SEASONAL ADJUSTMENT OF CPI FOR MILLING AND BAKING PRODUCTS MONTHLY EVOLUTION AS AGAINST DECEMBER PREVIOUS YEAR IN ROMANIA – COMPARISON BETWEEN JDEMETRA+ 2.2.4 AND JDEMETRA+ 3.0.0

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Abstract

In the present context, the consumption and saving patterns are subjected to change both locally and worldwide. The evidence on consumption reveals the importance of data handling and processing using the most relevant tools available. This research paper looks into official statistics data of Consumer Price Indexes (CPI) for milling and baking products and is based on seasonal adjustment. As such, JDemetra+ software is selected as officially recommended by Eurostat for seasonal adjustment.

First section presents the official software recommended by Eurostat for seasonal adjustment, while section two discusses the characteristics and functionalities of the software. Furthermore, the following section presents the selected seasonal adjustment technique and describes the usage of monthly data. Section four analysing the results of all the seasonality tests for the selected series is followed next by a brief concluding remarks and observations section. Moreover, in terms of the conducted analysis, the paper examines to test JDemetra+ 3.0.0 pre-release version against JDemetra+ 2.2.4.

Evidence favouring JDemetra+ 2.2.4 is obtained, the results showing that some new strategies might be needed in order to obtain better results on seasonal adjustment process using TRAMO-SEATS in JDemetra+ 3.0.0. Seasonal adjustment practitioners in official statistics should be aware and recognize the impact of statistical package selection. In this respect, optimal selection of analysis procedures is needed in the evaluation of a series and thus migrating from JDemetra+ 2.2.4 to JDemetra+ 3.0.0 is problematic without employing resources in developing appropriate strategies for improvement of the obtained results.

Keywords: *seasonal adjustment, JDemetra+, Romania, business cycles*

Clasificare JEL: *C01, C80, E30*

1. Introduction

Software testing is an essential element of quality assurance in the software industry, consuming approximately half of the development efforts (Tuteja and Dubey, 2012). There are various types of software testing methods, most commonly classified into black-box testing – implies checking the program in real life situations – and white-box testing – implies executing each code line and correcting for errors (Ahmed, 2010). Black-box tests, in particular functional ones are the most common used tests (Garoussi and Zhi, 2013).

JDemetra+ is a software officially recommended by Eurostat for seasonal adjustment and it is developed in concordance with the European Guidelines of Seasonal Adjustment (European Commission, 2015). In this paper, we aim to test JDemetra+ 3.0.0 (a pre-release version) against JDemetra+ 2.2.4 in a typical situation for statistical production, namely seasonal adjustment of a time series affected by outliers. More specifically, the paper seeks to observe how the new algorithms implemented in JDemetra+ 3.0.0 might affect decision making of statisticians in the seasonal adjustment process. Unless algorithms are fine tuned to offer good performance, offering good outputs without employing additional resources and developing effective strategies for improvements may become problematic.

2. Literature review

Toma (2019) performs an extensive testing of JDemetra+ 2.2.2 using data on the Romanian GDP and its components. The author concludes that the software offers a broad range of functionalities on seasonal adjustment and time series analysis, particularly useful for practitioners in official statistics.

The next full version of JDemetra+ is 2.2.3. According to its GitHub page, this version brings several bug fixies and incorporates a new estimation method, namely "current[AO]" (https://github.com/jdemetra/jdemetra-app/releases/tag/v2.2.3 accessed June 12th 2023). This method implies that "the ARIMA model, outliers and other regression variables are not re-identified and the values of the associated coefficients are fixed" while also keeping the same type of transformation (https://jdemetradocumentation.github.io/JDemetra-documentation/pages/case-studies/revision-ao.html accessed June 12th 2023). Version 2.2.4 brings mainly bug fixies and supports Java 14 (https://github.com/jdemetra/jdemetra-app/releases/tag/v2.2.4 accessed June 12th 2023).

JDemetra+ 3.0.0 requires Java 17 or higher and contains several new features and modules including: the possibility of dealing with weekly and daily data, calendar options and improved tools for dealing with outliers (https://github.com/jdemetra/jdemetra-app/releases/tag/v3.0.0-RC1 accessed June 12th 2023). Also, the R packages built for this version allow users to move the entire seasonal adjustment process in R (thus increasing productivity) as they offer access to all functionalities (Smyk and Barthelemy, 2023). The new outlier detection tool is based on Basic Structural Models, which although they are less common than ARIMA models, they may be more robust (Palate and Smyk, 2021). Considering the management of daily data, there are already examples in the scientific literature of the use of JDemetra+ for this purpose: Sanguiao-Sande (2023) analyses the patterns of the COVID-19 7 days incidence – a series with evident weekly pattern due to the decrease in the activity of healthcare units during the weekends; Smyk (2023) decomposes the French daily births – a very long time series from 1968 to 2020.

