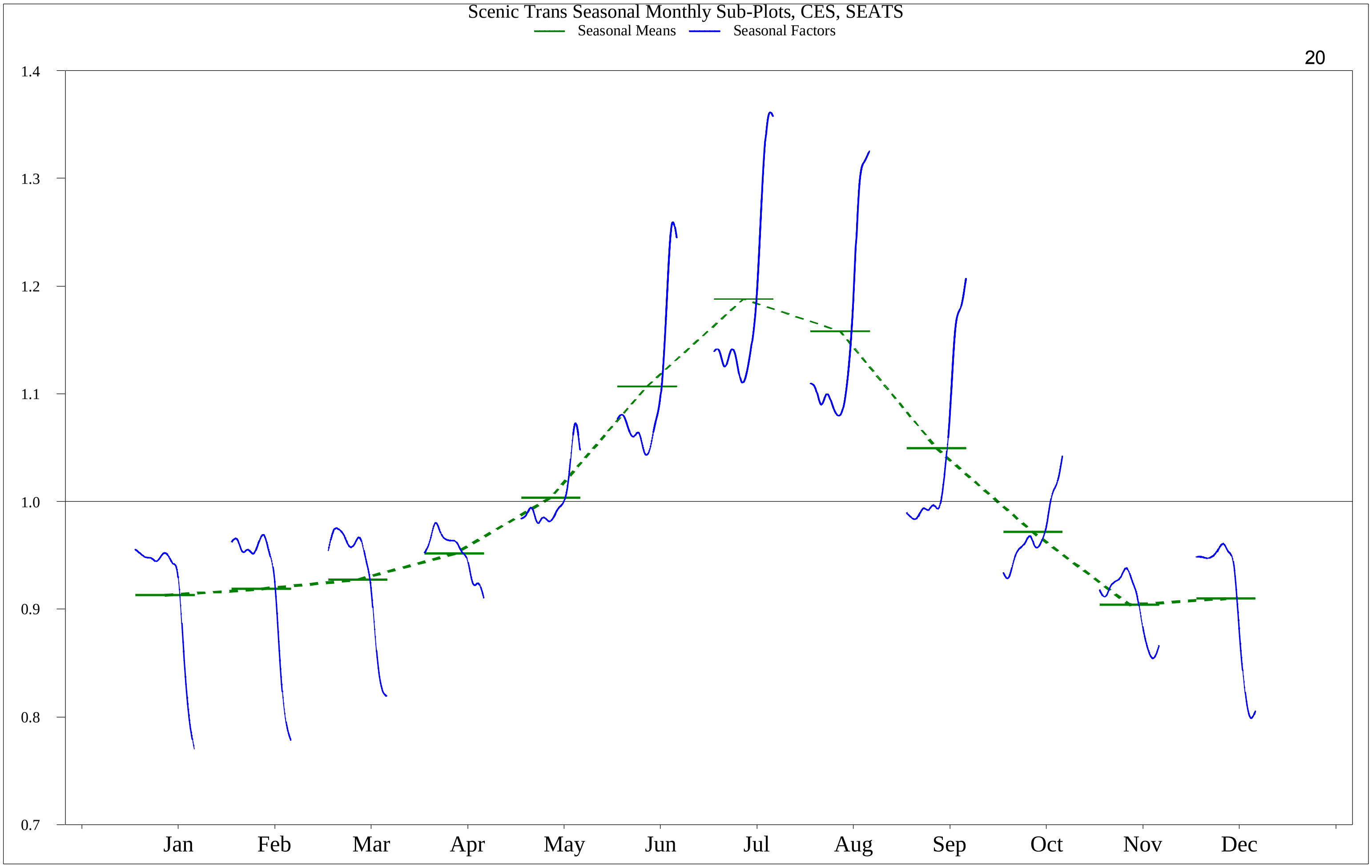


Publications Autoregressive Spectrum (Decibels), PPI, X-11
Irregular
Visually Significant Peak
Median
-14
-15
-16
-17
-18
-19
-20
-21
-22
-23
-24
-25
-26
-27
-28
-29
-30
-31
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months

