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Assessment and application of seasonal models with additive trends to predict sales of a wholesaling company

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The paper analyzes studies on the issue of seasonality. It has been determined that a considerable amount of research is devoted to the problem of seasonality. The most objective methods are defined to be the methods considering the phenomenon of seasonality as a component of time series. Among these methods Special attention should be paid to the toolkit that combines autoregressive approach and moving average processing. Priority models for determining the seasonality have been identified including Holt– Winters model and Theil–Wage model. From a practical point of view Theil Wage model is more preferable due to its features in order to take in the properties of additive trends. For a practical test, database of a whole-trading company has been used. Testing the model in practical terms has shown good results and proved its reliability. On the basis of the sales data of the previous five years, the predicted sales of four separate item categories have been determined taking seasonality into consideration. The main priorities and directions of further research have been set forth.
Keywords: seasonality, forecast, time series, parameter, method, evaluation, results, trade, product.

Романовський І.Г. ОЦІНКА ТА ЗАЛУЧЕННЯ МОДЕЛЕЙ ІЗ АДИТИВНИМИ ТРЕНДАМИ ДЛЯ ПРОГНОЗУВАННЯ СЕЗОННОСТІ ПРОДАЖ КОМПАНІЇ ГУРТОВОЇ ТОРГІВЛІ
В роботі виконано аналіз досліджень щодо питання сезонності продаж. Визначено, що значна кількість досліджень присвячена вивченню проблеми сезонності. Найбільш об'єктивними визначено методи, які розглядають явище сезонності як складову часових рядів. Серед розглянутих методів визначення сезонності них особливу увагу заслуговують методи, які поєднують авто-регресійний підхід та підхід ковзаючої середньої. Визначено пріоритетні моделі щодо визначення сезонності, до яких віднесено моделі Холта Винтера та Тейла Вейджа. Перевагу в плані практичного використання надано моделі Тейла Вейджа внаслідок її особливостей щодо більш комплексного урахування властивостей адитивних трендів. Для практичного випробовування використана база даних торгівельного підприємства, яке спеціалізується на гуртовій торгівлі сезонними товарами (фруктами). Випробовування моделі в практичних умовах продемонструвало хороші результати та підтвердило надійність моделі. На підставі даних про продажі за п'ять попередніх років визначено прогнозовані обсяги продаж по чотирьом окремим товарним позиціям з урахуванням сезонності. Визначено основні напрямки щодо подальших досліджень.
Ключові слова: сезонність, прогноз, часовий ряд, параметр, метод, оцінка, результат, торгівля, товар.

Романовский И.Г. ОЦЕНКА И ПРИВЛЕЧЕНИЯ МОДЕЛЕЙ С АДДИТИВНЫМИ ТРЕНДАМИ ДЛЯ ПРОГНОЗИРОВАНИЯ СЕЗОННОСТИ ПРОДАЖ КРУПНООПТОВОЙ КОМПАНИИ
В работе выполнен анализ современных иностранных публикаций по вопросу сезонности. Определено, что проблеме сезонности продаж посвящено значительное количество исследований. В качестве наиболее объективных определены методы, рассматривающие явление сезонности как составляющую временных рядов. Среди таких методов особого внимания заслуживают методы, сочетающие авто-регрессионный подход и применение скользящей средней. Выделены приоритетные модели для оценки сезонности, к которым отнесены модели Холта–Винтерса и Тейла–Вейджа. Преимущество в плане практического использования предоставлено модели Тейла–Вейджа вследствие ее дополнительных возможностей более комплексного учета свойств аддитивных трендов. Для апробации модели использована база данных торгового предприятия, специализирующегося на оптовой торговли сезонными товарами (фруктами). Апробация модели в практических условиях дала хорошие результаты и подтвердила высокую надежность. На основании данных о продажах за пять предыдущих лет определены прогнозируемые объемы продаж по четырем отдельным товарным позициям с учетом сезонности. Сформулированы основные направления дальнейших исследований.
Ключевые слова: сезонность, прогноз, временной ряд, параметр, метод, оценка, результат, торговля, товар.

Formulation of the problem. The problem of seasonality is urgent due to several factors. The globalization of market economy exacerbates the competitive struggle in the markets of goods and services. Ability to accurately predict sales (or services) over a certain period of time in the future gives a company significant competitive advantages. Feasibility to determine the future actual sales quantities (service consumption) allows the company to account for cyclicality that influences the course of economic processes.

