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Forecasting of Tourism Processes in Uzbekistan in Correlation-Regression Models

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ABSTRACT: The article provides detailed information on the process of developing effective plans for the development of the tourism industry and choosing the optimal one based on them, forecasting the future development of the industry. It also considers the processes of using special computational and arithmetic methods that allow predicting the events and happenings in the tourism industry, to determine the regression function as a result of the interaction and interaction of indicators representing the type of activity. As a result of targeted research, using correlation-regression models, a forecast of the development trend of the tourism industry based on socio-economic factors affecting the tourism process was developed.

KEYWORDS: Prediction, model, correlation-regression models, Fisher criterion, correlation coefficient, Determination coefficient, multicollinearity.

INTRODUCTION

Development of the economy in the country, in particular, tourism, maximum satisfaction of tourism needs of the population, preservation of ecological balance and cultural heritage in the integrated development of the regions, ensuring sustainable development of tourism, steady increase in budget revenues from tourism; Extensive measures are being taken to establish promising tourism centers, increase the level of development of excursions, develop rural tourism, improve the information and advertising of regional tourist and recreational activities, and achieve certain results.

THE MAIN FINDINGS AND RESULTS

The development of effective plans for the development of the tourism industry in the Republic of Uzbekistan and the selection of optimal ones based on them is directly related to the process of forecasting the future development of the industry. This process involves the use of special computational and arithmetic methods that allow predicting the events and happenings in the tourism industry, to determine the regression function as a result of the interaction and interaction of indicators representing the tour activity. Scientific research on forecasting the development of socio-economic processes was carried out by foreign and domestic scientists A.Dimitrios [3], G.Stephen [3], I.I.Eliseevoy [4], A.V.Kostromin [6], M.T.Alimova [1,2], F.E. Gulmurodov [5] and others. As a result of targeted research, special attention was paid to hotels, the number of places in them, the quality of services and tour operators, among many factors affecting the tourism process.

Table 1. The number of foreign citizens and domestic tourists visiting Uzbekistan and the factors affecting them *(The table is based on the data of the Committee for Tourism Development of the Republic of Uzbekistan.)*

№	Кўрсаткичлар	2014	2015	2016	2017	2018	2019
1	Foreign citizens arriving in Uzbekistan (thousand people)	2000	2010	2070	2690	5300	6748
2	Export of tourist services (million dollars)	285	324	386	547	1040	1313
3	Number of domestic	4100	5700	6300	9800	14300	16900

	tourists (visits, thousands)						
4	Number of hotels (in units)	428	514	689	772	914	1188
6	Number of places (thousand)	19	24	30	39	41	53
7	Tour operators (together)	80	91	102	127	234	499

The above graphs show the dynamics of changes in the number of foreign citizens and the number of domestic tourists visiting Uzbekistan in 2014-2019:

In order to carry out this research, it is necessary to determine the dynamics of changes in the number of foreign citizens and domestic tourists visiting Uzbekistan on the basis of Table 1 and the factors influencing it, and to select the most important factors using correlation-regression methods.

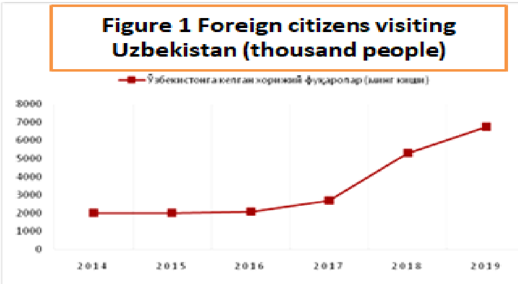


Figure 1 Foreign citizens visiting Uzbekistan (thousand people)

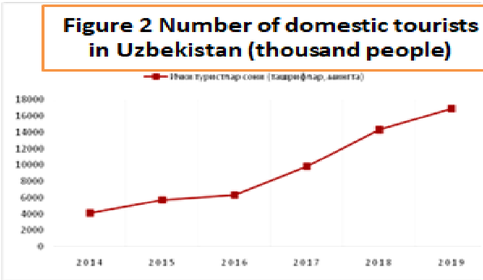


Figure 2 Number of domestic tourists in Uzbekistan (thousand people)

