




NOTIFICATION

On the recommendations of Academic Council made in its 24<sup>th</sup> (1/2025) meeting held on 26.08.2025, the Syndicate in its 72<sup>nd</sup> (4/2025) meeting held on 12.09.2025 has approved the revised curricula of following programs for implementation w.e.f. Fall 2025.

- |      |  |             |
|------|--|-------------|
| I.   | Associate Degree in Statistics                     | (Annex-'A') |
| II.  | BS in Statistics                                   | (Annex-'B') |
| III. | BS in Statistics (5 <sup>th</sup> Semester Intake) | (Annex-'C') |
| IV.  | M.Phil Statistics                                  | (Annex-'D') |
| V.   | Ph.D in Statistics                                 | (Annex-'E') |

  
(WAQAR AHMAD)  
Additional Registrar (General)  
Dated: 06.11.2025

No. SU/Acad/25/ 1200

Distribution:

- Chairman, Department of Statistics
- Controller of Examinations
- Director Academics

C.C:

- Dean Faculty of Sciences
- Director, QEC
- Additional Registrar (A & R) *{With the request to forward the notification alongwith curriculum to all Principals of affiliated colleges concerned}*
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

**SCHEME OF STUDIES AND OUTLINES**  
**FOR**  
**BS 4-YEAR**  
**UNDERGRADUATE PROGRAM IN STATISTICS**  
**(Semester/Term System)**



**Session: Fall 2025 – Onward**

**DEPARTMENT OF STATISTICS**  
**UNIVERSITY OF SARGODHA**

## 7. General Education (GE) Courses

S.N.	Course Code	Course Title	Credit Hours	Prereq.
1	URCG-5120	Exploring Quantitative Skills	3 (3-0)	Nil
2	URCG-5114	Basic Science	3 (2-1)	Nil
3	URCG-5118	Functional English	3 (3-0)	Nil
4	URCG-5123	Application of ICT	3 (2-1)	Nil
5	URCG-5129	Understanding of Holy Quran - I/Fehm-e-Quran - I	1 (0-1)	Nil
6	URCG-5121	Tools for Quantitative Reasoning	3 (3-0)	Nil
7	URCG-5119	Expository Writing	3 (3-0)	Nil
8	URCG-5128	Pakistan Studies	2 (2-0)	Nil
9	URCG-5112	Arts & Humanities	2 (2-0)	Nil
10	URCG-5105	Islamic Studies	2 (2-0)	Nil
11	URCG-5126	Ethics	2 (2-0)	Nil
12	URCG-5130	Understanding of Holy Quran - II/Fehm-e-Quran - II	1 (0-1)	Nil
13	URCG-5122	Ideology & Constitution of Pakistan	2 (2-0)	Nil
14	URCG-5127	Seerat of the Holy Prophet (SAW)	1 (0-1)	Nil
15	URCG-5116	Science of Society-I	2 (2-0)	Nil
16	URCG-5125	Civics & Community Engagement	2 (2-0)	Nil
17	URCG-5124	Entrepreneurship	2 (2-0)	Nil
18	URCG-5131	Ethics-I	1 (1-0)	Nil
19	URCG-5132	Ethics-II	1 (1-0)	Nil

## 8. List of Interdisciplinary Courses

S.N.	Course Code	Course Title	Credit Hours	Prerequisite
1	MATH-5101	Calculus - I	3 (3-0)	Nil
2	MATH-5102	Calculus - II	3 (3-0)	MATH-5101
3	MATH-5127	Linear Algebra	3 (3-0)	MATH-5102
4	BIOT-6112	Bioinformatics	3 (1-2)	Nil
5	CMPC-5201	Programming Fundamentals	3 (2-1)	Nil
6	CMPC-5203	Database Systems	3 (2-1)	Nil
7	ITDC-5202	Cyber Security	3 (2-1)	Nil

3  
 Chairman  
 Department of Statistics  
 University of Sargodha

8	AIDC-5101	Artificial Neural Networks & Deep Learning	3 (2-1)	Nil
9	DSDE-6207	Cloud Computing	3 (2-1)	Nil



Chairman  
Department of Statistics  
University of Sargodha

### 9. Major (Statistics) Courses

S.N.	Course Code	Course Title	Credit Hours	Prerequisite
1	STAT-5101	Introduction to Statistics	3 (3-0)	Nil
2	STAT-5102	Intro to Probability & Distributions	3 (3-0)	Nil
3	STAT-5103	Introduction to Sampling Theory	3 (3-0)	STAT-5101
4	STAT-5104	Basic Statistical Inference	3 (3-0)	STAT-5102
5	STAT-5105	EDA and Visualization	3 (3-0)	STAT-5101
6	STAT-5106	Official Statistics	3 (3-0)	Nil
7	STAT-5107	Intro to Regression and ANOVA	3 (3-0)	STAT-5104
8	STAT-5108	Data Wrangling	3 (3-0)	Nil
9	STAT-5109	Statistical Packages	3 (3-0)	Nil
10	STAT-5110	Non-Parametric Methods	3 (3-0)	Nil
11	STAT-6101	Probability Distributions	3 (3-0)	STAT-5102
12	STAT-6102	Design and Analysis of Experiments	3 (3-0)	STAT-5107
13	STAT-6103	Sampling Techniques	3 (3-0)	STAT-5103
14	STAT-6104	Biostatistics	3 (3-0)	Nil
15	STAT-6105	Statistical Inference	3 (3-0)	STAT-6101
16	STAT-6106	Regression Analysis	3 (3-0)	STAT-5104
17	STAT-6107	Programming in R and Python	3 (3-0)	Nil
18	STAT-6108	Research Methodology	3 (3-0)	Nil
19	STAT-6109	Statistical Quality Control	3 (3-0)	Nil
20	STAT-6110	Applied Multivariate Analysis	3 (3-0)	Nil

  
 Chairman  
 Department of Statistics  
 University of Sargodha

10. List of Electives Courses

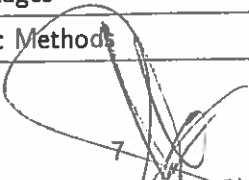
S.N.	Course Code	Course Title	Credit Hours
1	STAT-6111	Categorical Data Analysis	3(3-0)
2	STAT-6112	Stochastic Process	3(3-0)
3	STAT-6113	Reliability Analysis	3(3-0)
4	STAT-6114	Survival Analysis	3(3-0)
5	STAT-6115	Actuarial Statistics	3(3-0)
6	STAT-6116	Bayesian Statistics	3(3-0)
7	STAT-6117	Operation Research	3(3-0)
8	STAT-6118	Decision Theory	3(3-0)
9	STAT-6119	Data Mining	3(3-0)
10	STAT-6120	Mathematical Models and Simulation	3(3-0)
11	STAT-6121	Statistical Tools for Data Science	3(3-0)
12	STAT-6122	Statistics for Deep Learning	3(3-0)
13	STAT-6123	Statistical Machine Learning	3(3-0)
14	STAT-6124	Applied Artificial Intelligence	3(3-0)
15	STAT-6125	Big Data Analytics	3(3-0)
16	STAT-6126	Digital Analytics	3(3-0)
17	STAT-6127	High-Dimensional Data Analysis	3(3-0)
18	STAT-6128	Epidemiology	3(3-0)
19	STAT-6129	Analysis of Repeated Measurements	3(3-0)
20	STAT-6130	Design and Analysis of Medical Studies	3(3-0)
21	STAT-6131	Pharmaceutical Statistics	3(3-0)
22	STAT-6132	Clinical Trials	3(3-0)
23	STAT-6133	Financial Econometrics	3(3-0)
24	STAT-6134	Time Series Analysis and Forecasting	3(3-0)
25	STAT-6135	Predictive Modeling	3(3-0)
26	STAT-6136	Structural Equation Modeling	3(3-0)
27	STAT-6137	Applied Econometrics	3(3-0)
28	STAT-6138	Spatial Statistics	3(3-0)
29	STAT-6139	Population Studies and Demographic Techniques	3(3-0)
30	STAT-6140	Environmental Statistics	3(3-0)
31	STAT-6141	Functional Data Analysis	3(3-0)
32	STAT-6142	Robust Methods	3 (3-0)

6

Chairman  
Department of Statistics  
University of Sargodha

### 11. Scheme of Studies

<b>Semester I</b>					
S.N.	Course Code	Course Title	Credit Hours	Prereq.	Category
1	STAT-5101	Introduction to Statistics	3 (3-0)	Nil	Major
2	URCG-5120	Exploring Quantitative Skills	3 (3-0)	Nil	GE
3	URCG-5114	Basic Science	3 (2-1)	Nil	GE
4	URCG-5118	Functional English	3 (3-0)	Nil	GE
5	URCG-5123	Application of ICT	3 (2-1)	Nil	GE
6	MATH-5101	Calculus - I	3 (3-0)	Nil	IDS
<b>Total Credits</b>			<b>18</b>		
<b>Semester II</b>					
1	STAT-5102	Intro to Probability & Distributions	3 (3-0)	Nil	Major
2	STAT-5103	Introduction to Sampling Theory	3 (3-0)	STAT-5101	Major
3	MATH-5102	Calculus - II	3 (3-0)	MATH-5101	IDS
4	URCG-5129	Understanding of Holy Quran - I/Fehm-e-Quran - I	1 (0-1)	Nil	GE
5	URCG-5121	Tools for Quantitative Reasoning	3 (3-0)	Nil	GE
6	URCG-5119	Expository Writing	3 (3-0)	Nil	GE
7	URCG-5128	Pakistan Studies	2 (2-0)	Nil	GE
8	URCG-5131	Ethics-I (for non Muslims)	1 (0-1)	Nil	GE
<b>Total Credits</b>			<b>18</b>		
<b>Semester III</b>					
1	STAT-5104	Basic Statistical Inference	3 (3-0)	STAT-5102	Major
2	STAT-5105	EDA and Visualization	3 (3-0)	STAT-5101	Major
3	URCG-5112	Arts & Humanities	2 (2-0)	Nil	GE
4	URCG-5105	Islamic Studies	2 (2-0)	Nil	GE
5	URCG-5126	Ethics (for non Muslims)	2 (2-0)	Nil	GE
6	URCG-5130	Understanding of Holy Quran - II/Fehm-e-Quran - II	1 (0-1)	Nil	GE
7	URCG-5122	Ideology & Constitution of Pakistan	2 (2-0)	Nil	GE
8	STAT-5106	Official Statistics	3 (3-0)	Nil	Major
9	URCG-5127	Seerat of the Holy Prophet (SAW)	1 (0-1)	Nil	GE
10	URCG-5132	Ethics-II (for non Muslims)	1 (0-1)	Nil	GE
<b>Total Credits</b>			<b>17</b>		
<b>Semester IV</b>					
1	STAT-5107	Intro to Regression and ANOVA	3 (3-0)	STAT-5104	Major
2	STAT-5108	Data Wrangling	3 (3-0)	Nil	Major
3	STAT-5109	Statistical Packages	3 (3-0)	Nil	Major
4	STAT-5110	Non-Parametric Methods	3 (3-0)	Nil	Major

  
 Chairman, Statistics  
 Department, University of Sargodha

5	URCG-5116	Science of Society-I	2 (2-0)	Nil	GE
6	URCG-5125	Civics & Community Engagement	2 (2-0)	Nil	GE
7	URCG-5124	Entrepreneurship	2 (2-0)	Nil	GE
<b>Total Credits</b>			<b>18</b>		
<b>Semester V</b>					
1	STAT-6101	Probability Distributions	3 (3-0)	STAT-5102	Major
2	STAT-6102	Design and Analysis of Experiments	3 (3-0)	STAT-5107	Major
3	STAT-6103	Sampling Techniques	3 (3-0)	STAT-5103	Major
4	STAT-6104	Biostatistics	3 (3-0)	Nil	Major
5	MATH-5127	Linear Algebra	3 (3-0)	MATH-5102	IDS
<b>Total Credits</b>			<b>15</b>		
<b>Semester VI</b>					
1	STAT-6105	Statistical Inference	3 (3-0)	STAT-6101	Major
2	STAT-6106	Regression Analysis	3 (3-0)	STAT-5104	Major
3	STAT-61xx	Elective I	3 (3-0)	Nil	Major
4	STAT-61xx	Elective II	3 (3-0)	Nil	Major
5	CMPC-5203	Database Systems	3 (3-0)	Nil	IDS
<b>Total Credits</b>			<b>15</b>		
<b>Semester VII</b>					
1	STAT-6107	Programming in R and Python	3 (3-0)	Nil	Major
2	STAT-6108	Research Methodology	3 (3-0)	Nil	Major
3	STAT-6109	Statistical Quality Control	3 (3-0)	Nil	Major
4	STAT-61xx	Elective III	3 (3-0)	Nil	Major
5	STAT-61xx	Elective IV	3 (3-0)	Nil	Major
<b>Total Credits</b>			<b>15</b>		
<b>Semester VIII</b>					
1	STAT-6110	Applied Multivariate Analysis	3 (3-0)	Nil	Major
2	STAT-61xx	Elective V	3 (3-0)	Nil	Major
3	STAT-61xx	Elective VI	3 (3-0)	Nil	Major
4	STAT-61xx	Elective VII	3 (3-0)	Nil	Major
5	STAT-6170	Capstone Project	3 (0-3)	Nil	Compulsory
<b>Total Credits</b>			<b>15</b>		
<b>Internship (Summer)</b>					
1	STAT-6150	Internship ( <i>Internship will be preferably offered in summer break after 5th semester</i> )	3 (0-3)	Nil	Compulsory

## 12. Exiting From Bachelor of Science in Statistics with the Associate Degree

Students enrolled in Bachelor of Science in Statistics are allowed to exit the program with the status of an Associate Degree provided that they have completed the requirements of the first four semesters of the BS degree program.

8

Chairman  
Department of Statistics  
University of Sargodha

**Course Outlines for Major Courses**

**Course Brief**

This foundational course introduces students to the basic principles and applications of statistics. It emphasizes the role of statistics in natural and social sciences, highlighting its importance as a tool for data-driven decision-making. Students will gain hands-on experience in collecting, presenting, analyzing, and interpreting data using descriptive statistical techniques.

Key topics include types of data and variables, levels of measurement, organization and presentation of data, measures of central tendency and variability, and the construction of index numbers.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Describe statistics as a field of knowledge, including its scope and relevance to other disciplines in the natural and social sciences.
2. Demonstrate preparedness for advanced coursework in the field of statistics.
3. Apply critical thinking to understand data sources, variable types, and levels of measurement.
4. Present, analyze, and interpret descriptive statistics effectively.
5. Construct and interpret index numbers in real-world contexts.

**Course Contents**

1. Introduction, Importance, and Scope of Statistics
2. Types of Variables and Data
3. Data Sources and Methods of Data Collection
4. Scales of Measurement: Nominal, Ordinal, Interval, and Ratio
5. Classification and Tabulation of Data
6. Presentation of Data:
  - Stem-and-Leaf Diagrams
  - Box-and-Whisker Plots
  - Bar Charts and Histograms: Creation and Interpretation
7. Measures of Central Tendency: Mean, Median, Mode
8. Measures of Dispersion: Range, Variance, Standard Deviation, IQR
9. Moments, Skewness, Kurtosis, and Shape of Distributions
10. Construction and Interpretation of Index Numbers

**Recommended Textbooks**

1. Clark, G. M., & Cooke, D. (1998). *A Basic Course of Statistics* (4th ed.). London: Arnold.

**Suggested Readings**

1. Weiss, N. A. (2015). *Introductory Statistics* (10th ed.). London: Pearson.
2. Agresti, A., & Franklin, C. (2017). *Statistics: The Art and Science of Learning from Data* (4th ed.). Boston: Pearson.
3. Moore, D. S., McCabe, G. P., & Craig, B. A. (2016). *Introduction to the Practice of Statistics* (9th ed.). New York: W. H. Freeman.

### Course Brief

This course provides a foundational understanding of probability theory and probability distributions, enabling students to model uncertainty and variability in real-world phenomena. It covers core principles such as counting methods, probability rules, and conditional probability including Bayes' Theorem. Students will explore both discrete and continuous random variables and learn to work with key probability distributions.

Through a blend of theory and practical examples, this course equips students with the skills to solve applied problems using binomial, Poisson, hypergeometric, and normal distributions—laying a critical foundation for statistical inference and modeling.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand fundamental concepts of probability theory, counting methods, and probability rules.
2. Understand and apply conditional probability and Bayes' Theorem.
3. Demonstrate comprehension of discrete and continuous random variables and their characteristics.
4. Apply probability distributions such as binomial, Poisson, hypergeometric, and normal distributions to model real-world scenarios.

### Course Contents


1. Introduction to Probability Theory:
  - Sample Spaces, Events, and Probability Axioms
  - Addition and Multiplication Rules
2. Counting Techniques:
  - Basic Principles of Counting
  - Permutations and Combinations
3. Conditional Probability:
  - Concept and Formula
  - Independence of Events
  - Bayes' Theorem and Applications
4. Random Variables:
  - Discrete and Continuous Types
  - Probability Mass and Density Functions
  - Cumulative Distribution Function
5. Expected Value and Variance:
  - Properties and Applications
  - Moment Generating Functions
6. Discrete Probability Distributions:
  - Binomial, Hypergeometric, Poisson
7. Continuous Probability Distributions:
  - Uniform and Normal Distributions

### Recommended Textbooks

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Hogg, R. V., & Tanis, E. A. (2010). *Probability and Statistical Inference* (8th ed.). Pearson.

### Suggested Readings

1. Ross, S. M. (2014). *Introduction to Probability Models* (11th ed.). Academic Press.
2. Sheldon, R. (2010). *Schaum's Outline of Probability and Statistics* (4th ed.). McGraw-Hill.
3. Spiegel, M. R., Schiller, J., & Srinivasan, R. (2009). *Probability and Statistics* (3rd ed.). McGraw-Hill.
4. Devore, J. L. (2017). *Probability and Statistics for Engineering and the Sciences* (9th ed.). Cengage Learning.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course introduces students to the foundational principles of sampling theory and its application in the collection and analysis of data. Students will explore various probability and non-probability sampling techniques, the concept of sampling frames, and the importance of representative data in statistical inference. The course also covers computation of sample sizes for different practical needs and an introduction to the sampling distributions of common statistics such as means, variances, and proportions.

The aim is to provide students with the necessary tools to design effective sampling strategies, make informed decisions based on sample data, and understand the variability associated with sampling processes.

**Course Learning Outcomes**

By the end of the course, students will be able to:

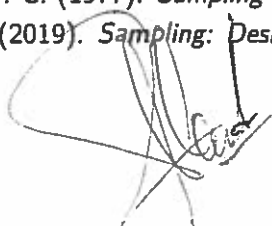
1. Understand basic sampling theory, including the concepts of population, sample, sampling frame, and sampling units.
2. Identify and describe various sampling methods such as simple random sampling, stratified sampling, cluster sampling, and systematic sampling.
3. Calculate appropriate sample sizes for a variety of practical research and survey contexts.
4. Understand the sampling distributions of common statistics such as sample mean, variance, and proportion, and apply this knowledge in data interpretation.

**Course Contents**

1. Introduction to Sampling:
  - Population vs. Sample
  - Sampling Frame and Sampling Units
2. Types of Sampling Methods:
  - Probability Sampling: Simple Random, Stratified, Systematic, Cluster
  - Non-Probability Sampling: Convenience, Judgmental, Quota, Snowball
3. Sample Size Determination:
  - Estimating Sample Sizes for Means and Proportions
  - Precision, Confidence Levels, and Margin of Error
4. Sampling Distribution:
  - Central Limit Theorem
  - Distribution of Sample Mean, Sample Proportion, and Sample Variance
5. Bias, Accuracy, and Efficiency in Sampling
6. Applications in Survey and Experimental Design

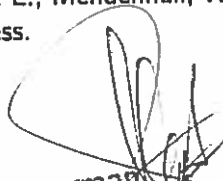
**Recommended Textbooks**

1. Cochran, W. G. (1977). *Sampling Techniques* (3rd ed.). Wiley.
2. Lohr, S. L. (2019). *Sampling: Design and Analysis* (2nd ed.). Chapman & Hall/CRC.



### Suggested Readings

1. Kish, L. (1965). *Survey Sampling*. Wiley.
2. Thompson, S. K. (2012). *Sampling* (3rd ed.). Wiley.
3. Scheaffer, R. L., Mendenhall, W., & Ott, L. (1996). *Elementary Survey Sampling* (5th ed.). Duxbury Press.



Chairman of Statistics  
Department  
University of Sargodha

#### 4. Basic Statistical Inference (STAT-5104)

3(3-0)

##### Course Brief

This course introduces students to the core concepts of statistical inference, focusing on estimation and hypothesis testing. It aims to equip students with the skills required to draw conclusions from sample data and to make data-informed decisions. Through theoretical understanding and practical examples, students will learn how to construct confidence intervals, test hypotheses, and evaluate the performance of statistical estimators. The course emphasizes interpreting results within real-world decision-making contexts, building a strong foundation for more advanced statistical analysis.

##### Course Learning Outcomes

By the end of the course, students will be able to:

1. Use statistical estimation techniques, including point estimation and interval estimation.
2. Understand and evaluate the properties of point estimators such as unbiasedness, consistency, and efficiency.
3. Perform hypothesis testing for population parameters and interpret statistical results in the context of real-world decision-making.
4. Apply the concepts of statistical inference to practical situations involving real datasets.

##### Course Contents

1. Introduction to Statistical Inference
2. Point Estimation:
  - Methods of Estimation (Method of Moments, Maximum Likelihood)
  - Properties of Estimators: Unbiasedness, Consistency, Efficiency
3. Interval Estimation:
  - Confidence Intervals for Means, Proportions, and Variances
  - Interpretation and Applications
4. Hypothesis Testing:
  - Null and Alternative Hypotheses
  - Type I and Type II Errors
  - p-values and Test Statistics
  - One-sample and Two-sample Tests for Mean and Proportion
5. Decision Making Using Hypothesis Testing
6. Applications of Inference to Real-World Problems

##### Recommended Textbooks

1. Hogg, R. V., Tanis, E. A. (2013). *Probability and Statistical Inference* (9th ed.). Pearson.
2. Casella, G., Berger, R. L. (2002). *Statistical Inference* (2nd ed.). Cengage Learning.

##### Suggested Readings

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). *Probability and Statistics for Engineers and Scientists* (9th ed.). Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences* (9th ed.). Cengage Learning.
3. Moore, D. S., McCabe, G. P., Craig, B. A. (2016). *Introduction to the Practice of Statistics* (9th ed.). W. H. Freeman.

### Course Brief

This course focuses on the foundational techniques of exploratory data analysis (EDA) and the principles of effective data visualization. Students will develop the ability to explore, summarize, and present data using various visualization tools and techniques. Through the use of programming languages such as R and Python, and platforms like Power BI, students will learn to communicate statistical insights effectively. The course emphasizes best practices in visual analytics, detection of data patterns and anomalies, and evaluation of visual representations for bias and clarity.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Apply principles of effective data visualization to communicate statistical insights clearly.
2. Design and interpret various types of charts and graphs, including bar charts, scatter plots, histograms, and heatmaps using R, Python, or Power BI.
3. Implement interactive and dynamic visualizations for exploratory data analysis.
4. Analyze and critique data visualizations for accuracy, bias, and misleading representations.
5. Integrate data visualization techniques into real-world statistical reports and presentations.

### Course Contents

1. Introduction to Exploratory Data Analysis (EDA)
2. Principles of Effective Data Visualization
3. Summary Statistics and Data Distributions
4. Visual Tools for Categorical and Numerical Data
  - Bar Charts, Histograms, Boxplots, and Scatterplots
  - Line Charts and Heatmaps
5. Multivariate Data Visualization
6. Identifying Outliers and Patterns in Data
7. Interactive and Dynamic Visualizations using R/Python/Power BI
8. Common Pitfalls and Bias in Data Visualization
9. Case Studies in Visual Analytics
10. Integrating Visualizations in Statistical Reports and Presentations

### Recommended Textbooks

1. Wickham, H., & Golemund, G. (2016). *R for Data Science*. O'Reilly Media.
2. Tufte, E. R. (2001). *The Visual Display of Quantitative Information* (2nd ed.). Graphics Press.

### Suggested Readings

1. Healy, K. (2018). *Data Visualization: A Practical Introduction*. Princeton University Press.
2. Cairo, A. (2016). *The Truthful Art: Data, Charts, and Maps for Communication*. New Riders.
3. Few, S. (2012). *Show Me the Numbers: Designing Tables and Graphs to Enlighten*. Analytics Press.
4. McKinney, W. (2022). *Python for Data Analysis* (3rd ed.). O'Reilly Media.

**Course Brief**

This course introduces students to the domain of official statistics and their importance in national planning, administration, and public policy. It covers the organization, collection, and dissemination of demographic and social statistics by official bodies. Students will explore the scope of national statistical systems, understand the standards for official data collection, and become familiar with the key institutions involved in statistical reporting in Pakistan. Emphasis is placed on understanding the reliability, interpretation, and practical use of official datasets from sources like NADRA, PBS, and other government agencies.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the official, demographic, and social statistics.
2. Explain the scope and organizational structure of official statistical systems.
3. Understand the roles of planning and administrative statistics in public decision-making.
4. Describe the structure and functions of national statistical organizations.
5. Utilize and interpret data from statistical sources such as NADRA, PBS, and other national agencies.

