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**Department of Statistics**

**College of Administration&Economy**

**University of Salahaddin**

**Subject: Bayesian Decision Theory**

**Course Book – (Year 3)**

**Lecturer's name:Huda Qardagh Yalda**

**Academic Year: 2022/2023**

**Course Book**

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| **1. Course name** | **Decision Theory** |
| **2. Lecturer in charge** | **Huda Qardagh Yalda** |
| **3. Department/ College** | **Statistics – Administration & Economics College** |
| **4. Contact** | **e-mail:Huda.yalda @Yahoo.com**  **Tel.0750 4874330** |
| **5. Time (in hours) per week** | **Theory: 2 hours**  **Practical: 1houes** |
| **6. Office hours** | **2 per week** |
| **7. Course code** | **SAE102** |
| **8. Teacher's academic profile** | **I born in Erbil- Iraq on 1967 . At Administration & Economics College – Salahaddin university , Salahaddin**  **-MSC ( Statistic Department ) (College Administration & Economics– Salahaddin university , Salahaddin ) 2000**  **Assistant lecturer (2001) The university of Salahaddin Erbil**  **Lecturer (2014) The university of Salahaddin- Erbil**  **Teaching from (16) years at The university of Salahaddin- Erbil**  **The Subjects That I taught**  **-(Statistic – 1th Stage ) (Account dep.)**  **-(Computer-1th Stage) (Account dep. And Administration dep. )**  **-(Linear Al-gerbera- 2 th stage) (Stat. dep.)**  **-(Math. Stats.- 3th stage) (Stat. dep.)**  **-Decision Theory-3th stage) (Stat. dep.)**  **Multivariate Aanlysis -4th stage) (Stat. dep.)**  **The Number of researches that I had accomplished (2)**  **The Language**  **Arabic**  **Kurdish**  **English** |
| **9. Keywords** | Multivariate Normal Dist. Var.-Cov.Matrix Correlation (Multiple and partial corr.) Eigen Values. |
| **10. Course overview:**  Multivariate analysis consists of a collection of methods that can be used when several measurements are made on each individual or object in one or more samples. We will refer to the measurements as variables and to the individuals or objects as units (research units, sampling units, or experimental units) or observations. In practice, multivariate data sets are common, although they are not always analyzed as such. But the exclusive use of Univariate procedures with such data is no longer excusable, given the availability of multivariate techniques and inexpensive computing power to carry them out.▪  Historically, the bulk of applications of multivariate techniques have been in the behavioral and biological sciences. However, interest in multivariate methods has now spread to numerous other fields of investigation. For example, I have collaborated on multivariate problems with researchers in education, chemistry, physics, geology, engineering, law, business, literature, religion, public broadcasting, nursing, mining, linguistics, biology, psychology, and many other fields.  The statistical prerequisites are basic familiarity with the normal distribution, t-tests, confidence intervals, multiple regression, and analysis of variance. These techniques are reviewed as each is extended to the analogous multivariate procedure. This is a multivariate methods text. Most of the results are given without proof. In a few cases proofs are provided, but the major emphasis is on heuristic explanations. Our goal is an intuitive grasp of multivariate analysis, in the same mode as other statistical methods courses. Some problems are algebraic in nature, but the majority involve data sets to be | |
| **11. Course objective:**  **After completing the study of this subject through the academic year the students will be able to understanding these subjects (In English language):**  I have formulated three objectives that I hope this lectures will achieve for the student. These objectives are based on long experience teaching a course in multivariate methods, consulting on multivariate problems with researchers in many fields, and guiding statistics graduate students as they consulted with similar clients.  The first objective is to gain a thorough understanding of the details of various multivariate techniques, their purposes, their assumptions, their limitations, and so on. Many of these techniques are related; yet they differ in some essential ways. We emphasize these similarities and differences.  The second objective is to be able to select one or more appropriate techniques for a given multivariate data set. Recognizing the essential nature of a multivariate data set is the first step in a meaningful analysis.  Ministry of Higher Education and Scientific research  The third objective is to be able to interpret the results of a computer analysis of a multivariate data | |
| **12. Student's obligation**  Students commitment to come to the lecture by the times specified in the weekly schedule, and is located on the student's responsibility to cooperate with the teacher in the discussion of the ideas raised during the lecture. As well as the need for collective participation by students to solve the questions and exercises that put on the lecture in addition to the questions that are required to be resolved outside the times of the lecture (Homework).  The student should be preparing for sudden exams (Quizzes) that may accrue by the teacher to ascertain the extent of follow-up of article was dominate in time of need. | |
| **13. Forms of teaching**  To get best understanding to the students the lecturer use different forms of teaching such as:  Power point presentation for the head titles, definitions, figures, summary of conclusions.  The traditional method of teaching (Chalk and talk).  Solving the examples by shearing the students to get them will understand.  Classroom discussions. | |
| 14. Assessment scheme  During the study , the students are required to do two closed book examinations ; there will be an examination in the first course of 15 marks , and the second examination in the second course of 20 marks , and 3 marks to write a report analytic using real data or quizzes . The remaining marks scores for daily activities .There will be a final examination of 60 marks. | |
| 15. Student learning outcome:  Student learning that each data type has extensions and various combinations of the four are possible.  A few examples of analyses for each case are as follows:  **1.** A single sample with several variables measured on each sampling unit:  **(a)** Test the hypothesis that the means of the variables have specified values.  **(b)** Test the hypothesis that the variables are uncorrelated and have a common variance.  **(c)** Find a small set of linear combinations of the original variables that summarizes  most of the variation in the data (principal components).  **(d)** Express the original variables as linear functions of a smaller set of underlying  variables that account for the original variables and their intercorrelations (factor analysis).  **2.** A single sample with two sets of variables measured on each unit:  **(a)** Determine the number, the size, and the nature of relationships between the two sets of variables (canonical correlation). For example, you may wish to relate a set of interest variables to a set of achievement variables. How much overall correlation is there between these two sets?  **(b)** Find a model to predict one set of variables from the other set (multivariate multiple regression).  **3.** Two samples with several variables measured on each unit:  **(a)** Compare the means of the variables across the two samples (Hotelling’s *T* 2-test).  **(b)** Find a linear combination of the variables that best separates the two samples  (discriminant analysis).  **(c)** Find a function of the variables that accurately allocates the units into the two groups (classification analysis).  **4.** Three or more samples with several variables measured on each unit:  **(a)** Compare the means of the variables across the groups (multivariate analysis  of variance).  **(b)** Extension of 3(b) to more than two groups.  **(c)** Extension of 3(c) to more than two groups. | |
| **16. Course Reading List and References :**  1- Benz´ecri, J.-P. (1992), *Correspondence Analysis Handbook*, New York: Marcel Dekker.  2- Bock, R. D. (1963), ―Multivariate Analysis of Variance of Repeated Measurements,‖ in *Problems of Measuring Change*, C. W. Harris (ed.), Madison, Wis.: University of Wisconsin Press, pp. 85–103.  3- Bock, R. D. (1975), *Multivariate Statistical Methods in Behavioral Research*, New York: McGraw-Hill.  4- Box, G. E. P. (1954), ―Some Theorems on Quadratic Forms Applied in the Study of Analysis of Variance Problems: II. The Effect of Inequality of Variance and of Correlation between Errors in the Two-Way Classification,‖ *Annals of Mathematical Statistics*.  5- Burdick, R. K. (1979), ―On the Use of Canonical Analysis to Test MANOVA Hypotheses,‖ Presented at the Annual Meeting of the American Statistical Association, Washington, D.C., August 1979.  6- Chambers, J. M., and Kleiner, B. (1982), ―Graphical Techniques for Multivariate Data and for Clustering,‖ in *Handbook of Statistics*, Vol. 2, P. R. Krishnaiah and L. N. Kanal  Ministry of Higher Education and Scientific research  (eds.), New York: North-Holland.  7- Cramer, E.M., and Nicewander,W. A. (1979), ―Some Symmetric, Invariant Measures of Multivariate Association,‖ *Psychometrika*.  8- Davidson, M. L. (1972), ―Univariate versus Multivariate Tests in Repeated Measures Experiments,‖ *Psychological Bulletin*.  . | |

