INSTITUTO NACIONAL DE ESTADISTICA

INE standard on seasonal and calendar adjustment

March 2019

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0 Introduction

Short-term economic statistics are a tool used for analysing the economic cycle, and serve for political decision-making. However, these indicators are influenced by seasonal effects and calendar effects that prevent understanding the economic phenomenon clearly.

The main objective of seasonal adjustment is to filter the series for these seasonal and calendar effect fluctuations, such that the information that they contribute be clearer and easier to interpret. Seasonal fluctuations are movements that occur with a similar intensity each month, each quarter or each season of the year, and which are expected to continue occurring. The calendar effect is defined as the impact produced in the time series of a variable, due to the different structure that the months (or quarters) present in the different years (in both length and composition), even if the remaining factors influencing said variable remain constant.

Seasonally adjusted series, that is, those that are adjusted for seasonal and calendar effects, provide an estimate of what is "new" in a series (change in the trend, the cycle and the irregular component).

Statistics offices and central banks, as well as other public and private study institutions and services that work with economic time series or in the analysis of the short term, are continuously carrying out the seasonal adjustment in said data.

Nonetheless, despite being a customary practice, seasonal adjustment is also a source of constant debate, due to the different methods that can be used, and the different tools and computer programs that exist. Moreover, the possible manipulation of the original data through seasonal adjustment is also questioned.

Due to this controversy, until 2013 the general dissemination policy of the National Statistics Institute had been to offer only the original item of data in the short-term series, and in some cases, the item of data adjusted for the calendar effect[1].

Since 2013, INE has published the seasonally adjusted series (corrected for seasonal and calendar effects) for two main reasons:

- On the one hand, the statutory requirements from Eurostat demand the transmission of not only unadjusted data but seasonally adjusted series as well. In addition, in some short-term indicators, the seasonally adjusted European aggregate is prepared as a grouping of the seasonally adjusted data of the Member States (indirect method).
- On the other hand, statistics offices are expected to provide users, and the general public, with data in the most easily interpreted way possible, eliminating those effects that are not relevant in the analysis of the economic cycle.

[1]Exceptions to this rule have been the Quarterly National Accounts and the Harmonised Labour Cost Index, where the seasonally adjusted data had also been disseminated

Nevertheless, the INE is conscious of the risks of disseminating data that is seasonally adjusted, among others:

- The series that are adjusted for seasonal and calendar effects depend on the method used and on the assumptions of the chosen model, as well as on the software used in the process.
- An inappropriate or poor quality seasonal adjustment can generate erroneous results and false signals.
- The presence of residual seasonality or excessive smoothing negatively affects the interpretation of the seasonally adjusted data.

In order to reduce these risks as much as possible, as well as to make the whole seasonal adjustment process transparent, INE has designed the standard presented in this document.

This standard is set out, following the recommendations in the *ESS guidelines on seasonal adjustment.* This guide published by Eurostat in 2009, last updated in 2015, meets the standardisation or harmonisation needs that had been expressed on numerous occasions by users and European political institutions, such as the ECB, the EFC and the ECOFIN.

The recommendations reflected in the ESS guidelines on seasonal adjustment are not solely restricted to the seasonal adjustment process, but rather cover other aspects, such as the pre-treatment of the series, the revision policy and the adjustment quality, as well as matters relating to the dissemination of the results and the associated metadata. The guide describes three alternatives for each of the items studied: A) the best practice is considered, B) an acceptable option is considered and C) practices that should be avoided are shown.

In order to guarantee harmonisation with the recommendations included in the ESS guidelines on seasonal adjustment and thus ensure international comparability, the present INE standard regarding seasonal adjustment follows a similar structure to the European document. Each subsection in this document has the same format: 1) a short introduction on the subject, as extracted from the ESS guidelines on seasonal adjustment, 2) alternative A from the ESS guidelines on seasonal adjustment, that is, the best practice considered for each matter (though in some cases it also includes acceptable practices) and 3) the practices recommended for the seasonal adjustment in the INE, which are in line with alternative A, included in the European manual so as to guarantee coherence and comparability on an international level.

1 Pre-treatment

1.1 Calendar adjustment

The structure and composition of the calendar affect economic activity in different ways. If these effects are not well adjusted, the identification of the ARIMA model may not be correct, and therefore, the quality of the adjustment of the seasonal effects may be affected. Typical calendar effects include the following:

- The different number of working days in each month.
- The different composition of the number of working days.
- The leap-year effect.
- Moving holidays, in our case, the Easter holiday.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: RegARIMA approach, with significance and plausibility tests of the effects.

INE STANDARD

1. **The non-significant parameters with a clear economic interpretation may be eliminated.** In any case, if the value of Student-t statistic is greater than 1, it is recommended to leave the regressor in the model.

2. **Conversely, parameters with values that are excessively far from the expected values according to their economic interpretation must be eliminated from the model.** Example: The term leap year must represent the effect that the length of the month is the greatest unit (without considering composition). Therefore, in an additive model with levels, the coefficient would represent the average activity on any given day and in an additive model with logarithms, the coefficient would represent the variation rate of the activity with regard to the inclusion of another day. In this case, it is recommended to establish the value of the parameter as reference value 1/N (where N indicates the average length of the months of February), or estimate it, checking (especially for short series) that its value is not very far from this reference value.

3. **It is considered adequate to use information from the respondents, which allows building regressors that include all of the calendar effects jointly.** In the surveys in which the respondents themselves provide data regarding the number of days actually worked during the month, this may be used in order to build a regressor that captures all of the calendar effects jointly; so long as the Promoting Service considers the information to be of sufficient quality, and the metadata specifies everything related to the regressor.

4. **It is recommended that the series adjusted for calendar effects be centred in the base year**, that is, their average must be 100 in the base year. To this end, the entire series must be multiplied by a certain coefficient.

1.1.1 METHODS FOR WORKING-DAY ADJUSTMENT

The working-day adjustment has the purpose of obtaining a series whose values do not depend on the length of the month or quarter, nor the number of working days distribution.

It be noted that the length and composition of each month or quarter has a seasonal part. For example, March always has 31 days and, on average, it has more Mondays that February. This seasonal part must be captured in the seasonal component, and must not be eliminated, therefore, with the adjustment for calendar effect. The working-day adjustment must only be associated with the non-seasonal part of the effect.

The non-seasonal part of the composition of the working days of the month or quarter may be estimated by the deviation of this number of days from its long-term average, calculated over a 28-year calendar.

Therefore, in order not to eliminate seasonality, it is necessary to calculate the regressors in deviations from the average for each month/quarter.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: RegARIMA approach, with tests to determine the number of regressors, the length and composition of the month and the plausibility of the effects.

<u>INE STANDARD</u>

1. **Working day regressor.** In order to avoid eliminating the seasonal part of this effect it is recommended to prepare the following working day regressor:

$$(\textit{Días háb}_{(m/t)T} - \overline{\textit{Días háb}_{m/t}}) - \frac{\overline{\textit{Días háb}}}{\overline{\textit{Días inháb}}} * (\textit{Días inháb}_{(m/t)T} - \overline{\textit{Días inháb}_{m/t}})$$

where:

- $\textit{Días háb}_{(m/t)T}$ is the number of working days in the month (m) or quarter (t) from year T.
- $\overline{\textit{Días háb}_{m/t}}$ is the average number of working days for each month m = January, February, ..., December, or quarter = I, II, III or IV calculated over a 28-year calendar. In shorter series, this average of working days in each month or quarter is obtained with the calendar of the complete series, and is recalculated every year.
- $\textit{Días inháb}_{(m/t)T}$ is the number of non-working days in the month (m) or quarter (t) of the year T.
- $\overline{\textit{Días inháb}_{m/t}}$ is the average number of non-working days in each month m = January, February, ..., December or quarter = I, II, III or IV calculated over a 28-year calendar. In shorter series, this average of non-working days in

each month is obtained with the calendar of the complete series, and is recalculated every year.