Due to this ability, the goods and services being rendered by the company are brought in line with demand. Thus, opportunities for more complete and prompt satisfaction of consumers' needs are being created.

In addition, the company has opportunity to carry out more effectively tactical and strategic planning, that is, to provide additional equipment needs, trade areas, personnel etc.

Using a reliable toolkit to account for the factors of seasonality, the company, gets additional benefits in the implementation of its financial activities.

Taking factors of seasonality of sales into account is of particular importance for trading enterprises, since it allows them to meet the changeable demands head-on without the stocks of unrealized products. The application of reliable and easy-to-use licensed software for running seasonal indexes mathematical models significantly improves their use in the terms of trade enterprises. Thus, testing conditions and further application of such models are facilitated. Accordingly, if the of test results prove to be positive, the scientific and practical value of the models increases.

Therefore, research on seasonality of sales is timely and relevant.

Analysis of recent research and publications. Currently, determining the seasonal indexes in some cases is facilitated by existence of information systems and corresponding databases. This allows managing the sales process at an operational level. So, in the travel industry, on-line management tends to a wide-spread performance of efficient marketing tools for pricing, logistics etc. [1; 2].

However, with the successful operational planning of tourist and transport flows, hotel reservation, catering planning, etc., the need arises for a special toolkit to predict seasonality over a long period of time. First and foremost, this is due to the length of investment needs for the creation of appropriate tourist infrastructure.

Companies that sell goods also face the seasonality influence and have to apply different methods to tackle the issue.

The traditional and most widespread techniques estimating the factor of seasonality in economic processes is the use of time series. Calculations of predicted values of the corresponding parameters are carried out by processing historical data of the object under investigation (e.g. previous actual sales quantities) [3].

At the same time, both absolute figures (sales either in physical or monetary units) and relative indicators (actual sales quantity of a given time interval involved as a reference point) are being used to estimate subsequent changes.

In the author's opinion, plotting a usual trend line and to adjust it by seasonal factors is a rather approximate assumption. Defining the sales trend line by a *n*-level function pattern is also a rather contingent and dubious attempt to solve the problem [4].

More sophisticated models for baseline data processing and seasonal forecasting should be mentioned.

The autoregressive moving-average model (ARMA)[5] is one of the more widespread mathematical models used in statistics to analyze and predict stationary time series. The ARMA model generalizes two simpler models of time series – the autoregression model (AR) and the moving average model (MA)

$$X_i = c + \varepsilon_t + \sum_{i=1}^{p} \alpha_i X_{t-i} + \sum_{i=1}^{q} \beta_i \varepsilon_{t-i} \quad (1)$$

where c – a constant,

ε_t – «a white noise» – a sequence of independent and identically (normally) distributed random variables with zero mean,

X_t – real numbers;

α_i – autoregressive coefficients;

β_i –moving average coefficients.

The emergence of the term «white noise» is due to the industry in which the ARMA method was initially used (radio physics: transmission of signals within a communication network) [5]. That is, the application of a technical model for determining economic processes (seasonality) has its features. When forecasting the seasonality of sales, «a white noise» defines the minimum sales level for the entire time interval.

The ARIMA model (p, d, q) can be represented as [6]:

$$Y_t = -\left(\Delta^d Y_t - Y_{t-1}\right) + \phi_0 + \sum_{i=1}^{p} \phi_1 \Delta^d Y_{t-1} - \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} + \varepsilon_t \quad (2)$$

Where d corresponds to d-differences between nonstationary and stationary time series definition sets;

$\phi_1,\ldots,\phi_p$ – parameters defining to the «autoregressive» part of the model;

$\theta_1,\ldots,\theta_q$ the parameters defining the «moving average» part of the model;

ϕ_0 – a constant value;

ε_t – error of an observed value.

While applicating ARIMA model, the coefficients and number of regressions have to be defined. The model is more sensitive to the precision with which its coefficients are determined, than a ARMA. Nevertheless, The term ARMA and ARIMA are confusing because both models have the same mathematical form [7].

The ARIMA model can be further generalized to consider more profoundly the effect of seasonality, turning into SARIMA (seasonal autoregressive integrated moving average) model [8].

