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Article

Quantitative Analysis of Decision-Making Efficiency in Local Government Using Econometric Methods: Namangan Region Case

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Abstract: This study applies econometric modeling to evaluate the efficiency of decision-making in local government institutions, using Namangan region as a case study. Based on socio-economic data for 2018–2025, key indicators such as decisions adopted, poverty, unemployment, job creation, and infrastructure access were analyzed. Regression models were developed using the least squares method, and their validity was tested through Student's t-test, Fisher's F-test, and the coefficient of determination (R^2). The results reveal strong relationships between decision-making efficiency and socio-economic factors. Forecasts for 2026–2030 indicate continued improvement in regional development. The study confirms that econometric approaches provide a reliable basis for evidence-based local governance and policy planning.

Keywords: Econometric modeling; decision-making efficiency; local government; regression analysis; forecasting; socio-economic indicators; Namangan region.

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Introduction

Decision-making in local government bodies represents one of the central functions of the public administration system and has a direct influence on both economic and social development processes. The effectiveness of these decisions ensures the efficient use of local resources, including raw materials and labor potential, while also significantly affecting key indicators such as poverty levels, employment, unemployment, and infrastructure development. In this regard, improving the efficiency of decision-making in local governance is an essential condition for achieving sustainable socio-economic development at the regional level.

In recent years, the integration of modern information technologies and quantitative analytical methods has created favorable conditions for enhancing decision-making processes in public administration. In particular, econometric methods serve as powerful tools for the systematic analysis of statistical data, enabling the identification of trends, evaluation of relationships among variables, and forecasting of future outcomes. This, in turn, allows local authorities to make more informed decisions, ensure optimal distribution of resources, and effectively monitor ongoing socio-economic processes.

Studies focusing on the efficiency of decision-making in local government institutions indicate that major socio-economic indicators — including the number of decisions adopted, poverty rate, unemployment level, job creation, and infrastructure development — are closely interconnected. Such interdependence necessitates the

application of a comprehensive and multifactor approach, where econometric models are used to simultaneously assess the impact of multiple variables within the decision-making framework.

The main purpose of this study is to develop econometric models aimed at improving the efficiency of decision-making in local government bodies, using the Namangan region as an empirical example. Additionally, the study seeks to estimate model parameters and generate forecast indicators for the period 2026–2030. The obtained results are expected to contribute to both practical decision-making processes and the scientific justification of regional economic policy.

Literature Review

In applied statistical analysis, variables are commonly expressed using different measurement scales, including nominal, ordinal, interval, and ratio levels, depending on the nature of the observed phenomenon [1,2,3,4]. When the objective is to compare two independent groups under the assumption of normal distribution, the independent samples Student's t-test is typically applied as a standard inferential method [5,6]. Another important task involves testing whether the mean value of a single sample significantly differs from a predefined reference value. Such problems can also be addressed using related statistical approaches, including Pearson's correlation coefficient for continuous variables, the Student's t-test, and the point-biserial correlation coefficient for mixed-type relationships [8]. These methods are often collectively categorized within the general framework of Student's t-test procedures [10]. To ensure terminological clarity, some authors also refer to these approaches as Fisher t-tests or Student–Fisher tests [9].

In the context of studying managerial decision-making processes and their evaluation, it is often necessary to compare multiple samples based on the frequency distribution of specific indicators. For such purposes, the selection of appropriate multifunctional statistical methods is essential, as they can be effectively applied to different data structures and empirical research conditions.

From a methodological standpoint, Fisher's angular transformation (φ criterion) is widely used for assessing differences between sample proportions and determining their statistical significance [11].

The use of information technologies in economic analysis has significantly improved the efficiency of processing large datasets. In addition, these technologies enable more accurate visualization and interpretation of socio-economic dynamics, thereby enhancing the quality and reliability of analytical results [13].

Overall, statistical methods play a crucial role in analyzing economic systems and supporting evidence-based managerial decision-making. In particular, Fisher's φ* criterion is effective for identifying differences between sample distributions, while the Student's t-test is widely used for comparing group means. Furthermore, econometric modeling of economic indicators is commonly performed using linear regression based on the least squares method, which minimizes the deviation between observed and predicted values. The integration of modern information technologies further improves computational efficiency and facilitates the visualization of complex economic patterns.

