INE Standard for the Adjustment of Seasonal Effects and Calendar Effects in Short-term Series

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Short-term economics statistics are a tool used for analysing the economics 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 the seasonal adjustment is to filter the series of these seasonal fluctuations and calendar effects, in such a way that the information that they provide is 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 item of data through seasonal adjustment is also questioned.

Due to this controversy, the general dissemination policy of the National Statistics Institute has 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.

At this time, however, the INE is considering publishing the seasonally adjusted series (adjusted for seasonal effects and for calendar effects). The main two reasons for this change are as follows:

- On the one hand, Eurostat has begun to demand the dispatch of not only the gross data, but also the seasonally adjusted series. In addition, in some short-term indicators, the seasonally adjusted European aggregated is prepared as a grouping of the seasonally adjusted data of the Member States (indirect method).
- On the other hand, at an unsure moment of short-term economics, it is compulsory for statistics offices to provide users, and the general public, with data in the most easily interpreted way possible, eliminating those effects that are not relevant of 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 item of data is also 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 clearer, the 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, 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 remains a similar structure to the European document. It is divided into chapters with the same subjects (except chapter 4 from the *ESS guidelines on seasonal adjustment*, which in this standard is divided into two chapters: 4 and 7) and within each chapter, they are also divided into the same subchapters as the European document (except the aforementioned chapter 4).

Each subsection in this document has the same format: 1) a small 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.

Lastly, it is important to mention that the additional chapter in this standard is not an exceptional subject, but rather corresponds to a subsection of chapter 4 from the *ESS guidelines on seasonal adjustment*: the dissemination of the
metadata from the seasonal adjustment. The INE standard has preferred to separate this matter in a different chapter, in order to grant it greater relevance, given that the INE considers that clarity is of vital importance in this matter.
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 each month
− The different composition of the number of working days
− The effect of the leap year
− Moving holidays, in our case, the Easter holiday.

The best alternative in the 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 without logarithm transform, the coefficient would represent the average activity on any day, and in an additive model with logarithm transform, 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 survey team considers the information to be of sufficient quality, and the metadata specifies everything relating to the said 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, the composition, nor the number of working days.

It must be taken into consideration 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 than February. This seasonal part must be captured in the seasonal component, and must not be eliminated, therefore, with the adjustment for the 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-day calendar.

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

The best alternative in the 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.

INE Standard:

1. **Working day regressor.** In order to eliminate the seasonal part of this effect, we recommend preparing the following working day regressor:

\[
(\text{Working days}_{(m/t)T} - \text{Working days}_{n/1}) - \frac{\text{Working days}_{m/T}}{\text{Non-working days}} \times (\text{Non-working days}_{(m/t)T} - \text{Non-working days}_{n/1})
\]

where:

- \(\text{Working days}_{(m/t)T}\) is the number of working days in month \((m)\) or quarter \((t)\) from year \(T\).

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

- \(\text{Non-working days}_{(m/t)T}\) is the number of non-working days each month \((m)\) or quarter \((t)\) in year \(T\).

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

\[
\frac{\text{Working days}}{\text{Non-working days}}
\]

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 build, 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 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 pertinent.

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. **Calendar effect of the Leap year.** 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 (regarding 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 pertinent); 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 ADJUSTING FOR MOVING HOLIDAYS

The adjustment to moving holidays intends 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.
The best alternative in the 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 effect of the moving holiday must be made, based on the results of the previous tests. Carry out a test of the plausibility of the effect.

INE Standard:

**Regressor for the Easter holiday.** The regressor(s) for the Easter holiday must be built in such a way that they intend to capture the effect that this moving holiday can have on the economic series that is 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 regressor for the Easter holiday 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 to be either working or non-working, as pertinent in 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 knows the behaviour of the phenomenon measured by the statistical operation, must define this regressor both referring to 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 that the series 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. This way, for example, if Monday of the Easter holiday 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 the Monday of the Easter holiday 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 choose the survey team from their business knowledge. 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 average for the month/quarter throughout the entire series must be calculated.
- 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, but also the holidays of the Autonomous Communities. 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 general index (or the highest-level aggregate) in these statistics, 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 cases that are similar to the above, it is advisable to build a different regressor for working days 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 regressor for working days will be modified with the base change of the indicator.