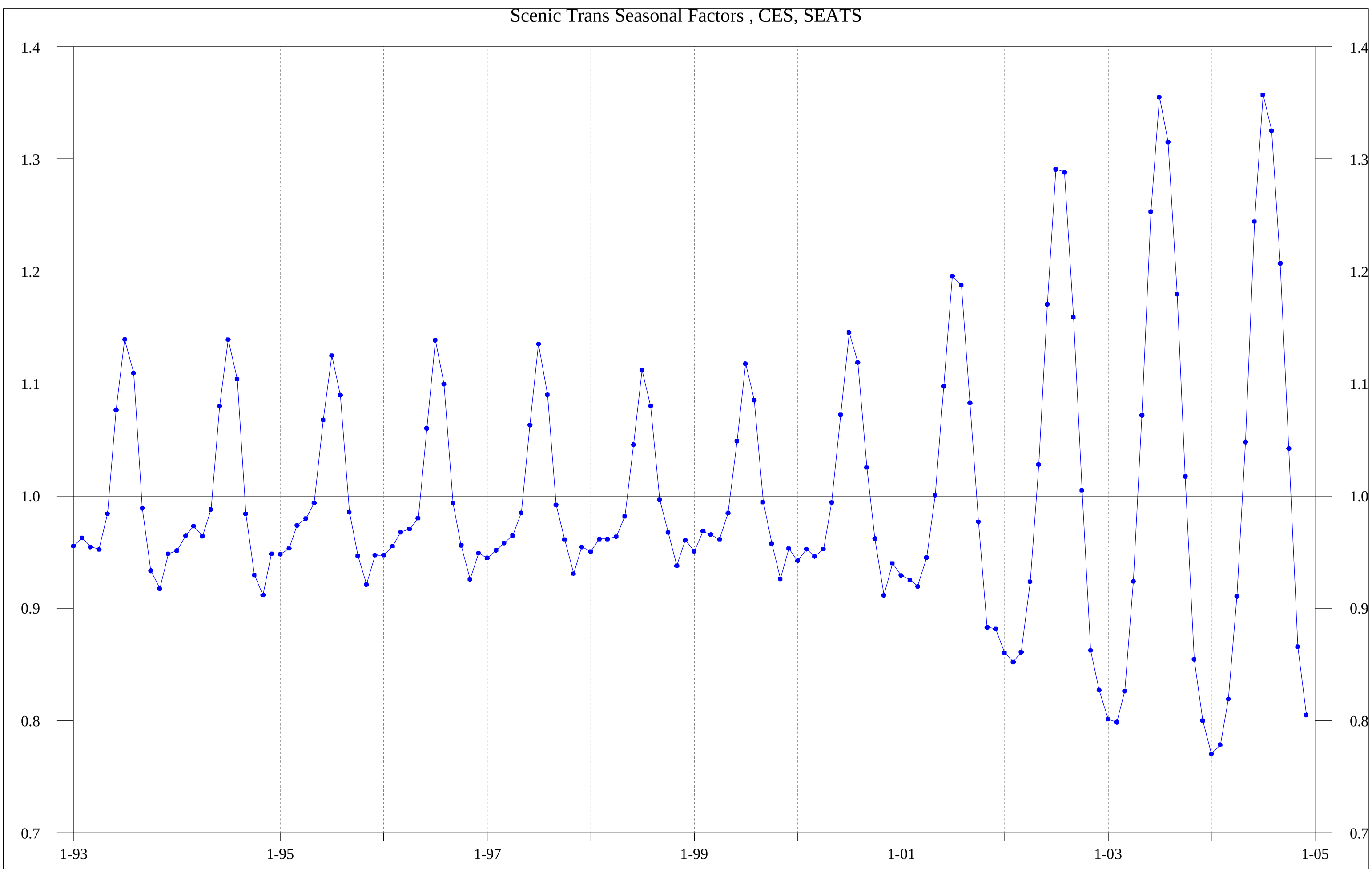

Publications Seasonal Monthly Sub-Plots, PPI, X-11
Seasonal Means
Seasonal Factors
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Publications Seasonal Factors, PPI, X-11
Seasonal Filter = 3x5, Stable-F = 57.3, Moving-F = 1.4, MSR = 4.1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
1-93
1-95
1-97
1-99
1-01
1-03
1-05

