Department of: Statistics

College of: Administration & Economics

University of: Salahaddin University - Erbil

Subject: Non-Parametric Tests

Course Book – master

Lecturer's name: Nazeera S. Kareem (PhD)

Academic Year: 2023/2024

Course Book

1. Course name	**Numerical Analysis**

2.Lecturer in charge	**Nazeera S.Kareem**
3.Department/ College	**Statistics/ Administration & Economics**
4. Contact	**e-mail: nazeera.kareem@su.edu.krd** **nazeera.barznji@gmail.com** **Tel: (optional)٠٧٥٠٤٨١٢٥٥٠**
5. Time (in hours) per week	**Theory: 2 hours** **Practical: 1 hour**
6. Office hours	**20 hours per week**
7. Course code	**SAE104**
8.Teacher's academic profile	• **BSC(Statistics department)(College Administration & Economics) from (The University of Sulaimania)** • **MSC (Statistics department)(College Administration & Economics) from (The University of Salahaddin-Erbil)(2001)** • **PHD (Statistics department)(College Administration & Economics) from the(University of Salahaddin-Erbil) (2015)** • **Assistant researcher(College Administration & Economics)1980** • **Assistant lecturer (The University of Salahaddin -Erbil) (2006)** • **Lecturer(2015)(The University of Salahaddin - Erbil)** • **Assistant Prof.(2019))(The University of Salahaddin -Erbil)** • **Teaching from (43) years at the University of Salahaddin -Erbil)** **The Subjects that I taught:** -Non Parametric Statistical test (Master- Statistics department) (Numerical Analysis --2nd Stage) (Statistics department) (Numerical Analysis with R programming Language --2nd Stage) (Statistics department)

	- (Advanced Statistics--2nd Stage) (Economics department) -(Principle of Statistics--1st Stage)(Economics department) -(Principle of Statistics--1st Stage) (Administration department) -(Computer- M.S. Excel)-- 2nd Stage) (Administration department) -(Principle of Mathematics--1st Stage) (Finance and Banks department) -(Academic Debate --1st Stage) (Statistics department)- -(Methodical Research --4st Stage) (Statistics department)- • **The researches that I had accomplished** 1-PhD (A Dissertation) about [Genetic Effects using R-QTL Statistical Analysis after Chemical Attack on Survivors in Halabja- kurdistan 2- MSC(Thesis) Statistical Study in Analyzing the Chemical Structure of Some Carbonic Rocks in Kurdistan-Iraq 3- (Women and education)for-conference about the reality of women (in the global women's day) it took 3 days (3 / 11-8 / 2008) 4- (University leadership) in conference the Ministry of Higher Education and Scientific research 2008 5- (Using Entropy in Kurdish poetry(homeland) from poet Fayaq Bekas in work shop for World Statistics Day(20/10/2015) 6- construction robust simple linear regression profile monitoring(Simulation study) (7/3/2017) 7- De-noise data by using Multivariate Wavelets in the Path analysis with application 8-Entropy- in the Kurdish Poetry of poets (Fayaq Bekas) and (Goran) 9-Logistic Regression and Discriminant analysis to identify the risk of Diabetes 10-Constructing mathematical Models, by Interpolation Methods, of people's interest to listening to Quran's voice or music 11-تقليل ضوضائية البيانات للتحليل التمييزي باستخدام مويجات (متعددة المتغيرات)(محاكاة مع تطبيق عملي)

	12- **Languages** -Kurdish the mother language -English -Arabic
9. Keywords	

A statistical method is called ***non-parametric*** if it makes no assumption on the population distribution or sample size. This is in contrast with most parametric methods in elementary statistics that assume that the data set used is quantitative, the population has a normal distribution and the sample size is sufficiently large. In general, conclusions drawn from non-parametric methods are not as powerful as the parametric ones. However, as non-parametric methods make fewer assumptions, they are more flexible, more robust, and applicable to non-quantitative data.

