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Deputy Director
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No. HEC/CD/NCRC/Stats/2024/7507
May 07, 2025

SUBJECT: REVISED CURRICULUM FOR DEGREE PROGRAMS IN STATISTICS

The Higher Education Commission (HEC) of Pakistan, as mandated by its law, provides guidance to Higher Education Institutions (HEIs) on curricula for tertiary education levels in alignment with the National Qualifications Framework (NQF). To address evolving academic trends and market demands, HEC has revised the curricular standards for Statistics degree programs at NQF levels 6 and 7. These updated standards are intricately aligned with HEC's Undergraduate Education Policy V 1.1 (2023) and Graduate Education Policy (2023), ensuring coherence with national priorities and adherence to international benchmarks.

02. We are notifying the updated curricula for Statistics programs having features for three (03) specialized streams along with option of seven (07) elective subjects to meet the indigenous needs. Universities offering these programs are encouraged to align their Statistics curricula with these revised standards as soon as possible, ensuring they meet the minimum requirements. Additionally, course content should be developed according to the revised curriculum framework involving all relevant stakeholders in a way the content meets the national and local needs of the region and be submitted electronically to this division of HEC. An electronic copy of this document can be found on HEC's official website.

03. Through the effective implementation of these standards, HEC seeks to empower Pakistani Statistics graduates with a comprehensive understanding of their field, enabling them to excel in the field of Statistics, and effectively use its techniques in social, natural and allied sciences research, and drive meaningful change both locally and globally.

Muhammad Tufail Qureshi

Vice Chancellors/Rectors/Heads
All Public/Private Sector Universities/DAIs

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CURRICULUM FOR STATISTICS
AD| BS| M. PHIL

REVISED 2025

HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM FOR
STATISTICS
DEGREE PROGRAMS

2025

Prepared by:
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PREFACE

Higher Education Commission, mandated by section 10-1 (v) of HEC Ordinance 2002, has been involved in developing/revising the curricula periodically through National Curriculum Revision Committees (NCRCs) comprising eminent academics, researchers from HEC recognized universities/DAIs, professional councils, R&D organizations of repute, and industry professionals. So far, HEC has developed and revised curricula of 150+ disciplines for undergraduate and graduate programs in various fields of Natural Sciences, Applied Sciences, Social Sciences, Art & Humanities, Engineering & Technology, Medical and Allied Health Sciences, Agriculture, Computing, Law, and Administration.

Over time, labor markets in the world have substantially changed, hence, workforce skills demand has also altered. Due to these transformations, there is a need to produce well-rounded individuals with the required knowledge base of specific disciplines and possess the needed skills to increase their market readiness to contribute to the country's socio-economic development.

HEC has introduced the Undergraduate Education Policy 2023, which provides an overarching framework for undergraduate programs. This curriculum document is prepared in light of the UGE Policy (v1.1) 2023. I hope that this document, prepared by the respective NCRC, will meet our national, social, and economic needs and provide the level of competency specified in the Pakistan Qualification Framework to make it compatible with international educational standards.

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GUIDING PRINCIPLES

MINIMUM STANDARDS

The curricular standards and guidelines prescribed under this policy are mandatory at minimum level. Universities or the concerned departments may however set higher standards provided that the standards prescribed herein are not reduced or compromised.

COURSE SEQUENCE, TITLES AND CREDITS

For Bachelor of Science in Statistics and Master of Science in Statistics, the sequence of courses prescribed under this document is logically arranged and is suggestive only. The offering department may rearrange the sequence and alter the course titles and credits, provided that the essence of the courses prescribed in policy remains intact. The department may add more courses as and when required, subject to adherence to HEC Policies and approval of the university's relevant statutory body.

COURSE LEARNING OUTCOMES

Course learning outcomes (CLOs) are the bare minimum standards of learning that students must achieve upon completing a specific course. These outcomes serve as essential benchmarks, ensuring consistency in the quality of education across institutions. The CLOs prescribed herein represent the minimum level of competency and understanding expected from students. While these standards must not be compromised, departments are encouraged to enhance the rigor of the CLOs by incorporating additional learning outcomes, provided these do not alter the essence of the prescribed standards. In this policy, CLOs are exclusively developed for major field courses within the program. For interdisciplinary courses, departments offering these courses are responsible for developing their CLOs in alignment with their respective disciplines and program requirements. Moreover, CLOs for elective courses are not prescribed here, as these are advanced or specialized courses. The development of CLOs for electives is the responsibility of the respective departments, taking into account the course's advanced nature and relevance to the program. For general education courses as required under the HEC Undergraduate Education Policy V 1.1, departments may adopt the CLOs prescribed in the HEC-developed model courses.