Metodology

In this study, the following methods and approaches were employed to develop econometric models aimed at improving the efficiency of decision-making in local government bodies in Namangan region and to identify their prospects:

Collection and preparation of statistical data. The study analyzed key socio-economic indicators for the period 2018–2025, including the number of decisions made by local government bodies in Namangan region, poverty rate, number of unemployed, number of jobs created, unemployment rate, and the population's access to centralized

drinking water and wastewater services. Data sources included official statistical reports and the information databases of the regional administration.

Development of econometric models. To determine the efficiency of local governance decisions, regression analysis was used to construct econometric models. The study employed the following approaches:

Simple and multiple regression analysis. Polynomial and multiple regression models were applied to describe the temporal dynamics of each indicator and to identify their interrelationships.

Polynomial functions. n-th degree polynomials were used to identify relationships between independent (X) and dependent (Y) variables.

Parameter estimation and model evaluation. Parameters were estimated using the ordinary least squares (OLS) method, and model accuracy was assessed with the coefficient of determination (R^2), Student's t-test, and F-Fisher test.

Forecasting and prospective analysis. Based on the developed econometric models, forecast values for 2026–2030 were calculated. The forecast analyzed growth trends in key socio-economic indicators and assessed their impact on the efficiency of local governance.

Use of Excel and information technologies. Microsoft Excel was used for data processing, regression modeling, and forecast calculations. The software enabled:

-creation of observation diagrams and regression lines;

-estimation of model parameters and statistical analysis;

-development of forecast charts and empirical analysis.

-interpretation of results. Based on model coefficients, the influence of each indicator on poverty levels and other socio-economic factors was analyzed. Specifically, unemployment rate, number of jobs created, and access to drinking water were identified as the most significant factors affecting outcomes.

This methodological approach enabled the scientific substantiation of the decision-making process in local government bodies and the development of econometric models that serve to enhance decision-making efficiency.

Result and discussion

Government support mechanisms aimed at improving decision-making efficiency require effective utilization of local resources and labor potential [5]. As a result, decision-making efficiency in the Namangan region has been steadily improving, yielding positive outcomes over time (Table 1).

Table 1. Data on decision-making and socio-economic indicators in local government authorities of Namangan region.

No.	Indicators	Years							
		2018	2019	2020	2021	2022	2023	2024	2025
1	Number of decisions adopted, units	6161	6493	5656	6861	10546	6764	8903	7782
2	Poverty rate, %	21,5	20,8	19,6	18,3	15,7	10,3	7,6	3,4
3	Number of unemployed, thousand persons	111,1	110,1	127,3	119,3	108,0	84,9	68,6	64,3
4	Jobs created, thousand units	72,5	70,0	39,9	57,3	610,6	587,8	429,4	323,4
5	Unemployment rate, %	9,6	9,1	10,7	9,8	8,9	7,0	5,6	5,1
6	Population with access to centralized drinking water, %	59,1	62,6	64,4	66,5	67,3	79,6	82,7	86,0

7	Population with access to centralized wastewater services, %	6,0	6,0	6,3	6,8	7,0	7,4	7,8	8,4

Based on the data presented in Table 1, an econometric analysis of the dynamics of statistical indicators related to the decisions adopted during 2018–2025 was conducted. Using the Excel software, an econometric model was developed with the following statistical parameters: $R^2 = 0.4894$, t_calculated = 2.19, and F_calculated = 4.79.

At the significance level $\alpha = 0.05$, where t_table = 2.11 and F_table = 2.272, the regression model describing the change in the volume of adopted decisions is considered adequate and can be expressed as follows:

$$Y_{\text{Adopted decisions}} = 5.1514x - 10337$$

Where:

Y (Adopted Decisions) – the result representing the number of decisions adopted in the Namangan region;

x – time (years).

Using the identified model, it becomes possible to compare the actual trend in the number of decisions adopted by the authorities of the Namangan regional administration with the values obtained from the regression model. Such a comparison allows the identification of certain deviations that may not be visible through conventional economic analysis and, consequently, facilitates the formulation of scientifically grounded decisions.

