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FORECASTING OF SOME KEY INDICATORS OF THE RFI AND RFP PROCESSES OF THE BULGARIAN MOBILE TELECOMMUNICATION OPERATORS

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Abstract

The present paper regards the opportunities of forecasting of some key indicators in the "Request for Information" (RFI) and "Request for Proposal" (RFP) processes in the supply chain at the Bulgarian mobile telecommunication operators. The presented hereby forecasting is based on the use of the Holt-Winters method for exponential smoothing in the presence of additive and multiplicative seasonality and is made or indicators: "number of contracts", "number of contracts with savings" and "number of the issued purchase orders". The lowest "Stationary R square", "R square" and MAPE (Mean Absolute Percentage of Error) values are used as measurement of accuracy and for selection of the best fit models that are applied. It is also important to point out that the measurement is being done for the so-called "bottle necks" or "narrow places" in the RFI and RFP processes. The purpose of this bottle-neck forecasting is to provide timely point for "Go/Not Go" decisions point for these very same process and thus to result in an improved risk management in the form of risk aversion and risk minimization.

Keywords: *forecasting, Holt-Winters exponential smoothing, supply chain management, risk management, RFI and RFP process, telecommunication operators*

JEL Codes: *L93, O18, F47*

Introduction

The present paper regards the opportunities of forecasting of some key indicators in the "Request for Information" (RFI) and "Request for Proposal" (RFP) processes in the supply chain at the Bulgarian mobile telecommunication operators. The presented hereby forecasting is based on the use of the Holt-Winters method for exponential smoothing in the presence of additive and multiplicative seasonality and is made or indicators: "number of contracts", "number of contracts with savings" and "number of the issued purchase orders". The lowest "Stationary R square" "R square" and MAPE (Mean Absolute Percentage of Error) values are used as measurement of accuracy and for selection of the best fit models that are applied. It is also important to point out that the measurement is being done for the so-called "bottle necks" or 'narrow places" in the RFI and RFP processes. The purpose of this bottle-neck forecasting is to provide timely point for "Go/Not Go" decisions point for these very same processes and thus to result in an improved risk management in the form of risk aversion and risk minimization.

1. Literature review and some basic concept notes

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The present paper's approach for forecasting of the key indicators in the RFI and RFP process in the supply chain of mobile telecommunication operators in based on the univariate methods of forecasting, or more specifically on the use of the exponential smoothing forecasting methods. As Preslav Dimitrov (2012, 2020) points out the development and usage of the univariate and particularly of the exponential forecasting methods dates back from the works of R. G. Brown (1959) in the 1940's the results of which were published in 1959. These were further developed and expanded by C. C. Holt (1957) and Peter Winters (1960). In 1960's Pegles (1969) developed the first taxonomy for the classification of the available at that time exponential smoothing forecasting methods. In the 1980's Gardner (1985, 1987) presented some interesting techniques aimed at smoothing of the error residuals in the achieved forecasts. Gardner (1985) and Taylor (2003) also further expanded the opportunities for classifying the exponential smoothing forecasting methods according to so-called "forecasting profiles" or "forecasting patterns".

The problem of the initialization of variables that are to be used in the exponential smoothing equations was also regarded by numerous authors such as Ledolter and Abraham (1984) and Hyndman (2014). Hyndman, Koehler, Snyder, Grose (2002) and Hyndman, Koehler, Ord and Snyder (2008) published their works on the usage of the so-called state-space approach in exponential smoothing.

In the years, the capacity of the univariate and particularly of the exponential forecasting methods to produce reliable forecast was further explored also by other researchers such Ledolter and Abraham (1984), Gardner and McKenzie (1985, 1988), Chatfield and Yar (1988), Hamilton (1994), Tashman and Kruk (1996), Delurgio (1998), Williams and Miller (1999), Tsay (2005) and many others.