3. Methodology

For the purpose of this paper, data on the Consumer Price Index for Milling and baking products monthly evolution as against December previous year in Romania, was retrieved from the TEMPO Online database of the National Institute of Statistics Romania on June 11th 2023. Data cover 267 months, form January 2001 to March 2023.

Two versions of JDemetra+ are used for seasonal adjustment: JDemetra+ 2.2.4 (final release, available on GitHub since January 31st 2023) and JDemetra+ 3.0.0 (release candidate 1, available on GitHub since July 15th 2022). Of the final versions, JDemetra+ 2.2.4 is the latest version available. JDemetra+ 3.0.0 is only available as first candidate (https://github.com/jdemetra/jdemetra-app/releases accessed June 11th 2023).

In order to perform the seasonal adjustment of the series, the following steps were taken, as previously suggested by the scientific literature (see for example Toma, Mirică, &; Paunica, 2018): seasonality tests were performed on the series in order to check whether or not seasonality is present; the series has been assessed with regard to the presence of outliers and shortened appropriately; a national calendar was defined for the pre-adjustment phase; series was seasonally adjusted using the automatic procedure in TRAMO-SEATS and X13. Results are displayed for the entire series as well as for the short-span series.

The calendar for the pre-adjustment phase includes all legal holidays in Romania at the time of writing this paper, as in previous studies (Mirică et al., 2022). Adjusting for working days was also performed when using JDemetra 2.2.4. However, this feature is not available in JDemetra+ 3.0.0, which has new and improved functionalities for dealing with calendars (JDemetra+ 3.0.0 release notes, available at https://github.com/jdemetra/jdemetra-app/releases accessed June 11th

2023). Of these functionalities, TD3 was employed. Julian Easter related holidays, such as Whit Monday or Good Friday were defined in JDemetra+ 3.0.0 as Easter related holidays with the appropriate offset.

4. Results

Table 1 presents the results of all the seasonality tests for the selected series using JDemetra+ 2.2.4 and JDemetra+ 3.3.0. All the results show that seasonality is present. In JDemetra+ 3.0.0 the test on regression with fixed seasonal dummies performed using an automatically identified ARIMA model is not available.

Table 1. Seasonality tests with distribution and results for the selected series; source: designed by the authors using JDemetra+ 2.2.4 and JDemetra 3.0.0

Seasonality test	Distribution and results	
	JDemetra+ 2.2.4	JDemetra+ 3.0.0
Auto-correlations at seasonal lags	Chi2 with 2 degrees of freedom Value 69.8539*	Chi2 with 2.0 degrees of freedom Value: 69.8539*
Friedman (non parametric)	Chi2 with 11 degrees of freedom Value 53.0014*	Chi2 with 11.0 degrees of freedom Value: 53.0014*
Kruskall-Wallis (non parametric)	Chi2 with 11 degrees of freedom Value 46.5958*	Chi2 with 11.0 degrees of freedom Value: 46.5958*
Spectral peaks	At.A-.At.At.At.At**	At.A-.At.At.At.At**
Periodogram	F with 11 degrees of freedom in the nominator and 252 degrees of freedom in the denominator Value 10.2534*	F with 11.0 degrees of freedom in the nominator and 252.0 degrees of freedom in the denominator Value: 10.2534*
Seasonal dummies	F with 11 degrees of freedom in the nominator and 252 degrees of freedom in the denominator Value 10.1271*	F with 11.0 degrees of freedom in the nominator and 254.0 degrees of freedom in the denominator Value: 10.3469*
Seasonal dummies (AMI)	F with 11 degrees of freedom in the nominator and 253 degrees of freedom in the denominator Value 9.7093*	-

*P-value = 0.000

**"T" or "t" for Tukey periodogram, "A" or "a" for autoregressive spectrum; "A" or "T" for very significant peaks; "a" or "t" for significant peaks; "-" for non-significant peaks

Figure 1 shows the outliers identified using the outlier identification tool in JDemetra+ 2.2.4 and JDemetra+ 3.3.0. Both versions of the program displayed the same outliers in terms of types, values and probabilities. Moreover, the colour scheme for marking the outliers is preserved.