**Course Contents**

1. Introduction to Official Statistics
2. Role and Importance of Official Statistics in Policy and Planning
3. Classification: Demographic, Social, Economic, and Environmental Statistics
4. Organization and Scope of National Statistical Systems
5. Functions and Structure of Statistical Bureaus (PBS, NADRA, etc.)
6. Planning and Administrative Statistics
7. Census and Surveys: Methods and Challenges
8. Use of Official Statistics in Research and Development
9. Standards and Ethics in Official Statistics
10. Case Studies using National and International Statistical Reports

**Recommended Textbooks**

1. United Nations. (2001). *Principles and Recommendations for Population and Housing Censuses*. UN Publications.
2. Government of Pakistan. (Latest editions). *Pakistan Bureau of Statistics Reports*.

**Suggested Readings**

1. OECD. (2017). *Handbook on Official Statistics*.
2. United Nations Statistical Commission documents and training manuals.
3. Eurostat and World Bank online resources on National Statistical Systems.

Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course equips students with practical skills for data wrangling, a crucial step in the data analysis pipeline. Emphasizing real-world datasets, it provides a comprehensive understanding of data acquisition, cleaning, transformation, and preprocessing techniques. Students will explore tools and methods to handle messy, incomplete, or inconsistent data and learn how to transform it into analyzable formats. Emphasis will be placed on building reproducible data workflows that ensure data integrity and readiness for advanced statistical modeling and machine learning applications.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand and explain the key concepts, challenges, and importance of data wrangling in the data analysis pipeline.
2. Collect, clean, and preprocess raw data from various sources using appropriate tools.
3. Apply data transformation techniques, including handling missing data, outlier detection, and feature engineering, to improve data quality.
4. Integrate data preprocessing techniques into a reproducible data analysis pipeline, ensuring clean and ready-to-analyze datasets for statistical modeling.

**Course Contents**

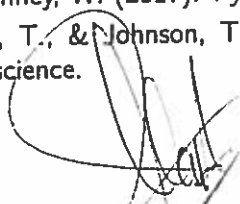
1. Introduction to Data Wrangling and the Data Science Workflow
2. Data Sources and Acquisition (CSVs, APIs, Web Scraping, Databases)
3. Data Cleaning: Removing Duplicates, Handling Missing Values
4. Data Transformation: Data Types, Normalization, Standardization
5. Handling Outliers and Anomalies
6. Feature Engineering and Variable Encoding
7. String and Text Data Processing
8. Merging, Joining, and Reshaping Datasets
9. Creating Reproducible Data Pipelines
10. Introduction to Data Wrangling Tools (R, Python, Excel, SQL)

**Recommended Textbooks**

1. Wickham, H., & Grolemund, G. (2017). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media.
2. VanderPlas, J. (2016). *Python Data Science Handbook*. O'Reilly Media.

**Suggested Readings**

1. Zume, N., & Mount, J. (2014). *Practical Data Science with R*. Manning Publications.
2. McKinney, W. (2017). *Python for Data Analysis* (2nd ed.). O'Reilly Media.
3. Dasu, T., & Johnson, T. (2003). *Exploratory Data Mining and Data Cleaning*. Wiley-Interscience.

  
Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course introduces students to the practical use of statistical software packages commonly employed in data analysis, including tools such as SPSS, R, Python, and Excel. The course provides hands-on experience in data manipulation, statistical analysis, and visualization. Emphasis is placed on applying statistical techniques such as descriptive statistics, hypothesis testing, and regression analysis through software, interpreting output, and producing professional reports. Students will gain critical software skills necessary for real-world data analysis and research tasks.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Demonstrate proficiency in using statistical software to perform data manipulation, analysis, and visualization tasks.
2. Apply various statistical techniques, such as descriptive statistics, hypothesis testing, and regression analysis, using the software tools.
3. Interpret the output generated by statistical software and communicate results effectively, including the creation of graphs and charts.
4. Troubleshoot common issues in data analysis and refine methods based on software capabilities to achieve accurate results.

**Course Contents**

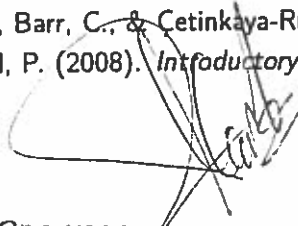
1. Introduction to Statistical Software Packages (Excel, SPSS, Minitab)
2. Data Entry, Importing, and Exporting Datasets
3. Data Cleaning and Transformation in Software
4. Descriptive Statistics and Summary Measures
5. Graphical Data Representation: Charts, Histograms, Boxplots
6. Hypothesis Testing: t-tests, Chi-square, ANOVA
7. Correlation and Regression Analysis
8. Data Visualization and Report Generation
9. Scripting and Automation in Statistical Tools
10. Troubleshooting and Debugging Data Analysis Procedures

**Recommended Textbooks**

1. Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics* (4th ed.). SAGE Publications.
2. Kabacoff, R. (2015). *R in Action: Data Analysis and Graphics with R* (2nd ed.). Manning.

**Suggested Readings**

1. McKinney, W. (2017). *Python for Data Analysis* (2nd ed.). O'Reilly Media.
2. Diez, D., Barr, C., & Cetinkaya-Rundel, M. (2019). *OpenIntro Statistics*.
3. Dalgaard, P. (2008). *Introductory Statistics with R* (2nd ed.). Springer.



Chairman  
Department Statistics 20  
University of Sargodha

**Course Brief**

This course focuses on statistical methods that do not rely on strict distributional assumptions. It is designed to equip students with robust tools for analyzing data when traditional parametric assumptions (such as normality) are violated. Emphasis is placed on understanding the rationale behind non-parametric techniques, applying them to real-world data, and interpreting results. The course covers a variety of non-parametric tests and modern resampling methods like bootstrapping and permutation tests.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the effectiveness and need of non-parametric methods in comparison to parametric techniques.
2. Understand the principles and applications of non-parametric statistical methods, including their advantages.
3. Apply non-parametric tests and resampling techniques on real-world datasets.

**Course Contents**

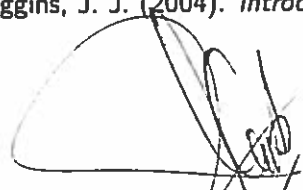
1. Introduction to Non-Parametric Statistics and When to Use Them
2. Comparison Between Parametric and Non-Parametric Methods
3. The Sign Test and Wilcoxon Signed-Rank Test
4. Mann-Whitney U Test and Kruskal-Wallis Test
5. Chi-Square Test of Independence and Goodness-of-Fit
6. Spearman's Rank Correlation
7. Run Tests and Median Tests
8. Bootstrap Methods and Confidence Intervals
9. Permutation Tests
10. Real-World Applications and Interpretation of Non-Parametric Tests

**Recommended Textbooks**

1. Gibbons, J. D., & Chakraborti, S. (2010). *Nonparametric Statistical Inference* (5th ed.). CRC Press.
2. Hollander, M., Wolfe, D. A., & Chicken, E. (2013). *Nonparametric Statistical Methods* (3rd ed.). Wiley.

**Suggested Readings**

1. Conover, W. J. (1999). *Practical Nonparametric Statistics* (3rd ed.). Wiley.
2. Higgins, J. J. (2004). *Introduction to Modern Nonparametric Statistics*. Cengage Learning.



Chairman  
Department of Statistics  
University of Sargodha

## 11. Probability Distributions (STAT-6101)

3(3-0)

### Course Brief

This course provides a comprehensive foundation in the theory and applications of probability distributions. Emphasizing both discrete and continuous random variables, the course explores key distributions, their derivations, properties, and uses in statistical modeling. Special attention is given to transformations of random variables, bivariate distributions, and order statistics. Students will learn to apply probabilistic reasoning to real-world scenarios and derive meaningful insights from statistical models.

### Course Learning Outcomes

By the end of this course, the students will be able to:

1. Understand the concepts of discrete and continuous probability distributions.
2. Derive the properties of the discrete and continuous distributions.
3. Apply one-, two-variable(s) transformation of random variables and their probability distributions.
4. Explore the bivariate normal distribution with its properties.
5. Demonstrate the use of order statistics with their probability distributions.

### Course Contents


1. Review of Random Variables and Probability Functions
2. Discrete Distributions: Binomial, Poisson, Hypergeometric, Negative Binomial
3. Continuous Distributions: Uniform, Exponential, Gamma, Normal
4. Distribution Functions and Properties (Moments, MGF, etc.)
5. Transformation of One and Two Random Variables
6. Joint, Marginal, and Conditional Distributions
7. Bivariate Normal Distribution: Definition, Properties, and Applications
8. Order Statistics: Definitions, Properties, and Applications
9. Applications in Real-World Statistical Modeling

### Recommended Textbooks

1. Hogg, R. V., McKean, J. W., & Craig, A. T. (2018). *Introduction to Mathematical Statistics* (8th ed.). Pearson.
2. Casella, G., & Berger, R. L. (2002). *Statistical Inference* (2nd ed.). Duxbury Press.

### Suggested Readings

1. Larsen, R. J., & Marx, M. L. (2018). *An Introduction to Mathematical Statistics and Its Applications* (6th ed.). Pearson.
2. Mood, A. M., Graybill, F. A., & Boes, D. C. (1974). *Introduction to the Theory of Statistics* (3rd ed.). McGraw-Hill.

  
Chairman  
Department  
University of Sargodha  
Statistics

**Course Brief**

This course focuses on the design and analysis of experiments in scientific research. Students will learn how to plan, conduct, and analyze experiments efficiently using a variety of experimental designs. Emphasis is placed on the principles of randomization, replication, and blocking. Topics include basic designs such as CRD and RCBD, factorial experiments, split-plot designs, incomplete block designs, and an introduction to response surface methodology. The course equips students with practical tools for applying these techniques in real-life data collection and analysis.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the basic experimental designs and principles with different treatment structures and applications.
2. Understand incomplete block designs.
3. Understand factorial experiments and split-plot designs.
4. Understand basic concepts of response surface methodology.

**Course Contents**

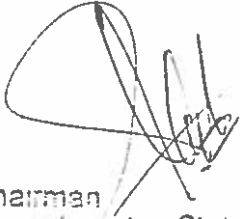
1. Introduction to Experimental Design and Basic Principles
2. Completely Randomized Design (CRD)
3. Randomized Complete Block Design (RCBD)
4. Latin Square Design (LSD)
5. Incomplete Block Designs: Balanced and Partially Balanced
6. Factorial Experiments:  $2^k$  and  $3^k$  Designs
7. Split-Plot and Strip-Plot Designs
8. Analysis of Covariance in Designed Experiments
9. Introduction to Response Surface Methodology (RSM)
10. Software Applications for Experimental Design (e.g., R, SPSS, MINITAB)

**Recommended Textbooks**

1. Montgomery, D. C. (2019). *Design and Analysis of Experiments* (10th ed.). Wiley.
2. Kuehl, R. O. (2000). *Design of Experiments: Statistical Principles of Research Design and Analysis* (2nd ed.). Duxbury Press.

**Suggested Readings**

1. Gomez, K. A., & Gomez, A. A. (1984). *Statistical Procedures for Agricultural Research* (2nd ed.). Wiley.
2. Box, G. E. P., Hunter, J. S., & Hunter, W. G. (2005). *Statistics for Experimenters: Design, Innovation, and Discovery* (2nd ed.). Wiley.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course provides an in-depth study of various sampling techniques used in statistical surveys and research. Students will learn both theoretical and practical aspects of probability and non-probability sampling, estimation of population parameters, and the application of specialized estimators. Emphasis is placed on designing efficient sampling plans and understanding the implications of different strategies on precision and bias. The course includes practical examples and exercises from fields such as social science, health, and market research.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Use and implement random and non-random sampling with their properties.
2. Estimate population total, mean, and variance for different sampling plans.
3. Distinguish among ratio, regression, and product estimators for different sampling designs and their applications.

**Course Contents**

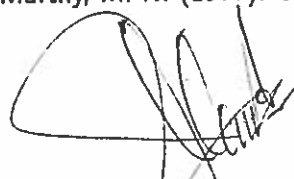
1. Introduction to Sampling: Concepts and Terminologies
2. Simple Random Sampling (With and Without Replacement)
3. Stratified Sampling and Allocation Techniques
4. Systematic Sampling
5. Cluster and Multi-stage Sampling
6. Estimation of Population Total, Mean, and Variance
7. Ratio, Regression, and Product Estimators
8. Comparison of Estimators and Efficiency Measures
9. Non-Probability Sampling Techniques: Quota and Judgment Sampling
10. Sampling Errors and Sample Size Determination
11. Use of Software for Sample Selection and Estimation (e.g., R, STATA)

**Recommended Textbooks**

1. Cochran, W. G. (1977). *Sampling Techniques* (3rd ed.). Wiley.
2. Singh, D., & Chaudhary, F. S. (1986). *Theory and Analysis of Sample Survey Designs*. Wiley Eastern.

**Suggested Readings**

1. Lohr, S. L. (2010). *Sampling: Design and Analysis* (2nd ed.). Brooks/Cole.
2. Murthy, M. N. (1977). *Sampling Theory and Methods*. Statistical Publishing Society.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course introduces statistical methods and their applications in the fields of biology, medicine, and public health. It emphasizes the use of appropriate statistical tools to analyze data collected in biomedical sciences, helping students to interpret and evaluate research findings. Students will gain experience in applying statistical reasoning to solve problems related to clinical trials, epidemiology, genetics, and public health using standard software packages.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Apply the concepts of statistics in health and biomedical sciences.
2. Understand sampling strategies in biomedical sciences.
3. Apply statistical methods in the analysis of biological and health-related data.
4. Demonstrate integration of statistical techniques with data analysis tools and methodologies to extract actionable insights from biological and health datasets.

**Course Contents**

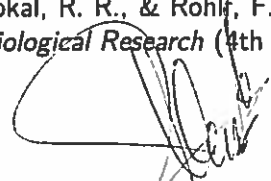
1. Introduction to Biostatistics and Its Role in Biomedical Sciences
2. Types of Data in Biomedical Research
3. Descriptive Statistics for Health Data
4. Probability Distributions in Biological Contexts
5. Sampling Methods in Medical Studies
6. Hypothesis Testing in Clinical Research
7. Statistical Inference: Confidence Intervals and  $p$ -values
8. Analysis of Categorical Data: Chi-Square Tests
9. Correlation and Regression in Medical Studies
10. Survival Analysis Basics
11. Design of Medical and Public Health Studies
12. Use of Statistical Software (e.g., SPSS, R, SAS) in Biostatistical Applications

**Recommended Textbooks**

1. Dawson, B., & Trapp, R. G. (2004). *Basic & Clinical Biostatistics* (4th ed.). McGraw-Hill.
2. Rosner, B. (2015). *Fundamentals of Biostatistics* (8th ed.). Cengage Learning.

**Suggested Readings**

1. Pagano, M., & Gauvreau, K. (2018). *Principles of Biostatistics* (2nd ed.). CRC Press.
2. Zar, J. H. (2010). *Biostatistical Analysis* (5th ed.). Pearson.
3. Sokal, R. R., & Rohlf, F. J. (2012). *Biometry: The Principles and Practice of Statistics in Biological Research* (4th ed.). W. H. Freeman.



Chairman  
Department of Statistics  
University of Barodha

**Course Brief**

This course provides a comprehensive understanding of statistical inference, equipping students with theoretical knowledge and practical skills required to make valid conclusions from data. The focus is on estimation theory and hypothesis testing, covering the key inferential procedures used in statistical analysis. The course emphasizes both classical methods and their applications in real-world scenarios.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the properties of point estimators.
2. Apply methods for point estimation, including Maximum Likelihood Estimation (MLE) and Method of Moments, and evaluate their properties such as unbiasedness and efficiency.
3. Understand the best critical region, uniformly most powerful test, likelihood ratio test, and sequential probability test.
4. Conduct hypothesis tests for population parameters, including testing for means, variances, and proportions, using classical statistical techniques.
5. Construct and interpret confidence intervals for various statistical parameters, understanding their relationship with the level of significance and margin of error.

**Course Contents**

1. Introduction to Statistical Inference
2. Properties of Point Estimators: Unbiasedness, Consistency, Efficiency, Sufficiency
3. Methods of Estimation: Method of Moments, Maximum Likelihood Estimation (MLE)
4. Interval Estimation and Confidence Intervals
5. Hypothesis Testing Framework and Concepts
6. Neyman-Pearson Lemma and Most Powerful Tests
7. Uniformly Most Powerful (UMP) Tests
8. Likelihood Ratio Tests
9. Sequential Probability Ratio Test (SPRT)
10. Tests for Means, Variances, and Proportions
11. Relationship between Confidence Intervals and Hypothesis Testing

**Recommended Textbooks**

1. Casella, G., & Berger, R. L. (2002). *Statistical Inference* (2nd ed.). Duxbury.
2. Hogg, R. V., Tanis, E. A., & Zimmerman, D. L. (2019). *Probability and Statistical Inference* (10th ed.). Pearson.

**Suggested Readings**

1. Mood, A. M., Graybill, F. A., & Boes, D. C. (1974). *Introduction to the Theory of Statistics* (3rd ed.). McGraw-Hill.
2. Lehmann, E. L., & Romano, J. P. (2005). *Testing Statistical Hypotheses* (3rd ed.). Springer.
3. Bickel, P. J., & Doksum, K. A. (2015). *Mathematical Statistics: Basic Ideas and Selected Topics* (2nd ed.). CRC Press.

**Course Brief**

This course covers fitting and evaluating linear regression models—simple, multiple, and hierarchical—including assessing the overall quality of models and interpreting the significance of individual predictors. Key statistical concepts such as R-squared, correlation, and the use of qualitative predictors are discussed in detail. Emphasis is placed on both theoretical and practical aspects of regression modeling, along with applications in short-term and long-term prediction. The course includes software demonstrations using SPSS, Minitab, Mathematica, and R to support hands-on learning. By the end of this course, students will be able to conduct and interpret their own regression analyses and critically evaluate related research.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand and differentiate types of regression and correlation.
2. Fit and evaluate simple, multiple, and hierarchical regression models.
3. Apply least squares and maximum likelihood estimation techniques.
4. Test significance of regression models and parameters.
5. Interpret regression coefficients, confidence intervals, and prediction intervals.
6. Perform model selection using stepwise regression and model fit criteria.
7. Analyze residuals, identify outliers and influential observations.
8. Implement polynomial and orthogonal regression techniques.
9. Use statistical software to apply and interpret regression models.

**Course Contents**

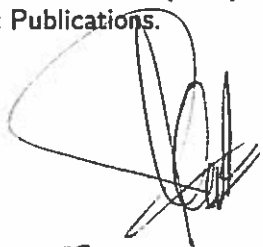
1. Introduction to regression and its types
2. Introduction to correlation and its types
3. Simple and multiple linear regression models
4. Linear regression and its assumptions
5. Least squares estimator
6. Maximum Likelihood Estimator
7. Tests of significance for regression model and regression parameters
8. Confidence interval for regression parameters
9. Interval estimation for predicted response
10. Regression models with single and multiple qualitative predictors
11. Stepwise regression and regression model selection criteria
12. Test of linearity of regression, use of extraneous information in linear regression
13. Residual analysis, detection and study of outliers and influential observations
14. Polynomial regression
15. Orthogonal polynomial and orthogonal regression analysis
16. Regression analysis with different statistical software

**Recommended Textbooks**

1. Draper, N. R. & Smith, H. (2004). *Applied Regression Analysis*. New York: John Wiley & Sons.
2. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2012). *Introduction to Linear Regression Analysis*. New York: John Wiley & Sons.

### Suggested Readings

1. Rawlings, J. O., Pantula, S. G., & Dickey, D. A. (2001). *Applied Regression Analysis: A Research Tool*. Springer.
2. Dielman, T. E. (2001). *Applied Regression Analysis for Business and Economics*. Pacific Grove.
3. Yan, X., & Zu, X. G. (2009). *Linear Regression Analysis: Theory and Computing*. World Scientific Publications.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course introduces students to statistical programming using two widely adopted languages in data science: R and Python. Emphasis is placed on the practical application of programming constructs and statistical functions to real-world data analysis problems. Students will gain hands-on experience in using R packages and Python libraries to write scripts, perform statistical computations, and automate data analysis workflows.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand basic programming concepts, including algorithms, data structures, and flow control, using R and Python.
2. Use various R packages and Python libraries (such as *tidyverse*, *pandas*, *numpy*, and *matplotlib*) for statistical computing.
3. Write and execute R and Python programs to solve statistical problems and conduct data analysis tasks.

**Course Contents**

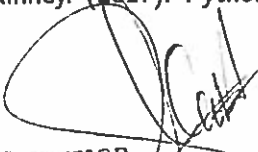
1. Introduction to R and Python Environments
2. Data Types, Variables, and Operators
3. Control Structures: Loops and Conditional Statements
4. Functions and Modules
5. Data Import, Export, and Cleaning
6. Data Manipulation using *dplyr* (R) and *pandas* (Python)
7. Data Visualization using *ggplot2* (R) and *matplotlib/seaborn* (Python)
8. Statistical Computing: Descriptive and Inferential Analysis
9. Writing Reproducible Scripts and Reports
10. Introduction to Automation and Reporting in Statistical Projects

**Recommended Textbooks**

1. Golemund, G. (2014). *Hands-On Programming with R*. O'Reilly Media.
2. Lutz, M. (2013). *Learning Python* (5th ed.). O'Reilly Media.

**Suggested Readings**

1. Wickham, H., & Golemund, G. (2016). *R for Data Science*. O'Reilly Media.
2. VanderPlas, J. (2016). *Python Data Science Handbook*. O'Reilly Media.
3. Wes McKinney. (2017). *Python for Data Analysis* (2nd ed.). O'Reilly Media.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course equips students with a comprehensive understanding of the principles and practices of research methodology. It covers the various types and designs of research, introduces data collection tools, and emphasizes ethical considerations and academic integrity in conducting research. Students will also learn how to develop, validate, and analyze research instruments like questionnaires and write scientific research reports.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the fundamental principles of research methodology, encompassing various research types, designs, and pertinent procedures.
2. Use various data collection tools effectively.
3. Develop a questionnaire, and assess its validity and reliability.
4. Understand research ethics and principles of scientific report writing.

**Course Contents**

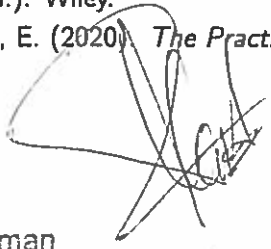
1. Introduction to Research and Research Process
2. Types of Research: Basic, Applied, Qualitative, Quantitative
3. Research Design: Exploratory, Descriptive, Experimental
4. Literature Review and Problem Formulation
5. Sampling Techniques and Sample Size Determination
6. Data Collection Methods: Surveys, Interviews, Observations
7. Designing and Validating Questionnaires
8. Measurement Scales and Reliability Testing
9. Ethics in Research and Plagiarism Awareness
10. Writing Research Proposals and Final Reports

**Recommended Textbooks**

1. Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications.
2. Kumar, R. (2019). *Research Methodology: A Step-by-Step Guide for Beginners* (5th ed.). SAGE Publications.

**Suggested Readings**

1. Neuman, W. L. (2013). *Social Research Methods: Qualitative and Quantitative Approaches* (7th ed.). Pearson.
2. Sekaran, U., & Bougie, R. (2016). *Research Methods for Business: A Skill Building Approach* (7th ed.). Wiley.
3. Babbie, E. (2020). *The Practice of Social Research* (15th ed.). Cengage Learning.



**Course Brief**

This course introduces the fundamental concepts and techniques of Statistical Quality Control (SQC), essential for quality improvement and assurance in industrial and business processes. Students will gain practical skills in monitoring production processes using control charts and conducting acceptance sampling. The course also addresses the roles of consumer's and producer's risk in quality decision-making, enabling students to implement and interpret statistical tools to ensure consistent product quality.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the fundamental principles, techniques, and tools of Statistical Quality Control.
2. Monitor statistical processes using various control charts.
3. Observe consumers' and producers' risk using different acceptance sampling plans.

**Course Contents**

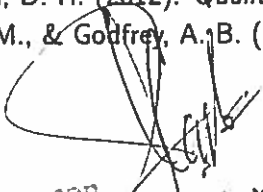
1. Introduction to Quality and Quality Control Concepts
2. Control Charts for Variables (X-bar, R, s Charts)
3. Control Charts for Attributes (p, np, c, and u Charts)
4. Process Capability Analysis and Interpretation
5. Acceptance Sampling: Single, Double, and Sequential Plans
6. Operating Characteristic (OC) Curves and Risk Analysis
7. Consumer's Risk and Producer's Risk in Quality Control
8. Applications of SQC in Industrial and Service Sectors
9. Software Tools for Quality Control (e.g., Minitab, R)

**Recommended Textbooks**

1. Montgomery, D. C. (2020). *Introduction to Statistical Quality Control* (8th ed.). Wiley.
2. Mitra, A. (2016). *Fundamentals of Quality Control and Improvement* (4th ed.). Wiley.

**Suggested Readings**

1. Grant, E. L., & Leavenworth, R. S. (1996). *Statistical Quality Control* (7th ed.). McGraw-Hill.
2. Besterfield, D. H. (2012). *Quality Control* (8th ed.). Pearson.
3. Juran, J. M., & Godfrey, A. B. (1999). *Juran's Quality Handbook* (5th ed.). McGraw-Hill.

  
Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course provides comprehensive coverage of multivariate statistical methods used to analyze data involving multiple variables simultaneously. Students will learn how to apply inference in multivariate settings, use multivariate regression models, and understand advanced techniques such as principal component analysis, factor analysis, discriminant analysis, and cluster analysis. The course emphasizes both theoretical understanding and practical implementation for real-world datasets.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Apply statistical inference for multivariate data.
2. Apply multivariate regression and relevant inference techniques.
3. Understand multivariate statistical techniques for dimension reduction such as principal component analysis and factor analysis.
4. Use discriminant analysis and clustering techniques.