Fully regular cyclic variations in time series can be considered in the analysis of time series using a (co)sinusoidal model with one or more sinusoids, the duration of which depends on the purpose of the research [9Ошибка! Источник ссылки не найден.].

Another method of simulating seasonality is the use of the Fourier term pairs []. Like implication of a sinusoidal model, the Fourier terms add trigonometric functions to regression models to simulate seasonality. Each periodic function can be approximated by the inclusion of Fourier terms.

In general, the difference between the sinusoidal model and the Fourier regression can be simplified as follows [9]

Sinusoidal model

$$Y_i = a + bt + \propto \sin\left(2\pi\omega T_i + \Phi\right) + E_i \qquad (3)$$

Regression with Fourier terms

$$Y_i = a + bt + \sum_{k=1}^{k}(\propto_k \sin\left(\frac{2\pi kt}{m} + \Phi\right) + \beta_k \cos\left(\frac{2\pi kt}{m} + \Phi\right)) + E_i \qquad (4)$$

The models apply the «Seasonal adjustment» – an attempt to clean the seasonal component out of time series. The seasonally adjusted data received is used, for example, in an analysis or a report of off-season trends for an interval longer than a seasonal period. The appropriate method of seasonal adjustment is chosen subjectively due to the breakdown of time series into components.

In principle, there are two ways of representing a seasonal effect:

– through an additive component;

– through a multiplicative component [10].

If the seasonal component acts additionally, the adjustment method has two following stages.

1. Estimation of the seasonal component of the variation of time series.

2. To subtract the seasonal component from the initial time series to define the seasonally adjusted series

$$Y_t - S_t = T_t + E_t \qquad (5)$$

where Y_t – time series actual values;

S_t –seasonal component;

T_t – trend-line values;

E_t – cyclical component.

For multiplicative models, the magnitude of seasonal variations varies depending on the intensity of changes in economic series [9]. Taking into account seasonality, seasonally adjusted multiplicative decomposition can be written as

$$\frac{Y_t}{S_t} = T_t \times E_t \qquad (6)$$

provided that the initial time series are divided into the expected seasonal component.

The multiplicative model can be transformed into an additive model by means of multiplicative decomposition

$$Y_t = S_t \times T_t \times E_t\,, \qquad (7)$$

either in form of:

$$lnY_t = lnS_t + lnT_t + lnE_t \qquad (8)$$

In regression analysis using the least squares method, if a seasonally modified dependent variable is influenced by a few of independent variables, seasonality can be accounted for and measured by the inclusion of $n-1$ dummy variables, one for each season, with the exception of an arbitrary selected reference season.

In this case, the parameter n stands for number of seasons (e.g., 12 months a year). Each dummy variable is set to be either 1 (the data point is extracted from the correspondent season) or 0 (extracted from the «wrong» season»). Then the predicted value of the dependent variable for the reference season is calculated from the regression equation, whereas for any other period it is being calculated using the remaining regression and by inserting a value for a dummy variable for this season.

The difference between seasonal models and cyclic patterns is as follows.

A seasonal pattern occurs when time series affect seasonal factors (*the* day (not *a* day) of the week).

Cycle (aka periodicity) occurs when data discovery increases and falls, which does not have a fixed period. These fluctuations (associated with economic environment) are usually referred to as «a business cycle».

Many products tend to grow or fall in sales, regardless of the stage of the life cycle they are in.

For some products, there are significant seasonal changes in sales, so it is advisable to take into account the specific nature of the trend and seasonal fluctuations in order to forecast the product sales. Based on the model, Holt created in 1957 and Winters revised 1960 a predictive model that takes into account the exponential trend and additive seasonality (Holt-Winters model) [7].

$$\begin{cases} \hat{y}_{t+d} = a_t(r_t)^d\theta_t + (d \bmod S) - S \\ a_t = a_1\dfrac{y_t}{\theta_{t-S}} + (1-\propto_1) \times a_{t-1} \times r_{t-1} \\ r_t = a_3\dfrac{a_t}{a_{t-1}} + (1-\propto_3) \times r_{t-1} \\ \theta_t = a_2\dfrac{y}{a_t} + (1-\propto_2) \times \theta_{t-s} \end{cases} \quad (9)$$

The first equation determines forecast parameter's value affected by three following smoothing equations – involving a level of parameter (a_t), a trend parameter (r_t) and a seasonality parameter (θ_t).