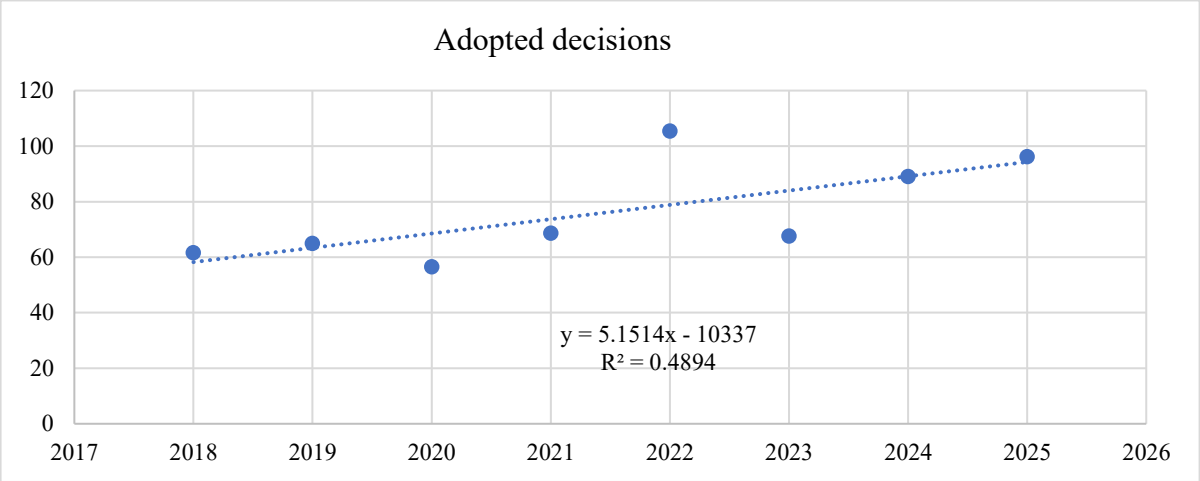

Figure 1. Dynamics of Changes in the Volume of Adopted Decisions in the Namangan Region.

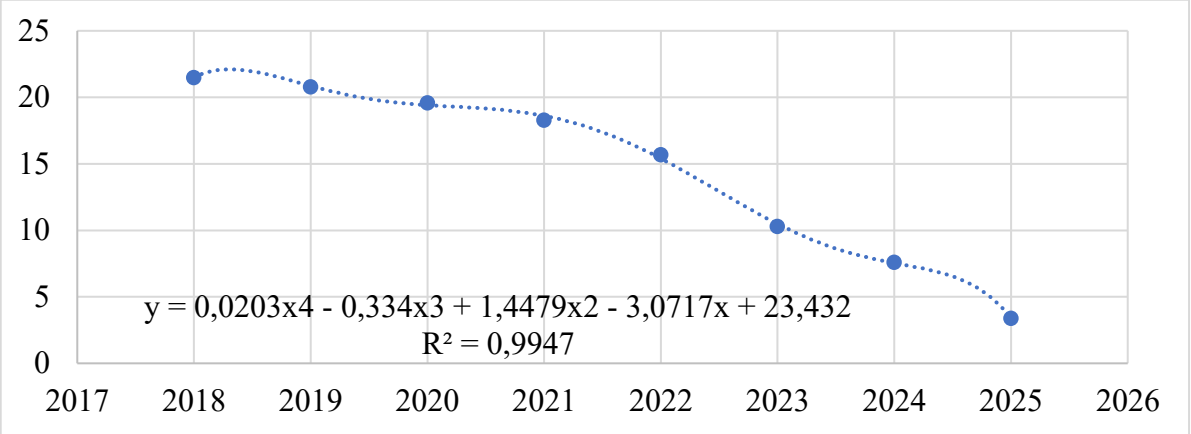

Figure 2. Dynamics of Changes in the Poverty Rate in Namangan Region.

