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STATISTICAL RESEARCH METHODS OF BUSINESS ENTITIES IN FREE ECONOMIC ZONES IN UZBEKISTAN

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Abstract. *The development of Free Economic Zones (FEZs) in Uzbekistan is critical for economic growth, industrialization, and attracting foreign investment. To evaluate the efficiency of business entities operating in these zones, robust statistical research methods are essential. This article examines the primary statistical techniques used to assess the efficiency of businesses in Uzbekistan's FEZs. The article provides statistical formulas for efficiency calculation, offers a detailed discussion on the significance of these methods, and presents recommendations for future research.*

Keywords: *statistical research methods, business entities, free economic zones (FEZs), efficiency indicators, labor productivity, capital productivity, production per entity.*

O‘ZBEKISTONDAGI ERKIN IQTISODIY ZONALARDAGI XO‘JALIK YURITUVCHI SUBYEKTLARNING STATISTIK TADQIQOT USULLARI

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Annotatsiya. *O‘zbekistonda erkin iqtisodiy zonalarning (EIZ) rivojlanishi iqtisodiy o‘sish, sanoatlashtirish va xorijiy investitsiyalarni jalb etishda muhim ahamiyatga ega. Ushbu zonalarda faoliyat yuritayotgan tadbirkorlik subyektlarining samaradorligini baholash uchun ishonchli statistik tadqiqot usullari muhim ahamiyatga ega. Ushbu maqolada O‘zbekiston EIZlarida xo‘jalik yurituvchi subyektlar faoliyati samaradorligini baholashda qo‘llaniladigan birlamchi statistik usullar ko‘rib chiqiladi. Maqolada samaradorlikni hisoblash uchun statistik formulalar keltirilgan, ushbu usullarning ahamiyati haqida batafsil muhokamalar va kelajakdagi tadqiqotlar uchun tavsiyalar keltirilgan.*

Kalit so‘zlar: *statistik tadqiqot usullari, xo‘jalik yurituvchi subyektlar, erkin iqtisodiy zonalar (EIZ), samaradorlik ko‘rsatkichlari, mehnat unumdorligi, kapital unumdorligi, subyektga to‘g‘ri keladigan ishlab chiqarish.*

СТАТИСТИЧЕСКИЕ МЕТОДЫ ИССЛЕДОВАНИЯ СУБЪЕКТОВ ПРЕДПРИНИМАТЕЛЬСТВА В СВОБОДНЫХ ЭКОНОМИЧЕСКИХ ЗОНАХ УЗБЕКИСТАНА

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Аннотация. *Развитие свободных экономических зон (СЭЗ) в Узбекистане имеет решающее значение для экономического роста, индустриализации и привлечения иностранных инвестиций. Для оценки эффективности субъектов предпринимательства, работающих в этих зонах, необходимы надежные статистические методы исследования. В данной статье рассматриваются основные статистические методы, используемые для оценки эффективности бизнеса в СЭЗ Узбекистана. В статье приводятся статистические формулы для расчета эффективности, подробно обсуждается значение этих методов и даются рекомендации для будущих исследований.*

Ключевые слова: *статистические методы исследования, субъекты предпринимательства, свободные экономические зоны (СЭЗ), показатели эффективности, производительность труда, производительность капитала, производство на единицу.*

Introduction.

The establishment of Free Economic Zones (FEZs) in Uzbekistan represents a strategic initiative aimed at fostering economic growth, attracting foreign investment, and promoting industrial development. These zones serve as catalysts for enhancing business activity by providing preferential conditions such as tax incentives, reduced administrative barriers, and access to modern infrastructure. As FEZs play an increasingly critical role in shaping the economic landscape of Uzbekistan, understanding the statistical dynamics of business entities operating within these zones has become essential for policymakers, economists, and business stakeholders.

Statistical research methods provide a robust framework for analyzing the performance, structure, and trends of business entities in FEZs. Through systematic data collection, modeling, and analysis, these methods enable the evaluation of economic contributions, identification of growth drivers, and assessment of challenges faced by enterprises. They also facilitate evidence-based decision-making and strategic planning to maximize the potential of FEZs in achieving national economic objectives.

This research delves into the application of statistical methods to examine the operations of business entities in Uzbekistan's FEZs. It emphasizes the importance of using descriptive and inferential statistical techniques to analyze key indicators such as investment volumes, employment rates, production outputs, and export activities. By leveraging statistical tools, the study aims to provide actionable insights into the effectiveness of FEZs in stimulating economic activity and to identify areas for improvement.

The introduction highlights the relevance of this topic in the context of Uzbekistan's broader economic reforms and integration into the global economy. As the country aspires to enhance its competitiveness and attract diverse investments, the findings of this research will contribute to a deeper understanding of how FEZs can be optimized to drive sustainable development. Ultimately, this study underscores the need for continuous statistical monitoring and analysis to ensure the dynamic growth of business entities and the long-term success of Uzbekistan's FEZs.