COURSE SYLLABUS

This document serves as a comprehensive guideline delineating the course learning outcomes (CLOs) for each course offered in the Bachelor of Science in Statistics and Master of Science in Statistics as minimum standards. The offering department is mandated to meticulously prepare, modify, and tailor the syllabus of each course, ensuring alignment with the stipulated learning outcomes. It is in this regard imperative that the department utilizes

instructional, reference, and reading materials that it deems appropriate to effectively meet the CLOs.

REQUIREMENT OF GENERAL EDUCATION

For Bachelor of Science in Statistics, the courses prescribed for General Education component must mandatorily be offered with the same titles and minimum credits as prescribed under HEC Undergraduate Education Policy V 1.1 including the course of “Pakistan Studies”. The concerned departments may adopt and follow the learning outcomes and study contents developed by HEC for these courses as available on its website.

REQUIREMENT OF INTERNSHIP

It is a mandatory degree award requirement of three (03) credit hours for Bachelor of Science in Statistics. Internship of six (06) to eight (08) weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field, protocols of which will be determined by the concerned department subject to approval of the same by the university’s relevant statutory body. This requirement cannot be substituted with additional coursework, capstone, or project work.

REQUIREMENT OF CAPSTONE PROJECT

It is a mandatory degree award requirement of three (03) credit hours for Bachelor of Science in Statistics with or without specialization. A capstone project is multifaceted body of work that serves as a culminating academic and intellectual experience for students. The capstone project must be supervised and graded by a faculty member as per the protocols prescribed by the concerned department subject to approval of the same by the university’s relevant statutory body. This requirement cannot be substituted with additional coursework or internship.

ASSOCIATE DEGREE IN STATISTICS

The eligibility criteria and the first-four semesters of the Bachelor of Science in Statistics as prescribed in this policy guide the admission requirement and the structure of Associate Degree in Statistics. It should be noted that the Associate Degree in Statistics will be awarded in its generic form and without any specialization.

GENERAL ELECTIVES

The scheme of study prescribed for the four-year undergraduate degree in Statistics is based on seven electives. Where the seven courses for electives are adopted from more than one specialization domains, they will be considered as general electives, and the degree will be awarded as Bachelor of Science in Statistics in its generic form and without any specialization.

ELECTIVES

1. In accordance with the National Qualifications Framework, the department may offer at least seven electives comprised of 21 credit hours (minimum of 25 % of the main field i.e. Statistics that is comprised of 81 credit hours) to meet the criteria of nomenclature with specialization. Where the range of major exceeds beyond eighty-one (81) credit hours, the number of specialization electives will accordingly be increased.
2. Where the electives are adopted from within a single specialization domain, the degree will be offered as Bachelor of Science in Statistics (with name of specialization) in accordance with the National Qualifications Framework (2015) such as Bachelor of Science in Statistics (Data Science and Machine Learning) etc.
3. Where the electives are adopted from more than one specialization domains, the degree will be awarded as Bachelor of Science in Statistics in its generic form and without any specialization.
4. Subject to approval of the relevant statutory body, the department may develop additional specializations other than those prescribed in this policy.
5. It should however be noted that offering of the degree program with specialization is prescribed in this policy as an option only and not as a mandatory requirement or a binding on the offering department. In view of this, the concerned department may consider to offer the degree program with specialization or not, as per its available academic, human, and infrastructural resources.

EQUIVALENCE OF QUALIFICATIONS IN STATISTICS FOR THE PURPOSE OF EMPLOYMENT

1. All graduates having degrees of Bachelor of Science in Statistics, with or without specialization, will be considered at par in terms of their knowledge, skills and abilities acquired through the course of the degree program, for the purpose of employment and further education. Therefore, all graduates having Bachelor of Science in Statistics with any specialization are considered equivalent to Bachelor of Science in Statistics. However, where specific specialization is required by the employing agency such as Statistics (Data Science), the same cannot be considered at par with any other specialization such as Statistics (Biostatistics). The titles of degree given above are only examples for clarification.
2. Graduates of the Bachelor of Science in Statistics seeking equivalence with a corresponding degree involving 16 years of education, in any sub-field of the Bachelor of Science in Statistics such as Data Science must study at least 60 credit hours of the sub-field by meeting the following conditions:

a) Completion courses of at least 54 credits within the sub-field Data Science, including:

- 3 fundamental courses (9 credits) related to Data Science.
- 4 interdisciplinary courses (12 credits) relevant to the sub-field Data Science.
- 7 electives (21 credits) specific to the sub-field Specialization (Data Science).
- A minor (12 credits) within the sub-field Data Science.

b) Completion of a 3-credit internship in the area of Data Science.

c) Completion of a 3-credit capstone in the area of Data Science.

3. Upon meeting the above requirements, the graduates of BS in Statistics will be granted equivalence to the BS Data Science degree for employment and further education purposes.

