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**Department of Statistics**

**College of Administration and Economics**

**University of Salahaddin-Erbil**

**Subject: Statistical Inference**

**Course Book – Fourth Stage**

**Academic Year: 2022-2023**

**Course Book**

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| **1. Course name** | **Statistical Inference** | |
| **2. Lecturer in charge** | **Dr. Luceen Immanuel Kework** | |
| **3. Department/ College** | **Statistics/ Administration and Economics** | |
| **4. Contact** |  | |
| **5. Time (in hours) per week** |  | |
| **6. Office hours** |  | |
| **7. Course code** |  | |
| **8. Teacher's academic profile** |  | |
| **9. Keywords** | **Probability Distributions of Random Variables.**  **Transformations,** **Order Statistics, Point and Interval Estimation, Unbiasedness, Consistency and Sufficiency Estimator, Completenes,**  **Uniqueness,**   **Efficiency , Fisher Information , Maximum Likelihood Estimation . Minimum Variance Method Bayesian Estimation Method, Interval Estimation**  **Neyman -Pearson Theorem, Testing of Statistical Hypotheses.** | |
| **10. Course overview:**  **Statistical Inference is considered a topic in department of statistics, because at the beginning the student will get familiar with statistical distribution most of the researches are depending on this distributions for analyzing data.**  **-Via statistics students will learn proving any rules and how they formed, we will make students learn them especially according to their distributions.**  **-How distribution of functions is found in different researches.**  **-How proved the properties of best estimators to discrete and continuous distributions.**  **-How is estimate the parameters of population by traditional method or by Bayesian method.**  **- How testing of Hypotheses for parameters of population.**  **The most important things that the students should keep the subject under control, we should take this point into consideration.**  **1. The important of the subjects in mathematical statistics in the third stage, students should review the basic rules.**  **2. Memorizing or recognizing statistical rules which are (24) basic rules that we always take them into consideration.**  **3. Students should make a connection between the previous subject and current one.**  **4. While displaying important points students should write them down because these notes are crucial for solving the questions.**  **5. Following up those questions that are left unsolved students should do their best to solve them.** | | |
| **11. Course objective:**  **1. Know what is Inference?**  **2. Know what is the estimation of parameter?**  **3. Understand hypothesis testing & the “types of errors” in decision making.**  **4. Know what the α-level means.**  **5. Learn how to use test statistics to examine hypothesis about population mean, proportion.**  **This course is divided into two parts. The first part deals with estimation (point estimation and confidence intervals), properties of an estimator, methods for finding estimators, and the second part deals with hypothesis tests.**  **Statistical inference is a formal process of using sample data to answer questions or to draw conclusions about a population (Estimating population parameters and testing hypotheses). Confidence intervals provide a method for using sample data to construct estimates of population characteristics, whereas hypothesis tests allow us to use sample data to decide between two competing claims, called hypotheses, about a population characteristic. Although confidence intervals and hypothesis tests are generally used for different purposes, they share a common goal of generalizing from a sample to a population.** | | |
| **12. Student's obligation**  **The attendance and completion of all tests, exams, assignments, reports.** | | |
| **13. Forms of teaching**  **Different forms of teaching will be used to reach the objectives of the course: data show PowerPoint presentations for the head titles and summary of conclusion, classification of material and any other illustrations. There will be classroom discussions and the lecture will give enough background to translate, solve,**  **analyze, derive, and evaluate problems by using white board.** | | |
| **14. Assessment scheme**  **Grading: Grades will be assigned on a curve, using the following percentages: 5% report, 5% Quizzes and the presence and absence of students, 30% Exams, 60% Final and Pass: 50%.** | | |
| **15. Student learning outcome:**  **The clarity of the basic objectives of subject for students, namely;**  **They Learned how to find distribution of random variables of functions by using transformation technique, and order statistics function (discrete or continuous) in univariate and bivariate cases, and how to apply it in real life. They knew the properties of best estimators for the population parameters, They knew how to estimates the population parameters.**  **Content article is appropriate to the requirements of the outside world and the labour market because it deals with all types of data in the outside world and the labour market.**  **The new things that the student learn through this article are: Learned how to test the hypotheses. Learned all the details about the common continuous and discrete distributions in the population and how to deal with it.** | | |
| **16. Course Reading List and References‌:**  **1. Introduction to Mathematical Statistics, 5th edition; By Robert V. Hogg and Craig,1995.**  **2. Introduction to Probability Theory and Statistical Inference, 3rd edition; By Harold J. Larson, 1982.**  **3. Statistical inference / George Casella, Roger L. Berger.-2nd edition 2002.**  **4. Principles of Statistical Inference, D.R. Cox, 2006.**  **5. An introduction to Probability and Mathematical Statistics, Rohatgi, V.K. , 1976.**  **6. Theory of Point Estimation, E.L. Lehmann George Casella 2nd edition 1998.**  **7. Statistical Distributions. Merran Evans, Nicholas Hastings, Brian Peacock, 3rd Edition, 2000.**  **8. Mathematical Statistics. Ferguson, T.S. 1968.**  **9. Statistical inference. Silvey 1973.**  **10. Bayesian Inference in Statistical Analysis. Box and Tiro 1973.**  **11. The Theory of Statistical Inference. Zacks, S.**  **12. Introduction to Probability and Statistical Inference. George Roussas 2003.**  **13. Probability and Mathematical Statistics. Prasanna Sahoo 2013.** | | |
| **17. The Topics: Contents** | | **Lecturer's name** |