- $\dfrac{\overline{\textit{Días hábiles}}}{\overline{\textit{Días inháb}}}$ is the quotient between the average of the number of working days and the average of the non-working days, calculated over a 28-year calendar. In shorter series, this quotient is obtained with the calendar of the complete series, and is recalculated every year; though it may stabilise near the same value in long series.

The regressor for working days, thus built, is recalculated every year since the beginning of the series with the new averages of working and non-working days each month or quarter and the new proportion between working and non-working days.

In the regressor for working days, the 29th of February and the days in the Easter holiday must be included as either working or non-working, as appropriate.

2. Different composition of working days. It is recommended to test whether there are differences between the different working days, above all in long monthly series that measure the evolution of some variable or phenomenon in which, a priori, behaviour may be different each day of the week. In selecting this scheme, it must be considered that, facing similar corrections, more parsimonious models are preferable, that is, models with a smaller number of regressors.

3. Leap year calendar effect. Every four years, the month of February has 29 days, and this can affect the economic series for two reasons: the composition of the month varies (in terms of working or non-working days with regard to the average) and the length of the month is changed. The first effect is measured with the regressor for working days (where the 29th must be considered either working or non-working, as appropriate); whereas the second effect must be quantified with the regressor for the leap year.

   This regressor must also be calculated in deviations as compared with the average, and therefore, its value will be 0.75 in the months of February in leap years, -0.25 in the months of February in non-leap years and 0 in the remaining months.

1.1.2 ADJUSTMENT FOR MOVING HOLIDAYS

The adjustment for moving holidays aims to eliminate those values that are affected by events following a complex pattern over the years from the series. The moving holiday that most affects our series is the Easter holiday. In addition, in this case, this effect is partially seasonal, in that on average, it is celebrated more often in April than in March. Given that the seasonal part must be captured in the seasonal component, it must not also be eliminated with the correction of the Easter holiday effect.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: regARIMA approach, with tests to determine the effect of the Easter holiday and other moving holidays. The length of the moving holiday effect must be made based on the results of the previous tests. Test the plausibility of the effect.

<u>INE STANDARD</u>

Regressor for the Easter holiday. The regressor(s) for the Easter holiday must be built in such a way that they aim to capture the effect that this moving holiday can have on the economic series being analysed. It is not possible to specify a standard way of preparing this regressor, because the repercussion that this holiday may have is very different from one series to another. The effect of the Easter holiday regressor and the regressor for working days is accumulative. That is, the regressor for working days must be calculated considering the days of the Easter holiday as either working or non-working, according to each statistical operation. In turn, the regressor for the Easter holiday will quantify the additional effect that this holiday has on the economic series, by the fact of being the Easter holiday, and may be defined as the survey team deems appropriate.

Nevertheless, some general lines may be presented to define this regressor and interpret the coefficients:

- The survey team, that which best understands the behaviour of the phenomenon measured by the statistical operation, must define this regressor both in terms of the length of the effect (six days, from Monday to Saturday of that week; seven days, from Palm Sunday; nine days, from Good Friday or five days, from Wednesday to Sunday), and referring to the parameterisation of the regressor (considering each day separately, different groups of days or a single regressor as a whole).
- Regarding the parameterisation, it must be considered that to include several regressors, in order to represent the effect of the Easter holiday on different days, can be complex and will require the series to have a sufficient length. On the other hand, if a single regressor is used to represent this effect, the estimated coefficient for said regressor will measure the additional effect (increase or decrease) on the activity of a working/non-working day in the Easter holiday with regard to the effect of a working/non-working day in week that is not the Easter holiday. Therefore, for example, if Easter Monday were included as working in the regressor for working days, and Good Friday were included as non-working in the regressor for working days, on the Easter holiday having a single regressor, this would implicitly imply the restriction that the additional effect of Easter Monday with regard to any other working Monday, would have to be the same as the additional effect of Good Friday with regard to any other non-working Friday.
- An alternative to differentiate between the different days (groups of days) within the Easter holiday, rather than several regressors, consists of defining a single regressor, including the days (or groups of days) with different weightings (adding up to one), which will be chosen by the survey team using their knowledge of the analysed phenomenon. In this case, the additional effect

of the Easter holiday on each one of the days (groups of days) will be given by the product of the coefficient by the different weightings.

In any case, aside from how this regressor is defined, the following must always be met:

- In order not to eliminate the seasonal component of the Easter holiday (which on average is held more often in April than in March), regressors in deviations with regard to the 28 years calendar average for the month/quarter in wich Easter falls.
- The metadata must specify everything relating to the construction of the Easter holiday regressor.

1.1.3 NATIONAL AND AUTONOMOUS COMMUNITY CALENDARS

The ESS guidelines on seasonal adjustment document recommends the preparation of a European Union calendar as an average of the number of working days in the different countries, weighted by the appropriate weight of that country in each European series.

In a similar way, in order to consider not only the calendar of the national public holidays, but also the calendar of the different public holidays in the Autonomous Communities, a national calendar must be built bearing in mind the said public holidays.

INE STANDARD

Preparation of the national calendar. At the time of building the regressor for working days, not only must national holidays be taken into account. The holidays of the Autonomous Communities should also be included. In the calculation of both working and non-working days, this must consider the number of each of these days in each month in the different Autonomous Communities weighted by the weight that said Autonomous Community has in the economic series that is being adjusted for this effect.

As a general rule, the weight of the holidays in each Autonomous Community will be the weighting for said Autonomous Community in the overall index (or the highest-level aggregate) in that statistic, and a single regressor will be constructed for working days, in order to correct all of the economic series of a single statistical operation, with their different functional breakdown levels (for example: sections, divisions, groups or classes of CNAE).

However, if there is evidence of different behaviour in the effect of working days at different breakdown levels (for example, different activities), and moreover, the weight of the Autonomous Communities is different in each one of them, it is recommended to build a regressor for each one of those series in which the concrete weighting of each Autonomous Community is taken into consideration. Example: the effect of working days may be different in Accommodation Turnover than in Information and Communications Activities, and moreover, the weight of each Autonomous Community may be different in each one of these activities. In similar cases to the above, it is advisable to build a different working day regressor for each activity. In these cases, for the functional breakdowns of each of them, a recalculated regressor will be used for the greatest aggregate.

The weighting of each Autonomous Community to prepare the working day regressor will be modified with the base change of the indicator for fixed base indices. In the case of chained indices such weighting will be amended annually.

1.2 Outlier detection and correction

Outliers are abnormal or atypical values in the series. These may appear in different forms: as an impulse, a transitory change, a level shift (step) or a change in the variation rate (ramp).

