

**Educational Establishment  
"Grodno State Agrarian University"**

**APPROVED**

**rector**

\_\_\_\_\_ **V.K.Pestis**  
" " \_\_\_\_\_ **2019**  
**Registration № UD \_\_\_\_\_**

**QUANTITATIVE METHODS OF ANALYSIS IN AGRO-INDUSTRIAL  
COMPLEX**

**The curriculum of higher education institutions for undergraduates**

**1-25 80 01 "Economics" (profiling - "Agricultural Economics")**

2019 y.

**COMPILED BY:**

E. A. SUCHANOVA, lecturer of the department of computer science and economic and mathematical modeling in the agricultural sector  
educational establishment "Grodno state agrarian university"

**RECOMMENDED FOR APPROVAL:**

Department of computer science and economics and mathematical modeling in the agricultural sector

(protocol № 15 on 24.05.2019);

Methodical council of educational establishment "Grodno state agrarian university"

(protocol №     on \_\_\_\_\_.\_\_\_\_.\_\_\_\_ )

Responsible for editorial     E. A. Suchanova

Responsible for release     T.V. Snopko

## **EXPLANATORY NOTE**

### **The goals and objectives of the discipline**

The purpose of teaching the discipline is the formation of graduate students of modern practical knowledge, skills in using in practice quantitative methods of data analysis.

Objectives of the discipline:

- provide basic theoretical knowledge about quantitative data analysis methods;
- develop skills in using methods of quantitative data analysis and competent interpretation of analysis results, understanding the features of the data used.

### **Place of discipline in the system of training a specialist with higher education**

The discipline is included in the "Component of higher education institution" section of the curriculum for undergraduates in the specialty 1-25 80 01 "Economics" (specialization "Agricultural Economics").

The mastery of the discipline is based on the competencies acquired earlier by undergraduates in the study of the disciplines "Higher Mathematics", "Computer Information Technologies", "Statistics".

### **Requirements for the level of development of the content of the academic discipline**

As a result of studying the discipline, the undergraduate must consolidate and develop the following academic (AC) and social-personal (SPC) competencies:

AC-1. To be able to apply basic scientific and theoretical knowledge to solve theoretical and practical professional problems.

AC-2. Be able to do comparative analysis.

AC-3. Be able to work independently.

AC-4. Have an interdisciplinary approach to solving problems.

AC-5. Have skills when working with computer equipment.

SPC-1. Have the ability to interpersonal communications.

SPC-2. Be able to work in a team.

As a result of studying the discipline, the undergraduate must possess the following professional competencies (PC):

PC-1. Make decisions on choosing the optimal informational structure of production.

PC-2. Conduct organizational and management survey of production.

PC-3. Choose the most effective forms of adaptation of the enterprise to environmental conditions.

PC-4. Use modern information technologies and applied data processing programs to substantiate management decisions.

PC-5. To develop the production program of the enterprise.

PC-6. Make effective management decisions in the economic sphere.

PC-7. Be able to analyze the organization's activities in international markets and develop strategies for their conquest.

PC-8. To evaluate the results of economic activities of organizations.

PC-9. Work with scientific, technical and patent literature.

To acquire professional competencies PC-1 - PC-9 as a result of studying the discipline, the undergraduate must know:

- modern trends and methods of mathematical research of economic phenomena;
- The main quantitative methods of analysis and methods of their application for solving practical problems;

- the scope of quantitative analysis methods.

To be able and able to:

- identify quantitative methods of analysis;
- wisely use theoretical knowledge in practice;
- solve practical problems using modern information technologies based on real data;

- adequately interpret the research results and develop practical recommendations for their application in practice.

#### **Total hours and class hours**

198 hours are maximum allocated for mastering the discipline, including 60 hours of classroom hours.

#### **Higher Education Form**

When studying the discipline, such forms of training are provided: full-time and part-time.

