



THE MANUAL «QUANTITATIVE METHODS IN BEHAVIORAL SCIENCES»

Liudmyla Yaremenko

Candidate of Pedagogical Sciences, Associate Professor

Central Ukrainian State Pedagogical University named after Volodymyr
Vynnychenko

llut4enko@gmail.com



Funded by the
Erasmus+ Programme
of the European Union



This manual, devoted quantitative methods in behavioral sciences, is intended for educational and methodological support the course «Quantitative Methods in Behavioral Sciences»

The course «Quantitative Methods in Behavioral Sciences» is designated for teaching students, whose specialty is 011 Educational, Pedagogical Sciences, Educational Program: «Educational Measurement. Gender studies: research»

The aim of the course «Quantitative Methods in Behavioral Sciences» is to provide specialists in the sphere of modern theory and practice of educational measuring systems with the mathematical- statistical apparatus, which will enable them to analyze empirical data in the behavioral sciences in gender studies.

The course «Quantitative Methods in Behavioral Sciences» enables the students to master basic quantitative methods of analysis and synthesis of the statistical data, mastering the method of determining interdependencies between different phenomena in sampling, non-parametrical methods of checking statistical hypothesis and the correlation criteria (deviation), using results for scientific and practical conclusions.

The course curriculum consists from the two modules, so the manual consists from the two chapters :

1. Organizing and methodology of quantitative research, processing and analysis of empirical data.
2. Elements of statistical analysis of empirical data of gender research in behavioral sciences





Funded by the
Erasmus+ Programme
of the European Union

CHAPTER 1. ORGANIZATION AND METHOD OF QUANTITATIVE RESEARCH, PROCESSING AND ANALYSIS OF EMPIRICAL DATA

РОЗДІЛ 1. ОРГАНІЗАЦІЯ ТА МЕТОДИКА КІЛЬКІСНИХ ДОСЛІДЖЕНЬ, ОБРОБКА ТА АНАЛІЗ ЕМПІРИЧНИХ ДАНИХ

1.1 Methods of quantitative research in behavioral sciences.

**1.2 The organization of the statistical research.
The sampling method.**

1.3 The calculation of the main statistical characteristics of the sample

1.1 Methods of quantitative research in behavioral sciences

A brief description of the methods of quantitative research in behavioral sciences is given: methods of document analysis (including content analysis as a method of gender analysis of school textbooks); social research (including the use of tests in social research); observation as a research method; questioning (its types); experiment (its types and procedure); method of questionnaires; other survey methods

1.2 The organization of the statistical research. The sampling method

The concepts that are used in conducting statistical studies, the classification of statistical indicators are discussed. Particular attention is paid to the software-methodological and organizational issues of statistical measurement, its types, especially their application in gender research. The mistakes that can be made during observation and ways of their control are indicated



1.3 The calculation of the main statistical characteristics of the sample

In this paragraph the rules of determining quantitative characteristics of the selection: central tendencies, varieties and forms with their characteristics, construction of distribution interval series. Graphical depiction of statistical series.

Theory is supplemented with examples of their use in the process of gender studies

EXAMPLE

To calculate and compare the statistical characteristics of the test results of the male and female students'. Make conclusions about the differences between the level of educational achievements of the male and female students' .

Male: 19, 18, 22, 16, 17, 21, 19, 19, 18, 17, 18, 22, 19

Female: 16, 19, 20, 21, 20, 15, 18, 16, 20, 19, 17, 19, 18, 19, 20, 17 .



Characteristic is calculated by the formula	
Mean	$\bar{X} = \frac{1}{N} \sum_{i=1}^N X_i$
Variance	$S_x^2 = \frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N-1}$
Standard deviation	$S_x = \sqrt{S_x^2}$
Asymmetry	$A = \frac{\sum_{i=1}^N (X_i - \bar{X})^3}{S_x^3 \cdot N}$
Excess	$E = \frac{\sum_{i=1}^N (X_i - \bar{X})^4}{S_x^4 \cdot N} - 3$



The differences in the statistical indicators based on the results of the testing of the male and female students' has been considered. At first glance, the statistical characteristics of the central tendency and the variation of the test individual scores of male students' differ little from the same statistical characteristics of the test individual scores of female students'. This means that gender differences in the teaching of freshmen in higher mathematics are not significant. But significant differences in the numerical characteristics of the form are noticeable.

Statistical indicators of test results

Characteristic	Quantitative value of the characteristic for male students'	Quantitative value of the characteristic for female students'
Mean	18,846	18,375
Mode	19	19,5
Median	19	19
Variance	3,47	3,05
Standard deviation	1,86	1,75
Asymmetry	0,537	-0,491
Excess	-0,389	-0,747





Funded by the
Erasmus+ Programme
of the European Union

CHAPTER 2. ELEMENTS OF STATISTICAL ANALYSIS OF GENDER STUDIES EMPIRICAL DATA IN BEHAVIORAL SCIENCES

РОЗДІЛ 2. ЕЛЕМЕНТИ СТАТИСТИЧНОГО АНАЛІЗУ ЕМПІРИЧНИХ ДАНИХ ГЕНДЕРНИХ ДОСЛІДЖЕНЬ В ПОВЕДІНКОВИХ НАУКАХ

- 2.1. The comparison of the statistical characteristics of the different samples.**
- 2.2. Establishing dependencies between different signs in the sample.**
- 2.3. Nonparametric tests of differences (dissimilarities).**

2.1 The comparison of the statistical characteristics of the different samples

The possibilities of selection comparison with the account of the average data variation, testing for statistical homogeneity are given there. The algorithms for using the criteria are given. Theory is supplemented with examples of their use in the process of gender studies.