These values must be detected and modelled prior to estimating the seasonal adjustment and the calendar adjustment, in order to avoid the estimates being distorted or biased. However, the outliers must remain visible in the series that is adjusted for seasonal and calendar effects, because they provide information regarding certain events, for example, strikes. That is, the outliers must be reintroduced in the time series after estimating the seasonal and calendar component. Outliers are not easy to process, especially at the end of the series.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: To carry out tests in order to determine the presence of different type of outliers. Once identified, the outliers due to errors must be corrected in the gross series. The remaining outliers must be explained/modelled with all the information available. Those outliers that have a clear explanation (strikes, consequences of changes in government policies, territorial changes affecting countries or economic areas, etc.) are included as regressors in the model. As an acceptable alternative, the fully automatic process is considered for detecting outliers.

INE STANDARD

1. **Outlier detection**:

   - It is considered acceptable to carry out an automatic process for the detection of outliers, though for the most important aggregates of each statistical operation, it is recommended to test and model the outliers with all of the information available. In addition, it is recommended to pay special attention to the latest observations, given that the greatest difficulty for identifying them in the final part of the series may lead to including interventions for non-existent outliers, or to leaving true outliers without intervention, which could disturb the adjusted series considerably and cause important revisions.

   - The coefficients of the regressors for the calendar effect must be estimated having modelled the most noteworthy outliers whose coefficients are significant. Given that the processing of the outliers may cause significant differences in the revisions of the series adjusted for the calendar effect, it is recommended to be especially careful in modelling outliers, above all in short series.

- Outliers with a known explanation are included as regressors in the model and remain in model revisions, though their coefficients cease to be significant in the new revisions.

2. Series adjusted for the calendar effect: Interventions must not be removed from the calendar adjusted series (nor from the seasonally adjusted series).

   For example, assuming that the series X_t is broken down as follows:

$$X_t = C_t + S_t + R_t + \xi_t$$

   Where C_t represents the calendar component, S_t the seasonal component, R_t the interventions, and ξ_t is the rest (including cycle, trend and irregular components).

   Then:

- the series adjusted for calendar effects is:

$$X_t^C = X_t - C_t = S_t + R_t + \xi_t$$

- and the seasonally adjusted series is

$$X_t^D = X_t - C_t - S_t = R_t + \xi_t$$

   In no case will it be necessary to carry out

$$X_t^C = X_t - C_t - R_t = S_t + \xi_t$$

   or

$$X_t^D = X_t - C_t - S_t - R_t = \xi_t$$

1.3 Model selection

An adequate model selection includes, but is not limited to, decision making regarding:

- Whether or not to apply the logarithmic transformation
- The adequate differentiation orders in the regular and seasonal part.
- The use of additive or multiplicative components.
- The statistical tests in order to assess whether the model is adequate.
- How to analyse the sufficient decomposition, in accordance with the chosen model.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: To carry out a model selection based on statistical tests (normality, heteroscedasticity, correlation,...) and the spectral analysis of the residuals. Manual model selection for important aggregates or problematic series.

INE STANDARD

It is considered acceptable to carry out an automatic process for the model selection, through for the overall index and the most important aggregates for each statistical operation, it is recommended to carry out a manual selection.

At the time of selecting the model, all of the tests provided by the statistical package used (Gretl, TRAMO-SEATS and/or JDemetra+) must be checked, as well as the graphs of the series and residuals.

2 Seasonal Adjustment

2.1 Selection of the seasonal adjustment method

The two most used approaches for seasonally adjusting time series are the seasonal adjustment based on ARIMA models and fixed filters.

The seasonal adjustment based on ARIMA models consists of the following steps: first an ARIMA model is built for the series to be adjusted; next, other models for the components are obtained from it; the Wiener-Kolmogorov filter is used to separate them, and lastly, they are aggregated again, excluding the seasonal component.

Methods based on fixed filters allow the series to be broken down into non-observable components through an iterative procedure based on sequential smoothing. This smoothing is obtained by applying moving averages.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: Both approaches can be used for seasonal adjustment. The choice between the two should take into account previous statistical analyses and past practices.

<u>INE STANDARD</u>

In the European Statistical System, the two approaches are considered on an equal basis. In the recommendations document (ESS Guidelines on Seasonal Adjustment), the relative relevance of each one of them is not discussed, considering that they are valued equally, as is reflected by the broad use of both of them within the European Statistical System.

Currently, the INE carries out the seasonal adjustment based on ARIMA models.

2.2 Software selection

There are many interfaces for the recommended seasonal adjustment methods.

The first interface for the ARIMA model-based methods is the TRAMO-SEATS package. This package incorporates a program for the automatic identification, estimation and diagnosis of the model (TRAMO) and another one that separates the components (SEATS).

The programs in the X-11 family, from the US Census Bureau, are those which are used most frequently for fixed filter based adjustment. As of the X-12-ARIMA, the series are extended through predictions made with ARIMA models. This reduces revisions at the end of the series.

Currently, programs have been developed that allow for making the adjustment via two approaches. Some of these programs are the X-13 ARIMA-SEATS and the JDemetra +, both recommended by Eurostat.

The choice of software involves the consideration of various aspects: versions, maintenance and support, compatibility with ESS Guidelines on Seasonal Adjustment, documentation, open source architecture and mass production.

In any case, the tools used to seasonally adjust the series must be always up to date, and the methods and versions used at every moment in time must be communicated to users.

Best Alternative in ESS guidelines on Seasonal Adjustment: use public domain software, preferably open source, thoroughly tested and containing several of the recommended methods.

INE STANDARD

Currently, the INE carries out the seasonal adjustment based on ARIMA models, using updated versions of JDemetra+ for it, except in some operations where TRAMO SEATS is still used (currently).

2.3 Consistency between the gross data and data adjusted for seasonal effects

The effect of seasonality is not neutral over an entire year, especially if a multiplicative decomposition model including changing seasonality and calendar effects has been chosen. Although it is possible to force the annual sum or average of the seasonally adjusted data to be the same as the annual sum or average of the gross data, there is no theoretical justification for doing so.

The disadvantages of forcing this equality are multiple: this can introduce biases in the data adjusted for seasonal effects (especially when the calendar effects and other non-linear effects are significant), the data that is finally seasonally adjusted might not be the best and subsequent calculation adjustments are necessary, whereas the only benefit of this restriction is the annual consistency between the gross data and the data that is seasonally adjusted. However, this could be necessary when coherence is required between the annual data and the more frequent data. For example: National Accounts, Balance of Payments or Foreign Trade.

Best Alternative in ESS guidelines on Seasonal Adjustment: not to impose the annual equality restriction (as a sum or on average) of seasonal and calendar adjusted data to unadjusted data or calendar adjusted data, unless there are requirements on the part of users that justify the use of benchmarking. In this case, in the presence of calendar effects, force annual equality to calendar adjusted data. If there are no calendar effects, equality will be forced to the unadjusted data. To this end, known benchmarking methods should be used, which preserve short-term movements.

INE STANDARD

1. **It is not recommended to force annual equality (as a sum or as an average) from seasonally and calendar-adjusted data to unadjusted data or calendar-adjusted data.**
2. Under certain circumstances (due to user requirements) it is considered acceptable to force the equality of seasonal and calendar-adjusted data to calendar-adjusted data. In these cases, known benchmarking methods must be used [1] that must be specified in the metadata.

   It would not be correct to force the coherence between the seasonal and calendar adjusted data and the unadjusted data whose time aggregation (annual data) could have calendar effects. Nonetheless, if it is considered that the calendar effect of the annual data is not significant, or an economic explanation is not found, then the adjustment can be considered for the seasonal and calendar adjusted data (SAC) to the unadjusted data.