In a multi-factor correlation-regression model, several factors are involved, and it is important to correctly select the most important of these factors and incorporate them into the regression model. The correct selection of important factors and its interdependence is done in three stages. In the first stage, the factors are selected without any conditions. In the second stage, they analyze the bond density on the basis of double correlation. To do this, and a pair of correlation values between the variables, their matrix is constructed. In the third stage, a regression model is constructed and the quality of its parameters is determined using statistical methods.

The first stage. Exports of tour operators and tourist services were selected as factors influencing the outcome factor of the number of foreign citizens visiting Uzbekistan. The number of hotels, the number of places, tour operators were selected as factors influencing the outcome factor of the number of domestic tourists.

These outcome factors and the factors influencing it were identified in the following order:

Table 2

Factor: Number of foreign citizens visiting Uzbekistan, thousand people – Y_1	
Factors	Marking
Exports of tourist services, mln	X_1
Tour operators, together	X_2

Table 3

Outcome factor: Number of domestic tourists in Uzbekistan, thousands of visits	
Factors	Marking
Number of hotels, in units	X_3
Number of places, thousand	X_4
Tour operators, together	X_5

The second stage. The value of the double correlation coefficient between variables x_i and y_i, $i = 1,...,n$ is calculated according to the following formula:

$$r_{ij} = \frac{\left(\sum x_i x_j - \sum x_i \times \sum x_j / n\right)}{\sqrt{\left(\sum x_i^2 - \left(\sum x_i\right)^2 / n\right)\left(\sum x_j^2 - \left(\sum x_j\right)^2 / n\right)}} \qquad (1)$$

Based on formula 1, we calculate the double correlation coefficients between the factors and construct their matrix.

The values of the correlation coefficients between the resultant factor and the factors influencing the number of foreign citizens visiting Uzbekistan are given in Table 4.

Based on the analysis of the data in Table 4, it can be said that the result factor is a strong direct link between the number of domestic tourists in Uzbekistan (Y_2) and exports of tourist services (X_1) and tour operators (X_2).

The values of the correlation coefficients between the resultant factor of the number of domestic tourists in Uzbekistan and the factors influencing it are given in Table 5.

Table 4

A matrix of correlation coefficients of relationships between factors

	Y_1	X_1	X_2
Y_1	1,00		
X_1	0,93	1,00	
X_2	0,95	0,94	1,00

Table 5

A matrix of correlation coefficients of relationships between factors

	Y_2	X_3	X_4	X_5
Y_2	1,00			
X_3	0,97	1,00		
X_4	0,96	0,99	1,00	
X_5	0,90	0,92	0,88	1,00

Based on the analysis of the data in Table 5, it can be said that there is a strong direct correlation between the number of foreign nationals visiting Uzbekistan (Y_1) and the number of hotels (X_3), number of places (X_4) and tour operators (X_5).

The third stage. We proposed the use of a multivariate regression linear model for prognosis. This model has the following general appearance:

$$y = a_0 + \sum_{i=1}^{m} a_i(x_i) \qquad (2)$$

where a_0 - release limit, $a_1, a_2, ..., a_n$ - multifactor model parameters, - result factor; $x_1, x_2, ..., x_n$ - Influencing factors.

(2) To find the values of the unknown a_0 , $a_1,...,a_n$ parameters in the model, a system of equations is constructed as follows. Based on the solution of this system of equations, the values of a_0 , $a_1,...,a_n$ parameters are determined [4]:

$$\begin{cases} na_0 + a_1\sum x_1 + a_2\sum x_2 + ... + a_n\sum x_n = \sum y \\ a_0\sum x_1 + a_1\sum x_1^2 + a_2\sum x_1x_2 + ... + a_n\sum x_nx_1 = \sum yx_1 \\ .... \\ a_0\sum x_n + a_1\sum x_1x_n + a_2\sum x_2x_n + ... + a_n\sum x_n^2 = \sum yx_n \end{cases} \qquad (3)$$

In the constructed regression model, the coefficient of determination (R^2) is used to determine the density of the correlation of the resulting factor with the selected factors. This figure is calculated on the basis of the following formula:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \qquad (4)$$

where y_i is the observed amount of the resulting factor; $\bar{y}$ - arithmetic mean of the resulting factor; $\hat{y}$ - determined, flattened quantities of the resulting factor; n - number of observations.