#### **Classroom time distribution by occupation, course and semester**

Discipline is studied for full-time study in the 1st semester, while the class time is divided into 30 hours of lecture, 10 practical and 20 hours of laboratory classes.

#### **Forms of current certification in academic discipline**

Assessment of academic achievements of a graduate student is an exam. To assess the educational achievements of undergraduates, criteria are used, approved by the Ministry of Education of the Republic of Belarus.

Evaluation of intermediate academic achievements of undergraduates is carried out in accordance with the selected grade scale.

To assess the achievements of undergraduates, the following diagnostic tools are used (competencies are checked):

- presentation by a graduate student at a conference on a prepared abstract (AC-1, AC-3, AC-4, AC-5, SPC-1, SPC-2, PC-9);

- conducting ongoing quizzes on selected topics (PC-1 - PC-9);

- protection of individual tasks performed in laboratory studies (AC-3, AC-5, SPC-1, PC-1 - PC-9);

- protection of individual tasks performed within the framework of controlled independent work (AC-1, AC-3, AC-5, SPC-1, PC-1 - PC-9);

- passing the exam in the discipline (AC-1 - AC-5, PC-1 - PC-9).

## **CONTENT OF EDUCATIONAL MATERIAL**

### **Theme 1. SUMMARY STATISTICS**

Data collection methods. Data tabulation. Graphic display of information. Medium. Comparison of averages. Indicators of variation. Interpretation of indicators of variation. Comparison of indicators of variation. Methods for subsequent data analysis.

### **Theme 2. BASES OF THE PROBABILITY THEORY**

The basics of estimating probability. The combination of events. Tree of probabilities. Decision analysis. Expected Values. Decision tree. Binomial distribution. Poisson distribution. Continuous probability distribution. Normal distribution. Confidence limits. Significance and sampling. Hypothesis test.

### **Theme 3. RELATIONS**

Relationship mapping. Linear and nonlinear dependence. Linear correlation coefficient. Rank correlation. Interpretation of the correlation coefficient. Coefficient of determination. The line of "best fit." Regression methods. Nonlinear dependence. Multiple Regression

### **Theme 4. FINANCIAL MATHEMATICS**

Simple percentage. Compound interest. Interest rate on an annualized basis. Net present value. Depreciation. Annuity and repayment fund. Investment valuation.

### **Theme 5. INDICES**

Simple indexes. Indexes with a variable (chain) base. General indexes. Weighted units. Laspeyres Index Paasche Index. Comparison of the Laspeyres and Paasche indices. Other indices. Quantitative Indices. Cost of Living Indices. Other business indices.

### **Theme 6. FORECASTING**

Time Series Elements. Highlighting a trend: regression methods. Highlighting the trend: moving averages. Highlighting the trend: centered moving averages. Highlighting the trend: exponential smoothing. Seasonal fluctuations. Seasonal fluctuations: addition method. Seasonal fluctuations: multiplication method. Cyclic vibrations. Random fluctuations: prediction errors. The effectiveness of forecasting models. Other forecasting issues.

### **Theme 7. RESOURCE MANAGEMENT**

Characteristic of inventory management. The model is the optimal order size. The formula for the optimal order size. Quantity discounts. Order cycle. Deficit. Production order size model. Uncertain demand. Periodic inspection model. Other inventory management models. Practical issues

### **Theme 8. LINEAR PROGRAMMING**

Formulation of the linear programming problem. Graphic solution. A brief description of graphical methods. Maximization and minimization. Special cases. Simplex method: maximization with restrictions with a sign  $\leq$ . Simplex method: minimization with restrictions with the sign  $\geq$ . Transport task. Unbalanced transport task. Maximization problem. Interpretation of results: management issues.

### **Theme 9. MODELING METHODS**

Development of simulation models. Random numbers. Using random numbers in modeling. Demand modeling. Inventory Management. The occurrence of a deficit. Cost accounting. Comparison of inventory management strategies. Queuing tasks. Waiting time. Cost / income analysis. Practical use. Modeling a normal variable. Assessment of modeling methods.