2.4 Direct approach as compared with indirect approach

The direct seasonal adjustment is made when all of the series (from the most basic series to the aggregates) are adjusted individually for seasonal effects. Conversely, in the indirect seasonal adjustment, some series are obtained as a combination or two or more series adjusted for seasonal effects. The choice of one approach or the other is an open question. There is no theoretical or empirical evidence in favour or one approach or the other.

Some considerations can be taken into account when choosing between the two options:

- Descriptive statistics of the quality of the adjustment by both methods. Example: smoothing of aggregates, tests of residual seasonality in the series adjusted by the indirect approach, measurement of revisions.
- Characteristics of the seasonal patterns in the different series.
- User demand regarding the consistency and coherence of the data, especially when they are additive.
- The existing restrictions between the series disaggregated and aggregated data.

The different options that may arise are as follows:

- Direct approach in all of the series, using the same software in all of them (regardless of the level of detail), and without eliminating the discrepancies in the adherence to the restrictions.

[1] International Monetary Fund, (2017) Quarterly National Accounts Manual. Chapter 6:

- Direct approach in all of the series in a similar way as the above case, but the possible discrepancies appearing are distributed through the aggregation structure. If the discrepancies are small, some calibration procedure may be applied in order to ensure additivity.
- Indirect approach where all of the basic series or series with a lower aggregation level are adjusted using the same approach and software, and the totals adjusted for seasonal effects are obtained through the aggregation of the adjusted component series.
- Mixed indirect approach where the seasonal adjustment of the series with the lowest aggregation level is carried out using different approaches and software, and the totals adjusted for seasonal effects are obtained through the aggregation of the previously adjusted series, though not much information is available regarding the options and parameters used.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: The choice of one approach or the other must be carefully considered. The direct approach is preferred due to its transparency and accuracy, especially when all of the components of the series show a similar seasonality pattern. Whereas, if the seasonal pattern shown by the components is significantly different, the indirect method is more appropriate.

On the other hand, it is considered an acceptable alternative to use the direct approach, applying some technique to eliminate the discrepancies between the adjusted data of the components and the aggregates, or the indirect method, when there is a strong demand by users for a coherence or consistency between the aggregates at different levels (for example, additivity). In any case, so long as the indirect method is used, the presence of residual seasonality in the seasonally adjusted aggregates must be tested.

<u>INE STANDARD</u>

1. **Choice between the direct approach and the indirect approach.** The decision to apply one approach or the other must be made bearing in mind several factors, among the following: the characteristics of the gross series, the demand by users regarding the coherence between the aggregates on different levels and the similarity of the filters applied.

   If the gross series are not additive, for example, in the case of the chain-linked series (where the aggregate is not the linear combination of the basic indices), it is recommended to use the direct method, due to its simplicity and transparency.

   On the other hand, if the gross series are additive and there is no strong demand by users regarding the coherence between the aggregates on different levels, the decision between the direct approach and the indirect approach must only be based on the quality of the results. In this case, it is possible to opt for comparing the filters of the different series, and if they are similar, to use the direct method, due to its greater simplicity. The means of making the comparison would be to observe the filter transfer function.

If there are no external restrictions, the decision must be made, as indicated, depending on the similarity of the filter transfer function, and not depending on the analogy of the seasonal patterns of the series. It could occur that two series could have a different seasonal pattern, and their sum could be seasonally adjusted in a similar way using the direct or indirect method. Conversely, two series with the same seasonal pattern can provide an aggregation of another whose seasonally adjusted data is different using both methods.

Lastly, if there are external restrictions that impose coherence between the seasonally adjusted series on different levels, the indirect method can be used, or the direct method can be used, but eliminating the discrepancies between the adjusted data of the series comprising the aggregate and said aggregate.

When there are different aggregation levels, it is possible to opt to seasonally adjust the intermediate aggregates by the direct method and adjust the discrepancies upwards and downwards.

2. **Technique for eliminating the discrepancies between the adjusted data of the components and the aggregates.** In case of using a direct approach for all of the aggregation levels, subsequently eliminating the discrepancies, known techniques must be used, and they must be specified in the metadata from the statistics.

3. **Tools for checking whether there is residual seasonality.** It must be verified that there is no residual seasonality remaining in any of the series when:

    - The indirect method is applied
    - The direct method is applied, subsequently eliminating the discrepancies between the lower breakdown levels and the seasonally adjusted aggregate.

The following patterns may be followed to this end:

- Graphically analyse the quarterly/monthly rates of the seasonally adjusted series, being those whose rates may present a certain seasonal pattern.
- Study the periodogram of the seasonally adjusted series and their monthly/quarterly rates[1]. It is to be expected that the periodogram of a seasonally adjusted series will present small values in the seasonal frequencies, as compared with their value in the rest of the frequencies (the value of the periodogram for each frequency depends on the series measurement unit, and therefore, its scale is not informational, what is important is its relative magnitude in the different frequencies). It must therefore be verified that there are no peaks in the frequencies corresponding to 1, 2, 3, 4, 5, or 6 cycles per year (in monthly series) or to 1 or 2 cycles per year (for quarterly series)

[1] See Annex I

- Analyse seasonal patterns. The seasonal pattern is obtained as the quotient between the unadjusted series and the seasonal and calendar adjusted series (SAC). It must be taken into consideration that:

  - A flat seasonal pattern indicates the absence of seasonality (the gross series is equal or similar to the SAC series). If the gross series has seasonality, a flat seasonal pattern indicates that the seasonality has not been eliminated in the SAC series.

  - The seasonal pattern can change. If the change is gradual, it is not necessarily important. If the change is brusque, the cause of that change must be analysed. If the change does not originate from the gross series, review the seasonally adjusting process and allocation of discrepancies (if any) and check whether the SAC series has residual seasonality

- Confirm the statistics regarding seasonality provided by the software used. Another way of testing the presence of residual seasonality is to treat the seasonally adjusted series (SAC) obtained by the indirect method, or the seasonally adjusted series after having made the adjustments necessary for assigning the discrepancies, with the program used and verifying the statistics on seasonality provided.

  In the direct method with subsequent adjustment, check whether the possible residual seasonality in some series comes from the subsequent assignations (necessary to reach longitudinal and transversal coherence in some statistics). In order to correct said residual seasonality, a different distribution of the discrepancies found must be carried out.

3 Revisions

3.1 General policy on revisions

Revisions of the data adjusted for seasonal effects and calendar effects mainly take place for two reasons: 1) as a result of the revision of the unadjusted data, due to an improvement in the information (in terms of coverage and/or reliability) and 2) as a result of a better estimation of the seasonality pattern, due to new information provided by new unadjusted data, and due to the characteristics of the filters and procedures that eliminate the calendar and seasonal components.

Revisions based on new information are necessary, although a single additional observation could cause revisions of the adjusted data for several years, which may confuse users.

Therefore, a balance must be found between the need to adjust the data as best as possible, especially at the end of the series, and the need to avoid minor revisions in data that, at a later date, might return to its previous state (that is, a balance between the precision and stability of the adjustment).

At the time of developing a revision policy, both user needs and available resources must be borne in mind. The revision policy must cover at least the following issues: frequency and relative size of the revision due to the seasonal adjustment; the precision of the adjusted data; the period throughout which the unadjusted data has been revised, and the relation between the publication dates of the revisions of the adjusted data and the unadjusted data.