In Bulgaria, up to the 1990's only a small portion of the univariate forecasting methods (actually the simplest ones) and the exponential smoothing methods were virtually unknown due to the weak English language skills of the researchers and the preference given in the field of forecasting to the multivariate forecasting methods and mainly the usage of French and Swedish econometric models. In 1996 Sirakov published a book named "Conjuncture and Forecasting of International Markets" in which an application of the Brown's single exponential smoothing was made in regards to the Bulgarian export of textile production equipment and machinery for the African countries and mainly in Nigeria. This application was however very narrow in scope. An Internet publication that tried to make the exponential forecasting smoothing methods more popular in Bulgaria was published in 2007 by Ivanov (2007) from the New Bulgarian University as a part of his lecture course materials on business processes forecasting. Another try for a more explicit explanation and usage of the exponential forecasting methods and namely the Halt and Halt-Winters method was made in another book published in Bulgarian language by Mishev and Goev (2012), i.e. "Statistical analysis of time series". Even though, however, the theoretical presentation of the regarded method was limited and narrowed to the practical application of several software packages. In the field of the Bulgarian tourism, the published studies in the application of the exponential smoothing methods up to 2010 were also limited. However, within the period of 2010 up to 2020, a significant number of publications were made by Dimitrov (2010, 2011, 2012, 2013), Dimitrov, Krasteva and Mirchova (2014), Dimitrov, Kalinova, Gantchev and Nikolov (2015), Dimitrov and Stoyanova (2015) (2016), Dimitrov, Daleva and Stoyanova (2016) (2017), as well as by Dimitrov, Krasteva, Dimitrov and Parvanov (2018). All these publications regard the use of the Halt and Halt-Winters methods for forecasting of the number of tourism arrivals, the tourism receipts and the tourism remunerations in Bulgaria, as well as within certain micro tourism destinations within this country.

2. Methodology and main results

For the needs of the research that stands for the present paper, as well as taking into account of the extremely dynamic development of the sector of the mobile telecommunication operators both globally and in Bulgaria, as well as the capacity of these very same mobile operators to produce and store big volumes of data including time series for their RFI and RFP process, the method of Holt-Winters was selected for carrying out of the necessary forecasting.

The mathematical notation of the Holt-Winters method for **multiplicative seasonality**, as pointed by Dimitrov et al. (2016) is as follows:

- The smoothing of **the level (the base) – "B"**:

(1) $$B_t = \alpha \frac{Y_t}{S_{t-L}} + (1-\alpha)(B_{t-1} + T_{t-1}) \qquad 0 \le \alpha \le 1$$

- The smoothing of **the trend – "T":**

(2) $$T_t = \beta(B_t - B_{t-1}) + (1-\beta)T_{t-1} \qquad 0 \le \beta \le 1$$

- The smoothing of **the seasonal (cyclicity) factor – "S":**

(3) $$S_t = \gamma \frac{Y_t}{B_t} + (1-\gamma)S_{t-L} \qquad 0 \le \gamma \le 1)$$

- The calculation of the final forecast **"F_{t+m}"** for **"$_{t+m}$" the period ahead of time:**

(4) $$F_{t+m} = (B_{t-1} + mT_{t-1})S_{t+m-L},$$

Where:

„α", „β" and "γ" are the smoothing constants for the base, trend and seasonality (cyclicity), which can take the value between 0 and 1.

And the mathematical notation of the Holt-Winters method in the presence of **additive seasonality** is as follows (Dimitrov et al., 2016):

- The smoothing of the level (the base) – "B":

(5) $$B_t = \alpha(Y_t - S_{t-L}) + (1-\alpha)(B_{t-1} + T_{t-1}) \qquad 0 \le \alpha \le 1$$

- The smoothing of **the trend – "T":**

(6) $$T_t = \beta(B_t - B_{t-1}) + (1-\beta)T_{t-1} \qquad 0 \le \beta \le 1$$

- he smoothing of **the seasonal (cyclicity) factor – "S":**

(7) $$S_t = \gamma(Y_t - B_t) + (1-\gamma)S_{t-L} \qquad 0 \le \gamma \le 1$$

- The calculation of the final forecast **"F_{t+m}"** for **"$_{t+m}$" the period ahead of time:**

(8) $$F_{t+m} = B_{t-1} + mT_{t-1} + S_{t+m-L},$$

Where:

„α", „β" и "γ" are the smoothing constants for the base, trend and seasonality (cyclicity), which can take the value between 0 and 1.