**Subject : Decision Theory**

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| **Week ( 1 ) :** | * The Bayesian decision theory /Prior probability and posterior probability |
| **Week ( 2 )** ; | Problem taking decision of the first type |
| **Week( 3)** | Problems |
| **Week ( 4 ) ;** | **Example :** If the utility function is  the prior prob. for the state of nature ( θ ) is normal dist. Mean equal to ( θ0 ) and var. equal one θ ~ N ( θo, 1 )  **Find :** The Bayes estimation for ( θ ) and Bayes utility of ( θ ) |
| **Week ( 5 )** | * Median/ 1- If the prior prob. for the state of nature is discrete , Then Median is : |
| **Week(6)** | 2- If the prior prob. for the state of nature is continuous, Then Median is : |
| **Week ( 7 ) :** | Example/ consider the following utility T.  If P ( θ1 ) = P (θ2 )  P ( θ1 ) = 2P (θ3 )  **Find :** 1 – The S. utility table  2- The Bayes decision and Bayes utility |
| **Week ( 8)** | * Example / If the prior dist.. for the state of nature is :   1- If the utility function is :  Find the Bayes decision |
| **Week ( 9)** | 2- If the utility function is : u ( d , θ ) = - | d - θ |  Find the Bayes decision  3- If the utility function is :  Find the Bayes decision and Bayes utility . |
| **Week ( 10 )** | **Solution ( 3)** |
| **Week ( 11 )**  **Week ( 12)** | : Problem taking decision of the secone type  Problem taking decision of the secone type | |
| **Week ( 13 ) :**  Week(14) | Example ( 1 )/ consider the following S .utility T.   * And you have the following * information * P ( Z1/ θ1 ) = 2 / 3 P (θ1 ) = P ( Z1/ θ2 ) = 1 / 2 * Also we have observation or two observation was Known about the random variable ( Z ) which are ( Z1,Z2) * **Find : 1-**  If ( Z1 ) is Known , what is Bayes decision depending upon the posterior for the state of nature , and What is the posterior Bayes utility   2-If ( Z2 ) is Known , what is Bayes decision depending upon the posterior for the state of nature , and What is the posterior Bayes utility  3- find posterior Bayes utility |