The INE has a revision policy that can be consulted at the following link:

http://www.ine.es/ine/codigobp/politica_revision.pdf

Best Alternative in *ESS guidelines on Seasonal Adjustment*: Revisions of the adjusted data are published in accordance with a coherent and transparent revision policy and calendar, which are coordinated with the revision policy and calendar for the unadjusted data. Revisions of the adjusted data are not disseminated more frequently than the unadjusted data. The public is informed of the average of the previous revisions for important macroeconomic variables. In addition, it is considered acceptable that they are published according to a number of independent policies that apply to different publications.

INE STANDARD

1. **Revision policy.** It is recommended that the revisions of the data adjusted for seasonal effects and calendar effects be published in accordance with a transparent revision policy, coordinated with the publication of the unadjusted data, and made known by users. The revision policy must be disseminated through the metadata for each of the statistics.

2. **Information on revisions.** Users should be informed on the average of previous data revisions.

To this end, it is recommended to include the values of an indicator that measures the size of revisions between two estimates in the metadata template for each statistic.

2.1 Indicators of the size of revisions with respect to the last published series:

- **MAR (Mean Absolute Revision):**

$$\boldsymbol{MAR} = \frac{1}{\boldsymbol{n}} \sum_{t=1}^{n} \left| \boldsymbol{X}_{Lt} - \boldsymbol{X}_{Pt} \right|$$

- **RMAR (Relative mean absolute revision):**

$$RMAR = \sum_{t=1}^{n} \left[\frac{\left| X_{Lt} - X_{Pt} \right|}{\left| X_{Lt} \right|} \frac{\left| X_{Lt} \right|}{\sum_{t=1}^{n} \left| X_{Lt} \right|} \right] = \frac{\sum_{t=1}^{n} \left| X_{Lt} - X_{Pt} \right|}{\sum_{t=1}^{n} \left| X_{Lt} \right|}$$

- **MR (Mean revision):** if the revision sign is important, this indicator is used.

$$MR = \frac{1}{n} \sum_{t=1}^{n} \left(X_{Lt} - X_{Pt} \right)$$

where:

X_{Lt} is the seasonally adjusted data for reference period *t* with the last adjustment made, *L-th* publication of X.

X_{Pt} is the seasonally adjusted data for reference period *t* with the previous setting, *P-th* publication of X.

n is the number of observations (reference periods) in the time series. This number of observations will depend on the horizon for the publication of revisions. If the revision horizon is the complete series or a previous period, n can be the total number of observations or a smaller number of observations can be set, with n@20 recommended for the quarterly series and n@30 for the monthly series.

3. The calendar of revisions must be coordinated with the calendar of revisions for unadjusted data, so **it may be different for each of the statistics.**

3.2 Concurrent revisions versus current revisions

The way in which the seasonal adjustment is carried out has implications for revisions of seasonal and calendar adjusted data. There are a range of possible strategies, the extremes of which are:

- Current revision: The model, filters, outliers and regressors are re-identified and the respective parameters and components re-estimated in the appropriate revision periods. The seasonal and calendar filters used to adjust new unadjusted data between revisions are the estimates in the last revision.
- Concurrent revision: The model, filters, outliers and regressors are re-identified and the respective parameters and components are re-estimated each time new data arrives or the previous data is revised.

These two strategies have both advantages and disadvantages. The current revision reduces the frequency of revisions and mainly concentrates them in the review period but may show a lack of precision in the estimation of the latest adjusted data. In turn, the concurrent revision produces more precise adjusted data at each point in time, but leads to more revisions, many of which will be small and perhaps in opposite directions, in addition to a high instability of the seasonal pattern.

In practice, alternatives are used that balance the two extremes, seeking the advantages of both and trying to avoid the disadvantages. These alternatives include partially concurrent revisions and/or controlled current revisions.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: When the time horizon of the revisions is less than two years or new observations are available, partially concurrent revision is the most appropriate method, given that it considers the new information and minimises the size of revisions due to the adjustment process. However, if the seasonal component is sufficiently stable, the controlled current revision could also be considered, but in this case a complete revision of all the seasonal adjustment parameters must be carried out at least once a year. Finally, when the review period for unadjusted data covers periods of two years or longer (as occurs in the national accounts) the model, filters, outliers, regressors must be re-identified and their parameters estimated.

<u>INE STANDARD</u>

1. **Partially concurrent revision.** To find a balance between the size of the revisions and the quality of the adjustment, it is recommended to carry out a partially concurrent revision of the seasonal adjustment process. To this end:

   - The model (including: outlier intervention variables and regressors for the correction for calendar effects) is identified and fixed once a year.
   - During the current year, with each new observation:

     The following are re-estimated:

     - The model parameters (ARIMA)
     - The regression parameters for the adjustment of calendar effects and outlier intervention variables.

     The following are re-calculated:

     - Filters to produce the seasonally adjusted series

An attempt is made to preserve the stability of the extracted components by controlling the assignment of the model roots.

2. **Current revision with annual control:** It is considered acceptable within the standard to carry out a current revision with annual control when the size of the revisions is to be reduced. In this case the model (including the intervention variables of the outliers and regressors for the correction of calendar effects) is identified, the parameters (of the ARIMA model, of the regressors for the correction of calendar effects and of the intervention variables of the outliers) are estimated and the filters are calculated and fixed once a year. In this way the seasonal filters and corrections of calendar effects that are used to adjust new unadjusted data throughout the year do not vary.

3.3 Horizon for the publication of revisions

As a general rule, when a new observation is added, the seasonally adjusted data changes from the beginning of the series. These changes can be published in full, but it is not required. There are arguments in favour of republishing the complete series: the systematically homogeneous treatment of all values and the fact that it is easier to understand and reproduce the calculation. However, it is questionable as to whether additional new data really contains relevant information to make significant revisions to the estimation of seasonal fluctuations in past decades.

In practice, to balance the information gain and the revision horizon, the revision period for seasonally adjusted data is usually limited. Typically, unless a substantially poor specification of the model is found, an appropriate choice may be 3 to 4 years longer than the review period for unadjusted data.

For earlier periods, seasonal components may be frozen. The choice of the review period for seasonally adjusted data should take into account both the review period for unadjusted data and the convergence properties of normal seasonal filters. The output of the software used indicates how quickly the revision decreases as new observations are added, as well as the size of the revisions. By combining the two, an optimal revision horizon duration can be obtained, if desired, for each of the series.

However, in situations where unadjusted data is revised from the beginning of the series (e.g. base changes, changes in definitions or nomenclatures, sample design, etc.) the entire adjusted series should be revised.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: The revision horizon for the adjusted data must cover the revision period for the unadjusted data at least. On the other hand, due to the filter properties, it is suggested to set the revision period for adjusted data up to 3-4 years after the revision period for unadjusted data and to freeze adjusted data prior to that date. It is also considered acceptable to review the entire adjusted series regardless of the review period of the unadjusted data.

INE STANDARD

1. **Review the complete seasonal and calendar adjusted data with each new observation.** In the partially concurrent revision, with each new observation, the model parameters are re-estimated and the filters recalculated, yielding a new seasonally adjusted series from the beginning of the series. It is recommended that the new adjusted series be published from the beginning in order to have a homogeneous treatment of all values.

