Labour Market Forecasting of the Russian Federation

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ABSTRACT
The labour market is an important indicator of the living standards of the population and the development of the country's economy. Employment and unemployment indicators are among the key macroeconomic indicators on the basis of which they assess current trends and prospects for economic growth, investment attractiveness of countries and regions, risks and opportunities for business development. The formation and regulation of the labor market is one of the key and acute problems of the market economy. Maintaining the fullest employment is an important objective of the economic and social policies of any State. The aim of the study is to construct a forecast model of employment and unemployment using basic statistical analysis and forecasting methods. The analysis was carried out using the STATISTICA software package. The findings reflected developments in the coming period. As a result of the work, forecast models of employment and unemployment of the population of the Russian Federation were built.

Keywords: *Labour market, Statistical analysis, Forecasting, Employment, Unemployment*.

1. INTRODUCTION

The labour market is a rather vulnerable indicator of the level of development and current state of the economy of any country, the effectiveness of the implemented state policy, including employment and social protection programs, and also acts as a crucial indicator of the standard of living of the population.

Statistical analysis occupies an important place and is an integral part of the economic life of society. Determines the dynamics of development, decline, growth of social phenomena. The results of the study of mass phenomena by statistical analysis methods are an objective basis for other sciences.

The study on this issue is relevant and consists in the high need to obtain data on the situation in the labor market, as well as constant monitoring, assessment and control over them. The labour market of the Russian Federation is considered as the object of the study. The theoretical base is based on textbooks on the general theory of statistics, scientific articles on this topic, statistics of the Federal State Statistics Service, educational and methodological literature.

2. MATERIALS AND METHODS

Forecasting is a special scientific study aimed at identifying the prospects for the development of a phenomenon or process.

Prediction is a scientific judgment based on the construction of the probability of the state of an object in the future, alternative ways and the timing of its achievement.

One of the important directions of forecasting social development is economic forecasting - a scientific discipline, the object of which is the process of specific extended reproduction, and the object is the knowledge of the possible states of functioning economic objects in the future, the study of laws and methods of developing economic forecasts [1].

Economic forecasting is called the process of developing forecasts based on scientific methods of knowing phenomena and using the whole set of methods, tools and methods of economic prognostication [2].

The economic outlook allows us to anticipate the state of the economy in the future, as well as interest rates and other factors affecting the development of any enterprise. According to the results of the economic forecast, decisions are made related to the working personnel of the enterprise. The issues of expansion or

reduction of production capacities, conclusion of new contracts, attraction of investments and so on are also resolved [3].

The process of creating a forecast consists in processing the currently available information about the object. As a result, they get an idea of the directions of its evolution based on an analysis of existing trends in the development of this object.

The forecast of the employed population of the Russian Federation is based on the method of exponential smoothing. Exponential smoothing is a method of smoothing time series, the computational procedure of which involves processing all previous observations. This prediction method is quite efficient and reliable. The main advantages of the method are the ability to take into account the information of the source information, the simplicity of computational operations, the flexibility of describing process dynamics [4].

The exponential smoothing method allows you to evaluate the trend parameters that characterize the trend that has developed by the time of the last observation. The basis of the method is the selection of a smoothing parameter (smoothing constant) and initial conditions.

The employment and unemployment forecast is built by exponential smoothing in STATISTICA, a statistical analysis software package developed by StatSoft, which implements the functions of analysis, search and data management, as well as the construction of various forecast models. Using the effective sign Y – the number of employed population, we predict the number of employed in Russia for 2020-2024, using exponential smoothing without a seasonal component. For a conclusion of the schedule it is necessary to come into the Statistics tab → Advanced Models → Time Series/Forecasting → Y (number of occupied) → Exponential Smoothing and Forecasting → Review series → Label data points with (to choose dates) → Dates from a var → Review and plot variables → Review highlighted variable → Plot. The time series graph shown in Figure 1 is displayed.

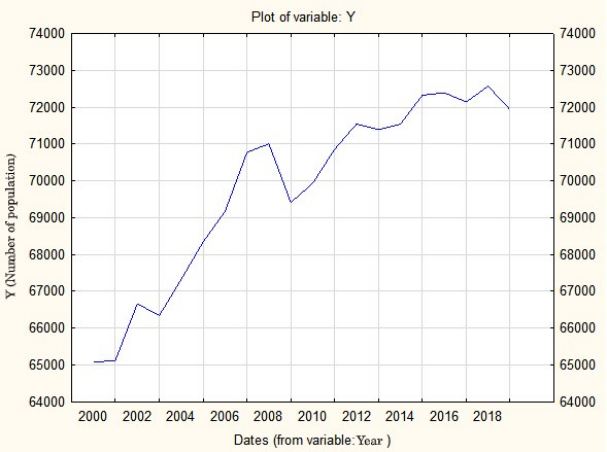

Figure 1 Time series of employed population

Next, in the Advanced → Forecast tab, we set the number 5, which will determine the values of the population employed for five years. To select the best values for alpha and gamma, you must perform a grid search.

