International Journal of Economics, Commerce and Management
United Kingdom ISSN 2348 0386 Vol. VII, Issue 6, June 2019
http://ijecm.co.uk/

MODELING AND FORECASTING THE PROCESS OF PRODUCING WINE USING ECONOMETRIC PACKAGE EVIEWS

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Abstract

Modeling and forecasting of the manufacturing process becomes more and more actual. The article proposes a method of using Eviews package for modeling and forecasting the process of producing wine in the economic development of developing countries (the Republic of Uzbekistan). The results of the study showed acceptability of the proposed model for the development of the strategy for the development of the viticulture-wine-making branch.

Keywords: Modeling, Forecasting, Econometrics, Uzbekistan

INTRODUCTION

Economic and mathematical modeling is an integral part of any research in the field of defining a model of an economic development strategy. The development of mathematical analysis, operations research, probability theory and mathematical statistics contributed to the formation of various kinds of approaches to the study of issues of modeling the cluster development of the industry (Dennis et al, n.d.).

Objects of a single production cluster of different levels of economic processes can be viewed from the standpoint of a systematic approach and exposure to the environment, predetermine the choice of their research method. In the system of grapes-wine industry, the problem is in organization models of strategic economic development of definite economic sphere the Republic of Uzbekistan.

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The scientific literature describes the development of a number of specialized packages designed to build adequate econometric models. One of them is the EVIEWS package. The Eviews package allows regression estimation not only by the least squares method, but also by maximum likelihood methods, weighted and nonlinear least squares methods, it is enough to simply type the name of the method on the command line when estimating the model coefficients (Christopher and Robert, 1992).

But in the literature, it is difficult to find the use of the EVIEWS package based on statistical data of a certain sector of the economy. The use of this package in order to develop a model for forecasting and designing strategic development of viticulture and winemaking will help in determining competitive grape varieties, taking into account the influence of production factors, etc.

Complex composition of grapes, availability of various ways of their processing, quality control of the finished products, give the possibility to predict the type and name of finished products, their properties, corresponding to quality and features of each grape variety. In order to simplify predicting, we have divided all grape varieties into V Groups. The division took place based on the quality of the wine, produced from given grape variety and its characteristics.

METHODOLOGY

The methodology for compiling industry modeling is the subject of research and development of research organizations and companies that produce software packages in the field of economics. However, the techniques used in practice are often insufficient to obtain a comprehensive picture of the future strategy of an enterprise. This is due to the narrow specialization of existing systems, with the lack of support for business planning methods based on economic-mathematical methods and models.

Under the methodology of creating a model of the production process is understood a set of ways in which objects of an industry cluster are represented as a model. Any technique includes three main components:

- theoretical base;
-description of the steps necessary to obtain a given result;
- recommendations for use methods separately and as part of a group.

When forming the model, we checked the condition on the normal distribution of variables. To test the relationship between variables, the coefficients of partial and pair correlation are calculated, and a multifactorial econometric model is constructed. Our investigation we made on the basis of data taken from Agency of development of vine and wine industry and internet data of FAO. Taken data were input into EVIEWS program results of which were analyzed.

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RESULTS AND DISCUSSIONS

In the conditions of market economy, forecasting is the key of successful development of business and industry. Adoption of any strategic management decision requires foresight for the development of the economic situation. To do this, we use statistical methods of forecasting, using time series, taking into account past and current regularities of the industry development.

The time series is a set of numbers, attached to the serial, usually equidistant time points. Data on release or consumption of various goods within certain time are time series. Numbers that make up series and are resulting from observation of some process, are called elements, and the interval between observations –sampling time (Shodiev et al, 1999). Series elements are numbered according to the number of the timepoint to which this element belongs (i.e. designated as ($Y_1, Y_2, ..., Y_n$)).

Time series includes information about features and regularities of the forecasting process, and statistical analysis is used to assess characteristics of the process in the future. The task of forecasting come down to obtaining estimates of series values at some period in the future, that is, to obtaining value $Yp(t)$, $t = N + 1, N+2, ...$. Using extrapolation methods, we proceeded from the assumption of maintaining regularities of the past development for the forecasting period. In many cases, when developing real-time forecast (up to one year) and short-term (up to 2 years) forecast, these assumptions are true.

The forecast is calculated for two stages. At the first stage- formal-using statistical methods, regularity of the past development is found, extrapolated for some period in the future.

At the second stage – correction of obtained forecast is performed, taking into account results of conceptual analysis of the current state.