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.

The best alternative in the 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. Special attention must be paid at the end of the series. As an acceptable alternative, the totally 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 nonexistent 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.

- Those outliers with a known explanation are included as regressors in the model and are maintained in the reviews of the models, though their coefficients cease to be significant in the new reviews.

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 $\xi_t$ is the rest (including cycle, trend and irregular component).

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

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

In no case will it be necessary to carry out

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

or

$$X_t^O = X_t - C_t - S_t - R_t = \xi_t$$
1.3 Model selection

An adequate model selection includes, among others, 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.

The best alternative in the ESS guidelines on Seasonal Adjustment: To carry out an automatic selection with statistical tests (normality, heteroskedasticity, correlation, etc.) and diagnostics of the spectrum. 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 general 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 must be checked, as well as the graphs from the series and from the 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 models, and that which is based on non-parametric methods.

The seasonal adjustment based on models consists of the following steps: first a model is built for the series that is 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. The most broadly-used implementation of this method is the TRAMO-SEATS package. This package incorporates a program for automatic identification, estimation and model diagnostics (TRAMO) and another that carries out the separation of the components (SEATS).

The non-parametric methods enable decomposing the series into non-observable components through an iterative procedure based on sequential smoothing. This smoothing is obtained by applying moving averages. The programs in the X-11 family, from the US Census Bureau, are those which are used most frequently to make this type of adjustment. As of the X-12-ARIMA, the series are extended through predictions made with ARIMA models. In this way, the revisions at the end of the series are reduced.

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 DEMETRA +.

The best alternative in the ESS guidelines on Seasonal Adjustment: Both TRAMO-SEATS and X-12 ARIMA can be used to carry out the seasonal adjustment. The election between the two could be based on the experience of the expert, in subjective considerations or in characteristics of the series. 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 notified to users.

INE Standard:

In the European Statistical System, the two approaches (TRAMO-SEATS and X-12 ARIMA) 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 models, using the most updated version of TRAMO-SEATS.

1 The latest versions of the programs TRAMO SEATS, and their interfaces in Windows (TSW) and SAS, have been developed by Agustín Maravall and his team from the Bank of Spain, on the basis of the programs developed by Agustín Maravall and Víctor Gómez.
2.2 Consistency between the gross data and the data adjusted for seasonal effects

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

The best alternative in the ESS guidelines on Seasonal Adjustment: Not to impose the annual equality restriction (as a sum or on average) of the gross data and the deseasonalised data or data adjusted for calendar effects. However, it is considered acceptable to force the equality between the data adjusted for calendar effects and the data affected for calendar and seasonal effects, or the gross data and the data adjusted only for seasonal effects under very specific circumstances, and in this case, known benchmarking methods must be used.

INE Standard:

1. It is not necessary to force annual equality (as a sum or on average) of the gross data and the deseasonalised data.

2. Under certain circumstances (adjustment objectives and user needs), it is considered acceptable to force the equality between the data adjusted for calendar effects and the data adjusted for calendar and seasonal effects, or the original data and the data adjusted only for seasonal effects. In these cases, known benchmarking methods must be used \(^1\) that must be specified in the metadata.

The annual data might have calendar effects, as the calendar varies from one year to the next. It is therefore considered acceptable, either to force the equality between the data adjusted for seasonal and calendar effects (SAC) and the annual data adjusted for calendar effects, or to force the equality between the data adjusted only for seasonality (SA) and the non-adjusted gross data.

In turn, it would not be correct to force the coherence between the data adjusted for seasonal and calendar effects and the gross 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 data adjusted for seasonal and calendar effects (SAC) to the gross data.

2.3 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.

