**Statistical Inference-QM210**

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| Resource Person: |  |
| Email:  |  |
| Contact Hours: | Write your counselling Hours |
| Office Address: |  |
| Programme: | Write your program name |
| Section: |  |
| Semester: |  |
| Course Pre-requisites: | Mathematics |
| Credit Hours: | 03 |
| Course Type: | Mixed: Theory and Practice |
| Venue/Day/Time: |  |
| Course URL (if any): |  |

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| **Course Description:** |
| This course is aimed to provide a review of statistical decision making and its tools, along with a more detailed discussion on their applications in Business & Economics. This course will also provide necessary statistics background for advance courses in the areas of Business, Finance, Operations, and Economics.**Learning Objectives**The objectives of the course are to gain knowledge of following topics in Business Statistics:• How, where, when and why decisions implementation applicable in Statistics.• Ethical responsibility towards collection of data and data analysis.• Comparative analysis and practice across the border.• Estimation of parameters, Regression and Association, Sampling methodologies• Business applications in various domains of Testing of Hypothesis.**Learning Outcomes**Upon successfully completing this course, the participants will be able to:• Discuss and review Decision making concepts and tools.• Students can able to handle sustainable development goals in context of data handling and possible to apply particular data on worldwide practices.• Describe how to apply different Hypothesis techniques and quantitative methods relate to decision making in areas of Business, Finance, Marketing and Economics using Ms. Excel.• Guide how to statistical decision and relationships between different market variables in Business, Finance, Marketing and Economics using different methods extensively in their careers. |
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| **Course Teaching Methodology:** |
| Interactive Classes |

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| **Programme Educational Objectives (POs):** |
| PO-1 | This topic aims to review and discuss the basic concepts of probability and sampling distribution and Ethics of data handling. |
| PO-2 | These topics intend to discuss the difference between point estimates and confidence intervals. |
| PO-3 | How these concepts are helpful for quality control and in decision making. |
| PO-4 | This topic plans to discuss the most important feature of inferential statistics which is hypothesis testing, the situations under which it is used. |
| PO-5 | How it is used in decision making and its significance in terms of completing and carrying out different research projects. |
| PO-6 | This topic targets to discuss the logic behind, and demonstrate the techniques for, using sample data to test hypotheses and develop interval estimates about the difference between two population means for independent samples. |
| PO-7 | This topic targets to discuss the logic behind, and demonstrate the techniques for, using sample data to test hypotheses and develop interval estimates about the difference between two population proportions for independent and dependent samples. |
| PO-8 | This topic is aimed to provide the basic logic of analysis of variance, perform a hypothesis test for a single-factor design using ANOVA manually and with the help of MS Excel. |
| PO-9 | Basic logic of analysis of variance is to perform a hypothesis test for a single-factor design using ANOVA manually and with the help of MS Excel, conduct and interpret post-analysis of variance pair wise comparisons procedures recognize when randomized block ANOVA is useful and be able to perform ANOVA on randomized block design. |
| PO-10 | To let the students know to calculate and interpret the connection between two variables, to determine whether the connection is significant. |
| PO-11 | To calculate the simple linear regression equation for a set of data and know the basic assumptions behind regression analysis, to determine whether a regression model is significant. |
| PO-12 | To let to know students how to recognize regression analysis applications purposes of description and prediction, calculate and interpret confidence intervals for the regression analysis, recognize some potential problems if regression analysis is used incorrectly. |
| PO-13 | This topic is aimed to let the students understand the general concepts behind model building using multiple regression analysis. |
|  PO-14 | Apply multiple regression analysis to business decision-making situations, analyze the computer output for a multiple regression model and interpret the regression results. |

