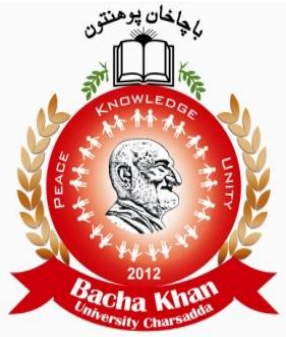
DEPARTMENT OF MATHEMATICS & STATISTICS
BACHA KHAN UNIVERSITY CHARSADDA
REVISED CURRICULUM FOR BS/AD IN STATISTICS

Effective For BS/AD Statistics Program for the Student Admitted in Fall 2025 Semester and Onwards in the Department of Mathematics & Statistics Bacha Khan University Charsadda, and Affiliated Colleges.

Approved by:

9th Board of Studies of Department of Mathematics & Statistics,
12th Board of Faculty of Sciences,
15th Academic Council of BKUC
and
Final approval by 36th Syndicate of BKUC.



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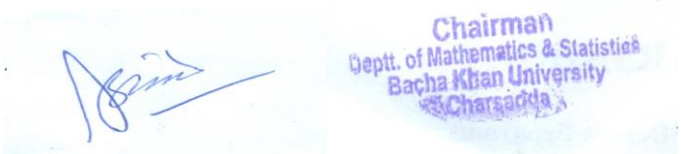
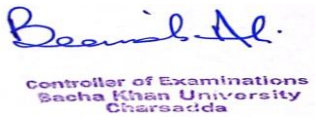
BACHA KHAN UNIVERSITY
CHARSADDA, PAKISTAN
2025





Curriculum of Statistics

BS (4-year)

DEPARTMENT OF MATHEMATICS & STATISTICS

BACHA KHAN UNIVERSITY CHARSADDA

(2025)

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Deptt. of Mathematics & Statistics
Bacha Khan University
Charsadda

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AIMS AND OBJECTIVES

The major aims and objectives of the curriculum of Statistics are to adapt the international standard in the curriculum.

1. To provide a sound footing of the subject matter of statistical theory with applications, so that they can pursue higher degrees and research in the field of statistics.
2. To upgrade the graduates with the knowledge of statistical theory with applications, statistical software and techniques of data collection and analysis so that they can compete in the job market.
3. To enhance and involve the graduates with the participation of project based activities so that they can be better trained in the field of published research.
4. To develop a solid foundation for the effective operational and strategic decisions using statistical theory in almost every discipline.

ELIGIBILITY CRITERIA

The minimum requirements for admission in BS Statistics Program of the Department of Statistics is:

a. Pre-Medical/ Pre- Engineering/ FCS/ General Science/ Inter Science/ FA (with Mathematics or Statistics) with at least 45% marks

SCHEME OF STUDIES FOR BS STATISTICS				
FIRST YEAR: FIRST SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
1.	ENG-311	Gen Ed-I (English-I)	Functional English	03
2.	PS-321	Gen Ed-II	Ideology and Constitution of Pakistan	02
3.	EDU-312	Gen Ed-III (Natural Science)	General Science	03
4.	MATH-313	Gen Ed-IV (QR-I)	Quantitative Reasoning-I	03
5.	STAT-311	Major-Statistics	Introduction to Statistics	03
6.	MATH-315	Interdisciplinary-I	Mathematics-I	03
7.	QUR-300	Gen Ed- V	Understanding Holy Quran -I	01
Total Credit Hours				**18**

FIRST YEAR: SECOND SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
8.	ENG- 321	Gen Ed-VI (English-II)	Expository Writing	03
9.	IS-312	Gen Ed-VII	Islamic Studies/ Ethics	02
10.	SOC-313	Gen Ed –VIII	Civics and Community Engagement	02
11.	MATH-326	Gen Ed –IX	QR-II	03
12.	STAT-321	Major-Statistics	Introduction to probability distributions	03
13.	MATH-325	Interdisciplinary-II	Mathematics-II	03
14.		Gen Ed- X	Understanding Holy Quran –II	01
Total Credit Hours				**17**

SECOND YEAR: THIRD SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
15.	POL-311	Gen Ed-XI (Social Sciences)	Introduction to Political Science	02
16.	CS-311	Gen Ed-XII	Applications of Information and Communication Technologies	03(2+1)
17.		Gen Ed-XIII (Arts & Humanities)	Language/ Education	02
18.	STAT-431	Major-Statistics	Basic Statistical Inference	03
19.	STAT-432	Major-Statistics	Applied Statistics	03
20.	STAT-433	Major-Statistics	Numerical methods	03
21.		Gen Ed – XIV	Pakistan studies	02
Total Credit Hours				**18**

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SECOND YEAR: FOURTH SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
22.	STAT-441	Major-Statistics	Non-Parametric Methods	03
23.	STAT-442	Major-Statistics	Statistical Packages	03
24.	STAT-443	Major-Statistics	Time Series Analysis-I	03
25.	STAT-445	Major-Statistics	Introduction to Statistical Quality Control	03
26.	STAT-444	Major-Statistics	Introduction to Regression Analysis and Analysis of variance	03
27.	MGT-411	Gen Ed-XII	Entrepreneurship	02
Total Credit Hours				**17**

THIRD YEAR: FIFTH SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
28.	STAT-551	Major-Statistics	Probability and Probability Distributions-I	03
29.	STAT-552	Major-Statistics	Sampling Techniques-I	03
30.	STAT-553	Major-Statistics	Regression Analysis	03
31.	STAT-554	Major-Statistics	Population Studies	03
32.	ECO-311	Interdisciplinary-III	Principles of Microeconomics	03
Total Credit Hours				**15**

THIRD YEAR: SIXTH SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
33.	STAT-	Elective-I	Elective subject	03
34.	STAT-	Elective-II	Elective	03
35.	STAT-	Elective-III	Elective	03
36.	STAT-564	Major-Statistics	Design and Analysis of Experiments-I	03
37.	ECO-321	Interdisciplinary-IV	Principles of Macroeconomics	03
38.	Stat-598*	Mandatory Requirement	Field Experience/ Internship (summer Break)	03
Total Credit Hours				**18**

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FOURTH YEAR: SEVENTH SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
39.	STAT-671	Major-Statistics	Statistical Inference-I	03
40.	STAT-	Elective-IV	Elective	03
41.	STAT-	Major-Statistics	Biostatistics	3
42.	STAT-674	Major-Statistics	Introduction to Data Science	03
43.	STAT-	Major-Statistics	Survey and Research Methods	03
Total Credit Hours				**15**

FOURTH YEAR: EIGHT SEMESTER				
S.NO	**COURSE CODE**	**COURSE TYPE**	**COURSE TITLE**	**CREDIT HOURS**
44.	STAT-	Elective-V	Elective	03
45.	STAT-	Elective-VI	Elective	03
46.	STAT-	Elective-VII	Elective	03
47.	STAT-699	Capstone Project	Research Thesis/ Project	03
48.	Stat-	Major-Statistics	Introduction to Multivariate Analysis	03
Total Credit Hours				**15**
GRAND TOTAL CREDIT HOURS				**133**

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ELECTIVE COURSES

Note: University/Affiliated Colleges/ Students can select any of the following subjects as their elective subject. All elective courses are of three credits hours.			
S.NO	**COURSE CODE**	**COURSE TITLE**	**CREDIT HOURS**
1.	STAT-561	Probability and Probability Distribution-II	03
2.	STAT-562	Sampling Technique-II	03
3.	STAT-563	Econometrics	03
4.	STAT-572	Design and Analysis of Experiments-II	03
5.	Stat-685	Survival Analysis	03
6.	Stat-676	Categorical Data Analysis	03
7.	Stat-577	Bayesian Statistics	03
8.	Stat-578	Operations Research	03
9.	Stat-579	Stochastic Processes	03
10.	Stat-664	Time Series Analysis-II	03
11.	Stat-686	Robust Methods	03
12.	Stat-688	Mathematical Modeling and Simulation	03
13.	Stat-689	Reliability Analysis	03
14.	Stat-661	Decision Theory	03
15.	Stat-663	Official Statistics	03
16.	Stat-662	Data Mining	03
17.	Stat-635	Exploratory Data Analysis and Visualization	03
18.	STAT-646	Functional Data Analysis	03
19.	STAT-645	Research Methodology	03
20.	Any other subject depending upon the expertise available		

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ARTS AND HUMANITIES (Please select one Course in entire Degree)

S.NO	COURSE CODE	COURSE TITLE	CREDIT HOURS
1.		Pashto*	03
2.		Urdu*	03
3.		Arabic*	03
4.		Turkish*	03
5.		Chinese*	03
6.		Philosophy**	03
7.		Islamic History and Culture**	03
8.		History**	03
9.		Education**	03

- Or any other language approved by BKUC *
- or any other approved course of BKUC**

SOCIAL SCIENCE (Please select one Course in entire Degree)

S.NO	COURSE CODE	COURSE TITLE	CREDIT HOURS
1.		Political Science	03
2.		Sociology	03
3.		Psychology	03
4.		Economics	03
5.		Law	03

- Or any other approved Basic course of BKUC

NATURAL SCIENCES (Please select one Course in entire Degree)

S.NO	COURSE CODE	COURSE TITLE	CREDIT HOURS
1.		Mathematics	03
2.		Statistics	03
3.		Computer Science	03
4.		Botany	03
5.		Zoology	03
6.		Chemistry	03
7.		Physics	03
8.		General Science	03

- Or any other approved Basic Course of BKUC

Interdisciplinary/ Allied Courses

S.NO	COURSE CODE	COURSE TITLE	CREDIT HOURS
1.		Principles of Microeconomics	03
2.		Principles of Commerce	03
3.		Principles of Accounting	03
4.		Ordinary Differential Equations	03

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5.		Numerical Computing	03
6.		Calculus-I	03
7.		Introduction to Physics	03
8.		Computer Programing	03
9.		Human Resources Management	03
10.		Classification and regression trees	03
11.		Exploratory Data Analysis and Visualization	03

- Or any other approved Allied Course of BKUC

DETAILS OF THE COURSES

The proposed outlines of the BS (4-year) program in Statistics are as follows.

COURSE TITLE: **English I: Functional English**
LEVEL: **BS 1st**
COURSE CODE: **ENG-311**
CREDITS HOURS: **03**
COURSE TYPE: **Foundational Course**

Course Description
This course introduces the students to the basic grammatical rules of English language. It describes the use of grammatical structures in different contexts. The course also describes the grammatical function of words in the general use of English language. Instead of teaching grammar in isolation and only at sentence level, this course is based on developing the language abilities of the students. This course is comprised of parts of speech, phrases and clauses, vocabulary, basic tenses, voices, direct and indirect narrations which encompasses different aspects of English language.

Course Objectives
- To enable students to understand basics of English grammar
- To teach them the use ofgrammar
- To acquaint them with cohesive devices and their functions in the text

Course Contents

- Parts of Speech: Nouns, Pronouns, Verbs, Adjectives, Adverbs, Prepositions, Conjunctions, Articles, and Interjections
- Vocabulary: Synonyms, Antonyms, Pair of words, Idioms, Proverbs
- Phrase and its types
- Clause and its types
- Sentence and its structure
- Tenses: Active Tenses, Active and Passive, Direct and Indirect Narration

Recommended Readings

1. High School English Grammar & Composition by Wren and Martin.
2. Practical English Grammar by A.J. Thomson & A.V. Martinet. Exercises 1 & 2. 3rd edition. Oxford University Press.
3. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand& Francoise Grellet. Oxford Supplementary Skills. 4th Impression 1993.
4. Reading. Upper Intermediate. Brian Tomilson& Rod Ellis. Oxford Supplementary Skills. 3rd Impression 1992

PS-321: Ideology & Constitution of Pakistan (**Credit hours: 02**)

Course Outline:

1. **Introduction to the Ideology of Pakistan:**
   - Definition and significance of ideology.
   - Historical context of the creation of Pakistan (with emphasis on socio-political. religious, and cultural dynamics of British India between 1857 till 1947).
   - Contributions of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
   - Contributions of women and students in the freedom movement for separate homeland for Muslims of British India.
2. **Two-Nation Theory:**
   - Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
   - Role of communalism and religious differences.
3. **Introduction to the Constitution of Pakistan:**
   - Definition and importance of a constitution.
   - Ideological factors that shaped the Constitution(s) of Pakistan (Objectives Resolution 1949).
   - Overview of constitutional developments in Pakistan.
4. **Constitution and State Structure:**
   - Structure of Government (executive, legislature, and judiciary).
   - Distribution of powers between federal and provincial governments.
   - 18th Amendment and its impact on federalism.
5. **Fundamental Rights, Principles of Policy and Responsibilities:**
   - Overview of fundamental rights guaranteed to citizens by the Constitution of Pakistan 1973 (Articles 8-28).
   - Overview of Principles of Policy (Articles 29-40).
   - Responsibilities of the Pakistani citizens (Article 5).
6. **Constitutional Amendments:**
   - Procedures for amending the Constitution.
   - Notable constitutional amendments and their implications.

Recommended Books:

1. "The Idea of Pakistan" by Stephen P. Cohen.
2. "Ideology of Pakistan" by Javed Iqbal.
3. "The Struggle for Pakistan" by I.H. Qureshi.
4. "Pakistan the Formative Phase" by Khalid Bin Sayeed.
5. "Pakistan: Political Roots and Development" by Safdar Mahmood.
6. "Ideology of Pakistan" by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics" by Ayesha Jalal.
8. "Jinnah, Pakistan and Islamic Identity: The Search for Saladin" by Akbar S. Ahmed.
9. "The Making of Pakistan: A Study in Nationalism" by K.K. Aziz.
10. "Pakistan: A New History" by Ian Talbot.
11. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring.
12. "The Constitution of Pakistan 1973". Original.
13. "Constitutional and Political Development of Pakistan" by Hamid Khan.
14. "The Parliament of Pakistan" by Mahboob Hussain.
15. "Constitutional Development in Pakistan " by G.W. Choudhury.
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury.

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Course Code: MATH-313 Quantitative Reasoning-I (Credit hours: 03)

Course Objectives: This course aims to develop the basic mathematical skills which ultimately enhance problem solving skills using inductive and deductive reasoning, Polya's strategy, and sets. The basic concepts will be develop with applications form the real world such as algebraic models with equations, rates, ratios, and percentages will be discussed. Students will also explore linear models, including rectangular-coordinates, functions, empowering them to analyze real-world problems with logical precision. By the course's end, students will have honed problem-solving, logical reasoning, and mathematical modeling abilities to tackle diverse challenges confidently.

Course Outline:

1.Numerical Literacy: Number system and basic arithmetic operations, Units and their conversions, dimension, area, perimeter and volume**,** Rates, ratios, proportions and percentage Types and sources of data**,** Measurements scales**,** Tabular and graphical presentation of data**,** Quantitative reasoning exercise using number knowledge

2. Fundamental Mathematical Concepts: Basic of geometry (lines, angles, circles, polygons etc.)**,** Sets and their operations**,** Relation, function and their graphs**,** Exponents, factoring and simplyfing algebraic expressions**,** Algebraic and graphical solutions of linear and quadratic equation and inequalities**,** Quantitative reasoning exercises using fundamental mathematical concepts.

3. Fundamental Statistical Concepts: Population and sample**,** Measures of central tendency, dispersion and data interpretation**,** Rules of counting (multiplicative, permutation and combination)**,** Basic probability theory**,** Introduction to random variables and their probability distributions**,** Quantitative reasoning exercises using fundamental statistical concepts.

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Recommended Books:

1. "Quantitative Reasoning: Tools for Today's Informed Citizen" by Bernard L. Madison, Lynn and Arthur Steen.
2. "Quantitative Reasoning for the Information Age" by Bernard L. Madison and David M. Bressoud.
3. "Fundamentals of Mathematics" by Wade Ellis.
4. "Quantitative Reasoning: Thinking in Numbers" by Eric Zaslow.
5. "Thinking Clearly with Data: A Guide to Quantitative Reasoning and Analysis" by Ethan Bueno de Mesquita and Anthony Fowler.
6. "Using and Understanding Mathematics: A Quantitative Reasoning Approach" by Bennett, J. O., Briggs, W. L., & Badalamenti, A.
7. "Discrete Mathematics and its Applications" by Kenneth H. Rosen.
8. "Statistics for Technology: A Course in Applied Statistics" by Chatfield, C.
9. "Statistics: Unlocking the Power of Data" by Robin H. Lock, Patti Frazer Lock, Kari Lock Morgan, and Eric F. Lock.

STAT-311: <u>Introduction to Statistics</u>

The nature and scope of the Statistics. Organizing of Data, classification of data, Graphs and Charts: Stem-and leaf diagram, Box and Whisker plots and their interpretation. Measures of Central Tendency and Dispersion: Their properties, usage, limitations and comparison. Calculations for the ungrouped and grouped data. Measures of Skewness and Kurtosis and Distribution shapes. Probability Concepts, Addition and Multiplication rules, Bivariate frequency tables, joint and marginal probabilities, Conditional probability and independence, Bayes' rule.

Pre-Requisite: Nil

<u>Books Recommended</u>

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics", 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

2. Clark, G.M and Cooke, D. (1998), "A Basic Course in Statistics" 4th ed, Arnold, London.

3. Walpole, R.E., Myers, R.H and Myers, S.L. (1998), "Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.

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4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) "Statistics for Business & Economics" 9th ed.Prentice Hall, New Jersey.

5. Weiss, N,A.(1997), "Introductory Statistics" 4th ed. Addison-Wesley Pub. Company, Inc.

6. Chaudhry, S.M.and Kamal, S. (1996), "Introduction to Statistical Theory" Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

Course Code: ENG – 321 ENGLISH-II: EXPOSITORY WRITING (Credit hours: 03)

Course Description

The course is designed to help students take a deep approach in reading and writing academic texts which involve effective learning strategies and techniques to improve their productive skills. This course consists of two major parts: the 'reading section' focuses on recognizing topic sentence, skimming, scanning, use of cohesive devices, identifying facts and opinions, and to guess meanings of unfamiliar words. The 'writing section' deals with the knowledge and use of various grammatical components such as, parts of speech, tenses, voice, narration, modals etc. in practical contexts.

Course Objectives:

- To enable students identify the audience, message, and purpose of writing.
- To demonstrate the ability to compose at an intermediate level the for different areas of expository writing.
- To demonstrate a broadened knowledge of how evaluating media and text influences the world around them.

Course Contents:

- Writing Process
- Types of reading
- Brain storming, pre-writing, writing, and post-writing
- Paragraph writing
- The essentials of a good paragraph
- Precis writing
- Essay writing
- The types of essay

(Expository, Descriptive, Argumentative, Narrative)

- Letter Writing
- The types of letters (cover letter, recommendation letter, grievance letter)
- Applications
- Memorandum
- Curriculum vitae (CV), Resume

- Email Writing
- Fax messages
- Advertisement

Recommended Readings

1. A Writer's Reference by Hacker, D. 1992. 2nd ed. Boston: St. Martin
2. College Writing Skills by John Langan. MC-Graw-Hill Higher Education 2004
3. Critical Reading and Writing: An Introductory Course by Goatly, A. 2000. London: Taylor & Francis
4. Oxford English for Undergraduates by Howe, D. H, Kirkpatrick, T. A. & Kirkpatrick, D. L. 2004. Karachi: Oxford University Press.

Course Code: MATH-326 Quantitative Reasoning-II (Credit hours: 03)

Course Objectives: The primary objective of this course is to explore, probability and statistics. The curriculum includes in-depth study of exponential and logarithmic functions, as well as problem-solving related to these mathematical concepts. Solving system of linear equations and matrix algebra is the part of this course which ultimately develops the necessary background for data analysis. Overall, the course aims to equip students with a comprehensive understanding of mathematical concepts relevant to probability and statistics enabling them to apply these skills in real-world scenarios.

Course Outline:

1. **Logic, Logical and critical Reasoning:** Introduction and importance of logic, Inductive, deductive and adductive approaches of reasoning, Proposition Arguments (Valid, invalid) logical connectives, truth tables and propositional equivalences, Logical Fallacies, Venn Diagrams, Predicates and Quantifiers, Quantitate Reasoning exercises using logical reasoning logical reasoning concepts and techniques.

2. Mathematical modeling and Analysis: Introduction to deterministic models, Use of linear function for modeling in real- world situations, Modeling of the system of linear equation and others solutions, Elementary introduction to derivatives in mathematical modeling, Linear and exponential growth and decay models, Quantitative reasoning exercises using mathematical modeling.

3. Statistical Modeling and Analyses: Introduction to Probabilistic models, Bivariate analysis, Scatter plots, Simple linear regression model and correlation analysis, Basics of estimation and confidence

interval, Testing of hypothesis (z-test, t-test), Statistical inference in decision making, Quantitative reasoning exercise using statistical modelling.

Recommended Books:

1. "Using and Understanding Mathematics: A Quantitative Reasoning Approach" by Bennett, J. O., Briggs, W. L., & Badalamenti, A.
2. "Discrete Mathematics and its Applications" by Kenneth H. Rosen.
3. "Discrete Mathematics with Applications" by Susanna S. Epp.
4. "Applied Mathematics for Business, Economics and Social Sciences" by Frank S Budnick.
5. "Elementary Statistics: A Step by Step Approach" by Allan Bluman.
6. "Introductory Statistics" by Prem S. Mann.
7. "Applied Statistical Modeling" by Salvatore Babones.
8. "Barrons SAT" by Sharvon Weiner Green, M.A and Ira K.Wolf.

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IS-312: Islamic Studies (Credit hours: 03)

Course Outline:

1. **Introduction to Islam:**
   - Definition of Islam and its core beliefs.
   - The Holy Quran (introduction, revelation and compilation).
   - Hadith and Sunnah (compilation, classification, and significance).
   - Key theological concepts and themes (Tawhid, Prophethood, Akhirah etc.).
2. **Sirah of the Holy Prophet (Peace Be Upon Him) as Uswa-i-Hasana:**
   - Life and legacy of the Holy Prophet PBUH.
   - Diverse roles of the Holy Prophet PBUH (as an individual, educator, peace maker, leader etc.).
3. **Islamic History and Civilization:**
   - World before Islam.
   - The Rashidun Caliphate and expansion of Islamic rule.
   - Contribution of Muslim scientists and philosophers in shaping world civilization.
4. **Islamic Jurisprudence (Fiqh):**
   - Fundamental sources of Islamic jurisprudence.
   - Pillars of Islam and their significance.
   - Major schools of Islamic jurisprudence.
   - Significance and principles of Ijtihad.
5. **Family and Society in Islam:**
   - Status and rights of women in Islamic teachings.
   - Marriage, family, and gender roles in Muslim society.
   - Family structure and values in Muslim society.
6. **Islam and the Modern World:**
   - Relevance of Islam in the modern world (globalization, challenges and prospects).
   - Islamophobia, interfaith dialogue, and multiculturalism.
   - Islamic viewpoint towards socio-cultural and technological changes.

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1. "The Five Pillars of Islam: A Journey Through the Divine Acts of Worship" by Muhammad Mustafa Al-Azami.
2. "The Five Pillars of Islam: A Framework for Islamic Values and Character Building" by Musharraf Hussain.
3. "Towards Understanding Islam" by Abul A' la Mawdudi.
4. "Islami Nazria e Hayat" by Khurshid Ahmad.
5. "An Introduction to Islamic Theology" by John Renard.
6. "Islamic Civilization Foundations Belief & Principles" by Abul A' la Mawdudi.
7. "Women and Social Justice: An Islamic Paradigm" by Dr. Anis Ahmad.
8. "Islam: Its Meaning and Message" by Khurshid Ahmad.

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SOC-313: Civics & Community engagement (Credit hours: 03)

Course Outline:

1. **Civics and Citizenship:**
   - Concepts of civics, citizenship, and civic engagement.
   - Foundations of modern society and citizenship.
   - Types of citizenship: active, participatory, digital, etc.
2. **State, Government and Civil Society:**
   - Structure and functions of government in Pakistan.
   - The relationship between democracy and civil society.
   - Right to vote and importance of political participation and representation.
3. **Rights and Responsibilities:**
   - Overview of fundamental rights and liberties of citizens under Constitution of Pakistan 1973.
   - Civic responsibilities and duties.
   - Ethical considerations in civic engagement (accountability, non-violence, peaceful dialogue, civility, etc.)
4. **Community Engagement:**
   - Concept, nature and characteristics of community.
   - Community development and social cohesion.
   - Approaches to effective community engagement.
   - Case studies of successful community driven initiatives.
5. **Advocacy and Activism:**
   - Public discourse and public opinion.
   - Role of advocacy in addressing social issues.
   - Social action movements.
6. **Digital Citizenship and Technology:**
   - The use of digital platforms for civic engagement.
   - Cyber ethics and responsible use of social media.
   - Digital divides and disparities (access, usage, socioeconomic, geographic, etc.) and their impacts on citizenship.
7. **Diversity, Inclusion and Social Justice:**
   - Understanding diversity in society (ethnic, cultural, economic, political etc.).
   - Youth, women and minorities' engagement in social development.
   - Addressing social inequalities and injustices in Pakistan.
   - Promoting inclusive citizenship and equal rights for societal harmony and peaceful co-existence.

Books Recommended

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1. "Civics Today: Citizenship, Economics, & You" by McGraw-Hill Education.
2. "Citizenship in Diverse Societies" by Will Kymlicka and Wayne Norman.
3. "Engaging Youth in Civic Life" by James Youniss and Peter Levine.
4. "Digital Citizenship in Action: Empowering Students to Engage in Online Communities" by Kristen Mattson.
5. "Globalization and Citizenship: In the Pursuit of a Cosmopolitan Education" by Graham Pike and David Selby.
6. "Community Engagement: Principles, Strategies, and Practices" by Becky J. Feldpausch and Susan M. Omilian.
7. "Creating Social Change: A Blueprint for a Better World" by Matthew Clarke and Marie-Monique Steckel.

PASH-424: Arts and Humanities: Pashto Course Pool (Credit hours: 03)

پښتو ژبه: پېژندګلو او پرمختګ
Pashto Language: Introduction and Development

Course Title	پښتو ژبه: پېژندګلو او پرمختګ Pashto Language: Introduction and Development
Course Code	PASH.323
Semester	2nd
No. of Credit Hours	02
Objectives	1. دا کورس د پښتو زده کونکيو تر څنګ د نورو ځانګو د پاره مه دے ځکه پکښې د پښتو تعارف په لږ کښې ابتدايي مواد شامل دي چې دوي د پښتو د ابتدايي نقوشو نه خبر شي 2. زده کونکي د پښتو د ليک دود سره اشنا کول 3. زده کونکي د پښتو ژبې او قام په اساسي نظرياتو خبرول 4. زده کونکي د پښتو ادب او پښتو نومورو شاعرانو د ژوند او شاعرۍ نه خبرول
Course Contents	• املاء او رسم الخط کښې فرق • د رسم الخط مختلف قسمونو بيان • د پښتو املاء ارتقاء • پښتو املاء کښې روښانې اختراعات • پښتو املاء ته د خوشحال خان خټک بخښنې • د باړه ګلی سيمنارونه او پښتو املاء • د پښتو د املاء او رسم الخط په لږ کښې انفرادي کوششونه • د پښتو ژبې په اړه بېلابېلې نظريې (سامي النسل نظريه ـ اريايي نظريه ـــ پښتانه بني اسرائيل دي؟ ـــ پښتانه اريا دي؟) • د نومورو پښتو شاعرانو د ژوند احوال:

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(خوشحال خان خټک ـــ رحمان بابا ـــ حميد بابا ـــ کاظم خان شېدا ـــ حمزه بابا ـــ غني خان ـــ اجمل خټک ـــ قلندرمومند) • د لاندينو شاعرانو د ورکړو شوو غزلونو تشريحات: o توره چې تېريوي خو ګزار لره کنه خوشحال خان خټک o په شه خوي له بد خواهانو بې پروا يم رحمان بابا o د ستا د شونډو په څېر کله دي د ګل رنګ حميد بابا o د يارانو د هجران له جور و جرمه علي خان o ستا غمونه به ختمېږي هم که نه حمزه بابا o پوهه مي او زده کړه مي د مينې له آئينه ده ډاکټر محمد اعظم اعظم • د لاندينو افسانه نګارانو د لاندينو دوو افسانو فني او فکري جايزه o قلندر مومند: ګجرې o زيتون بانو:ژوندي غمونه	

مجوزه کتابونه:

1. ليکوالي املا او انشاء ، از ګل باچا الفت
2. د خيرالبيان ليک دود ، مشموله خېرالبيان،کابل چاپ،پوهاند عبدالشکور رشاد ، مخ ۵۵ تا ۸۰ پورې
3. پښتو ليک دود ، از پرېشان خټک
4. پښتو املاء ، پروفېسر ډاکټر راج ولي شاه خټک
5. پښتو ليک دود ، از خان شهيد عندالصمدخان
6. معياري پښتو ، ډاکټر عبدالرزاق پالوال
7. پښتو ليک دود ـــــــــــــــــــــــــــ ډاکټر نصرالله جان ـــــــــــ پښتو اکېډيمي
8. ساهو پښتو ـــــــــــــــــــــــــــــــــــــــ مشتاق مجروح
9. پښتانه ليکوال ـــــــ همېش خليل
10. د ياد شوو شاعرانو د شاعرۍدواوين/شعري ټولګي
11. ګجرې ـــــــــــــــــــــــــــــــــــــــ قلندر مومند
12. ژوندي غمونه ـــــــــــــــــــــــــــــــــــ زيتون بانو

STAT-321: Introduction to Probability Distributions (Credit hours: 03)

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Discrete Random Variables, Probability Distribution, Mean and Variance of a discrete random variable Bernoulli trials. Properties, applications and fitting of Binomial, Poisson, Hypergeometric. Negative Binomial and Geometric distributions. Continuous Random Variable, probability density function and its properties. Normal Distribution and its properties, Standard Normal Curve, Normal approximation to Binomial and Poisson distributions.

Pre-requisite: STAT-311

Books Recommended

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics", 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

2. Clark, G.M. and Cooke, D. (1998), "A Basic Course in Statistics" 4th ed, Arnold, London.

3. Walpole, RE., Myers, R.H and Myers, S.L. (1998), 'Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.

4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) "Statistics for Business & Economics" 9th ed, Prentice Hall, New Jersey.

5. Weiss, N.A.(1997), "Introductory Statistics" 4th ed. Addison-Wesley Pub. Company, Inc.

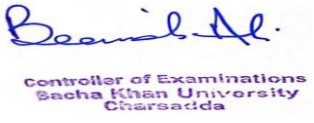
6. Chaudhry. S.M.and Kamal, S. (1996), "Introduction to Statistical Theory" Parts I & Il, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

Course Code: MATH-315 Course Title: Mathematics-I (Credit hours: 03)

Course Outline: Preliminaries: Real-number system, complex numbers, introduction to sets, set operations, functions, types of functions. Matrices: Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule, eigenvalue problem. Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equation, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations. Sequences and Series: Arithmetic progression, geometric progression, harmonic progression. Binomial Theorem: Introduction to mathematical induction, binomial theorem with rational and irrational indices. Trigonometry: Fundamentals of trigonometry, trigonometric identities.

Recommended Books:

1. Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin, Boston (suggested text)
2. Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
3. Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston



Course Code: MATH-325 Course Title: Mathematics-II (Credit hours: 03)

Course Outline: Preliminaries: Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities. Limits and Continuity: Limit of a function, left-hand and right-hand limits, continuity, continuous functions. Derivatives and their Applications: Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives. Integration and Definite Integrals: Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals.

Recommended Books

1. Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York

2. Stewart J, Calculus (3rd edition), 1995, Brooks/Cole (suggested text) Swokowski EW, Calculus and Analytic Geometry, 1983, PWS-Kent Company, Boston

3. Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, Reading, Ma, USA

MGT-411: Entrepreneurship (Credit hours: 03)

Course Outline:

1. **Introduction to Entrepreneurship:**
   - Definition and concept of entrepreneurship.
   - Why to become an entrepreneur?
   - Entrepreneurial process.
   - Role of entrepreneurship in economic development.
2. **Entrepreneurial Skills:**
   - Characteristics and qualities of successful entrepreneurs (including stories of successes and failures).
   - Areas of essential entrepreneurial skill and ability such as creative and critical thinking, innovation and risk taking abilities etc.
3. **Opportunity Recognition and Idea Generation:**
   - Opportunity identification, evaluation and exploitation;
   - Innovative idea generation techniques for entrepreneurial ventures.
4. **Marketing and Sales**
   - Target market identification and segmentation;
   - Four P's of Marketing.
   - Developing a marketing strategy.
   - Branding.

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Books Recommended:

1. "Entrepreneurship: Successfully Launching New Ventures" by Bruce R. Barringer and R. Duane Ireland.
2. "Entrepreneurship: Theory, Process, and Practice" by Donald F. Kuratko.
3. "New Venture Creation: Entrepreneurship for the 21st Century" by Jeffry A. Timmons, Stephen Spinelli Jr., and Rob Adams.
4. "Entrepreneurship: A Real-World Approach" by Rhonda Abrams.
5. "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries.
6. "Effectual Entrepreneurship" by Stuart Read, Saras Sarasvathy, Nick Dew, Robert Wiltbank, and Anne-Valérie Ohlsson.

5. **Financial Literacy:**
   - Basic concepts of income, savings and investments.
   - Basic concepts of assets, liabilities and equity.
   - Basic concepts of revenue and expenses.
   - Overview of cash-flows.
   - Overview of banking products including Islamic modes of financing.
   - Sources of funding for startups (angel financing, debt financing, equity financing etc.).
6. **Team Building for Startups:**
   - Characteristics and features of effective teams.
   - Team building and effective leadership for startups.
7. **Regulatory Requirements to Establish Enterprises in Pakistan:**
   - Types of enterprises (e.g., sole proprietorship; partnership; private limited companies etc.).
   - Intellectual property rights and protection.
   - Regulatory requirements to register an enterprise in Pakistan, with special emphasis on export firms.
   - Taxation and financial reporting obligation.

STAT-431: BASIC STATISTICAL INFERENCE (Credit hours: 03)

Sampling techniques: Simple Random, Stratified and Systematic random sampling. Distribution of sample mean and central limit theorem. Estimation: Point Estimation. Desirable Properties of a Good Estimator. Interval Estimation. Estimation of population mean. Large and small sample confidence intervals for Population Mean. Nature of Hypothesis Testing and Types of errors. Hypothesis Testing for Population Mean and variance. Inferences for Two Population Means. Large-sample inferences for Two Populations using Independent Samples. Inferences for the Mean of Two Normal Populations using Independent Samples (variances are assumed Equal/Not Equal). Inference for Two Populations Mean using Paired Samples. Inferences for Population Proportions. Confidence Intervals and hypothesis Testing for Population Proportion. Inferences for Two Populations Proportions using independent Samples, Estimation of sample size.Chi-Square Procedure. Chi-Square Goodness-of fit Test. Chi-Square Independence Tests.

Pre-Requisite- STAT- 321

Books Recommended

1. Spiegel, MR., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics', 2nd ed. Schaums Outlines Series. McGraw Hill. NY.

2. Clark, G.M. and Cooke, D. (1998), "A Basic Course in Statistics" 4th ed, Arnold, London.

3. Mclave, J.T., Benson P.G. and Snitch, T. (2005) "Statistics for Business & Economics" 9th Prentice Hall New Jersey.

4. Walpole, RE., Myers, R.H. and Myers, S.L. (1998), "Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.

5. Weiss, N.A. (1997), "Introductory Statistics" 4th ed. Addison-Wesley Pub. Company, Inc.

6. Chaudhry, S.M. and Kamal, S. (1996), "Introduction to Statistical Theory" Part I, II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

CS-311: Application of Information and Communication Technologies

(Credit hours: 3(2+1)

Course Learning Outcomes (CLOs):		
At the end of the course the students will be able to:	**Domain**	**BT Level***
1. Explain the fundamental concepts, components, and scope of Information and Communication Technologies OCT)	C	1
2. Identify uses of various ICT platforms and tools for different purposes.	C	2
3. Apply ICT platforms and tools for different purposes to address basic needs in different domains of daily, academic, and professional life.	C	2
4. Understand the ethical and legal considerations in use of ICT platforms and tools.	C	3
* BT = Bloom's Taxonomy, C = Cognitive domain, P = Psychomotor domain, A = Affective domain		

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Course Content:

1. Introduction to Information and Communication Technologies:
   - Components of Information and Communication Technologies (basics of hardware. software, ICT platforms, networks, local and cloud data storage etc.).
   - Scope of Information and Communication Technologies (use of ICT in education, business, governance, healthcare, digital media and entertainment, etc.).
   - Emerging technologies and future trends.
2. Basic ICT Productivity Tools:
   - Effective use of popular search engines (e.g., Google, Bing, etc.) to explore World Wide Web.
   - Formal communication tools and etiquettes (Gmail, Microsoft Outlook, etc.).
   - Microsoft Office Suites (Word, Excel, PowerPoint).
   - Google Workspace (Google Docs, Sheets, Slides).
   - Dropbox (Cloud storage and file sharing), Google Drive (Cloud storage with Google Docs integration) and Microsoft OneDrive (Cloud storage with Microsoft Office integration).
   - Evernote (Note-taking and organization applications) and OneNote (Microsoft's digital notebook for capturing and organizing ideas).
   - Video conferencing (Google Meet, Microsoft Teams, Zoom, etc.).
   - Social media applications (Linkedln, Facebook, Instagram, etc.).
3. ICT in Education:
   - Working with learning management systems (Moodle, Canvas, Google Classrooms, etc.).
   - Sources of online education courses (Coursera, edX, Udemy, Khan Academy, etc.).
   - Interactive multimedia and virtual classrooms.
   - ICT in Health and Well-being:
   - Health and fitness tracking devices and applications (Google Fit, Samsung Health, Apple Health, Xiaomi Mi Band, Runkccpcr, etc.).
   - Telemedicine and online health consultations (OLADOC, Sehat Kahani, Marham, etc.).
4. ICT in Personal Financial and Shopping:
   - Online banking and financial management tools (JazzCash, Easypaisa, Zong PayMax, I LINK and MNET, Keenu Wallet, etc.).
   - E-commerce platforms (Daraz.pk, Telcmart, Shophivc, etc.)
   - Digital Citizenship and Online Etiquette:
   - Digital identity and online reputation.
   - Netiquette and respectful online communication.
   - Cyberbullying and online harassment.
5. Ethical Considerations in Use of ICT Platforms and Tools:
   - Intellectual property and copyright issues.
   - Ensuring originality in content creation by avoiding plagiarism and unauthorized use of information sources.

- Content accuracy and integrity (ensuring that the content shared through ICT platforms is free from misinformation, fake news, and manipulation)

PRACTICAL REQUIREMENTS

As part of the overall learning requirements, the course will include:

1. Guided tutorials and exercises to ensure that students are proficient in commonly used software applications such as word processing software (e.g., Microsoft Word), presentation software (e.g., Microsoft PowerPoint), and spreadsheet software (e.g., Microsoft Excel) among such other tools. Students may be assigned practical tasks that require them to create documents, presentations, and spreadsheets etc.
2. Assigning of tasks that involve creating, managing, and organizing files and folders on both local and cloud storage systems. Students will practice file naming conventions, creating directories, and using cloud storage solutions (e.g., Google Drive, OneDrive).
3. The use of online learning management systems (LMS) where students can access course materials, submit assignments, participate in discussion forums, and take quizzes or tests. This will provide students with the practical experience with online platforms commonly used in education and the workplace.

Teaching Methodology:

Lecturing, Written Assignments, Project

Course Assessment:

Sessional Exam, Home Assignments, Quizzes, Lab, Presentation, Final Exam

Reference Materials:

1. Discovering Computers" by Vermaat, Shaffer, and Freund.
2. "GO! with Microsoft Office" Series by Gaskin, Vargas, and McLellan.
3. "Exploring Microsoft Office" Series by Grauer and Poatsy.
4. "Computing Essentials" by Morley and Parker.
5. "Technology in Action" by Evans, Martin, and Poatsy.

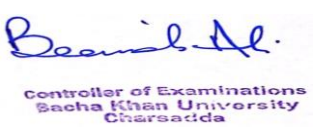
POL-311: INTRODUCTION TO POLITICAL SCIENCE (**Credit hours: 03**)

COURSE OBJECTIVE: To give knowledge about the Political principles and its implication to the Modern Society and the subject also provide knowledge about the theoretical concepts involved in common political phenomenon.

COURSE CONTENTS:

Introduction:

- Meaning and Definition of Political Science.
- Subject matter of Political Science.
- Scope and Importance of Political Science.



 Relationship of Political Science with other Social Science.
 Methods and approaches of Political Science.
 Use of Political Science knowledge to the Contemporary Societies.

State:
 Meaning and Definition of state.
 Forms of State
 Elements of State.
 Differentiation between State, Association, Nation, Government and Society.
 Introduction, Definitions, and Sources of Law.
 Introduction, Definition, Characteristics, and Forms of Governments.

Legislations/Legislature:
 Introduction, meaning and Definitions of Legislations/Legislature.
 Functions and kinds of Legislations/Legislature.
 Introduction, Definitions, Merits, Demerits, and Kinds of Referendum.

Political Parties:

 Introduction, meaning and Definitions of Political Parties.
 Importance of Political Parties.
 Functions of Political Parties.
 Merits and Demerits of Political Parties.
 Kinds of Political Parties.

United Nations (UN):

 Aims of UN
 Organs of UN
 Principles of UN
 Functions of UN.

Constitutional Development in Pakistan

 Constitution of 1956
 Constitution of 1962
 Constitution of 1973

RECOMMANDED BOOKS:

1. Agarwal, R.C. (2006). Political theory: Principles of political science. New Delhi: S.Chand & Co.
2. Haq, Mazhar. (1996). Theory and practice in Political Science. Lahore: Book Land.
3. Roskin, Michael. G. (1997). Political Science: an Introduction. London: Prentice Hall.
4. SA. Syed (2007). Political Science: Part-1. Nowshera: Classic Publishers Nowshera.
5. S.A.Syed. (2007). Political Science: Part-II Nowshera: Classic Publishers Nowshera.
6. Sarwar, M. (1996). Introduction to Political Science. Lahore: IlmiKutubKhana.

STAT-444: Introduction to Regression Analysis and Analysis of Variance (Credit hours: 03)

Concepts of Regression and Correlation, Simple Linear regression and Multiple regression, Inference regarding regression parameters, Linear correlation: simple, partial and multiple correlation. Inference regarding correlation coefficient, Coefficient of determination. One-Way and Two-Way Analysis of Variance. Multiple Comparisons (LSD and Duncan's test).

Pre-Requisite: STAT-322

Books Recommended

1. Clark, G. M. and Kempson, R. E. (1997), "Introduction to the Design & Analysis of Experiment" Arnold London.
2. Walpole, P.E., Myers R.H., Myers S.L. (1998), "Probability and Statistics for Engineers and Scientists", 7th ed.Prentice Hall.
3. Weiss, N.A, (1997), "Introductory Statistics" 4th ed. Addison-Wesley Pub.Company, Inc.
4. Chaudhry, S.M., and Kamal, S., (1996), "Introduction to Statistical Theory" Part I, II, 6th ed, Ilmi Kitan Khana, Lahore, Pakistan.

STAT-432: Applied Statistics (Credit hours: 03)

Sampling: Need of sampling, Sample versus population, Random and nonrandom sampling, concepts of statistic and population parameter. Sampling techniques: Simple Random, Stratified and Systematic random sampling. Census and survey problem framing of questionnaire. Sampling and Non-Sampling Errors. Index numbers: construction and uses of index numbers, un-weighted index numbers (simple aggregative index, average of relative price index numbers). Weighted index numbers (Laspayers, Paaches and Fishers ideal index numbers). Consumer price index (CPI) and Sensitive Price Indicators.. Time Series Analysis: Components of time series and trend analysis of time series. Vital Statistics: Meaning of vital statistics, registrations of Birth and death in Pakistan. Uses of vital statistics, short comings of vital statistics, rates and ratios (Sex ratio, child women ratio, birth and death ratio, population growth rate, classification of natal rates, death rates or mortality rates, crude death rate, specific death rate, infant mortality rate, case fatality rate, fertility rates, crude birth rate, specific birth rate, standardized death rate, reproduction rates, gross reproduction rate, net reproduction rate, morbidity or sickness rates, marriage rates, divorce rates etc. general; fertility rate, total fertility rate.)

Books Recommended

1. Clark, G.M. and Cooke, D. (1998), "A Basic Course in Statistics" 4th ed, Arnold, London.
2. Mclave, J.T. Benson, P.G. and Snitch, T. (2005) "Statistics for Business & Economics" 9th Prentice Hall New Jersey.
3. Walpole, P.E. Myers, RH., Myers S.L. (1998), "Probability and Statistics for Engineers and Scientists", Prentice Hall.
4.Chaudhry, S.M. and S. Kamal, (1996), "introduction to Statistical Theory" Part I, II, 6th Ed, llmi Kitab Khana, Lahore, Pakistan.
5. Cochran, W.G. "Sampling Techniques".3rd Ed.

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6. Pollard, A.H.. Yousuf, F. and Pollard G.M. (1982), "Demographic Techniques", Pergamon Press, Sydney.

STAT-445: Introduction to Statistical Quality Control (**Credit hours: 03**)

Concept of quality control, total control and Total Quality Management (TQM) Statistical Methods in Quality Improvement. Statistical Process Control (SPC). Statistical Quality Control (SQC). Shewhart control charts: philosophy, construction, advantages. CUSUM and moving average control charts: Average Run Length (ARL); Fast Initial Response (FIR). ARL and FIR for X, R and S-charts Acceptance sampling for attributes and variables. Acceptance sampling plans: Single, double, and multiple sampling plans with their O.C. curves,. Introduction to ISO- 9000 and ISO-14000 series.

Books Recommended

1. Montgomery, D.C. (2004). "Introduction to Statistical Quality Control". McGraw Hill, New York.
2. Miltag H. J. and Rinne H. (1993). "Statistical Methods of QtialityAssurance", Chapman & Hall. London.
3. Nelson, W. (1990). "Accelerated Testing". John Wiley, New York.
4. Banks, J. (1989). "Principles of Quality Control". John Wiley, New York.
5. Ryan, T.P. (1989). "Statistical Methods for Quality Improvement". John Wiley, New York.
6. Juran, J.M. and Guyana, F.K. (1988). "Juan's Quality Control Handbook". McGraw Hill New York.
7. Feigenbaum, A.V. (1986). "Total Quality Control". McGraw Hill, New York.

STAT-433 Linear Algebra

Introduction to Vectors. Vector spaces and subspaces. Linear independence and Dependence. Basis and Dimension. Inner product spaces. Orthogonality. Orthonormal set. Gram –Schmidt Orthogonalization process.Introduction to matrices. Basic Matrix operations. Elementary Results on Matrix Algebra. Partitioned matrices. Idempotent Matrices. Trace of matrices. Determinant and its properties. Minors and cofactors. Adjoint, Matrix Inversion. Rank of Matrices. System of Linear Equations (Homogeneous and Non-homogeneous). Gauss Elimination and Gauss-Jordan Methods. Numerical solution of non-linear solution: iterative methods; Newton Raphson method. Gauss Seidel Method and Jacobi method. Introduction to Eigenvalues and Eigenvectors. Roots of characteristic polynomial. Diagonalization of Symmetric Matrices. Properties of the Eigen values and Eigen vectors of Symmetric Matrices. Application of Spectral Decomposition Theorem. Quadratic forms and Definiteness. Diagonalization of Quadratic forms.

Books Recommended.

1- Lay, D.C. (2006) "Linear Algebra and its applications" 3rd Edition, Addison-Wesely.

2- Strang, G. (2009), "Introduction to Linear Algebra" 4th Edition, Wellesley-Cambridge Press.

3- Lang, C. “Introduction to Linear Algebra”, Springer (Latest Edition)

4- LIPSCHUTZ,S “Linear Algebra Schaum’s Outline Series”, McGraw-Hill Book Company. .(Latest Edition)

5- Hadley, G. “Linear Algebra”, Addison Wesley Publishing Company. .(Latest Edition)

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STAT-441: Non-Parametric Methods (Credit hours: 03)

Location estimates for single samples: The sign test, modified sign test, Wilcoxon signed rank test, Runs test for randomness. Distribution tests. Kolmogrov's test, Lilliefor's test and Shapiro-Wilks test for normality. Tests and estimation for two independent samples; the median test, Wilcoxon Mann — Whitney test. The Siegel — Turkey test, the squared rank test for variance, Smirnov test. Tests for paired samples. Kruskal — Wallis test Friedman test, multiple comparison with the Friedman test, Cochran's test for binary responses. Spearman's rank correlation coefficient, Kendall's rank correlation coefficient. Theil's regression method.

Books Recommended

1.Conover, W.J. (1999), Practical Nonparametric Statistics, 3rd Edition, John Wiley and Sons, New York.
2. Maritz, J.S. (1995). Distribution-Free Statistical Methods. Chapman & Hall London.
3. Gibbons, J.D. and Chakraborti, S.(1992), Nonparametric Statistical Inference, Marcel Decker, New York.
4. Sprint, P. (1989). Applied Nonparametric Statistical Methods. Chapman & Hall London.
5.Lehman, EL. (1973), Nonparametric Statistical Methods, based on Ranks, Holden-Day San Francesco.

STAT-521: Statistical Packages (Credit hours: 03)

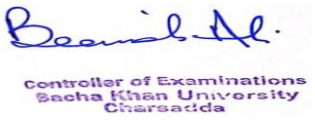
Introduction to R-language, Qualitatively and Quantitative data manipulation in R and graphical representation, Qualitatively and Quantitative data presentation and analyzing data in R. Implementation of different statistical techniques discussed in previous courses based on R and SPSS/Stata/Minitab.
Introduction of SPSS/Stata/Minitab, data manipulation in SPSS/Stata/Minitab, simple arithmetic in SPSS/Stata/Minitab, SPSS/Stata/Minitab function related to probability distributions, SPSS/Stata modules, simple graphing in SPSS/Stata/Minitab.
Analysis using SPSS/Stata syntax programming.

Pre-Requisite: STAT-311, STAT-322,STAT-412

Books Recommended

1. Delwiche, Lora D. and Slaughter Susan J. (1998) The Little SAS Book : A Primer, Second Edn., SAS institute, North Carolina.
2. Norusis, Marija(2006) SPSS 14.0 Guide to Data Analysis, Prentice Hall, New Jersey.
3. SPSS (2006) SPSS 14.0 Base User's Guide, , Prentice Hall, New Jersey.
4. Marques de Sá, Joaquim P.(2003) Applied Statistics using SPSS**,** STATISTICA and MATLAB
5. Wickham, H., Grolemund, G. (2017), R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media; 1 edition

STAT- 443: Time Series Analysis -I (Credit hours: 03)



Stochastic Process, Stationary Time-Series, auto-correlation and auto-covariance, estimates functions and standard error of the auto-correlation function (ACF) and PACF, , Linear stationary models: Auto regressive, Moving Average and mixed models, Stochastic Difference equation models, ARMA models, Stationarity, Stationarity tests (Dickey Fuller test, Augmented Dickey Fuller test, Canova Hansen test), Models with Trend: Deterministic and stochastic Trends, Removing the trend. Box Jenkin's Methodology

Pre-Requisite: STAT-322

Books Recommended

1- Cox, D. R., Hinckley D.V. and Nielsen O.E.B. (1996). "Time Series Models - In Econometrics, finances and other fields"; Chapman & Hall, London.
2- Chatfield, C. (1996). "The Analysis of Time Series.' An Introduction", Chapman and Hall, London.
3- Andy, P, West M. and Harrison, P. J. (1994). "Applied Bayesian Forecasting and Time Series Analysis". Chapman & Hall New York.
4- Brock well P.J. and Davis R.A. (1991). "Time Series Theory and Methods", Springer Verlag New York.
5- Harvey, AC. (1990). "Forecasting Structural Time Series Models arid the Calamander", Cambridge University Press, Cambridge.
6- Daggle, P.J. (1990), "Time Series: A Biostatistical Introduction", Clarendon Press, Oxford.
7- Bovas, A. and Johannes, L. (1983), "Statistical Methods for Forecasting", John Wiley. New York
8- Priestley, MB. (1981), "SpectralAnalysis and Time Series", Academic Press, London.
9- Box, G.E.P. and Jenkins, G.M. (1999). "Time Series Analysis: Forecasting and Control', San Francisco.

STAT-564: Design and Analysis of Experiments-I (**Credit hours: 03**)

Principles of Design of Experiments. Analysis of variance and its assumptions. Cochran theorem. Fixed, random and mixed effect models. effect of violation of assumptions and transformations. Completely Randomized, Randomized Complete Block, Latin square, Greaco-Latin square. Missing observations. Relative efficiency of designs. Estimation of mean squares and their expectations. Multiple Comparisons Tests and contrast.

Pre-Requisite: STAT-431

Books Recommended

1. Montgomery, D.C. (2000). "Design and Analysis of Experiments", John Wiley, New York.
Clarke, G.M., and Kempton, RE. (1997), "Introduction to the Design & Analysis of Experiments", Edward

Arnold.
2. Steel, Robert, G. D., Terrie James H., and Dickey David A. (1997). "Principles and Procedures of Statistics: A Biometrical Approach" 3rd Edition, McGraw Hill, New York.
3. Boniface, DR. (1995). "Experiment Design & Statistical Methods", Chapman & Hall.
4. Myers, R.H. and Montgomery, D.C. (1995). "Response Surface Methodology: Process & Product Optimization Using Design", John Wiley.
5. Clarke, G.M. (1994). "Statistics & Experimental Design". Edward Arnold.
6. Harold, R. L (1992). "Analysis of Variance in Experin7ental Design". Springer Verlag:
7. Maxwell, S.E. and Delaney, H.D. (1990). "Designing Experiments and Analysis of Data". A model comparison perspective. Belment and Wadeson.
8. Mead, R. (1988). "The Design of Experiments". Cambridge University Press, Cambridge.
9. Das, M.N.and Geri, N.C, (1986). "3esign and Analysis of Experiments", John Wiley, New York.
10. Gomez, K.A., and Gomez, A.A. (1984)."Statistical Procedures for Agricultural Research", 2nd Edition. John Wiley, New York.
11. Hicks, CR. (1982). "Fundamental Concepts in Design and Analysis of Experiments" Saunders
12. Cochran, W.G. and Cox, G.M. (1957). "Experimental Design", John Wiley, New York.

STAT-551: Probability & Probability Distributions–I (Credit hours: 03)

Probability as a set function, Conditional Probability and Bayes' theorem, Chebychev's inequality, Random variables, Distribution function and Probability density function, Joint distributions and probability density functions of two or more random variables, Marginal and conditional distributions, Mathematical expectations, Conditional expectations, Variance and moments, Probability generating functions, Moment generating functions, Characteristics function and their existence properties. Binomial, Poisson, Hypergeometric, Negative Binomial, Geometric Distribution..

Pre-Requisite: STAT-311

Books Recommended

1. Hogg, R. T., McKean, J. W. & Craig, A. T. (2012), Introduction to Mathematical Statistics. 7th Edition, Pearson.
2. Stuart, A. & Ord, J. K. Kedalls, (2010), Advanced Theory of Mathematical Statistics (volume I), 6th Edition, John Wiley & Sons.
3. Scheaffer, R. L., (2009), Introduction to Probability and its Applications, Cengage Learning; 003 edition.
4. Walpole, R. E., Myers, R. H., Myers, S. L., and Ye, K. E., (2016), Probability and Statistics For Engineers and ScientiST, 9thEdition, Pearson.
5. Horgan, J. M. (2009), Probability with R: An introduction with computer science applications. John Wiley & Sons.
6. Ugarte, M. D., Militino, A. F., and Arnholt, A. T. (2008), Probability and Statistics with R. CRC Press, Taylor and Francis Group.
7. Montgomery, D. C. and Runger, G. C. (2014), Applied Statistics and Probability for Engineers. 6th Edition, John Wiley & Sons.
8. Tijms, H. (2012), Understanding Probability. 3rd Edition, Cambridge University Press.

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STAT-561: Probability and Probability Distributions-Il (**Credit hours: 03**)

Continuous Distribution: Uniform, exponential, Beta, Gamma, Normal distributions, Bivariate Normal distribution, Cauchy, Laplace, Weibull, Pareto, Rayleigh and Log normal distributions their derivations and properties such as Mean, variance and Moment generating functions. Sampling distribution: Chi Squares and student's t distribution. Order Statistics, Distribution of the minimum, maximum and rth order Statistic, distribution of median, range and quantiles.

Pre-Requisite: STAT-321

Books Recommended

1. Stirzaker, D. (1999). "Probability and Random Variables". Cambridge University Press, Cambridge.
2. Stuart, A. and Ord, J .K. Kendall's (1998), "Advanced Theory of Stat/st/cs", Vol. I, Charles Griffin, London.
3. Hirai, A.S. (1998), "A Course/n Mathematical Statistics", limiKutabKhana, Lahore.
4. Fridett, B. & Gray, L. (1997). "A Modern Approach to Probability Theory" Birkhallser, Boston.
5. Freund, J. E. (1997). "Mathematical Statistics", Prentice Hall, New Jersey.
6. Mood, AM, Graybill, F.A. and Boss, D.C. (1997), "Introduction to the Theory of Statistics", McGraw Hill, New York.
7. Hogg, R.M. and Craig, AT. (1995), "Introduction to Mathematical Statistics". Prentice Hall, Engle wood Cliffs, New Jersey.
8. Khan, M. K., (1996). "Probability with Applications", MaktibaIlmi, Lahore.
9. Haq, M. (1984). "Foundation of Probability and Statist/cs", Tahir sons, Urdu Bazar, Karachi.

STAT-552: Sampling Techniques-I **(Credit Hours: 03)**

Basic concepts, advantages of sampling methods, requirements of a good sample, bias, sampling and non-sampling errors, Steps and problems involved in planning and conduct of census and Sample surveys. Selection and estimation procedures. Description and properties of simple random sampling. Sampling for proportions and percentages. Estimation of variances, standard errors and confidence limits. Sample size determination under different conditions. Description and properties of stratified random sampling. Formation of strata, Different methods of allocation of sample size. Systematic sampling. Ratio and regression estimates in simple and stratified random sampling.

Books Recommended:

1. Raj, D. & Chandhok, P. (1998), "Sample Survey Theory". Narosa Publishing House, New Delhi.
2. Ferguson, T.S. (1996), "A Course in large Sample Ttheory, Chapman & Hall, London.
3. Singh, R. and Singh N, (1996), "Elements of Survey Sampling", KuiwarAcademic Publisher, Dodrecht.
4.Kish, L. (1992). "Survey Sampling", John Wiley, New York.
5. Sukhatme, P.V, Sukhatme, B., Sukhatme, S., and Asok, A. (1985), "Sampling Theory of Survey with Application". Iowa State University Press.

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6. Cochran, W.G. (1977), "Sampling Techniques' 3rd ed, John Wiley and Sons, New York.
7. Raj, D. (1971) "Design of Sample Survey". McGraw Hill, New York.

STAT-553: Regression Analysis (**Credit hours: 03**)

General linear model and its assumptions, Least squares estimators, MLE, Least squares estimators, tests of hypothesis, tests of significance of a single and complete regression, tests of significance of subset of coefficients. Significance tests and confidence intervals. Test of linearity of regression. Use of extraneous information in linear regression model. Residual analysis, Detection and study of outliers. Specification of models.

Pre-Requisite:STAT-431

Books Recommended

1. Draper, N.R. and Smith, H. (2004)." Applied Regression Analysis", John Wiley. New York.
2. Baltagi, B. H. (1999). "Econometrics", 2nd Edition, Springer Varlog.
3. Gujrati, D. (1998). "Econometrics", John Wiley, New York.
4. Wonnacott, T.H. and Wonnacott R.J. (1998). "Econometrics", John Wiley, New -York.
5. Johnston, J. and Di. Nardo, J., (1997). "Econometric Method", 4th Edition, McGraw Hill, New York.
6. Ryan, P. T. (1996) "Modern Regression Methods", John Wiley and sons Inc. New York.
7. Montgomery, D.C., and Peck E.A. (1992)."lntroduction to linear Regression Analysis", 2nd Edition, John Wiley and sons Inc. New York.
8. Guttmann, I, (1980); "Linear Models: An Introduction", John Wiley, New York.
9. Koutsoyiannis, A. (1980), " Theory of Econometrics", Macmillan. N.Y.
10. Maddela, G.S. (1977). "Econometrics", McGraw Hill. New York.
11. Searle, S. R. (1971), "Linear Models", John Wiley, New York.

STAT-672: Design and Analysis of Experiments-Il (**Credit hours: 03**)

Analysis of covariance (ANCOVA) . Factorial experiments: 2k, 3k series and mixed level factorial experiments and their analyses. Confounding in factorial experiments, Complete and partial confounding, Confounding in Fractional replications, Quasi-Latin square designs. Split-plot, split block, split-split plot, strip plot and nested designs. Missing observations in Split plot design. Incomplete block designs: BIBD.

Pre-Requisite: STAT-444
Books Recommended

1. Montgomery, D.C. (2000). Design and Analysis of Experiments", John Wiley, New York.
2. Clarke, G.M., and Kempton, RE. (1997), "Introduction to the Design & Analysis of Experiments', Edward Arnold.
3. Steel, G. D., Terrie, and Dickey A. (1997). "Principles and Procedures of Statistics: A Biometrical

Approach" 3rd Edition, McGraw Hill, New York.
4. Boniface, DR. (1995). Experimental Design & Statistical Methods, Chapman & Hall.
5. Myers, R.H. and Montgomery, D.C. (1995). "Response Surface Methodology; Process & Product Optimization Using Design", John Wiley.
6. Clarke, G.M. (1994). "Statistics & Experimental Design". Edward Arnold.
7. Harold, R. L (1992). "Analysis of Variance in Experimental Design". Springer Verlag:
8. Maxwell, SE. and Delaney, H.D. (1990). Designing Experiments and Analysis of Data. A Model Comparison Perspective Belmont and Wadeson.
9. Mead, R. (1988). "The Design of Experiments". Cambridge University Press, Cambridge.
10. Das, M.N.and Gin, N.C, (1986). "Design andAnalysis of Experiments", John Wiley, New York.
11. Gomez, K.A., and Gomez, A.A. (1984). "Statistical Procedures forAgricultural Research". 2nd Edition, John Wiley, New York.
12. Hicks, C.R. (1982). "Fundamental Concepts in Design and Analysis of Experiments"; Saunders
13.Cochran, W.G. and Cox, G.M. (1957). "Experimental Design", John Wiley, New York.

STAT-562: Sampling Techniques-Il (Credit hours: 03)

Cluster Sampling, Sub sampling, PPS-Sampling. Double Sampling, Multistage and Multiphase sampling. Thomson Hurwitz estimator. Comparison of different sample designs. Sampling and non sampling errors and their sources. non-response, their sources and bias. Randomized response. Randomized Response Techniques (RRT). Critical study of National sample surveys conducted in Pakistan: Census of Agriculture, Household Income and Expenditure Survey (HIES), Pakistan Demographic Survey (PDS) and National Population and Housing Census and Surveys (NPHCS).

Pre-Requisite: STAT-552

Books Recommended

1. Des Raj & Chandhok, P. (1998), "Sample Survey Theory". Narosa Publishing House, New Delhi.
2. Ferguson, T.S. (1996), "A Course in Large Sample Theory", Chapman & Hall, London.
3. Singh, R. and Singh N, (1996), "Elements of Survey Sampling", Kuiwar, Dodrecht.
4. Kish, L. (1992), "Survey Sampling", John Wiley, New York.
5. Sukhatme, P.V, Sukhatme, B., Sukhatme, S., and Asok, A. (1985), "Sampling Theory of Survey with
6. Application". Iowa State University Press.
7. Cochran, W.G. (1977), "Sampling Techniques", John Wiley and Sons, 3rd ed, New York
8. Des Raj, (1971), Design of Sample Survey. McGraw Hill, New York.
9. Various publications of FBS, ACO and P00.

STAT-563: Econometrics (Credit hours: 03)

Errors in Variables. Problems of autocorrelation, multicollinearity, heteroscedasticity and their solution. Ridge regression. Lagged variables. Dummy variables. System of simultaneous linear equations

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Identification- Estimation method, indirect and two-stage least squares methods, restricted least squares. Test of identifying restrictions. Estimation with stochastic regressor, generalized least squares estimators.

Pre-Requisite: STAT-553

Books Recommended

1. Draper, N.R. and Smith, H. (2004). "Applied Regression Analysis", John Wiley, New York.
2. Baltagi, B. H. (1999). "Econometrics", 2nd Edition, Springer Varlog.
3. Gujrati, D. (1998). "Econometrics", John Wiley, New York.
4. Wonnacot, T.H. and Wonnacot R.J. (1998). "Econometrics", John Wiley,
5. Johnston, J. and Di. Nardo, J., (1997). "Econometric Method", 4th Edition, McGraw Hill, New York.
6. Montgomery, D.C., and Peck E.A. (1992). "Introduction to Linear Regression Analysis", 2nd Edition, 7. John Wiley and sons Inc. New York.
7. Guttmann, I. (1980): "Linear Models: An Introduction", John Wiley, New York.
8. Koutsoyiannis, A. (1980), " Theory of Econometrics", Macmillan.
9. Maddela, G.S. (1977). 'Econometrics", McGraw Hill. New York.
10. Searle, S. R. (1971), "Linear Models", John Wiley, New York.

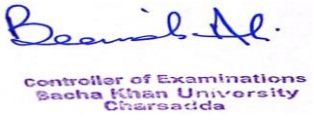
STAT-554: Population Studies (**Credit hours: 03**)

The population census and its types, Registration system. Components of population growth, composition of population and vital events. Types and sources of errors. General testing procedures. index of rectangularity, whipple index and myers index. Fertility and mortality measures. Total and general fertility rates. Construction of complete and abridged life tables. Different types of life tables. Graphs of lx, qx and ex. Description and uses of life table columns, stationary population models and their applications. Population projection methods, arithmetic increase method, geometric increase method. Malthus theory about population growth. Consequences of population growth. Overview of Population of Pakistan from 1951 and onward.

Pre-Requisite: STAT-432

Books Recommended

1. Jay Weinstein, Vijayan, K. Pillai, (2001) "Demography: The Science of Population". Allyn & Bacon.
2. Hind, A., (1998). "Demographic Method", Arnold
3. United Nations (1998), "World Population Assessment", UNFPA; New York.
4. Govt. of Pakistan (1998), National, Provincial and District census reports and other supplementary reports with respect to 1996 census; PCO, Islamabad.
5. United Nations (1996), "Added years of Life in Asia", ESCAP; U.N., Thailand.
6. Palmore, J .A; Gardner, R.W. (1994), "Measuring Mortality Increase"; East West Centre, Honolulu.
7. Bogue, D.J. Arniagu, E.E., Anderson, D.L. (1993), "Readings in Population Research Methodology". Vol. l-VIII,
8. United Nations Fund; Social Development Centre, Chicago.



9. mpagliazo, J. (1993), Deterministic Aspects of Mathematical Demography, Springer Verlag New York.
10. United Nations (1990), " World Population Monitoring 1989", UNFPA.
11. Rukanuddin AR. and Farooqi, M.N.l.., (1988), "The State of Population in Pakistan — 1987", NIPS, lslamabad.
12. Keyfitz, N. (1983) "Applied Mathematical Demography", Springer Verlag N.Y.
13. Pollard, A.H., Yousaf, F & Pollard, G.M. (1982), "Demographic Techniques", Pergamon Press. Sydney.
14. Pakistan Demographic Survey, Govt. of Pakistan, Federal Bureau of Statistics.
15. Publications of population census organizations.

STAT-671: Statistical Inference-I (Credit hours: 03)

Estimation of Parameters. Properties of Estimators: unbiasedness, consistency, sufficiency, efficiency, completeness, Cramer-Rao inequality, Rao-Blackwell and Lehmann - Scheffe Theorems. Methods of Estimation: Moments, Maximum likelihood, least-squares, minimum Chi- square.

Pre-Requisite: STAT-561

Books Recommended

1. Mood, A.M., Graybill, F.A. and Boss, D.C. (1997). "Introduction to the Theory of Statistics". McGraw Hill, New York.
2. Hogg, R.V. and Craig, AT. (1996). "Introduction to Mathematical Statistics". Prentice Hall, New Jersey.
3. Lindgren, B.W. (1998). "Statistical Theory". Chapman and Hall, New York.
4. Stuart, A. and Ord, J.K. (1998). Kendall's'"Advanced Theory of Statistics" Vol. II. Charles Griffin, London.
5. Zacks, S. (1973), "Parametric Statistical Inference", John Wiley, New York.
6. Rao, C.R., (1973). "Linear Statistical Inference and its Applications", John Wiley, New York.
7. Bickel, P.J., and Docksum, K.A. (2001), Mathematical Statistics, Vol l,Prentice Hall, N.J., 2nd ed.

STAT-675: Introduction to Multivariate Analysis (Credit hours: 03)

Introduction to Multivariate Analysis, Mean Vector, Covariance Matrix and Correlation Matrix Linear Combinations , Eigen Values and Vectors, Spectral Decomposition theorem and its applications. Multivariate Normal Distribution; Estimation of the mean vector and covariance matrix. Hotelling's T^2 –Distribution. Multivariate Hypothesis testing. One sample and multi-sample hypothesis. Principal Component Analysis, Factor Analysis, Discriminant Analysis.

Books Recommended

1. Johnson, R.A. and Wincher, D.W. (2004). *Applied Multivariate Statistical Analysis*. Prentice Hall. London.

2. Sharma, S. (1996), Applied Multivariate Techniques, John Wiley and Sons, New York.

3. Tabachnick, B.G and Fidell, L.S. (1996), Using Multivariate Statistics, 3rd ed. Harper Collins College, Publishers.

4. Hair, J.F., Anderson R.E., Jatham, R.L.and Black W.C., (1998). Multivariate Data Analysis, 5th ed. Pearson Education, Re print 2005, Asia edition.

5. Flurry B. (1997) *A First Course in Multivariate Statistics*, Springer Valerg, New York.

6. Morrison. F. (1990). *Multivariate Statistical Methods,* McGraw Hill, New York.

7. Manly, B.F.J. (1994). *Multivariate Statistical Methods,* A Primer 2nd Edition, Chapman and Hall, London.

8. Anderson, T.W. (2003). An *Introduction to Multivariate Statistical Analysis,* John Wiley, New York.

9. Chatfield, C. and Collins, A.J. (1980). *Introduction to Multivariate Analysis,* Chapman and Hall, London.

10. Mardia, K.V., Kent, J.T. and Bibby, J.M. (1979). *Multivariate Analysis,* Academic Press, London.

11. Everett, B.J. (1974). *Cluster Analysis,* McGraw Hill, New York.

12. Afifi, A. A. and Clark Virginia (1984). *Computer Aided Multivariate Analysis*, Lifetime learning publications, Belmont California.

STAT-673: Research Methodology (**Credit hours: 03**)

Definition of Research, Types of Research, Selection of Problem, Search of References, Formation of Hypothesis and Procedure for its Testing, Research Methodology, Planning of Experiments to Test Hypothesis Objectivity, Principals of Experimental Design, Steps in Experimentation, Collection of Data, Data Analysis to Determine Functional Relationship Between Variables, Levels of Significance, Interpretation of Results, Components of Scientific Reports and Various Methods of Data Presentation, Preparation of Scientific Reports, Publication Procedures.

Books Recommended

1. Andrew, C.O. and P.E. Hildebrand. (1993) 'Applied Agricultural Research", Foundations and Methodology, Western Press.

2. Hashmi, N. (1989) Style Manual of Technical Writings", USAID/NARC, Islamabad.

3. Gimbaled, J. and W.S. Acuter (1988) "MLA handbook for Writers of Research Papers", McGraw The Modern Language Association of America.

4. Little, T.M. and F.J. Hills (1978) "Agricultural Experimentation", John Wiley & Sons.

STAT—681: Statistical Inference-Il (**Credit hours: 03**)

Bayesian approach of estimation, Interval Estimation: Pivotal and other methods of finding confidence interval, confidence interval in large samples, shortest confidence interval, optimum confidence interval. Bayes' Interval estimation. Tests of Hypotheses: Simple and composite hypotheses, critical regions. Neyman-Pearson Lemma, power functions, uniformly most powerful tests. Deriving tests of Hypothesis concerning parameters in normal, exponential, gamma and uniform distributions. Randomized Tests. Unbiased tests, Likelihood ratio tests and their asymptotic properties. Sequential Tests: SPRT and its properties, A.S.N. and O.C. functions.

Pre-Requisite: STAT-671

Books Recommended

1. Stuart, A and Ord, J.K. (1998). Kendall's'"Advanced Theory of Statist/cs" Vol. II. Ctiarles Griffin, London.

2. Lindgren, B.W. (1998). "Statistical Theory". Chapman and Hall, New York.

3. Mood, A.M. Gray Bill, F.A. and Boss, D.C. (1997). "Introduction to the Theory of Statistics". McGraw Hill, New York.

4. Lehman, EL. (1997). "Testing Statistical Hypotheses". SpringIer - Volga, New York.

5. Hogg. R.V. and Craig, A.T. (1996). “Introduction to Mathematical Statistics”. Prentice Hall, New Jersey.

6. Zacks, S. (1973), “Parametric Statistical Inference”, John Wiley, New York.

7. Rao, CR., (1973). “Linear Statistical Inference and its Applications”, John Wiley, New York.

STAT-683: Biostatistics (**Credit hours: 03**)

Definition of Biostatistics, viz-a-viz the type of variables and observations in biological, health and medical sciences, Uniqueness in terms of behaviour of variables their domain, and units; Categorical, numerical and censored data. Populations, Target populations and samples; Role of sampling in biostatistics, Size of samples of various types of studies, Proportions, rates and ratios; incidence, prevalence and odds. Distributional behaviour of biological variables (Binomial, Poisson and Normal), Role of transformation for analysis of biological variables. Probit and Logit transformations and their analysis, p values, its importance and role. Confidence Interval in simple and composite hypothesis testing.

Books Recommended

1. Zar, J. (2000). “Biostatistical Analysis”, 5th Edition, John Wiley and Sons.

2. Shoukri, M. M & Pause, C. A. (1998). “Statistical Methods for Health Sciences”. 2nd Edition, CRC Press, Florida.

3. Daniel, W.W. (1996). “Biostatistics: A Foundation for the Health Sciences”, 6th Edition, John Wiley, New York.

4. Diggle, J. P., Liang, Kung-Yee and Zeger, S. L. (1996). “Analysis of Longitudinal Data”, Clarendon Press, Oxford.

5. Dunn, G. and Event, B. (1995). “Clinical Biostatistics”, Edward Arnold,London.

6. Rosner, B. (1994). “Fundamentals of Biostatistics”, 4th Edition, Duxbury Press.

7. Zolman, J.F. (1993). “Biostatistics: Experimental Design and Statistical Inference”, Oxford University Press, New York.

8. Lee, E.T. (1992). “Statistical Methods for Survival Data Analysis”, 2nd Edition, John Wiley, New York.

9. Harris, E. K. and Albert, A. (1991). “Survivorship Analysis for Clinical”

10. “Studies”. Marcel Decker, New York.

11. Altman, G. (1991). “Practical Statistics for Medical Research”. Chapman & Hall, London.

12. Lawless, J. F. (1982). Statistical Models and Methods for Life Time Data. John Wiley, New York.

OPTIONAL COURSES

STAT- 664: Time Series Analysis-II (Credit hours: 03)

Course Contents

1. Model Building, various stages of model building, Identification of model from sample time series, steps for model identification, estimating the auto-covariance, auto-correlation function and partial auto-correlation function, pattern of theoretical ACF and PACF as a tool of model identification 2. Estimating the parameters of an auto-regressive model,
2. estimating the parameters of moving average, Back casting, dual estimation, mixed ARMA model and integrated model. The Box-Jenkins seasonal model. Model diagnostics; Residual analysis, over fitting and parameter redundancy, portmanteau tests. Model selection criteria, AIC, BIC.
3. 3. Forecasting: Univariate procedures, Minimum mean square estimate of forecast, forecast weights, mean, variance and forecast limits for forecast, forecast error, minimum mean square forecast error, structure of minimum mean square forecast error. Multivariate procedures comparison of forecasting procedures. Prediction theory.

Books Recommended

1. Chatfield, C. (2003). The analysis of time series: An introduction (6th ed.). Chapman & Hall: London.
2. Wei, W. (1990). Time series analysis: Univariate and multivariate methods. Addison-Wesley publishing company, Inc. Box. GEP, Jenkins, G.M. & Reinsel, G.C. (2004). Time series analysis: Forecasting andvcontrol (3rded.). Holden-dayk: San Francisco,vBrockwell, P.J., & Davis, R.A. (2002). Introduction to time series and forecasting. (2nded.). Springer: New York
3. Gottman, J.M. (1981). Time series analysis, University Press: Cambridge.
4. Gyer, J.D. (1990). Time series analysis. Duxbury Press: Boston Montgomery, DC (1990) Forecasting and time series analysis (2nd ed.). McGraw Hill Book Company: New York
5. Anderson. T.W. (1994). Statistical analysis of time series. Wiley: New York. Janacek & Gareth. (2001). Practical time series. Arnold Co.: UK. Akaike, H. & Kitagawa, G. (1999). The practice of time series analysis Springer: New York.

6. Hamilton, & James, D. (1994). Time series analysis. Princeton University Press: New Jersey. Chatfield, C. (2000), Time series forecasting Chapman & Hill/CRC: New York.

STAT- 578: Operations Research (**Credit hours: 03**)

History and definition of OR. Introduction to linear programming. Formulation of LP model. Graphical solution of two variables. Standard Form. Simplex method. Duality theory, Sensitivity Analysis, Primal and dual form. Gaussian elimination. Transportation Problem, Assignment problem. Introduction to CPM and PERT techniques. Queuing Models, Inventory models, Dynamic programming and simulation models.

Books Recommended:

1. Taha, HA. (1998). "Operations Research". Macmillan. London.

2. Hillier, F.5. and Lieberman G. J. (1996). "Introduction to Operations Research", Holden Day.

3. Gupta, P.K. & Hira, D.S. (1994). "Operations Research". S. Chand & Co., New Delhi.

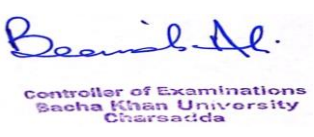
4. Bazarra, N.M., Jarvis J.J. and Sherali, H.D. (1990) "Linear Programming and Network Flows", John Wiley & Sons, 2nd ed.

5. Ravindran, A., Philips, D.J and Sillerg, J.J. (1987). "Operations Research: Principles and Practice" John Wiley.

6. Bronson, R. (1983). "Operations Research — Schaums' Outline Series" — McGraw Hill.

STAT-579: Stochastic Processes (**Credit hours: 03**)

Introduction. Generating Functions. Laplace Transforms. Difference Equations. Differential – Difference Equations. Introduction to Stochastic Processes. The Random Walk in one and two Dimensions. The Classical Gambler's Ruin Problem. Expected Duration of the Game. Markov Chains: Definition. Higher Transition Probabilities. Classification of States and Chains. Markov processes with Discrete State Space.



Poisson Process and its Generalization. Pure Birth and Death Processes. Markov Processes with Discrete State Space (Continuous Time Markov Chains). Markov Processes with Continuous State Space. Introduction to Brownian Motion. The Wiener Process. Diffusion Equations for the Wiener Process.

Books Recommended

1. Ross, S. (1996). "Stochastic Process", 2nd Edition, John Wiley, New York.
2. Feller, W. (1992). "An Introduction to Probability Theory and itsApplications", John Wiley, New York.
3. Srinivasin, S.K. and Mehta, K.M. (1988). "Stochastic Processes". Tata McGraw Hill.
4. Karlin, S.A. and Taylor H.M. (1984). "A first course in Stochastic Process", Academic Press London.
5. Hole, P.G., Port, S. and Stone, C.L. (1984). "An Introduction to Stochastic Process' John Wiley, New York.
6. Cox, D.R.and Miller H.D. (1984). "The Theory of Stochastic Processes", Chapman and Hall. London.
7. Medhi, J. (1982), "Stochastic Processes' Wiley Eastern Ltd.

STAT-689: Reliability Analysis (**Credit hours: 03**)

Basic concepts of reliability. Structural reliability. Lifetime distributions (Failure models): Hazard rate; Gamma, Weibill, Gumball, Log-Normal and Inverse Gaussian Distribution. Stochastic fatigue-rate models. Point and interval estimation. Fatigue-life model. Testing reliability hypothesis. Monte-Carlo, distribution- free and Bayes' methods in reliability. System reliability; series and parallel systems. Failure models, (kout-of-rn) New-better-than used models. Inferences for these models. Accelerated life testing.

Books Recommended

1. Achintya Haldar, Sankaran Mahadevan (2000). Reliability Assessment Using Stochastic Finite Element Analysis".

2. Crowder, M .J. (1994). “Statistical Analysis of Reliability Data”.

3. Lee, J. Bain, Bain Bain, (1991). “Statistical Analysis of Reliability and Life-Testing Models”.

4. Gertsbakh, lB. (1989). “Statistical Reliability Theory”. Marcel Decker. New York.

5. Lawless, J.F. (1982). “Statistical Model and Methods for Lifetime Data”.

6. Gertsbakh, lB. (1988). “Statistical Reliability Theory”.

7. Mann, N.R., Scheefer, R.E. and Singapoor wel, N.D. (1974). Methods for Statistical Analysis of Reliability, John Wiley & Sons.

STAT-661 Decision Theory

The nature and concept of loss functions, parameters, decisions and sample spaces. Risk and average loss. Admissibility and the class of admissible decisions. Minimax principle and its application to simple decision problems, linear and quadratic losses and their uses in problems of estimation and testing hypotheses. Asymptotically minimax procedure. A prior distributions and conjugate priors. Bayes’ decision procedure, admissibility of Bayes’ and minimax procedures.

Books Recommended

1. Berger, J. 0. (1985). “Statistical Decision Theory & Bayesian Analysis”, Springer Verlag.
2. Lindgren, B.W. (1971), “Elements of Decision Theory, Macmillan”, New York.
3. Blackwell, D. and Graphic, M.A. (1966). “Theory of Games and Statistical Decision”, John Wiley. New York.

STAT-686: Robust Methods (**Credit hours: 03**)

Introduction to Robustness. Objective function. M-estimator of location. Estimator, R-estimator and Westimator, Redesending M-estimator’s The Breakdown point of Robust estimator Influence function. M estimator for scale. Outliers and influential observations. Outliers in Regression analysis.

Books Recommended

1. Rousseau, P.J. and Leroy, AM. (1987). “Robust Regression and outlier detection”, John Wiley. New York

2. Hamper, T.R. Brochette, EM. Rousseau, P.J. and Satchel, WA. (1986). "Robust Statistics', The approach Based on Influence functions", John Wiley New York.
3. Huber, P.J. (1981). "Robust Statistics", John Wiley, New York.

STAT-663 Official Statistics

Design and planning of a Statistical Investigation. Data collection-approach and operation; Role of sampling in generation of Statistics, Sampling plans and survey Designs. Sources of Errors, Types of Errors, methods of their control. Data processing, presentation, and publication of Statistics. Different modes of Data Dissemination. Official Statistics, Statistical systems and standards, SoUrces of official statistics, their role, working and publication. Role of Official Statistics, Official Publications. Setup of official organizations in Pakistan their role, working & publication, Statistics Division, Federal Bureau of Statistics, Agricultural Census Organization, Population Census Organization, Ministry of Food, Agriculture and Livestock; National Data Base and Registration Authority (NADRA). Provincial Bureaus of Statistics. Financial Statistics: Ministry of Finance, State Bank of Pakistan-Department of Statistics, their working, publications and responsibilities. Other Organization's Statistical output, National and International series, classification and standards. Use of Statistics in administration and planning. Concepts and evaluation of GDP, GNP, NNP, Balance of Trade and payments. Measurement of Income Distribution, use of Index Numbers. and time series. Deflation and Inflation of series. National sample surveys and censuses conducted in Pakistan. Assignment: Visit of major Statistical Organizations will be a part of the course. An assignment will have to be submitted on any topic given by the course Incharge.

Books Recommended:

1. Kish, L. (1992). "Survey Sampling", John Wiley, New York.

2. Statistics Division, "Activity Report" (1988-89). Government of Pakistan, Islamabad.

3. Statistical Institute for Asia & Pacific SlAP (1984). "Training of Trainers in Statistical Operations and Procedures" Part-I, II UNDP, Tokyo.

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4. Hansen M.H. (1980). “Progress and Problems in Survey Methods and Theory”. Illustrated by the work of U.S. Bureau of the Census, U.S. Department of Commerce; A Monograph.

5. Murthy, MN. (1979). “ Quality of Data, Country Course on Sample Surveys”, Karachi.

6. Statistics Division (1979). “Retrospect, Perspective and Prospect”, Islamabad.

7. State Bank of Pakistan (1966). “Deptt. of Statistics-A Chronicle”.

8. Zarkovich S.S. (1966) “Quality of Statistical Data, Food and Agricultural Organization”, The U.N. Rome.

9. NIPA (1962)”Administrative uses of Statistics”, NIPA Res. Sr.No.2 Karachi.

10. Yates F. (1960), “Sampling Methods for Census and Surveys”, Charles Griffin. FAO Year Books.

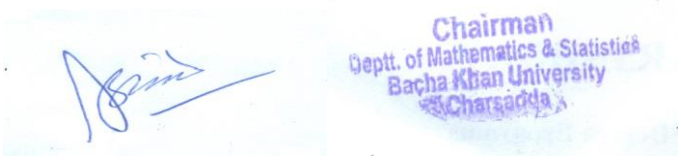
11. Various Publications of FBS, P00, ACO, “State bank of Pakistan, Ministry of Finance” etc.

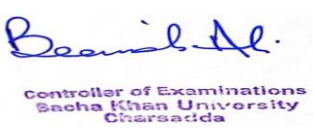
STAT-685: Survival Analysis (**Credit hours: 03**)

Survival data, censoring, covariates, basic distribution theory, survival function, hazard function; Special distributions: exponential, extreme value, Weibull, gamma and log logistic distributions with special reference to survival analysis, ML inference for parametric model with single sample, Non-Parametric estimation of survival function; life table method, Product-limit method; diagnostic plots, Modeling dependence on covariates: proportional hazard model; Weibull model; accelerated life models; Graphical methods for checking models, Inference for semi-parametric proportional hazards model. Cox Proportional Hazard Model.

Books Recommended

1. Muller, R. G. & Xian Zhou, (1997), Survival Analysis with long-term Survivors, John Wiley, New York.
2. Cox D. R. & Oakes D. (1984) Analysis of Survival Data, Chapman and Hall
3. Lawless, J. F. (2003), Statistical Models and Methods for Life Time Data, John Wiley, New York.
4. Collet, D. (2014). Modeling Survival Data in Medical Research, Chapman and Hall: London.
5. Hosmer, W. D., &Lemeshow, S. (2008). Applied Survival Analysis: Regression Modeling of Time to Event Data.2nd edition Wiley-Interscience, Hoboken: New Jersey.





6. Lee, E.T. and Wang, J. W. (2013). Statistical Methods for Survival Data Analysis, 4thEdt. John Wiley, New York.
7. Kalbfleisch, J. D. and Prentice, R. L. (2002) The Statistical Analysis of Failure Time Data, John Wiley and Sons.
8. Moore, D. F .(2016). Applied survival analysis using R. Springer

STAT-666 Data Mining

Introduction to databases including simple arid relational databases: data warehouses Review of classification methods from multivariate analysis: classification and decision tress Clustering Methods from both statistical and data mining viewpoints vector quantization. Unsupervised learning from univariate and multivariate data, dimension reduction and feature selection. Supervised learning Ron moderate to high dimensional input spaces artificial neural networks and extensions of regress; on models, regression trees. Association rules and prediction; applications to electronic commerce.

Books Recommended

1. Han J and Camber, M. (2000). Data Mining; "Concepts and Techniques" Morgan Gutitmann.

2. Benson end Smith, S.J (1997). "Data Waiehousinj. Data Mining and OLAP McCraw-Hill

3. Mitchell. F.M 1997). "Machine Learning" McGraw—Hill.

4. Ripley, B D. (1 996). "Pattern Recognition and Neural Networks". Cambridge University Press.

5. Breiman L. Friedman, J.H. Olshen, R.A. and Stone, C.J. (1984) 'Classification ansi Regression Trees Wadsworth and Brooks/Cole.

STAT-688: Mathematical Modeling and Simulation (**Credit hours: 03**)

Monte Carlo methods: Different methods of generating random variables, generation of random numbers, acceptance and rejection techniques from various distributions. Comparison of algorithms to generate random variables. Generating random variables from failure rates. Generation from multinomial distribution / Monte Carlo integration. Gibbs sampling and other techniques. Variance reduction techniques: importance sampling for integration, control varieties and antithetic variables.

Books Recommended:

1. Ross, S.M.(2002). "Simulation" (Third Edition) (Academic)

2. Fishman, G.S. (1996). Monte Carlo: "Concepts, Algorithms, and Applications", (Springer).

3. Rubinstein, R.Y. (1981). "Simulation and the Monte Carlo Method' (Wiley).

4. Ripley, B.D. (1987) "Stochastic Simulations" (Wiley)

STAT-676 Categorical Data Analysis

Introduction, describing two way contingency tables, inference for two way contingency tables, models for binary response variables, Log linear models, fitting Log linear and Logit models, building and applying Log linear models, Log linear Logit models for ordinal variables, multinomial response models for matched pairs, analyzing repeated categorical response data, logistic regression models and their analysis.

Books Recommended

1. Agresti, A. (1990), "Categorical Data Analysis", John Wiley and Sons.

2. Bishop, Y.V.V., Fienberg, SE. and Holland, P.W. (1975). "Discrete Multivariate Analysis", MA: MIT Press Cambridge.

3. Cox, DR. and Snell, E.J.(1989). "The Analysis of Binary Data", Chapman and Hall, London.

4. David, W.H., Leweshow, S.L. (1989). "Applied Logistic Regression".

5. Mc GulIah, P. and Nelder, J.A. (1989). "Generalized Linear Models", 2nd ed. Chapman and Hall, London.

STAT-577: Bayesian Statistics

Prior information, prior distributions, methods of elicitations of prior distributions, posterior distributions, posteriors mean, median (bayes estimator under loss functions) and variances of univariate and bivariate posterior distributions, noninformative priors: methods of elicitations of noninformative priors, Bayesian hypothesis testing: bayes factor; the highest density region; posterior probability hypothesis.

Recommended Books:

1. Berger, J.O., Statistical Decision Theory and Bayesian Analysis (2nd Ed.), New York, Springer Verlag (1985)
2. Bernardo, J. M. & Smith, A.F.M., Bayesian Theory, John Wiley, New York (1994).

3. Box, G.E. P & Tiao, G. C. Bayesian Inference in Statistical Analysis, Reading Addison-Wesley (1973).
4. Introduction to Bayesian Statistics by William M. Bolstad (2004)
5. Lee, P.M. Bayesian Statistics, an Introduction, Oxford University Press, New York (1991).
6. O.Hagan A. Kendall's Advanced Theory of Statistics (Vol.2B), Bayesian Inference, Cambridge, The University Press (1994)

Course Name: Exploratory Data Analysis

Course Outline:

Introduction of Exploratory Data Analysis and Visualization, Building Blocks and Basic Operations; Types of Exploratory Graphs, single and multi-dimensional summaries, five number summary, box plots, histogram, bar plot and others; Distributions, their representation using histograms, outliers, variance; Probability Mass Functions and their visualization; Cumulative distribution functions, percentile-based statistics, random numbers; Modelling distributions, exponential, normal, lognormal, pareto; Probability density functions, kernel density estimation; Relationship between variables, scatter plots, correlation, covariance; Estimation and Hypothesis Testing; Clustering using K-means and Hierarchical; Time series and survival analysis; Implementing concepts with R (or similar language)

Reference Materials:

i. "Exploratory Data Analysis with R" by Roger D. Peng

Course Name: Classification and Regression Trees

Contents

Meaning of classification, classifier and an overview of classification techniques, Difference between supervised and un-supervised learning/classifiers, Decision trees and their generation procedures (tree growing process), role of evaluation functions to split parent node into two sub-nodes, Various node splitting evaluation functions(impurity-based and non-impurity-based) including Gini index, Twoing rule and Entropy function. Properties of impurity-based evaluation functions, Selection criterion to split a node, Estimation of error rates and right sized classification trees. Construction of classification trees; evaluating the performance of a classifier: Holdout Method, Random Sub-Sampling, Cross-Validation and Bootstrap Samples

i) Andrew, R. W. Statistical Pattern Recognition. Second edition. JohnWilley&SonsLtd. UK, (2002).

ii) Bramer, M. Principles of Data Mining. Springer-VerlagLondonLimited UK, (2007).

iii) Breiman, L., Friedman, J. H., Olshen, R. A. & Stone, C. J.Classification and Regression Trees. Wadsworth InternationalGroup, Belmont, CA, (1984).

iv) Efron, B.&Tibshirani, R. J. An Introduction to the Bootstrap.Chapman and Hall, London, UK, 1993.

v) Rao, C. R., Wegman, E. J. &Solka, J. L. Handbook of Statistics, Vol.24: Data mining and data visualization. Elsevier B.V., North Holland,2005.

vi) Ripley, B. D. Pattern Recognition and Neural Networks. Cambridge,New York, NY, 1996.7.Tan, P., Steinbach, M. & Kumar, V. Introduction to Data Mining.Addison Wesley, New York, 2006.

STAT- 674: Introduction to Data Science (Credit hours: 03)

Course Outline:

Introduction: What is Data Science? Big Data and Data Science, Datafication, Current landscape of perspectives, Essential skills for data analysis; Statistical Inference: Populations and samples, Statistical modeling, probability distributions, fitting a model, Brief introduction to R environments; Exploratory

Data Analysis and the Data Science Process; Brief introduction to basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (k-NN), k-means, Feature Generation and Feature Selection; Dimensionality Reduction: Singular Value Decomposition, Principal Component Analysis; Introduction to mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs; Data Visualization: Basic principles, ideas and tools for data visualization; Data Science and Ethical Issues: Discussions on privacy, security, ethics, Next-generation data scientists.

Reference Materials:

i) Foundations of data science, Blum, A., Hopcroft, J., & Kannan, R., VorabversioneinesLehrbuchs, 2016.
ii) An Introduction to Data Science, Jeffrey S. Saltz, Jeffrey M. Stanton, SAGE Publications, 2017.
iii) Python for everybody: Exploring data using Python 3, Severance, C.R., reateSpace Independent Pub Platform. 2016.
iv) Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly. 2014.
v) Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, EMC Education Services, John Wiley & Sons, 2015.

ECO-311: Principles of Microeconomics (**Credit hours: 03**)

Course Contents

Introduction

Definition, concept and meaning of Economics, Adam smith definition (science of wealth), Marshallian definition (science of welfare) Robbins Definition (science of scarcity and science of choice) Classification of economics, Importance and scope of micro-economics, Basic concepts: Commodities, Income and Resources, Production and Consumption,

Consumer's Behavior

Consumers/ households as economic agents, Problem of the consumers, The utility theory, Laws of diminishing marginal utility and law of equi-marginal utilities, Indifference curve, Budget constraint and consumer's equilibrium,

The Price Mechanism

The concept of a market economy, Laws of demand and supply, schedules & graphs of demand and supply, Market equilibrium and determination of price, Movement along and shifting of demand and supply curves, Concept of elasticity of demand and supply, Importance of elasticity.

Production

Production function, Primary inputs: factors of production, Secondary/intermediate inputs: Raw material and energy, The laws of returns, Iso-Quant, Iso-Cost Producer Equilibrium, Maximization of Output, Minimization of Cost

Revenue and Revenue Curves

Definition, meaning and concept of Revenue, concept of Total Revenue(TR), Marginal Revenue (MR) and Average Revenue (AR), Curves of TR, MR and AR under Perfect competition, Curves of TR, MR and AR under Imperfect Competition, Relationship between TR, MR, AR

Cost and Cost Functions

Meaning and Concept of Cost and Cost function, meaning and concept of short run cost, Total Cost (TC), Marginal Cost (MC), Average Cost (AC), Total Variable Cost (TVC), Total Fixed Cost (TFC), Average Variable Cost (AVC), meaning and concept of long run cost, long run cost curves

Market structure

Definition and concept of market, classification of market, condition of perfect and imperfect market, short run and long run equilibrium of firm under perfect competition, short run and long run equilibrium of firm under monopoly

ECO-321: PRINCIPLES OF MACROECONOMICS (Credit hours: 03)

Course Contents

Introduction

The economy in aggregate, definition, concept and Scope of macroeconomics, Brief account of the development of macroeconomics, problems of Macroeconomics, objectives of Macroeconomics Macroeconomic variables and their mutual relationship, Macroeconomics vs Microeconomics

National Income

Definition and concept of national income, Gross Domestic Product (GDP), Gross National Product (GNP), GDP, Net National Product (NNP), Personal Income (PI), Personal Disposable Income (PDI) Computation/ measurement of national income: Product, Income and Expenditure approaches, Circular flow of income, Nominal versus Real income, Per capita income

Components of Aggregate Demand

Components of aggregate demand: Consumption, consumption function, MPC APC, Saving and Saving function, Investment, autonomous Investment, induced investment, investment multiplier National Income determination in two sector economy.

Money

Barter system and difficulties of Barter system, Definition of money, forms/ types of money and functions of money, Fisher Quantity theory of money, Inflation, Deflation and Stagflation, Demand pull and Cost Push Inflation, Demand for money and supply of money.

Banking

Definition and concept of Bank, Types of Banks, concept and functions of commercial bank, meaning and concept of Central Bank and its functions with reference to the State Bank of Pakistan, Commercial banking, Monetary policy: Meaning, concept and brief introduction, Objectives and tools of Monetary Policy

Public Finance and Taxation

Meaning and concept of Public finance, Public vs Private Finance, Sources of public revenue, Various forms of taxes: Direct and Indirect, Income and Commodity taxes, Sales, Excise, Customs, Major heads of public expenditure, Fiscal policy: meaning and objectives.

International Trade

Definition, meaning and concept of International Trade, Inter-regional vs international Trade Concept of imports and exports, Theory of absolute and comparative advantage, Currency exchange rates, Balance of Payments: causes of deficits in BOP of Pakistan and remedial measures, Commercial Policy: objectives and scope.

COURSE TITLE:	**GENERAL SCIENCE**
LEVEL:	**BS 1st**
COURSE CODE:	**EDU-312**
CREDIT HOURS:	**03**
COURSE TYPE:	**GENERAL**

Course Outline

Unit 01: Nature of General Science
1.1 Definition and nature of General Science
1.2 Importance of General Science in Daily Life
1.3 Contributions of Muslim Scientists in Different Areas of Science
1.4 Scope of General Science
Unit 02: Introductions to Physics
2.1 Introduction to Physics
2.2 Branches of Physics
2.3 Islam and Physics
2.4 Scientific Method
Unit 03: Measurements
3.1 Concept of Physical Quantities
3.2 Different Systems of Units
3.3 Relationship of Different Quantities
3.4 Pre-fixes and Scientific Notation
Unit 04: Introduction to Chemistry
4.1 Meaning and Importance to Chemistry
4.2 History of Chemistry
4.3 Braches of Chemistry
4.4 Chemistry and its Applications
Unit 05: Basic Concepts of Chemistry
5.1 Atom, Molecule, Valence Simple formulae
5.2 Atomic Number, Atomic Weight, Formulae weight
5.3 Structure of Atom
5.4 Different Atomic Theories
Unit 06: Introductions to Biology
6.1 Introductions to Biology
6.2 Quran and Biology
6.3 Branches of Biology
6.4 Biology and Human Welfare
Unit 07: Basic Concepts of Biology

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7.1 Cell, Tissue, Organs and System
7.2 Parts and Structure of Plant Cell
7.3 Parts and Structure of Animal Cell
7.4 Difference Between Animal and Plant Cell
Unit 08: Concept of Physical Chemistry
8.1 Ideal Gas Equation
8.2 Vander Waals Equations
8.3 Thermodynamics
8.4 Free Energy and Chemical Equilibrium
Unit 09: Waves
9.1 Concept of Wave
9.2 Types of Waves
9.3 Simple Harmonic Motion
9.4 Derivation of Equation
Unit 10: Conservation of Energy
10.1 Conservation laws in Physical World
10.2 Conservation of Energy
10.3 Conservative Forces
10.4 Conservation of Linear Momentum
Unit 11: Diversity
11.1 Taxonomy of Plants
11.2 Taxonomy of Animals
11.3 Fauna and Flora
Unit 12: Systems in plants Transportation
12.2 Excretion
12.3 Photosynthesis

Recommended Books

Harlen, W. (2003). Teaching of Science, London: David Fulton.
Hassard J. (2004) Minds of Science: Middle and secondary methods, New York: Harper Collins
Publishers.
Monler Martin (1999) Learning to teach science, London, the Falmer Press
Nellist, J. & Nicholl, B. (2004). Science Teachers Handbook. London: the Association of Science
Education
Rehman M. (2004).Teaching of science and Mathematics. Ijaz Printer Peshawer Pakistan.
Lewis Eikenberry, W. (2008) The teaching of general science, The University of Chicago Press

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Pool Course: Arts & Humanities-II
Course Title: Introduction to Education
Course Code: EDU-414
Credit Hours: 03

COURSE CONTENTS:

Introduction:

- Meaning and Definition of Education
- Importance of Education
- Modes of Education.

Foundation/Perspectives of Education:

- Philosophical
- Psychological
- Socio-Cultural, and
- Economic

Instructional Objectives:

- Goals
- Aim
- Objectives
- Importance of Learning Objectives.
- Taxonomy of educational Objectives.

Teaching Methodology:

- Traditional
- Modern
- Instructional Material.
- Instructional Techniques.

Class Room Management:

- Criteria for students classification
- Need for classification
- Psychological factors of classification in system of examination.

Learning:

- Introduction
- Meaning and Definition
- Nature of Learning.
- Factors effecting learning.
- Approaches of Learning (Behavioral and Cognitive).

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Educational Guidance and Counseling:

- Definition and Nature of Guidance.
- Role and Function of Guidance.
- Counseling and its Principles.

COURSE RECOMMANDED BOOKS:

1. Elias, John L. and Merriam, Sharan.(1984). Philosophical Foundation of Education. Malabar Florida: Krieger Publishing Company.
2. Friere, P.(1970). Pedagogy of the Oppressed: What we Consume. W.W.F and Richmond Publishing Company.
3. Gutek, Gerald L. (1988). Philosophical Thinking in Educational Practice. Westport: Con,Praeger Publisher.
4. Iqbal, M. (2001). Reconstruction of Religion Thoughts in Islam.National Education policies, (1972, 1979, 1998, 2010).

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