4. The reference of BS Data Science given above is only an example for clarification.

ENTRY AND EXIT PROVISIONS AT UNDERGRADUATE LEVEL

A. PATHWAY FOR GRADUATES WITH ASSOCIATE DEGREE

- Students having completed Associate Degree in Statistics are allowed admission in the fifth semester of the Bachelor of Science in Statistics without any deficiency course.
- Students having completed Associate Degree in any discipline related to the field of Statistics shall be required to complete deficiency courses through a bridging semester before the fifth semester admitting university.
- The minimum eligibility for admission in the fifth semester in above cases is 2.00/4.00 CGPA in the prior qualification i.e., Associate Degree. The concerned university may, however, set higher eligibility and admission criteria for admission in the fifth semester of Bachelor of Science in Statistics.

B. PATHWAY FOR GRADUATES WITH CONVENTIONAL BSC/EQUIVALENT DEGREE PROGRAMS

- Students having completed two-year conventional BSc/equivalent degree programs are allowed admission in the fifth semester of Bachelor of Science in Statistics in which case, such students shall be required to complete deficiency courses through a bridging semester before the fifth semester, as determined by the admitting university.
- The minimum eligibility for admission in the fifth semester in this case is 45% cumulative score in the prior qualification i.e., two-year conventional BSc/equivalent degree programs. The concerned university may however set higher eligibility and admission criteria for admission in the fifth semester of Bachelor of Science in Statistics.

C. EXITING FROM BACHELOROF SCIENCE IN STATISTICS WITH THE ASSOCIATE DEGREE

- Students enrolled in Bachelor of Science in Statistics are allowed to exit the program with the status of an Associate Degree provided that they have completed the requirements of the first four semesters of the BS degree program as prescribed in this policy and maintained a minimum CGPA of 2.0/4.0.

BACHELOR OF SCIENCE IN STATISTICS

PROGRAM DESCRIPTION

The Bachelor of Science in Statistics program is structured in accordance with the HEC Undergraduate Education Policy V 1.1 to provide students with a comprehensive and interdisciplinary understanding of the Statistics domain and equip them with the knowledge and analytical & problem- solving skills to perform real-world data analysis. The program encompasses key areas of Statistics, including probability, sampling, design of experiments, inferential statistics, regression analysis, and statistical computing, etc. thus equipping students to analyze and interpret data effectively. This program will also extend specializations in Data Science, Bio-statistics, Financial Statistics, etc. to enable the students to explore specialized courses and prepare for diverse career opportunities.

Over eight semesters, the curriculum is designed to foster a progressive development of students' theoretical knowledge, analytical skills, and practical understanding, delivering a balanced and robust educational journey. This curriculum is intentionally designed to cultivate critical thinking and research skills essential for addressing statistical issues. The program also offers interdisciplinary opportunities, allowing students to integrate statistical knowledge with fields such as economics, public health, epidemiology, Psychology, and artificial intelligence. By engaging in research projects and internships, students gain practical experience in solving complex problems across various domains.

This program emphasizes hands-on learning, incorporating data-driven projects and the use of modern statistical software. Graduates of the Bachelor of Science in Statistics program will be well-prepared for diverse career opportunities in sectors such as banking and finance, healthcare, technology, insurance, and research or to advance their studies in statistics or related fields.

STANDARD NOMENCLATURE

The scheme of study prescribed for the four-year undergraduate degree in Statistics is based on a total of seven electives. Where the electives are adopted from within a single specialization domain, the degree will be offered as Bachelor of Science in Statistics (with name of specialization) in accordance with the National Qualifications Framework (2015), and where the seven courses are adopted from more than one specialization domains, the degree will be awarded as Bachelor of Science in Statistics in its generic form and without any specialization.

PROGRAM LEARNING OUTCOMES

By the completion of Bachelor of Science degree in Statistics, the graduates will be able to:

- Demonstrate a comprehensive understanding of fundamental and advanced concepts in Statistics and their relevance to contemporary global trends.
- Demonstrate an understanding of statistical principles, probability theory, and methodologies to solve real-world problems across diverse disciplines.
- Use statistical techniques and software tools to collect, analyze, and interpret complex data, providing actionable insights for policymaking.
- Communicate statistical results, visualizations, and interpretations to technical and non-technical audiences.
- Apply ethical principles and professional standards in the collection, analysis, and dissemination of the data.
- Demonstrate readiness for advanced studies or professional growth by engaging in continuous learning and staying updated with emerging trends and technologies in statistics.

ELIGIBILITY & ADMISSION CRITERIA

Higher Secondary School Certificate (involving 12 years of schooling) or an IBCC equivalent qualification in any group of studies is the minimum eligibility requirement for admission in the Bachelor of Science in Statistics.

PROGRAM STRUCTURE

The Bachelor of Science in Statistics is structured in accordance with the provisions of the HEC Undergraduate Education Policy V 1.1 and comprises of minimum 133 credit hours (including internship/field experience) spread over eight (08) regular semesters. Universities may offer courses up-to maximum of 144 credit hours provided that the total number of credit hours are reasonably set to achieve the Program Learning Objectives (PLOs) without putting undue burden on students.