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| **Programme Learning Outcomes (PLOs):****After completing this degree programme, students shall be able to:** |
|  | **Mapping the PLOs with POs** |
| PLO-1 | Students will understand some basic background of data collection, to learn ethical responsibility of using data in statistical Inferences. | PO-1-PO3 |
| PLO-2 | Students will become skilled at the applications of industrial quality under control confidence limit for population parameter using sample information. | PO-1-PO3 |
| PLO-3 | Students will become skilled at the applications of industrial quality under control confidence limit for population parameter using sample information. | PO-1-PO3 |
| PLO-4 | Students will become skilled towards decision making. | PO-2-PO4 |
| PLO-5 | Students will become skilled towards decision making. | PO-2-PO5 |
| PLO-6 | Students will become skilled at the use of testing of different hypotheses. | PO-3-PO7 |
| PLO-7 | Students will be able to check data direction either accept or reject by using different decision making approaches. | PO-4-PO10 |
| PLO-8 | Students will become skilled at the use of Estimation of parameters and decision making for two population samples. | PO-43-PO8 |
| PLO-9 | Students will become skilled at the use of simplest experimental design technique (ANOVA) and its applications. | PO-3-PO11 |
| PLO-10 | Students will become skilled at the use of experimental design technique (ANOVA) with one sided blocking. | PO-5-PO12 |
| PLO-11 | Students will understand the applications of Correlation (relationships between variables). | PO-3-PO12 |
| PLO-12 | Students will understand the applications of impact of one variable on another variable. | PO1-PO12 |
| PLO-13 | Students will understand the check the impact of one variable on another variable, also applicable for industrial variables to find better predictable model using sample information. | PO3-PO12 |
| PLO-14 | Students will understand the check the impact of at least two variables on another variable, also applicable for industrial variables to find better predictable model using sample information. | PO4-PO12 |
| PLO-15 | Students will understand the check the impact of at least two variables on another variable, also applicable for industrial variables to find better predictable model using sample information. To check model selection | PO1-PO12 |

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| **Course Objectives (COs)** |
| CO-1 | How, where, when and why decisions implementation applicable in Statistics. |
| CO-2 | Ethical responsibility towards collection of data and data analysis. |
| CO-3 | Comparative analysis and practice across the border. |
| CO-4 | Estimation of parameters, Regression and Association, Sampling methodologies |
| CO-5 | Business applications in various domains of Testing of Hypothesis |

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| **Course Learning Outcomes (CLOs):****After completing this course, students shall be able to:** |
|  | **Mapping the CLOs with PLOs** |
| CLO-1 | Discuss and review Decision making concepts and tools.  | PLO1-PLO12 |
| CLO-2 | Students can able to handle sustainable development goals in context of data handling and possible to apply particular data on worldwide practices. | PLO1-PLO12 |
| CLO-3 | Describe how to apply different Hypothesis techniques and quantitative methods relate to decision making in areas of Business, Finance, Marketing and Economics using Ms. Excel. | PLO1-PLO12 |
| CLO-4 | Guide how to statistical decision and relationships between different market variables in Business, Finance, Marketing and Economics using different methods extensively in their careers. | PLO1-PLO12 |

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| **Assurance of Learning and Assessment Items:***Specify Assessment Items that will assure student learning through application and achieve objectives of specific PLOs / COs / CLOs* |
| **Assessment Item** | **Application/ Objectives****PLO / CO / CLO** |
| Quizzes | All |
| Assignments | All |
| Class Activities | All |
| Mid-term exam | All |
| Final exam | All |