This book is designed for students to acquire basic skills needed for solving real life problems where data meet minimal assumption and secondly to beef up their reading list as well as provide them with a "one shop stop" textbook on Nonparametric.

Our Approach

This book is an introduction to basic ideas and techniques of nonparametric statistical methods and is intended to prepare students of the sciences as well as the humanities, for a better understanding of some underlying explanations of real life situations. Researchers will find the text useful since it provides a step-by-step presentation of procedures, use of more practical data sets, and new problems from real-life situations. The book continues to emphasize the importance of nonparametric methods as a significant branch of modern statistics and equips readers with the conceptual and technical skills necessary to select and apply the appropriate procedures for any given situation.

Written by leading statisticians, ***Introduction to Nonparametric Statistical Methods***, provides readers with crucial nonparametric techniques in a variety of settings, emphasizing the assumptions underlying the methods. The book provides an extensive array of examples that clearly illustrate how to use nonparametric approaches for handling one- or two-sample location and dispersion problems, dichotomous data, one-way analysis of variance, rank tests, goodness-of-fit tests and tests of randomness.

A wide range of topics is covered in this text although the treatment is limited to the elementary level. There are solved, partly solved and unsolved assignments with every section, to make the student or reader familiar with the methods introduced.

11. Course objective:

The typical introductory courses in hypothesis-testing and confidence interval examine primarily parametric statistical procedures. A main feature of these statistical procedures is the assumption that we are working with random samples from normal populations. These procedures are known as ***parametric methods*** because they are based on a particular parametric family of distributions – in this case, the normal. For example, given a set of independent observations from a normal distribution, we often want to infer something about the unknown parameters. Here the *t*-test is usually used to determine whether or not the hypothesized value for the population mean should be rejected or not. More usefully, we may construct a confidence interval for the 'true' population mean. 0 □

Parametric inference is sometimes inappropriate or even impossible. To assume that samples come from any specified family of distributions may be unreasonable. For example, we may not have examination marks for each candidate but know only the numbers of candidates who obtained the ordered grades *A*, *B*+, *B*, *B*–, *C*+, *C*, *D* and *F*. Given these grade distributions for two different courses, we may want to know if they indicate a difference in performance between the two courses. In this case it is inappropriate to use the traditional (parametric) method of analysis.

In this book we describe procedures called ***nonparametric*** and ***distribution-free methods*.** Nonparametric methods provide an alternative series of statistical methods that require no or very limited assumptions to be made about the data. These methods are most often used to analyse data which do not meet the distributional requirements of parametric methods. In particular, skewed data are frequently analysed by non-parametric methods, although data transformation can sometimes make the data suitable for parametric analyses. These procedures have considerable appeal. One of their advantages is that the data need not be quantitative but can be categorical (such as yes or no) or rank data.

Generally, if both parametric and nonparametric methods are applicable to a particular problem, we should use the more efficient parametric method.

12. Student's obligation

The role of students and their obligations

1-The student attendance to lecture at the time and place as scheduled
by the head of department

2- Preparing the home work

3- Solving the problem(exercise) on the whiteboard by the students

4- The student is ready for the sudden exam on the material is described before (Most of the homework exercises will come after explaining theorems or applications on computer).

5- Enquiry the student of topics mysterious and unintelligible in leisure time of lecturer

6- Preparing the student for daily tests (quiz) after clarify and explain Article The main technique will be used in the lectures. At the beginning of each lecture I will inquire students if they were reading the previous lecture by 5 Minutes (quiz).

7-After complementing explaining the lecture I encourage student to ask questions if they are unable to ask their questions in class, then they may ask outside of class in any time I am in the office.

13. Forms of teaching

The course is structured in lectures and exercises in the computer laboratory. More precisely, the lectures on the numerical methods for differential problems described by ordinary or partial differential equations are followed by laboratory exercises aimed at implementing these methods in R and developing an adequate sensitivity and awareness of their use.