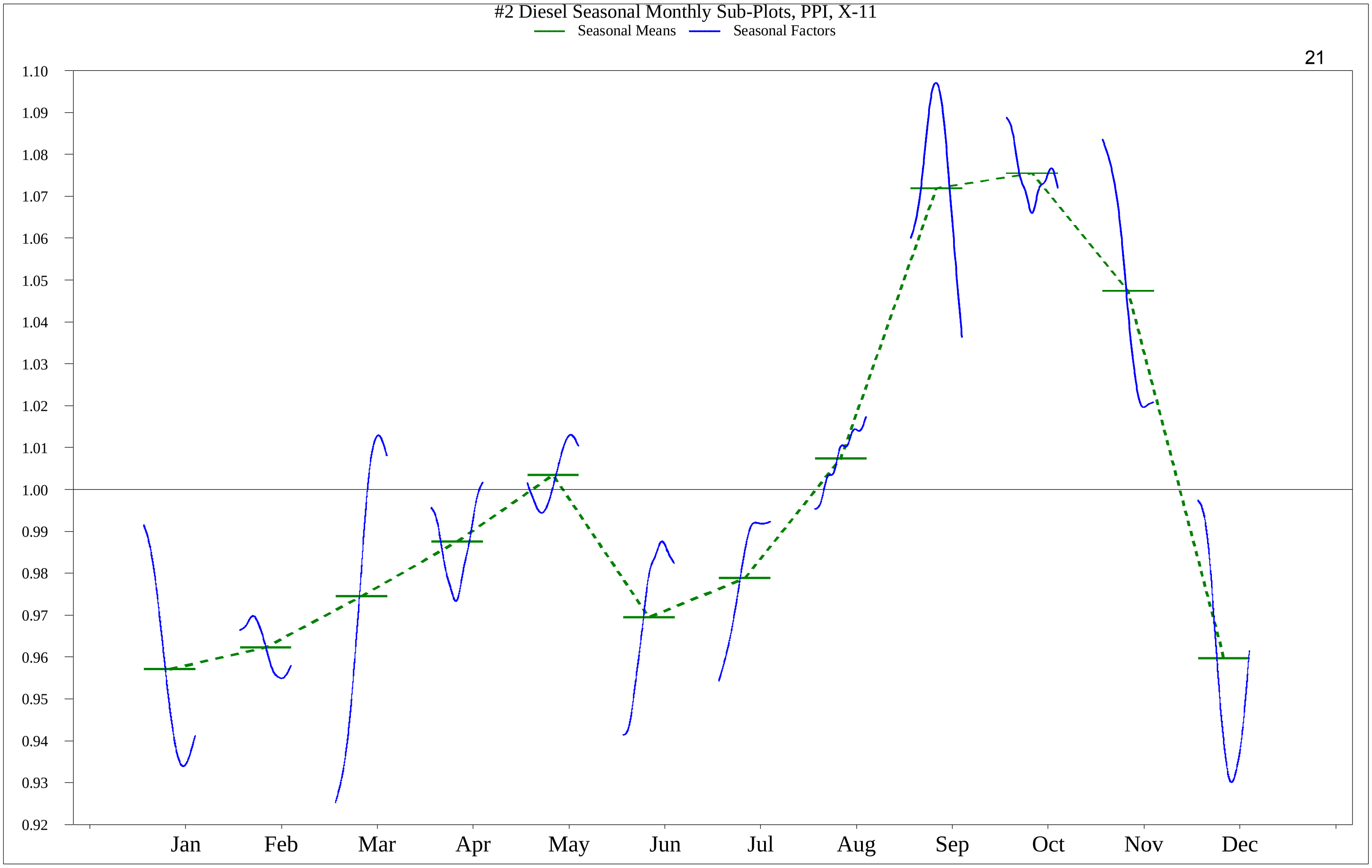

Scenic Trans, CES, SEATS
Series scentran
NBER Recessions in Gray
Unadjusted
Seasonally Adjusted
Trend
36000
35000
34000
33000
32000
31000
30000
29000
28000
27000
26000
25000
24000
23000
22000
21000
20000
19000
TC
TC
TC
LS
AO
AO
AO
AO
AO
1-95
1-96
1-97
1-98
1-99
1-00
1-01
1-02
1-03
1-04
1-05

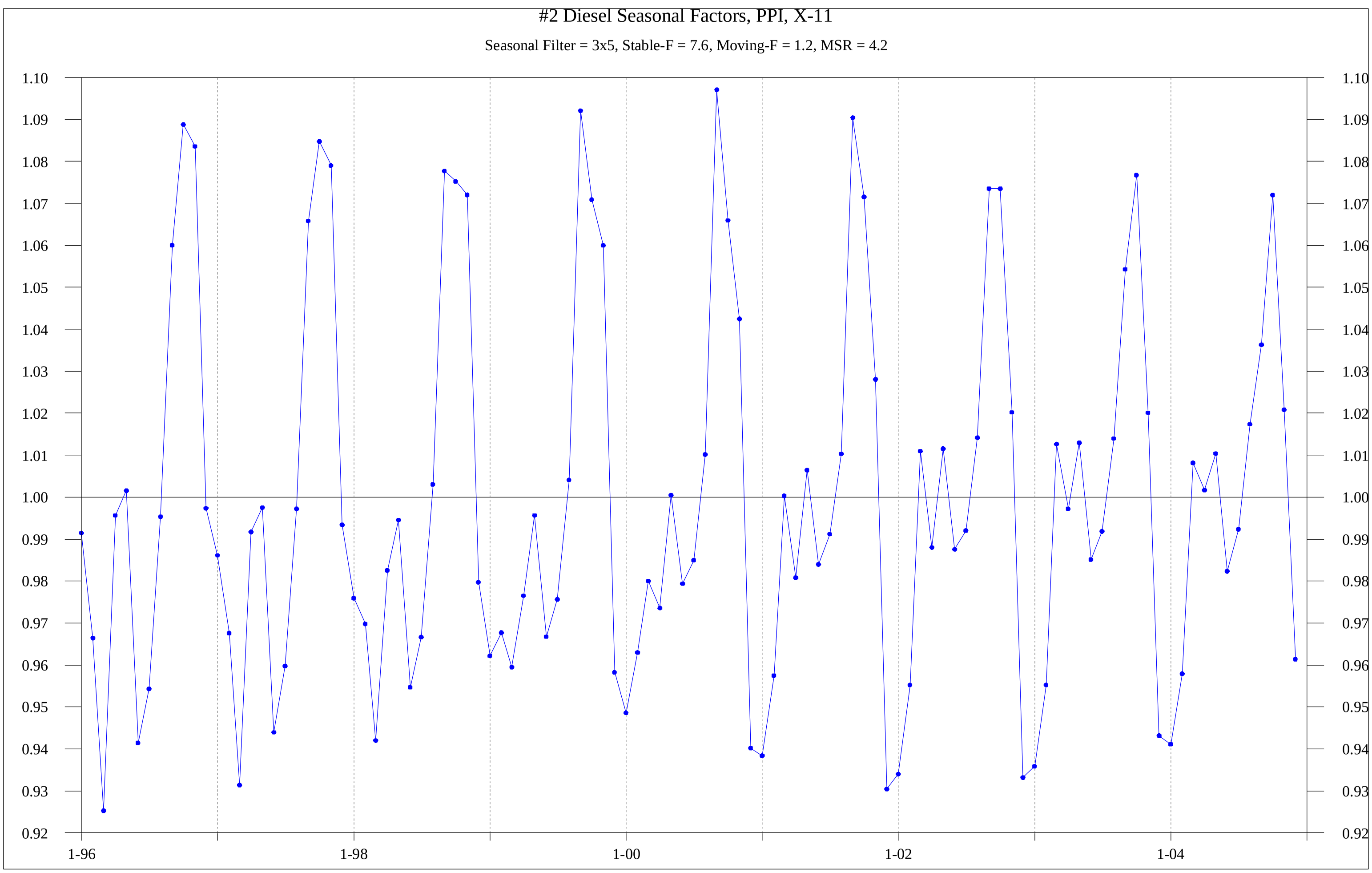


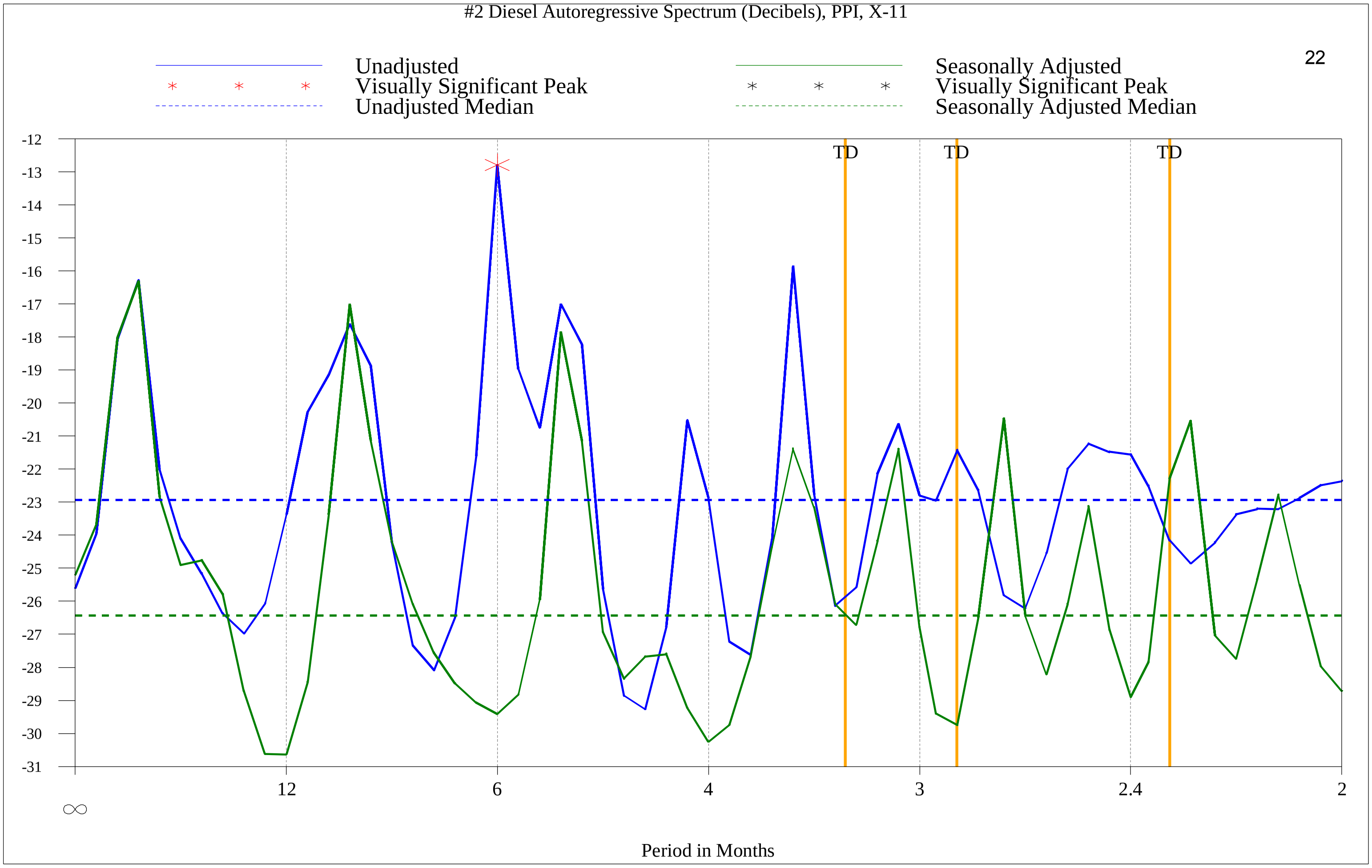
Scenic Trans Seasonal Monthly Sub-Plots, CES, SEATS
Seasonal Means
Seasonal Factors
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