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| **Assessment Structure and Grading Policy\*:** |
| **Assessment Item** | **Weight (%)** | **Execution Plan** |
| Quizzes | 15 | 04 |
| Assignments | 15 | 06 |
| Class Activities | 10 | 2 |
| Mid-term exam | 25 | One-time assessment |
| Final exam | 35 | One-time assessment |
| **Total**  | **100** |  |
| **Notes – Norms and Important Class Policies:** *(such as submission guidelines, academic honesty, make-up policy, code of conduct)*• Be On TimeYou need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent. • Mobile PolicyTURN OFF YOUR MOBILE PHONE! It is unprofessional to be texting or otherwise.• Email PolicyREAD YOUR EMAILS! You are responsible if you miss a deadline because you did not read your email.Participants should regularly check their university emails accounts regularly and respond accordingly. • Class Attendance PolicyA minimum of 80% attendance is required for a participant to be eligible to sit in the final examination. Being sick and going to weddings are absences and will not be counted as present. You have the opportunity to use 6 absences out of 30 classes. Participants with less than 80% of attendance in a course will be given grade ‘F’ (Fail) and will not be allowed to take end term exams. International students who will be leaving for visa during semester should not use any days off except for visa trip. Otherwise they could reach short attendance.• Withdraw PolicyStudents may withdraw from a course till the end of the 12th week of the semester. Consequently, grade W will be awarded to the student which shall have no impact on the calculation of the GPA of the student. A Student withdrawing after the 12th week shall be automatically awarded “F” grade which shall count in the GPA.• Moodle UMT –LMS (Moodle) is an Open Source Course Management System (CMS), also known as a learning Management System (LMS). Participants should regularly visit the course website on MOODLE Course Management system, and fully benefit from its capabilities. If you are facing any problem using moodle, visit http://oit.umt.edu.pk/moodle. For further query send your queries to moodle@umt.edu.pk• Harassment PolicySexual or any other harassment is prohibited and is constituted as punishable offence. Sexual or any other harassment of any participant will not be tolerated. All actions categorized as sexual or any other harassment when done physically or verbally would also be considered as sexual harassment when done using electronic media such as computers, mobiles, internet, emails etc.• Use of Unfair Means/Honesty PolicyAny participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action. • Plagiarism PolicyAll students are required to attach a “Turnitin” report on every assignment, big or small. Any student who attempts to bypass “Turnitin” will receive “F” grade which will count towards the CGPA. The participants submit the plagiarism report to the resource person with every assignment, report, project, thesis etc. If student attempts to cheat “Turnitin”, he/she will receive a second “F” that will count towards the CGPA. There are special rules on plagiarism for final reports etc. all outlined in your handbook.• Communication of ResultsThe results of quizzes, midterms and assignments are communicated to the participants during the semester and answer books are returned to them. It is the responsibility of the course instructor to keep the participants informed about his/her progress during the semester. The course instructor will inform a participant at least one week before the final examination related to his or her performance in the course.  |

*\*Rubrics for all assessments (including mid and final exams) will be provided separately to the students.*

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| **Weekly Sessions Plan:** |
| **Week** | **Topics / Contents** | **Activity** | **Application/Objectives****PLO / CO / CLO** |
| 1 | **Introduction:*** Review of Normal Distribution
* Sampling and Sampling Distribution Concepts
 |  | All |
| 2 | **Estimating Single Population Parameters:*** Point of Confidence Interval Estimates for a Population Mean:
* Points Estimates and Confidence Intervals
* Interval Estimate for the Population Mean, σ Known Confidence Interval Calculation
* Impact of the Confidence Level on the Interval Estimate
* Impact of the sample size on the Interval Estimate
* Confidence Interval Estimates for a Population Mean, σ Unknown student’s t-distribution
* Estimation with Larger Sample Size
 | Assignment-1 | All |
| 3 | **Estimating Single Population Parameters:*** Determining the Required Sample size for Estimating a Population Mean:
* Determining the required Sample size for Estimating µ, σ Known
* Determining the required Sample size for Estimating µ, σ Unknown

**Estimating a Population Proportion*** Confidence Interval Estimate for a Population Proportion
* Determining the Required Sample size for estimating a Population Proportion
 | Assignment-2 | All |
| 4 | **Introduction to Hypothesis Testing:*** Hypothesis Tests for Means
* Formulating the Hypothesis
* Null and Alternative Hypothesis
* Testing a Research Hypothesis
* Testing a claim about the Population
* Types of Statistical Errors
* Significance Level and Critical values
* Hypothesis test for $µ$, σ Known
* Calculating Critical Values
* Decision Rules and Test Statistics
 | Quiz -1 | All |
| 5 | **Introduction to Hypothesis Testing:*** Hypothesis Tests for Means:
* Types of Hypothesis test
* P-Value Approach
* *P*-value for Two-Tailed Test
* Hypothesis test for $ µ$, σ Unknown