At the time of selecting one of the two options, some considerations may be borne in mind, such as:

- Descriptive statistics of the quality of the adjustment by both methods. Example: the smoothing of the time series component, the residual seasonality tests in the series adjusted by the indirect method, size of the revisions.
- Characteristics of the seasonal patterns in the different series.
- The demand by users regarding the consistency and coherence of the data, especially when they are additive.

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 that there might be in the aggregation structure.
- 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 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 prior adjusted series.
- Mixed indirect approach where the seasonal adjustment of the series with a lower aggregation level is carried out using different approaches and software, and the totals adjusted for seasonal effects are obtained through the aggregation of the prior adjusted series, though not much information is available regarding the options and parameters used.
The best alternative in the 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 on different levels (for example, additivity). In any case, so long as the indirect method is used, this must test the presence of residual seasonality in the seasonally adjusted aggregates.

INE Standard:

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 deseasonalised in similar way, using the direct or indirect method. Conversely, two series with the same seasonal pattern can provide an aggregation of another whose deseasonalisation is different using the two 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 for deseasonalising, using the direct method, the intermediate aggregates, and adjusting 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 deseasonalised aggregate.

The following patterns may be followed to this end:

- Graphically analyse the quarterly/monthly rates of the deseasonalised series, being those whose rates may present a certain seasonal pattern.

- Study the periodogram of the deseasonalised series and their monthly/quarterly rates . 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)

- Analyse the seasonal patterns. The seasonal pattern is obtained as the quotient between the gross series and the SAC series (adjusted for seasonal and calendar effects). 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, the deseasonalisation process and assignation of discrepancies (if any) must be revised, and it must be verified whether the SAC series has residual seasonality

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

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 regarding 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 gross 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 gross data, and due to the characteristics of the filters and procedures that eliminate the calendar and seasonal components.

Revisions based on new information are welcome. However, it could occur that a single additional observation could cause revisions of the adjusted data for several years, which on occasion may confuse users.

Therefore, a balance must be found between the need to adjust the data as well as possible, especially at the end of the series, and the need to avoid unimportant revisions in data that, at a later date, might return to its previous state (that is, a balance between the precision and the 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 gross data has been revised, and the relation between the publication dates of the revisions of the adjusted data and the gross data.

The best alternative in the 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 gross data. Revisions of the adjusted data are not disseminated more frequently than the gross data. The public is informed of the average of the previous revisions for important macroeconomic variables. Moreover, it is considered acceptable to publish in accordance with several independent policies applied 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 gross data, and known by users. The revision policy must be disseminated through the metadata for each of the statistics.

2. Information regarding the revisions. Users should be informed, in each publication for the main aggregates, of the average of the revisions of previous data.

To this end, it is recommended to include, in the metadata template of each of the statistics, the values of some indicator that measures the size of the
revisions with regard to the latest series published and/or as compared with
the first item of data published.

2.1 Indicators of the size of the revisions, as compared with the latest series
published:

- **MAR (Absolute average revision):**

\[
MAR = \frac{1}{n} \sum_{t=1}^{n} |X_{Lt} - X_{Pt}|
\]

where:

\(X_{Lt}\) is the deseasonalised item of data for reference period \(t\) with the
latest adjustment carried out, \(L\)-th publication of \(X\).

\(X_{Pt}\) is the deseasonalised item of data for reference period \(t\) with the
previous adjustment, \(P\)-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 horizon is the complete series, \(n\) will be
the total number of observations from the beginning of the series up
until that month/quarter. If the horizon for the publication of revisions
is reduced to the three/four/five last years, only those periods will be
covered.

- **RMAR: Relative absolute average revision.**

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

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

\[
MR = \frac{1}{n} \sum_{t=1}^{n} (X_{Lt} - X_{Pt})
\]

2.2 Indicators of the size of the revisions as compared with the first
estimation of each period \(t\):

- **MAR (Absolute average revision):**

\[
MAR = \frac{1}{n} \sum_{t=1}^{n} |X_{Lt} - X_{Pt}|
\]

where:

\(X_{Lt}\) is the deseasonalised item of data for reference period \(t\) with the
latest adjustment carried out, \(L\)-th publication of \(X\).
\( X_n \) is the deseasonalised item of data for reference period \( t \) with the previous adjustment, \( F \)-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 horizon is the complete series, \( n \) will be the total number of observations from the beginning of the series up until that month/quarter. If the horizon for the publication of revisions is reduced to the three/four/five last years, only those periods will be covered.

