Approved by the Order of the Chairman of the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan

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**Methodology for seasonal adjustment of statistical indicators developed on a monthly and quarterly basis**

**Chapter 1. General provisions**

1. The methodology for seasonal adjustment of statistical indicators developed on a monthly and quarterly basis (hereinafter - Methodology) refers to a statistical methodology formed in accordance with international standards and approved in accordance with [the Law](http://adilet.zan.kz/rus/docs/Z100000257_#z0) of the Republic of Kazakhstan dated March 19, 2010 "On State Statistics".
2. The methodology is intended for use by the Statistics Committee of the Ministry of National Economy of the Republic of Kazakhstan.
3. The purpose of this Methodology is to describe an algorithm for performing seasonal smoothing of statistical indicators developed on a monthly and quarterly basis.
4. The following definitions are used in this Methodology:
5. seasonal fluctuations - intra-annual recurring fluctuations in economic indicators that are stable and pronounced;
6. seasonal smoothing - exclusion from the time series of indicators of seasonal and calendar fluctuations;
7. trend - a change that determines the general direction of development, the main trend of the time series;
8. time series (series of dynamics, dynamic series) - a sequence of values of an indicator (attribute), ordered in chronological order, in ascending order of the time parameter;
9. into bursts (outliers) – anomalous values of the series that affect the quality of the seasonality assessment.

**Chapter 2 Time series preconditioning**

1. Statistical description of the development of economic processes in

time is carried out using time series. The information base for seasonal smoothing of time series is officially published monthly and quarterly periodicity statistics. The main sectors subject to seasonal adjustment are the statistics of national accounts, employment, industry, construction, services, foreign and domestic trade.

1. Seasonal adjustment starts with checking the original data and preparing the data for adjustment. The quality of the input data greatly influences the quality of the results (precision, length of the time series, quality of compilation methods, and consistency over time).
2. When analyzing seasonal fluctuations based on monthly dynamics series, the length of the time series is at least 3 years (36 observations), and for quarterly dynamics, 4 years (16 observations). To obtain high-quality seasonal adjustment, work is carried out with a time series length of more than seven years.

**Chapter 3. Graphical analysis of initial time series**

1. At the initial stage of seasonal adjustment, a time series plot is drawn up and a graphical analysis is carried out, which shows:
2. row duration;
3. the presence of zeros or bursts;
4. series structure: the presence of a trend cycle, seasonal component, volatility.
5. At the stage of graphical analysis, the component composition of time series is studied, steps are taken to select a model to describe their dynamics and subsequent forecasting.

On the graph of the quarterly gross domestic product by the production method, two main trends are revealed - a trend and periodic (original) fluctuations.

Seasonality factors are compared by quarters, where the factors are on average higher in the 3rd and 4th quarters. The graph of the quarterly gross domestic product by the production method is given in Appendix 1 to this Methodology.

**Chapter 4. Time Series Components**

1. Time series components consist of a trend component, a seasonal component, and a random ( irregular) component :

$Y=T+S+I$, (1)

where:

$Y$- the product that is published (initial data);

$T$– trend;

$S$- seasonality;

$I$- undefined effects.

The trend component is the main line of the time series, including the long-term development trend and the movement of the business cycle in the data.

The seasonal component includes seasonal fluctuations that recur annually at the same time, in the same direction and in the same magnitude.

1. Seasonal movements include the following reasons:
2. the impact of climatic factors, social (cultural) traditions and calendar effects, stable on an annual time scale;
3. social impact (increase in purchases during the pre-holiday period, increase in payments at the end of the quarter).

If the trend and the seasonal component are excluded from the time series, an irregular component remains.

The irregular component is a random variable that has no connection with a constant variance. This variable is called "white noise".

1. The time series contains outliers and a calendar effect. The scheme of the time series components is presented in Appendix 2 to this Methodology.

The components of the time series are calculated using the following formula:

$X\_{t}= O\_{t} + CE\_{t}+Z\_{t}$, (2)

$Z\_{t }= T\_{t}+S\_{t}+I\_{t} $, (3)

where:

$X\_{t}$– time series;

$O\_{t}$– emissions;

$CE\_{t}$– calendar effect;

$Z\_{t}$- an automatic variable that is modeled by Arima;

$T\_{t}$– component of the trend;

$S\_{t}$– seasonal component;

$I\_{t}$– error or irregular component.

**Chapter 5 Spotting and fixing splashes**

1. Dynamics time series contain anomalous values

(bursts). The sources of erroneous values are the comma shift when transferring information from the document, as well as entering data into another column. Revealing, excluding such values, replacing them with true or calculated ones is an important step in the initial data preparation. At times, anomalous values reflect the actual development of the process. Compliance of the initial information with all the specified requirements is checked at the stage of preliminary analysis of time series. After that, they proceed to the calculation and analysis of the main indicators of development dynamics, the construction of forecasting models, and the receipt of forecast estimates.