JDemetra+ 2.2.4

	Period	Value	StdErr	TStat
LS	2-2001	3.7328	0.3675	10.1583
LS	1-2002	-16.3308	0.3529	-46.2809
TC	1-2003	-8.8953	0.3051	-29.1590
AO	2-2003	1.3445	0.1628	8.2577
TC	4-2003	-1.4571	0.2600	-5.6043
TC	5-2003	-0.8964	0.2503	-3.5816
AO	10-2003	-0.6412	0.1420	-4.5164
LS	1-2004	-34.4285	0.3221	-106.8891
LS	1-2005	-3.3694	0.3059	-11.0154
LS	12-2005	-1.2216	0.2619	-4.6653
LS	1-2007	-4.1006	0.2918	-14.0523
LS	8-2007	2.2585	0.2528	8.9350
AO	9-2007	0.5684	0.1461	3.8908
LS	1-2008	-11.0763	0.2927	-37.8479
LS	1-2009	-3.0379	0.2912	-10.4340
LS	1-2010	1.2012	0.2873	4.1812
LS	7-2010	2.2659	0.2421	9.3608
TC	1-2011	-3.4552	0.2413	-14.3185
LS	1-2012	-2.7299	0.2724	-10.0210
LS	9-2013	-8.9910	0.2419	-37.1694
LS	1-2014	10.9381	0.2673	40.9152
LS	1-2015	1.8595	0.2698	6.8909
LS	6-2015	-2.6719	0.2419	-11.0450
LS	1-2016	4.7111	0.2687	17.5356
LS	1-2017	1.9176	0.2637	7.2714
LS	1-2019	-1.5707	0.2603	-6.0349
LS	1-2021	-2.0172	0.2803	-7.1976
TC	1-2022	-6.1100	0.2562	-23.8504
LS	4-2022	1.2892	0.2690	4.7930
LS	1-2023	-22.8326	0.3153	-72.4186

JDemetra+ 3.0.0

	Period	Value	StdErr	TStat
LS	2-2001	3.7328	0.3675	10.1583
LS	1-2002	-16.3308	0.3529	-46.2809
TC	1-2003	-8.8953	0.3051	-29.1590
AO	2-2003	1.3445	0.1628	8.2577
TC	4-2003	-1.4571	0.2600	-5.6043
TC	5-2003	-0.8964	0.2503	-3.5816
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LS	8-2007	2.2585	0.2528	8.9350
AO	9-2007	0.5684	0.1461	3.8908
LS	1-2008	-11.0763	0.2927	-37.8479
LS	1-2009	-3.0379	0.2912	-10.4340
LS	1-2010	1.2012	0.2873	4.1812
LS	7-2010	2.2659	0.2421	9.3608
TC	1-2011	-3.4552	0.2413	-14.3185
LS	1-2012	-2.7299	0.2724	-10.0210
LS	9-2013	-8.9910	0.2419	-37.1694
LS	1-2014	10.9381	0.2673	40.9152
LS	1-2015	1.8595	0.2698	6.8909
LS	6-2015	-2.6719	0.2419	-11.0450
LS	1-2016	4.7111	0.2687	17.5356
LS	1-2017	1.9176	0.2637	7.2714
LS	1-2019	-1.5707	0.2603	-6.0349
LS	1-2021	-2.0172	0.2803	-7.1976
TC	1-2022	-6.1100	0.2562	-23.8504
LS	4-2022	1.2892	0.2690	4.7930
LS	1-2023	-22.8326	0.3153	-72.4186

Figure 1. Outliers detected within the series; source: designed by the authors using JDemetra+ 2.2.4 and JDemetra 3.0.0

Table 2 and Table 3 present the main diagnostics of the of the seasonal adjustment process with TRAMO-SEATS and X-13 in JDemetra+ 2.2.4 and JDemetra+ 3.0.0. The seasonal adjustment process was performed using the entire series as well as a short series, form 2018. Main diagnostics in JDemetra+ 3.0.0 include additional reports compared to JDemetra+ 2.2.4, namely on out-of-sample.

Considering the results of the seasonal adjustment of the entire series, TRAMO-SEATS and X13 in both versions show a low quality of the seasonally adjusted data. When the series span was shortened, the quality of the seasonally adjusted data was good using TRAMO-SEATS in JDemetra+ 2.2.4 and uncertain in JDemetra+ 3.0.0; low quality results were obtained with X13 on both versions.

Table 2. Diagnostics of the seasonal adjustment process with TRAMO-SEATS; source: designed by the authors using JDemetra+ 2.2.4 and JDemetra 3.0.0