- \( \text{RMAR: Relative absolute average} \) revision.

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

- \( \text{MR (Average revision):} \) if \( \text{the sign of the revision is important, this indicator is used.} \)

\[
MR = \frac{1}{n} \sum_{t=1}^{n} (X_{Lt} - X_{Ft})
\]

3. **Access to the different versions.** It would be desirable for the users to have access to the different versions of the adjusted data.

4. The revision calendar must be coordinated with the revision calendar of the gross data, and it **may therefore be different for each of the statistics.**

### 3.2 Concurrent adjustment versus current adjustment

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

- **Current adjustment:** The model, the filters, the outliers and regressors are re-identified, and the respective parameters and components are re-estimated in the appropriate review periods. The seasonal and calendar filters that are used to adjust new gross data between reviews are those estimated in the last review.

- **Concurrent adjustment:** The model, the filters, the atypical outliers and regressors are re-identified, and the respective parameters and components are re-estimated each time that new data arrives or the previous data is revised.

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

In practice, alternatives are usually used that balance the two extremes, seeking the advantages of the two, and trying to avoid the disadvantages. Among these alternatives is the partially concurrent adjustment and/or the controlled current adjustment.

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

INE Standard:

1. **Partially concurrent adjustment.** In order to seek balance between the size of the revisions and the quality of the adjustment, it is recommended to carry out a partially concurrent adjustment process. To this end:
   - The model (including: the intervention variables of the outliers and the regressors for the correction of calendar effects) is identified and set once a year.
   - During the current year, with each new observation:
     - The parameters of the model (ARIMA)
     - The parameters of the regressors for the correction of calendar effects and of the intervention variables of the outliers.

   The following is re-calculated:
   - The filters to obtain the deseasonalised series

2. **Current adjustment with annual control:** It is considered acceptable within the standard to carry out a current adjustment with annual control when it is hoped to minimise the size of the revisions. In this case, the model (including the intervention variables of the outliers and the regressors for the correction of calendar effects) is identified, the parameters (of the ARIMA, 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 set
once a year. In this way, the seasonal filters and the corrections of calendar effects that are used to adjust new gross data during 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 may be published in their entirety, but not necessarily. There are arguments in favour of publishing the complete series once again: the methodologically homogenous treatment of all of the values and the fact that it is easier to understand and reproduce the calculation. However, it is questionable that a new added item of data actually contains information that is relevant for making significant revisions of the estimation of the seasonal fluctuations of past decades.

In practice, in order to balance the gaining of information and the revision horizon, the revision period for the seasonally adjusted data is usually limited. Customarily, unless a substantially bad specification of the model is found, an adequate choice may be for 3 to 4 years longer than the revision period of the gross data.

For previous periods, the seasonal components may be frozen. The selection of the revision period of the seasonally adjusted data must consider both the revision period of the gross data and the convergence properties of the normal seasonal filters. The output from TRAMO-SEATS indicates how quickly the revision diminishes as new observations are added, as well as the size of the revision. Combining the two, it is possible to obtain an optimal duration of the revision horizon, if desired, for each one of the series.

Nonetheless, in situations in which the gross data is revised from the beginning of the series (for example, base changes, changes of definitions or nomenclatures, sample design, etc.) the entire series must be revised.

The best alternative in the ESS guidelines on Seasonal Adjustment: The revision horizon for the adjusted data must reach at least the revision period of the gross data. On the other hand, due to the properties of the filters, it is suggested to set the revision period of the adjusted data to 3-4 years beyond the revision period of the gross data, and to freeze the adjusted data prior to that date. It is also considered acceptable to revise the entire adjusted series, regardless of the revision period of the gross data.