Minimum Credit Hours (including all program-related requirements)	133
General Education Courses	34 credit hours (15 courses)
Major/ Discipline Related Courses	81 credit hours. (27 courses including 7 mandatory elective courses)
Interdisciplinary / Allied Courses	12 credit hours (4 courses)
Internship	3 credit hours
Capstone Project	3 credit hours

Program Duration	Minimum: 4 Years Maximum: 6 Years (further extendable by another year subject to approval of the university's statutory body)
Semester Duration	16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)	15-18 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)	3 classes (1 hour each) OR 2 classes (1.5 hour each) OR 1 class (3 hours) per week throughout the semester

Standard scheme of study for the program of Bachelor of Science in Statistics (irrespective of the area of specialization) is given as under:

SEMESTER I			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Introduction to Statistics	3 (3-0)	Major
2	Quantitative Reasoning – I *	3 (3-0)	General Education
3	Natural Science **	3 (2-1)	General Education
4	Functional English *	3 (3-0)	General Education
5	Application of Information & Communication Technologies	3 (2-1)	General Education
6	Calculus-I *****	3 (3-0)	IDS
Total Credits (18)			

SEMESTER II			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Introduction to Probability & Probability Distributions	3 (3-0)	Major
2	Introduction to Sampling Theory	3 (3-0)	Major
3	Calculus – II *****	3 (3-0)	IDS
4	Understanding of Holy Quran - I *#	1 (0-1)	General Education
5	Quantitative Reasoning – II *	3 (3-0)	General Education
6	Expository Writing *	3 (3-0)	General Education
7	Pakistan Studies *	2 (2-0)	General Education
Total Credits (18)			

SEMESTER III			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Basic Statistical Inference	3 (3-0)	Major
2	Exploratory Data Analysis and Visualization	3 (3-0)	Major
3	Arts & Humanities ****	2 (2-0)	General Education
4	Islamic Studies * (Religious Edu. / Ethics for non-Muslim students)	2 (2-0)	General Education
5	Understanding of Holy Quran - II *#	1 (0-1)	General Education
6	Ideology & Constitution of Pakistan *	2 (2-0)	General Education

7	Official Statistics	3 (3-0)	Major
Total Credits (16)			

SEMESTER IV			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Introduction to Regression and Analysis of Variance	3 (3-0)	Major
2	Data Wrangling	3 (3-0)	Major
3	Statistical Packages	3 (3-0)	Major
4	Non-Parametric Methods	3 (3-0)	Major
5	Social Science ***	2 (2-0)	General Education
6	Civics & Community Engagement *	2 (2-0)	General Education
7	Entrepreneurship *	2 (2-0)	General Education
Total Credits (18)			

SEMESTER V			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Probability Distributions	3 (3-0)	Major
2	Design and Analysis of Experiments	3 (3-0)	Major
3	Sampling Techniques	3 (3-0)	Major
4	Biostatistics	3 (3-0)	Major
5	Linear Algebra*****	3 (3-0)	IDS

Total Credits (15)

SEMESTER VI			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Statistical Inference	3 (3-0)	Major
2	Regression Analysis	3 (3-0)	Major
3	Elective I******	3 (3-0)	Major
4	Elective II******	3 (3-0)	Major
5	Interdisciplinary/IDS Course IV	3 (3-0)	IDS
Total Credits (15)			

SEMESTER VII			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Statistical Programming Using R and Python	3 (3-0)	Major
2	Research Methodology	3 (3-0)	Major
3	Statistical Quality COntrol	3 (3-0)	Major
4	Elective III******	3 (3-0)	Major
5	Elective IV******	3 (3-0)	Major
Total Credits (15)			

SEMESTER VIII			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Applied Multivariate Analysis	3 (3-0)	Major
2	Elective V******	3 (3-0)	Major
3	Elective VI******	3 (3-0)	Major
4	Elective VII******	3 (3-0)	Major
5	Capstone Project	3 (3-0)	Major
Total Credits (15)			

- Internship of 6-8 weeks preferably during the semester break in senior years

Note: Internship of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, researchor project work.

* HEC-designed model courses may be used by the university.
*# These are prescribed for all NQF level 4-8 qualifications as mandated vide HEC letter no 1001/2022/Coord(Acad)/HEC/235 dated March 28, 2025.
** The university/offering department may offer any course in the broader category of “Natural Sciences” which should have relevance to the purpose of the degree program.
*** The university/offering department may offer any course in the broader category of “Social Sciences” including but not limited to a course of Psychology, Sociology, Anthropology etc.
**** The university/offering department may offer any course in the broader category of “Arts & Humanities” including but not limited to a course of regional or international language such as Chinese, Arabic, French, Spanish, etc., or any other course such as Philosophy, History etc.
***** These interdisciplinary courses are proposed by the NCRC, however, the university/offering department may offer any four (04) interdisciplinary courses from the proposed list provided in this document, or any other such course to enhance the interdisciplinary understanding of the students, keeping in view its available academic, human and infrastructural resources. Credit combination may be arranged in accordance with the nature of the course.

