

Ministry of Higher Education and Scientific research



**Department of Mathematics**

**College of Education**

**University of Salahaddin**

**Subject: Probability and Statistics**

**Course Book: Second year**

**Lecturer's name: Awaz Kakamam Muhammad**

**Academic Year: 2023/2024**



<b>9. Keywords</b>	Descriptive Statistics, Probability Density Function (PDF), Cumulative Distribution Function (CDF), probability distributions for discrete and continues random variable.
<p><b>10. Course overview:</b></p> <p>Probability and Statistics course is designed as one of the main core courses for second year undergraduate students with prior knowledge of basic statistics (Descriptive Statistics) and probability theory.</p> <p>The basic concepts of Statistics and Probability are studied in order to help students in understanding the value of statistics for acquiring cognition, so that preparing them with indepth learning principles of probability. Topics include presenting raw data by arranging them in statistical tables and various charts, probability density function (PDF) and cumulative density function (CDF), discrete and continuous probability distributions with some special types of pdfs including their characteristics as mean, variance and moment generating function. Multivariate random variables topic is a part in this course with studying the relation between two random variables by finding correlation coefficient of them. Finally, the function of univariate and multivariate random variable(s) are discussed.</p>	
<p><b>11. Course objective:</b></p> <p>This course is an introduction for statistics, the fundamental theory of random variable distribution and the multivariate probability distribution will be taken to prepare the students to get ready studying the Mathematical Statistics and Applied Statistics courses. In addition, it is preparing the students conducting graduation projects or researches by doing surveys and analysing data to make conclusions.</p>	
<p><b>12. Course Requirement:</b></p> <ol style="list-style-type: none"> <li>1. Students have an obligation to arrive on time and remain in the classroom for the duration of scheduled classes and activities.</li> <li>2. Students have an obligation to write, homework's, tests and final examinations at the times scheduled by the teacher or the College. Students have an obligation to inform themselves of, and respect, College examination procedures.</li> <li>3. Students have an obligation to show respectful behaviour and appropriate classroom deportment. Should a student be disruptive and/or disrespectful, the teacher has the right to exclude the disruptive student from learning activities (classes) and may refer the case to the director of Student Services under the Student Code of Conduct.</li> <li>4. Electronic/communication devices (including cell phones, mp3 players, etc.) have the effect of disturbing the teacher and other students. All these devices must be turned off and put away. Students who do not observe these rules will be asked to leave the classroom.</li> </ol>	
<p><b>13. Forms of Teaching:</b></p> <p>Different forms of teaching will be used to reach the objectives of these courses to the students: power point presentation for the course outline, head titles, definition, discussion and conclusions. Also, we shall use the blackboard to reach the objects, solving and explaining the examples.</p>	
<p><b>14. Assessment scheme</b></p> <ul style="list-style-type: none"> <li>• Homework and assignments, Quizzes, report, presentation. 10%</li> <li>• Midterm exams 30%</li> </ul>	

- Final exam 60%

**15. Student learning outcome:**

As a result of successfully completing this course, students will be able to use basic statistical instruments, including statistical tables and charts to perform simple statistical analyses for small samples, solve probabilistic problems, and then introduce students to main concepts of probability and statistical, which will help them apply the statistical tools learned to real life situations. Moreover, they will be prepared studying mathematical statistics subject in third class.

**16. Course Reading List and References:**

1-**Hogg, R. V., McKean, J. W., & Craig, A. T.** (2019). *Introduction to Mathematical Statistics* 8th Edition, Macmillan, New York.

2- **Spiegel, M. and Stephens, L.**, (2008), *Theory and Problems of Statistics (Schaum's Outline)*, 4<sup>th</sup> Edition, McGraw-Hill, USA

3- **Beaumont, G.**, (2005), *Probability and Random Variables*, Horwood, UK.

4-**Larson, R. And Marx, M.** (2006), *Introduction to Mathematical Statistics and Applications*, London, Pearson education Ltd. (Optional)

**Note:** For this course, other references such as books or internet links on mathematical statistics are applied.

**17. The Topics:** The course topics, which will be Presented throughout this academic year, are outlined weekly as follows:

**Lecturer's name**

**First semester**

Dr.Awaz Kakamam  
(3 hrs/ week )

**Week 1:** Definition of statistics, types of statistics, Frequency distribution, Or Frequency Table, Graphical representation (Histogram, Frequency polygon, frequency curve, Cumulative frequency curve, Pie chart)

**Week 2:** Measures of central tendency (Mean, Median, Mode, Geometric Mean, Quadratic Mean, Harmonic Mean) for grouped and ungrouped data, work examples.

**Week 3:** Measure of Variation (rang, mean deviation, standard deviation and the Variance, Absolute and relative dispersion, coefficient of variation, Standardized variable; Standard score, The correlation coefficient, Moments, skewness, and Kurtosis.