Coefficients $\propto_1, \propto_2, \propto_3 \in (0,1)$ are calculated by processing an historical database. The algorithm of the solution of the system is minimization of the error. The main disadvantage of the model is relatively low accuracy, since the first equation of the system does not consider the additivity of the factors.

Highlighting the previously unsettled issues the article is devoted to. Thus, despite the diversity of approaches to assessing the seasonality indicators, the author draws attention to the lack of a clear definition of tools that can be conveniently and reliably used to assess the impact of seasonality on sales. In addition, there are scarce recommendations on the practical application of the technique of seasonal evaluation and the criteria for assessing the reliability of the results. The author insists that the approach to the definition of seasonality should cover as much as possible and taking into account the interconnection of economic aspects of an enterprise with the mathematical possibilities and the nature of the toolkit used to evaluate the seasonality. In addition, it is necessary to determine and substantiate the method for assessing the reliability of the use of the toolkit, taking into account the judgements set forth above.

Formulating the goals of the article (task statement). The purpose of the work is to determine technics, the application of which in the terms of a whole-trading company allows to take into account seasonality of sales in a comprehensive and all-embracing way. The application of additive components makes the issues more rearranged to deal with.

On the basis a technics defined, regarding the complexity of seasonality factor, an approach to predicting actual sales quantity is to be set forth.

Testing the model in a company environment must confirm its reliability. In addition, the structure and level of the model should make it accessible and easy-to-use.

Presentation of the main research material with full substantiation of the received scientific results. In order to solve the research problem settled above, the author considers it expedient to use Theil-Wage ModelОшибка! Источник ссылки не найден.]. In essence, Theil-Wage Model model is a logical extension and an upgraded version of the model of Holt-Winters.

$$\begin{cases} \hat{y}_{t+d} = a_t + db_t\theta_t + (d \bmod S) - S \\ a_t = a_1(y_t - \theta_{t-s}) + (1-\propto_1) \times (a_{t-1} + b_{t-1}) \\ b_t = a_3(a_t - a_{t-1}) + (1-\propto_3) \times b_{t-1} \\ \theta_t = a_2(y_t - a_t) + (1-\propto_2) \times \theta_{t-s} \end{cases} \quad (10)$$

where S – seasonality period,

θ_t – seasonal profile,

b_t – trend parameter,

a_t – forecast parameter, cleared from trend and seasonal effects.

G. Theil and S. Wage proposed to apply a two-parameter predictor of Holt to describe the properties of adaptive models in probabilistic processes characterized by a stochastic trend. They derived solutions determining optimal adaptation parameters by minimize the mean square of prediction error.

In contrast to the Holt-Winters approach, this model takes into account both seasonality and additive trend. Moreover, it significantly simplifies the math technics applied and increases its predicative capabilities.

Theil-Wage model involves an experimental selection of parameters $\propto_1, \propto_2, \propto_3 \in (0,1)$ using the method of minimizing the mean square error.

To test the feasibility of using Theil-Wage Model model, the database of a whole-trading company having own storage facilities and specializing in wholesale sales of fruits was used. Information on monthly sales 4 years running (48 months) is given in Table 1.

Basing on sales data in interval from 2014 to 2016 as well data sales of 2012-2013, Theil-Wage Model model has been applied to check the 2017 sales figures of each product line.

The comparison table is shown below (Table 2).

To assess the reliability of the predicted results, Mean Error, MAE(Mean Absolute error), MSE (Mean Squared Error), RMSE(Root Mean Squared Error), MASE (Mean Absolute Scaled Error), SMAPE (symmetrical mean absolute percentage error) [12; 13] were involved. The Error Statistics is shown in Table 3.

The data shown in Table 3 testifies reliability of the model being used to evaluate seasonality.