**Course Contents**

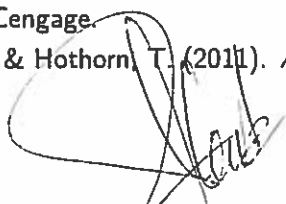
1. Introduction to Multivariate Data and Notation
2. Multivariate Normal Distribution and Its Properties
3. Inference About a Mean Vector
4. Comparison of Several Multivariate Means (MANOVA)
5. Multivariate Linear Regression Models
6. Principal Component Analysis (PCA)
7. Factor Analysis and Interpretation
8. Canonical Correlation Analysis
9. Discriminant Analysis
10. Cluster Analysis: Hierarchical and Non-hierarchical Methods
11. Applications Using Statistical Software (e.g., R, SPSS)

**Recommended Textbooks**

1. Johnson, R. A., & Wichern, D. W. (2018). *Applied Multivariate Statistical Analysis* (6th ed.). Pearson.
2. Rencher, A. C., & Christensen, W. F. (2012). *Methods of Multivariate Analysis* (3rd ed.). Wiley.

**Suggested Readings**

1. Anderson, T. W. (2003). *An Introduction to Multivariate Statistical Analysis* (3rd ed.). Wiley.
2. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate Data Analysis* (8th ed.). Cengage.
3. Everitt, B., & Hothorn, T. (2011). *An Introduction to Applied Multivariate Analysis with R*. Springer.

  
Chairman  
Department Statistics  
University of Sargodha

## **Course Outlines for Interdisciplinary Courses**

**Course Brief**

This foundational course in calculus introduces students to the fundamental concepts of limits, continuity, and differentiation. It emphasizes the application of these concepts to solve problems in mathematics, science, and engineering. Through problem-solving and analysis, students will gain critical skills necessary for advanced study in quantitative disciplines.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Describe the basic concepts of limits, continuity, and differentiation, and explain their significance in mathematical analysis.
2. Solve problems involving the differentiation of algebraic functions, including applications to rates of change and motion.
3. Use derivatives to analyze the behavior of functions, such as identifying critical points, inflection points, and intervals of increase or decrease.
4. Apply calculus concepts to solve real-world problems, such as optimization and related rates, demonstrating critical thinking and analytical reasoning.

**Course Contents**

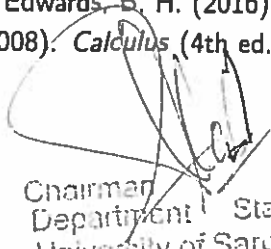
1. Review of Functions and Graphs
2. Limits and Continuity
3. The Derivative and Differentiation Rules
4. Applications of Derivatives (Rates of Change, Motion)
5. Curve Sketching and Analysis of Functions
6. Optimization Problems
7. Related Rates
8. Implicit Differentiation
9. Introduction to Exponential and Logarithmic Functions

**Recommended Textbooks**

1. Stewart, J. (2016). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
2. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' Calculus* (14th ed.). Pearson.

**Suggested Readings**

1. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus* (11th ed.). Wiley.
2. Larson, R., & Edwards, B. H. (2016). *Calculus of a Single Variable* (10th ed.). Cengage.
3. Spivak, M. (2008). *Calculus* (4th ed.). Cambridge University Press.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This continuation of Calculus I deepens students' understanding of integral calculus and introduces them to sequences and series. Emphasis is placed on techniques of integration and their applications in solving real-world problems. The course also explores the convergence of series and their role in approximating functions.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Evaluate definite and indefinite integrals using various techniques, including substitution, integration by parts, and partial fractions.
2. Analyze the applications of integration to solve problems involving areas, volumes, arc lengths, and work.
3. Investigate sequences and series, including tests for convergence and representations of functions as power series.
4. Apply core concepts of integration to solve real-world problems, such as optimization and related rates, demonstrating critical thinking and analytical reasoning.

**Course Contents**

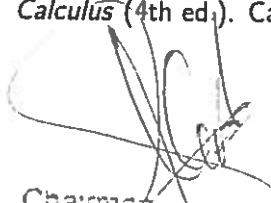
1. Techniques of Integration
2. Applications of Integration (Areas, Volumes, Arc Lengths, Work)
3. Improper Integrals
4. Introduction to Differential Equations
5. Sequences and Their Limits
6. Infinite Series and Convergence Tests
7. Power Series and Taylor Series
8. Parametric Equations and Polar Coordinates (if time permits)

**Recommended Textbooks**

1. Stewart, J. (2016). *Calculus: Early Transcendentals* (8th ed.). Cengage Learning.
2. Thomas, G. B., Weir, M. D., & Hass, J. (2018). *Thomas' Calculus* (14th ed.). Pearson.

**Suggested Readings**

1. Anton, H., Bivens, I., & Davis, S. (2016). *Calculus* (11th ed.). Wiley.
2. Larson, R., & Edwards, B. H. (2016). *Calculus of a Single Variable* (10th ed.). Cengage.
3. Spivak, M. (2008). *Calculus* (4th ed.). Cambridge University Press.



Chairman  
Department Statistics  
University of Sardodha

**Course Brief**

This course introduces students to the fundamental principles of linear algebra and its applications in statistics and data science. Topics include matrices, vectors, systems of linear equations, vector spaces, and eigenvalue analysis. The course emphasizes both theoretical understanding and practical problem-solving skills relevant to computational and statistical contexts.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Explain fundamental concepts of matrices, vectors, and linear systems, and demonstrate their application in statistical problems.
2. Apply matrix operations and transformations to solve systems of linear equations in computational contexts.
3. Analyze the properties of vector spaces and eigenvalues to interpret results for data science and statistical models.

**Course Contents**

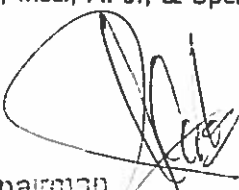
1. Introduction to Matrices and Vectors
2. Matrix Operations and Inverses
3. Systems of Linear Equations and Gaussian Elimination
4. Determinants and Cramer's Rule
5. Vector Spaces, Subspaces, Basis, and Dimension
6. Linear Independence and Rank
7. Linear Transformations and Matrix Representation
8. Eigenvalues and Eigenvectors
9. Diagonalization and Applications in Statistics

**Recommended Textbooks**

1. Lay, D. C., Lay, S. R., & McDonald, J. J. (2016). *Linear Algebra and Its Applications* (5th ed.). Pearson.
2. Strang, G. (2016). *Introduction to Linear Algebra* (5th ed.). Wellesley-Cambridge Press.

**Suggested Readings**

1. Anton, H., & Rorres, C. (2013). *Elementary Linear Algebra with Applications* (11th ed.). Wiley.
2. Meyer, C. D. (2000). *Matrix Analysis and Applied Linear Algebra*. SIAM.
3. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2003). *Linear Algebra* (4th ed.). Pearson.



Chairman  
Department of Statistics  
University of Sergodha

### Course Brief

Bioinformatics is defined broadly as the study of the inherent structure of biological information. The objective of the course is to introduce students to the rapidly evolving field of bioinformatics. The main objective is to familiarize students with biological data mining from online databases and the use of various bioinformatics tools for extracting and processing biological data. Upon completing this course, students will gain an understanding of the computational challenges (and their solutions) in analyzing large biological datasets. They will also understand how commonly used bioinformatics tools function, how to apply them effectively, and how to critically evaluate research articles in the field.

### Course Learning Outcomes

1. Understand the fundamental concepts and scope of bioinformatics.
2. Retrieve and interpret biological data from public repositories and databases.
3. Perform sequence alignment and analyze structural and functional features of biological molecules.
4. Apply bioinformatics tools for genome annotation, protein modeling, and phylogenetic analysis.
5. Evaluate computational strategies for whole genome sequencing and assembly.

### Course Contents

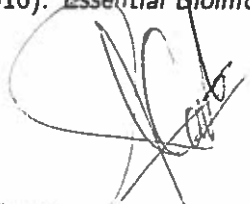
1. Introduction; bio-computing
2. Biological databases - types and retrieval of nucleic acid (or genomic) or protein sequence information
3. Sequence alignment - pairwise, multiple
4. Phylogenetics; in silico identification of protein motifs and domains
5. Structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules
6. Identification of genes and promoter regions within genomes; networks
7. Strategies for whole genome sequencing and assembly

### Recommended Databases and Tools

- NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG
- BioEdit, RepeatMasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM
- CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript
- Genetic Analysis Software, Phylip, MEGA 4.0

### Recommended Textbooks

- Claverie, J.M., & Notredame, C. (2014). *Bioinformatics for Dummies* (4th Ed.). Wiley Publishing.
- Xiong, J. (2016). *Essential Bioinformatics* (3rd Ed.). Cambridge University Press.

  
Chairman  
Department Statistics  
University of Sargodha

### Suggested Readings

- Mathura, V., & Kanguane, P. (2016). *Bioinformatics: A Concept-Based Introduction*. Springer.
- Mount, D.W. (2001). *Bioinformatics Sequence and Genome Analysis* (4th Ed.). Cold Spring Harbor Laboratory Press.
- Sperschneider, V. (2016). *Bioinformatics: Problem Solving Paradigms*. Springer.

A handwritten signature in black ink, consisting of several overlapping loops and lines, positioned above the printed name.

Chairman  
Department Statistics  
University of Sargodha

### Course Brief

This course provides fundamental concepts of programming to freshmen. The course is a prerequisite to many others; therefore, students are strongly advised to thoroughly cover all contents and achieve the course learning outcomes to the fullest extent. While the course may be taught language-independently, the university may choose any modern, market-oriented language for practical/lab sessions.

### Course Learning Outcomes

1. Understand basic problem solving steps and logic constructs (C2: *Understand*)
2. Apply basic programming concepts (C3: *Apply*)
3. Design and implement algorithms to solve real-world problems (C3: *Solve*)

### Course Contents

The course covers foundational programming concepts beginning with an introduction to problem solving and a brief review of the Von-Neumann architecture. It then explores programming fundamentals including the role of compilers and linkers, and the basics of algorithms. Students will learn about data types, variables, input/output constructs, and various operators (arithmetic, comparison, and logical). Control flow structures such as conditional and repetitive statements are introduced, along with lists, multidimensional lists, and memory organization. Further topics include modular programming, function definition and invocation, stack behavior (rolling and unrolling), string manipulation, pointers/references, and both static and dynamic memory allocation. Finally, the course introduces file input/output operations, equipping students with comprehensive knowledge required for basic software development.

### Recommended Textbooks

1. Robert Lafore. *Object Oriented Programming in C++*, latest edition.
2. Tony Gaddis. *Starting Out with Programming Logic and Design*, latest edition.
3. Brian W. Kernighan & Dennis M. Ritchie. *The C Programming Language*, 2nd Edition.
4. Paul Deitel & Harvey Deitel. *C++ How to Program*, latest edition.
5. Jeri R. Hanly & Elliot B. Koffman. *Problem Solving and Program Design in C++*, latest edition.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

The course aims to introduce basic database concepts, different data models, data storage and retrieval techniques, and database design methodologies. It places strong emphasis on the relational data model and Database Management System (DBMS) principles, providing students with the practical skills and theoretical foundation necessary to work effectively with modern databases.

### Course Learning Outcomes

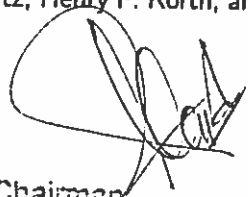
1. Explain fundamental database concepts (C2: *Explain*)
2. Design conceptual, logical, and physical database schemas using different data models (C5: *Design*)
3. Identify functional dependencies and resolve database anomalies by normalizing database tables (C2: *Identify*)
4. Use Structured Query Language (SQL) for database definition and manipulation in any DBMS (C4: *Use*)

### Course Contents

This course begins with an overview of basic database concepts and contrasts the database approach with traditional file-based systems. It introduces database architecture and the three-level schema model, highlighting the concept of data independence. The relational data model is thoroughly explored, covering attributes, schemas, tuples, domains, relation instances, keys, and integrity constraints. Students learn relational algebra operations such as selection, projection, Cartesian product, and various types of joins. The course also covers normalization techniques, functional dependencies, and different normal forms. It provides instruction on the Entity-Relationship (ER) model, including entity sets, attributes, relationships, and ER diagrams. SQL is covered in depth, including joins, subqueries, grouping, and aggregation. Advanced topics such as concurrency control, backup and recovery, indexing techniques, and an introduction to NoSQL systems are also included.

### Recommended Textbooks

1. Mark L. Gillenson. *Fundamentals of Database Management Systems*, 3rd Edition, 2023.
2. Thomas Connolly and Carolyn Begg. *Database Systems: A Practical Approach to Design, Implementation, and Management*, 6th Edition, 2019.
3. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom. *Database Systems: The Complete Book*, 2nd Edition, 2013.
4. Avi Silberschatz, Henry F. Korth, and S. Sudarshan. *Database System Concepts*, 6th Edition, 2019.



Chairman  
Department Statistics  
University of Samudra

**Course Brief**

The Cyber Security course focuses on safeguarding digital systems and data. It introduces students to the fundamentals of cyber threats, encryption, and risk management strategies, and prepares them to defend against cyberattacks while ensuring the security of information assets.

**Course Learning Outcomes**

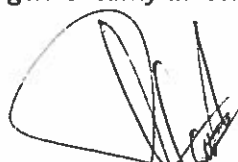
1. To be able to identify computer system threats (C2: *Understand*)
2. To be able to identify malware attacks and understand the stages of attack and payloads (C2: *Understand*)
3. Implement various cryptographic techniques and simulate attack scenarios (C3: *Apply*)

**Course Contents**

The course covers a wide range of cyber security topics, beginning with an introduction to cyber security and networking fundamentals. It explores the cyber threat landscape, key information security principles (Confidentiality, Integrity, Availability), and common terminology. Students will examine attacker profiles, including Advanced Persistent Threats (APT), and types of malware, along with the malware attack lifecycle. The course delves into social engineering tactics, attack payloads, and industrial espionage in cyberspace. Core cryptographic techniques are introduced, followed by discussions on web application security, database security, the cyber kill chain, and issues of privacy and anonymity. Additional modules include network and wireless security, software and mobile device security, cyber terrorism, information warfare, and an introduction to digital forensics and its various categories.

**Recommended Textbooks**

1. Chuck Easttom. *Computer Security Fundamentals*, 4th Edition or latest.
2. Mark Ciampa. *Security+ Guide to Network Security Fundamentals*, 5th Edition.
3. C.P. Pfleeger. *Security in Computing*, Prentice-Hall, 4th Edition or latest.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course introduces Artificial Neural Networks (ANNs) and Deep Learning. It begins with the basic architecture of ANNs and how they emulate the human brain using simple mathematical models. Students will learn the essential concepts and learning laws associated with brain-inspired computing, and how to choose activation functions and train networks for classification tasks. The course progresses to advanced deep learning topics, including convolutional and recurrent neural networks, unsupervised deep learning, reinforcement learning, and state-of-the-art models in computer vision and natural language processing.

### Course Learning Outcomes


1. Understand the fundamentals of neural networks in AI (C2: Understand)
2. Explain how simple ANNs can be designed (C2: Understand)
3. Apply ANN for classification problems (C3: Apply)
4. Apply deep learning algorithms to real-world problems (C3: Apply)
5. Analyze results from deep learning to select appropriate solutions (C4: Analyze)

### Course Contents

Introduction and history of neural networks; basic architecture of neural networks; perceptron and Adaline (Minimum Error Learning); basics of deep learning; machine learning theory – training and test sets, evaluation metrics; learning algorithms: gradient descent, Hebbian and neo-Hebbian learning, differential Hebbian learning, reinforcement learning; Kohonen self-organizing maps; associative memory and bi-directional associative memory (BAM); Boltzmann machines; backpropagation and feedforward networks; theory of generalization; multi-layer perceptrons; deep convolutional networks and their computational complexity; unsupervised deep learning: autoencoders, deep belief networks, restricted Boltzmann machines; deep recurrent neural networks including BPTT and LSTM; GPU programming for deep learning using CuDNN; generative adversarial networks (GANs); sparse coding and autoencoders; data augmentation techniques; regularization methods including dropout, batch normalization, dropconnect; recent deep learning architectures such as ResNet and GoogleNet.

### Recommended Textbooks

1. Chollet, F. *Deep Learning with Python*, Simon and Schuster, 2021.
2. Goodfellow, I., Bengio, Y., & Courville, A. *Deep Learning*, MIT Press, 2016.
3. Graupe, D. *Deep Learning Neural Networks: Design and Case Studies*, World Scientific Publishing, 2016.
4. Anderson, J. A. *An Introduction to Neural Networks*, MIT Press, 1995.
5. Hassoun, M. H. *Fundamentals of Artificial Neural Networks*, MIT Press, 1995.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course introduces students to the foundations and applications of cloud computing. It explores distributed computing techniques, cloud ecosystems, and real-world use cases. Emphasis is placed on cloud services, deployment models, and related tools through hands-on labs and a term project.

### Course Learning Outcomes

1. Understand fundamental concepts of distributed computing and their implementation in modern cloud systems (C1: Knowledge)
2. Understand the basic principles of cloud deployment and service models (C2: Understand)
3. Demonstrate deployment of cloud service models using simulators, VMware, or OpenStack (C2: Understand)

### Course Contents

The course begins with an overview of distributed computing and the emergence of cloud computing, emphasizing the global nature and reliability of cloud models. Topics include cloud-based service offerings such as Communication-as-a-Service (CaaS), Infrastructure-as-a-Service (IaaS), Monitoring-as-a-Service (MaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). Key areas also include virtualization, security in the cloud, privacy and identity management, cloud federation, and mobile access to cloud services. Students will examine common cloud standards, legal considerations, and challenges faced in cloud environments.

### Recommended Textbooks

1. Erl, T. (2023). *Cloud Computing: Concepts, Technology, Security, and Architecture*. Pearson Digital Enterprise Series.
2. Rittinghouse, J. W., & Ransome, J. F. (2010). *Cloud Computing Implementation, Management, and Security*. Taylor and Francis Group.
3. Liu, M.-L. (2004). *Distributed Computing: Principles and Applications*. Pearson.
4. Buyya, R., & Dastjerdi, A. V. (Eds.). *Internet of Things: Principles and Paradigms*. Morgan Kaufmann.
5. <https://arxiv.org/abs/1601.02752>
6. <https://www.vmware.com/pdf/virtualization.pdf>
7. [https://www.vmware.com/pdf/virtualization\\_considerations.pdf](https://www.vmware.com/pdf/virtualization_considerations.pdf)
8. [https://www.researchgate.net/publication/270581440\\_Cloud\\_Federation\\_characteristics\\_and\\_conceptual\\_model](https://www.researchgate.net/publication/270581440_Cloud_Federation_characteristics_and_conceptual_model)
9. <https://xmpp.org/>
10. *Architecting the Cloud: Design Decision for Cloud Computing Service Models (SaaS, PaaS and IaaS)*. Wiley India, 2014.

Chairman  
Department of Statistics  
University of Sargodha

**Course Outlines for Elective Courses**

**Course Brief**

This course provides a comprehensive introduction to the statistical analysis of categorical data, which arises frequently in the social sciences, health studies, marketing, and other applied fields. The course covers methods for analyzing binary, nominal, and ordinal outcomes using both classical and modern approaches.

Students will learn how to construct contingency tables, apply logistic regression models, and interpret results in the context of real-world datasets. Emphasis is placed on practical application, model interpretation, and communication of statistical findings.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the types and structure of categorical data.
2. Construct and interpret contingency tables.
3. Apply chi-square tests for independence and goodness-of-fit.
4. Fit and interpret binary and multinomial logistic regression models.
5. Analyze ordinal data using appropriate statistical models.
6. Evaluate model fit and identify influential observations.
7. Use statistical software (e.g., R, SAS, or SPSS) for categorical data analysis.

**Course Contents**

1. Introduction to Categorical Data: Types and Examples
2. Contingency Tables and Measures of Association
3. Chi-Square Tests: Independence, Homogeneity, and Goodness-of-Fit
4. Binary Response Models and Logistic Regression
5. Inference in Logistic Regression: Odds Ratios and Confidence Intervals
6. Multinomial Logistic Regression for Nominal Outcomes
7. Ordinal Logistic Regression Models (Proportional Odds Model)
8. Loglinear Models for Multi-way Tables
9. Model Selection and Assessment for Categorical Models
10. Overdispersion and Quasi-likelihood Methods
11. Applications in Epidemiology, Social Sciences, and Marketing
12. Software Implementation and Interpretation of Outputs

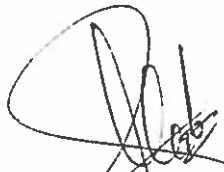
**Recommended Textbooks**

1. Agresti, A. (2018). *Statistical Methods for the Social Sciences*. Pearson.
2. Agresti, A. (2013). *Categorical Data Analysis*. Wiley.

**Suggested Readings**

1. Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied Logistic Regression*. Wiley.
2. Menard, S. (2002). *Applied Logistic Regression Analysis*. Sage Publications.
3. Powers, D. A., & Xie, Y. (2008). *Statistical Methods for Categorical Data Analysis*. Emerald Group Publishing.

4. Kleinbaum, D. G., & Klein, M. (2010). *Logistic Regression: A Self-Learning Text*. Springer.
5. Long, J. S. (1997). *Regression Models for Categorical and Limited Dependent Variables*. Sage Publications.



Chairman  
Department of Statistics  
University of Sargodha.

**Course Brief**

This course provides a comprehensive introduction to stochastic processes, which are collections of random variables representing systems evolving over time under uncertainty. It equips students with analytical tools to model, analyze, and interpret dynamic random phenomena in areas such as queueing theory, finance, biology, telecommunications, and operations research.

Topics include Markov chains, Poisson processes, renewal theory, and Brownian motion, with emphasis on both theoretical foundations and practical applications.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the fundamental concepts and classifications of stochastic processes.
2. Analyze discrete-time and continuous-time Markov chains.
3. Solve problems involving Poisson processes and their properties.
4. Apply renewal theory to systems with repetitive random events.
5. Understand the behavior and applications of Brownian motion.
6. Use stochastic models in applications such as queueing, reliability, and inventory systems.

**Course Contents**

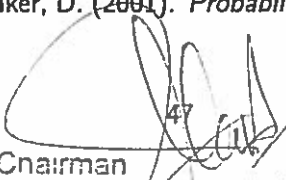
1. Introduction to Stochastic Processes and Random Variables Review
2. Classification of Stochastic Processes: Discrete vs. Continuous, Markovian vs. Non-Markovian
3. Discrete-Time Markov Chains (DTMCs):
  - Transition Matrices and Chapman-Kolmogorov Equations
  - Classification of States and Limiting Behavior
4. Continuous-Time Markov Chains (CTMCs):
  - Birth-Death Processes
  - Transition Rate Matrix and Kolmogorov Differential Equations
5. Poisson Process and Variants
6. Renewal Processes and Applications
7. Markov Renewal and Semi-Markov Processes
8. Branching Processes
9. Brownian Motion and the Wiener Process
10. Applications in Queueing Theory, Reliability, and Finance
11. Simulation of Stochastic Processes

**Recommended Textbooks**

1. Ross, S. M. (2014). *Introduction to Probability Models*. Academic Press.
2. Medhi, J. (2009). *Stochastic Processes*. New Age International Publishers.

**Suggested Readings**

1. Karlin, S., & Taylor, H. M. (1975). *A First Course in Stochastic Processes*. Academic Press.
2. Grimmett, G., & Stirzaker, D. (2001). *Probability and Random Processes*. Oxford University Press.

  
Chairman  
Department of Statistics  
University of Sargodha

3. Norris, J. R. (1997). *Markov Chains*. Cambridge University Press.
4. Durrett, R. (2019). *Essentials of Stochastic Processes*. Springer.
5. Cinlar, E. (2011). *Probability and Stochastics*. Springer.



Chairman  
Department of Statistics  
University of Sargodha

### 3. Reliability Analysis (STAT-6113)

#### Course Brief

This course introduces the principles and methods of reliability analysis, focusing on modeling, estimation, and evaluation of the lifetime and performance of systems and components. It covers key concepts such as failure rates, system configurations, life distributions, and maintenance strategies.

Students will learn how to apply statistical techniques to assess system reliability, estimate model parameters, and develop reliability improvement strategies for engineering, industrial, and safety-critical applications.

#### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand fundamental concepts such as reliability, hazard function, and mean time to failure (MTTF).
2. Model lifetimes using exponential, Weibull, and other life distributions.
3. Estimate reliability parameters from failure data using statistical methods.
4. Analyze system reliability for series, parallel, and complex configurations.
5. Apply preventive maintenance and reliability-centered maintenance principles.
6. Use reliability software and simulation tools to evaluate system performance.

#### Course Contents

1. Introduction to Reliability Engineering and Definitions
2. Probability Concepts in Reliability
3. Lifetime Distributions: Exponential, Weibull, Gamma, Lognormal
4. Reliability Functions, Hazard Rate, and Cumulative Hazard
5. Mean Time to Failure (MTTF) and Mean Time Between Failures (MTBF)
6. Parameter Estimation: Maximum Likelihood and Least Squares Methods
7. System Reliability Analysis: Series, Parallel, k-out-of-n Systems
8. Fault Tree and Reliability Block Diagrams
9. Redundancy and Reliability Improvement Techniques
10. Preventive and Corrective Maintenance Policies
11. Accelerated Life Testing and Censoring Techniques
12. Case Studies in Engineering, Electronics, and Industrial Systems

#### Recommended Textbooks

1. Elsayed, E. A. (2012). *Reliability Engineering*. Wiley.
2. Modarres, M., Kaminskiy, M., & Krivtsov, V. (2016). *Reliability Engineering and Risk Analysis*. CRC Press.