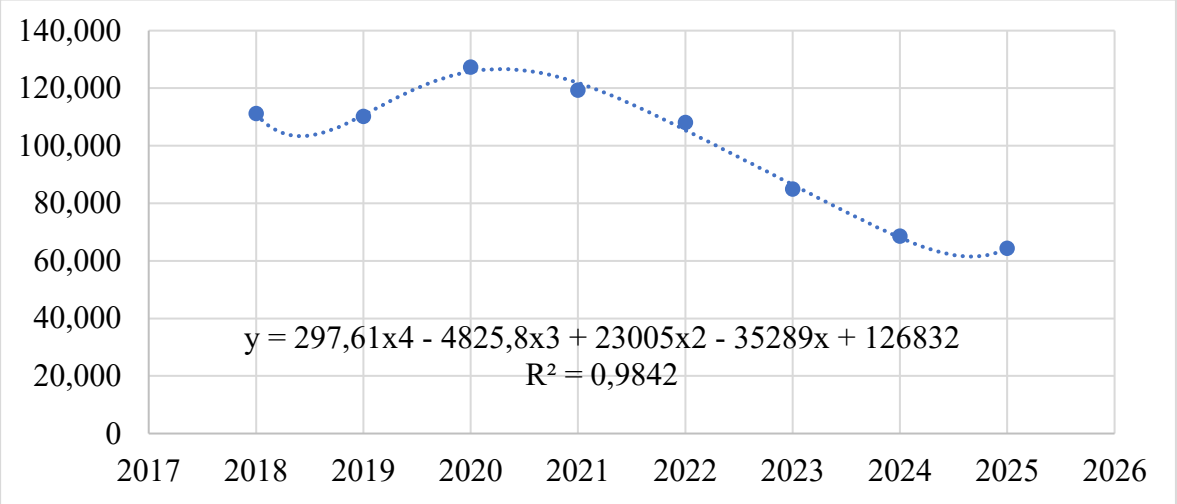

Figure 3. Dynamics of Changes in the Number of Unemployed in Namangan Region.

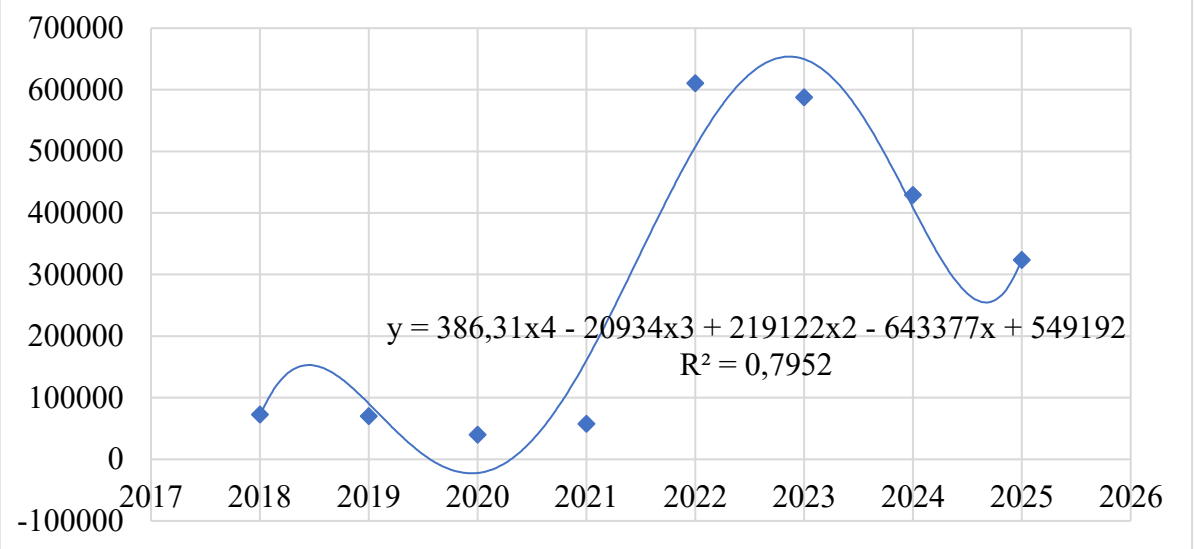

Figure 4. Dynamics of Changes in Job Creation in Namangan Region.