1. Bursts are divided into:
2. additive bursts - show a sharp increase or decrease, and disappear one period ahead in $X\_{t}$;
3. temporary changes - show a sharp increase or decrease and gradually disappear over time;
4. level changes - show a constant increase or decrease $X\_{t}$.

Graphs of burst types are presented in Appendix 3 to this Methodology.

1. The mathematical formula for the anomalous values of the series is as follows:

$Outliers=LS+AO+TC$, (4)

where:

LS - level changes;

AO - additive bursts;

TC - temporary changes.

**Chapter 6. Calendar adjustment**

1. The purpose of calendar adjustment is to obtain seasonally adjusted series, independent of the length and composition of days (number of working days and days off) of a month or quarter.
2. The calendar component includes effects associated with different characteristics of the calendar from period to period. Calendar effects are divided into seasonal and non-seasonal. The "non-seasonal" part is included in the calendar component, and considered separately, the "seasonal" part is included in the seasonal component. The calendar effects used include transaction or business day effects.

The trading day effect determines the different number of each day of the week during a particular quarter relative to the standard composition of weekdays in the quarter. The workday effect covers the difference

between the number of working days and holidays in a quarter.

Holidays are treated as non-working days. The number of non-working days increases by the number of holidays, and the number of working days decreases accordingly.

The effect of working days is captured by a single regressor that compares a group of working days (Monday to Friday) through the equation:

Working days = number of days of the week - (5/2) number of holidays

The 5/2 factor equates the workday regressions to zero in the standard seven-day week composition. The deviation from the standard week is reflected in the regressor if the working day is greater than zero, which means that there are more working days in month or quarter t than in the standard week.

The moving holiday effect is associated with events of religious or cultural significance, within a country the date of which varies from year to year.

Leap year effect, takes into account the extra day in February of a leap year, which generates a four-year cycle with a peak in the first quarter of a leap year (if February is a leap year, then "0.75", otherwise "-0.25", if February is not a leap year, then "0 "). The leap year regressor represents a deterministic four-year cycle with a peak in February of the leap year, over four years, the effect of the leap year is fully offset by negative effects in subsequent non-leap years.

1. The calendar effects measures used in seasonal adjustment are spread across four base calendars associated with:
2. weekends;
3. public holidays;
4. the influence of a leap year;
5. the first day of Eid al-Adha and Orthodox Christmas.
6. When evaluating calendar effects, ten types of regressors are used using various combinations of base calendars. Regressors for calendar variables are presented in Appendix 4 to this Methodology.
7. Specific calendar regressors are compiled using holidays. The algorithm for calculating the calendar variables of regressions is given in Appendix 5 to this Methodology.
8. Smoothing of calendar effects is carried out for statistical data and data with an economic interpretation of calendar effects. This estimate is based on the statistical and economic significance of their regression coefficients. Statistically, the regression coefficient is considered to be significantly different from zero when the t-statistic is higher than a certain threshold (usually 2, but lower thresholds are also acceptable). When the t-statistic is lower than the chosen threshold value or difficult to interpret in economic terms (impossible size or coefficient value), the calendar effect series should not be smoothed.

**Chapter 7 Seasonal adjustment**

1. Seasonal smoothing, or seasonal adjustment, consists in estimating and excluding seasonal and calendar factors from the original series of indicators. After excluding seasonal and calendar effects, indicators do not reflect typical regular changes, but new information about the process (changes in trend, production cycles or irregular components), which is the purpose of seasonal smoothing.
2. Seasonally adjusted indicators of time series are a standard tool for statistical observation and are developed along with initial indicators (unsmoothed), allowing to identify and measure the patterns and trends of socio-economic processes, and to detect changes occurring in these processes in a timely manner. Preparation and publication of seasonally adjusted time series of indicators is one of the important tasks of statistical observation.
3. The seasonal adjustment procedure in national statistics is carried out using the TRAMO/SEATS for Windows method (hereinafter –TSW).
4. The TRAMO and SEATS programs are a fully model-based method for predicting and signaling in univariate time series. The Tramo system determines the presence of calendar effects and uncertain actions or outliers in indicators. The Seats module performs a seasonal smoothing decomposition ) using a model-based approach.

When applied for seasonal adjustment purposes, TRAMO preconditions the time series for adjustment using SEATS.

The mathematical formula that Tramo uses is:

$Y\_{t}=β\*X\_{t}+Z\_{t}$,(5)

where:

$Z\_{t}$≈ $Arima(p,d,q)(BP,BD,BQ)+U\_{t}$, indicators $(p,d,q)(BP,BD,BQ)$- the system selects automatically;

$X\_{t}$– independent variables that include calendar effects and outliers;

$β$– coefficient (determined automatically by the system);

$U\_{t}$- seasonal errors.

1. When seasonally adjusting the data, the publication format is independently determined. The presentation of seasonally adjusted data depends on user needs. At the initial stage, the original (original) and seasonally adjusted data are displayed simultaneously in the text and in the publication table.