To accomplish acceptable outcome the lecturer use several methods to explain and clarify the lecture

1- Power point presentation for, title of theorem, definitions, graph, results general formula, Exercises.
2- Use Data Show to view PowerPoint representation.
2- White board using to prove theories and solutions for examples or exercise**.**

14. Assessment scheme

The exam aims to verify the achievement of the following educational objectives:

- Knowledge of the numerical-mathematical aspects and of the main algorithmic methodologies that deal with the numerical solution

- Ability to solve real problems of interest in numerical methods and writing the corresponding algorithms in R.

The end-of-course exam (the evaluation of which is in thirtieths) will take place in a single test which includes both the development of R codes for the numerical solution of problems, and the written answer to theoretical questions on the topics covered in the lessons.

During the test, the use of support material such as textbooks, notes, computer supports is not allowed.

-Daily students activity(quiz, homework , attendance,)

15. Student learning outcome:

The course includes a laboratory activity in which the R software will be used. The corresponding teaching material will be made available to the student in electronic format and will be downloadable Internet

It is well known that the use of numerical methods for the analysis systems has been increasing at a rapid rate. Therefore, this course is intended to better prepare future

computational scientists, in understanding the fundamentals of numerical methods, especially their application, limitations, and potentials. The course will cover the classical fundamental topics in numerical methods the viewpoint will be modern, with connections made between each topic and a variety of applications. By the end of the course, the student should not only be familiar, but more confident, in effectively using numerical tools to solve problems in their own field of interest. In particular, the students will become proficient in: Understanding the theoretical and practical aspects of the use of numerical methods implementing numerical methods for a variety of multidisciplinary applications establishing the limitations, advantages, and disadvantages of numerical methods the expected learning outcomes for the course will be assessed through: Exams, home works, in- class activities and class discussions. In this course, the emphasis will be to apply well-known numerical techniques to solve engineering problems and evaluate the results. The objective will be to train students to understand why the methods work, what type of errors to expect, and when an application might lead to difficulties. In particular, the students will become proficient in:

The expected learning outcomes for the course will be assessed through Exams, home works, in- class activities and class discussions. 1.Understanding the theoretical and practical aspects of the use of numerical methods

2.Implementing numerical methods for a variety of multidisciplinary applications

3.Establishing the limitations, advantages, and disadvantages of nonparametric

4. The students should be able to select from alternative methods the one method that is most appropriate for a specific problem.

5. The students should be able to formulate questions to solve problems.

6. They should understand the limitations of each numerical method, especially the conditions under which they fail to converge to a solution. nonparametric testing have become essential in many areas of modern life in the list of immense and extends across most major disciplines and fields of work.

1-Advanced nonparametric methods are essential in making numerical weather prediction feasible. weather, monitor climate change,

2-It is used to predict pick out stock market trends, compute actuarial data Insurance companies use numerical programs for actuarial analysis.

3- Computing the trajectory of a spacecraft requires the accurate numerical solution of a system of ordinary differential equations.

4- Car companies can improve the crash safety of their vehicles by using computer simulations of car crashes. Such simulations essentially consist of solving partial differential equations numerically.

5- Hedge funds (private investment funds) use tools from all fields of numerical analysis to attempt to calculate the value of stocks and derivatives more precisely than other market participants.

Advantages of nonparametric statistics

The following are some of the advantages of the available nonparametric statistical

procedures.

1. Make fewer assumptions.

Nonparametric Statistical Procedures are procedures that generally do not need rigid parametric assumptions with regards to the populations from which the data are taken.

2. Wider scope.

Since there are fewer assumptions that are made about the sample being studied, nonparametric statistics are usually wider in scope as compared to parametric statistics that actually assume a distribution.