The coefficient of determination represents the proportion of the resulting variable variance of the factors affected by the constructed model. The analysis of the quality of the built model is carried out by checking the "zero hypothesis". The "null hypothesis" determines the overall quality of the coefficients of the regression model. If the results of the analysis do not refute the "zero hypothesis", then it is concluded that "the effect of factors $x_1, x_2, \ldots, x_k$ on the resultant indicator "*y*" is insignificant, the overall quality of the regression equation is low." The "zero hypothesis" is tested using variance analysis, and the "zero hypothesis" is expressed as $H_0:D_{факт}=D_{қолд}$, The alternative hypothesis against is $H_1:D_{факт}>D_{қолд}$. The F-Fisher criterion is used to test these hypotheses [1].

The actual value of the Fisher criterion is calculated by the following formula:

$$F = \frac{\sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2 / k}{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 / (n-k-1)} = \frac{R^2}{1-R^2} * \frac{(n-k-1)}{k} \qquad (5)$$

where $\sum_{i=1}^{n}(\hat{y}_i - \bar{y})^2 / k$ is the factorial variance per one degree of freedom (number of degrees of freedom; 2 is the number of residual variances per degree of freedom γ1=k); $\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 / (n-k-1)$ is the number of observationsγ1=n-k-1); n is the number of factors (parameters) in the multivariate regression equation).

The true value of the Fisher criterion is compared with the critical value of the criterion (F_{tab}(α; k; n-k-1)). If F_{real} is a real> F_{tab} table, then the defined model is significant [4].

The following results (Tables 6-9) were obtained using the SPSS program to perform the above calculations.

Table 6. Results of multifactor linear model parameters (Number of foreign citizens visiting Uzbekistan)

	Non-standardized coefficients		**Standardized coefficients**	**t- statistics**	**Probability**
	Coefficient	**Default error**	**Бета**		
a_0	**438,99**	**1469,407**		**0,009**	**0,993**
X_1	**4,204**	**3,041**	**0,354**	**0,861**	**0,453**
X_2	**1,596**	**5,194**	**0,624**	**1,520**	**0,226**

Table 7. Criteria for checking the quality and relevance of a multifactor linear model
(Number of foreign citizens visiting Uzbekistan)

Multifactor correlation coefficient R	**The multifactor determination coefficient is R-square**	**Correction-resurrected R-square**	**Standard error of evaluation**	**F-real**
0,99	**0,98**	**0,96**	**988,30**	**65,933**

Here the related variable is: *Y*; method: smallest squares; selection: 2014-2019 years number of observations: 6

Based on the data in Tables 6-7 and Formula 2, we write the appearance of a multivariate linear model as follows:

$$Y_1 = 438.991 + 4.204 \cdot x_1 + 1.596 \cdot x_2 \qquad (6)$$

This multi-factor linear model shows that if the export of tourist services (X_1) increases by an average of $ 1 million, the number of foreigners visiting Uzbekistan will increase by 4,204,000. The increase in the number of tour operators by an average of one will lead to an increase in the number of foreigners visiting Uzbekistan by 1,596.