#### Suggested Readings

1. Lewis, E. E. (1996). *Introduction to Reliability Engineering*. Wiley.
2. O'Connor, P. D. T., & Kleyner, A. (2012). *Practical Reliability Engineering*. Wiley.
3. Kapur, K. C., & Lamberson, L. R. (1977). *Reliability in Engineering Design*. Wiley.
4. Meeker, W. Q., & Escobar, L. A. (1998). *Statistical Methods for Reliability Data*. Wiley.
5. Rausand, M., & Høyland, A. (2004). *System Reliability Theory*. Wiley.

### Course Brief

This course introduces the statistical methods used to analyze time-to-event data, commonly referred to as survival data. It is widely applied in clinical trials, epidemiology, engineering, social sciences, and reliability studies. The course covers censoring mechanisms, survival and hazard functions, non-parametric and semi-parametric methods, and regression models for survival data. Students will develop the ability to handle censored data, interpret survival curves, and apply appropriate statistical models using both theoretical understanding and hands-on experience with real-world datasets.

### Course Learning Outcomes

By the end of the course, students will be able to:

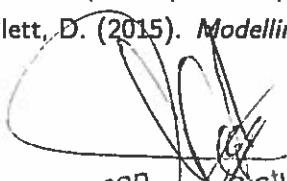
1. Understand the basic concepts of survival analysis including censoring and truncation.
2. Estimate survival and hazard functions using non-parametric methods.
3. Compare survival curves using statistical tests such as the log-rank test.
4. Fit and interpret Cox proportional hazards models.
5. Apply parametric survival models (e.g., exponential, Weibull).
6. Analyze real-life survival data using statistical software (e.g., R or SAS).

### Course Contents

1. Introduction to Survival Analysis and Time-to-Event Data
2. Types of Censoring and Truncation
3. Survival Function, Hazard Function, and Cumulative Hazard
4. Non-parametric Estimation:
  - Kaplan-Meier Estimator
  - Nelson-Aalen Estimator
5. Comparing Survival Curves: Log-Rank and Wilcoxon Tests
6. Cox Proportional Hazards Model:
  - Assumptions and Interpretation
  - Model Checking and Diagnostics
7. Parametric Models: Exponential, Weibull, Log-normal
8. Accelerated Failure Time (AFT) Models
9. Time-Dependent Covariates and Stratified Cox Models
10. Competing Risks and Recurrent Event Analysis
11. Applications in Medicine, Reliability, and Social Sciences
12. Software Implementation in R or SAS

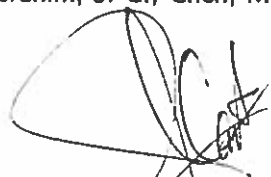
### Recommended Textbooks

1. Kleinbaum, D. G., & Klein, M. (2012). *Survival Analysis: A Self-Learning Text*. Springer.
2. Collett, D. (2015). *Modelling Survival Data in Medical Research*. CRC Press.

  
Chairman  
Department of Statistics  
University of Sargodha

### Suggested Readings

1. Kalbfleisch, J. D., & Prentice, R. L. (2002). *The Statistical Analysis of Failure Time Data*. Wiley.
2. Hosmer, D. W., Lemeshow, S., & May, S. (2008). *Applied Survival Analysis*. Wiley.
3. Therneau, T. M., & Grambsch, P. M. (2000). *Modeling Survival Data: Extending the Cox Model*. Springer.
4. Lee, E. T., & Wang, J. W. (2013). *Statistical Methods for Survival Data Analysis*. Wiley.
5. Ibrahim, J. G., Chen, M. H., & Sinha, D. (2001). *Bayesian Survival Analysis*. Springer.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course provides a rigorous foundation in actuarial statistics, focusing on probability models and statistical methods used in insurance and financial risk management. It covers the modeling of claim distributions, survival models, credibility theory, and estimation techniques. The course prepares students for professional actuarial exams and equips them with analytical tools for real-world actuarial practice.

Students will gain experience applying statistical techniques to model insurance claims, life contingencies, and other uncertain future events, making informed decisions based on probabilistic outcomes.

### Course Learning Outcomes

By the end of the course, students will be able to:


1. Understand key concepts in actuarial science including risk, loss distributions, and insurance principles.
2. Apply probability models to assess life, health, and general insurance risks.
3. Estimate parameters and fit models to claim and loss data.
4. Analyze survival and hazard functions using life tables and parametric models.
5. Apply credibility theory for experience rating.
6. Use simulation and numerical methods for pricing and reserve estimation.

### Course Contents

1. Introduction to Actuarial Science and Insurance Principles
2. Review of Probability Theory and Common Distributions
3. Loss Models: Frequency and Severity Distributions (Poisson, Binomial, Exponential, Pareto)
4. Aggregate Loss Models and Risk Measures (VaR, TVaR)
5. Estimation Techniques: Maximum Likelihood and Bayesian Estimation
6. Model Selection and Goodness-of-Fit Tests
7. Survival Models and Life Tables
8. Hazard Rates, Force of Mortality, and Parametric Lifetime Distributions
9. Multiple Life and Multiple Decrement Models
10. Credibility Theory: Classical and Bayesian Approaches
11. Simulation Methods in Actuarial Modeling
12. Applications in Life, Health, and Property Insurance

### Recommended Textbooks

1. Klugman, S. A., Panjer, H. H., & Willmot, G. E. (2012). *Loss Models: From Data to Decisions*. Wiley.
2. Dickson, D. C. M., Hardy, M. R., & Waters, H. R. (2013). *Actuarial Mathematics for Life Contingent Risks*. Cambridge University Press.



Chairman  
Department  
University of Sargodha

### Suggested Readings

1. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. (1997). *Actuarial Mathematics*. Society of Actuaries.
2. Cunningham, R., Herzog, T. N., & London, R. (2001). *Models for Quantifying Risk*. ACTEX Publications.
3. Kaas, R., Goovaerts, M., Dhaene, J., & Denuit, M. (2008). *Modern Actuarial Risk Theory*. Springer.
4. Frees, E. W. (2010). *Regression Modeling with Actuarial and Financial Applications*. Cambridge University Press.
5. Haberman, S., & Pitacco, E. (1999). *Actuarial Models for Disability Insurance*. Chapman and Hall/CRC.



Chairman  
Department Statistics  
University of Sargodha

### Course Brief

This course introduces the principles and methods of Bayesian statistics, which offers a coherent framework for updating beliefs in the presence of uncertainty. Unlike classical approaches, Bayesian inference combines prior knowledge with observed data using Bayes' theorem, leading to flexible and interpretable models.

Students will learn to construct Bayesian models, perform inference using both analytical and computational methods, and apply Bayesian thinking to real-world problems in science, business, and engineering. The course includes hands-on experience with Bayesian computation using tools such as R, Stan, or PyMC.

### Course Learning Outcomes

By the end of the course, students will be able to:


1. Understand the conceptual foundations of Bayesian inference and contrast it with frequentist methods.
2. Specify and interpret prior, likelihood, and posterior distributions.
3. Perform Bayesian inference for parameters in common statistical models.
4. Use Bayesian model comparison criteria such as Bayes factors and DIC.
5. Implement computational techniques including Gibbs sampling and MCMC.
6. Apply Bayesian methods to real-world datasets using appropriate software tools.

### Course Contents

1. Introduction to Bayesian Thinking and Bayes' Theorem
2. Prior Distributions: Informative vs. Non-informative Priors
3. Conjugate Priors for Common Models (Binomial, Poisson, Normal)
4. Posterior Distributions and Bayesian Estimation
5. Bayesian Hypothesis Testing and Credible Intervals
6. Bayesian Linear Regression
7. Hierarchical Bayesian Models
8. Introduction to Markov Chain Monte Carlo (MCMC)
9. Gibbs Sampling, Metropolis-Hastings, and Hamiltonian Monte Carlo
10. Model Comparison: Bayes Factors, Posterior Predictive Checks, DIC
11. Bayesian Decision Theory
12. Applications in Medicine, Engineering, Social Sciences, and Machine Learning

### Recommended Textbooks

1. Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian Data Analysis*. CRC Press.
2. Kruschke, J. K. (2015). *Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan*. Academic Press.

  
Chairman  
Department of Statistics  
University of Sargodha

### Suggested Readings

1. McElreath, R. (2020). *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*. CRC Press.
2. Bernardo, J. M., & Smith, A. F. M. (1994). *Bayesian Theory*. Wiley.
3. Hoff, P. D. (2009). *A First Course in Bayesian Statistical Methods*. Springer.
4. Lunn, D., Jackson, C., Best, N., Thomas, A., & Spiegelhalter, D. (2012). *The BUGS Book: A Practical Introduction to Bayesian Analysis*. CRC Press.
5. Lee, P. M. (2012). *Bayesian Statistics: An Introduction*. Wiley.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course provides an introduction to the principles and techniques of Operations Research (OR), a discipline that uses mathematical modeling, optimization, and analytical methods to support decision-making in complex systems. The course covers foundational topics such as linear programming, transportation models, network flows, and queuing theory.

Students will learn to formulate and solve real-world optimization problems and gain proficiency in using computational tools for OR applications in business, engineering, logistics, and public policy.

**Course Learning Outcomes**

By the end of the course, students will be able to:

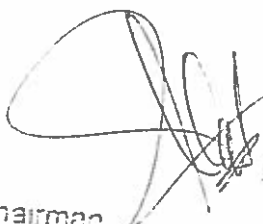
1. Understand the scope, methodology, and applications of operations research.
2. Formulate linear programming models for decision problems.
3. Solve optimization problems using the simplex method and duality theory.
4. Analyze and solve transportation, assignment, and network flow problems.
5. Apply dynamic programming and integer programming techniques.
6. Understand the basics of queuing models and simulation in OR.
7. Use OR software tools to model and analyze real-life problems.

**Course Contents**

1. Introduction to Operations Research and Modeling Principles
2. Linear Programming:
  - Problem Formulation
  - Graphical and Simplex Methods
  - Duality and Sensitivity Analysis
3. Transportation and Assignment Problems
4. Network Models:
  - Shortest Path, Minimum Spanning Tree
  - Max-Flow and Network Optimization
5. Integer Programming and Binary Decision Models
6. Dynamic Programming and Multi-Stage Decision Problems
7. Queuing Theory and Service Systems
8. Decision Theory and Game Theory (Basics)
9. Simulation Techniques and Monte Carlo Methods
10. Case Studies and Applications in Industry, Supply Chain, and Healthcare

**Recommended Textbooks**

1. Taha, H. A. (2017). *Operations Research: An Introduction*. Pearson.
2. Hillier, F. S., & Lieberman, G. J. (2020). *Introduction to Operations Research*. McGraw-Hill.



56  
Chairman  
Department Statistics  
University of Sargodha

### Suggested Readings

1. Winston, W. L. (2003). *Operations Research: Applications and Algorithms*. Cengage Learning.
2. Ravindran, A., Phillips, D. T., & Solberg, J. J. (2007). *Operations Research: Principles and Practice*. Wiley.
3. Sharma, J. K. (2016). *Operations Research: Theory and Applications*. Macmillan.
4. Gupta, P. K., & Hira, D. S. (2014). *Operations Research*. S. Chand Publishing.
5. Pinedo, M. (2016). *Scheduling: Theory, Algorithms, and Systems*. Springer.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course introduces the principles and methods of decision theory, focusing on making rational choices under conditions of uncertainty and risk. It explores both classical and Bayesian frameworks, incorporating decision trees, utility theory, and multi-criteria decision-making. Applications span economics, business, healthcare, engineering, and public policy.

Students will learn to structure decision problems, quantify uncertainty, assess outcomes using utility functions, and apply statistical tools to guide optimal decision-making in complex scenarios.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the foundational principles of decision theory and rational choice.
2. Construct decision trees and analyze them using expected utility.
3. Apply decision-making under risk and uncertainty using probability models.
4. Use utility theory to quantify preferences and model individual or group decisions.
5. Incorporate Bayesian decision-making principles and posterior distributions.
6. Solve multi-criteria decision problems and sensitivity analysis.
7. Apply decision theory to real-world problems using statistical software or decision analysis tools.

**Course Contents**

1. Introduction to Decision Theory: Structure, Scope, and Applications
2. Elements of a Decision Problem: Acts, States, Outcomes, and Preferences
3. Decision-Making Under Certainty, Risk, and Uncertainty
4. Decision Trees and Payoff Tables
5. Expected Value and Expected Utility Approaches
6. Utility Functions and Risk Preferences
7. Bayesian Decision Theory:
  - Prior and Posterior Distributions
  - Bayes Risk and Bayesian Optimal Decisions
8. Value of Information and Decision-Making with Imperfect Information
9. Multi-Attribute Utility Theory (MAUT) and Analytic Hierarchy Process (AHP)
10. Group Decision-Making and Game-Theoretic Approaches
11. Sensitivity Analysis and Robust Decision-Making
12. Case Studies in Economics, Health Policy, and Engineering Systems

**Recommended Textbooks**

1. Berger, J. O. (1985). *Statistical Decision Theory and Bayesian Analysis*. Springer.
2. Raiffa, H., & Schlaifer, R. (2000). *Applied Statistical Decision Theory*. Wiley Classics Library.




58

Chairman  
Department Statistics  
University of Sargodha

### Suggested Readings

1. DeGroot, M. H. (2004). *Optimal Statistical Decisions*. Wiley.
2. Clemen, R. T., & Reilly, T. (2013). *Making Hard Decisions with DecisionTools*. Cengage Learning.
3. French, S. (1986). *Decision Theory: An Introduction to the Mathematics of Rationality*. Ellis Horwood.
4. Keeney, R. L., & Raiffa, H. (1993). *Decisions with Multiple Objectives: Preferences and Value Trade-Offs*. Cambridge University Press.
5. Kadane, J. B. (2011). *Principles of Uncertainty*. CRC Press.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course provides a comprehensive introduction to data mining — the process of discovering patterns, trends, and knowledge from large datasets. It combines statistical analysis, machine learning, and database techniques to extract meaningful insights for decision-making in business, science, and engineering.

Students will explore key concepts including data preprocessing, classification, clustering, association rule mining, and anomaly detection. The course includes practical applications and hands-on experience with data mining tools and programming in R or Python.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the data mining process and its role in knowledge discovery.
2. Preprocess and clean large datasets for analysis.
3. Apply classification techniques such as decision trees, logistic regression, and support vector machines.
4. Perform clustering using k-means, hierarchical, and density-based methods.
5. Discover association rules using the Apriori and FP-growth algorithms.
6. Evaluate and validate data mining models using appropriate metrics.
7. Implement data mining algorithms using software tools (e.g., Python, R, Weka).

**Course Contents**

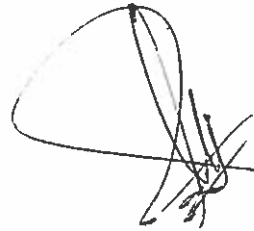
1. Introduction to Data Mining and Knowledge Discovery in Databases (KDD)
2. Data Understanding and Preprocessing:
  - Cleaning, Transformation, Normalization, Handling Missing Data
3. Exploratory Data Analysis and Visualization
4. Classification Methods:
  - Decision Trees, Naïve Bayes, Logistic Regression, SVM
  - k-Nearest Neighbors (k-NN), Ensemble Methods (Random Forest, Boosting)
5. Clustering Techniques:
  - k-Means, Hierarchical Clustering, DBSCAN, Gaussian Mixture Models
6. Association Rule Mining:
  - Market Basket Analysis, Apriori, FP-Growth
7. Anomaly Detection and Outlier Analysis
8. Model Evaluation:
  - Confusion Matrix, Accuracy, Precision, Recall, ROC Curve
9. Text Mining and Web Mining (Introductory)
10. Case Studies and Applications in Business, Health, and Social Networks

**Recommended Textbooks**

1. Han, J., Kamber, M., & Pei, J. (2011). *Data Mining: Concepts and Techniques*. Elsevier.
2. Tan, P. N., Steinbach, M., Karpatne, A., & Kumar, V. (2018). *Introduction to Data Mining*. Pearson.

### Suggested Readings

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). *Data Mining: Practical Machine Learning Tools and Techniques*. Elsevier.
2. Aggarwal, C. C. (2015). *Data Mining: The Textbook*. Springer.
3. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning*. Springer.
4. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning*. Springer.
5. Kuhn, M., & Johnson, K. (2013). *Applied Predictive Modeling*. Springer.

A handwritten signature in black ink, consisting of several overlapping loops and lines, positioned above the typed name.

Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course provides a systematic introduction to the formulation, analysis, and implementation of mathematical models and simulation techniques for solving real-world problems. Students will learn how to construct mathematical representations of physical, biological, and social systems, and simulate their behavior using analytical and computational methods.

The course emphasizes model validation, sensitivity analysis, and the use of simulation tools for decision-making in engineering, economics, ecology, and operations research.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the modeling process and the role of simulation in applied problem-solving.
2. Formulate mathematical models using algebraic, differential, and probabilistic structures.
3. Analyze the behavior of models and assess their assumptions and limitations.
4. Develop simulation algorithms for deterministic and stochastic systems.
5. Validate and calibrate models using empirical data.
6. Apply simulation software (e.g., MATLAB, Python, AnyLogic) to implement and analyze models.

**Course Contents**

1. Introduction to Mathematical Modeling and Simulation
2. Classification of Models: Deterministic vs. Stochastic, Static vs. Dynamic
3. Model Formulation Techniques:
  - Empirical, Mechanistic, and Data-Driven Models
4. Linear and Nonlinear Models
5. Differential Equation Models:
  - Population Dynamics, Epidemics, Mechanical Systems
6. Difference Equations and Discrete-Time Models
7. Optimization Models in Operations Research
8. Stochastic Modeling: Markov Chains, Queuing Systems
9. Monte Carlo Simulation and Random Number Generation
10. Simulation Modeling Tools and Software
11. Model Validation, Calibration, and Sensitivity Analysis
12. Case Studies in Engineering, Environment, and Health Sciences

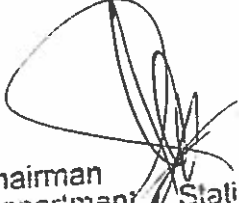
**Recommended Textbooks**

1. Giordano, F. R., Fox, W. P., & Horton, S. B. (2014). *A First Course in Mathematical Modeling*. Cengage Learning.
2. Law, A. M. (2014). *Simulation Modeling and Analysis*. McGraw-Hill.

**Suggested Readings**

1. Kreyszig, E. (2011). *Advanced Engineering Mathematics*. Wiley.
2. Higham, D. J., & Higham, N. J. (2016). *Mathematical Modelling: A Chemical Engineer's Perspective*. SIAM.

3. Banks, J., Carson, J. S., Nelson, B. L., & Nicol, D. M. (2010). *Discrete-Event System Simulation*. Pearson.
4. AnyLogic Company. *AnyLogic in Three Days: A Quick Course in Simulation Modeling*.
5. Kloeden, P. E., & Platen, E. (1992). *Numerical Solution of Stochastic Differential Equations*. Springer.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course introduces the essential statistical tools and techniques used in modern data science. It focuses on data exploration, visualization, statistical inference, and predictive modeling. The course equips students with practical skills to analyze complex datasets, draw valid conclusions, and make data-driven decisions.

Students will use statistical software (e.g., R or Python) for hands-on analysis, developing a foundation for advanced study in machine learning, artificial intelligence, and applied analytics.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand core statistical concepts relevant to data science.
2. Explore and visualize data using appropriate graphical techniques.
3. Apply statistical inference methods to estimate population parameters and test hypotheses.
4. Build and evaluate linear and logistic regression models.
5. Perform dimensionality reduction and correlation analysis.
6. Use statistical programming tools to conduct reproducible data analysis.

### Course Contents

1. Introduction to Data Science and Statistical Thinking
2. Data Types, Measurement Scales, and Summary Statistics
3. Data Visualization: Histograms, Boxplots, Heatmaps, Scatterplots
4. Probability Concepts and Distributions (Normal, Binomial, Poisson)
5. Sampling Distributions and the Central Limit Theorem
6. Estimation and Confidence Intervals
7. Hypothesis Testing (t-test, z-test, chi-square test)
8. Correlation and Simple Linear Regression
9. Multiple Linear Regression and Model Diagnostics
10. Logistic Regression and Classification Metrics
11. Feature Selection and Dimensionality Reduction (e.g., PCA)
12. Introduction to Statistical Programming in R/Python

### Recommended Textbooks

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning*. Springer.
2. Verzani, J. (2014). *Using R for Introductory Statistics*. CRC Press.

### Suggested Readings

1. Wickham, H., & Golemund, G. (2016). *R for Data Science*. O'Reilly Media.
2. McKinney, W. (2017). *Python for Data Analysis*. O'Reilly Media.
3. Dasgupta, S., & Jin, C. (2021). *Algorithms for Data Science*. Springer.
4. Gelman, A., & Hill, J. (2006). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press.
5. Dean, J., & Tukey, J. W. (1990). *Data Analysis and Regression: A Second Course in Statistics*. Addison-Wesley.

### Course Brief

This course bridges fundamental statistical principles with deep learning, enabling students to understand and apply statistical thinking in neural network modeling. The course emphasizes probability theory, estimation, inference, and model evaluation techniques crucial for training, regularizing, and interpreting deep learning models.

Students will explore how statistical reasoning informs design choices in deep architectures and optimization, gain insights into uncertainty quantification, and use statistical tools to assess model robustness, interpretability, and generalization.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand core statistical concepts used in deep learning.
2. Analyze and preprocess data using probabilistic and statistical tools.
3. Evaluate deep learning models using statistical performance metrics.
4. Apply regularization and Bayesian techniques for model generalization.
5. Interpret deep learning outputs using statistical methods (e.g., confidence intervals, uncertainty estimation).
6. Utilize statistical diagnostics to detect overfitting, bias, and data imbalance.

### Course Contents

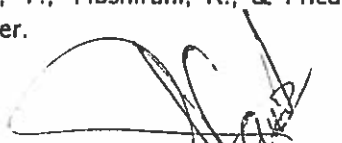
1. Review of Probability and Statistical Inference
2. Exploratory Data Analysis for Deep Learning Datasets
3. Probability Distributions and Likelihood Functions
4. Estimation Theory: MLE and MAP
5. Hypothesis Testing and Confidence Intervals in Model Evaluation
6. Loss Functions from a Statistical Perspective (Cross-Entropy, MSE)
7. Regularization Techniques: L1/L2, Dropout, Early Stopping
8. Bayesian Deep Learning and Uncertainty Quantification
9. Statistical Considerations in Training and Validation (Bias-Variance Tradeoff)
10. Evaluation Metrics: Accuracy, Precision, Recall, F1, AUC, Calibration
11. Handling Imbalanced Data: SMOTE, Stratified Sampling
12. Case Studies: Image, Text, and Tabular Data Applications

### Recommended Textbooks

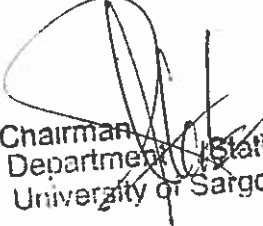
1. Murphy, K. P. (2022). *Probabilistic Machine Learning: An Introduction*. MIT Press.
2. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.

### Suggested Readings

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
2. Gal, Y. (2016). *Uncertainty in Deep Learning*. PhD Thesis, University of Cambridge.
3. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning*. Springer.

  
Chairman  
Department of Statistics  
University of Sargodha

4. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*. O'Reilly Media.
5. McElreath, R. (2020). *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*. CRC Press.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course provides a rigorous foundation in statistical machine learning, combining concepts from statistics, optimization, and computational learning theory. It emphasizes the role of statistical inference in building, evaluating, and interpreting predictive models.

Students will explore both supervised and unsupervised learning algorithms, focusing on the statistical principles that guide model selection, regularization, generalization, and performance evaluation. Practical applications will be implemented using statistical programming tools such as R or Python.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the statistical foundations of key machine learning algorithms.
2. Apply regression, classification, and clustering methods to real-world datasets.
3. Use regularization techniques to prevent overfitting.
4. Evaluate model performance using statistical metrics and cross-validation.
5. Analyze the bias-variance tradeoff and its impact on model generalization.
6. Implement and tune machine learning models using statistical programming environments.

### Course Contents

1. Introduction to Statistical Machine Learning and Core Concepts
2. Linear Regression and Model Selection (AIC, BIC, Adjusted  $R^2$ )
3. Classification Methods: Logistic Regression, LDA, QDA, Naïve Bayes
4. Resampling Techniques: Cross-Validation and Bootstrap
5. Regularization: Ridge Regression, Lasso, Elastic Net
6. Nonlinear Models: Splines, Generalized Additive Models (GAMs)
7. Tree-Based Methods: Decision Trees, Random Forests, Gradient Boosting
8. Support Vector Machines and Kernel Methods
9. Unsupervised Learning: PCA, K-Means, Hierarchical Clustering
10. Model Evaluation: ROC, AUC, Confusion Matrix, Precision-Recall
11. Introduction to Ensemble Learning and Bagging/Boosting
12. Bayesian Approaches in Machine Learning

### Recommended Textbooks

1. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning*. Springer.
2. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning*. Springer.

### Suggested Readings

1. Murphy, K. P. (2012). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
3. Kuhn, M., & Johnson, K. (2013). *Applied Predictive Modeling*. Springer.

4. Efron, B., & Hastie, T. (2016). *Computer Age Statistical Inference*. Cambridge University Press.
5. Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2018). *Foundations of Machine Learning*. MIT Press.

A handwritten signature in black ink, consisting of several overlapping loops and a final flourish extending to the right.

Chairman  
Department Statistics  
University of Sargodha

### Course Brief

This course provides a practical introduction to Artificial Intelligence (AI) with a focus on real-world statistical applications. It emphasizes hands-on development and deployment of intelligent systems using data-driven approaches. Topics include intelligent agents, AI programming, search techniques, machine learning, knowledge representation, and decision-making.