INE Standard:

1. Revise the complete series adjusted for seasonal effects and calendar effects with each new observation. In the partially concurrent adjustment, with each new observation, the model parameters are re-estimated and the filters are re-calculated, yielding a new seasonally adjusted series from the beginning of the series. It is recommended that the new adjusted series be disseminated from its beginning, in order to have a homogenous treatment of all values.
2. **Set a revision horizon.** The standard accepts setting a revision horizon that may be determined by those responsible for each of the statistics, and disseminated in the metadata therein as part of the revision policy. In order to determine the revision horizon, several elements of the revision policy must be considered so as to maintain coherence with them:

- The strategy carried out in order to perform the seasonal adjustment: partially concurrent adjustment or current adjustment with annual control.
- The revision period of the gross data.
- The external user demand regarding the coherence between the annual data and the more frequent data.
- The decrease in the size of the revisions as new observations are added using the results of the TRAMO-SEAT.

Beyond that horizon, the seasonal component of each series can be frozen, and therefore, the deseasonalised series may also be frozen. Nevertheless, when significant transformations occur in the gross data (base change and/or changes in nomenclatures, definitions, etc.), the deseasonalised series must be revised from its beginning.
4 Quality of the seasonal adjustment

4.1 Validation of the seasonal adjustment

The seasonal adjustment is a complex statistical treatment of the data, requiring precise monitoring prior to accepting the results. In order to ensure the quality of the data adjusted for seasonal effects and calendar effects, these must be validated, using a broad scope of quality measures. Among these is the verification of the absence of residual seasonality or of calendar effects, as well as the testing of the stability of the seasonal pattern.

The validation of the seasonally-adjusted data must be carried out through graphic analysis, as well as through parametric and non-parametric descriptive criteria included in the outputs from the seasonal adjustment program used.

The best alternative in the ESS guidelines on Seasonal Adjustment: To use a detailed set of parametric and non-parametric graphs and descriptive criteria to validate the seasonal adjustment. To redo the seasonal adjustment with a different set of options in the cases in which the results are not accepted. To verify that the deseasonalised series have the following characteristics: absence of residual seasonality, absence of calendar effects, absences of an over-adjustment of calendar effects and seasonal effects, absence of autocorrelation for the seasonal lags in the irregular component, stability in the seasonal component. Moreover, it is necessary to verify the appropriateness 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 a same period in the year.

INE Standard:

It is recommended to carry out the following actions in order to test the validity of the seasonal adjustment.

1. Check the appropriateness of the regARIMA model estimated (specification).

1.A. Main diagnoses: If any of the following diagnostics are not fulfilled, this would indicate a poor specification of the regARIMA model and it must be changed:

- **Absence of auto-correlation** In the lags of the residuals of the regARIMA model:
  - Ljung Box Statistics: These statistics measure the existence of some linear structure in the residuals. TRAMO calculates them for all of the lags, and shows lag 24 (in monthly series) or lag 16 (in quarterly series) in the "Summary." In the case of the monthly series, this is distributed as a Chi-Squared with k degrees of freedom, where k is equal to 24-# AR and MA parameters. In the case of the quarterly series, this is distributed as a Chi-Squared with 16-# AR and MA parameters.
To examine the simple and partial (ACF and PACF) autocorrelation function of residuals of the model, 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 ARIMA structure must be changed, though it also may be the result of outliers.

- **BIC o AIC information criteria**, provided by the TRAMO program: Also called model selection criteria, these enable deciding between several models, accounting for the fit of the models, but also considering their complexity. As a result, they may be seen as a trade-off between fit and parsimony. The BIC is justified as well because if the true process belongs to the class in which we work (regARIMA), for long series, we are guaranteed selecting the correct orders of the model. Conversely, the AIC is justified when the true process does not belong to the class where the model is sought.

- **Non-existence of high correlations** between the model parameters (especially in case of identifying a model with a auto-regressive part and regular moving averages). The TRAMO program offers, for each model, the correlation between parameters, 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 cancelled.

1.B Secondary diagnostics. Failure to comply with any of them does not imply a poor specification of the model, and therefore, would not entail the compulsory change in the ARIMA structure.