Parameter grid search (Smallest abs. errors are highlighted) (Number of population)
Model: Linear trend, no season ; S0=649E2 T0=361,2
Y

Model Number	Alpha	Gamma	Mean Error	Mean Abs Error	Sums of Squares	Mean Squares	Mean % Error	Mean Abs % Error
73	0,900000	0,100000	-66,4070	585,6292	11505930	575296,5	-0,091206	0,842069
64	0,800000	0,100000	-69,2622	589,9236	11563116	578155,8	-0,094888	0,847880
55	0,700000	0,100000	-72,5734	596,3686	11765992	588299,6	-0,099043	0,856670
65	0,800000	0,200000	-77,9086	596,7047	12056764	602838,2	-0,108256	0,857700
74	0,900000	0,200000	-73,1752	595,2707	12088988	604449,4	-0,101784	0,855771
46	0,600000	0,100000	-76,0988	615,8190	12159878	607993,9	-0,103262	0,883797
56	0,700000	0,200000	-84,0120	595,2548	12168545	608427,3	-0,116503	0,855605
47	0,600000	0,200000	-91,8915	594,0872	12461356	623067,8	-0,127024	0,853829
66	0,800000	0,300000	-73,0578	606,4933	12662362	633118,1	-0,102286	0,871446
57	0,700000	0,300000	-78,8691	603,1370	12688089	634404,5	-0,110298	0,866768

Figure 2 Grid Search for Employment Forecast

The first line shows the best alpha, gamma model values. Alpha = 0,9; Gamma = 0,1. The average absolute error percentage was 0.84%.

Then return to the Time series/Forecasting → Continue current → Advanced → Linear trend (Holt) window → set Alpha (0.9) and Gamma (0.1) → Summary: Exponential smoothing. The result is a table with three columns: the number of employees (Y), smoothed serias, and resids. That is, the original and smoothed series, as well as a number of residues. The table is shown in Figure 3.

Exp. smoothing: S0=649E2 T0=361,2 Y (Number of population)
Lin.trend,no season; Alpha= ,900 Gamma=,100
Y

Year (Dates)	Y	Smoothed Series	Resids
2000	65070,00	65250,61	-180,61
2001	65123,00	65433,02	-310,02
2002	66659,00	65471,06	1187,94
2003	66339,00	66964,18	-625,18
2004	67319,00	66769,22	549,78
2005	68339,00	67681,21	657,79
2006	69169,00	68749,61	419,39
2007	70770,00	69641,19	1128,81
2008	71003,00	71272,84	-269,84
2009	69410,00	71621,42	-2211,42
2010	69934,00	70023,55	-89,55
2011	70857,00	70327,31	529,69
2012	71545,00	71236,05	308,95
2013	71391,00	71973,93	-582,93
2014	71539,00	71856,66	-317,66
2015	72324,00	71949,54	374,46
2016	72393,00	72699,03	-306,03
2017	72142,00	72808,54	-666,54
2018	72569,00	72533,60	35,40
2019	71933,00	72893,59	-960,59
2020		72270,74	
2021		72512,42	
2022		72754,09	
2023		72995,77	
2024		73237,45	

Figure 3 Original, Smoothed Series and Series of Residues

A graph with three curves was also plotted, on which the blue shows the initial data; red - forecast (smoothed row); green is the residue plot (the difference between the original row and the smoothed row). The graph is shown in Figure 4.

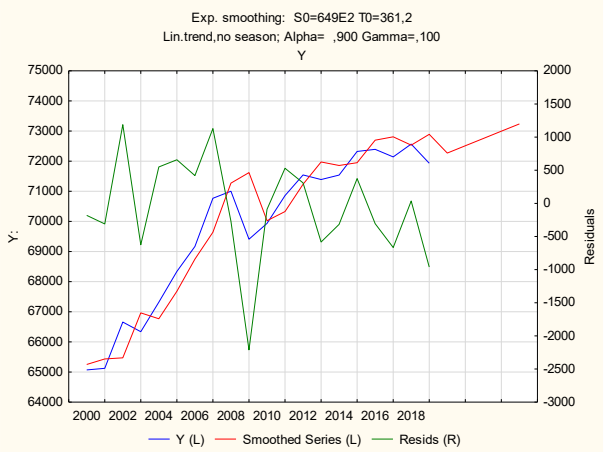

Figure 4 Original and smoothed series and series of residues

Thus, as a result of the construction of the forecast of the number of employed population for 2020-2024, there is an increase in the number of employed in the next five years.