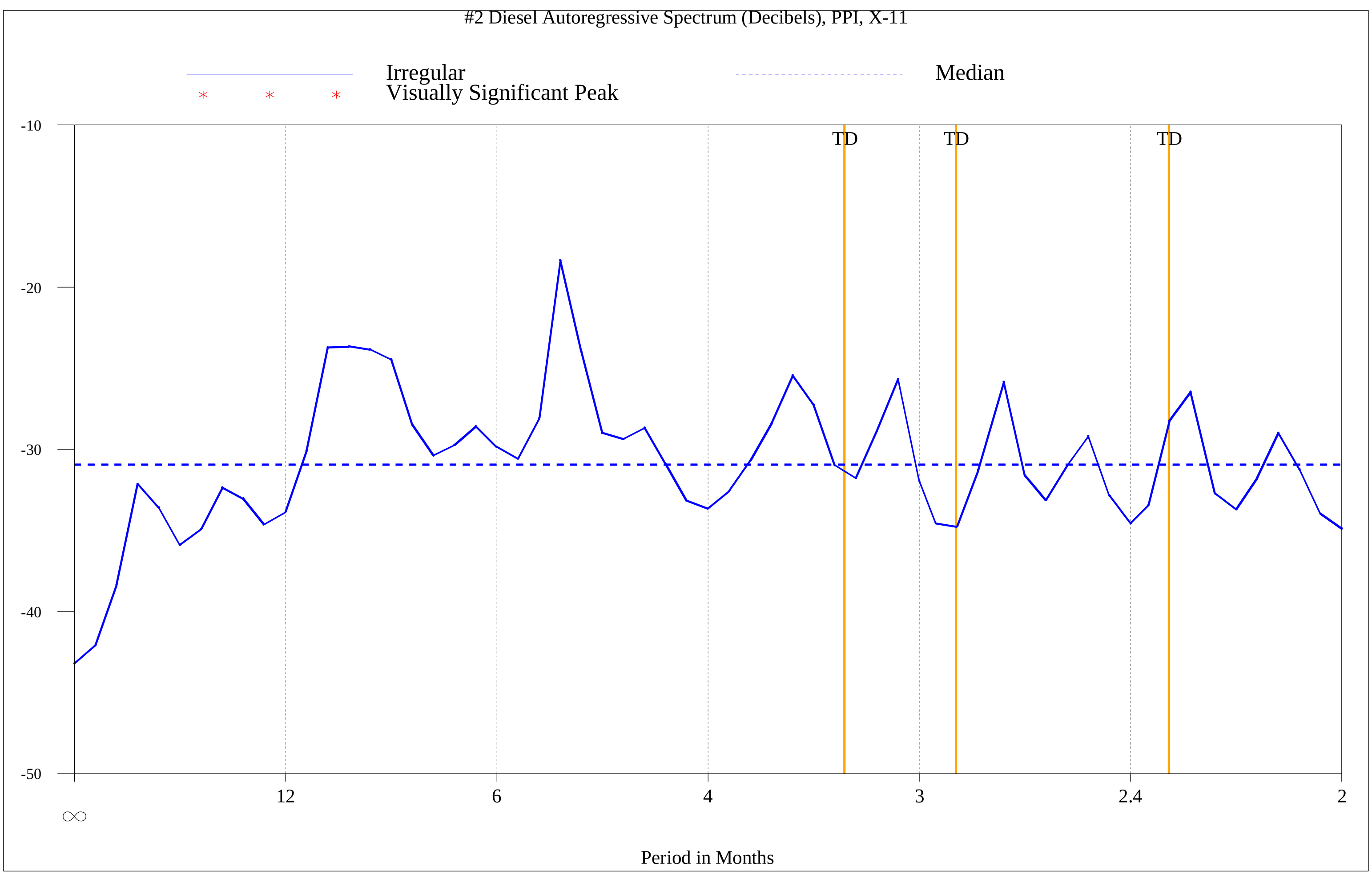


Scenic Trans Seasonal Factors , CES, SEATS
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
1-93
1-95
1-97
1-99
1-01
1-03
1-05


#2 Diesel Seasonal Monthly Sub-Plots, PPI, X-11
Seasonal Means
Seasonal Factors
1.10
1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


#2 Diesel Seasonal Factors, PPI, X-11
Seasonal Filter = 3x5, Stable-F = 7.6, Moving-F = 1.2, MSR = 4.2
1.10
1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
1-96
1-98
1-00
1-02
1-04


#2 Diesel Autoregressive Spectrum (Decibels), PPI, X-11
Unadjusted
Visually Significant Peak
Unadjusted Median
Seasonally Adjusted
Visually Significant Peak
Seasonally Adjusted Median
-12
-13
-14
-15
-16
-17
-18
-19
-20
-21
-22
-23
-24
-25
-26
-27
-28
-29
-30
-31
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months


#2 Diesel Autoregressive Spectrum (Decibels), PPI, X-11
Irregular
Visually Significant Peak
Median
-10
-20
-30
-40
-50
TD
TD
TD
∞
12
6
4
3
2.4
2
Period in Months