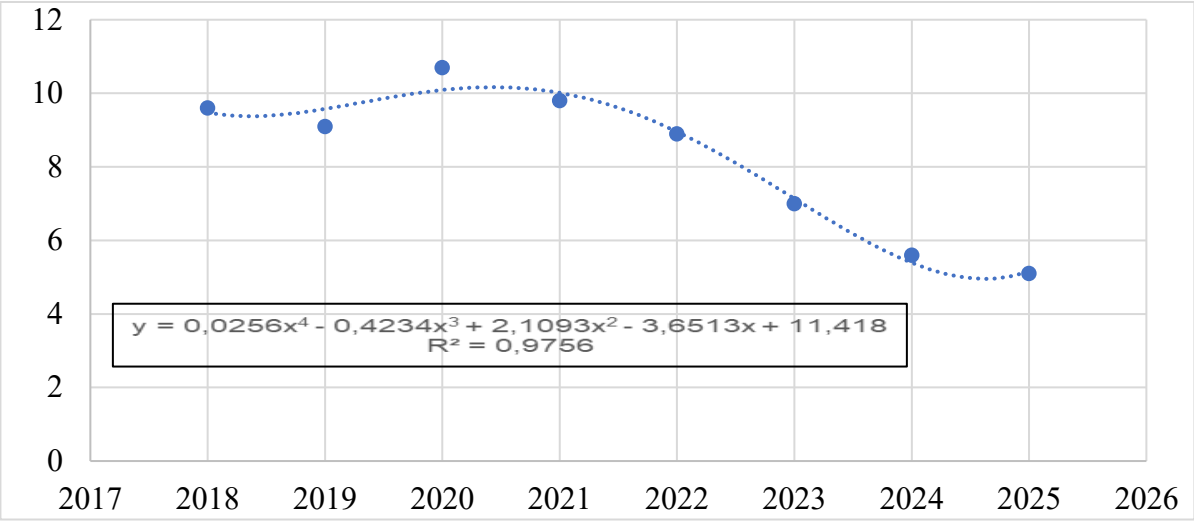

Figure 5. Dynamics of Changes in the Unemployment Rate in Namangan Region.

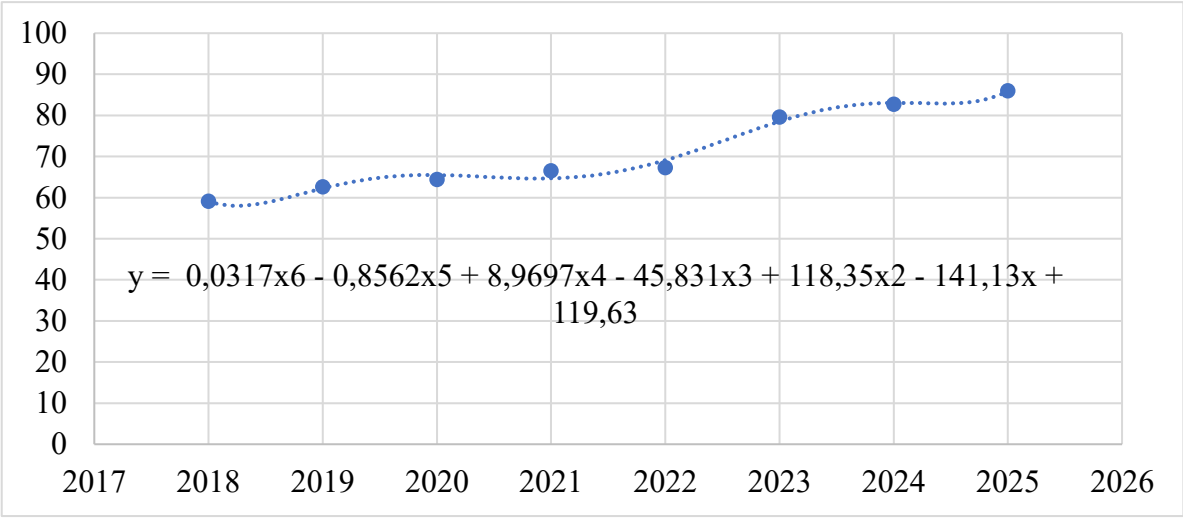

Figure 6. Dynamics of Changes in the Level of Population Access to Centralized Drinking Water Supply in Namangan Region.

