**Dr. Hasan Murad School of Management (HSM)**

**Course Title:** Statistical Inference

**Course Code:** QM-210

**Resource Person:**

**Department:** Economics and Statistics

**HSM Vision**

HSM envisions its success in the sustainable contribution that it will make to the industry, academia and research in public and private sector. HSM will lead by providing professionally competent and ethically conscious human resources engaged in the global and local context to foster socio-economic growth and sustainability for the society. HSM envisages having faculty with high research potential and a deep desire for cutting edge research including collaboration with national and international partners.

**HSM Mission**

Being a research-oriented and student-centric business school, we emphasize research publications in impact factor journals as well as state-of -the-art learning methodologies.  We will prepare our students to become the future ethical business leaders and the guiding post for the society, while equipping them with the knowledge and skills required by world-class professionals.  We will be the leading choice for organizations seeking highly talented human resource. HSM will foster internationalization with key stakeholders and actively work to exchange best practices with business schools across Pakistan through collaborations, workshops, conferences and other means.

**Course Objectives**

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.

**Teaching Methodology (List methodologies used –examples are given below)**

Interactive Classes

**STUDENTS ARE REQUIRED TO READ AND UNDERSTAND ALL ITEMS OUTLINED IN THE PARTICIPANT HANDBOOK**

**Class Policy: -**

* Be on Time

You need to be at class at the assigned time. After 10 minutes past the assigned time, you will be marked absent.

* Mobile Policy

**TURN OFF YOUR MOBILE PHONE!** It is unprofessional to be texting or otherwise.

* Email Policy

**READ 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 Policy

A 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 Policy

Students 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 Policy

Sexual 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 Policy

Any participant found using unfair means or assisting another participant during a class test/quiz, assignments or examination would be liable to disciplinary action.

* Plagiarism Policy

All 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 Results

The 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.

**Course Outline**

**Course Code:** QM-210 **Course Title**: Statistical Inference

|  |  |
| --- | --- |
| Program | Under Graduate |
| Credit Hours | 03 |
| Duration | 15-Weeks |
| Prerequisites (If any) | Business Mathematics & Business Statistics |
| Resource PersonName and Email |  |
| Counseling Timing |  |
| Contact no. | NA |
| Web Links: -(Face book, Linked In, Google Groups, Other platforms) | NA |

 **Chairman/Director Programme signature…………………………………. Date…………………….**

**Dean’s signature…………………………… …………………. Date………………………………………….**

**Grade Evaluation Criteria**

Following is the criteria for the distribution of marks to evaluate final grade in a semester.

**Marks Evaluation Marks in Percentage**

Quizzes 15%

Assignments 15%

Mid Term 20%

Class Activities 00%

Term Project & Presentations 10%

Final exam 40%

Total 100%

**Recommended Text Book:**

**Business Statistics: A Decision-Making Approach** (8th Edition) By David F. Groebner, Patrick W. Shannon, Phillip C. Fry and Kent D. Smith

**Reference Book:**

**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

**Statistics for Business and Economics (7th Edition)** By Benson and McClave

**Magazines/ Journals:**

**AMSTATNEWS**

The Membership Magazine of the American Statistical Association

**Journal of Business and Economics Statistics**

An Official Journal of the American Statistical Association

**Journal of Quantitative Methods**

Department of Economics and Statistics

Dr. Hasan Murad School of Management

**Course Title:** Statistical Inference **Course Code:** QM-210 **Book:** Business Statistics byGroebner

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No** | **Topics to be****covered in the course** | **Learning Objective****of this topic** | **Expected Outcomes from Students** | **Teaching Method** | **Assessment Criteria** | **Deadlines and Homework** |
| 1 | **Introduction:*** Review of Normal Distribution
* Sampling and Sampling Distribution Concepts
 | This topic aims to review and discuss the basic concepts of probability and sampling distribution and Ethics of data handling. | Students will understand some basic background of data collection, to learn ethical responsibility of using data in statistical Inferences. | Lecture | Assignment # 1 | Within a week |
| 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
 | These topics intend to discuss the difference between point estimates and confidence intervals. | Students will become skilled at the applications of industrial quality under control confidence limit for population parameter using sample information. | Lecture | Quiz # 1 |  |
| 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
 | How these concepts are helpful for quality control and in decision making. | Students will become skilled at the applications of industrial quality under control confidence limit for population parameter using sample information. | Lecture | Quiz # 2 |  |
| 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
 | This topic plans to discuss the most important feature of inferential statistics which is hypothesis testing, the situations under which it is used. | Students will become skilled towards decision making. | Lecture | Assignment # 2 | Within a week |
| 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
 | How it is used in decision making and its significance in terms of completing and carrying out different research projects. | Students will become skilled towards decision making. | Lecture | Quiz # 3 |  |
| 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?
 | 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. | Students will become skilled at the use of testing of different hypotheses.Students will be able to check data direction either accept or reject by using different decision-making approaches. | Lecture | Assignment # 3 | Within a week |
| 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
 | 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. | Students will become skilled at the use of Estimation of parameters and decision making for two population samples. | Lecture | Quiz # 4 |  |
| 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
 | 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. | Students will become skilled at the use of simplest experimental design technique (ANOVA) and its applications. | Lecture | Assignment # 4 | Within a week |
| 9 | **Mid Term** |  |  |  |  |  |
| 10 | **Randomized complete Block Analysis of Variance:*** Randomized complete block ANOVA
* Was blocking necessary?
* Fisher’s Least Significant Difference Test
 | 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. | Students will become skilled at the use of experimental design technique (ANOVA) with one sided blocking. | Lecture | Assignment # 5 | Within a week |
| 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
 | To let the students, know to calculate and interpret the connection between two variables, to determine whether the connection is significant. | Students will understand the applications of Correlation (relationships between variables). | Lecture | Quiz # 5 |  |
| 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
 | 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. | Students will understand the applications of impact of one variable on another variable. | Lecture | Assignment # 6 | Within a week |
| 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
 | 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. | 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. | Lecture | Quiz # 6 |  |
| 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
 | This topic is aimed to let the students understand the general concepts behind model building using multiple regression analysis. | 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. | Lecture | Assignment # 7 | Within a week |
| 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
 | Apply multiple regression analysis to business decision-making situations, analyze the computer output for a multiple regression model and interpret the regression results. | 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 | Lecture | Quiz # 7 |  |