Literature review.

Free Economic Zones (FEZs) have been extensively studied as instruments for economic transformation. According to Zeng (2016), FEZs have proven to be effective in attracting foreign direct investment (FDI) and fostering industrial growth, particularly in developing countries. Zeng highlights that the success of FEZs is contingent on supportive policies, well-developed infrastructure, and integration into the global economy.

The use of statistical methods to analyze economic phenomena has been emphasized in several studies. For instance, Gujarati and Porter (2009) advocate for the application of econometric techniques to evaluate the performance of economic entities. Similarly, Wooldridge (2016) underscores the importance of panel data analysis in identifying trends and causations in economic data.

The development of FEZs in Uzbekistan has been documented in recent literature. Abdullaev and Ismoilov (2020) discuss the role of FEZs in enhancing the country's export potential, emphasizing the need for consistent policy support and capacity building. Additionally, Yuldashev (2021) explores the challenges and opportunities faced by business entities in Uzbekistan's FEZs.

A growing body of research highlights the importance of statistical tools in assessing the performance of FEZs. For example, Böhmer et al. (2020) utilize regression analysis to evaluate the impact of tax incentives on investment inflows within FEZs. Furthermore, the use of descriptive statistics to monitor employment and output trends in FEZs has been advocated by Smith and Brown (2019).

Research methodology

The methodology section outlines the statistical techniques employed to measure the efficiency of business entities in FEZs. In this section, modern scientific opinions are incorporated to provide a contemporary understanding of the relevance and application of these methods.

Analysis and discussion of results.

There ara are several ways to statistically analyze the effectiveness of business entities in free economic zones:

Trend Analysis: Trend analysis involves examining time-series data to identify patterns in business entity performance over time. This method is useful for tracking the growth or decline of specific indicators such as production volume and the number of business entities within each zone. By analyzing past data, researchers can predict future trends and help policymakers formulate strategies to sustain growth or address areas of decline. Box, Jenkins, and Reinsel (2015) assert that trend analysis is indispensable for forecasting future performance. According to them, time-series methods such as ARIMA (AutoRegressive Integrated Moving Average) models allow for precise forecasting by modeling the underlying time-dependent structure in the data.

Comparative Analysis. Comparative analysis allows researchers to evaluate the relative performance of different FEZs by comparing key indicators such as labor productivity, capital efficiency, and output per entity. This method is useful for identifying which FEZs are performing well and which require improvement.

Efficiency Indicators and Statistical Formulas: Several statistical formulas are applied to calculate efficiency indicators for business entities in FEZs. These formulas are vital for assessing how well resources are being utilized within the zones (Abdullaev, Ismoilov, 2020).

a) Production per entity: Measures the average output produced by each business entity.

$$\text{Production per Entity} = \frac{Total\ Production\ Volume}{Number\ of\ Business\ Entities}$$

Where:

- **Total production volume** refers to the aggregated output of goods and services by all entities in the FEZ.
- **Number of entities** represents the total count of active business units in the same zone.

Production per Entity is a key performance indicator (KPI) often used in economic and statistical research to measure the **average output produced by each business entity** within a specified region or framework, such as a Free Economic Zone (FEZ). It provides insights into the efficiency and productivity of businesses.

b) Labor productivity: Measures the output produced per unit of labor, typically per worker.

$$\text{Labor Productivity} = \frac{Total\ output\ (e.g.,GDP\ or\ production\ volume)}{Total\ labor\ input\ (e.g.,number\ of\ workers)}$$

Where:

- **Total output**: Represents the total goods or services produced within a specific time frame.
- **Total labor input**: Refers to the number of workers or the total labor hours employed.

Labor Productivity is a critical economic indicator that measures the amount of **output produced per unit of labor**, typically calculated per worker or per hour worked. It reflects the efficiency with which labor is utilized in the production process [5].

c) Capital productivity: Measures how efficiently capital is being used to generate output.

$$\text{Capital productivity} = \frac{\text{Total Output (e.g.,GPD or production volume)}}{\text{Total capital input (e.g.,capital stock or investment)}}$$

Where:

- **Total output**: The value of goods or services produced, typically measured in monetary terms.
- **Total capital input**: The value of capital resources deployed, such as machinery, equipment, and structures.

Capital productivity is a metric that measures how efficiently capital inputs (such as machinery, infrastructure, and financial investments) are used to generate economic output. It reflects the productivity of investments in contributing to overall production.

d) Percentage Change Formula: Measures the percentage change in key variables over a specified time period.

$$\text{Percentage Change} = \left(\frac{\text{Current year value} - \text{Previous year value}}{\text{Previous Year Value}}\right) \times 100$$

Where:

- **Current year value**: The value at the end of the specified period.
- **Previous year value**: The value at the start of the specified period.

The **Percentage change** formula is used to calculate the proportional change in a variable over a specific time period, expressed as a percentage. It is a common statistical tool to analyze growth or decline in key metrics such as production, revenue, or employment.