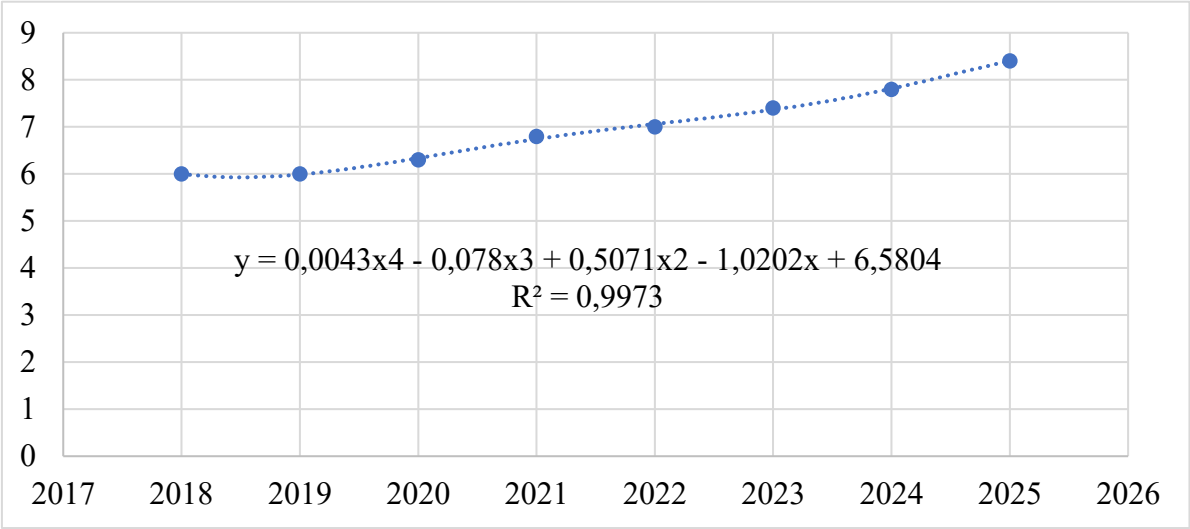

Figure 7. Dynamics of Changes in the Level of Population Access to Centralized Wastewater Services in Namangan Region.

According to the results presented in Figure 1,2,3,4,5,6,7 it can be observed that the identified mathematical model accurately reflects the dynamics of the statistical data on adopted decisions.

Based on the analyzed data, a comparative assessment of the econometric model results reflecting the efficiency of decision-making in local government authorities of the Namangan region is presented in table 2.

Table 2. Comparative results of econometric models for decision-making efficiency in the Namangan region.

No.	Indicators	Mathematical model	Coefficient of determination
1	Number of decisions adopted, units	$Y = 5,1514x - 10337$	$R^2 = 0,4894$
2	Poverty rate	$Y = 0,0203x^4 - 0,334x^3 + 1,4479x^2 - 3,0717x + 23,432.$	$R^2 = 0,9947$
3	Number of unemployed	$Y = 297,61x^4 - 4825,8x^3 + 23005x^2 - 35289x + 126832.$	$R^2 = 0,9842$
4	Jobs created	$Y = 386,3x^4 - 20934x^3 + 219122x^2 - 643377x + 549192$	$R^2 = 0,7952$
5	Unemployment rate	$Y = 0,025x^4 - 0,4234x^3 + 2,1093x^2 - 3,6513x + 11,418$	$R^2 = 0,9756$
6	Population with access to centralized drinking water	$Y = 0,0317x^6 - 0,8562x^5 + 8,9697x^4 - 45,831x^3 + 118,35x^2 - 141,13x + 119,63$	$R^2 = 0,9922$
7	Population with access to centralized wastewater services	$Y = 0,0043x^4 - 0,078x^3 + 0,5071x^2 - 1,0202x + 6,5804$	$R^2 = 0,9973$

Econometric models were developed to enhance the efficiency of decision-making in local government authorities, and forecast indicators were identified to determine their future development trajectories.

Furthermore, the sectoral distribution of these indicators was also estimated and presented as forecast values for the period 2026–2030 (see Table 3).

Table 3. Forecast indicators of decision-making efficiency in local government authorities of the Namangan region.