Statistical research methods proceed from assumptions about possibility of presenting levels of time series as a sum of several components, reflecting the regularity and randomness of the development, particularly as the sum of four components:

$$Y(t) = f(t) + S(t) + U(t) + E(t), \qquad (1)$$

Where,

Y(t) – trend (long-term tendency) of development;

S (t) – seasonal component;

U (t) – cyclical component;

E (t) – residual component.

In cases where the period of fluctuations is a few years, they say that in the time series, there is cyclical component. The main objective of the statistical analysis of time series -study of the correlation between regularity and randomness in formation of values of the series levels, assessment of quantitative measure of their impact.

For time series analysis, graphics methods are applied. As tabular presentation of the time series and descriptive characteristics often do not allow understanding the process nature, and on time series chart, it is possible to make certain conclusions, which can be checked then, using calculations.

For modeling and forecasting the process of producing wine from grapes, modern econometric package Eviews is used. It is a modern statistical package, "intended" for time-series analysis, and it presents wide opportunities when analyzing the data, presented in the form of time series (Kasimov 2017). For building multi-factor econometric model, logarithmic initial data are given in table 1.

Table 1 Logarithmic initial data

Years	**Volume of wine production (ths. Litres), Y**	**Gross harvest of grape (ton), X_1**	**Planting acreage ths. Ha, X_2**	**Crop productivity c/ha., X_3**
2000	10,62132735	13,34423	11,50186	4,144721
2001	10,68051622	13,25882	11,50892	4,053523
2002	10,42168593	13,15464	11,52584	3,931826
2003	10,73094707	12,90304	11,48761	3,718438
2004	10,46310334	13,28637	11,4804	4,10759
2005	10,08996712	13,37174	11,50489	4,166665
2006	10,0471549	13,59679	11,52462	4,374498
2007	10,12502982	13,68802	11,50489	4,445001
2008	10,10479441	13,58105	11,53469	4,348987
2009	9,955605507	13,70971	11,56741	4,445001
2010	9,965522943	13,80273	11,58152	4,508659
2011	10,49515556	13,90191	11,62194	4,582925
2012	10,53236284	14,00286	11,61814	4,687671
2013	10,48681987	14,09472	11,64258	4,755313
2014	10,49127422	14,18099	11,7279	4,755313
2015	10,50916871	14,27252	11,82316	4,891101
2016	10,51975369	14,31164	11,81402	4,955123

Source: Initial data got from annual report of Agency of development vine and wine industry and investigations of FAO published in internet

For building a multi-factor model, descriptive statistics was conducted, results of which are shown in table 2.

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Table 2 Results of descriptive statistics

Name of values	Y	X_1	X_2	X_3
Mean	10.36707	13.67422	11.58649	4.404256
Median	10.48682	13.68802	11.53469	4.445001
Maximum	10.73095	14.31164	11.82316	4.955123
Minimum	9.955606	12.90304	11.48040	3.718438
Std. Dev.	0.257579	0.416718	0.109341	0.348724
Skewness	-0.405278	-0.059383	1.142734	-0.196781
Kurtosis	1.705656	1.991577	3.095753	2.190794
Jarque-Bera	1.652065	0.730308	3.706377	0.573542
Probability	0.437783	0.694090	0.156737	0.750684
Sum	176.2402	232.4618	196.9704	74.87235
Sum Sq. Dev.	1.061553	2.778460	0.191289	1.945730
Observations	17	17	17	17

Table 2 identifies mean value (mean), median values (median), standard deviations (std.Dev.), minimum and maximum values (max, min) of variables.