### **Theme 10. PROJECT MANAGEMENT**

Networking. Using pseudo actions. Timing. Critical Path Analysis. Definition and calculation of the reserve of time. Gantt chart. Resource Planning. Reducing the duration of the action and the cost of the urgent program. Method for Evaluation and Review of Plans (PERT). Alternative methods of building network diagrams.

## EDUCATIONAL-METHODICAL MAP

Section number, topics, classes	Section title, topics, classes; list of issues under study	Total hours	The number of class hours				The number of hours devoted to independent work of students (including hours allocated for the implementation of the course work / project)	Financial support classes (visual, manuals, etc.)	Literature	The forms of knowledge control
			lectures	practical (seminar) classes	laboratory classes	Independent work of students (CER)				
1	2	3	4	5	6	7	8	9	10	11
<b>Theme 1.</b>	<b>SUMMARY STATISTICS</b> Data collection methods. Data tabulation. Graphic display of information. Medium. Comparison of averages. Indicators of variation. Interpretation of indicators of variation. Comparison of indicators of variation. Methods for subsequent data analysis.	<b>14</b>	<b>2</b>		<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	Testing
<b>Theme 2.</b>	<b>BASES OF THE PROBABILITY THEORY</b> The basics of estimating probability. The combination of events. Tree of probabilities. Decision analysis. Expected Values. Decision tree. Binomial distribution. Poisson distribution. Continuous probability distribution. Normal distribution. Confidence limits. Significance and sampling. Hypothesis test..	<b>14</b>	<b>2</b>		<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	Testing
<b>Theme 3.</b>	<b>RELATIONS</b> Relationship mapping. Linear and nonlinear dependence. Linear correlation coefficient. Rank correlation. Interpretation of the correlation coefficient. Coefficient of determination. The line of "best fit." Regression methods. Nonlinear dependence. Multiple Regression	<b>20</b>	<b>4</b>		<b>4</b>	<b>12</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	Testing
<b>Theme 4</b>	<b>FINANCIAL MATHEMATICS</b> Simple percentage. Compound interest. Interest rate on an annualized basis. Net present value. Depreciation. Annuity and repayment fund. Investment valuation.	<b>20</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>12</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	Testing
<b>Theme 5</b>	<b>INDICES</b> Simple indexes. Indexes with a variable (chain) base. General indexes. Weighted units. Laspeyres Index Paasche Index. Comparison of the Laspeyres and Paasche indices. Other indices. Quantitative Indices. Cost of Living Indices. Other business indices.	<b>14</b>	<b>2</b>		<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	Testing

1	2	3	4	5	6	7	8	9	10	11
<b>Theme 6</b>	<b>FORECASTING</b> Time Series Elements. Highlighting a trend: regression methods. Highlighting the trend: moving averages. Highlighting the trend: centered moving averages. Highlighting the trend: exponential smoothing. Seasonal fluctuations. Seasonal fluctuations: addition method. Seasonal fluctuations: multiplication method. Cyclic vibrations. Random fluctuations: prediction errors. The effectiveness of forecasting models. Other forecasting issues.	<b>18</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	lab work report
<b>Theme 7</b>	<b>RESOURCE MANAGEMENT</b> Characteristic of inventory management. The model is the optimal order size. The formula for the optimal order size. Quantity discounts. Order cycle. Deficit. Production order size model. Uncertain demand. Periodic inspection model. Other inventory management models. Practical issues	<b>18</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	lab work report
<b>Theme 8</b>	<b>LINEAR PROGRAMMING</b> Formulation of the linear programming problem. Graphic solution. A brief description of graphical methods. Maximization and minimization. Special cases. Simplex method: maximization with restrictions with a sign $\leq$ . Simplex method: minimization with restrictions with the sign $\geq$ . Transport task. Unbalanced transport task. Maximization problem. Interpretation of results: management issues.	<b>18</b>	<b>4</b>	<b>2</b>	<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	lab work report
<b>Theme 9</b>	<b>MODELING METHODS</b> Development of simulation models. Random numbers. Using random numbers in modeling. Demand modeling. Inventory Management. The occurrence of a deficit. Cost accounting. Comparison of inventory management strategies. Queuing tasks. Waiting time. Cost / income analysis. Practical use. Modeling a normal variable. Assessment of modeling methods.	<b>14</b>	<b>2</b>		<b>2</b>	<b>10</b>		EEMC and online tutorials featured in the local network of the library, testing through distance learning site	[1-3]	lab work report
<b>Theme 10</b>	<b>PROJECT MANAGEMENT</b> Networking. Using pseudo actions. Timing. Critical Path Analysis. Definition and calculation of the reserve of time. Gantt chart. Resource Planning. Reducing the duration of the action and the cost of the urgent program. Method for Evaluation and Review of Plans (PERT). Alternative methods of building network diagrams.	<b>12</b>	<b>2</b>	<b>2</b>		<b>8</b>			[1-3]	Testing
	<b>Exam preparation</b>	<b>36</b>				<b>36</b>				
	<b>Total</b>	<b>198</b>	<b>30</b>	<b>10</b>	<b>20</b>	<b>138</b>				