The forecast of the number of unemployed population is also built by the method of exponential smoothing. Using the effective sign Y – the number of unemployed population we predict the number of unemployed in Russia for 2020-2024, using exponential smoothing without a seasonal component. For a conclusion of the schedule it is necessary to come into the Statistics tab → Advanced Models → Time Series/Forecasting → Y (number of the unemployed) → Exponential Smoothing and Forecasting → Review series → Label data points with (to choose dates) → Dates from a var → Review and plot variables → Review highlighted variable → Plot. The time series graph shown in Figure 5 is displayed.

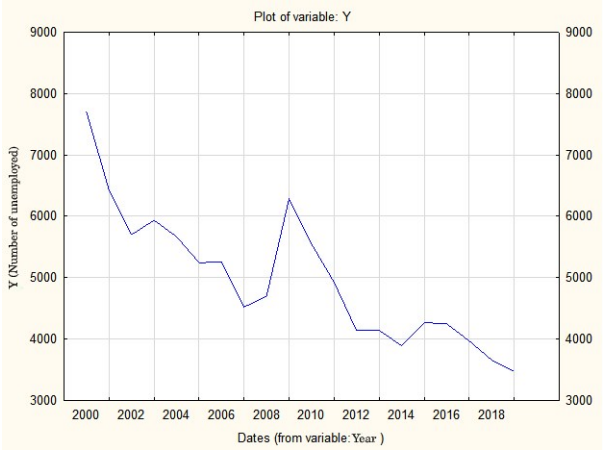

Figure 5 Time series of unemployed population

Next, in the Advanced → Forecast tab, we set the number 5, which will determine the values of the unemployed population for five years. To select the best values for alpha and gamma, select grid search.

Parameter grid search (Smallest abs. errors are highlighted) Y (Number of unemployed)
Model: Linear trend, no season ; S0=7811, T0=-223,
Y

Model Number	Alpha	Gamma	Mean Error	Mean Abs Error	Sums of Squares	Mean Squares	Mean % Error	Mean Abs % Error
73	0,900000	0,100000	21,86151	421,7808	7209692	360484,6	0,177127	8,046706
64	0,800000	0,100000	25,33936	412,5426	7280733	364036,6	0,218891	7,873761
55	0,700000	0,100000	30,19244	395,3724	7400457	370022,8	0,299808	7,534128
46	0,600000	0,100000	36,93125	406,9092	7572548	378627,4	0,439365	7,781073
74	0,900000	0,200000	14,32786	453,1305	7782331	389116,6	-0,048604	8,698382
37	0,500000	0,100000	46,32201	409,5374	7819943	390997,1	0,667066	7,835033
65	0,800000	0,200000	16,92650	447,4067	7848367	392418,3	-0,049272	8,603742
56	0,700000	0,200000	20,86577	433,4461	7964797	398239,9	-0,017053	8,342244
47	0,600000	0,200000	26,60586	437,7510	8129096	406454,8	0,064546	8,463576
28	0,400000	0,100000	59,83732	410,1620	8200808	410040,4	1,040017	7,774161

Figure 6 Grid Search for Unemployment Forecast

After analyzing the graph, we can conclude that the best model is a model with values $\alpha = 0.7$ and $\gamma = 0.1$. The one with the lowest average absolute error.

Next, you must return to the Time series/Forecasting → Continue current → Advanced → Linear trend (Holt) window → specify the values $\alpha = 0.7$ and $\gamma = 0.1$ → Summary: Exponential smoothing. As a result, a table with three columns was built: the number of unemployed (Y), smoothed serias and resids. That is, the original and smoothed series, as well as a number of residues. The table is shown in Figure 7.

Year (Dates)	Y	Smoothed Series	Resids
	Exp. smoothing: S0=7811, T0=-223, Y (Number of unemployed) Lin.trend,no season; Alpha= ,700 Gamma=,100 Y		
2000	7700,000	7588,553	111,45
2001	6424,000	7451,472	-1027,47
2002	5698,000	6445,225	-747,23
2003	5934,000	5582,845	351,15
2004	5666,000	5513,912	152,09
2005	5242,000	5316,278	-74,28
2006	5250,000	4954,989	295,01
2007	4519,000	4872,853	-353,85
2008	4697,000	4311,742	385,26
2009	6284,000	4294,977	1989,02
2010	5544,000	5540,079	3,92
2011	4922,000	5395,884	-473,88
2012	4131,000	4884,054	-753,05
2013	4137,000	4124,091	12,91
2014	3889,000	3901,206	-12,21
2015	4264,000	3659,886	604,11
2016	4243,000	3892,278	350,72
2017	3967,000	3971,846	-4,85
2018	3654,000	3802,177	-148,18
2019	3465,000	3521,804	-56,80
2020		3301,416	
2021		3120,791	
2022		2940,165	
2023		2759,540	
2024		2578,915	

Figure 7 Original, Smoothed Series and Series of Residues

A graph was also plotted with three curves: blue shows the initial data; red - forecast (smoothed row); green is the residue plot (the difference between the original row and the smoothed row). The graph is shown in Figure 8.