Students will work on applied problems in areas such as healthcare, finance, natural language processing, and predictive analytics using Python-based AI libraries (e.g., Scikit-learn, TensorFlow, OpenAI Gym). Ethical and societal implications of AI in practice are also discussed.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the fundamentals and scope of applied AI.
2. Implement search and optimization strategies in practical scenarios.
3. Apply supervised and unsupervised machine learning methods to real datasets.
4. Represent and manipulate knowledge using logical and statistical tools.
5. Develop AI-based solutions for domain-specific applications.
6. Use Python libraries to build and evaluate intelligent systems.
7. Critically assess ethical concerns in deploying AI systems.

### Course Contents

1. Introduction to Applied AI and Intelligent Systems
2. Python for AI: Libraries and Tools (Scikit-learn, TensorFlow, OpenAI Gym)
3. Search and Optimization Techniques:
  - Uninformed Search (BFS, DFS)
  - Informed Search (A\*, Greedy, Hill-Climbing)
4. Knowledge Representation and Logic
5. Decision Making Under Uncertainty: Bayesian Reasoning
6. Machine Learning Foundations:
  - Supervised Learning (Decision Trees, SVM, KNN)
  - Unsupervised Learning (Clustering, PCA)
7. Applications in Natural Language Processing and Image Recognition
8. AI in Statistical Modeling and Predictive Analytics
9. Case Studies in Healthcare, Finance, and Social Sciences
10. Project Work: Building and Evaluating an AI Application
11. AI Ethics, Bias, and Societal Impacts

### Recommended Textbooks

1. Russell, S. J., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach*. Pearson.
2. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*. O'Reilly Media.
3. Poole, D., & Mackworth, A. (2017). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge University Press.

### Course Brief

This course introduces students to the principles, technologies, and tools used in big data analytics. It focuses on the storage, processing, and analysis of massive datasets that cannot be handled by traditional systems. Students will learn about distributed computing frameworks, data management techniques, and scalable algorithms for extracting insights from structured and unstructured data.

Through hands-on labs and case studies, students will gain practical experience using big data platforms such as Hadoop, Spark, and NoSQL databases for real-world analytics applications.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the architecture and challenges of big data systems.
2. Use distributed computing tools (e.g., Hadoop, Spark) to process large-scale data.
3. Store and retrieve data using NoSQL databases (e.g., MongoDB, Cassandra).
4. Apply data wrangling, transformation, and aggregation techniques to big datasets.
5. Implement machine learning algorithms on large-scale data using scalable frameworks.
6. Analyze streaming data and real-time analytics pipelines.

### Course Contents

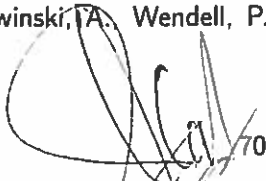
1. Introduction to Big Data: Characteristics, Value, and Ecosystem
2. Hadoop Ecosystem: HDFS, MapReduce, YARN
3. Apache Spark: RDDs, DataFrames, Spark SQL, MLlib
4. Data Ingestion Tools: Sqoop, Flume, Kafka
5. NoSQL Databases: MongoDB, Cassandra, HBase
6. Data Preprocessing at Scale: Cleaning, Filtering, Transformation
7. Distributed Algorithms for Classification, Clustering, and Regression
8. Real-Time Data Processing and Stream Analytics
9. Data Visualization Techniques for Big Data
10. Cloud Platforms for Big Data: AWS, Azure, GCP (Overview)
11. Privacy, Security, and Ethical Considerations in Big Data
12. Case Studies in Healthcare, Finance, Marketing, and IoT

### Recommended Textbooks

1. Marz, N., & Warren, J. (2015). *Big Data: Principles and Best Practices of Scalable Real-Time Data Systems*. Manning Publications.
2. Rajaraman, A., & Ullman, J. D. (2012). *Mining of Massive Datasets*. Cambridge University Press.

### Suggested Readings

1. White, T. (2015). *Hadoop: The Definitive Guide*. O'Reilly Media.
2. Karau, H., Konwinski, A., Wendell, P., & Zaharia, M. (2015). *Learning Spark*. O'Reilly Media.

  
Chairman  
Department of Statistics  
University of Sargodha

3. Dean, J., & Ghemawat, S. (2008). *MapReduce: Simplified Data Processing on Large Clusters*. Communications of the ACM.
4. Das, T. K., & Mohapatra, S. (2016). *Big Data Analytics: A Practitioner's Approach*. McGraw-Hill.
5. Beaulieu, A. (2015). *Learning SQL*. O'Reilly Media.



Chairman  
Department of Statistics  
University of Sargodha

### Course Brief

This course provides an in-depth introduction to digital analytics, focusing on the measurement, collection, analysis, and reporting of digital data to optimize user experiences and business outcomes. It covers core principles of web and social media analytics, digital marketing metrics, customer behavior tracking, and data-driven decision-making.

Students will learn to use popular digital analytics platforms and tools, interpret key performance indicators (KPIs), and apply statistical and machine learning techniques to improve digital strategy and ROI.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the role of digital analytics in modern business and marketing.
2. Identify and define KPIs for websites, campaigns, and social platforms.
3. Use tools such as Google Analytics and social media dashboards to track performance.
4. Analyze user behavior, funnel conversion, and customer journeys.
5. Apply A/B testing, segmentation, and predictive analytics in digital environments.
6. Develop actionable insights and recommendations based on digital data.

### Course Contents

1. Introduction to Digital Analytics and Marketing Ecosystems
2. Web Analytics Fundamentals: Sessions, Users, Bounce Rate, Conversion
3. Tools Overview: Google Analytics, Google Tag Manager, Data Studio
4. Social Media Analytics: Engagement Metrics, Sentiment, Reach
5. Customer Segmentation and Behavior Analysis
6. Funnel Analysis and Multi-Channel Attribution
7. A/B Testing and Experimentation Methods
8. Predictive Analytics and Machine Learning Applications
9. Dashboards and Reporting for Decision Makers
10. Privacy, Ethics, and Compliance in Digital Analytics (GDPR, CCPA)
11. Case Studies in E-Commerce, Media, Education, and Finance
12. Capstone Project: End-to-End Digital Analytics Solution

### Recommended Textbooks

1. Kaushik, A. (2010). *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity*. Wiley.
2. Clifton, B. (2012). *Advanced Web Metrics with Google Analytics*. Wiley.

### Suggested Readings

1. Cutroni, J. (2010). *Google Analytics*. O'Reilly Media.
2. Marshall, G. W., & Johnston, M. W. (2021). *Marketing Management*. McGraw-Hill.
3. Sterne, J. (2010). *Social Media Metrics: How to Measure and Optimize Your Marketing Investment*. Wiley.
4. Chaffey, D., & Ellis-Chadwick, F. (2019). *Digital Marketing*. Pearson Education.
5. Tufte, E. R. (2001). *The Visual Display of Quantitative Information*. Graphics Press.

### Course Brief

This course explores statistical methods and computational tools for analyzing high-dimensional data, where the number of variables far exceeds the number of observations. Such data arises frequently in genomics, imaging, finance, and text mining. The course emphasizes model selection, regularization, dimensionality reduction, and the challenges of overfitting and interpretability in high dimensions.

Students will gain both theoretical understanding and practical skills for applying sparse models, penalized regression, and machine learning techniques to high-dimensional datasets.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the statistical challenges unique to high-dimensional settings.
2. Apply dimensionality reduction techniques such as PCA and factor analysis.
3. Fit penalized regression models including Lasso, Ridge, and Elastic Net.
4. Implement variable selection and regularization in high-dimensional regression.
5. Evaluate model stability, interpretability, and prediction accuracy.
6. Use resampling methods (e.g., cross-validation, bootstrap) for model validation.

### Course Contents

1. Introduction to High-Dimensional Data: Examples and Challenges
2. Linear Models in High Dimensions and Multicollinearity
3. Principal Component Analysis (PCA) and Factor Models
4. Shrinkage Methods:
  - Ridge Regression
  - Lasso Regression
  - Elastic Net
5. Model Selection Criteria: AIC, BIC, Cross-Validation
6. Multiple Testing and False Discovery Rate (FDR) Control
7. High-Dimensional Classification:
  - Regularized Logistic Regression
  - Linear Discriminant Analysis in High Dimensions
8. Sparse Matrix Methods and Screening Rules
9. Graphical Models and Covariance Estimation
10. Applications in Genomics, Neuroimaging, and Text Mining
11. Software Implementation using R and Python


### Recommended Textbooks

1. Bühlmann, P., & Van De Geer, S. (2011). *Statistics for High-Dimensional Data*. Springer.
2. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning*. Springer.



### Suggested Readings

1. Fan, J., & Lv, J. (2010). *A Selective Overview of Variable Selection in High-Dimensional Feature Space*. Statistica Sinica.
2. Witten, D. M., & Tibshirani, R. (2011). *Penalized Classification Using Fisher's Linear Discriminant*. Journal of the Royal Statistical Society.
3. Zhao, S. D., & Li, Y. (2012). *Principles of High-Dimensional Data Analysis*. CRC Press.
4. Efron, B. (2010). *Large-Scale Inference: Empirical Bayes Methods for Estimation, Testing, and Prediction*. Cambridge University Press.
5. Tenenbaum, J. B., Silva, V. d., & Langford, J. C. (2000). *A Global Geometric Framework for Nonlinear Dimensionality Reduction*. Science.



Chairman  
Department Statistics  
University of Sargodha

### Course Brief

This course introduces the foundational concepts, methods, and applications of epidemiology—the study of the distribution and determinants of health-related states in specified populations. It emphasizes study design, disease surveillance, and the evaluation of health interventions. The course equips students with tools to critically assess public health data, interpret associations, and contribute to evidence-based decision-making.

Students will explore real-world epidemiological data and case studies to understand patterns of disease, risk factors, and prevention strategies at the population level.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the scope, principles, and terminology of epidemiology.
2. Design and interpret descriptive, analytical, and experimental epidemiological studies.
3. Measure disease frequency using incidence, prevalence, and mortality rates.
4. Assess associations using relative risk, odds ratios, and attributable risk.
5. Recognize bias, confounding, and effect modification in studies.
6. Evaluate public health interventions and screening programs.

### Course Contents

1. Introduction to Epidemiology: History, Uses, and Key Concepts
2. Measures of Disease Frequency: Incidence, Prevalence, Mortality
3. Epidemiologic Study Designs:
  - Cross-sectional Studies
  - Case-Control Studies
  - Cohort Studies
  - Randomized Controlled Trials
4. Measures of Association: Risk Ratios, Odds Ratios, Risk Differences
5. Bias, Confounding, and Effect Modification
6. Screening and Diagnostic Testing: Sensitivity, Specificity, Predictive Value
7. Outbreak Investigation and Surveillance Systems
8. Causal Inference in Epidemiology: Hill's Criteria
9. Public Health Applications: Chronic, Infectious, and Occupational Diseases
10. Ethics and Data Protection in Epidemiological Research
11. Statistical Software for Epidemiologic Analysis (e.g., Epi Info, R, Stata)

### Recommended Textbooks

1. Gordis, L. (2014). *Epidemiology* (5th ed.). Elsevier.
2. Friis, R. H., & Sellers, T. A. (2020). *Epidemiology for Public Health Practice*. Jones & Bartlett Learning.

### Suggested Readings

1. Rothman, K. J., Greenland, S., & Lash, T. L. (2008). *Modern Epidemiology*. Lippincott Williams & Wilkins.
2. Hennekens, C. H., & Buring, J. E. (1987). *Epidemiology in Medicine*. Little, Brown and Company.
3. Kleinbaum, D. G., Kupper, L. L., & Morgenstern, H. (1982). *Epidemiologic Research: Principles and Quantitative Methods*. Wiley.
4. Beaglehole, R., Bonita, R., & Kjellström, T. (2006). *Basic Epidemiology*. World Health Organization.
5. Porta, M. (Ed.). (2014). *A Dictionary of Epidemiology*. Oxford University Press.

A handwritten signature in black ink, appearing to be 'M. Porta', written over a faint circular stamp or watermark.

Chairman  
Department Statistics  
University of Sargodha

### Course Brief

This course focuses on statistical methods for analyzing repeated measurements data, where multiple observations are collected from the same subject or experimental unit over time or under different conditions. Emphasis is placed on understanding the correlation structure within subjects and applying appropriate models for longitudinal and within-subject variability.

Students will learn how to formulate, estimate, and interpret linear and nonlinear models for repeated measures using both traditional and modern approaches, with applications in medicine, psychology, agriculture, and industrial experimentation.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand the nature and challenges of repeated measurements data.
2. Explore and visualize longitudinal and within-subject variability.
3. Fit and interpret linear models for repeated measures (LMRM).
4. Apply mixed-effects models and generalized estimating equations (GEE).
5. Assess model assumptions and choose appropriate covariance structures.
6. Analyze data using statistical software such as R, SAS, or SPSS.

### Course Contents


1. Introduction to Repeated Measures and Longitudinal Data
2. Examples and Applications in Biomedical, Social, and Agricultural Sciences
3. Exploratory Data Analysis for Repeated Measures
4. Linear Models for Repeated Measurements (LMRM)
5. Assumptions and Covariance Structures (Compound Symmetry, AR(1), Unstructured)
6. Introduction to Linear Mixed-Effects Models (LMM)
7. Random Intercepts and Slopes Models
8. Model Selection and Inference in Mixed Models
9. Generalized Estimating Equations (GEE) for Non-Normal Outcomes
10. Comparison with Traditional ANOVA Approaches
11. Software Implementation in R (e.g., 'nlme', 'lme4') and SAS (e.g., 'PROC MIXED')
12. Case Studies and Reporting Results in Scientific Publications

### Recommended Textbooks

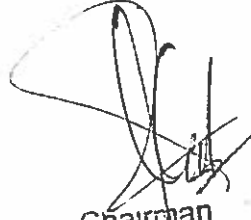
1. Littell, R. C., Milliken, G. A., Stroup, W. W., Wolfinger, R. D., & Schabenberger, O. (2006). *SAS for Mixed Models*. SAS Institute.
2. Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2012). *Applied Longitudinal Analysis*. Wiley.

### Suggested Readings

1. Verbeke, G., & Molenberghs, G. (2009). *Linear Mixed Models for Longitudinal Data*. Springer.
2. Diggle, P. J., Heagerty, P., Liang, K. Y., & Zeger, S. L. (2002). *Analysis of Longitudinal Data*. Oxford University Press.

  
Chairman  
Department Statistics

3. Gueorguieva, R., & Krystal, J. H. (2004). *Move Over ANOVA: Progress in Analyzing Repeated-Measures Data and Its Reflection in Papers Published in the Archives of General Psychiatry*. Arch Gen Psychiatry.
4. West, B. T., Welch, K. B., & Galecki, A. T. (2014). *Linear Mixed Models: A Practical Guide Using Statistical Software*. CRC Press.
5. Cnaan, A., Laird, N. M., & Slasor, P. (1997). *Using the General Linear Mixed Model to Analyse Unbalanced Repeated Measures and Longitudinal Data*. Stat Med.

A handwritten signature in black ink, consisting of several overlapping loops and lines, positioned above the printed text.

Chairman  
Department Statistics  
University of Sargodha.

### Course Brief

This course covers the fundamental principles and practical strategies involved in the design and statistical analysis of medical and clinical studies. It emphasizes sound methodological planning, ethical considerations, and appropriate statistical techniques for various study types, including observational studies, clinical trials, and diagnostic tests.

Students will learn to critically assess published medical literature, design valid and efficient studies, and apply statistical methods to analyze and interpret biomedical data using statistical software.

### Course Learning Outcomes

By the end of the course, students will be able to:

1. Understand key principles of study design in medical research.
2. Distinguish between observational and experimental study designs.
3. Plan and calculate sample size and power for medical studies.
4. Analyze data from cohort, case-control, and randomized controlled trials.
5. Apply statistical techniques for comparing groups and modeling associations.
6. Evaluate bias, confounding, interaction, and causality in medical studies.

### Course Contents

1. Introduction to Medical Study Design and Clinical Research Workflow
2. Types of Study Designs:
  - Cross-sectional and Case-Control Studies
  - Cohort Studies
  - Randomized Controlled Trials (RCTs)
  - Diagnostic and Screening Studies
3. Ethical Considerations and Institutional Review Boards (IRBs)
4. Sampling Techniques, Randomization, and Blinding
5. Sample Size Determination and Power Analysis
6. Data Collection, Quality Assurance, and Management
7. Statistical Analysis of:
  - Binary and Continuous Outcomes
  - Time-to-Event (Survival) Data
  - Repeated Measures and Longitudinal Data
8. Use of Regression Models: Linear, Logistic, Cox Proportional Hazards
9. Handling Missing Data and Dropouts
10. Meta-analysis and Systematic Review Fundamentals
11. Interpreting and Reporting Medical Study Results

### Recommended Textbooks

1. Friedman, L. M., Furberg, C. D., & DeMets, D. L. (2010). *Fundamentals of Clinical Trials*. Springer.
2. Piantadosi, S. (2017). *Clinical Trials: A Methodologic Perspective*. Wiley.

### Suggested Readings

1. Hulley, S. B., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing Clinical Research*. Lippincott Williams & Wilkins.
2. Pocock, S. J. (2013). *Clinical Trials: A Practical Approach*. Wiley.
3. Machin, D., Campbell, M. J., Tan, S. B., & Tan, S. H. (2018). *Sample Size Tables for Clinical Studies*. Wiley-Blackwell.
4. Rothman, K. J. (2012). *Epidemiology: An Introduction*. Oxford University Press.
5. Altman, D. G. (1991). *Practical Statistics for Medical Research*. Chapman and Hall.

A handwritten signature in black ink, consisting of several overlapping loops and lines, positioned above the typed name.

Chairman  
Department Statistics  
University of Sargodha.

**Course Brief**

This course provides a comprehensive overview of statistical methods applied in the pharmaceutical industry, with an emphasis on drug development, clinical trials, quality control, and regulatory compliance. It covers statistical concepts and techniques critical to preclinical studies, Phase I-IV clinical trials, bioequivalence testing, and pharmacokinetic/pharmacodynamic (PK/PD) modeling.

Students will gain practical experience using statistical tools to design experiments, analyze data, and interpret results in alignment with guidelines from regulatory bodies such as the FDA, EMA, and ICH.

**Course Learning Outcomes**

By the end of the course, students will be able to:

1. Understand the role of statistics throughout the pharmaceutical R&D lifecycle.
2. Apply statistical methods in the design and analysis of clinical trials.
3. Perform sample size and power calculations for pharmaceutical studies.
4. Evaluate drug efficacy and safety using hypothesis testing and confidence intervals.
5. Conduct bioequivalence studies and analyze PK/PD data.
6. Interpret regulatory statistical guidelines and prepare statistical reports.

**Course Contents**

1. Introduction to Pharmaceutical Statistics and Drug Development Phases
2. Good Clinical Practice (GCP) and Regulatory Guidelines (FDA, EMA, ICH)
3. Design of Experiments in Preclinical and Clinical Studies
4. Randomization, Blinding, and Control Group Strategies
5. Statistical Methods for Phase I-IV Clinical Trials
6. Hypothesis Testing and Confidence Intervals for Efficacy and Safety
7. Analysis of Variance (ANOVA) and Covariance (ANCOVA)
8. Repeated Measures and Longitudinal Analysis in Clinical Settings
9. Bioequivalence Testing and Two-One-Sided Test (TOST) Procedure
10. Pharmacokinetic and Pharmacodynamic Modeling (PK/PD)
11. Handling Missing Data and Interim Analysis
12. Statistical Software in the Pharmaceutical Industry: SAS, R, and WinNonlin

**Recommended Textbooks**

1. Chow, S. C., & Liu, J. P. (2013). *Design and Analysis of Clinical Trials: Concepts and Methodologies*. Wiley.
2. Bolton, S., & Bon, C. (2003). *Pharmaceutical Statistics: Practical and Clinical Applications*. CRC Press.

**Suggested Readings**

1. Berry, D. A. (2006). *Bayesian Approaches to Clinical Trials and Health-Care Evaluation*. Wiley.

2. Endrenyi, L., & Tothfalusi, L. (2017). *Bioequivalence Studies in Drug Development*. CRC Press.
  3. Piantadosi, S. (2017). *Clinical Trials: A Methodologic Perspective*. Wiley.
  4. Lesaffre, E., & Spiessens, B. (2001). *On the Effect of the Number of Interim Analyses in Group Sequential Designs*. *Statistics in Medicine*.
  5. ICH E9, E6, and E10 Guidelines on Statistical Principles for Clinical Trials.
22. **Statistical Methods for Clinical Trials (STAT-6132)** **3(3-0)**

### Course Brief

This course introduces statistical methods used in the design, conduct, and analysis of clinical trials. It covers essential concepts such as randomization, blinding, power analysis, and the interpretation of trial results. Emphasis is placed on both the theoretical underpinnings and the practical application of statistical tools in real clinical research, enabling students to critically evaluate evidence and contribute to trial design and analysis.

### Course Learning Outcomes

By the end of this course, the students will be able to:

1. Understand the role and scope of statistics in the planning and analysis of clinical trials.
2. Apply statistical principles to the design of randomized controlled trials.
3. Perform statistical analysis using appropriate models for different clinical trial designs.
4. Interpret the results of clinical studies, accounting for bias, variability, and clinical relevance.
5. Assess statistical validity, power, and sample size considerations in trials.

### Course Contents

1. Introduction to Clinical Trials and Role of Statistics
2. Basic Trial Designs: Parallel, Crossover, Cluster-Randomized Trials
3. Randomization and Blinding: Methods and Importance
4. Sample Size Determination and Power Calculations
5. Statistical Inference in Clinical Trials: Parametric and Non-parametric Methods
6. Interim Analyses and Sequential Designs
7. Survival Analysis Techniques in Clinical Trials
8. Analysis of Binary and Longitudinal Outcomes
9. Handling Missing Data and Protocol Deviations
10. Ethical and Regulatory Aspects of Clinical Trials

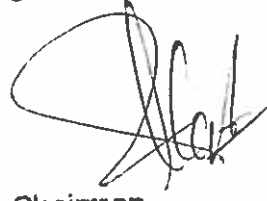
### Recommended Textbooks

1. Piantadosi, S. (2017). *Clinical Trials: A Methodologic Perspective* (3rd ed.). Wiley.
2. Chow, S.-C., & Liu, J. P. (2013). *Design and Analysis of Clinical Trials: Concepts and Methodologies* (3rd ed.). Wiley.

### Suggested Readings

1. Machin, D., Campbell, M. J., Tan, S. B., & Tan, S. H. (2018). *Sample Size Tables for Clinical Studies* (4th ed.). Wiley-Blackwell.
2. Meinert, C. L. (2012). *Clinical Trials: Design, Conduct, and Analysis* (2nd ed.). Oxford University Press.

- Friedman, L. M., Furberg, C. D., & DeMets, D. L. (2015). *Fundamentals of Clinical Trials* (5th ed.). Springer.

A handwritten signature in black ink, appearing to be 'D. L. DeMets', written in a cursive style.

Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

This course provides students with a comprehensive understanding of econometric techniques used in the analysis of financial data. The focus is on time series modeling, volatility estimation, and forecasting in financial markets. Applications include asset pricing, risk management, and portfolio analysis. Emphasis is placed on real-world data and empirical model implementation using statistical software.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the foundational concepts of financial time series and econometric modeling.
2. Apply econometric techniques to model financial returns, volatility, and market risk.
3. Implement ARIMA, GARCH, and other relevant models for analyzing financial time series.
4. Interpret results from financial econometric models and assess their empirical relevance.
5. Use financial econometrics to inform decision-making in asset pricing, portfolio management, and risk forecasting.

**Course Contents**

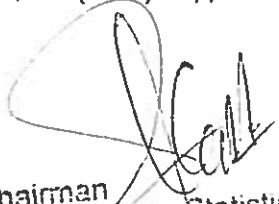
1. Introduction to Financial Econometrics and Financial Data Characteristics
2. Stationarity, Unit Roots, and Cointegration
3. Modeling Asset Returns: AR, MA, ARIMA Models
4. Volatility Modeling: ARCH, GARCH, and Extensions
5. Risk Management: Value at Risk (VaR) and Expected Shortfall
6. High-Frequency Data and Market Microstructure
7. Multivariate Models: VAR, VECM, and Factor Models
8. Empirical Applications in Portfolio Optimization and Asset Pricing

**Recommended Textbooks**

1. Tsay, R. S. (2010). *Analysis of Financial Time Series* (3rd ed.). Wiley.
2. Brooks, C. (2019). *Introductory Econometrics for Finance* (4th ed.). Cambridge University Press.

**Suggested Readings**

1. Alexander, C. (2008). *Market Risk Analysis: Practical Financial Econometrics*. Wiley.
2. Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The Econometrics of Financial Markets*. Princeton University Press.
3. Enders, W. (2014). *Applied Econometric Time Series* (4th ed.). Wiley.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course introduces the core concepts and methodologies for analyzing time-dependent data. Emphasis is placed on identifying patterns, building statistical models for time series, and generating forecasts. Students will learn to apply techniques such as autoregressive models, moving averages, ARIMA models, and exponential smoothing. Real-world applications in economics, business, and environmental sciences will be explored.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the fundamental components of time series data (trend, seasonality, and irregular variation).
2. Identify and apply appropriate models for stationary and non-stationary time series data.
3. Use methods such as AR, MA, ARMA, and ARIMA for modeling time series.
4. Evaluate and validate time series models using diagnostic tools.
5. Apply forecasting techniques to real-world time series problems and assess forecast accuracy.