The initialization of the values of the level "B", the trend "T" and the seasonal factor "S" is achieved though the following set of equations (9, 10, 11and 12):

- For **the level (base) "B_0"**:

(9) $$B_0 = \frac{1}{L}(Y_1 + Y_2 + ..Y_L)$$

➢ For the trend **"T_0"**:

(10) $$T_0 = \frac{1}{L}(\frac{Y_{L+1} - Y_1}{L} + \frac{Y_{L+2} - Y_2}{L} + \ldots + \frac{Y_{L+L} - Y_L}{L})$$

➢ For the seasonality (cyclic) factor – **"S_0"**:

(11) $$S_0 = \frac{1}{N}\sum_{j=1}^{N}\frac{Y_{L(j-1)+i}}{A_j} \qquad \forall_i = 1,2,...,L,$$

Where:

(12) $$A_j = \frac{\sum_{i=1}^{L} Y_{L(j-1)+i}}{L} \qquad \forall_j = 1,2,...,N \ ,$$

Aj represents the average value of *Y* where j is the concerned time series.

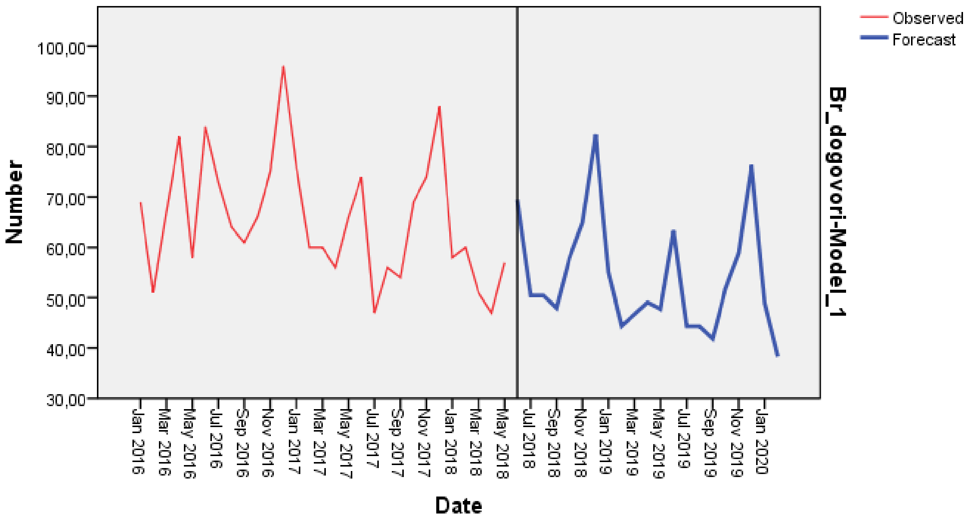
Here, for the initialization of the seasonal factor other alternative methods are also available and Hyndman (2014) recommends the following approach for the multiplicative seasonality:

(13) $S_o = Y_i / B_m$, where i=1, …, m.

However, the present paper will use equation (11) even if it is a little bit more complex to achieve and is close to an autoregressive approach for initialization of the seasonal indices.

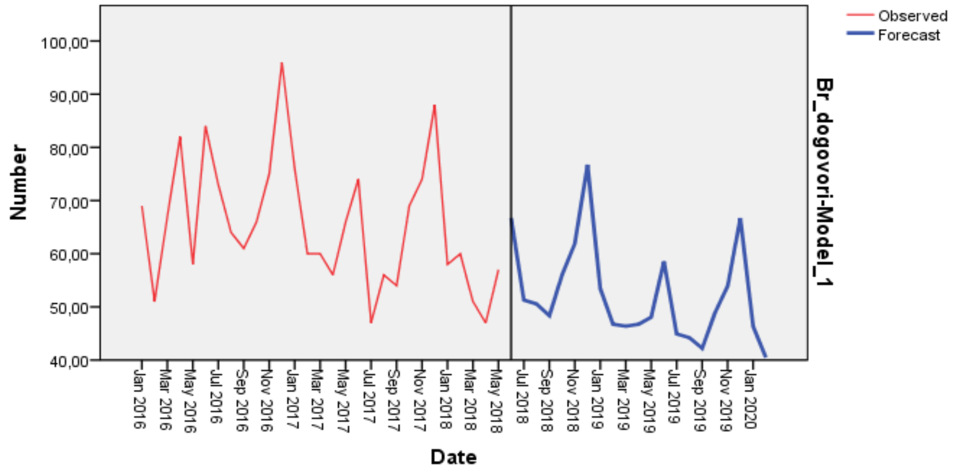
The **Forecasting the basic parameters of the RFI and RFP processes** is made through indicators: "number of contracts", "number of contracts with savings" and "number of the issued purchase orders". The forecasting itself is carried out by the use of the Holt-Winters exponentials smoothing in the presence of additive and multiplicative seasonality, based on the lowest "Stationary R square", "R square" and MAPE values (Figure1, Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6).