2. **Set a revision horizon.** It is agreed within the standard that a revision horizon should be set, which may be determined by those responsible for each statistic and published in its metadata as part of the revision policy. In order to determine this revision horizon, several elements of the revision policy must be considered for consistency:

   - The strategy implemented to carry out the seasonal adjustment: partial concurrent adjustment or planned revision with annual control.
   - The review period for the unadjusted data.
   - External demand for coherence between annual and more frequent data.
   - The decrease in the size of the revisions as new observations are added using the software results.

Beyond that horizon, the seasonal component of each series can be frozen and, therefore, the seasonally adjusted series can be frozen as well. However, when there are major changes in the unadjusted data (change of base and/or changes in nomenclatures, definitions, etc.) the seasonally adjusted series should be revised from the beginning.

4 Quality of the seasonal adjustment

4.1 Validation of the seasonal adjustment

Seasonal adjustment is a complex statistical treatment of data that requires a careful follow-up before results can be accepted. To ensure the quality of data adjusted for seasonal and calendar effects, they should be validated using a wide range of quality measures. These include checking the absence of residual seasonality and calendar effects, as well as comparing the stability of the seasonal pattern.

Validation of seasonally adjusted data should be carried out through graphical analyses, as well as descriptive parametric and non-parametric criteria included in the outputs of the seasonal adjustment programme used.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: Use a detailed set of descriptive, parametric and non-parametric graphs and criteria to validate the seasonal adjustment. Redo the seasonal adjustment with a different set of options in cases where the results are not accepted. Verify that the seasonally adjusted series have the following characteristics: no residual seasonality, no calendar effects, no under/overestimation of seasonal effects, no seasonal lag autocorrelation of the irregular component, stability of the seasonal component. In addition, it is necessary to verify the suitability of the identified model using adequate diagnostics and some other additional considerations, such as the number of outliers being relatively small and these not being focused around the same period in the year.

INE STANDARD

The following actions are recommended to test the validity of the seasonality adjustment.

1. **Check the suitability of the estimated regARIMA model (specification).**

    - ***No autocorrelation*** in the residual delays from the regARIMA model:

        - Ljung Box Statistics: These statistics tests the existence of autocorrelation in residuals. The software calculates it up to 24 lag in monthly series and up to 16 in quarterly series. In the case of monthly series, it is distributed as a Chi-Square with k degrees of freedom, where k is equal to *24 - No. parameters AR and MA*. In the case of quarterly series, it is distributed as a Chi-Square of *16 - No. parameters AR and MA*.

        - To examine the simple and partial (ACF and PACF) autocorrelation functions of the residuals, testing the existence of values that are statistically different from zero.

          The rejection of the null hypothesis of non-correlation or the existence of values that are significantly different from zero in the ACF or PACF may be an indication of misspecification of the model and, therefore, the model identification must be revised although it can also be the result of outliers data.

- **BIC or AIC information criteria**provided by the software. Also called model selection criteria, which enable the decision between several models taking into account the fit of each of them, but also their complexity. Consequently, they can be seen as a compromise between adjustment and parsimony. The BIC is also justified because if the real process belongs to the class in which we work (regARIMA), for large series lengths it ensures we select the correct model orders. The AIC, on the other hand, has its justification when the real process does not belong to the class where the model is sought.
- **No high correlations** between the model parameters (especially when identifying a model with an autoregressive part and regular moving averages). The software provides correlation between parameters for each model, a high correlation (above 0.80) may indicate that there are redundant elements in the model, such as roots in the AR and MA parts that are deleted.
- ***Normality tests.*** The software performs a Jarque Bera type normality test, using a statistic that is distributed as a Chi-Square with 2 degrees of freedom and at 95% it should not take values greater than 6. Normality is highly recommended for proper model specification, as its absence may produce various undesirable effects that may lead to a sub-optimal estimation of the seasonal component.
- ***Symmetry and kurtosis tests.*** The symmetry and kurtosis tests provided by the software are performed with statistics that are distributed according to a N(0.1) and at 95% it should not take values greater than 2.
- ***Runs test for residuals.*** The software tests the random nature of the residuals using a runs test that is distributed as a N (0.1) and at 95% should not take values above 2.
- ***Verification that the average residual is zero.*** The software checks that the average residual is statistically equal to zero.
- ***Non-linearity test applying the Ljung Box statistic to the square of the residuals.*** If a linear model is suitable, this statistic will follow a Chi-Square distribution. The software calculates it up to the 24 lag in monthly series and up to 16 lag in quarterly series. Therefore, for monthly series it is distributed according to a Chi-Square with 24 degrees of freedom. In the case of quarterly series, this is distributed as a Chi-Squared of 16 degrees of freedom.

2. **Check the suitability of the decomposition (specification).**

The software allows the similarity comparison between the component estimators and their numerical estimates. The following should be met;

- *The first-order and seasonal-order autocorrelations of each component for the theoretical estimator and its empirical estimate must be similar.* If ρ_1 and ρ_{12} are the first-order and seasonal-order autocorrelation coefficients for the theoretical estimator and $\hat{\rho}_1, \hat{\rho}_{12}$ for their empirical estimate, the following must be fulfilled: $\rho_1 \in [\hat{\rho}_1 \pm 2SE(\hat{\rho}_1)]$ and $\rho_{12} \in [\hat{\rho}_{12} \pm 2SE(\hat{\rho}_{12})]$. If it is not fulfilled, this is an indicator of misspecification.

- *The variance of the theoretical estimator $V_{\hat{s}}$ of each component and its empirical estimate $\hat{V}_{\hat{s}}$, must not differ much.* As with the above, the following must be fulfilled: $V_{\hat{s}} \in [\hat{V}_{\hat{s}} \pm 2SE(\hat{V}_{\hat{s}})]$. If $V_{\hat{s}}$ is greater than the upper limit of the bracket, there would be signs of an underestimation of the component, whereas if it is lower than the lower limit of the bracket, there would be signs of an overestimation of the component.
- **Test for non-correlation of the components.** The cross-correlations of the theoretical components must be zero, given that the software carries out a canonical decomposition. However, in obtaining the theoretical estimators and the empirical estimates, some correlation is introduced. There must be fulfilment that the cross-correlations of the theoretical estimators $\rho_{\hat{p}\hat{e}}$ and their empirical estimates $\hat{\rho}_{\hat{p}\hat{e}}$ be similar, in such a way that the following occurs:

$$\rho_{\hat{p}\hat{e}} \in [\hat{\rho}_{\hat{p}\hat{e}} \pm 2SE(\hat{\rho}_{\hat{p}\hat{e}})]$$

- **Verify that there are no large discrepancies between the annual averages of the original series, as compared with the adjusted series and cycle-trend.** When a logarithmic transformation of the series is carried out, differences appear due to the non-linearity of the transformation. Check that the measurement of the bias provided by the software is within the recommended values.[1] If this is not the case, it is advisable to analyse the series in levels.

3. **Check the absence of residual seasonality of the seasonally adjusted series.**

The absence of residual seasonality will be checked through the various graphical analyses and seasonality tests as well as spectral tests, periodogram analysis, etc., either self-developed or provided by the software, such as for example:

[1] Sylwia Grudkowska (2016), JDemetra+ Reference Manual Version 2.1
Maravall, A.,Caporello, G. (2004) Program TSW. Revised reference manual

- **Spectral diagnostics provided by SEATS.** The program estimates the spectrum (through AR(30) and Tukey methods) and subsequently tests whether there are significant peaks in the seasonal frequencies (1, 2, 3, 4, 5 and 6 cycles per year in the monthly series, and 1 and 2 cycles per year in the quarterly series). Moreover, it offers graphs on the spectrum estimated by the two methods. SEATS carries out these tests, among others, for the seasonally adjusted series, the trend-cycle and the irregular component.
- **Graphical analysis of the periodogram of the seasonally adjusted series and of its monthly/quarterly rates.** Verify, in the periodogram of the series, that there are no large values in the seasonal frequencies as compared with their value in the rest of the frequencies. In the monthly series, it must be verified whether there are peaks in the frequencies corresponding to 1, 2, 3, 4, 5 or 6 cycles per year, and in the quarterly series, whether there are peaks in the frequencies corresponding to 1 or 2 cycles per year.