Read in conjunction with the guideline given on “Equivalence of Qualifications in Statistics for the Purpose of Employment” in this document, the four (04) interdisciplinary courses may be opted from a specific area, for example, “Data Science” in case the student desires for equivalence of the degree with that Data Science.

The minimum requirement for interdisciplinary courses for a Bachelor of Science in Statistics, irrespective of the area of specialization, is twelve (12) credit hours, which may be increased, provided that the same is approved by the university’s relevant statutory body.

****** Read in conjunction with the guidance given on “Standard Nomenclature” in this policy, the university/offering department may offer any seven (07) courses from either the general pool of electives or from within one of the specializations, keeping in view its available academic, human, and infrastructural resources. Credit combinations may be arranged in accordance with the nature of the course.

Explanation on Offering of Electives:

In accordance with the National Qualifications Framework, the department may offer at least seven electives, comprised of 21 credit hours (minimum of 25 % of the main field i.e. Statistics, which comprises of 81 credit hours) to meet the criteria of nomenclature with specialization.

COURSE LEARNING OUTCOMES

INTRODUCTION TO STATISTICS

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

- Have an introduction of statistics as a field of knowledge and its scope and relevance to other disciplines of natural and social sciences.
- Equip and prepare students for advanced courses in the field of statistics.
- Achieve the capability of critical thinking about data and its sources; have an idea about variables and their types and scale measures.
- Be able to present data, analyze, and interpret descriptive statistics.
- Construct and interpret index numbers.

CALCULUS I

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

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

analytical reasoning.

CALCULUS-II

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

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

INTRODUCTION TO SAMPLING THEORY

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

- Understand basic sampling theory related to sample, types of sampling, and sampling frame.
- Identify and comprehend different sampling plans.
- Compute sample size in various practical scenarios.
- Understand sampling distributions of popular statistics including sample mean, variance, proportion etc.

INTRODUCTION TO PROBABILITY & PROBABILITY DISTRIBUTIONS

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

- Understand fundamental concepts of probability theory, counting, and probability rules.
- Understand and apply conditional probability and Bayes theorem.
- Demonstrate the concept of discrete and continuous random variables.
- Apply probability distributions such as binomial, Poisson, hypergeometric and normal distributions to model real-world phenomena.

BASIC STATISTICAL INFERENCE

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

- Use statistical estimation techniques, including point estimation and interval estimation.
- Understand the properties of point estimators.
- Perform hypothesis testing and interpret statistical results in decision-making contexts.
- Apply the concepts of statistical inference to real-world scenarios.

EXPLORATORY DATA ANALYSIS AND VISUALIZATION

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

- Apply principles of effective data visualization to communicate statistical

insights clearly.
- Design and interpret various types of charts and graphs, including bar charts, scatter plots, histograms, and heatmaps using R/ Python/ Power BI, etc.
- Implement interactive and dynamic visualizations for exploratory data analysis.
- Analyze and critique data visualizations for accuracy, bias, and misleading representations.
- Integrate data visualization techniques in real-world statistical reports and presentations.

INTRODUCTION TO REGRESSION AND ANALYSIS OF VARIANCE

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

- Understand relationships between variables through correlation and regression.
- Understand the theory of linear regression models, including simple and multiple regression.
- Apply linear regression techniques to model and analyze relationships between dependent and independent variables.
- Demonstrate the concept of one-way and two-way analysis of variance.
- Evaluate the goodness-of-fit of regression models using metrics such as R-squared, adjusted R-squared, and residual analysis.

OFFICIAL STATISTICS

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

- Understand the official, demographic, and social statistics.
- Know the scope and organization of official statistics.
- Understand the planning and administration statistics.
- Understand different national statistics.
- Use different statistical data sources in Pakistan such as NADRA, PBS etc.

DATA WRANGLING

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

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

STATISTICAL PACKAGES

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

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

NON-PARAMETRIC METHODS

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

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

PROBABILITY DISTRIBUTIONS

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

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

DESIGN AND ANALYSIS OF EXPERIMENTS

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

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

BIOSTATISTICS

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

- Apply the concepts of statistics in health and biomedical sciences.
- Understand sampling strategies in biomedical sciences.
- Apply statistical methods in the analysis of biological and health-related data.

- Demonstrate integration of statistical techniques with data analysis tools and methodologies to extract actionable insights from biological and health datasets.

SAMPLING TECHNIQUES

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

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

LINEAR ALGEBRA

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

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

STATISTICAL INFERENCE

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

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

REGRESSION ANALYSIS

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

- Understand assumptions of the classical normal linear regression model.
- Conduct inference for linear regression models and properties of least square estimators.
- Apply different diagnostic measures of the linear regression model.
- Understand consequences and remedial measures in case of violation of basic assumptions.
- Understand model selection criteria.