- **Normality tests**. TRAMO carries out the normality test of Jarque Bera that is distributed as a Chi-Squared of 2 degrees of freedom and at 95% should not take values above 6. Strictly speaking, normality is not necessary for the good specification of the model, but if the residuals are not normal, this may indicate the presence of outliers.

- **Tests for symmetry and kurtosis**. The tests for symmetry and kurtosis provided by TRAMO are distributed as a N (0.1) and 95% should not take values above 2. They are related to the absence of normality, which as mentioned above, is not strictly necessary for the good specification of the model.

- **Runs test for residuals**. TRAMO 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 mean of the residuals is zero**. TRAMO tests that the mean of the residuals is statistically equal to zero.
Autocorrelation test for the squared residuals through the squared Ljung Box statistics, that measures the existence of some non-linear structure in the residuals. TRAMO calculates it for all of the lags, and shows lag 24 (in monthly series) or lag 16 (in quarterly series) in the Summary. In the case of monthly series, this is distributed as a Chi-Squared of 24. In the case of quarterly series, this is distributed as a Chi-Squared of 16 TRAMO.

2. Verify the appropriateness of the decomposition (specification) through the diagnoses provided by the SEATS program.

The SEATS program enables testing the similarity of the distributions of:

1. The theoretical models for components obtained through the factoring of the autoregressive polynomial and the canonical decomposition of the polynomial of moving averages using the regARIMA model identified for the original series (Component).

2. The theoretical models of the estimators of the components obtained on applying the WK filter to the process of the original series (Theoretical estimator).

3. The sample values obtained from the series of the components (Empirical estimate), through the variations and the autocorrelation functions.

The following must be fulfilled:

- The first-order and seasonal-order autocorrelations of each component for the theoretical estimator and its empirical estimate must be similar. If $\rho_1$ and $\rho_{12}$ 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 variances in the components must always be greater than those of the theoretical estimator $V_\hat{s}$ and its empirical estimate $\hat{V}_s$, and the later two must not differ much. As with the above, the following must be fulfilled: $V_\hat{s} \in [\hat{V}_s \pm 2SE(\hat{V}_s)]$. 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 SEATS carries out a canonical decomposition. However, on obtaining the theoretical estimators and the empirical estimates, some correlation is introduced. However, there must be fulfilment that the cross-correlations of the theoretical estimators...
\[ \rho_{\hat{p}_e} \] and their empirical estimates \( \hat{\rho}_{\hat{p}_e} \) be similar, in such a way that the following occurs:

\[ \rho_{\hat{p}_e} \in \left[ \hat{\rho}_{\hat{p}_e} \pm 2SE(\hat{\rho}_{\hat{p}_e}) \right] \]

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 the series is treated in levels, there is no discrepancy, because the averages of the irregular and seasonal components are zero, but when a logarithmic transformation is carried out, differences appear due to the non-linearity of the transformation. The absolute value of the differences of the averages must be less than 0.5. If this requirement is not met, it is recommended to analyse the series in levels.

3. Verify the absence of residual seasonality in the deseasonalised series

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 for the deseasonalised series, the cycle-trend and the irregular component.

Graphical analysis of the periodogram of the deseasonalised 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.

4. Verify the absence of residual calendar effects of the deseasonalised series.

Spectral diagnostics provided by SEATS. The program uses two statistics: AR (30) and the estimator of the Tukey spectrum to check whether there are peaks in the spectrum of the series in those frequencies related to the weekly cycle (between 4.17 and 4.18 cycles per year in the monthly series). SEATS carries out these tests for the deseasonalised series, the cycle-trend and the irregular component.

Graphical analysis of the periodogram of the deseasonalised series and of their 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.
5. Graphical analysis of the deseasonalised series: Verify that a seasonal pattern is not observed in the deseasonalised series or in its monthly/quarterly rates.

The SEATS program also offers **other measures to assess the quality of the adjustment that is recommended to be reviewed:**

- **Precision.** The precision of the model may be measured through the standard deviation of the errors of the concurrent estimator. The smaller this value is, the more precise the model will be.