**Course Contents**


1. Introduction to Time Series Data and Applications
2. Components of Time Series: Trend, Seasonal, Cyclical, and Irregular
3. Stationarity and Differencing
4. Autoregressive (AR), Moving Average (MA), ARMA, and ARIMA Models
5. Model Selection and Parameter Estimation
6. Seasonal ARIMA (SARIMA) Models
7. Forecasting Techniques and Accuracy Metrics
8. Applications in Economics, Business, and Environmental Studies

**Recommended Textbooks**

1. Brockwell, P. J., & Davis, R. A. (2016). *Introduction to Time Series and Forecasting* (3rd ed.). Springer.
2. Cryer, J. D., & Chan, K.-S. (2008). *Time Series Analysis: With Applications in R* (2nd ed.). Springer.

**Suggested Readings**

1. Hyndman, R. J., & Athanasopoulos, G. (2021). *Forecasting: Principles and Practice* (3rd ed.). OTexts.
2. Wei, W. W. S. (2006). *Time Series Analysis: Univariate and Multivariate Methods* (2nd ed.). Pearson.
3. Shumway, R. H., & Stoffer, D. S. (2017). *Time Series Analysis and Its Applications: With R Examples* (4th ed.). Springer.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course provides a comprehensive introduction to predictive modeling, equipping students with statistical and machine learning tools to forecast future outcomes based on historical data. Emphasis is placed on understanding model assumptions, selecting appropriate algorithms, evaluating model performance, and interpreting results in a real-world context. Students will apply techniques using statistical software and programming languages such as R or Python.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand key concepts in supervised learning and predictive analytics.
2. Develop regression and classification models to make data-driven predictions.
3. Apply model validation techniques such as cross-validation and performance metrics (e.g., RMSE, AUC).
4. Handle issues such as overfitting, bias-variance tradeoff, and model selection.
5. Implement predictive models using R/Python for practical datasets across domains.

**Course Contents**


1. Introduction to Predictive Modeling and Applications
2. Data Preprocessing and Feature Engineering
3. Linear and Logistic Regression Models
4. Decision Trees and Ensemble Methods (e.g., Random Forest, Gradient Boosting)
5. Model Evaluation Metrics and Validation Strategies
6. Overfitting, Regularization (Ridge, Lasso)
7. Classification Models: k-NN, SVM, Naive Bayes
8. Model Interpretation and Deployment Considerations

**Recommended Textbooks**

1. Kuhn, M., & Johnson, K. (2013). *Applied Predictive Modeling*. Springer.
2. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). *An Introduction to Statistical Learning with Applications in R* (2nd ed.). Springer.

**Suggested Readings**

1. Provost, F., & Fawcett, T. (2013). *Data Science for Business*. O'Reilly Media.
2. Shmueli, G., Bruce, P. C., Gedeck, P., & Patel, N. R. (2020). *Data Mining for Business Analytics*. Wiley.
3. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning* (2nd ed.). Springer.



Chairman  
Department of Statistics  
University of Sardarshah

**Course Brief**

This course introduces students to the theory and application of Structural Equation Modeling (SEM), an advanced multivariate technique used for testing and estimating causal relationships among variables. It integrates factor analysis and multiple regression, allowing the modeling of complex relationships using observed and latent variables. Students will gain hands-on experience using SEM software to build, evaluate, and interpret structural models in real-world contexts.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the fundamental concepts, assumptions, and terminology of SEM.
2. Construct measurement models using confirmatory factor analysis.
3. Specify, estimate, and evaluate structural models representing complex variable relationships.
4. Assess model fit using various goodness-of-fit indices and diagnostics.
5. Use SEM software tools (e.g., AMOS, LISREL, or R and Python packages) to perform SEM analysis.

**Course Contents**

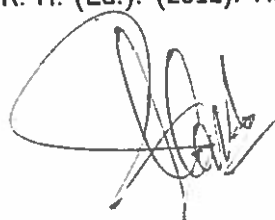
1. Introduction to SEM and its Applications
2. Measurement Models and Confirmatory Factor Analysis
3. Path Analysis and Model Specification
4. Estimation Techniques in SEM
5. Model Identification and Modification
6. Assessing Model Fit (CFI, RMSEA, SRMR, etc.)
7. Latent Variable Modeling and Mediation Analysis
8. Longitudinal and Multigroup SEM
9. Applications in Social Sciences, Psychology, and Health Research

**Recommended Textbooks**

1. Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling* (4th ed.). Guilford Press.
2. Byrne, B. M. (2016). *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming* (3rd ed.). Routledge.

**Suggested Readings**

1. Schumacker, R. E., & Lomax, R. G. (2016). *A Beginner's Guide to Structural Equation Modeling* (4th ed.). Routledge.
2. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2018). *Multivariate Data Analysis* (8th ed.). Pearson.
3. Hoyle, R. H. (Ed.). (2012). *Handbook of Structural Equation Modeling*. Guilford Press.



### Course Brief

This course introduces the practical application of econometric methods to real-world economic data. It focuses on understanding, modeling, and interpreting economic relationships using statistical tools. Students will learn to apply regression techniques, detect econometric problems, and use econometric software for estimation and policy analysis. Emphasis is placed on hands-on data analysis, interpretation of results, and communication of findings relevant to economics, finance, and social sciences.

### Course Learning Outcomes

By the end of this course, the students will be able to:

1. Understand the principles and assumptions of econometric models.
2. Apply linear and multiple regression models to economic datasets.
3. Detect and address issues such as multicollinearity, heteroscedasticity, autocorrelation, and endogeneity.
4. Conduct hypothesis testing and model diagnostics in an econometric framework.
5. Use statistical software (e.g., R, STATA, EViews) for data estimation and policy evaluation.

### Course Contents

1. Introduction to Econometrics and Economic Data
2. The Classical Linear Regression Model (CLRM)
3. Functional Forms and Dummy Variables
4. Violation of CLRM Assumptions: Multicollinearity, Heteroscedasticity, and Autocorrelation
5. Instrumental Variables and Endogeneity
6. Qualitative Response Models (Probit, Logit)
7. Time Series Econometrics: Stationarity, Cointegration, ARIMA
8. Panel Data Models and Applications
9. Forecasting and Policy Evaluation

### Recommended Textbooks

1. Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics* (5th ed.). McGraw-Hill.
2. Wooldridge, J. M. (2019). *Introductory Econometrics: A Modern Approach* (7th ed.). Cengage Learning.

### Suggested Readings

1. Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson.
2. Kennedy, P. (2008). *A Guide to Econometrics* (6th ed.). Wiley-Blackwell.
3. Stock, J. H., & Watson, M. W. (2015). *Introduction to Econometrics* (3rd ed.). Pearson.
4. Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: Methods and Applications*. Cambridge University Press.

**Course Brief**

This course provides an introduction to statistical methods for analyzing spatial and spatio-temporal data. It covers foundational concepts such as spatial dependence, spatial autocorrelation, and spatial point processes. Students will learn to model, visualize, and interpret spatial data using classical and modern statistical techniques, enabling them to tackle challenges in environmental science, epidemiology, urban planning, and geoinformatics.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand key concepts and challenges in analyzing spatial and spatio-temporal data.
2. Apply methods for exploratory spatial data analysis (ESDA), including measures of spatial autocorrelation.
3. Fit spatial statistical models such as geostatistical models (e.g., kriging), lattice models, and spatial point processes.
4. Interpret the output of spatial statistical models for real-world decision making.
5. Use software tools such as R or GIS packages to visualize and analyze spatial datasets.

**Course Contents**

1. Introduction to Spatial Data Types and Applications
2. Coordinate Systems and Georeferencing
3. Spatial Dependence and Spatial Autocorrelation (Moran's I, Geary's C)
4. Exploratory Spatial Data Analysis (ESDA)
5. Spatial Point Patterns and Quadrat Analysis
6. Geostatistics: Variograms and Kriging
7. Lattice Data and Spatial Regression Models
8. Spatio-Temporal Modeling and Applications

**Recommended Textbooks**

1. Bivand, R. S., Pebesma, E., & Gómez-Rubio, V. (2013). *Applied Spatial Data Analysis with R*. Springer.
2. Cressie, N. (1993). *Statistics for Spatial Data*. Wiley-Interscience.

**Suggested Readings**

1. Banerjee, S., Carlin, B. P., & Gelfand, A. E. (2014). *Hierarchical Modeling and Analysis for Spatial Data*. CRC Press.
2. Haining, R. (2003). *Spatial Data Analysis: Theory and Practice*. Cambridge University Press.
3. Schabenberger, O., & Gotway, C. A. (2005). *Statistical Methods for Spatial Data Analysis*. CRC Press.
4. Lawson, A. B. (2013). *Bayesian Disease Mapping: Hierarchical Modeling in Spatial Epidemiology*. CRC Press.

**Course Brief**

This course introduces the fundamental concepts, measures, and techniques used in population studies and demography. It focuses on analyzing population dynamics, including fertility, mortality, migration, and growth. The course equips students with tools to interpret demographic data and apply statistical techniques to real-world population issues, supporting planning and policy-making in public health, urban development, and resource allocation.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand core demographic concepts such as population structure, fertility, mortality, and migration.
2. Apply demographic methods to calculate and interpret rates, ratios, and indices.
3. Analyze population data using life tables, age-sex pyramids, and population projections.
4. Interpret census, survey, and vital statistics data.
5. Evaluate population policies and their impact on demographic trends.

**Course Contents**

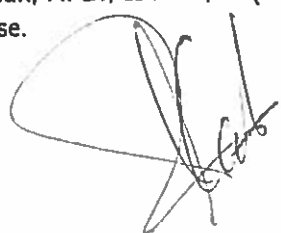
1. Introduction to Population Studies and Demographic Data Sources
2. Basic Measures of Population: Rate, Ratio, Proportion
3. Fertility Measures: Crude Birth Rate, TFR, ASFR, GRR, NRR
4. Mortality Measures: Crude Death Rate, ASDR, IMR, Life Tables
5. Migration: Concepts, Types, and Measurement Techniques
6. Population Age Structure and Dependency Ratios
7. Population Projections and Models of Growth
8. Demographic Transition Theory and Population Policies

**Recommended Textbooks**

1. Rowland, D. T. (2003). *Demographic Methods and Concepts*. Oxford University Press.
2. Siegel, J. S., & Swanson, D. A. (2004). *The Methods and Materials of Demography*. Elsevier Academic Press.

**Suggested Readings**

1. Preston, S. H., Heuveline, P., & Guillot, M. (2000). *Demography: Measuring and Modeling Population Processes*. Blackwell.
2. United Nations (2017). *Principles and Recommendations for Population and Housing Censuses*. UN Publications.
3. Shryock, H. S., Siegel, J. S., & Associates (1976). *The Methods and Materials of Demography*. Academic Press.
4. Pathak, K. B., & Ram, F. (1998). *Techniques of Demographic Analysis*. Himalaya Publishing House.



Chairman  
Department of Statistics  
University of Gandhinagar

### Course Brief

This course provides students with a statistical foundation for addressing environmental challenges. It emphasizes the use of statistical methods to analyze environmental data related to air quality, water resources, climate change, pollution, and ecological monitoring. The course integrates real-world environmental datasets and introduces relevant software tools for modeling, estimation, and inference in environmental contexts.

### Course Learning Outcomes

By the end of this course, the students will be able to:

1. Understand key concepts and types of environmental data and measurements.
2. Apply appropriate statistical techniques to analyze environmental datasets.
3. Model spatial and temporal environmental data using regression and time series methods.
4. Perform risk and uncertainty analysis in environmental studies.
5. Use statistical tools to support decision-making in environmental management and policy.

### Course Contents

1. Introduction to Environmental Data and Statistical Challenges
2. Exploratory Data Analysis for Environmental Datasets
3. Probability Distributions in Environmental Contexts
4. Sampling Techniques for Environmental Monitoring
5. Temporal Analysis: Trends, Seasonality, and Time Series Models
6. Spatial Data Analysis and Geostatistics
7. Environmental Risk Assessment and Uncertainty Analysis
8. Case Studies: Climate Change, Air and Water Pollution, Ecological Data

### Recommended Textbooks

1. Glickman, T. S. (2000). *Glossary of Meteorology*. American Meteorological Society.
2. Millard, S. P., & Neerchal, N. K. (2001). *Environmental Statistics with S-PLUS*. CRC Press.

### Suggested Readings

1. Ott, W. R., & Longnecker, M. P. (2008). *An Introduction to Statistical Methods and Data Analysis*. Cengage.
2. Zuur, A. F., et al. (2009). *Mixed Effects Models and Extensions in Ecology with R*. Springer.
3. Manly, B. F. J. (2008). *Statistics for Environmental Science and Management*. CRC Press.
4. Cressie, N. (1993). *Statistics for Spatial Data*. Wiley.



Chairman  
Department of Statistics  
University of Burgodha

**Course Brief**

This advanced course introduces the concepts and methods of Functional Data Analysis (FDA), focusing on statistical techniques for analyzing data that can be viewed as functions, curves, or shapes. Students will explore tools for smoothing, functional principal component analysis, and functional linear models. The course is designed for applications in diverse fields such as medicine, finance, and environmental science where data are recorded over a continuum like time or space.

**Course Learning Outcomes**

By the end of this course, the students will be able to:

1. Understand the nature and structure of functional data and its differences from classical multivariate data.
2. Apply functional data representation techniques, including basis function expansion and smoothing.
3. Perform Functional Principal Component Analysis (FPCA) and interpret functional modes of variation.
4. Model relationships using Functional Linear Models (FLM) and functional regression techniques.
5. Apply FDA tools to real-world datasets in domains such as biostatistics, climatology, and finance.

**Course Contents**

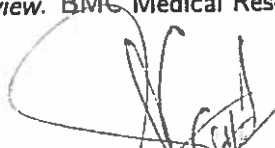
1. Introduction to Functional Data and Motivating Applications
2. Data Smoothing and Basis Function Representations
3. Functional Principal Component Analysis (FPCA)
4. Functional Linear Models and Functional Regression
5. Functional Analysis of Variance (FANOVA)
6. Functional Clustering and Classification
7. Time Warping and Alignment of Functional Data
8. Case Studies in FDA: Biomedical, Environmental, and Financial Data

**Recommended Textbooks**

1. Ramsay, J. O., & Silverman, B. W. (2005). *Functional Data Analysis* (2nd ed.). Springer.
2. Horváth, L., & Kokoszka, P. (2012). *Inference for Functional Data with Applications*. Springer.

**Suggested Readings**

1. Ferraty, F., & Vieu, P. (2006). *Nonparametric Functional Data Analysis: Theory and Practice*. Springer.
2. Ramsay, J. O., Hooker, G., & Graves, S. (2009). *Functional Data Analysis with R and MATLAB*. Springer.
3. Ullah, S., & Finch, C. F. (2013). *Applications of Functional Data Analysis: A Systematic Review*. BMC Medical Research Methodology.

  
Chairman  
Department, Statistics  
University of Sargodha

### Course Brief

This course introduces robust statistical methods that remain effective under violations of assumptions such as normality or homoscedasticity. It focuses on techniques that mitigate the influence of outliers and leverage points, providing reliable alternatives to classical parametric procedures. Students will learn theoretical justifications for robust procedures, including M-estimators, L-estimators, R-estimators, and breakdown points, and explore robust versions of common models such as regression, ANOVA, and multivariate analysis. Practical implementation using statistical software is emphasized.

### Course Learning Outcomes

1. Understand the need for robust statistical procedures in applied data analysis.
2. Define and compare classical estimators with their robust counterparts.
3. Apply robust techniques to regression, location-scale models, and multivariate data.
4. Evaluate robustness criteria such as influence functions and breakdown points.
5. Utilize statistical software to implement and interpret robust methods.

### Course Contents

1. Introduction to robustness: concept and historical motivation
2. Influence functions and breakdown point
3. Robust estimators of location and scale: trimmed means, Winsorized means, MAD
4. M-estimators, L-estimators, and R-estimators
5. Robust regression methods: Least Trimmed Squares, MM-estimation
6. Diagnostic tools for robust models
7. Robust ANOVA and hypothesis testing
8. Robust multivariate techniques: robust covariance estimation, robust PCA
9. High breakdown point estimators: S-estimators, MM-estimators
10. Comparison of robust and classical methods using simulations
11. Implementation of robust methods in R and other statistical software

### Recommended Textbooks

- Huber, P. J., & Ronchetti, E. M. (2009). *Robust Statistics* (2nd ed.). Wiley.
- Maronna, R. A., Martin, R. D., & Yohai, V. J. (2006). *Robust Statistics: Theory and Methods*. Wiley.

### Suggested Readings

- Hampel, F. R. et al. (1986). *Robust Statistics: The Approach Based on Influence Functions*. Wiley.
- Rousseeuw, P. J., & Leroy, A. M. (2003). *Robust Regression and Outlier Detection*. Wiley.



Chairman  
Department of Statistics  
University of Sargodha

## **Course Outlines for General Education Courses**

**Course Brief**

The course will enable students to explore human experiences, cultivate an appreciation of the past, enrich their capacity to participate in the life of their times, and enable an engagement with other cultures and civilizations, both ancient and modern. But independently of any specific application, the study of these subjects teaches understanding and delight in the highest achievements of humanity. The three components of the course, including fables, wisdom literature and epic, will enable the learners to explore and understand the classic tradition in literature. Development of personal virtue, a deep Sufi ethic and an unwavering concern for the permanent over the fleeting and the ephemeral are some of the key themes explored in the contents that will develop an intimate connection between literature and life.

**Contents**

## 1. Fables

- a) The Fables of Bidpai
- b) The Lion and the Bull
- c) The Ring-dove
- d) The Owls and the Crows
- e) Selected poem from Bang-i-Dara

## 2. Gulistan-e- Sa'di

- a) Ten hikāyāt from John T. Platts, The Gulistan

## 3. Epic


- a) THE SHĀHNĀMA OF FIRDAUSI

**Recommended Books**

1. John T. P. (1876). The Gulistan; or, Rose Garden of Shaikh Muslihu'd- Dīn Sa'dī of Shīrāz. London: Wm. II. Allen.
2. Chishtī, Y.S. (1991). Sharaḥ-ibāng-idarā. Lāhaur: Maktaba-ita'mīr-i-insāniyat

**Suggested Readings**

1. Thackston, W. (2000). A Millennium of Classical Persian Poetry. Maryland: Ibex Publishers.
2. Wood, R. (2013). Kalila and Dimna: Fables of Conflict and Intrigue. United Kingdom: Medina Publishing, Limited.

  
 Chairman  
 Department of Statistics  
 University of Sargodha.

**Course Brief**

Life, its characteristics, natural science, biology and its branches; Importance of Flora & Fauna in biodiversity; Importance of Natural Compounds in daily life, medicine and human health; Latest developments in natural sciences (Biotechnology); Ecosystem and its components; Environment and its components; Pollutants and their effect on the environment (Greenhouse effect, global warming, acid rains, water pollution and ozone depletions etc.); Introduction to micro-organism and its types (bacteria, fungi, viruses)

**Course Contents**

1. Life and Its Characteristics: Definition and properties of life, features of living organisms.
2. Natural Science: Overview, significance, interdisciplinary connections.
3. Biology and Its Branches: Study of living organisms, branches like botany, zoology, microbiology, genetics, and ecology.
4. Importance of Flora and Fauna in Biodiversity: Ecological balance, impact on stability and human well-being.
5. Importance of Natural Compounds: Use in medicine, healthcare, and daily living.
6. Latest Developments in Natural Sciences (Biotechnology): Genetic engineering, applications in various fields.
7. Ecosystem and Its Components: Definition, structure, producers, consumers, decomposers.
8. Environment and Its Components: Physical, chemical, biological components, human impact.
9. Pollutants and Their Effects: Types, environmental issues like greenhouse effect, global warming, acid rain, pollution, ozone depletion.
10. Introduction to Microorganisms: Overview, classification of bacteria, fungi, viruses, and their roles.

**Practical**

1. Field Survey of Flora & Fauna and their identification
2. Study of herbarium
3. Study of Museum

**Recommended Books**

1. Keddy, P.A. (2017). Plant ecology origins, processes, consequences. Cambridge, University Press.
2. Canadell, J.G., Diaz, S., Heldmaier, G., Jackson, R.B., Levia, D.F., Schulze, E.D. & Sommer, U. (2019). Ecological studies. Springer.
3. Bhat, S.V., Nagasampagi, B.A. & Sirakumar, M. (2006). Chemistry of Natural Products. Springer Science
4. De, A.K. (2019). Environmental Chemistry. New Age International Press

**Suggested Books:**

1. Fath, B. (2018). Encyclopedia of ecology. Elsevier.
2. Ajith, H. Urmas. P., Pastur, G. M & Iversion L. R. (2018). Ecosystem services from forest landscapes: broadscale consideration. 1st Edition. Springer International Publishing AG.
3. Xu, R., Ye, Y. & Zhao, W. (2011). Introduction to Natural Product Chemistry. CRC Press
4. Tayler, D.J., Green, N.P.O. & Stout, G.W. (1997). Biological Science 1&2. Cambridge University Press
5. Tayler, M.R., Simon, E.J., Dickey, D.J. & Hogan, K.A. (2020). Campbell Biology: Concepts & Connections (10th Edition). Pearson

**Course Brief**

This course will introduce students with the subject matter of social science, its scope, nature and ways of looking at social phenomenon. It will make the participants acquaintance with the foundations of modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including sociology, politics, economics anthropology and psychology and make them learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and non-western contexts. Instruction will include the use of written texts, audio-visual aids and field visits.

**Learning Outcomes**

1. Introduce student with the nature of human social behavior and foundations of human group life
2. Analyze the reciprocal relationship between individuals and society.
3. Make students aware of the nature of societies existing in the modern world.
4. Familiarize students with the philosophy of knowledge in social sciences.
5. Introduce students to the works of prominent theorists explaining human group behavior.
6. Help students understand the foundations of society, including culture, socialization, politics, and economy.
7. Introduce students to various dimensions of social inequalities related to gender, race, ethnicity, and religion.
8. Make students aware of the themes related to social science in a local context.
9. Help them recognize the difference between the objective identification of empirical facts and the subjective formulation of opinionated arguments.

**Contents****1. Introduction to Social Sciences**

- o Social world, human social behavior, foundations of society
- o Evolution of social sciences
- o Philosophy of science
- o Scope and nature of social sciences
- o Modernity and social sciences
- o Branches of social science: Sociology, Anthropology, Political Science, Economics
- o Society and community, historical evolution of society
- o Types of societies: Foraging society, horticultural society, pastoralist society, agrarian societies, industrial society, post-industrial society

**2. Philosophy of Knowledge in Social Science and Social Inquiry**

- o Understanding social phenomena
- o Alternative ways of knowing
- o Science as a source to explore social reality
- o Objectivity and value-free research
- o Positivism vs. Interpretivism
- o Qualitative vs. Quantitative research

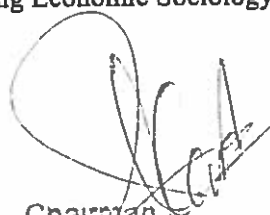
**3. Culture and Society**

- o Idea of culture, assumptions of culture
- o Types, components, civilization, and culture

- Individual and culture, cultural ethnocentrism, cultural relativism
- Outlook of Pakistani culture
- Global flows of culture, homogeneity, and heterogeneity
- 4. **Social Stratification and Social Inequality**
  - Dimensions of inequality, social class
  - Gender, race, religion, ethnicity, caste
  - Patterns of social stratification in Pakistan
  - Class and caste systems in agrarian society
  - Ascription vs. Achievement, meritocracy
  - Global stratification in the modern world, global patterns of inequality
- 5. **Personality, Self, and Socialization**
  - Concept of self, personality
  - Nature vs. Nurture, biological vs. social influences
  - Development of personality
  - Socialization as a process, agents of socialization
  - Socialization and self/group identity
- 6. **Gender and Power**
  - Understanding gender
  - Social construction of patriarchy
  - Feminism in historical context, gender debates
  - Gender and development
  - Gender issues in Pakistani society, women's participation in politics, economy, and education
  - Toward a gender-sensitive society, gender mainstreaming
- 7. **Pakistan: State, Society, Economy, and Polity**
  - Colonialism, colonial legacy, national identity
  - Transformation in Pakistani society: Traditionalism vs. Modernism
  - Economy, informality of economy, modern economy and Pakistan
  - Political economy, sociology of economy

**Recommended Textbooks and Reading Materials:**

1. Giddens, A. (2018). *Sociology* (11th ed.). UK: Polity Press.
2. Henslin, J. M. (2018). *Essentials of Sociology: A Down-to-Earth Approach* (18th ed.). Pearson Publisher.
3. Macionis, J. J. (2016). *Sociology* (16th ed.). New Jersey: Prentice-Hall.
4. Qadeer, M. (2006). *Pakistan: Social and Cultural Transformation in a Muslim Nation*.
5. Smelser, N. J., & Swedberg, R. *The Handbook of Economic Sociology*, Chapter 1: "Introducing Economic Sociology," Princeton University Press.
6. *Systems of Stratification* | Boundless Sociology. Available at: <https://courses.lumenlearning.com/boundless-sociology/chapter/systems-of-stratification/>
7. Jalal, A. (Ed.). (1995). "The Colonial Legacy in India and Pakistan," in *Democracy and Authoritarianism in South Asia: A Comparative and Historical Perspective*. Cambridge: Cambridge University Press.
8. Zaidi, S. A. (2015). *Issues in Pakistan's Economy: A Political Economy Perspective*. Oxford University Press. Chapter 26.
9. Akhtar, A. S. (2017). *The Politics of Common Sense: State, Society, and Culture in Pakistan*. Cambridge: Cambridge University Press.
10. Smelser, N. J., & Swedberg, R. *The Handbook of Economic Sociology*, Chapter 1: "Introducing Economic Sociology," Princeton University Press.