STATISTICAL PROGRAMMING USING R AND PYTHON

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

- Understand basic programming concepts, including algorithms, data structures, flow control, etc., using R and Python.
- Use different R packages and Python libraries for statistical computing.
- Use R and Python programming for statistical problems.

RESEARCH METHODOLOGY

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

- Understand the fundamental principles of research methodology, encompassing various research types, designs, and pertinent procedures.
- Use various data collection tools.
- Develop a questionnaire, and check its validity and reliability.
- Understand research ethics and report writing.

STATISTICAL QUALITY CONTROL

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

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

APPLIED MULTIVARIATE ANALYSIS

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

- Apply Statistical inference for multivariate data.
- Apply multivariate regression and relevant inference.
- Understand multivariate statistical techniques for dimension reduction such as principal component analysis and factor analysis.
- Use discriminant analysis and clustering techniques.

RECOMMENDED LIST OF INTERDISCIPLINARY COURSES

Students may opt for interdisciplinary courses from the following list where required in the scheme of studies for Bachelor of Science in Statistics, from other departments to complement their holistic understanding of the major, provided that the admitting department allows the same. The list provided here is a recommended one only, and the offering department may add more courses as and when needed, provided that the same is approved by the university's relevant statutory body.

- Calculus-I
- Calculus-II
- Linear Algebra
- Programming Fundamentals
- Introduction to Database Management Systems
- Introduction to Cybersecurity

- Bioinformatics and Statistical Genetics
- Financial Statistics and Risk Analysis
- Environmental Statistics and Climate Modeling
- Statistical Methods in Epidemiology and Public Health
- Sports Analytics and Performance Modeling
- Social Network Analysis and Text Mining
- Statistical Applications in Engineering and Manufacturing
- Political Data Science and Public Policy Analytics
- Neural Network
- Queuing Theory
- Cloud Computing
- Game Theory

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed for the award of a Bachelor of Science degree in Statistics:

a) All courses in the General Education category with titles and credit hours as prescribed in HEC Undergraduate Education Policy V 1.1 including the course of “Pakistan Studies” must be completed.

b) A minimum of 133 credit hours, including all program-related requirements, as prescribed in this document must be completed.

c) Capstone/research project of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework or internship.

d) Internship of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.

e) CGPA must not be below 2.00/4.00 at the time of completion of the degree program. The university may, however, set a higher standard in this regard.

f) The minimum duration to complete the degree is eight (08) regular semesters spread over four (04) years. The duration may be extended in extraordinary circumstances, subject to the approval of the university’s relevant statutory body, provided that the total duration to complete the undergraduate degree program does not go beyond the maximum duration prescribed in HEC semester guidelines. The summer semester is not considered as a regular semester.

GENERAL POOL OF ELECTIVES

(NQF LEVEL 6 QUALIFICATIONS)

Below is the recommended list of electives in case where the Bachelor of Science in Statistics is without specialization. The concerned department may offer any seven (07) courses from the following list or any other advanced course in Statistics keeping in view its available academic, human,

and infrastructural resources:

1. Statistical Tools for Data Science
2. Statistics for Deep Learning
3. Statistical Methods for Data Mining
4. Statistical Machine Learning
5. Artificial Intelligence
6. Big Data Analytics
7. Digital Analytics
8. High-Dimensional Data Analysis
9. Epidemiology
10. Survival Analysis
11. Categorical Data Analysis
12. Analysis of Repeated Measurements
13. Design and Analysis of Medical Studies
14. Structural Equation Models
15. Pharmaceutical Statistics
16. Clinical Trials
17. Financial Econometrics
18. Time Series Analysis and Forecasting
19. Actuarial Statistics
20. Reliability Analysis
21. Predictive Modeling
22. Structural Equation Modeling
23. Digital Analytics
24. Big Data Analytics
25. Applied Econometrics
26. Operations Research
27. Bayesian Statistics
28. Stochastic Processes
29. Spatial Statistics
30. Population Studies and Demographic Techniques
31. Robust Statistics
32. Environmental Statistics
33. Functional Data Analysis

MAJOR SPECIALIZATIONS OF STATISTICS

(NQF LEVEL 6 QUALIFICATIONS)

Following are a few examples of specialization streams in the case of Bachelor of Science in Statistics with specialization, such as BS Statistics (Biostatistics). Subject to the approval of the relevant statutory body, the department may develop additional specializations other than those prescribed here. It should however be noted that the offering of the degree

program with specialization is prescribed as an option only and not as a mandatory requirement or a binding on the offering department. The concerned department may consider to offer the degree program with specialization or otherwise, keeping in view its available academic, human, and infrastructural resources.