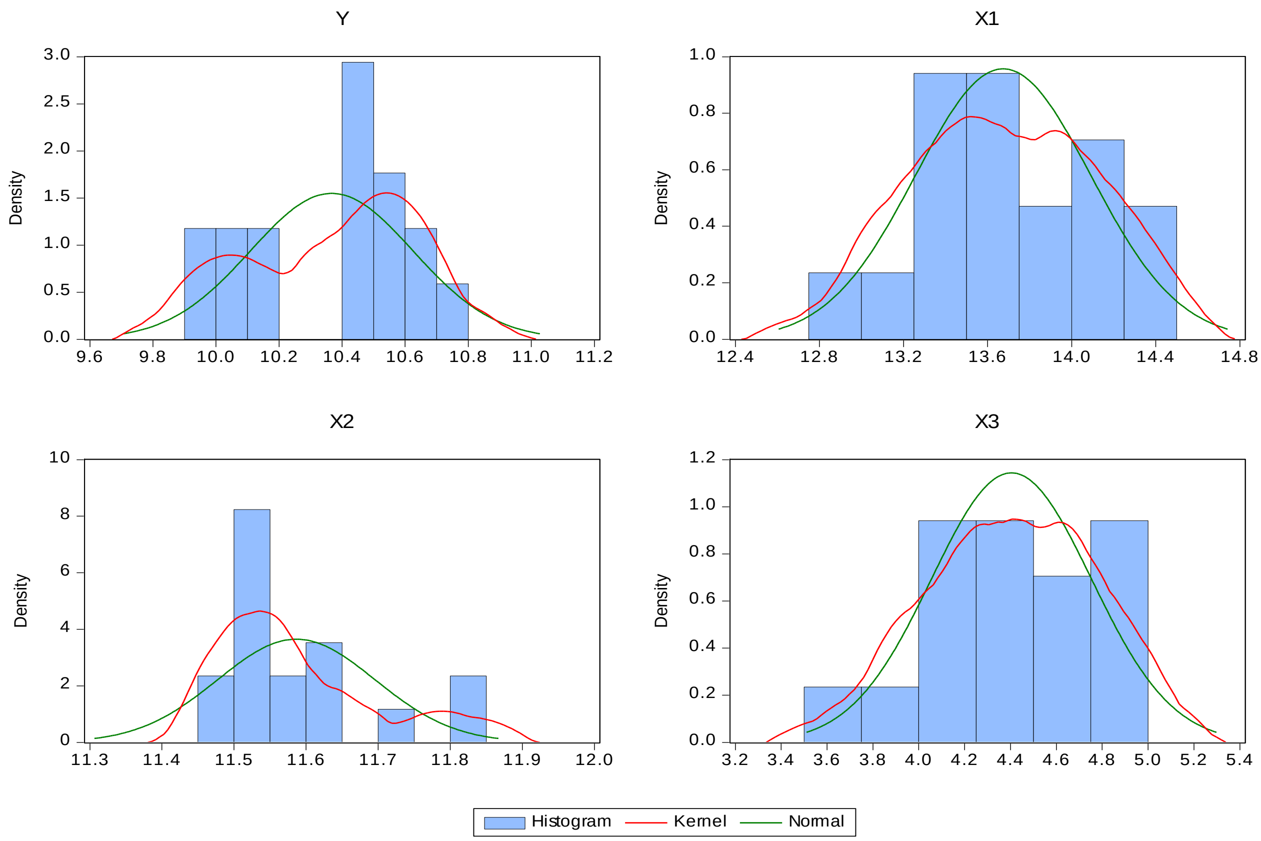

Figure 1 Check of variables for normal distribution

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Visual analysis of time series chart (histogram) allowed making conclusions:

- existence of trend and its nature;
- presence of seasonal and cyclical components;
- degrees of smoothness or intermittence of changes of series consecutive values after removal of trend.

As figure 1 shows, variables X_1 and X_3 correspond to normal distribution law. Variable Y has left-handed bias, and variable X_2 has right-handed bias. Because values of asymmetry coefficients adopt negative and positive values.

To verify the relationship between variables, coefficients of partial and pair correlation are calculated (table. 3).

Table 3 Coefficients of partial and pair correlation

Covariance Analysis: Ordinary
Date: 11/17/18 Time: 11:21
Sample: 2000 2016
Included observations: 17

Correlation
t-Statistic

	Y	X_1	X_2	X_3
Y	1.000000			
X_1	-0.068559	1.000000		
X_2	0.205707	0.879621	1.000000	
X_3	-0.104236	0.996627	0.855261	1.000000

The next step is the analysis of partial correlation coefficient.

Table 4 Calculation of multi-factor econometric model

Dependent Variable: Y
Method: Least Squares
Date: 11/17/18 Time: 11:28
Sample: 2000 2016
Included observations: 17

Variable	Coefficient	Std. Error	t-Statistic	Probability
X1	0.842001	0.106886	7.877561	0.00430
X2	2.261103	0.904522	2.499777	0.01740

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X3	-1.686121	2.420778	-0.69652	0.09084
C	-19.91878	14.43308	-1.38008	0.01908
R-squared	0.841998	Mean dependent var		10.36707
Adjusted R-squared	0.708961	S.D. dependent var		0.257579
S.E. of regression	0.231800	Akaike info criterion		0.116438
Sum squared resid	0.698504	Schwarz criterion		0.312488
Log likelihood	3.010280	Hannan-Quinn criter.		0.135925
F-statistic	22,52256	Durbin-Watson stat		1.879199
Prob(F-statistic)	0.00000			

Table 4...

Then multi-factor econometric model is built, which looks as follows:

$$\hat{Y} = -19{,}92 + 0{,}842 \cdot X_1 + 2{,}261 \cdot X_2 - 1{,}686 \cdot X_3$$

Analysis of the obtained multifactor model has shown that:

- 1 ton increase in gross harvest of grapes (x_1) will lead to increase in volume of wine production on average by 0.842 tons;

- 1 ha increase in the planting acreage of grapes will lead to increase in volume of wine production on average by 2.261 tons;

- 1 centner/ha decrease in crop productivity of grapes will lead to reduction of wine production volume on average by 1.686 tons.

Verification of statistical significance of obtained multi-factor model was conducted, using coefficient of determination.

Estimated value of the coefficient of determination is $R^2 = 0{,}8419$. This shows that the volume of wine production (Y) by 84.19 percent depends on factors, included in the model, i.e.:

- gross harvest of grapes (X_1);

- planting acreage of grapes (X_2);

- crop productivity of grapes (X_3).

The rest 15.81 per cent (100-84,19) is the influence of unaccounted factors.

To determine adequacy of the received model, F value of Fisher statistics is used. If $F_{est.} > F_{tab.}$, obtained model is adequate for the studied process. Since $F_{est.}=22{,}52$, and $F_{tab.}=3{,}16$, it can be said that obtained model is adequate.

Check of reliability of multi-factor model coefficients showed the use of t-statistic of Student. If $t_{est.} > t_{tab.}$, obtained coefficients of multi-factor model are reliable. Since $t_{x1}=7{,}877$, $t_{x2}=2{,}499$, $t_{x3}=-0{,}696$, and $t_{tab.}=2{,}43$, we can say that factors X_1 and X_2 are reliable. Factor X_3 is considered unreliable.

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Check of autocorrelation of Y series remainders was based on the use of Durbin-Watson statistics. If estimated value of Durbin Watson statistics adopt value between 2 and 4, in the series remainder, there is no autocorrelation. In our calculation, Durbin-Watson statistic takes value 1.879199. This shows that in the studied series there is no autocorrelation.

Based on obtained multi-factor model`, volume of wine production in the Republic of Uzbekistan is forecasted.

Table 5 Forecasted value of wine production volume and factors, affecting it, for 2018-2021

Years	Volume of wine production (ths. litres)	Gross harvest of grapes (ton)	Planting acreage ths. ha	Crop productivity c/ha.
2018*	**37808,1**	**1894880**	**130190,5**	**155,9**
2019*	**37841,7**	**2048688**	**132691,2**	**166,3**
2020*	**37875,4**	**2214980**	**135240,0**	**177,3**
2021*	**37909,1**	**2394771**	**137837,7**	**189,1**

On the basis of forecasted values of multi-factor models, appropriate graphics are built (figure 2–5).

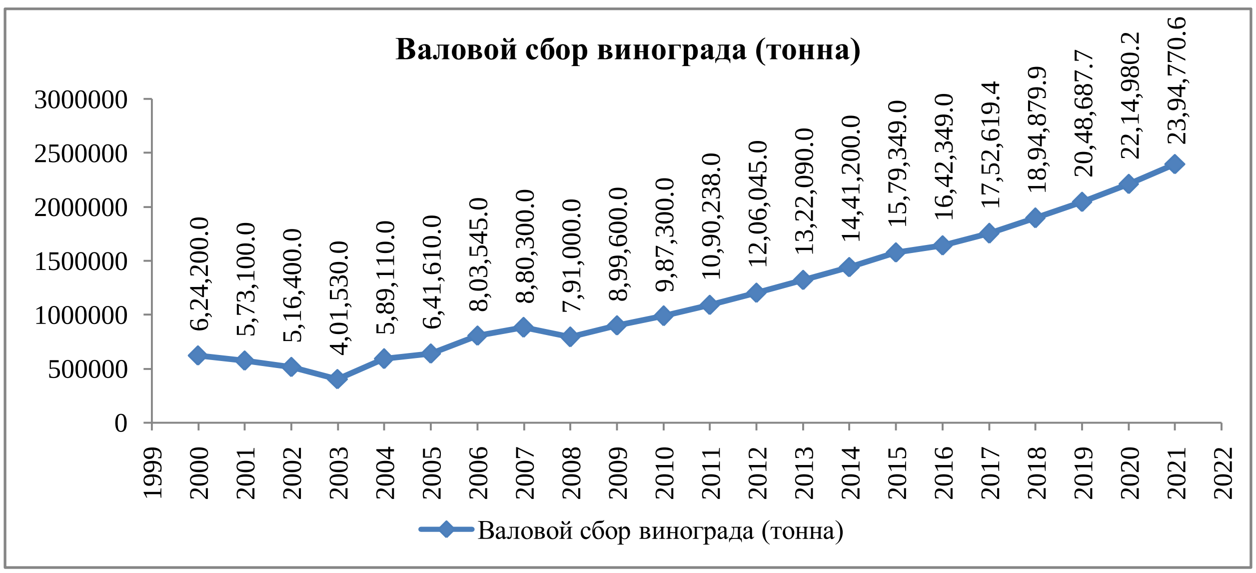

Figure 2 Forecast of bulk yield of grapes

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Figure 3 Forecast of grapes planting acreage