For more detail on the absence of residual seasonality see the software manual used.[1].

4. Check the absence of residual calendar effects in the seasonally adjusted series

The absence of residual calendar effect will be checked through the different calendar effect tests provided by the software or by our own development, similar to those in the previous section, such as for example:

- **Spectral diagnostics provided by SEATS.** The program estimates the spectrum (through AR(30) and Tukey methods) and subsequently tests whether there are significant peaks in the weekly cycle frequencies (between 4.17 and 4.18 cycles per year in the monthly series). SEATS carries out these tests, among others, for the seasonally adjusted series, the trend-cycle and the irregular component.
- **Graphical analysis of the periodogram of the seasonally adjusted series and of its monthly/quarterly rates.** Verify, in the periodogram of the series, that there are no large values in the frequencies related to the calendar effects: in the frequency of approximately 4.2 cycles per year for the weekly cycle and in the frequencies of between 2 and 3 cycles per year for the Easter holiday effect.

For more details on the absence of residual calendar effect see the manual of the software used.[2]

[1] Sylwia Grudkowska (2016), JDemetra+ Reference Manual Version 2.1
Maravall, A.,Caporello, G. (2004) Program TSW. Revised reference manual
Maravall, A.,Caporello, G., Pérez, D., López, R. (2014) New features and modifications in Tramo&Seats

[2] Sylwia Grudkowska (2016), JDemetra+ Reference Manual Version 2.1
Maravall, A.,Caporello, G. (2004) Program TSW. Revised reference manual
Maravall, A.,Caporello, G., Pérez, D., López, R. (2014) New features and modifications in Tramo&Seats

5. **Graphical analysis of the seasonally adjusted series: Verify that a seasonal pattern is not observed in the seasonally adjusted series or in its monthly/quarterly rates.**

Other measures to assess the quality of the adjustment that is recommended to be reviewed:

- **Precision** The accuracy of the historical estimator can be measured through the standard deviation of its error. The smaller this value is, the more precise the model will be.
- **Stability.** There are several measures of the stability of the adjustment:
  - Standard deviation for the innovations of the seasonal component (the lower the value, the more stable the seasonal component will be).
  - Standard deviation of the revision of the concurrent estimator (the smaller the standard deviation of the revision is, the more stability the adjustment has).
  - Convergence through the percentage reduction of the RMSE[1] of the revision error after 1 and 5 years of additional data.
  - Seasonal component stability analysis: in general, the software used provides this component. Since this component is collecting the series movements that are repeated periodically over the years, the seasonal pattern in one year must be similar to that of other years and any change in this behaviour must be analysed.
- **Significance of the seasonal component.** The software tests that, for a given period, the seasonal component is other than zero, and reports the number of periods for which it being null is rejected. A large number of non-zero periods would indicate a more significant seasonal component.

All these tests are highly recommended. In practice, however, non-compliance does not preclude the use of a particular model in the case of complex series where a better solution cannot be achieved.

[1] Root Mean Squared Error.

5 Other matters in seasonal adjustment

5.1 Seasonal adjustment in short series

When the series are too short to use the seasonal adjustment methods mentioned in section 2.1, it is possible to choose not to adjust them for seasonal effects or to use other less standard procedures. With series long enough to be adjusted by such methods (with a length of 3 to 7 years) instability problems may arise. In these cases, empirical comparisons should be made to evaluate the different methods. As a general rule, when the series have a length of less than seven years, the specification of the parameters used in the pre-treatment and in the seasonal adjustment must be checked more frequently (for example: twice a year) in order to treat the high degree of instability of these series. Moreover, users must be informed regarding the instability problems of these short series.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: When the length of a series is less than three years, it should not be seasonally adjusted. With series with a length between 3 and 7 years, the seasonal adjustment must be carried out, whenever possible with standard tools. In addition, when reliable, in order to estimate the seasonal component, the series must be extended backward so as to extend the sample and stabilise the adjustment. Simulations must be carried out with the existing standard tools. Users must be informed on the methods used and the greater instability of these short series. A clear dissemination policy must be defined. The adjustment and the parameters for the seasonal adjustment must be checked more than once a year. As an acceptable alternative, it is proposed not to adjust series with a length between 3 and 7 years.

<u>INE STANDARD</u>

- **Very short series.** The series with a length of less than three years cannot be adjusted with methods based on ARIMA models. It is recommended that series with this length are not adjusted for seasonal effects.
- **Short Series.** Those series with a length shorter than 7 years can present a great degree of instability. It is recommended that series with this length are not adjusted for seasonal effects. Nonetheless, if it were necessary to carry out the seasonal adjustment (due to user demand or as aid in the short-term analysis), users must be notified regarding the methods used and the greater instability of these short series. In addition, the adjustment and the parameters for the seasonal adjustment must be checked more than once a year.

5.2 Treatment of problematic series

Some series can have very specific characteristics:

- High degree of non-linearity, even due to the short length of the series, which does not allow the identification of an acceptable model.

- Absence of a clear signal due to the presence of a dominant irregular component (for example: small or non-seasonal peaks in the original series, differentiated or in logarithms).
- Unstable seasonality (visible in graphs or in incoherent adjustments in overlapping time intervals).
- Very high number of outliers, compared with the length of the series (for example, more than 10% of outliers).
- Heteroskedasticity (in the series/components), which is not limited to a few months/quarters or it is not possible to avoid via the suppression of some years at the beginning of the series (leaving enough data for the estimation of the model) or using the logarithmic transformation.

These series cannot be treated with a standard adjustment, but rather, an ad hoc adjustment must be carried out, both in the treatment and in the software used. The quality of the seasonally adjusted data will depend on the appropriateness of the strategy adopted.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: To carry out the seasonal adjustment for problematic series, using a specific adjustment for each series rather than a standard adjustment, consulting literature, manuals and experts. In addition, users must be notified of the strategy adopted. As an acceptable alternative, it is proposed to carry out the seasonal adjustment of problematic series only if they are very relevant, when the lack of adjustment of these series entails a residual seasonality in significant aggregates on a higher level.

<u>INE STANDARD</u>

- **To carry out a seasonal adjustment for problematic series.** It is recommended to carry out a seasonal adjustment for problematic series. In these cases, seek a special method for each series that must be known by users and disseminated in the corresponding metadata.

6 Data presentation

6.1 Data available in the databases

The results associated with the seasonal adjustment process must be stored within a secure and available database environment. The minimum set of series that must be stored is as follows: the unadjusted data, the seasonally adjusted data and the series with the corresponding months/quarters. Moreover, other series may be included: the calendar adjusted data, the cycle-trend series, the seasonal factors and the metadata associated with the seasonal adjustment.