## INFORMATION AND METHODOLOGICAL PART

### *Monitoring the academic achievements of undergraduates*

For current monitoring of academic achievements of undergraduates, tests, multilevel control tasks, oral questioning during classes and other diagnostic tools are used. The final assessment of academic achievement is carried out on the exam. For this, criteria approved by the Ministry of Education of the Republic of Belarus are used.

### *Sample list of questions for the final control*

1. Tell us about data collection methods.
2. Tell us about the methods of data reduction in tables and their graphical display.
3. List descriptive statistics.
4. Explain the need for statistical indicators.
5. Tell us about the use of statistical indicators in the evaluation of commercial information.
6. Explain the use of the basic rules for determining probability.
7. Tell us about the use of the decision tree when making business decisions.
8. What constitutes a discrete and continuous distribution.
9. Tell us about the use of confidence limits in determining significance.
10. Tell us about the application of hypothesis testing criteria based on the mean values.
11. Tell us about the analysis of the relationship between two variables using graphical methods.
12. Tell us about the calculation of correlation coefficients in order to determine the strength of dependence.
13. Tell us about using regression methods to get simple predictions.
14. Explain the differences between linear and non-linear relationships.
15. Tell us about the use of dependence in economic situations when making management decisions.
16. Tell us about the use of various methods for calculating the amount of interest payable.
17. Explain the use of interest rate calculations for depreciation and discounting.
18. Tell us about the use of methods for evaluating and comparing investment offers based on the values of the net present value and internal rate of return.
19. Tell us about calculating the value of investments, such as annuity and repayment fund.
20. Explain the use of indexes in business activities.
21. Tell us about the methods for calculating indices.
22. Explain the weighting methods in compiling the indices.
23. Explain methods for calculating price and quantity indices.

24. Tell us about the use of indexes in conducting comparative analysis of data.
25. List the main methods for predicting business activity.
26. Explain how various possible forecasting models are analyzed.
27. Tell us how forecasting is changing in commercial activities.
28. Tell us how the suitability and reliability of the methods used are determined.
29. Tell us how the effectiveness and accuracy of different methods are compared.
30. List the main characteristics of inventory management models.
31. Tell us about determining the optimal order size.
32. Tell us how the effect of discounts on determining the optimal order size is analyzed.
33. Define inventory management policies.
34. Tell us about the use of linear programming methods in the optimization and interpretation of the results.
35. Tell us about the use of modeling in the analysis of decisions on inventory management.
36. Tell us about the use of modeling in solving queuing problems.
37. Tell us about the value of modeling in solving various business problems.
38. Explain the use of networking in project management.
39. Tell us about the application of probabilistic methods in network analysis.