**Hypothesis tests for Population Proportion*** Testing a hypothesis about a single population proportion
* Types of Error
* Calculating Beta
* Controlling Alpha and Beta
* Power of the Test
 | Class Activities-1 | All |
| 6 | **Estimation and Hypothesis Testing for two Populations*** Estimation for two Population Means using Independent Samples
* Estimating the difference between two population means when σ1 and σ2 are known, using Independent samples
* Estimating the difference between two population means when σ1 and σ2 are unknown, using Independent samples
* What if the populations Variances are not equal?
 | Quiz -2 | All |
| 7 | **Estimation and Hypothesis Testing for two Populations*** Hypothesis test for two Population means using Independent Samples
* Testing for µ1-  µ2 when σ1 and σ2 are known, using Independent samples using *P*-Values
* Testing for µ1-  µ2 when σ1 and σ2 are Unknown, using Independent samples
* What if the Population Variances are not equal?

**Interval Estimation and Hypothesis test for paired samples** * Why use paired samples?
* Hypothesis testing for paired samples

Estimation and Hypothesis Test for two Population Proportions* Estimating the difference between two Population Proportions
* Hypothesis test for the difference between two Population Proportions
 | Assignment-3 | All |
| 8 | **Analysis of the Variance:*** One-way analysis of the variance
* The Logic behind one-way ANOVA
* Partitioning the sum of square
* The ANOVA Assumptions
* Applying One-way ANOVA
* The turkey-Karmer Producer for multiple comparisons
* Fixed effects versus Random Effect in analysis of Variance
 |  | All |
| 9 | **Mid Term** |  |  |
| 10 | **Randomized complete Block Analysis of Variance:*** Randomized complete block ANOVA
* Was blocking necessary?
* Fisher’s Least Significant difference Test
 | Assignment-4 | All |
| 11 | **Introduction to Linear Regression and Correlation Analysis*** **Scatter Plots and Correlation:**
* Correlation Versus Regression
* The Correlation Coefficient
* Significance test for the Correlation
* Cause and effect Interpretations
 | Quiz -3 | All |
| 12 | **Simple Linear Regression Analysis:*** The Regression Model and Assumption
* Meaning of the Regression Coefficient
* Least square Regression properties
* Significance test in Regression Analysis
* The Coefficient of Determination, R2
* Significance of the slope Coefficient
 | Assignment-5 | All |
| 13 | **Introduction to Linear Regression and Correlation Analysis:*** **Uses for Regression Analysis**
* Regression Analysis for Description
* Regression Analysis for Prediction
* Confidence interval for the average *y*, Given *x*
* Prediction interval for a Particular  *y*, Given *x*
* Common problems Using Regression analysis
 | Assignment-6 | All |
| 14 | **Multiple Regression Analysis and Model Building:*** **Introduction to Multiple Regression Analysis:**
* Basic Model-Building Concept
* Model Specification
* Model Building
* Model Diagnosis
* Computing the Regression Equation
 | Quiz -4 | All |
| 15 | **Multiple Regression Analysis and Model Building:*** The Coefficient of the Determination
* Is the Model Significant?
* Are the Individual Variables Significant?
* Is the Stranded Deviation of the Regression Model too Large?
* Is multicollinearity a Problem?
* Confidence Interval Estimation for Regression Coefficient

**Using Qualitative Independent Variables*** Possible Improvements to the first city Appraisal Model
 | Class Activities-2 | All |
| 16 | Final Term Examination |  |  |

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| **Primary Text Book (s):** |
| * Statistics: A Decision-Making Approach (8th Edition) By: David F. Groebner, Patrick W. Shannon, Phillip C. Fry, Kent D. Smith
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| **Reference / Supplementary Reading (s):** |
| * Statistical Techniques in Business and Economics (13th Edition) By: Douglas A. Lind, William G. Marchal, and David Wathen
* Essentials of Modern Business Statistics with Microsoft Excel (3rd Edition)By: Anderson and Sweeny
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| **Useful Online / Web Resources:** |
| * https://lms.umt.edu.pk/
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