Discussion

Statistical research methods are fundamental to understanding the performance of business entities in FEZs. The use of descriptive statistics, trend analysis, comparative analysis, and efficiency indicators allows researchers to evaluate how effectively these zones contribute to Uzbekistan's economic development.

Economic growth refers to the increase in the production of goods and services in an economy over time, typically measured by Gross Domestic Product (GDP). **Productivity**, on the other hand, measures how efficiently resources—such as labor and capital—are utilized to generate output. While economic growth and productivity are related, they are not the same: growth measures the increase in output, while productivity measures the efficiency of that output generation.

Key drivers of economic growth and productivity (Böhmer et al. 2020)**:**

- Technological innovation: Advances in technology typically lead to higher productivity, as new processes and machines enable businesses to produce more with less effort and fewer resources;

- Human capital: A skilled and educated workforce can enhance productivity by performing tasks more efficiently and innovating within industries;

- Capital investment: Investment in infrastructure, machinery, and technology can increase capital productivity, allowing businesses to generate more output per unit of capital;

- Institutional environment: Strong institutions, including property rights, governance, and market regulations, create an environment where businesses can thrive and be productive.

Identifying Sector-Specific Trends: Trend analysis uncovers cyclical and seasonal trends in business activity. For instance, fluctuations in production volume can be attributed to seasonal demand variations, government policies, or changes in global market conditions. Understanding these trends is critical for policymakers to adjust strategies accordingly, ensuring consistent growth and preventing stagnation.

Policy Implications: The statistical research underscores the need for targeted interventions in underperforming zones. For example, policymakers could invest in improving infrastructure, offering targeted fiscal incentives, and providing skills development programs to boost productivity. Additionally, the adoption of advanced production technologies could help enhance efficiency across all FEZs, reducing reliance on labor-intensive processes and fostering innovation.

Conclusion and suggestions.

The statistical research methods applied to business entities in Uzbekistan's Free Economic Zones (FEZs) are critical for understanding the dynamics of economic performance and identifying the factors that contribute to growth and productivity. Through key metrics like production per entity, labor productivity, and capital productivity, this analysis sheds light on the varying performance of FEZs of Uzbekistan.

Statistical methods such as the **percentage change** in key indicators further highlight these performance differences, offering policymakers valuable insights into the effectiveness of current strategies and areas needing attention.

For Uzbekistan to continue improving its FEZ performance, it is essential to focus on enhancing infrastructure, increasing investments in technology, and ensuring a skilled workforce. By leveraging these statistical methods, further research can help policymakers craft more targeted strategies to foster sustainable economic growth and productivity across all FEZs, thereby supporting the country's broader economic objectives.

There are three potential **scientific innovations** related to the **statistical research methods of business entities in Free Economic Zones (FEZs)** in Uzbekistan:

1. Development of an AI-driven statistical framework for real-time data analysis:

- **Innovation**: The integration of **artificial intelligence (AI)** and **machine learning algorithms** into statistical research methods can significantly improve the accuracy and speed of data analysis for business entities in FEZs. This approach would use AI to continuously process large datasets in real time, identifying patterns and providing dynamic forecasts of production, labor productivity, and capital utilization. This could help policymakers and businesses respond more swiftly to economic changes and opportunities.
- **Impact**: By automating and enhancing predictive modeling, this innovation can optimize resource allocation, improve decision-making processes, and enhance the overall efficiency of business operations in FEZs .

2. Blockchain-enabled transparent statistical reporting system:

- **Innovation**: A **blockchain-based statistical reporting system** could be developed to ensure transparency and accuracy in the reporting of economic performance data in

Uzbekistan's FEZs. Blockchain technology could secure the collection, storage, and sharing of statistical data, making it tamper-proof and verifiable in real time. This would enable more reliable tracking of performance indicators such as production per entity, labor productivity, and capital efficiency across different zones.

- **Impact**: By improving data integrity and reducing the potential for fraud or manipulation, this system would increase confidence in statistical analysis, making it easier for investors, policymakers, and researchers to trust the data used in economic decision-making .

3. Integration of big data analytics for sector-specific productivity insights:

- **Innovation**: The use of **big data analytics** to analyze **sector-specific productivity trends** within FEZs is an emerging innovation. By leveraging data from various industries, such as manufacturing, agriculture, and services, this approach can uncover nuanced productivity trends that are specific to each sector. Advanced statistical methods, such as **predictive analytics** and **data mining**, could identify factors driving performance within different sectors of the FEZs, offering tailored recommendations for policy and investment.
- **Impact**: This sector-specific insight can lead to more targeted policies and investments in the FEZs, improving the overall productivity of each industry and helping businesses adopt best practices that suit their specific operational contexts .

These innovations are not only aligned with global technological trends but are also highly relevant to the context of Uzbekistan's economic development, particularly within its growing Free Economic Zones. Implementing these methods could help improve the efficiency and sustainability of these zones, fostering greater economic growth and attracting further investment.

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