**Chapter 8 Direct and indirect approaches**

1. The seasonally adjusted aggregates are calculated by aggregating the seasonally adjusted components (indirect adjustment) or by adjusting the aggregated data and the components themselves (direct adjustment).
2. When carrying out the seasonal smoothing procedure, two approaches are used.

The direct approach is used up to the disaggregated level, while the upper aggregated series are computed indirectly. Statistical data are positions of sums or differences (the volume of the whole industry includes mining, manufacturing, electricity and water).

The indirect approach ensures consistency in data analysis, while the direct approach does not determine the contributions of subcomponents. To ensure consistency between sub-sectors and aggregated data, an indirect approach is used in adjusting for seasonal and calendar effects.

1. The method of calculating statistical data with seasonal smoothing is carried out by the method of calculating the initial data.

**Chapter 9 Revision of seasonally adjusted data**

1. Revisions to seasonally adjusted data are applied for two reasons:
2. seasonally adjusted data are revised due to revisions to the raw data that result from having a set of improved information (in terms of coverage and reliability);
3. revisions to seasonally adjusted data are considered due to better estimation (identification) of the seasonal pattern due to new information provided by new unadjusted data or due to the characteristics of filters and procedures that remove seasonal and calendar components. Revisions are based on new information.
4. The date of the first revision of seasonally adjusted data is set at the beginning of the calendar year, at least three years before the revision period for unadjusted data. This date is fixed for up to five years for reasons of transparency. For earlier periods, seasonal factors are frozen.

Appendix 1 to the Methodology for Seasonal Adjustment of Statistical Indicators Developed on a Monthly and Quarterly Basis

**Quarterly gross domestic product by production method**

Appendix 2 to the Methodology for Seasonal Adjustment of Statistical Indicators Developed on a Monthly and Quarterly Basis

**Scheme of the components of the time series**

|  |
| --- |
| **time series** |
| Componenttrend cycle | Seasonalcomponent | Irregularcomponent |
|  | seasonality | calendar effect |
|  |  | Festive effectdays | Effectworkingdays |

Appendix 3

to the Methodology for Seasonal Adjustment of Statistical Indicators Developed on a Monthly and Quarterly Basis

**Burst Type Plots**

Additive outliers

2. Transitory changes

3. Level shifts

Appendix 4

to the Methodology for Seasonal Adjustment of Statistical Indicators Developed on a Monthly and Quarterly Basis

**Regressors for calendar variables**

|  |  |
| --- | --- |
| Name | Description |
| Regressor1 | Non-Fixed | Do not work on holidays |
| Regressor2 | Non-Moving | They do not work on the first day of Eid al-Adha and on Orthodox Christmas |
| Regressor3 | Non-Sunday | Not open on Sundays |
| Regressor4 | Non Sunday & Fixed | Not open on Sundays and public holidays |
| Regressor5 | Non Sunday & Moving | Closed on Sundays , on the first day of Eid al-Adha and on Orthodox Christmas |
| Regressor6 | Non Sunday & Fixed & Moving | They do not work on Sundays, on holidays , on the first day of Eid al-Adha and on Orthodox Christmas |
| Regressor7 | Non Saturday & Sunday | Do not work on weekends |
| Regressor8 | Non Saturday & Sunday & Fixed | Not open on weekends and public holidays |
| Regressor9 | Non Saturday & Sunday & Moving | They do not work on weekends , on the first day of Eid al-Adha and on Orthodox Christmas |
| Regressor10 | Non Saturday & Sunday & Fixed & Moving | They do not work on weekends , on holidays , on the first day of Eid al-Adha and on Orthodox Christmas |

Annex 5

to the Methodology for Seasonal Adjustment of Statistical Indicators Developed on a Monthly and Quarterly Basis

**Algorithm for Calculating Calendar Variables of Regressions**

|  |  |  |
| --- | --- | --- |
| Stages | Names | Short description |
| Step 0 | Making a list of holidays | Holidays celebrated in Kazakhstan are used. |
| Step 1 | Definition of regressors | Definition of the category of organizations (10 regressors), whose number of working and non-working days is distributed in accordance with Appendix 4. |
| Step 2 | Calculation of the number of working and non-working days of regressors | Drawing up a table where all working days, weekends and holidays for the period under consideration are determined for each regressor. Holidays are taken into account. |
| Step 3 | Data summary | Based on the data from the previous stages, a pivot table is compiled, where the number of working days in months for each year is calculated. |
| Step 4 | Finding the average number of working days | are found for each of the regressors. |
| Step 5 | Calculation of deviations from the average number of working days | The fifth step is the difference between the number of working days in a month and the average number of working days by month.These indicators reflect the change in the number of working days in a month in relation to the average number. If the resulting value is with a “+” sign, then the population has worked for this number more than the average value of working days. If the value is with a “-” sign, then the number of working days in the month was less than the average. |