Figure 1. Number of contracts – additive cyclicity



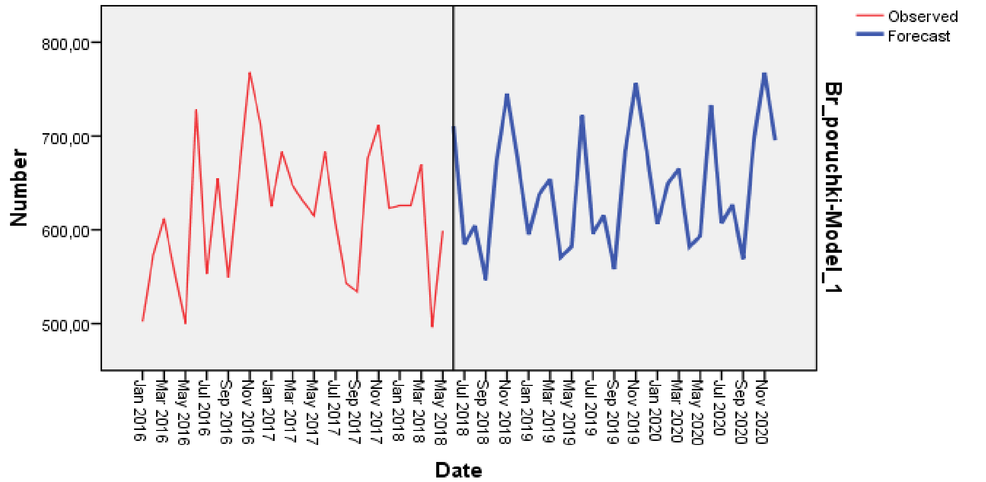
Source: Author's own calculations (2020)

Figure 2. Number of contracts – multiplicative cyclicity



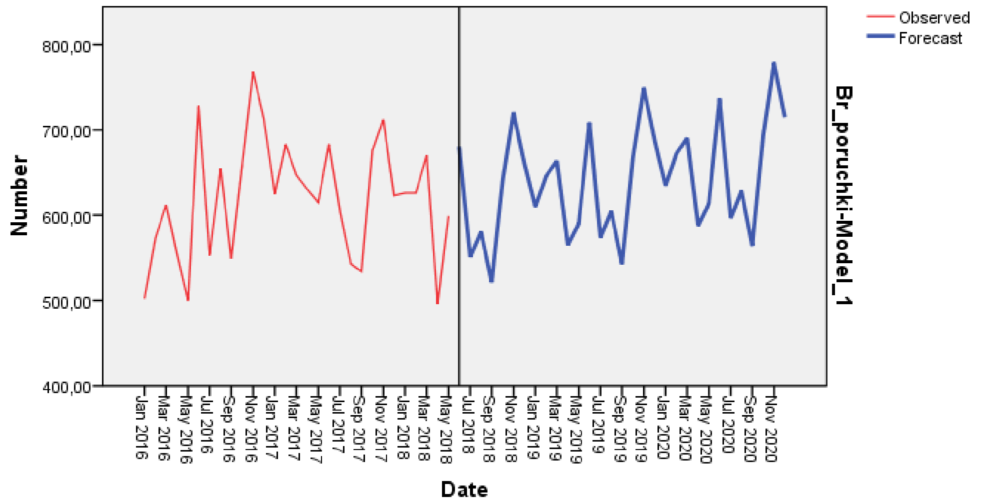
Source: Author's own calculations (2020)