Table 1

Monthly sales, tons

Time interval	Apples	Tangerines	Bananas	Oranges
Jan-14	676.3	509.3	788.0	375.4
Feb-14	541.4	561.8	743.6	353.3
Mar-14	731.2	582.3	643.7	310.2
Apr-14	726.6	491.9	700.3	336.7
May-14	780.3	530.6	607.0	294.5
Jun-14	813.6	477.3	676.8	319.2
Jul-14	872.6	490.1	597.6	274.3
Aug-14	933.2	436.9	530.4	246.4
Sep-14	758.1	412.9	650.9	295.1
Oct-14	821.9	495.4	687.8	307.8
Nov-14	695.9	504.7	694.4	352.3
Dec-14	712.4	533.0	758.5	345.8
Jan-15	678.0	543.0	878.1	411.2
Feb-15	615.7	572.1	825.2	421.0
Mar-15	783.0	541.4	779.5	349.9
Apr-15	730.2	460.5	830.6	403.3
May-15	794.0	492.4	694.4	335.6
Jun-15	832.3	490.4	771.7	344.3
Jul-15	960.3	471.2	668.1	315.3
Aug-15	947.1	410.4	587.8	271.9
Sep-15	791.5	383.6	719.2	329.7
Oct-15	885.8	458.0	732.1	334.2
Nov-15	764.6	459.4	828.9	380.8
Dec-15	736.2	491.7	841.9	412.8
Jan-16	641.0	584.4	817.0	468.7
Feb-16	609.4	629.5	770.9	481.1
Mar-16	702.1	634.8	727.5	437.1
Apr-16	740.1	578.3	732.2	420.8
May-16	783.6	606.7	728.7	409.6
Jun-16	866.1	560.9	697.8	431.3
Jul-16	872.0	544.6	688.4	373.5
Aug-16	921.2	519.0	602.2	362.0
Sep-16	755.5	471.5	715.4	404.3
Oct-16	773.6	571.3	781.3	421.2
Nov-16	735.6	597.4	821.5	447.4
Dec-16	744.0	620.2	811.9	505.6
Jan-17	678.5	538.6	1230.1	513.5
Feb-17	598.5	588.2	1239.0	534.9
Mar-17	745.8	623.9	1044.3	470.1
Apr-17	780.6	546.2	1032.3	428.7
May-17	818.3	537.0	923.6	386.9
Jun-17	882.8	473.2	973.5	419.0
Jul-17	911.3	461.4	879.1	358.8
Aug-17	921.0	451.9	791.6	349.0
Sep-17	774.7	405.4	979.1	425.6
Oct-17	840.7	523.3	928.3	410.9
Nov-17	743.9	471.6	1024.4	470.0
Dec-17	737.7	530.8	1153.8	478.4

Table 2

The comparison table of predicted and actual sales quantities in 2017

Time interval	Apples		Tangerines		Bananas		Oranges	
	actual	predict.	actual	predict.	actual	predict.	actual	predict.
Jan-17	678.5	740.3	538.6	520.2	1230.1	1225.1	513.5	486.3
Feb-17	598.5	610.4	588.2	631.7	1239.0	1340.6	534.9	495.9
Mar-17	745.8	746.6	623.9	587.7	1044.3	1088.1	470.1	449.4
Apr-17	780.6	850.1	546.2	508	1032.3	1087.0	428.7	428.7
May-17	818.3	765.1	537.0	560	923.6	859.9	386.9	413.9
Jun-17	882.8	802.4	473.2	459	973.5	998.8	419.0	441.3
Jul-17	911.3	908.5	461.4	480.3	879.1	936.3	358.8	370.3
Aug-17	921.0	874	451.9	426.6	791.6	768.7	349.0	381.4
Sep-17	774.7	797.2	405.4	394.9	979.1	1075.0	425.6	410.7
Oct-17	840.7	785.2	523.3	556.8	928.3	940.4	410.9	448.3
Nov-17	743.9	752	471.6	482.4	1024.4	1118.6	470.0	486.4
Dec-17	737.7	731.1	530.8	578.6	1153.8	1051.1	478.4	517.1

Table 3

Error Statistics

	Apples	Tangerines	Bananas	Oranges
ME	5.8976	-2.8993	-24.2057	-6.9926
MSE	1998.9291	862.7675	4376.8584	707.8786
RMSE	44.7094	29.3729	66.1578	26.6060
MAE	34.9983	26.6810	56.5899	23.9728
MPE	0.0037	-0.0051	-0.0233	-0.0208
MAPE	0.0438	0.0507	0.0552	0.0550
SMAPE	0.0440	0.0504	0.0544	0.0541

In the opinion of the author, within Table 3 the most sensitive indicator is considered to be MASE, which equals [13]

$$MASE = \frac{\frac{1}{n}\sum_{i=1}^{n}|e_i|}{\frac{1}{n-t}\sum_{i=t+1}^{n}|y_i - y_{i-t}|}$$

Since the application of Theil-Wage model proved to be reliable, the model was used to determine the forecast sales by the item categories. Relying on the database of the previous time intervals, item categories' sales seasonality forecasts were determined.