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| **First week**  **4 hrs**  **2019 / 10 / 6** | **Review subjects and laws of Mathematical Statistics, Statistical Distributions, Discrete and Continuous.** |
| **Second week**  **4 hrs**  **2019 / 10 / 13** | **Distributions of Functions of Random Variables( Discrete & Continuous).** |
| **Third week**  **4 hrs**  **2019 / 10 / 20** | **Distribution of Order Statistics.** |
| **Fourth week**  **4 hrs**  **2019/ 10 / 27** | **Statistical Inference**  **Concepts and Important Definitions about Statistical Inference.** |
| **Fifth week**  **4 hrs**  **2019 / 11 / 3** | **Estimation of Parameters (Point Estimation) (properties of an estimator)**  **Unbiasedness.** |
| **Sixth week**  **4 hrs**  **2019 / 11 / 10** | **Biased Part & Unbiased in Limit Mean Square Error** |
| **Seventh week**  **4 hrs**  **2019 / 11/ 17** | **Consistency Estimator, The Score Function** |
| **Eighth week**  **4 hrs**  **2019 / 11/ 24** | **Sufficiency (method 1)** |
| **Ninth week**  **4 hrs**  **2019 / 12 / 1** | **Sufficiency (method 2 conditional)** |
| **Tenth week**  **4 hrs**  **2019 / 12 / 8** | **Sufficiency (method 3 factorization)** |
| **Eleven week**  **4 hrs**  **2019 / 12 / 15** | **Joint Sufficient Estimator**  **Exam 1** |
| **Twelve week**  **4 hrs**  **2019 / 12 / 22** | **The Exponential Class of Probability Density Functions** |
| **Thirteenth week**  **4 hrs**  **2019/ 12 / 29** | **The Rao-Blackwell Theorem**  **Examples of Rao-Blackwell Theorem** |
| **Fourteenth week**  **4 hrs**  **2020/ 1 / 5** | **Completeness** |
| **Fifteenth week**  **4 hrs**  **2020/ 1 / 12** | **Uniqueness Estimator (M.V.U.E)** |
| **Sixteenth week**  **4 hrs**  **2020/ 1 / 19** | **Efficiency (Relative Efficiency)** |
| **Seventeenth week**  **4 hrs**  **2020 / 1 / 26** | **Fisher Information** |
| **Eighteenth week**  **4 hrs**  **2020 / 2 / 2** | **The Rao- Cramer Inequality**  **Cramer-Rao Lower Bound** |
| **Nineteenth week**  **4 hrs**  **2020 / 2 / 9** | **Examples of Cramer-Rao Lower Bound**  **Exam 2** |
| **Twenty week**  **4 hrs**  **2020 / 2 / 16** | **Efficient Estimator, Mean Square Error,**  **Relative Efficient Estimator** |
| **Twenty one week**  **4 hrs**  **2020/ 2 / 23** | **Methods of Estimation**  **First: Maximum Likelihood Estimation** |
| **Twenty Two week**  **4 hrs**  **2020 / 3 / 1** | **Second: Moments Estimation Method** |
| **Twenty Three week 4 hrs**  **2020/ 4 / 5** | **Third: Minimum Variance Method** |
| **Twenty Four week**  **4 hrs**  **2020 / 4 / 12** | **Fourth: Bayesian Estimation Method**  **(Non-informative prior)** |
| **Twenty Five week 4 hrs**  **2020 / 4/ 19** | **Bayesian method (Informative prior)**  **Applications of Bayesian method** |
| **Twenty Six week**  **4 hrs**  **2020 / 4 / 26** | **Interval Estimation**  **- Confidence Interval for Means when the Variance is Known.**  **- Confidence Interval for Means when the Variance is Unknown.**  **- Confidence Interval For Difference Between Two Means.**  **- Confidence Interval For The Variance.**  **Exam 3** |
| **Twenty Seven week 4 hrs**  **2020/ 5 / 3** | **Testing of Statistical Hypotheses** |
| **Twenty Eight week**  **4 hrs**  **2020 / 5 / 10** | **Neyman -Pearson Theorem** |
| **Twenty Nine week**  **4 hrs**  **2020 / 5 / 17** | **Uniformly Most Powerful Test** |
| **Thirty week**  **4 hrs**  **2020 / 5 / 24** | **Likelihood Ratio Test** |
| **Thirty One week**  **4 hrs**  **2020/ 5 / 31** | **Examples on Likelihood Ratio Test** |

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| **18. Practical Topics (If there is any)** |  |
| **There isn’t any Practical Topics** | |
| **19. Examinations:**  **Q1:** let X1, X2,…, X*n* be a rssn taken from Exp(*θ*), let Y1 < Y2 < … < Y*n*be the order statistics of this sample. **Find** g(y2)  **Sol.:** X ~ Exp(*θ*)    **Q2: In a random sample of size (*n*) from normal distn N(*θ*, σ2). Is**  **unbiased estimator for the parameter (*σ*2).**  **Sol:** | |
| **20. Extra notes:**  **There isn’t any extra notes or comments** | |
| **21. Peer reviewپێداچوونه‌وه‌ی هاوه‌ڵ** | |