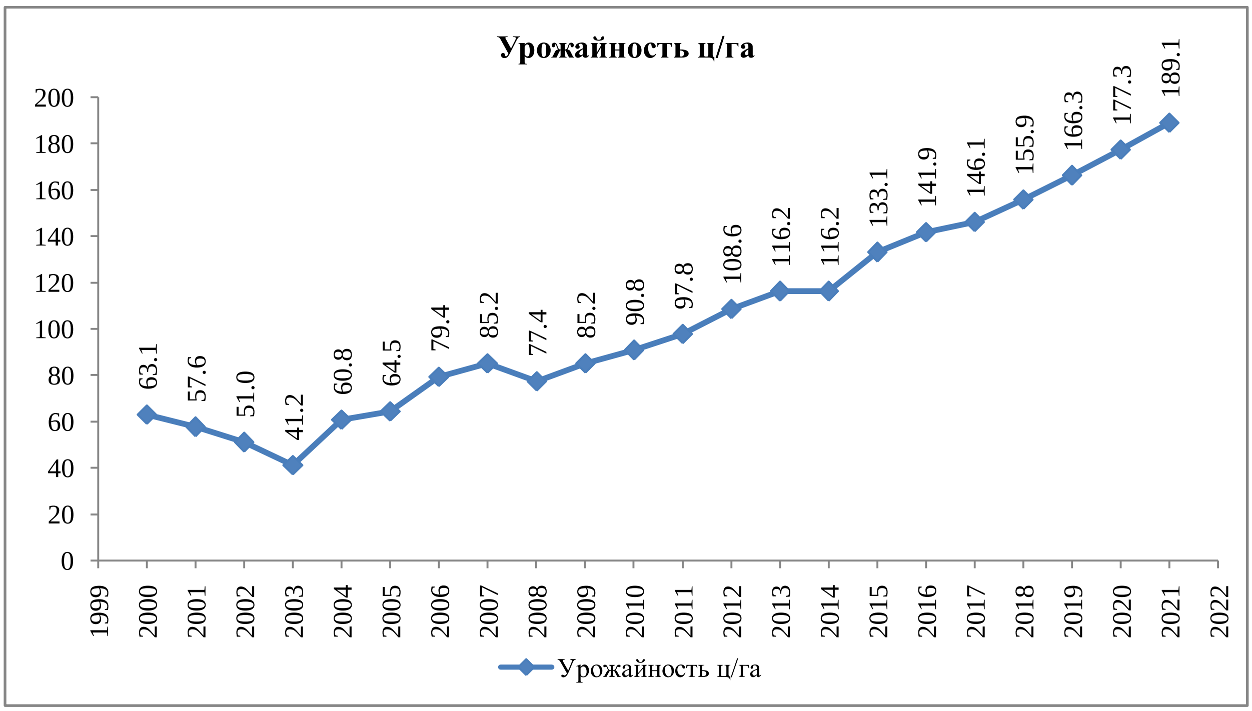

Figure 4 Forecast of grapes crop productivity

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Figure 5 Forecast of wine production volume

According to forecast calculations, continuous growth of grapes gross harvest due to increase in grapes planting acreage and crop productivity per hectare is observed, while the volume of wine production remains roughly at the same level.

CONCLUSION

Studies have shown that use of this model will allow improving the system of modeling and forecasting of the production process of the viticulture-wine-making branch in the Republic of Uzbekistan, this, in turn, will contribute to formation of strategy of industry cluster development. The forecast for various planning intervals in the wine industry is the basis for calculating and adjusting the output. In order to achieve higher results, the tasks assigned should be understood comprehensively and carried out in accordance with the established structure of objectives.

The paper discusses the factors affecting the efficiency of the production process, in the performance of which the selling price of the finished product will meet the predicted value. Conducted study is not enough for exploration of the entire industry, therefore it is preferable to develop econometric models to determine wines quality on the basis of characteristics of grape varieties.

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