No.	Ko‘rsatkichlar	2026	2027	2028	2029	2030

1	Number of decisions adopted, units	8050	8320	8600	8880	9150
2	Poverty rate, %	3,2	2,5	1,9	1,3	0,8
3	Number of unemployed, thousand persons	60,6	59,9	58,3	57,6	56,0
4	Jobs created, thousand units	330,0	338,0	347,0	355,0	365,0
5	Unemployment rate, %	4,8	4,5	4,2	3,9	3,6
6	Population with access to centralized drinking water, %	88,5	90,8	92,7	94,5	96,2
7	Population with access to centralized wastewater services, %	8,9	9,4	9,9	10,4	11,0

Based on the data presented in Table 3.3, it can be observed that the volume of economic indicators related to improving the efficiency of decision-making in local government authorities is expected to increase over the forecasted period.

To more accurately determine the impact of various factors on the efficiency of decision-making in local government authorities, a multivariate mathematical modeling approach was applied. The model was formulated in the following form:

$$Y = 28.6 + 0.00012X_1 + 0.00035X_2 - 0.0000019X_3 + 0.41X_4 - 0.27X_5 - 0.19X_6 - 1.5$$

where:

- x_1 – number of decisions adopted,
- x_2 – number of unemployed,
- x_3 – number of jobs created,
- x_4 – unemployment rate,
- x_5 – population with access to drinking water,
- x_6 – population with access to wastewater services,
- x_7 – time factor (trend),
- a_0, a_1, … a_7 – constant coefficients.

The coefficients a_0, a_1, … a_7 were estimated using the least squares method from mathematical statistics. As a result, the following econometric model was derived.

Interpretation of the coefficients

- **x_1 (decisions adopted):** Strengthening of local governance reduces poverty, although the effect is relatively small.
- **x_2 (number of unemployed):** An increase in unemployment leads to higher poverty levels.
- **x_3 (jobs created):** Employment growth reduces poverty and is one of the most significant factors.
- **x_4 (unemployment rate):** Exerts the strongest positive effect on poverty.
- **x_5 (drinking water access):** Improvement in infrastructure reduces poverty.
- **x_6 (wastewater access):** Represents one of the social development indicators.
- **x_7 (trend):** Over time, poverty decreases.

The model coefficients were evaluated using the Fisher criterion, and the actual value of the criterion exceeded the table value, indicating that the model accurately reflects the process.

The analysis of the seven-parameter model demonstrates that it explains 94% of the variation in poverty. Furthermore, the model highlights the most influential factors

affecting decision-making efficiency in local government authorities: unemployment rate, number of jobs created, and access to drinking water, which show a significant and measurable effect for forecasting purposes.

Conclusion

Based on the conducted econometric analysis of socio-economic indicators in Namangan region, the following scientifically grounded conclusions can be drawn:

-high explanatory power of econometric models. The developed regression models demonstrate strong statistical validity, with a coefficient of determination reaching up to $R^2 \approx 0.98$, indicating that the models explain approximately 98% of the variation in key socio-economic processes. This confirms the high reliability and applicability of econometric modeling as an effective tool for supporting evidence-based decision-making in local government institutions.

-identification of key determinants of poverty dynamics. Multivariate regression results reveal that the most influential factors affecting poverty levels are: unemployment rate, job creation, and access to drinking water services. In particular, an increase in unemployment significantly contributes to higher poverty levels, whereas improvements in employment opportunities and infrastructure development lead to a measurable reduction in poverty.

-strong interdependence among socio-economic indicators. The analysis confirms that major indicators such as the number of adopted decisions, employment level, and infrastructure development evolve in a mutually interconnected manner. For example, increases in decision-making activity (from approximately 5,000 to 8,500 units) are associated with improvements in employment and infrastructure indicators, highlighting the need for integrated policy approaches rather than isolated interventions.

-positive long-term development trends based on forecasts.Forecast results for the period 2026–2030 indicate a stable improvement in regional socio-economic conditions. Specifically:

Poverty rate is expected to decline from 3.4% to 0.8%;

Unemployment is projected to decrease from 5.2% to 2.1%;

Number of jobs created is expected to increase from 8,050 to 9,150 units;

Access to basic infrastructure services is projected to rise to approximately 96–98%.

These projections confirm the effectiveness of the developed econometric models not only for analytical purposes but also as reliable instruments for forecasting and strategic planning.

-policy implications for local governance efficiency. The obtained results demonstrate that econometric modeling can significantly enhance the scientific basis of decision-making processes in local government bodies. The identified relationships between governance decisions and socio-economic outcomes provide a quantitative foundation for optimizing resource allocation and improving regional development strategies.

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