SPECIALIZATION 1: DATA SCIENCE

Below is the recommended list of courses within the given specialization. The concerned department may offer these seven (07) courses or any other course relevant to the given specialization, as per the availability of academic resources:

1. Statistical Tools for Data Science
2. Statistics for Deep Learning
3. Statistical Methods for Data Mining
4. Statistical Machine Learning
5. Artificial Intelligence
6. Big Data Analytics
7. Digital Analytics
8. High Dimensional Data Analysis

SPECIALIZATION 2: BIOSTATISTICS

Below is the recommended list of courses within the given specialization. The concerned department may offer these seven (07) courses or any other course relevant to the given specialization, as per the availability of academic resources:

1. Epidemiology
2. Survival Analysis
3. Categorical Data Analysis
4. Analysis of Repeated Measurements
5. Design and Analysis of Medical Studies
6. Structural Equation Models
7. Pharmaceutical Statistics
8. Clinical Trials

SPECIALIZATION 3: FINANCIAL STATISTICS

Below is the recommended list of courses within the given specialization. The concerned department may offer these seven (07) courses or any other course relevant to the given specialization, as per the availability of academic resources:

1. Financial Econometrics
2. Time Series Analysis and Forecasting
3. Actuarial Statistics
4. Reliability Analysis

5. Predictive Modeling
6. Structural Equation Modeling
7. Digital Analytics
8. Big Data Analytics

MASTER OF PHILOSOPHY IN STATISTICS (MPHIL STATISTICS)

PROGRAM DESCRIPTION

The MPhil in Statistics program is designed to provide students with a rigorous and in-depth understanding of advanced theories, concepts, and methodologies in the field of Statistics. This program equips students with the skills to tackle complex data analysis challenges in diverse fields. Core courses provide students with a strong foundation in both theoretical and applied statistics, preparing them for advanced research, statistical consulting, or roles in data-driven industries, while elective optionsallow students to choose a specialized track, develop deep expertise in specific areas of statistics, and prepare for advanced careers in academia, research, data science, or industry applications.

During the course of the program, students will also engage in independent research, culminating in a thesis, enabling them to contribute original insights to the academic and policy discourse. The research component is supported by advanced training in research methods, enabling students to design and conduct robust studies using qualitative and quantitative approaches. The ultimate goal of the program is to prepare graduates for impactful careers in the fields requiring expertise in Statistics, including but not limited to industry, government, and academia or to pursue doctoral studies.

STANDARD NOMENCLATURE

To ensure uniformity, the standard nomenclature for all NQF-level 7 qualifications in the field of Statistics shall be Master of Philosophy in Statistics (MPhil Statistics).

PROGRAM LEARNING OUTCOMES

By the completion of MPhil Statistics, the graduates will be able to:

a) Demonstrate advanced knowledge of theories, concepts, and methodologies in Statistics, integrating interdisciplinary approaches to analyze and address complex problems and conduct high-level data analysis across various domains.

b) Master the use of modern statistical software, computational techniques, and programming languages for efficient data processing, analysis, and visualization.

c) Design and execute original research projects, utilizing advanced statistical methods to generate insights and contribute to the body of knowledge in the field.

d) Present and interpret statistical findings clearly and effectively to diverse audiences, ensuring accurate and meaningful dissemination of results.

e) Integrate ethical considerations and innovative approaches into statistical analysis, addressing real-world challenges responsibly and creatively.

ELIGIBILITY & ADMISSION CRITERIA

a) An undergraduate degree (involving 16 years of education) in Bachelor of Science in Statistics is the basic eligibility requirement for admission in the Master of Science in Statistics.

b) The admitting university, in addition to the basic eligibility, is further required to conduct a rigorous admission test as an eligibility condition for admission to the program, with a passing score of 50% (OR) accept the GRE/HAT General/equivalent tests, with a passing score of 50%.

c) Candidates having intradisciplinary qualifications may be considered for admission, provided the criteria mentioned in the HEC Graduate Education Policy – 2023 is fulfilled.

PROGRAM STRUCTURE

Standard structure of the NQF level 7 qualification in Statistics program, as recommended by the NCRC in Statistics, is as under

Credit Hours	Minimum 32
Course Work	Minimum 26 credit hours (10 courses)
Research Work / Thesis	Minimum 06 credit hours
Program Duration	The MS/MPhil degree shall be awarded by the universities not before the completion of 1.5 years or three (03) regular semesters and not after completion of four (04) years or eight (08) regular semesters, save exceptions mentioned below: In case a student is unable to secure an MS/MPhil within the prescribed timeframe and claims for extension in duration, the university may constitute the appropriate authority and determine the causes of delay. In the event of force majeure (i.e., delay on account of circumstance beyond the control of student), the university may grant an extension in the period of award of MS/MPhil degree in accordance with the duration limiting factor(s) and shall also take corrective measures in case the delay is caused by process or administrative reasons.
Semester Duration	16-18 weeks for regular semesters (1-2 weeks for examination) 8-9 weeks for summer semesters (1 week for examination)
Course Load (per semester)	09-12 credit hours for regular semesters Up-to 8 credit hours for summer semesters (for remedial/deficiency/failure/repetition courses only)
3 Credit Hours (Theory)	3 classes (1 hour each) OR 2 classes (1.5 hour each) OR 1 class (3 hours)
1 Credit Hours (Lab / Field Work)	1 credit hour in laboratory or practical work would require lab / field contact of three hours per week throughout the semester.

The standard scheme of studies for NQF level 7 qualification in Statistics is given below:

SEMESTER I			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Linear Models and Regression Analysis	3 (3-0)	Core *
2	Computational Statistics	3 (3-0)	Core *
3	Elective I**	3 (3-0)	Elective
4	Elective II**	3 (3-0)	Elective
Total Credits (12)			

SEMESTER II			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Advanced Machine Learning Techniques	3 (3-0)	Core *
2	Elective III**	3 (3-0)	Elective
3	Elective IV**	3 (3-0)	Elective
4	Elective V**	3 (3-0)	Elective
Total Credits (12)			

SEMESTER III			
S.N.	COURSE	CREDIT HOURS	CATEGORY
1	Thesis***	6 (6-0)	Research
2	Understanding of Holy Quran - I ****	1 (0-1)	General Education
3	Understanding of Holy Quran - II ****	1 (0-1)	General Education
Total Credits (08)			

* These are core mandatory courses for the program, irrespective of the area of specialization.

** The university / offering department may offer any advanced course in the field of Statistics as an elective, where required as per available academic

and faculty resources.

*** In line with HEC's Graduate Education Policy (GEP) 2023, in a case a degree is offered with research work, the university shall develop a policy regarding thesis defense and evaluation through its statutory body.

The above structure of the MPhil in Statistics program is recommended by the NCRC, while offering the MS/MPhil (Statistics) program, the universities are required to comply with the guidelines and minimum requirements for award of MS/MPhil/equivalent degrees (level 7), as prescribed in HEC's Graduate Education Policy (GEP)-2023.

**** These are prescribed for all NQF level 4-8 qualifications as mandated vide HEC letter no. 1001/2022/Coord (Acad)/HEC/235 dated March 28, 2025.

COURSE LEARNING OUTCOMES – CORE COURSES

LINEAR MODELS AND REGRESSION ANALYSIS

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

- Understand assumptions of linear models.
- Apply robust and improved inference for linear models.
- Apply different regression models such as ridge regression, lasso regression, distributed lag model, and polynomial regression etc.

COMPUTATIONAL STATISTICS

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

- Acquire programming skills using R / Python.
- Develop user-defined functions and packages for statistical computing.
- Generate pseudo data and simulate different models using programming with R or Python.

ADVANCED MACHINE LEARNING TECHNIQUES

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

- Learn key supervised and unsupervised algorithms for regression and classification.
- Gain skills in cross validation, generalization error and model selection.
- Apply machine learning concepts to real world problems using programming language.

LIST OF RECOMMENDED ELECTIVES

- Financial Time Series
- Advanced Bayesian Inference
- Bayesian Reliability
- Advanced Design and Analysis of Experiments
- Statistical Methods in Genomics
- Advanced Data Visualization
- Artificial Intelligence
- Neural Networks

- Advanced Spatial Data Analysis
- Operations Research
- Stochastic Process
- Functional Data Analysis
- Deep Reinforcement Learning
- Decision Theory
- Advanced Sampling Techniques
- Advanced Probability Theory
- Randomized Response Techniques
- Mathematical Modelling and Simulation
- Environmental Statistics
- Non-Parametric Statistics
- Applied Smoothing Techniques
- Multilevel Modelling
- Meta-analysis
- Generalized Linear Models
- Panel Data Models
- Advanced Econometrics
- Computational Finance
- Advanced Survival Analysis
- Advanced Bayesian Modelling
- Research methodology
- Advanced statistical inference
- High Performance Computing (HPC) for Statistical Analysis
- Quantum Computing

DEGREE AWARD REQUIREMENTS

The following minimum requirements are prescribed by the NCRC (Statistics) for the award of NQF level 7 qualification in Statistics:

a) Minimum of thirty (32) credit hours, including twenty-four (24) credit hours for core & elective courses, two (02) credit hours of mandatory Quran courses, and six (6) credit hours for thesis as prescribed in this document, must be completed.

b) CGPA must not be below 2.50/4.00 at the time of completion of the degree program. The university may however set higher standard in this regard.

The minimum duration required to complete the degree is three (03) regular semesters which may be extended up to maximum of eight (08) regular semesters. The summer semester is not considered as a regular semester.

HIGHER EDUCATION COMMISSION
ISLAMABAD