	JDemetra+ 2.2.4	JDemetra+ 3.0.0
TRAMO – SEATS; Entire series		
summary	**Severe**	**Severe**
basic checks	definition: Good (0.000) annual totals: Good (0.001)	definition: Good (0.000) annual totals: Good (0.001)
regarima residuals	normality: Bad (0.000) independence: Good (0.317) spectral td peaks: Uncertain (0.041) spectral seas peaks: Uncertain (0.088)	normality: Bad (0.000) independence: Good (0.368) spectral td peaks: Uncertain (0.085) spectral seas peaks: Uncertain (0.096)
Out-of-sample		mean: Good (0.283) mse: Uncertain (0.020)
outliers	number of outliers: Severe (0.112)	number of outliers: Severe (0.101)
seats	seas variance: Good (0.196) irregular variance: Good (0.385) seas/irr cross-correlation: Uncertain (0.036)	seas variance: Good (0.270) irregular variance: Good (0.824) seas/irr cross-correlation: Uncertain (0.031)
residual trading days tests	f-test on sa (td): Good (0.997)	F-Test on SA (td): Good (1.000)
residual seasonality tests	f-test on sa (seasonal dummies): Good (1.000)	Qs test on SA: Good (1.000) F-Test on SA (seasonal dummies): Good (1.000)
TRAMO – SEATS; Series from 2018		
summary	**Good**	**Uncertain**
basic checks	definition: Good (0.000) annual totals: Good (0.001)	definition: Good (0.000) annual totals: Good (0.001)
regarima residuals	normality: Good (0.671) independence: Good (0.909) spectral td peaks: Good (0.860) spectral seas peaks: Good (0.214)	normality: Uncertain (0.013) independence: Good (0.717) spectral td peaks: Good (0.422) spectral seas peaks: Good (0.193)
Out-of-sample	-	mean: Bad (0.000) mse: Bad (0.000)
outliers	number of outliers: Bad (0.095)	number of outliers: Bad (0.063)
seats	seas variance: Good (0.485) irregular variance: Good (0.137) seas/irr cross-correlation: Uncertain (0.010)	seas variance: Good (0.403) irregular variance: Good (0.362) seas/irr cross-correlation: Good (0.055)
residual trading days tests	f-test on sa (td): Good (0.999)	F-Test on SA (td): Good (1.000)
residual seasonality tests	f-test on sa (seasonal dummies): Good (1.000)	Qs test on SA: Good (1.000) F-Test on SA (seasonal dummies): Good (1.000)

Table 3. Diagnostics of the seasonal adjustment process with X13; source: designed by the authors using JDemetra+ 2.2.4 and JDemetra 3.0.0

	JDemetra+ 2.2.4	JDemetra+ 3.0.0
X13; Entire series		
summary	**Severe**	**Severe**
basic checks	definition: Good (0.000) annual totals: Good (0.001)	definition: Good (0.000) annual totals: Good (0.001)
regarima residuals	normality: Bad (0.000) independence: Uncertain (0.038) spectral td peaks: Good (0.141) spectral seas peaks: Uncertain (0.043)	normality: Bad (0.000) independence: Good (0.259) spectral td peaks: Good (0.181) spectral seas peaks: Uncertain (0.096)
Out-of-sample	-	mean: Good (0.274) mse: Uncertain (0.011)
outliers	number of outliers: Severe (0.112)	number of outliers: Severe (0.105)
m-statistics	q: Good (0.565) q-m2: Good (0.264)	q: Good (0.588) q2: Good (0.290)
residual trading days tests	f-test on sa (td): Good (0.991)	F-Test on SA (td): Good (0.999)
residual seasonality tests	f-test on sa (seasonal dummies): Good (1.000)	Qs test on SA: Good (1.000) F-Test on SA (seasonal dummies): Good (1.000)
X13; Series from 2018		
summary	**Severe**	**Severe**
basic checks	definition: Good (0.000) annual totals: Good (0.000)	definition: Good (0.000) annual totals: Good (0.000)
regarima residuals	normality: Good (0.245) independence: Good (0.731) spectral td peaks: Good (0.507) spectral seas peaks: Good (0.166)	normality: Good (0.747) independence: Good (0.707) spectral td peaks: Good (0.316) spectral seas peaks: Good (0.354)
Out-of-sample	-	mean: Bad (0.001) mse: Bad (0.000)
outliers	number of outliers: Severe (0.111)	number of outliers: Bad (0.095)
m-statistics	q: Good (0.639) q-m2: Good (0.166)	q: Good (0.634) q2: Good (0.216)
residual trading days tests	f-test on sa (td): Good (1.000)	F-Test on SA (td): Good (0.999)
residual seasonality tests	f-test on sa (seasonal dummies): Good (0.995)	Qs test on SA: Severe (0.000) F-Test on SA (seasonal dummies): Good (0.967)

5. Conclusions

Diagnostics indicators show a low quality of the seasonal adjustment process using TRAMO-SEATS in JDemetra+ 3.0.0 even after the series has been shortened. Meanwhile, in JDemetra+ 2.2.4, applying TRAMO-SEATS shows a good quality on the shortened series.

Shortening time series affected by outliers is recommended by scientific literature (see Mirică et al 2016). Thus, migrating from JDemetra+ 2.2.4 to JDemetra+ 3.0.0 might be problematic for practitioners in official statistics, as some new strategies might be needed in order to obtain good results on seasonal adjustment. In this respect, we recommend testing the seasonal adjustment

procedures in JDemetra+ 2.2.4 and JDemetra+ 3.0.0 especially for problematic series and developing appropriate strategies on a case by case basis.

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