- **Stability.** There are several measures of the stability of the model:
  - Standard deviation for the innovations of the seasonal component (the smaller the value is, 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 predictions will have).
  - Convergence through the reduction percentage of the RMSE \(^1\) of the revision error after having data for 1 and 5 years more (the faster the convergence, the more stable the components will be).
  - Analysis of the seasonal pattern: A seasonal pattern is understood to be the quotient between the gross data and the seasonally-adjusted series. Given that, with the seasonal component, we account for the movements of the series that repeat periodically over the years, the seasonal pattern in a year must be similar to that of other years, and any change occurring in said behaviour must be analysed.

- **Significance of the seasonal component.** The SEATS program tests that, for a given period, the seasonal component is other than zero, and notifies on the number of observations for which it being null is refused. A large number of observations other than zero would indicate a stronger seasonal component.

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\(^1\) 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 TRAMO-SEATS or X-12 ARIMA, there is the possibility of choosing either not to adjust them for seasonal effects or to use other less standard procedures. With series that are long enough that they can be adjusted with TRAMO-SEATS or X-12 ARIMA, but not too much (with a length of 3 to 7 years), instability problems may arise. In these cases, empirical comparisons must be made in order to compare both procedures, X-12 ARIMA and TRAMO-SEATS.

As a general rule, when the series have a length of shorter 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.

The best alternative in the ESS guidelines on Seasonal Adjustment: When the series is shorter than three years, it should not be seasonally adjusted. With series with a length of 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 prolonged backward so as to extend the sample and stabilise the adjustment. Simulations must be carried out with the existing standard tools. Users must be information regarding the methods used and regarding 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 of between 3 and 7 years.

INE Standard:

- **Very short series.** Those series with a length of less than three years cannot be adjusted with TRAMO-SEATS. It is recommended that the series with that length not be 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 the series with that length not be 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 regarding the greater instability of these short series. Moreover, 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 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.

The best alternative in the 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 to this end. 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.

INE Standard:

- 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 Information 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 gross data, the deseasonalised 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.

The best alternative in the ESS guidelines on Seasonal Adjustment: Systematic storage in a coordinated database: the gross series, the deseasonalised 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. With a view to guaranteeing transparency, the goal of users being capable of understanding and replicating the seasonal adjustment process must be achieved.

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: gross series, series corrected for calendar effects and series corrected for calendar effects and seasonal effects (deseasonalised 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 template of the metadata 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.

4. **Access to the different versions**: It would be desirable for users to be able to have access to the different versions of the adjusted data (vintage data).
6.2 Press releases

The data may be disseminated in different formats: original (gross), deseasonalised, only adjusted for calendar effects or in a cycle-trend form. The gross data contains all of the characteristics of the series. The deseasonalised data (corrected for calendar effects and for 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 (turning point), where months 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.

The best alternative in the ESS guidelines on Seasonal Adjustment: The objective of the press releases is to provide “innovations”. Therefore, the deseasonalised data is the most appropriate data to disseminate in said press releases. Moreover, users must have access (on request or online) to the historical series of the original data, deseasonalised 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 deseasonalised series. The rates of one period compared to the previous period, and changes in level, must be calculated over the deseasonalised 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 gross data.

INE Standard:

1. **Data published in the press releases.** It is recommended to publish, in the press releases, the deseasonalised data, at least of the most important aggregates, in addition to the data that had been published traditionally (gross 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 deseasonalised series. The annual rates may be calculated over the gross rates, the data corrected for calendar effects of the deseasonalised data.
7 Metadata for seasonal adjustment

7.1 Dissemination of the metadata for 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 *ESS Guidelines on Seasonal Adjustment* document includes a template designed to record the metadata on seasonal adjustment that must be disseminated with each production date and to be continuously updated.

The metadata regarding the seasonal adjustment are useful not only 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 guides.