### ***Recommended reading list***

#### *Main literature:*

1. Blundel, Richard. Effective organisational communication: perspectives, principles, and practices/Richard Blundel.2004, ctp 356
2. David, Fred R. Strategic management: concepts and cases / Fred R. David.—13th ed. p. Cm, 2009 – 694 p.
3. McAleese, Dermot. Economics for business: competition, macro-stability, and globalisation / Dermot McAleese.— 3rd ed 2004 – 643 p.
4. Pervez N. Ghauri, Research Methods in Business Studies: A Practical Guide/ Pervez N. Ghauri, Kjell Grønhaug – Pearson Education, 2005 – 257 p.
5. Saunders, Mark, 1959-Research methods for business students / Mark Saunders, Philip Lewis, Adrian Thornhill. —5th ed.p., 2009 – 605 p.

#### *Additional literature:*

1. Anderson *et al*, *An Introduction to Management Science*, West Publishing Company, St Paul, USA, 1994
2. Ball, *Quantitative Approaches to Management*, Butterworth-Heinemann, Oxford, 1991
3. Black, *Business Statistics - An Introductory Course*, West Publishing Company, St Paul, USA, 1992

4. BPP, *Quantitative Methods - Business Basics*, BPP Publishing, London, 1955
5. Carter/Williamson, *Quantitative Modelling for Management and Business*, Pitman, London, 1996
6. Curwin/Slater, *Quantitative Methods for Business Decisions*, Chapman & Hall, London, 1991
7. Eppen et al, *Introductory Management Science*, Prentice Hall, New Jersey, USA, 1993
8. Keller et al, *Statistics for Management and Economics*, Duxbury Press, 1994
9. Kvanli et al, *Introduction to Business Statistics*, West Publishing Company, St Paul, USA, 1992
10. Mathur/Solow, *Management Science - The Art of Decision Making*, Prentice Hall, New Jersey, USA, 1994
11. Morris, *Quantitative Approaches in Business Studies*, Pitman, London, 1993
12. Oakshott, *Quantitative Approaches to Decision Making*, DP Publications, 1993
13. Piascik, *Applied Mathematics for Business and the Social and Natural Sciences*, West Publishing Company, St Paul, USA, 1991
14. Targett, *Analytical Decision Making*, Pitman, London, 1996
15. Toh/Hu, *Basic Business Studies - An Intuitive Approach*, West Publishing Company, St Paul, USA, 1991
16. Waters, *A Practical Introduction to Management Science*, Addison Wesley, 1994
17. Winston, *Operations Research - Applications and Algorithms*, Duxbury Press, 1991

## PROTOCOL AGREEMENT CURRICULUM SVR

The name of discipline, which requires approval	Name of department	Proposals for changes in the content of the training on the subject matter under study program	Action taken by the Department, develop training programs (With date and protocol number)
Information support production	Department of Informatics and EMM in AIC	No offers	Considered at the meeting of the department, to Protocol N ° 15 on May 24, 2019
Information marketing	Department of Management, Marketing and Law	No offers	Considered at the meeting of the department, to Protocol N ° 15 on May 24, 2019

## ADDITIONS AND CHANGES TO EDUCATIONAL PROGRAM SVR

on \_\_\_\_ / \_\_\_\_ school year

№	Additions and changes	Base

The curriculum is reviewed and approved at a meeting of the department  
Informatics and EMM in the AIC (protocol № \_\_ from \_\_\_\_ 20\_\_)  
(the department name)

**Head of Department**

Candidate of Physics and Mathematics Sciences, Associate Professor \_\_\_\_\_  
(academic degree, academic title) (signature)

T.N.Izosimova  
(Initials and Family names)

**APPROVED**

**Dean of the Faculty**

Candidate of Economics. Sciences, Associate Professor \_\_\_\_\_  
(academic degree, academic title) (signature)

A.V. Gribov  
(Initials and Family names)