<p><b><u>Week 4, 5:</u></b> Introduction to probability theory, Random experiment, Events and Sample space, Techniques of counting Probability (Permutation and Combination), work examples.</p> <p><b><u>Week 6, 7:</u></b> Conditional probability and independence, Total probability, Bayes' Theorem, work examples.</p> <p><b><u>Week 8:</u></b> Probability distribution, Random variables.</p> <p><b><u>Week 9, 10:</u></b> Discrete Random Variables, probability mass function (pmf), Cumulative Distribution Function (cdf), work examples.</p> <p><b><u>Week 10:</u></b> Continues random variables, probability density function (pdf), Cumulative distribution function (cdf), work examples.</p> <p><b><u>Week 11:</u></b> Mathematical expectation, work examples.</p> <p><b><u>Week 12:</u></b> some special mathematical expectation, moment generating function (m.g.f), work examples.</p> <p><b><u>Week 13, 14:</u></b> properties of expected value mean, properties of variance, work examples.</p> <p><b><u>Second semester:</u></b></p> <p><b><u>Week 1, 2:</u></b> Multivariate Distributions, distribution of two random variables, The Joint and marginal distributions, Cumulative distribution of two random variables, Independent random variables , Expectation, work examples.</p> <p><b><u>Week 3-5:</u></b> Covariance and correlation, mutually stochastically independent, Discrete random variable and probability distribution: The Uniform distribution, The Bernoulli &amp; Binomial distribution. work examples.</p> <p><b><u>Week 6-8:</u></b> Geometric &amp; Negative Binomial distribution, the Poisson distribution, the Hyper Geometric distribution, work examples.</p> <p><b><u>Week 9-11:</u></b> Continuous random variable and probability distribution: The Uniform distribution, The Normal distribution, The Exponential distribution, work examples.</p> <p><b><u>Week 12-14:</u></b> The Gamma and Chi-square distribution, the Beta distribution, work examples</p> <p><b><u>Note:</u></b> the course program does not includes examination days, which needs at least 2 weeks for each semester (first + second), thus</p>	
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<p>the total number of weeks in course year (first and second semester) will be (28+4).</p>	
<p><b>18- Examinations:</b></p> <p><b>Q1// A)</b> Define standard deviation. (7 marks)          Prove that if <math>Y = X + k</math>, where <math>k &gt; 0</math> is constant, then <math>s_Y^2 = s_X^2</math>.</p> <p><b>B)</b> From the following data which is the record from temperature of a city during one week : 33, 34, 41, 44, 39, 38 and 44.          Find: Mode, Median, standardized score, and mean deviation. (8 marks)</p> <p><b>Q2// A)</b> State and prove the Bayes' Theorem. (7 marks)</p> <p><b>B)</b> If <math>P(A) = 0.2</math>, <math>P(B) = 0.4</math> and <math>P(A B) + P(B A) = 0.75</math>, then find <math>P(A \cap B)</math> (6 marks)</p> <p><b>C)</b> There are 3 arrangements of the word MAM, namely MAM, AMM, and MMA.          How many arrangements are there of the word Mathematics? (5 marks)</p> <p><b>Q3//</b> Let <math>X</math> have the pdf <math>f(x) = \begin{cases} \frac{3}{8}(7-x)^2 &amp; ; 5 \leq x \leq 7 \\ 0 &amp; \text{elsewhere} \end{cases}</math>. Then find          1) <math>E(x + 1)</math> 2) <math>\text{Var}(x)</math> 3) Find <math>F_X(x)</math> 4) Find <math>p(5 \leq x \leq 6)</math> (12 marks)</p> <p><b>Q4//A)</b> Let <math>X</math> be a random variable with pdf is <math>f(x) = \begin{cases} e^{-2x} + \frac{1}{2}e^{-x} &amp; ; x &gt; 0 \\ 0 &amp; \text{else where} \end{cases}</math>. Then          1- Find moment generating function <math>M_X(t)</math>.          2- Find <math>\mu</math> and <math>\sigma^2</math> by using moment generating function. (7 marks)</p> <p><b>B)</b> Define <b>FOUR</b> of the followings: (8 marks)</p> <p>1) Characteristic function      2) Class mark      3) Probability set function          4) Correlation coefficient      5) Size of class interval      6) Mutually event.</p> <p><b>Q1/</b> If the random variables <math>X</math> and <math>Y</math> have the joint pdf <math>f(x, y) = \begin{cases} 2e^{-x-y} &amp; ; 0 &lt; x &lt; y &lt; \infty \\ 0 &amp; \text{elsewhere} \end{cases}</math>,          then answer the following questions:          1) Are <math>X</math> any <math>Y</math> independent?      2) Find <math>E(Y X = x)</math>      3) Find <math>P(1 &lt; Y &lt; 2   X = \frac{1}{2})</math>. (10 marks)</p> <p><b>Q2/ A)</b> Suppose the joint mgf <math>M(t_1, t_2)</math> exist for random variables <math>X</math> and <math>Y</math>. Prove that if <math>M(t_1, t_2) = M(t_1)M(t_2)</math>, then <math>X</math> and <math>Y</math> are independent variables. (8 marks)</p> <p><b>B)</b> Let <math>X</math> and <math>Y</math> have joint pdf, defined by</p>	

$$f(x, y) = \begin{cases} 4xy & ; 0 \leq x \leq 1, \quad 0 \leq y \leq 1 \\ 0 & \text{elsewhere} \end{cases}$$

Then find: 1)  $F(x, y)$     2)  $P(X \leq \frac{1}{2}, Y \leq \frac{3}{4})$     3)  $Cov(X, Y)$     4) Correlation coefficient. (12 marks)

**19. Extra notes:**

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**20. Peer review**

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