To affirm the reliability of the results Confidence intervals with α = 0.95 were evaluated. The results are presented in Table 4.

In order to visualize the results of the study, graphs of fruit sales for the next two year period have been plotted, as shown in Fig. 1-4.

When making calculations, Visual Basic for Applications was applied. The application of special macros facilitates practical use of the approach set forth above and reveals additional opportunities for putting forward additional intermediate tasks and improving the reliability of the results.

Final Statements. To assess the seasonality of sales of a whole-trading company, an analysis of methodological approaches to the technics being used to estimate this factor was carried out. The results researches explored define time series methods to be an approach that allows accounting for the features of seasonality.

Theil-Wage method was involved to assess the seasonality of a whole-trading company, since the application of additive factors contributes to the fullest possible consideration of seasonal processes' features. Regarding the model's calculation technics to be reliable and acceptable, the model's performance proves to be efficient.

Using database of a trading company engaged in wholesale of fruits, the reliability of the mathematical model was tested. The results obtained reaffirm both the reliability of the proposed model and the validity of the approach chosen for the assessment of seasonality.

The results of the forecast of fruit sales for the next two years have been received, which

Table 4

Predicted sales for year 2018/2019

Time interval	Apples			Tangerines			Bananas			Oranges		
	Sales	confidence interval boundaries		Sales	confidence interval boundaries		Sales	confidence interval boundaries		Sales	confidence interval boundaries	
		lower	upper		lower	upper		lower	upper		lower	upper
Jan-18	666.6	608.3	724.9	565.9	485.1	646.8	1203.0	1047.7	1358.3	541.6	500.4	582.8
Feb-18	620.7	560.5	680.8	627.7	518.9	736.5	1155.3	935.7	1374.8	552.3	510.7	593.8
Mar-18	751.5	689.6	813.4	611.5	480.5	742.5	1111.5	842.6	1380.4	494.0	452.2	535.9
Apr-18	746.4	682.8	810.1	523.2	373.2	673.1	1141.4	830.8	1452.0	512.2	469.9	554.4
May-18	800.0	734.7	865.4	554.1	387.3	720.9	1072.6	725.2	1420.0	472.5	429.9	515.0
Jun-18	833.9	766.8	900.9	523.1	341.0	705.2	1165.8	785.0	1546.5	478.3	435.3	521.2
Jul-18	928.2	859.5	996.9	516.6	320.3	712.9	1074.5	663.1	1486.0	440.8	397.5	484.1
Aug-18	951.3	881.0	1021.6	467.3	257.7	676.8	999.3	559.2	1439.3	403.7	360.1	447.3
Sep-18	787.7	715.7	859.6	423.1	201.1	645.1	1125.9	658.9	1592.8	455.4	411.5	499.4
Oct-18	865.7	792.2	939.2	514.3	280.5	748.2	1153.6	661.1	1646.1	465.3	421.0	509.6
Nov-18	742.0	667.0	817.1	505.1	260.0	750.3	1205.9	689.2	1722.7	511.0	466.3	555.6
Dec-18	734.3	657.7	810.9	545.5	289.5	801.5	1247.6	707.6	1787.6	523.5	478.5	568.5
Jan-19	670.8	592.7	749.0	580.6	311.9	849.3	1296.8	734.4	1859.2	584.7	539.3	630.0
Feb-19	624.9	545.3	704.6	642.4	363.7	921.0	1249.0	665.2	1832.9	595.3	549.6	641.1
Mar-19	755.8	674.7	836.9	626.2	337.9	914.4	1205.3	600.6	1809.9	537.1	491.0	583.2
Apr-19	750.7	668.1	833.3	537.8	240.2	835.5	1235.2	610.4	1859.9	555.2	508.8	601.7
May-19	804.3	720.3	888.3	568.7	262.0	875.4	1166.4	522.0	1810.7	515.5	468.7	562.4
Jun-19	838.1	752.7	923.6	537.7	222.2	853.3	1259.5	596.2	1922.9	521.3	474.1	568.5
Jul-19	932.5	845.6	1019.4	531.3	207.2	855.4	1168.3	486.5	1850.2	483.9	436.3	531.4
Aug-19	955.6	867.2	1043.9	481.9	149.4	814.5	1093.1	393.1	1793.0	446.8	398.8	494.7
Sep-19	792.0	702.2	881.7	437.8	97.0	778.5	1219.6	502.1	1937.2	498.5	450.2	546.8
Oct-19	870.0	778.9	961.1	529.0	180.2	877.8	1247.4	512.6	1982.2	508.4	459.7	557.1
Nov-19	746.3	653.8	838.8	519.8	163.1	876.5	1299.7	548.0	2051.4	554.0	505.0	603.1
Dec-19	738.6	644.7	832.4	560.2	195.8	924.5	1341.4	573.2	2109.6	566.5	517.1	616.0