Table 8. Results of multifactor linear model parameters *(Number of domestic tourists in Uzbekistan)*

	Non-standardized coefficients		Standardized coefficients	t-statistics	Probability
	Coefficient	Default error	Бета		
a_0	-3176,865	4033,178		-0,788	0,513
X_3	7,823	28,085	0,421	0,279	0,807
X_4	174,255	520,258	0,423	0,335	0,770
X_5	4,434	15,462	0,140	0,287	0,801

Table 9. Criteria for checking the quality and importance of the multifactor linear model *(number of domestic tourists in Uzbekistan)*

Multifactor correlation coefficient R	The multifactor determination coefficient is R-square	Correction-resurrected R-square	Standard error of evaluation	F-real
0,97	0,94	0,85	1987,396	10,45

Here the related variable is: Y; method: smallest squares; selection: 2014-2019 number of observations: 6

Based on the data in Tables 8-9 and Formula 2, we write the appearance of the second multivariate linear model as follows:

$$Y_2 = -3176{,}865 + 7.823 \cdot x_3 + 174.255 \cdot x_4 + 4.434 \cdot x_5 \qquad (7)$$

This multi-factor linear model shows that an increase in the number of hotels (X_1) by an average of one leads to an increase in the number of domestic tourists by 7,800, an increase in the number of domestic tourists by an average of 17,425, and an increase in the number of domestic tourists by 4,434.

The coefficient of determination R^2 of the first resultant factor in the results is *0.98*, which indicates that the resultant factor is sufficiently closely related to the selected factors, i.e. the number of foreigners visiting Uzbekistan (Y_2) 94 % depends on multi-factor linear modeling factors, 6% not taken into account external influencing factors.

In order to be able to compare the models with different quantities of factors and that these quantitative factors do not affect the R^2 statistic, a corrected coefficient of determination is usually used, i.e. [3]:

$$R^2_{\text{текис}} = 1 - \frac{s^2}{s_y^2} \qquad (8)$$

In our results, the values of 0,96(Y_1) and 0,85(Y_2) of these corrected determination coefficients are derived from their proximity to R^2, which means that the change in the number of factors selected for the models assumes values around.

We use the F-criterion formula of the multifactor linear Fisher constructed 6 and 7 to verify the statistical significance and adequacy of the process under study. The actual values of the F-criterion, i.e., the first result factor (Y_1) $F_{\text{хисоб}} = 65.933$ and the second result factor (Y_2), are $F_{\text{хисоб}} = 10.45$.

We determine the table value of the Fisher F-criterion. To do this, we determine the value from the table of the F-criterion based on the values for the levels of freedom $k_1 = m$, $k_2 = n - m - 1$ and α for the levels of significance. For the first outcome factor, the significance level is $\alpha = 0{,}1$ and the freedom values are $k_1 = 2$ and $k_2 = 6 - 2 - 1 = 3$, with the table value of the F-criterion being $F_{жадвал} = 5.46$; based on the significance level $\alpha = 0{,}1$ and the freedom levels $k_1 = 3$ and $k_2 = 6-3-1=2$ for the second outcome factor, we find that the table value of the F-criterion is $F_{жадвал} = 9.16$.

Significance of these factors indicates that the values determined in $\alpha = 0{,}1$ satisfy condition $F_{account}>F_{table}$ are statistically significant and adequate.

According to the above models 6 and 7, we forecast the number of foreign citizens visiting Uzbekistan and the number of domestic tourists. To do this, we construct simple regression models of the time-dependent trend of the factors influencing the built models.

Trend model of tourist services export:

$$X_1 = 211.7 \cdot \mathrm{t} - 115. \tag{9}$$

Trend model of the number of tour operators:

$$X_1, X_5 = 72.829 \cdot t - 66.07. \tag{10}$$

Trend model of the number of hotels:

$$X_3 == 145.23 \cdot t + 242.53. \tag{11}$$

Trend model of the number of places:

$$X_4 = 17.598 \cdot t^{0.556}. \tag{12}$$

We calculate the forecast values of each factor on 9-12 simple trend regression models and place their values on models 6 and 7. The results are presented in Tables 11-12 and Figure 3-4.