  
 Chairman  
 Department Statistics  
 University of Sargodha

**Course Brief**

The course aims to help students understand the goals of effective writing, focusing on creating clear, organized, and impactful content. It emphasizes the mastery of grammatical and academic writing skills. Students will learn argumentative writing techniques and how to support their arguments with facts, examples, and statistical evidence. The course will also teach students how to convey knowledge and ideas objectively and persuasively. Additionally, it will cover ethical considerations in academic writing, such as citation, plagiarism, formatting, and referencing, as well as the technical aspects of proper referencing.

**Contents**

1. Developing Analytical Skills
2. Transitional Devices (words, phrases, and expressions)
3. Development of Ideas in Writing
4. Reading Comprehension
5. Precis Writing
6. Developing Arguments
7. Sentence Structure: Accuracy, Variation, Appropriateness, and Conciseness
8. Appropriate Use of Active and Passive Voice
9. Organization and Structure of a Paragraph
10. Organization and Structure of an Essay
11. Types of Essays

**Recommended Books**

1. Bailey, S. (2011). *Academic Writing: A Handbook for International Students* (3rd ed.). New York: Routledge.
2. Eastwood, J. (2011). *A Basic English Grammar*. Oxford: Oxford University Press.
3. Swales, J. M., & Feak, C. B. (2012). *Academic Writing for Graduate Students: Essential Tasks and Skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
4. Swan, M. (2018). *Practical English Usage* (8th ed.). Oxford: Oxford University Press.

**Suggested Books**

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman Grammar of Spoken and Written English*. Harlow Essex: MIT Press.
2. Cresswell, G. (2004). *Writing for Academic Success*. London: SAGE.
3. Johnson-Sheehan, R. (2019). *Writing Today*. Don Mills: Pearson.
4. Silvia, P. J. (2019). *How to Write a Lot: A Practical Guide to Productive Academic Writing*. Washington: American Psychological Association.
5. Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford: Oxford University Press.



Chairman  
Department of Statistics  
University of Sargodha

**Course Brief**

This course equips undergraduates with the skills needed to become effective writers and readers of English. It focuses on developing fundamental language abilities, particularly writing, to help students communicate confidently in both oral and written English beyond the classroom. The course is structured into five units and utilizes a Project-Based Learning approach. Each unit emphasizes 21st-century skills, self-reflection, and active community engagement. By the end of the course, students will have developed communication skills as reflective and self-directed learners, engaged with various stages of the writing process, and enhanced their analytical and problem-solving skills to address community-specific challenges.

**Contents****1. Self-Reflection**

- Introduction to the basics of the writing process
- Steps of essay writing
- Prewriting activities: Brainstorming, listing, clustering, and freewriting
- Practicing essay outlining

**2. Personalized Learning**

- Learning process, learning styles, goal setting, and creating a learning plan

**3. Oral Presentation**

- Structure and significance, content selection, slide presentation, and peer review

**4. Critical Reading Skills**

- Introduction to authentic reading (e.g., Dawn newspaper and non-specialist academic texts)
- Reading strategies and practice: Skimming, scanning, SQW3R, annotating, detailed reading, and note-taking
- Standard test practice (TOEFL and IELTS), model review reports, and annotated bibliographies

**5. Community Engagement**

- Student-led brainstorming on local versus global issues
- Identifying research problems and drafting research questions
- Drafting interview/survey questions for community research (in English or L1)
- Critical reading, presenting interview/survey information, fieldwork
- Writing a Community Engagement Project

**6. Letter to the Editor**

- Types, format, and purpose of letters to the editor
- Steps involved in writing a letter to the editor

**Recommended Books**

1. Bailey, S. (2011). *Academic Writing: A Handbook for International Students* (3rd ed.). New York: Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic Writing for Graduate Students: Essential Tasks and Skills* (3rd ed.). Ann Arbor: The University of Michigan Press.

**Suggested Books**

1. Cresswell, G. (2004). *Writing for Academic Success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing Today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to Write a Lot: A Practical Guide to Productive Academic Writing*. Washington: American Psychological Association.



Chairman  
Department Statistics  
University of Sargodha

This is an introductory-level undergraduate course that focuses on the fundamentals related to the quantitative concepts and analysis. The course is designed to familiarize students with the basic concepts of mathematics and statistics and to develop students' abilities to analyze and interpret quantitative information. Through a combination of theoretical concepts and practical exercises, this course will also enable students cultivate their quantitative literacy and problem solving skills while effectively expanding their academic horizon and breadth of knowledge of their specific major / field of study.

### Course Learning Outcomes

By the end of this course, students shall have:

1. Fundamental numerical literacy to enable them work with numbers, understand their meaning and present data accurately;
2. Understanding of fundamental mathematical and statistical concepts;
3. Basic ability to interpret data presented in various formats including but not limited to tables, graphs, charts, and equations etc.

### Contents

1. Numerical Literacy:
  - i. Numbers system and basic arithmetic operations;
  - ii. Units and their conversions, dimensions, area, perimeter and volume;
  - iii. Rates, ratios, proportions and percentages;
  - iv. Types and sources of data;
  - v. Measurement scales;
  - vi. Tabular and graphical presentation of data;
  - vii. Quantitative reasoning exercises using number knowledge.
2. Fundamental mathematical concepts:
  - i. Basics of geometry (lines, angles, circles, polygons etc.);
  - ii. Sets and their operations;
  - iii. Relations, functions, and their graphs;
  - iv. Exponents, factoring and simplifying algebraic expressions;
  - v. Algebraic and graphical solutions of linear and quadratic equations and inequalities;
  - vi. Quantitative reasoning exercises using fundamental mathematical concepts.
3. Fundamental Statistical Concepts:
  - i. Population and sample;
  - ii. Measures of central tendency, dispersion and data interpretation;
  - iii. Rules of counting (multiplicative, permutation and combination);
  - iv. Basic probability theory;
  - v. Introduction to random variables and their probability distributions;
  - vi. Quantitative reasoning exercises using fundamental statistical concepts.

100



Chairman  
Department of Statistics  
University of Sargodha

### Recommended Texts

1. Sevilla, A., & Somers, K. (2012). *Quantitative reasoning: tools for today's informed citizen*. New Jersey, John Wiley & Sons.
2. Burzynski, D., & Ellis, W. (2008). *Fundamentals of mathematics*. USA, Saunders College Publishing.

### Suggested Readings

1. Zaslow, E. (2020). *Quantitative reasoning: thinking in numbers*. Cambridge, Cambridge University Press.
2. de Mesquita, E. B., & Fowler, A. (2021). *Thinking clearly with data: A guide to quantitative reasoning and analysis*. New Jersey, Princeton University Press.
3. Bennett, J., & Briggs, W. (2019). *Using & understanding mathematics: a quantitative reasoning approach*. Pearson.
4. Rosen, K. H., & Krithivasan, K. (2012). *Discrete mathematics and its applications* (Vol. 6). New York: McGraw-Hill.
5. Chatfield, C. (2018). *Statistics for technology: a course in applied statistics*. Routledge.
6. Lock, R. H., Lock, P. F., Morgan, K. L., Lock, E. F., & Lock, D. F. (2020). *Statistics: Unlocking the power of data*. New Jersey, John Wiley & Sons.



Chairman  
Department of Statistics  
University of Sargodha

## General Education Cluster: Quantitative Reasoning

URCG-5121

Tools for Quantitative Reasoning

3(3-0)

This is a sequential undergraduate course that focuses on logical reasoning supported with mathematical and statistical concepts and modeling / analysis techniques to equip students with analytical skills and critical thinking abilities necessary to navigate the complexities of modern world. The course is designed to familiarize students with the quantitative concepts and techniques required to interpret and analyze numerical data and to inculcate ability in students the logical reasoning to construct and evaluate arguments, identify fallacies, and think systematically. Keeping the pre-requisite course of Quantitative reasoning (I) as its base, this course will enable students further their quantitative. Logical and critical reasoning abilities to complement their specific major field of study

### Course Learning Outcomes

By the end of the course, student shall have:

1. Understanding of logic and logical reasoning:
2. Understanding the basic quantitative Modeling and Analyses.
3. Logical reasoning skills and abilities to apply them to solve quantitative problems and evaluate arguments;
4. Ability to critically evaluate quantitative information to make evidence based decisions through appropriate computational tools.

### Contents

1. Logic, Logical and Critical Reasoning:
  - i. Introduction and importance of logic,
  - ii. Introductive, deductive and abductive approaches of reasoning,
  - iii. Propositions, arguments (valid; invalid), logical connectives, truth tables and propositional equivalences,
  - iv. Logical fallacies,
  - v. Venn Diagrams,
  - vi. Predicates and quantifiers,
  - vii. Quantitative reasoning exercises using logical reasoning concepts and techniques.
2. Mathematical Modeling and Analyses:
  - i. Introduction to deterministic models,
  - ii. Use of linear function for modeling in real-world situations,
  - iii. Modeling with the system of linear equation and linear solutions,
  - iv. Elementary introduction to derivatives in mathematical modeling,
  - v. Linear and exponential growth and decay models,
  - vi. Quantitative reasoning exercises using mathematical modeling.
3. Statistical Modeling and Analyses:
  - i. Introduction to probabilistic models,
  - ii. Bivariate analysis, scatter plots,
  - iii. Simple linear regression model and correlation analysis,
  - iv. Basics of estimation and confidence interval,
  - v. Testing of hypothesis (z-test; t-test),
  - vi. Statistical inference in decision making,
  - vii. Quantitative reasoning exercise using statistical modeling.

102




Chairman  
Department  
University of Sargodha  
Statistics

### Recommended Texts

1. Bennett, J., & Briggs, W. (2019). *Using & understanding mathematics: a quantitative reasoning approach*. Pearson.
2. Rosen, K. H., & Krithivasan, K. (2012). *Discrete mathematics and its applications* (Vol. 6). New York: McGraw-Hill.

### Suggested Readings

1. Epp, S. S. (1990). *Discrete mathematics with applications*. Wadsworth Publ. Co..
2. Budnick, F. S., Quinn, S., Bowser, K., & Flaherty, E. H. (1993). *Applied mathematics for business, economics, and the social sciences*. New York: McGraw-Hill.
3. Bluman, A. (2014). *Elementary Statistics: A step by step approach 9e*. McGraw Hill.
4. Mann, P. S. (2007). *Introductory statistics*. John Wiley & Sons.
5. Babones, S. (2013). *Applied statistical modeling. (No Title)*.
6. Green, S. W., Wolf, I.k., Stewrat, B. W. (2022). *SAT Study Guide Premium*. Barrons



Chairman  
Department Statistics  
University of Saradha

*Introductory/compulsory foundation course*

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam: Qur'aan and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational basis of Islam in fields that include Qur'aanic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'aan and Sunnah.

- To make students understand the relevance and pragmatic significance of Islam in their lives.
- To make learners comprehend the true spirit of Islam with reference to modern world.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges of being.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding the issues related to faith and religious life.

*Contents*

1. Introduction to Qur'aanic Studies	تعارف قرآن مجید
1) Basic Concepts of Qur'aan	قرآن مجید کا بنیادی تعارف
2) History of the compilation of Qur'aa	تاریخ جمع و تدوین قرآن مجید
3) Uloom-ul-Qur'aan	علوم القرآن

مطالعہ قرآن (تعارف قرآن مجید، منتخب آیات کا ترجمہ و تفسیر: سورۃ البقرہ آیات 1-5، 284-286؛ سورۃ الحجرات آیات 1-18؛ سورۃ الفرقان آیات 63-77؛ سورۃ المؤمنون آیات 1-11؛ سورۃ الاحزاب آیات 6، 21، 32، 33، 40، 56-59؛ سورۃ الانعام آیات 151-153؛ سورۃ الصف آیات 1-14؛ الشرح آیات 18-20؛ آل عمران آیات 190-192؛ النحل آیات 12-14؛ لقمن آیت 20، حم السجدہ آیت 53

2. Introduction to Hadith	تعارف حدیث
1) Legal Status of Hadith	حدیث کی قانونی حیثیت
2) History of the compilation of Hadith	تاریخ جمع و تدوین حدیث
3) Classifications of Hadith	حدیث کی اقسام

Chairman  
Department of Islamic Studies  
University of Sargodha

Chairman  
Department of Islamic Studies  
University of Sargodha

متن، حدیث: اور ذیل موضوعات پر امارت کا مطالعہ

- 1۔ اعمال کا اجریت پر منحصر ہے۔ 2۔ بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔ 3۔ کتاب و سنت گمراہی سے بچنے کا ذریعہ ہیں۔ 4۔ ارکان اسلام 5۔ اسلام، ایمان، احسان اور قیامت کی نشانیاں۔ 6۔ بچوں کو نماز کی تلقین۔ 7۔ دین کا کبرا انہم اللہ کی خاص عنایت ہے۔ 8۔ حصول علم، تلاوت قرآن اور عمل کی اہمیت و فضیلت، 9۔ روزِ عشر میں ہونے والا عاصفہ۔ 10۔ حقوق اللہ کے ساتھ ساتھ حقوق العباد کا لحاظ رکھنا بھی لازم ہے۔ 11۔ حسن خلق کی عظمت اور نقش و بدگونی کی مذمت۔ 12۔ دنیا و آخرت کی جمالی کی شانین چار چیزیں، 13۔ ہلاک کر دینے والی سات چیزیں، 14۔ بے عمل مبلغ کا عبرت ناک انجام۔ 15۔ ہر شخص عمران ہے اور ہر شخص مسئول

### 3. Sirah of the Prophet (PBUH)

سیرت النبی ﷺ

#### 1. Significance of Seerah Studies

مطالعہ سیرت کی ضرورت و اہمیت

#### 2. Prophetic principles of Character building

تعمیر سیرت و شخصیت کا نبوی منہاج

اقامت دین کا نبوی طریق کار، اقامت دین بعد خلافت راشدہ، بیثاق مدینہ، خطبہ تجہ الوداع، اخلاقی تعلیمات، تشکیل اجتماعیت اور اسوہ حسنہ، قرآن مجید میں سیرت سرور عالم کا بیان، غزوات نبوی ﷺ کے مقاصد و حکمتیں

### 4. Islamic Culture & Civilization

اسلامی تہذیب و تمدن

#### 1) Basic Concepts of Islamic Civilization

اسلامی تہذیب کا مفہوم

#### 2) Historical evaluation of Islamic Civilization

اسلامی تہذیب کا تاریخی ارتقاء

#### 3) Salient feature of Islamic Civilization

اسلامی تہذیب کی نمایاں خصوصیات

#### 4) Islamic Civilization and Contemporary Issues

اسلامی تہذیب و تمدن اور معاصر مسائل

اسلامی تہذیب کے عوامل و عناصر، اسلامی تہذیب کے علمی، معاشرتی اور سماجی اثرات، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و نتائج، طبی، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نامور مسلمان سائنسدان

Pre-Requisite: Nil

#### Recommended Books

- 1) Hameed ullah Muhammad, —Emergence of Islam, IRI, Islamabad
- 2) Hameed ullah Muhammad, —Muslim Conduct of State
- 3) Hameed ullah Muhammad, \_Introduction to Islam
- 4) Ahmad Hasan, —Principles of Islamic Jurisprudence, Islamic Research Institute, International Islamic University, Islamabad (1993)
- 5) Dr. Muhammad Zia-ul-Haq, —Introduction to Al Sharia Al Islamia, Allama Iqbal Open University, Islamabad (2001)
- 6) Dr. Muhammad Shahbaz Manj, Teleemat-e- Islam

205

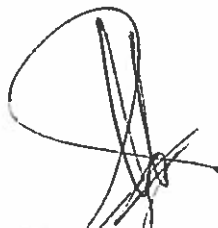
Chairman  
Department of Statistics  
University of Sargodha

**Contents**

1. Meaning and Scope of Ethics.
2. Relation of Ethics with:
  - a) Religion
  - b) Science
  - c) Law
3. Historical Development of Morality:
  - a) Instinctive Moral Life.
  - b) Customary Morality.
  - c) Reflective Morality.
4. Moral Theories:
  - a) Hedonism (Mill)
  - b) Intuitionism (Butler)
  - c) Kant's Moral Theory.
5. Moral Ethics and Society.
  - a) Freedom and Responsibility.
  - b) Tolerance
  - c) Justice
  - d) Punishment (Theories of Punishment)
6. Moral Teachings of Major Religions:
  - a) Judaism
  - b) Christianity
  - c) Islam
7. Professional Ethics:
  - a) Medical Ethics
  - b) Ethics of Students
  - c) Ethics of Teachers
  - d) Business Ethics

**REFERENCE BOOKS:**

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition
4. Ameer Ali, S. The Ethics of Islam. Culcutta: Noor Library Publishers, latest edition
5. Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University of



Chairman  
Department  
University of Sarhad  
Statistics  
106

**Course Brief**


This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan. It will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary

**Contents**

1. **Ideology of Pakistan**
  - o Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah. Two Nation Theory and Factors leading to Muslim separatism.
2. **Constitutional Developments**
  - o Salient Feature of the Government of India Act 1935
  - o Salient Feature of Indian Independence Act 1947 Objectives Resolution
  - o Salient Feature of the 1956 Constitution
  - o Developments leading to the abrogation of Constitution of 1956
  - o Salient features of the 1962 Constitution
  - o Causes of failure of the Constitution of 1962
  - o Comparative study of significant features of the Constitution of 1956, 1962 and 1973
3. **Fundamental rights**
4. **Principles of policy**
5. **Federation of Pakistan**
  - o President
  - o Parliament
  - o The Federal Government
6. **Provinces**
  - o Governors
  - o Provincial Assemblies
  - o Provincial Government
7. **The Judiciary**
  - o Supreme Court
  - o High Courts
  - o Federal Shariat Courts
  - o Supreme Judicial Council
  - o Administrative Courts and tribunals
8. **Islamic Provisions in Constitution**
9. **Significant Amendments of Constitution of Pakistan 1973**

### Recommended Books

1. *Constitutional and Political History of Pakistan* by Hamid Khan
2. Mahmood, Shaukat, and Shaukat, Nadeem. *Constitution of the Islamic Republic of Pakistan* (3rd revised edition). Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. *Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973*. Lahore: Law Publications, 1975.
4. Rizvi, Syed Shabbar Raza. *Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary* (2nd revised edition). Lahore: Vanguard, 2005.
5. *The Text of the Constitution of the Islamic Republic of Pakistan, 1973* (as amended).
6. *Fundamental Laws of Pakistan* by A.K. Brohi



Chairman  
Department of Statistics  
University of Sargodha

## URCG-5128:Pakistan Studies-2(2-0)

### Course Description:

This course is designed to provide students with a comprehensive exploration of Pakistan's identity, encompassing its geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Additionally, it examines the country's democratic transitions, military interventions, and socio-economic developments. The aim is to develop a nuanced understanding of Pakistan's past, present, and potential future trajectories while enabling students to critically evaluate the complex dynamics shaping the nation's development.

### Learning Outcomes:

By the end of this course, students will be able to:

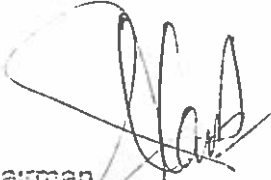
1. Gain enhanced knowledge of the geographical, historical, and political aspects of Pakistan.
2. Understand the societal and cultural diversity of Pakistan.
3. Analyze and explain Pakistan's socio-economic developments.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for its future.

### Course Outline:

1. **Introduction to Pakistan**
  - Geographical location and significance.
  - Historical background: Ancient civilizations in the region.
  - Factors leading to the creation of Pakistan.
2. **Political History of Pakistan**
  - Formative phase of Pakistan.
  - Military interventions and democratic transitions.
3. **Geography of Pakistan**
  - Physiography: Mountains, plains, plateaus, deserts, valleys, and coastal areas.
  - River systems: Indus River and its tributaries.
  - Climatic regions of Pakistan.
4. **Society and Culture of Pakistan**
  - Socio-cultural diversity.
  - Languages and literature of Pakistan.
5. **Economic Development of Pakistan**
  - Agriculture and industrial sectors.
  - Economic challenges and prospects.
6. **Contemporary Issues**
  - Foreign relations of Pakistan.
  - Security challenges: Terrorism, extremism, and regional conflicts.
  - Environmental problems and sustainable development (SDGs).
  - Media and social change.

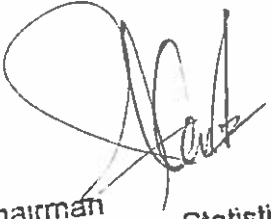
### Recommended Readings

1. *Jinnah of Pakistan* by Stanley Wolpert
2. *The Sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan* by Ayesha

  
Chairman  
Department of Statistics  
University of Sargodha

Jalal

3. *The Struggle for Pakistan* by Ishtiaq Hussain Qureshi
4. *Pakistan: The Formative Phase, 1857-1947* by Khalid B. Sayeed
5. *Pakistan Studies: A Book of Readings* by Sikandar Hayat
6. *Constitutional and Political History of Pakistan* by Hamid Khan
7. *Trek to Pakistan* by Ahmad Saeed and Kh. Mansur Sarwar
8. *Pakistan: A Modern History* by Ian Talbot
9. *Politics in Pakistan: The Nature and Direction of Change* by Khalid B. Sayeed
10. *Physical Geography of Pakistan* by Umar Jahangir
11. *A Geography of Pakistan: Environment, People, and Economy* by Fazle Karim Khan
12. *Pakistan's Foreign Policy: A Historical Analysis* by S.M. Burke
13. *Separatism in East Pakistan* by Rizwan Ullah Kokab
14. *Being Pakistani: Society, Culture and the Arts* by Raza Rumi
15. *Pakistan's Cultural Heritage: Socio-Economic and Technological Aspects* edited by Abdul Jabbar Khan
16. *Language and Politics in Pakistan* by Tariq Rahman
17. *Sociology* by Horton and Hunt
18. *Pakistan in the Twentieth Century: A Political History* by Lawrence Ziring
19. *Economic Development of Pakistan* by Ishrat Husain
20. *Issues in Pakistan's Economy* by S. Akbar Zaidi

  
Chairman  
Department Statistics  
University of Sargodha

## URCG-5123 Applications of Information and Communication Technologies (ICT) 3(2-1)

### Course Brief

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace. Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

### Contents

7. Introduction, Overview of Information Technology.
8. Hardware: Computer Systems & Components, Storage Devices.
9. Software: Operating Systems, Programming and Application Software.
10. Databases and Information Systems Networks.
11. File Processing Versus Database Management Systems.
12. Data Communication and Networks.
13. Physical Transmission Media & Wireless Transmission Media.
14. Applications of smart phone and usage.
15. The Internet, Browsers and Search Engines.
16. Websites and their types.
17. Email Collaborative Computing and Social Networking.
18. E-Commerce.
19. IT Security and other issues.
20. Cyber Laws and Ethics of using social media.
21. Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
22. Other IT tools/software specific to field of study of the students if any.

### Recommended Book

1. Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat, Susan L. Sebok; 17th edition.

### Suggested Books

1. Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 26th edition.
2. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**

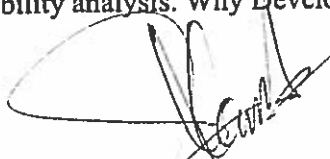
This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

**Course Learning Objectives**

1. To enhance the 'entrepreneurial intentions' of the students by improving their natural willingness to start a business.
2. To understand the process of entrepreneurship and learn the ways to manage it by working individually in the class and in the form of groups outside the class to conduct field assignments.
3. To educate the students about the practical underpinnings of the entrepreneurship with the aid of practical assignments and idea pitching.

**Contents**

1. **Background:** What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. **Forms of Business Ownership:** The Sole proprietorship, Partnership, Joint Stock Company
3. **Entrepreneurship:** The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. **The Challenges of Entrepreneurship:** The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. **Inside the Entrepreneurial Mind:** From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. **Products and technology, identification opportunities**
7. **Designing a Competitive Business Model and Building a Solid Strategic Plan:** Building a strategic plan, building a Competitive Advantage, The Strategic Management Process, formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. **Conducting a Feasibility Analysis and Crafting a Winning Business Plan:** Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis. Why Develop a Business Plan, The Elements of a Business Plan, What



Chairman  
Department Statistics  
University of Sardodha

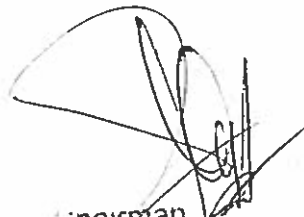
- Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.
9. **Building a Powerful Marketing Plan:** Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research. Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
  10. **E-Commerce and the Entrepreneur:** Factors to Consider before Launching into ECommerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
  11. **Pricing Strategies:** Three Potent Forces: Image, Competition, and Value, Pricing Strategies and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing
  12. **Attracting Venture Capitalist:** Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back & Suggestions on Student Project,
  13. **Idea Pitching:** Formal presentation, 5-minutes pitch, funding negotiation and launching.

#### **Recommended Books**

1. Scarborough, N. M. (2011). Essentials of entrepreneurship and small business management. Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458..

#### **Suggested Books**

2. Burstiner, I. (1989). Small business handbook. Prentice Hall Press.



Chairman  
Department Statistics  
University of Sargodha

**Course Brief**


The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship.