**The best alternative in the ESS guidelines on Seasonal Adjustment:** Use the template of 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 then 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 Series published
   - 1.2 Method used
   - 1.3 Software used
   - 2.2 Aggregation
   - 3. Revisions
   - 4. Quality indicators

2. Include this template as a document within section 20.6 of the reference metadata that must be published by all of the INE statistics as of the month of September 2012.

3. Continuously update the template, in order to reflect the changes in the seasonal adjustment process.
### 7.2 Metadata template

#### REFERENCE METADATA FOR THE SEASONAL ADJUSTMENT

**GROUP OF SERIES**
- **Name**
- **Frequency:** Monthly/Quarterly

### 1.1 Series published

<table>
<thead>
<tr>
<th>Type of adjustment</th>
<th>Level of detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross series</td>
<td></td>
</tr>
<tr>
<td>Series adjusted only for calendar effects (AC)</td>
<td></td>
</tr>
<tr>
<td>Deseasonalised series or series adjusted for seasonal effects and for calendar effects (SAC)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

### 1.2 Method used

### 1.3 Software used

<table>
<thead>
<tr>
<th>Software used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
</tr>
<tr>
<td>Version</td>
</tr>
</tbody>
</table>

### 1.4 Adjustment for Calendar Effects

<table>
<thead>
<tr>
<th>Type of adjustment (Direct/Indirect)</th>
<th>Level of detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>No calendar adjustment (reasons)</td>
<td></td>
</tr>
<tr>
<td>Working days</td>
<td></td>
</tr>
<tr>
<td>Mobile public holidays: Easter holiday</td>
<td></td>
</tr>
<tr>
<td>Leap Year</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Calendar used</td>
<td></td>
</tr>
</tbody>
</table>

### 1.5 Another Pre-adjustment

<table>
<thead>
<tr>
<th>Atypical values: types of intervention</th>
<th>Level of detail</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 2. Adjustment for Seasonal Effects

<table>
<thead>
<tr>
<th>Level of detail</th>
<th>General Index</th>
<th>Functional breakdown</th>
</tr>
</thead>
</table>

#### 2.1 Model
- Selection (manual/automatic)
- Model adjusted
- Average
- Type of decomposition of the seasonal adjustment (additive, log-additive,)

#### 2.2 Aggregation
- Direct/indirect adjustment
  - In the case of the indirect focus: indicate whether the residual seasonality is contrasted, and from which level the aggregation begins
- Consistency between different breakdown levels
  - In the case of the indirect focus: indicate whether the residual seasonality is contrasted, and from which level the aggregation begins
- Monthly/Annual or Quarterly/Annual time consistency
  - If there is consistency, specify between which type of series, for example: Data adjusted for seasonal and calendar effects (SAC) to the annual item of data corrected for calendar effects or Data adjusted only for seasonal effects (SA) to the non-adjusted gross item of

### 3. Reviews

<table>
<thead>
<tr>
<th>Re-identification of the model, filters, atypical values and regressors for the calendar effect</th>
<th>Describe the strategy adopted and specify the frequency of re-identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-estimation of parameters and re-calculation of components</td>
<td>Describe the strategy adopted and the frequency of re-estimation and re-calculation of components</td>
</tr>
<tr>
<td>Horizon for the data review</td>
<td>Complete series or limited period (specify the period)</td>
</tr>
</tbody>
</table>

### 4. Quality Indicators

<table>
<thead>
<tr>
<th>Structural metadata available</th>
<th>Indicate all of the quality measures used to assess the seasonal adjustment</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Links to methodological reports</th>
<th>Publish the regressors for working days and mobile public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links to calendars used</td>
<td>Available of detailed information that allows users to replicate the process</td>
</tr>
<tr>
<td>All series</td>
<td>Yes/No/As a customised request</td>
</tr>
<tr>
<td>The published series</td>
<td>Yes/No/As a customised request</td>
</tr>
<tr>
<td>Other</td>
<td>Yes/No/As a customised request</td>
</tr>
</tbody>
</table>


• Eurostat (2009), ESS Guidlines on the seasonal adjustment, Methodologies and Working Papers.