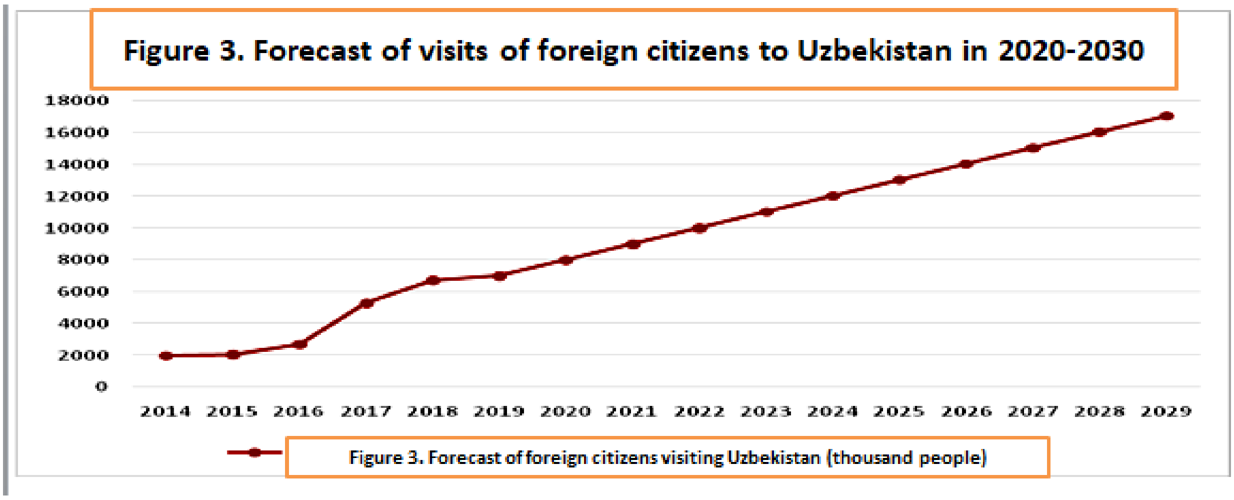
Table 11. Number of foreign citizens visiting Uzbekistan (dynamics in 2014-2019 and forecast values for 2020-2030)

Years	**Foreign citizens arriving in Uzbekistan (thousand people)**	**Export of tourist services (million dollars)**	**Tour operators (together)**
2014	2000	285	80
2015	2010	324	91
2016	2070	386	102
2017	2690	547	127
2018	5300	1040	234
2019	6748	1313	499
2020	7010	1367	517
2021	8017	1579	589
2022	9023	1790	662
2023	10029	2002	735
2024	11035	2214	808
2025	12042	2425	881
2026	13048	2637	954
2027	14054	2849	1026
2028	15061	3061	1099
2029	16067	3272	1172
2030	17073	3484	1245

Table 12. Number of foreign citizens visiting Uzbekistan (dynamics in 2014-2019 and forecast values for 2020-2030)

Years	Number of domestic tourists (visits, thousands)	Number of hotels (in units)	Number of places (thousand)	Tour operators (together)
2014	4100	428	19	80
2015	5700	514	24	91
2016	6300	689	30	102

2017	9800	772	39	127
2018	14300	914	41	234
2019	16900	1188	53	499
2020	19864	1404	56	517
2021	21985	1550	60	589
2022	24074	1695	63	662
2023	26136	1840	67	735
2024	28174	1985	70	808
2025	30191	2131	73	881
2026	32189	2276	77	954
2027	34170	2421	80	1026
2028	36136	2566	82	1099
2029	38089	2711	85	1172
2030	40025	2857	88	1245