2.2 Establishing dependencies between different signs in the sample

In this paragraph the elements of correlation-regression analysis of dependency between different features in the selection is considered; mathematical methods of determining parameters of regression linear equation; pair and rank correlation. Particular attention is paid to determining the significance of the distinguished indexes of correlation. The series of examples of applying theoretical material in gender research is given.



2.3 Nonparametric tests of differences (dissimilarities)

Nonparametric criteria of differences (divergences): the criteria of Q-Rosenbaum and U-Mann Whitney, criterion of signs, criterion Wilcoxon, serial criterion and other criteria are considered. A brief description of the method of expert evaluations is given.



Funded by the
Erasmus+ Programme
of the European Union



EXAMPLE

Study the differences between the level of educational achievements of the male and female students' using quantitative methods (The Q- Rosenbaum and U-Mann-Whitney's criteria):

Male: 19, 18, 22, 16, 17, 21, 19, 19, 18, 17, 18, 22, 19

Female: 16, 19, 20, 21, 20, 15, 18, 16, 20, 19, 17, 19, 18,
19, 20, 17



The level of educational achievements of students of higher mathematics has been analyzed, using the Q-Rosenbaum criterion.

The hypothesis of the research has been formulated as follows:

The main: H_0 the level of educational achievements of the male students' in the course "The Higher Mathematics", is not higher than the level of educational achievements of the female students' in this course.

The alternative: H_a : the level of educational achievements of male students' exceeds the level of educational achievements of female students' in this course.

The table of the ordered total individual scores of students according to test results in higher mathematics

Male students		Female Students	
№	Total number of test scores	№	Total number of test scores
1.	22		
2.	22		
3.	21	1.	21
		2.	20
		3.	20
		4.	20
		5.	20
4.	19	6.	19
5.	19	7.	19
6.	19	8.	19
7.	19	9.	19
8.	18	10.	18
9.	18	11.	18
10.	18		
11.	17	12.	17
12.	17	13.	17
13.	16	14.	16
		15.	16
		16.	15

Table of ordering of individual students test scores

$$Q_{exp} = 1+2=3$$

$$Q_{st} = 7, \text{ (for } a=0,05, n_1=13, n_2=16)$$

Thus, $Q_{exp} < Q_{st}$, the main hypothesis of our research is accepted



Funded by the
Erasmus+ Programme
of the European Union



The level of educational achievements of students of higher mathematics has been analysed, using the U-Mann-Whitney's criterion.

The hypothesis of our research is formulated as follows:

The main H_0 : the level educational achievements of the female students' in the course «The Higher Mathematics» **is not lower** than the level of the educational achievements the male students' in this course.

Alternative H_a : the level educational achievements of the female students' in the course «The Higher Mathematics» **is lower** than the level of the educational achievements the male students' in this course.



The empirical criterion value is calculated by the formula:

$$U = n_1 \cdot n_2 + \frac{n_{\max} \cdot (n_{\max} + 1)}{2} - T_{\max}$$

where n_1 , n_2 are independent samples' volumes, n_{\max} is the biggest sample's volume, T_{\max} is the largest of the rank-sums.

$$U_{\text{acc}} = 13 \cdot 16 + \frac{16 \cdot (16 + 1)}{2} - 232,5 = 111,5.$$

Table of ordering and ranking of individual students test scores
to test results in higher mathematics

Male students			Female Students		
№	Total number of test scores	Ранг, R_1	№	Total number of test scores	Ранг, R_2
1.	22	28,5			
2.	22	28,5			
3.	21	26,5	1.	21	26,5
			2.	20	23,5
			3.	20	23,5
			4.	20	23,5
			5.	20	23,5
4.	19	17,5	6.	19	17,5
5.	19	17,5	7.	19	17,5
6.	19	17,5	8.	19	17,5
7.	19	17,5	9.	19	17,5
8.	18	11	10.	18	11
9.	18	11	11.	18	11
10.	18	11			
11.	17	6,5	12.	17	6,5
12.	17	6,5	13.	17	6,5
13.	16	3	14.	16	3
			15.	16	3
			16.	15	1
		$\sum R_1 = 202,5$			$\sum R_2 = 232,5$

Table of ordering and ranking of individual students test scores

$$U_{exp} = 111,5$$

$$U_{st} = 65, \text{ (for } a=0,05, n_1=13, n_2=16)$$

Thus, $U_{exp} > U_{st}$, the main hypothesis of our research is accepted

- *Statistical conclusion:* the main hypothesis of our research is accepted. The level of the female students' educational achievements in the course «The Higher Mathematics» is not lower than the level of the male students' educational achievements in this course.
-

Thank you for attention!



Funded by the
Erasmus+ Programme
of the European Union