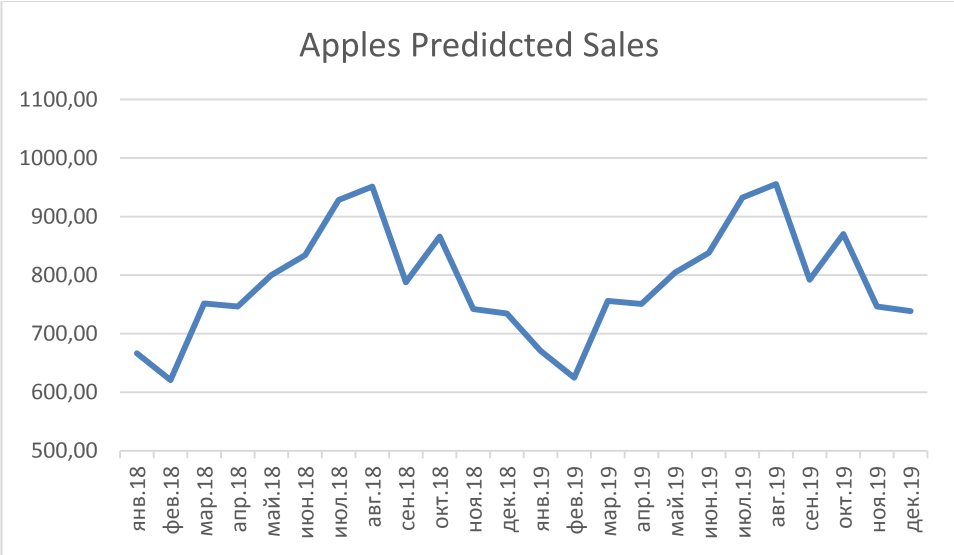

Figure 1. Apples predicted sales

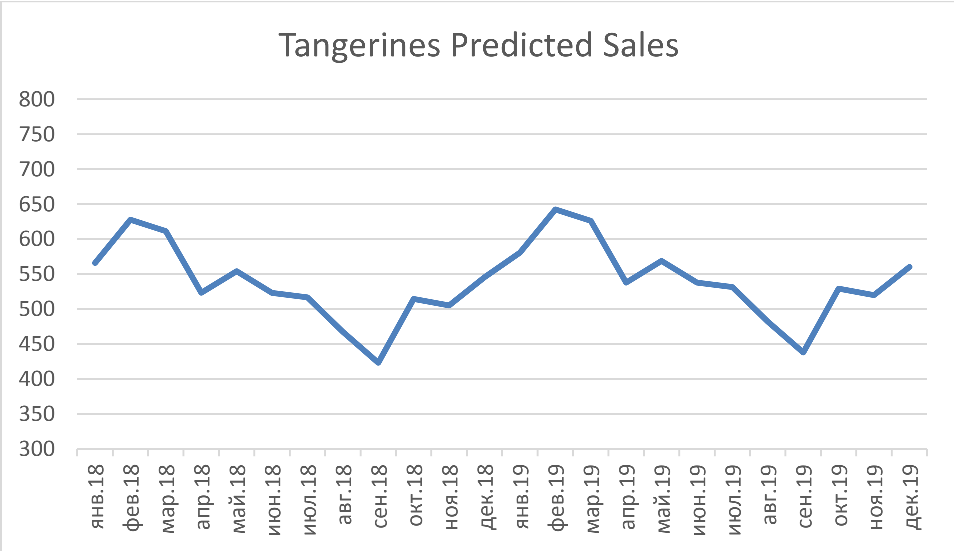

Figure 2. Tangerines predicted sales

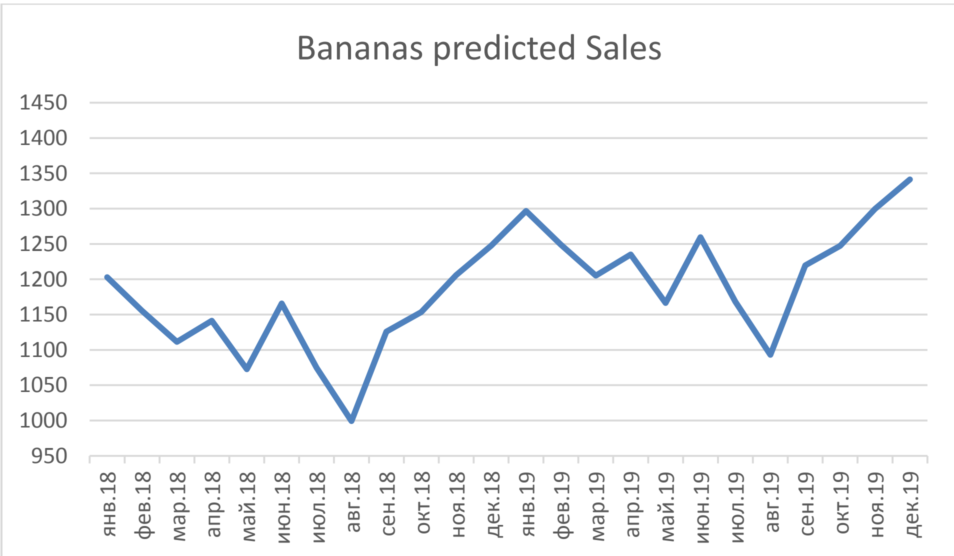

Figure 3. Bananas predicted sales

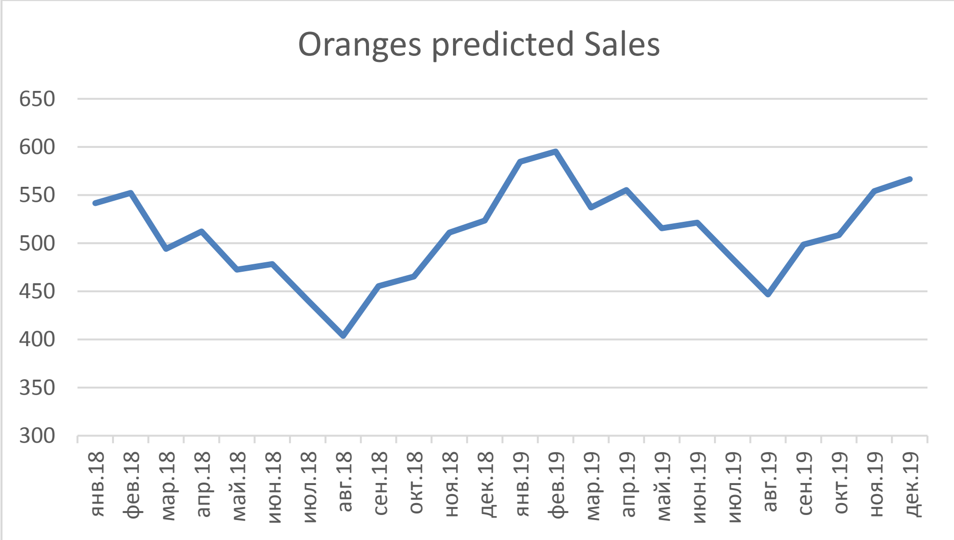

Figure 4. Oranges predicted sales

will facilitate the performance work of the whole-trading company and make it more efficient.

The author reaffirms the priority direction of exploring of a set of methods for predicting seasonality of sales. First and foremost, it would be advisable to examine in complex SARIMA and classic Holt-Winters method. In order to evaluate the results of such an assessment, Mariano Test should be involved, as far as it demonstrates reliable results for small databases[14]. In addition, further prospects for using Autoregressive Processes to assess the seasonal phenomenon should be mentioned.

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