3. Need not involve population parameters.

Parametric tests involve specific probability distributions (e.g., the normal distribution) and the tests involve estimation of the key parameters of that distribution (e.g., the mean or difference in means) from the sample data. However, nonparametric tests need not involve population parameters.

4. The chance of their being improperly used is small.

Since most nonparametric procedures depend on a minimum set of assumptions, the chance of their being improperly used is small.

5. Applicable even when data is measured on a weak measurement scale.

For interval or ratio data, you may use a parametric test *depending* on the shape of the distribution. Non-parametric test can be performed even when you are working with data that is nominal or ordinal.

6. Easy to understand.

Researchers with minimum preparation in Mathematics and Statistics usually find nonparametric procedures easy to understand.

7. Computations can quickly and easily be performed.

Nonparametric tests usually can be performed quickly and easily without automated instruments (calculators and computers). They are designed for small numbers of data

16. Course Reading List and References:

- Key references:

References

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17. The Topics:	**Lecturer's name**
	(6hrs) 27/1/2021
Chapter One **1.1 Introduction[Parametric and nonparametric methods]** **1.2 Advantages of parametric tests and Nonparametric tests** **1.3 Hypothesis Testing Procedures for parametric tests and Non Parametric tests** **Chapter Two** **2.One-Sample Nonparametric** **2.1 The one-sample sign test** **2.1.1 Assumptions** **2.1.2Hypotheses** **2.1.3 Large sample approximation** **2.1.4 Confidence interval for the median based on the sign test**	(10hrs) 12/2/2021

2.2 The Wilcoxon signed-ranks test **2.2.1Assumptions** **2.2.2 Hypotheses** **2.2.3 Test statistic** **2.2.4 Carrying out the Wilcoxon signed ranks test** **2.2.3 The one-sample runs test for randomness**	
Chapter Three **Two Independent Samples** **3.1The Mann-Whitney (Wilcoxon rank-sum) test** **3.1.1** Assumptions **3.1.2** Hypotheses **3.1.3 Large-Sample Approximation** **3. 2 The two-sample runs test for randomness**	(7hrs) 11/3/2021
Chapter Four **4. Three or More Independent Samples** **4.1** Introduction **4.2** Extension of the median test **4.3** The Kruskal-Wallis one-way analysis of variance by Ranks **4.1.1** Assumptions **4.1.2** Hypotheses	(10hrs) 27/3/2021
Chapter Five **5.Chi-Square Test of Homogeneity and Independence** **5.1** Introduction **5.2** The chi-square test of homogeneity **5.3** The chi-square test of independence **5.1.1** Assumptions **5.1.2**	(7hrs) 15/4/2021
Chapter Six:Randomness **Runs Test** **6.1.1 Assumptions** **6.1.2 Hypotheses** **Chapter Seven:Confidence interval** **for the median based on the sign test** **Chapter Eight:Goodness-of-Fit Tests** **8.1** Introduction **8.2** The chi-square goodness-of-fit test **8.3** Kolmogorov-Smirnov goodness-of-fit test **8.3.1** The Kolmogorov–Smirnov goodness-of-fit test	(9hrs) 25/4/2017

for a single sample **8.3.2** The Kolmogorov–Smirnov two-sample test **Chapter Nine Computer Application** 9.1Rank Correlation 9.1.1 Spearman's rank correlation 9.2 Procedures Using Data from Three or More Related Samples 9.2.1 Friedman two-way analysis of variance by ranks 9.2.2 Kendall's rank correlation coefficient 9.2.3 cochran 9.3 Two related Samples 9.3 .1-McNemar 9.3 .2The Wald-Wolfowitz 9.4 Several Independent Samples 9.4.1 Jonckheere terpstra 9.5 one sample Kolmogorov–Smirnov	

19. Examinations:

(Practical) This type of tests are depend on the basis that the questions include practical issues on R programming language to be resolved based on the theories and equations which will be used by students through

20. Extra notes:

Discussing Review Article

21. Peer review: