HIGHER EDUCATION COMMISSION
Government of Pakistan, Islamabad
(Curriculum Division)

هائر ايجوكيشن كميشن

ENDORSEMENT OF THE COURSE DESIGN COMMITTEE

A meeting of a course design committee was held on 20-21 July 2023 in the Higher Education Commission, Lahore (Regional Office) to design courses of "Quantitative Reasoning (I)" and "Quantitative Reasoning (II)" each of three (03) credits, as part of the general education component of the HEC Undergraduate Education Policy (V 1.1).

Following members of the committee attended the meeting and developed the draft of the two courses:

1. Dr. Asif Ali Shaikh, Professor & Chairman, Department of Basic Sciences and Related Studies, Mehran University of Engineering & Technology, Jamshoro
2. Dr. Muhammad Zubair Khan, Professor & Associate Dean, Faculty of Basic Sciences, Balochistan University of Information Technology, Engineering & Management Sciences, Quetta
3. Dr. Akbar Zada, Associate Professor, Department of Mathematics, University of Peshawar, Peshawar
4. Dr. Asad Ullah, Associate Professor & Chairman, Department of Mathematical Sciences, Karakoram International University, Gilgit
5. Dr. Jamal Abdul Nasir, Associate Professor & Chairman, Department of Statistics, Government College University, Lahore
6. Dr. Kalim Ul-Haq Tariq, Associate Professor, Department of Mathematics, Mirpur University of Science & Technology, Mirpur
7. Dr. Naveed Ahmad, Associate Professor, School of Mathematics and Computer Science, Institute of Business Administration, Karachi
8. Dr. Rizwan Ul Haq, Associate Professor, Department of Mathematics, School of Natural Sciences, National University of Sciences & Technology, Islamabad
9. Dr. Saima Altaf, Associate Professor, Department of Statistics, Bahauddin Zakariya University, Multan
10. Dr. Shaheen Nazir, Associate Professor, Department of Mathematics, Syed Babar Ali School of Science and Engineering, Lahore University of Management Sciences, Lahore
11. Dr. Shakila Bashir, Associate Professor, Department of Statistics, Forman Christian College University, Lahore
12. Mr. Muhammad Ali Baig, Deputy Director, Higher Education Commission, Islamabad

Following members of the committee could not attend the meeting due to official / other engagements:

1. Dr. Muhammad Akram, Professor & Chairman, Department of Mathematics, University of the Punjab, Lahore
2. Dr. Nasir Ali, Associate Professor & Chairman, Department of Mathematics & Statistics, International Islamic University, Islamabad
3. Dr. Nargis Aslam Khan, Associate Professor, Department of Mathematics, Islamia University of Bahawalpur, Bahawalpur

That after consultation and endorsement of the committee, the final drafts of the courses are hereby submitted to the office of the Director Curriculum Division, HEC, Islamabad by us / the undersigned on behalf of the committee for consideration of HEC.

Dr. Naveed Ahmad	Dr. Jamal Abdul Nasir	Mr. Muhammad Ali Baig
(Convener)	(Co-Convener)	(Secretary)

PLEASE NOTE:

1. The Curriculum Division, HEC may conduct an internal review of the draft submitted by the committee and make necessary amendments as and when needed, with or without sharing reasons of the same with the committee.
2. The Curriculum Division, HEC may refer the draft submitted by the committee to other experts or a new committee for review who may propose revisions / additional recommendations in the said draft.

QUANTITATIVE REASONING (I)

UGE Policy V 1.1 : General Education Course

Credits: 03
Pre-Requisite: Nil
Offering: Undergraduate Degrees (including Associate Degrees)
Placement: 1 - 4 Semesters
Type: Mandatory
Fields: All

DESCRIPTION

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

COURSE LEARNING OUTCOMES

By the end of this course, students shall have:

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

SYLLABUS

1. **Numerical Literacy**
    *   Number system and basic arithmetic operations;
    *   Units and their conversions, dimensions, area, perimeter and volume;
    *   Rates, ratios, proportions and percentages;
    *   Types and sources of data;
    *   Measurement scales;
    *   Tabular and graphical presentation of data;
    *   Quantitative reasoning exercises using number knowledge.
2. **Fundamental Mathematical Concepts**
    *   Basics of geometry (lines, angles, circles, polygons etc.);
    *   Sets and their operations;
    *   Relations, functions, and their graphs;
    *   Exponents, factoring and simplifying algebraic expressions;
    *   Algebraic and graphical solutions of linear and quadratic equations 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.

SUGGESTED INSTRUCTIONAL / READING MATERIALS

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.

QUANTITATIVE REASONING (II)

UGE Policy V 1.1 : General Education Course

Credits: 03
Pre-Requisite: Quantitative Reasoning (I)
Offering: Undergraduate Degrees (including Associate Degrees)
Placement: 2 - 4 Semesters
Type: Mandatory
Fields: All

DESCRIPTION

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

COURSE LEARNING OUTCOMES

By the end of this course, students shall have:

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

SYLLABUS

1. **Logic, Logical and Critical Reasoning**
   - Introduction and importance of logic;
   - Inductive, deductive and abductive approaches of reasoning;
   - Propositions, arguments (valid; invalid), logical connectives, truth tables and propositional equivalences;
   - Logical fallacies;
   - Venn Diagrams;
   - Predicates and quantifiers;
   - Quantitative reasoning exercises using logical reasoning concepts and techniques.
2. **Mathematical Modeling and Analyses**
   - Introduction to deterministic models;
   - Use of linear functions for modeling in real-world situations;
   - Modeling with the system of linear equations and their 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 exercises using statistical modeling.

SUGGESTED INSTRUCTIONAL / READING MATERIALS

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.