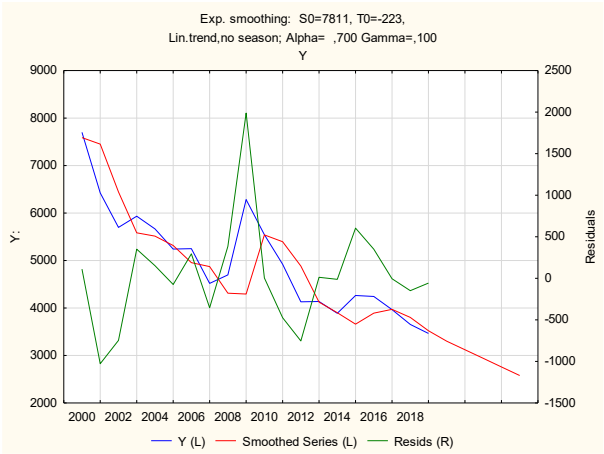

Figure 8 Original and smoothed series and series of residues

3. RESULTS AND DISCUSSION

Thus, as a result of the construction of the forecast of the number of unemployed population for 2020-2024, there is a decrease in the number of unemployed population in the next five years.

The exponential smoothing method allows you to build predictive models of various phenomena, as well as perform smoothing of time series, processing all previous observations. This method is widely used to predict transient time series. The result of the work is a statistical analysis and forecasting of the labor market of the Russian Federation. Forecast models of employment and unemployment rates have been constructed.

4. CONCLUSION

The labor market is a dynamic system that includes a set of social and labor relations according to the conditions of hiring, using and exchanging labor for wages.

The main indicators of the labor market: employment and unemployment require constant monitoring, assessment and control. The most effective tools for the study of employment and unemployment indicators are statistical analysis and forecasting methods, which allow not only to conduct a study, but also to build predictive models for the development of these indicators.

As a result, the objective was achieved: to build a forecast model of employment and unemployment using basic statistical forecasting methods.

The statistical analysis of the labour market of the Russian Federation and the construction of forecast models show that the level of employment is increasing, while the unemployment rate, on the contrary, is decreasing. This trend, of course, has a favorable effect on the development and growth of the economic system of the Russian Federation.

5. ACKNOWLEDGEMENTS

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REFERENCES

[1] T. N. Babich, Forecasting and planning in the market: Textbook, M.: Infra-M, 2018, pp. 256.

[2] N. M. Gromova, N. I. Gromova, Fundamentals of economic forecasting. https://monographies.ru/ru/book/section?id=151.

[3] V. L. Vasiliev Dynamics of the main macroeconomic indicators and the causes of unemployment in Russia/V.L. Vasiliev, I.A. Galimulin, Economics and society, 4(47) (2018) pp. 170-173.

[4] L. E. Basovsky, Market forecasting and planning: Tutorial, M.: Infra-M, 2018, pp. 352.

[5] I. I. Eremina, A. G. Faizullina, Statistical analysis of the professional competence study on the example of the field «applied information science in economics», International Journal of Pharmacy and Technology, 8(3) (2016) pp. 14911 – 14925.

[6] R. Chami, A Template for Analyzing and Projecting Labor Market Indicators. Technical notes and manuals, 2012, pp. 23.

[7] I. I. Eremina, E. V. Abrosimova, Problems of formation of competency modeling, application and information processes of enterprises and organizations in preparing IT- professionals of the economic sector at the university, MODERN JOURNAL OF LANGUAGE TEACHING METHODS, 7(12) (2017) pp. 43-48.

[8] Yu. N. Ivanova, Economic statistics: Textbook, Lomonosov Moscow State University (MSU); Converted and supplement - M.: INFRA-M, 2016, pp. 668.

[9] T. Boeri, J. V. Ours, The Economics of Imperfect Labor Markets: Second Edition, 2013, pp. 464.

[10] I. Ishmuradova, A. Karamyshev, D. Lysanov, A., Isavnin, I. Eremina, Features of software development of module tasks view of the existing software packages and their updates in the corporate information systems of the production organization, Proceedings - International Conference on Developments in eSystems Engineering, DeSE, 2019, pp. 180-183.