Figure 3. Number of issued purchase orders – additive cyclicity



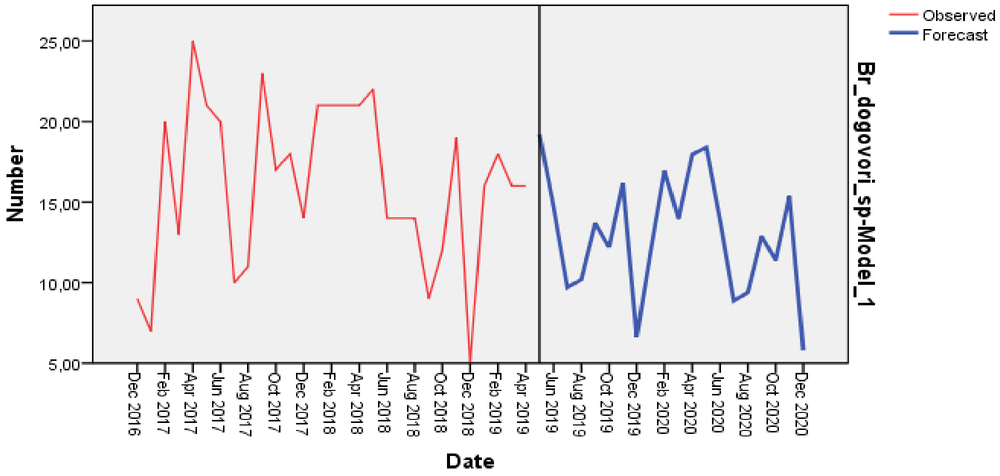
Source: Author's own calculations (2020)

Figure 4. Number of issued purchase orders – multiplicative cyclicity



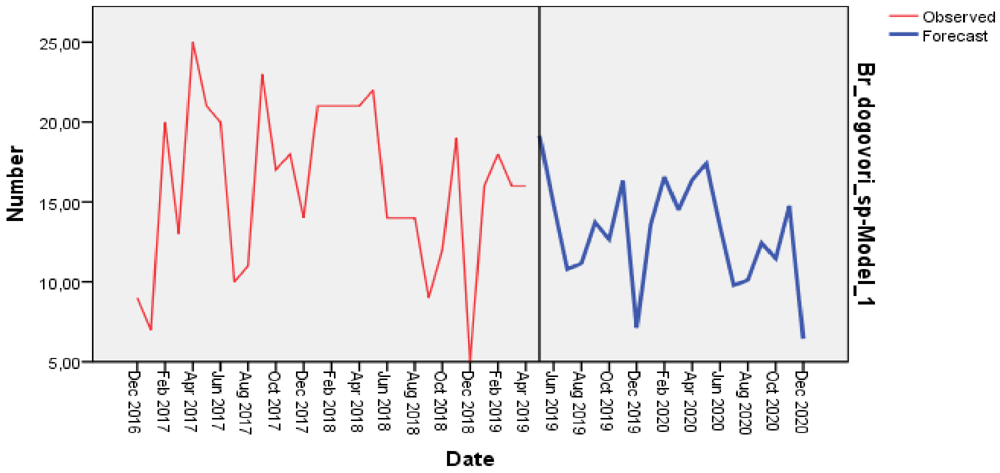
Source: Author's own calculations (2020)

Figure 5. Number contracts with savings –additive cyclicity



Source: Author's own calculations (2020)

Figure 6. Number contracts with savings – multiplicative cyclicity



Source: Author's own calculations (2020)

The produced hereby minimums within the forecasting curves are suggested to be used for "GO/NOT GOT" decision points for risk minimization and risk aversion purposes.

Conclusion

The presented methodology for forecasting of the key indicators in RFI and the RFP processes of the supply chain of the mobile telecommunication operators have not only proved valuable information for the future development of these very same processes. It also produced by the means of the predicted minimums within the forecast curves the necessary "Go / Not go" decision points, that were badly need for analysis and evaluation of the processes and elaborating of the respective decision that were aimed at risk minimization and risk aversion.

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