The database must be secure, but accessible for the production and storage of the time series estimates. The information stored may be used as part of a dissemination strategy that must be accessible to users, so long as there are no confidentiality problems.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: Systematic storage in a coordinated database: the unadjusted series, the seasonally adjusted series and other series of metadata (for example, different options of seasonal adjustment, prior corrections and the cycle-trend series). Ideally, it should also include the different prior versions (vintage data). In order to ensure that all of the data can be exchanged, it must provide some standard metadata. The information from the database must be secure, but attainable and accessible when required. To ensure transparency, users should be able to understand and replicate the seasonal adjustment process.

INE STANDARD

Following the recommendations of the *ESS guidelines on Seasonal Adjustment*, it is considered essential for the transparency of the entire seasonal adjustment process and the correct analysis of the series, to disseminate the following sets of data and metadata:

1. **Dissemination of series:** Dissemination is recommended via INEbase and TEMPUS for the following set of series for the main aggregates of the operations: unadjusted series, series corrected for calendar effects and series corrected for calendar effects and seasonal effects (seasonally adjusted series).
2. **Dissemination of other series:** Dissemination is recommended via INEbase and TEMPUS for the series of regressors for working days and moving holidays.
3. **Dissemination of metadata**: Dissemination is recommended via INEbase of the metadata template for the seasonal adjustment appearing in section 7.2. This metadata must be disseminated for all of the series published that are adjusted for seasonal effects and for calendar effects, or at least for the most relevant aggregates.

6.2 Press Releases

The data may be disseminated in different formats: original (unadjusted), seasonally adjusted, only adjusted for calendar effects or in a cycle-trend form. The unadjusted data contains all of the characteristics of the series. Seasonally adjusted data (corrected for calendar effects and seasonal effects) contains the "news" of the series, that is, the cycle-trend plus the irregular component.

Almost all of the discussions regarding the analysis of the cycle-trend focus on the so-called end point problem. Given that the values of the cycle-trend component at the end of the series are estimated by extrapolation, the estimated values for the cycle-trend in the most recent data are very uncertain, and may encounter phase-change problems. Special care must be taken at the turning points, where months/quarters are often needed until a new correct direction appears.

In all cases, the information contained in the press releases must respect the principles of transparency and aid to users in making informed decisions.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: The objective of the press releases is to provide the "Latest News". Therefore, the seasonally adjusted data is most appropriate data to disseminate in them. Moreover, users must have access (on request or online) to the historical series of the original data, seasonally adjusted data, data corrected for calendar effects and cycle-trend series if requested. If the latter are disseminated, they should not show the most recent values, in order to avoid end-point problems. This must include an error analysis of the revisions, at least of the seasonally adjusted series. The rates from one period compared to the previous period, and changes in level, must be calculated over the seasonally adjusted data, and must be used cautiously if the series are very volatile. The annual rates must be calculated over the data adjusted for calendar effects, or, in case of absence of calendar effects, over the unadjusted data.

<u>INE STANDARD</u>

1. **Data published in the press releases.** It is recommended to publish, in the press releases, seasonally adjusted data, at least of the most important aggregates, in addition to the data that had been published traditionally (unadjusted data and data corrected for calendar effects).

2. **Rates commented on in the press release**: It is recommended to include the monthly/quarterly rates of the seasonally adjusted series. The annual rates may be calculated over the unadjusted data, the data corrected for calendar effects or the seasonally adjusted data.

7 Metadata for the seasonal adjustment

7.1 Dissemination of metadata for the seasonal adjustment

Eurostat and the group of experts who prepared the *ESS Guidelines on Seasonal Adjustment document* consider it vitally important for the entire seasonal adjustment process be well-documented and public.

To this end, the information must be disseminated through a standard format, in line with the SDMX (Standard Data and Metadata Exchange) guides in force [1] The metadata regarding the seasonal adjustment is not only useful for the exchange of information within the European Statistical System, and with an informative purpose, but also for carrying out monitoring of the implementation of the seasonal adjustment guidelines.

Best Alternative in *ESS guidelines on Seasonal Adjustment*: Use the template for the metadata from the seasonal adjustment for all of the series, or at least for the most relevant aggregates. The information from the metadata template must be updated regularly, in order to reflect the changes in the seasonal adjustment process

INE STANDARD

Following the recommendations of the *ESS guidelines on Seasonal Adjustment*, it is considered essential for the transparency of the entire seasonal adjustment process to disseminate information on the metadata. To this end, the following is recommended:

1. **Complete the template of the metadata of the seasonal adjustment that appears in section 7.2.** This metadata must be disseminated for the published series adjusted for seasonal effects and for calendar effects, or at least for the most relevant aggregates. Within the template, the following sections are compulsory:

   - 1.1 Published series
   - 1.2 Method Used
   - 1.3 Software Used
   - 2.2 Aggregation
   - 3. Reviews
   - 4 Quality Indicators

2. **Attach this template as a document within the sub-section Adjustment of the section Statistical treatment of reference metadata that must be published by all INE statistics from September 2012.**

3. **Update the template annually to reflect changes in the seasonal adjustment process.**

[1] Commission Recommendation (2009/498/EC) 23 June 2009, on reference metadata for European Statistics.

7.2 Metadata Template

REFERENCE METADATA ON SEASONAL ADJUSTMENT

GROUP OF SERIES: Name
Frequency: Monthly/Quarterly

1.1 Published series	**Detail level**			
Type of adjustment	Aggregate Index	Functional Disaggregation		
Unadjusted series				
Calendar adjusted series (AC)				
Seasonal and calendar adjusted series (SAC)				
Other				

1.2 Method used

1.3 Software used				
Software				
Version				

	Detail level			
1.4 Calendar adjustment	Aggregate Index	Functional Disaggregation		
Type of adjustment (Direct/Indirect)				
Non calendar adjustment (reasons)				
Trading/Working days				
Moving Holidays: Easter working days / Easter non working days				
Leap year				
Other				
Calendar used				

	Detail level			
1.5 Other preadjustment	Aggregate Index	Functional Disaggregation		
Outliers: type of intervention				

2.Seasonal adjustment	**Detail level**			
2.1 Model	Aggregate Index	Functional Disaggregation		
Selection (Manual/Automatic)				
ARIMA model				
Mean				
Type of decomposition: additive, log-additive,multiplicative, other				
Number of regular polinomial AR roots assigned to the transitory component.				
SMOD				
2.2 Aggregation				
Type of adjustment (Direct/Indirect)	In case of indirect adjustment: inform about the chech or not of residual seasonality and the level of aggregation.			
Sectoral or geographical consistency	If any consistency is expected, inform about the type of adjutstment(Direct/Indirect) applied, indirect or direct with Benchmarking method.			
Temporal consistncy Monthly/Anual or Quarterly/Anual	If any consistency is expected, inform beetwen wich series, for example: Benchmark the seasonal and calendar adjusted series to the calendar adjusted low frequency series or Benchmark the seasonal adjusted series to the unadjusted low frequency series.			

3. Revisions	
Revision policy	
The model, filters, outliers and calendar regression are re-indentified.	Specify the strategy and frequency of re-identification.
Parameters and factors re-estimated	Specify the strategy and frequency of re-estimation.
Period revised	Full series or a specified period.

4. Quality indicators	Quality Indicators to evaluate the seasonal adjustment

5. Available Structural Metadata	
Links to Methodoloy documents	Link to survey methodology and standar on seasonal and calendar adjustment
Links to Calendar used	Calendar regressors and moving holidays

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