Forecast of the number of domestic tourists in Uzbekistan in 2020-2030

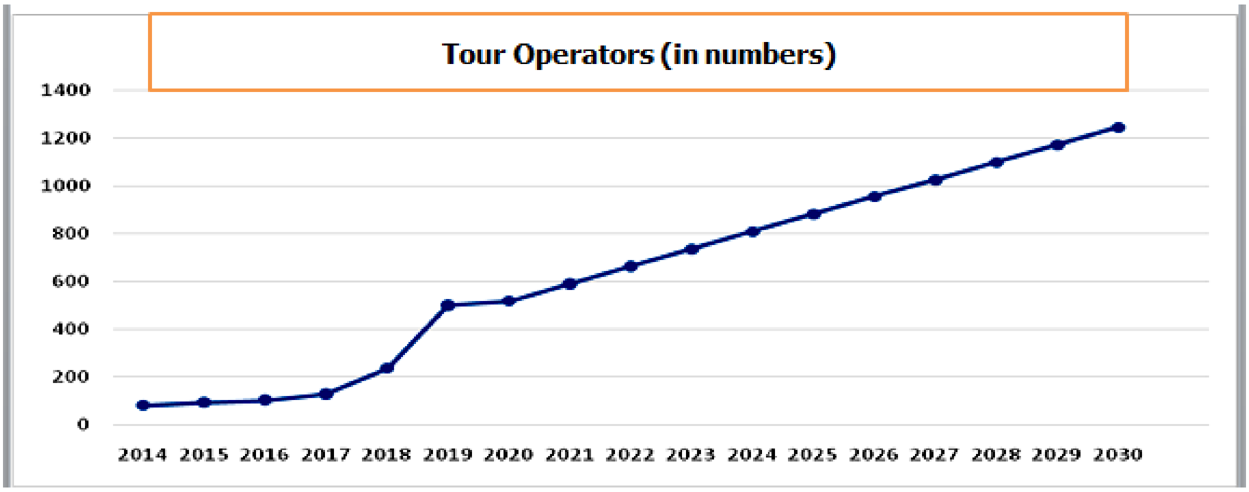


Figure 4. Forecast of the number of tour operators in Uzbekistan for 2020-2030

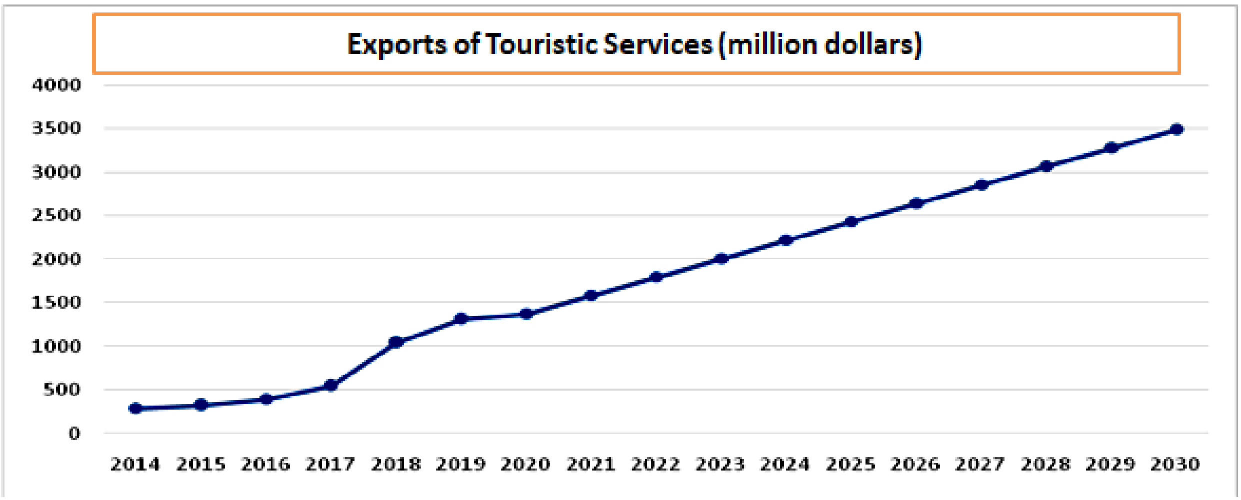


Figure 5. Forecast of tourism services exports in 2020-2030

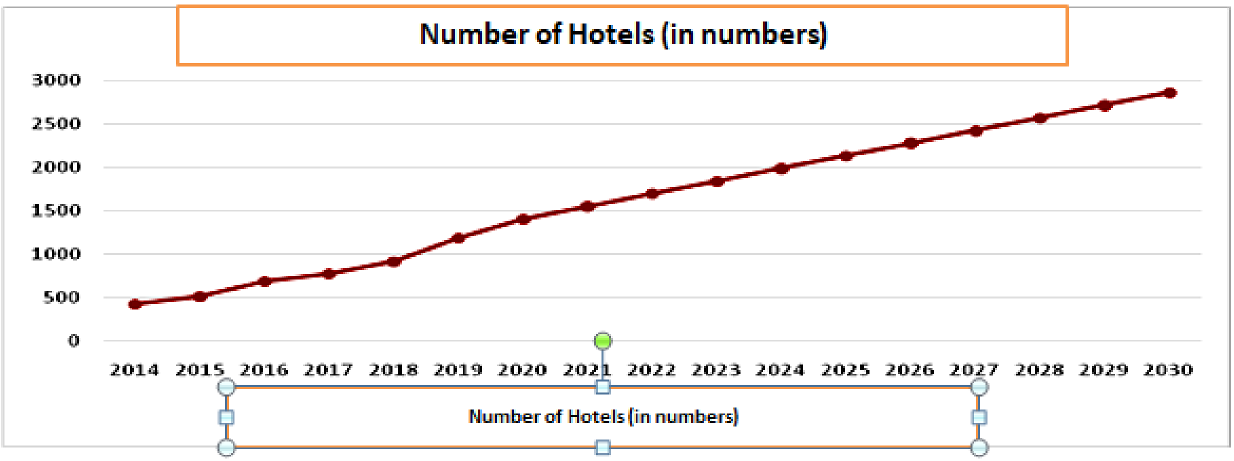


Figure 6 Forecast of the number of hotels in Uzbekistan for 2020-2030

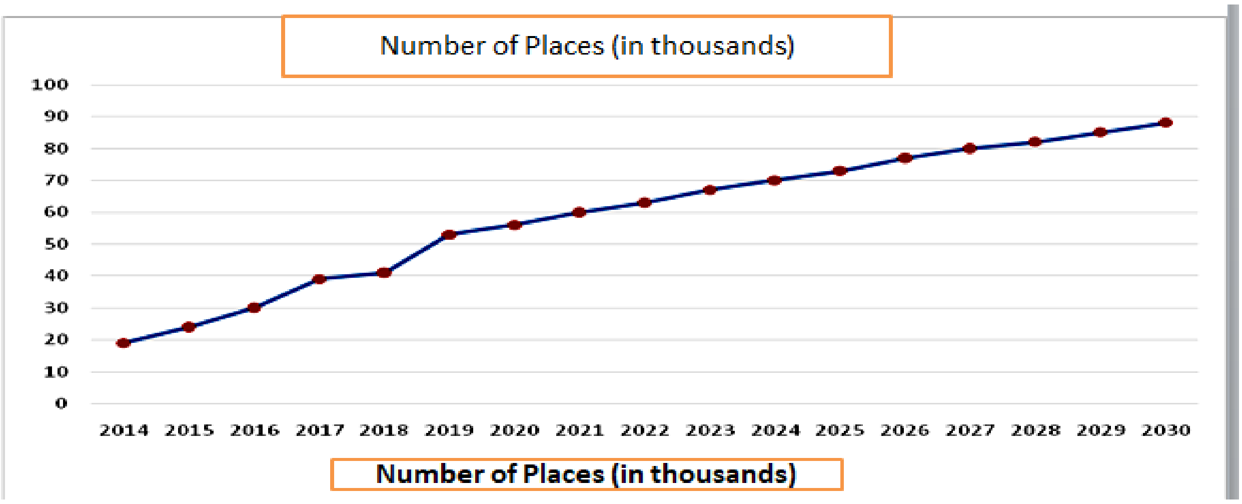


Figure 7. Forecast of the number of places in Uzbekistan in 2020-2030

CONCLUSION

In conclusion, it can be said that the built-in multivariate linear regression was found to be statistically significant when examined based on the criteria of the models, reliable when the model parameters were examined, and lack of multicollinearity. Built-in models can be suggested for use in forecasting.

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