**Course Learning outcomes**

1. After completing this course, students will be able to
2. Understand the concepts of civic engagement, community development, and social responsibility.
3. Understand rights and responsibilities of citizenship
4. Understand cultural diversity in local and global context
5. Analyze the significance of civic participation in promoting social justice, equity, and democracy.
7. Examine the historical and contemporary examples of successful civic and community engagement initiatives.
8. Identify and assess community needs, assets, and challenges to develop effective strategies for community improvement.
9. Explore the ethical implications and dilemmas associated with civic and community engagement.
10. Develop practical skills for effective community organizing, advocacy, and leadership.
11. Foster intercultural competence and respect for diversity in community engagement efforts.
12. Collaborate with community organizations, stakeholders, and fellow students to design and implement community-based projects.
13. Reflect on personal growth and learning through self-assessment and critical analysis of community engagement experiences.

**Course Contents**

1. **Introduction to Civics & Community Engagement**
  - a. Overview of the course: Civics & Community Engagement
  - b. Definition and importance of civics
  - c. Key concepts in civics: citizenship, democracy, governance, and the rule of law
  - d. Rights and responsibilities of citizens
2. **Citizenship and Community Engagement**
  - a. Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills
  - b. Approaches and Methodology for Active Citizenship
3. **Identity, Culture, and Social Harmony**
  - a. Concept and Development of Identity, Group identities
  - b. Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity,

  
 Chairman  
 Department of Statistics  
 University of Sargodha


- c. Globalization and Culture, Social Harmony, Religious Diversity (Understanding and affirmation of similarities & differences)
- d. Understanding Socio-Political Polarization
- e. Minorities, Social Inclusion, Affirmative actions
- 4. **Multi-cultural society and inter-cultural dialogue**
  - a. Inter-cultural dialogue (bridging the differences, promoting harmony)
  - b. Promoting intergroup contact/ Dialogue
  - c. Significance of diversity and its impact
  - d. Importance and domains of Inter-cultural dialogue
- 5. **Active Citizen: Locally Active, Globally Connected**
  - a. Importance of active citizenship at national and global level
  - b. Understanding community
  - c. Identification of resources (human, natural and others)
  - d. Utilization of resources for development (community participation)
  - e. Strategic planning, for development (community linkages and mobilization)
- 6. **Human rights, constitutionalism and citizens' responsibilities**
  - a. Introduction to Human Rights
  - b. Human rights in constitution of Pakistan
  - c. Public duties and responsibilities
  - d. Constitutionalism and democratic process
- 7. **Social Institutions, Social Groups, Formal Organizations and Bureaucracy**
  - a. Types of Groups, Group identities, Organizations
  - b. Bureaucracy, Weber's model of Bureaucracy
  - c. Role of political parties, interest groups, and non-governmental organizations
- 8. **Civic Engagement Strategies**
  - a. Grassroots organizing and community mobilization
  - b. Advocacy and lobbying for policy change
  - c. Volunteerism and service-learning opportunities
- 9. **Social issues/Problems of Pakistan**
  - a. Overview of major social issues of Pakistani society
- 10. **Social Action Project**

#### Recommended Books

1. Kennedy, J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

#### Suggested Books

1. 1. Glencoe McGraw-Hill. (n.d.). Civics Today: Citizenship, Economics, and Youth.
2. 2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.). Pearson.
3. 3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building and Democracy in the United States. Kettering Foundation Press.

  
 Chairman  
 Department Statistics  
 University of Sargodha

4. Bloemraad, I. (2006). *Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada*. University of California Press.
5. Kuyek, J. (2007). *Community Organizing: Theory and Practice*. Fernwood Publishing.
6. DeKieffer, D. E. (2010). *The Citizen's Guide to Lobbying Congress*. TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). *Advocacy and Opposition: An Introduction to Argumentation* (8th ed.). Routledge.
8. Kretzmann, J. P., & McKnight, J. L. (1993). *Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets*. ACTA Publications.
9. Patterson, T. E. (2005). *Engaging the Public: How Government and the Media Can Reinvigorate American Democracy*. Oxford University Press.
10. Love, N. S., & Mattern, M. (2005). *Doing Democracy: Activist Art and Cultural Politics*. SUNY



Chairman  
Department of Statistics  
University of Sarawak

## Model Course Outline for the Course Understanding of Quran – I

**Course Title:** Understanding of Quran – I                      **Course Code:** URCG-5129  
**Course Book:** Muallim ul Quran (Volume 1, 2 & 3) by Dr Ubaid ur Rahman  
**Credit Hours:** 1 (0-1)  
**Contact Hours:** 3 per week  
**Weeks:** 15-16 (45-48 hours)

### **Course Learning Outcomes:**

*By the end of this course, students will be able to:*

1. Develop the ability to understand basic words of the Quran, phrases and sentences that do not contain verbs (unit 1 to 5 of Muallim ul Quran Book) and then sentences having present tense (first half of unit 6 of Muallim ul Quran Book).
2. Acquire a strong foundation for understanding long verses of the Quran with clarity.
3. Comprehend Quranic vocabulary, particles (operative & non operative particles) , compounds (Adjective & Possessive compound), pronouns (singular & plural) and types of plural through hundreds of Quranic sentences.
4. Recognize and understand different styles of Quranic sentences, including nominal sentence, emphatic sentence, double emphatic sentence, negative sentence, interrogative sentence, oath –based sentences.
5. Strengthen understanding of fundamental Quranic linguistic styles, expressions and idioms.
6. Understand at least 30 to 40 % of each page of the holy Quran.

### **Provision of material, content and books:**

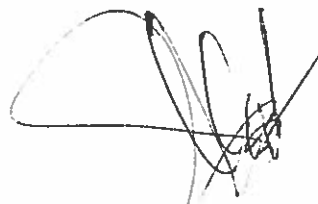
- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

  
Chairman  
Department Statistics  
University of Sargodha

### Course Outline:


Weeks	Lectures (1.5 hrs)	Units	Lessons	Assignments/Home Task	Linguistic Rules
1.	1.	1	1-6	Writing the meaning of Quranic words Lesson 1-8	Proper Noun Masculine & Feminine
	2.	1	9-14	Writing the meaning of Quranic words 9-14	Two kinds of plural Concept of (و) "And" Common Noun
2.	1.	1	15-17	Writing the meaning of Quranic words, phrases & translation of Sentences 15-17	Demonstrative Noun (This & That for Masculine (هذه) Demonstrative Noun (This & That for Feminine) (ذلك- تلك)
	2.	1	18-19 & Revision (Unit 1)	Writing the meaning of Quranic words , phrases & translation of Sentences 17-19 Quiz	Laam for emphasis (لام التأكيد) Superlative Degree like أكبر Revision of all Quranic Sentences
3.	1.	Unit 2	1-3	Writing the meaning of Quranic words, phrases & translation of Sentences 1-3	Emphatic Particle إن Preposition "For" (اللام) Preposition (في)
	2.	2	4-6	Writing the meaning of Quranic words, phrases & translation of Sentences 4-6	Preposition (على- من- إلى)
4.	1.	2	7-9	Writing the meaning of Quranic words & translation of Sentences 7-9	Preposition (الباء) Absolute Negation Particle Exceptive Particle (لا النافية إلا) (ما النافية) (للجنس)
	2.	2	10-13 & Revision (Unit 2)	Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 Quiz	Subordinating Conjunction (أن), Was (كان), Vocative Particle (حرف النداء)

5.	1.	Unit 3	1-2	Writing the meaning of Quranic phrases 1-2	Quranic Adjective Compounds (صفة وموصوف)
	2.	3	3-5	Writing the meaning of Quranic phrases & translation of sentences 3-5	Quranic Possessive Construction (مضاف ومضاف إليه)
6.	1.	3	6-7	Writing the meaning of Quranic phrase translation of sentences 6-7	Quranic Possessive Construction (مضاف ومضاف إليه)
	2.	3	8-10 & Revision (Unit 3)	Writing the meaning of Quranic phrase & translation of sentences 8-10 Quiz	Active Participle (اسم الفاعل), Passive Participle (اسم المفعول), Dual (مثنى)
7.	1.	Unit 4	1-2	Writing the meaning of Quranic phrase & translation of sentences 1-2	Personal Pronoun He (هو المنفصل) Possessive Pronoun His (له المتصل)
	2.	4	3-4	Writing the meaning of Quranic phrase & translation of sentences 3-4	Possessive Pronoun with prepositions like في بيته Pronoun "His" with prepositions like له، منه، فيه
8.	1.	4	5-8	Writing the meaning of Quranic sentences 5-8	Personal Pronoun You (أنت المنفصل) Possessive Pronoun Your (لك المتصل) Possessive Pronoun with prepositions like في بيتك Pronoun "your" with prepositions like لك، منك، فيك
	2.	Mid Term			

  
 Chairman  
 Department of Statistics  
 University of Sargodha

9.	1.	4	9-12	Writing the meaning of Quranic phrases & sentences 9-12	Personal Pronoun She ( هي المنفصل) Possessive Pronoun Her ها المتصل) Possessive Pronoun with prepositions like في بيتها Pronoun "Her" with prepositions like لها
	2.	4	13-16	Writing the meaning of Quranic phrases & sentences 13-16	Personal Pronoun I ( أنا المنفصل) Possessive Pronoun Her ي المتصل) Possessive Pronoun with prepositions like في بيتي Pronoun "My" with prepositions like لي
10.	1	4	17 & Revision Unit 4	Revision of all Quranic sentences of Unit 4 Quiz	Adverb (حال)
	2.	Unit 5	1-2	Writing the meaning of Quranic phrases & sentences 1-2	Masculine Plural جمع المذكر السالم و جمع المذكر السالم المسبوق بحرف الجر
11.	1.	5	3-4	Writing the meaning of Quranic phrases & sentences 3-4	Possessive Construction with Plurals جمع المذكر السالم المسبوق بالإضافة
	2.	5	5-6	Writing the meaning of Quranic phrases, sentences & verses 5-6	Personal Pronoun They ( هم المنفصل) Possessive Pronoun Their هم المتصل)
12.	1.	5	7-8	Writing the meaning of Quranic phrases, sentences & verses 7-8	Possessive Pronoun with prepositions like في بيتهم Pronoun "Their" with prepositions like لهم
	2.	5	9-11	Writing the meaning of Quranic phrases, sentences & verses 9-11	Personal Pronoun You ( أنتم المنفصل) Possessive Pronoun Your كم المتصل) Possessive Pronoun with prepositions

					like في بيتكم
13.	1.	5	12-14	Writing the meaning of Quranic phrases & sentences & verses 12-14	Pronoun "Your" with prepositions like لكم Personal Pronoun We ( نحن المنفصل) Possessive Pronoun Our (نا المتصل)
	2.	5	15-16	Writing the meaning of Quranic sentences & verses 15-16	Possessive Pronoun with prepositions like في بيتنا Pronoun "Our" with prepositions like لنا
14.	1.	5	17-18	Writing the meaning of Quranic sentences & Verses 17-18	Demonstrative Pronoun These, Those ( هؤلاء- أولئك )
	2.	5	19-23	Writing the meaning of Quranic sentences & Verses 19-23	ما / إلا، إن / إلا، إنما، ليس، ما ، ( أ/أم، أن، بل، كأن ) ( ألا، اليس، اليوم، يومئذ، سبحانه، ما بينهما، قل، إذن، بنس، نعم، كلا، ما أدراك، حسب، أعلم ب، مصير، مرجع، نبينا(تمييز)
15.	1.	5	Revision Unit 5	Quiz	
	2.	5	1-3 (till Page 16)	Writing the meaning of Quranic Verbs & Translation of Quranic Sentences & Verses (1-3)	Introduction of Present Tense (فعل مضارع) & Verbal Sentence ( جملة فعلية ) Present Tense الفعل المضارع صيغة المفرد يعلم
16.	1.	6	3 (From Page 17) & 4-5	Translation of Quranic Sentences & Verses 3-5	Present Tense الفعل المضارع صيغة المفرد يعلم
	2.	6	6	Translation of Quranic Sentences & Verses	Present Tense الفعل المضارع صيغة الجمع يعلمون

  
 Chairman  
 Department of Arabic  
 University of Sindh

## Model Course Outline for the Course Understanding of Quran – II

Course Title: Understanding of Quran – II      Course Code: URCG-5130  
 Course Book: Muallim ul Quran (Volume 3, 4 & 5) by Dr Ubaid ur Rahman  
 Credit Hours: 1 (0-1)  
 Contact Hours: 3 per week  
 Weeks: 15-16 (45-48 hours)

### Course Learning Outcomes:

By the end of this course, students will be able to:

1. Directly comprehend hundreds of Quranic sentences & verses.
2. Understand at least 80 to 85 % of each page of the holy Quran.
3. Understand common verses across different Quranic topics.
4. Achieve proficiency in the basic and advance linguistic aspects of the Arabic language.
5. Understand the difference between Quranic verbs in various forms, such as present, past and imperative.
6. Develop the ability to understand long verses of the holy Quran independently and then comprehend their interpretation.


### Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images is available on website.

### Course Outline:

Weeks	Lectures	Units	Lessons	Assignments/Home Task	
1.	1.	6	6	Understanding & Translation of Verses	Present Tense صيغة جمع منكر غائب مثل يعبدون
	2.	6	7-8	Understanding & Translation of Verses	Present Tense صيغة جمع منكر غائب مثل يعبدون
2.	1.	6	9-10	Understanding & Translation of Verses	Present Tense صيغة مفرد منكر مخاطب (تعبد) وجمع منكر مخاطب (تعبدون)
	2.	6	11-12	Understanding & Translation of Verses	Present Tense صيغة جمع منكر مخاطب (تعبدون)

122

  
 Chairman  
 Department  
 University of Sargodha


					صيغة المتكلم (اعيد)
3.	1.	6	13	Understanding & Translation of Verses	Present Tense صيغة جمع المتكلم (نعيد)
	2.	6	14-15	Understanding & Translation of Verses	Negative Imperative صيغة المفرد وصيغة الجمع , لا تعيدوا لا تعيدوا
4.	1.	6	16-17	Understanding & Translation of Verses	Conditional Sentences & masdar moawal (مصدر موزل)
	2.	6	18-19	Understanding & Translation of Verses	Laam uttaleel (لام التعليل) & Laam ul jhood(لام الجود)
5.	1.	6	20-21	Understanding & Translation of Verses	Present with object pronouns & Passive Voice
	2.	6	Revision (Unit 6)	Quiz	
6.	1.	Unit 7	1 (sec 1-3)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
	2.	6	1 (Sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
7.	1.	6	1 (Sec 5-6)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
	2.	6	1 (Sec 7-9)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
8.	1.	7	Revision	Understanding & Translation of Verses QUIZ	Past Tense صيغة المفرد للغائب
	2.	MID-TERM			
9.	1.	7	2 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
	2.	7	2 (sec 3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
10.	1.	7	2 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
	2.	7	2 (sec 6-7)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عبدوا
11.	1.	7	3 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم عندنا

123



Chairman  
Department Statistics  
University of Sargodha

	2.	7	3 (sec 2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم علينا
12.	1.	7	3 (sec 3-4)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم علينا
	2.	7	3 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم علينا
13.	1.	7	4 (sec 1-2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب علينا
	2.	7	4 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب علينا
14.	1.	7	5-6	Understanding & Translation of Verses Quiz	Past Tense صيغة المتكلم والمخاطب علينا ، عينا
	2.	7	7	Understanding & Translation of Verses	Past Tense صيغة المونث للغائب علينا
15.	1.	7	8	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول للمفرد
	2.	7	9	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول للجمع
16.	1.	8	1-4	Understanding & Translation of Verses	Imperative Verb for singular فعل الأمر للمفرد
	2.	7	5-8	Understanding & Translation of Verses	Imperative Verb for plural فعل الأمر للجمع

  
 Chairman  
 Department of Statistics  
 University of Sargodha

## مطالعہ سیرت النبی صلی اللہ علیہ وسلم

Course Code

URCG-5127

Title	Description
Semester	
Nature of Course	
No. of C.Hrs.	1(1-0)
Total Teaching weeks	18
Objectives of the Course	<p>۱۔ طلبہ کو مطالعہ سیرت النبی صلی اللہ علیہ وسلم کی ضرورت و اہمیت سے آگاہ کرنا  ۲۔ فقیر شخصیت میں مطالعہ سیرت النبی صلی اللہ علیہ وسلم کے کردار کو واضح کرنا  ۳۔ بخت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا  ۴۔ رسول اکرم صلی اللہ علیہ وسلم کی اور دنیا کی اس طرح مطالعہ کرنا کہ طلبہ ان واقعات سے تاج کا استفادہ کر سکیں  ۵۔ طلبہ کو محمد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا</p>

## Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالات و زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا تہذیبی ماحول و نسب ۲۔ مہذبہ ایشیا اور ابتدائی تربیت ۳۔ لاکھن پور و جہانگیر کے حالات و زندگی
2	بخت نبوی کے وقت دنیا کے حالات (۱)	۱۔ بخت نبوی کے وقت اہم تہذیبیں ۲۔ عرب، مصر، جوہرہ، ہندوستانی
3	بخت نبوی	۱۔ نئی مہذبہ و دعوت اسلام
4	بخت نبوی	۱۔ دنیا میں دعوت اسلام
5	حصص النبی	آپ کی زندگی و پیغمبرانہ
6	حصص النبی	بخت نبوی و معلم
7	حصص النبی	بخت نبوی
8	حصص النبی	بخت نبوی سربراہان سیاست
9	حصص النبی	ذاتی عیاش اور عالمگیر اثرات

Chairman  
Department of Statistics  
University of Sargodha

125

نمبر	نمونہ	توضیحات
10	نمائندہ ایجنسی	نمونہ رسالت
11	اسوہ حسنہ اور عمر حاضر	نمونہ مسلوں سے تعلقات
12	اسوہ حسنہ اور عمر حاضر	اسوہ حسنہ کی روشنی میں گھریلو زندگی
13	اسوہ حسنہ اور عمر حاضر	مستشرقین اور مطالعہ ہجرت
15	اسوہ حسنہ اور عمر حاضر	وطن سے محبت اور ہجرت
16	اسوہ حسنہ اور عمر حاضر	مستشرقین کے اعتراضات اور ان کے جوابات

### نصاب کتب

نمبر	نمونہ	توضیحات
1	ابن ہشام	نصاب کتب
2	مولانا شبلی نعمانی سید سلطان ندوی	اسیر و اجیر
3	قاضی محمد سلیمان سلطان منصور پوری	میر قاسمی صلی اللہ علیہ وسلم
4	مولانا سید ابوالحسن علی ندوی	رحمۃ اللعالمین
5	ڈاکٹر یحییٰ عظیم صدیقی	نبی رحمت صلی اللہ علیہ وسلم
6	ڈاکٹر خالد ندوی	مہمہ تجوی کا اقامت حکومت
		انسان کامل

### حوالہ جاتی کتب

نمبر	نمونہ	توضیحات
1	سید ابوالاعلیٰ مودودی	نصاب کتب
2	مولانا صفی الرحمن مہر کچھوی	حیرت سرور عالم صلی اللہ علیہ وسلم
3	پروفیسر محمد کرم شاہان زہری	ارحمتنا منقذہم
4	ڈاکٹر اکرم انصاری انصاری	قیامہ نبی صلی اللہ علیہ وسلم
5	مولانا عبدالرشاد انصاری	السيرة النبوية الصحيحة
		دعوت الہیہ



Chairman  
Department Statistics  
University of Sargodha

**1-Course Description**

The Ethics-I course is designed to provide students with a comprehensive understanding of ethical principles, practices, and theories in various societal contexts. Throughout this degree program, students will explore the complexities of ethical theories of semitic and non-semitic religions along with decision-making and develop critical thinking skills to navigate moral dilemmas. This course will also enable the students to interact with others religious identities with humanistic, inclusive and holistic approach

**2- Learning Objectives**

This course aims to:

1. Introduce students to the fundamental concepts, scope, and importance of ethics.
2. Explore the relationship between law, morality, and social values.
3. Develop a clear understanding of virtuous and immoral ethics and their impact on individual and collective life.
4. Study the role of major religious figures in the moral development of human society and enable students to apply ethical principles for personal development, conflict resolution, and social harmony.

**3- Learning Outcomes**

By the end of the course, students will be able to:

1. Students will be able to identify and analyze major ethical theories, values, and their scope in social and individual life.
2. Differentiate between law and ethics, and analyze their interrelationship.
3. Identify types of virtuous and immoral ethics and assess their social impacts.
4. Examine the ethical teachings of major religions and their relevance in contemporary society.
5. Apply ethical principles to address modern challenges in personal and professional life.

**4-Course Structure**

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

**Course Contents****Unit 1: Introduction and Fundamentals of Ethics**

1. Literal and terminological definition of ethics
2. Literal and terminological definition of values
3. Relationship between law and ethics
4. Need, importance, and scope of ethics

**Unit 2: Types of Ethics and Their Impact on Society**

- Virtuous ethics: concept, types, benefits, and outcomes
- Immoral ethics: concept, types, and harms
- Role of ethics in social refinement and establishment of peace

**Unit 3: Virtuous Ethics (Akhlāq-e-Hasanah)**

- Concept, need, and importance of virtuous ethics
- Scope of virtuous ethics in the light of religions
- Major virtues in revealed and non-revealed religions
- Impact of virtuous ethics on individual and collective life

**Unit 4: Immoral Ethics (Akhlāq-e-Razilah)**

- Concept of immoral ethics
- Social problems caused by immoral ethics
- Practical consequences of immoral ethics
- Major vices in revealed and non-revealed religions

**Unit 5: Role of World Religious Figures in Moral Development**

- Prophet Moses (AS): introduction, miracles, and role in moral refinement
- Prophet Jesus (AS): introduction, miracles, and role in moral refinement
- Prophet Muhammad (ﷺ): introduction, miracles, and role in moral refinement

**Textbook**

1. Izutsu, T. (2002). *Ethico-Religious Concepts in the Qur'an*. McGill-Queen's University Press.

**Suggested Readings**

1. Gert, B. (2005). *Morality: Its Nature and Justification*. Oxford University Press.
2. MacIntyre, A. (2007). *After Virtue: A Study in Moral Theory*. University of Notre Dame Press.
3. Al-Ghazali, Abu Hamid (2001). *The Alchemy of Happiness*. Islamic Texts Society.
4. Nasr, S. H. (1994). *The Heart of Islam: Enduring Values for Humanity*. Harper One.
5. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics*. Oxford University Press.
6. Hasan, Z. (2010). *Ethics in Islam: Key Concepts and Contemporary Challenges*. Islamic Research Institute.

127  
Chairman  
Department Statistics  
University of Sargodha

**1-Course Description**

The course *Ethics-II* is designed to provide students with a deeper understanding of ethical principles and practices from both Semitic and non-Semitic religions, as well as their application in professional and social contexts. Students will engage with Jewish, Christian, Islamic, Hindu, Buddhist, Sikh, Confucian, and Jain ethical traditions. The course emphasizes moral reasoning, decision-making, tolerance, and peacebuilding. It aims to cultivate an inclusive, humanistic, and holistic approach towards ethical living and interfaith engagement.

**2- Learning Objectives**

The course objectives are to:

1. Understand the fundamental principles and theories of ethics.
2. Introduce the ethical and moral teachings of Judaism, Christianity, Islam, and Hinduism.
3. Explore the ethical teachings of non-Semitic religions such as Buddhism, Sikhism, Confucianism, and Jainism.
4. Develop critical thinking skills to evaluate ethical arguments and theories.
5. Promote ethical leadership and interfaith harmony.

**3- Learning Outcomes**

By the end of this course, students will be able to:

1. Identify and analyze major ethical theories and teachings from world religions.
2. Understand the role of religions in improving moral values and social behavior.
3. Demonstrate ethical decision-making in various personal and professional contexts.
4. Recognize the impact of ethical decisions on individuals, communities, and society.
5. Apply skills of ethical leadership, including communication, conflict resolution, and inclusive engagement.

**4-Course Structure**

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

**Course Contents****Unit 1: Ethical Teachings of Semitic Religions**

- Judaism and its ethical teachings
- Christianity and its ethical teachings
- Islam and its ethical teachings

**Unit 2: Ethical Teachings of Non-Semitic Religions**

- Hinduism and its ethical teachings
- Sikhism and Buddhism: ethical values and practices
- Confucian and Jain ethical traditions

**Unit 3: Professional Ethics**

- Ethics for students and teachers
- Ethics in doctor-patient relationships
- Ethics in trader-customer interactions

**Unit 4: Concept and Significance of Tolerance**

- Definition, need, and importance of tolerance
- Teachings of Semitic religions on tolerance and their contemporary relevance
- Teachings of non-Semitic religions on tolerance and their contemporary relevance

**Unit 5: Foundational Values and Ethics for Peacebuilding in Society**

- Respect for sacred scriptures, personalities, places of worship, and religious symbols
- Promotion of tolerance and broadmindedness
- Encouragement of dialogue and harmony
- Benevolence towards humanity
- Establishment of justice and fairness
- Patience, forbearance, and forgiveness

**Textbook**

- Kidder, R. M. (2009). *How Good People Make Tough Choices: Resolving the Dilemmas of Ethical Living*. Harper.

**Suggested Readings**

1. Barash, D. P., & Webel, C. P. (2014). *Peace and Conflict Studies*. Sage.
2. Smart, N. (1998). *The World's Religions*. Cambridge University Press.
3. Nasr, S. H. (2003). *The Heart of Islam: Enduring Values for Humanity*. HarperOne.
4. Sharma, A. (2006). *Hindu Ethics: Purity, Abortion, and Euthanasia*. SUNY Press.
5. Harvey, P. (2000). *An Introduction to Buddhist Ethics: Foundations, Values and Issues*. Cambridge University Press.
6. Coward, H., & Perkinson, J. (2013). *A Cross-Cultural Dialogue on Ethical Leadership*. Wilfrid Laurier University Press.
7. Confucius. (1998). *The Analects*. Oxford University Press.

128