CURRICULUM
OF
STATISTICS
BS (4–YEAR)

2008

HIGHER EDUCATION COMMISSION
ISLAMABAD
CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi          Executive Director
Dr. Riaz-ul-Haq Tariq             Member (Acad.)
Miss Ghayyur Fatima               Deputy Director (Curri)
Mr. M. Tahir Ali Shah             Assistant Director
Mr. Shafiullah Khan               Assistant Director
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PREFACE

Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economics setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor’s Committee, the curriculum of a subject must be reviewed after every 3 years.

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. For those social sciences and basic sciences degrees, 63.50% of the curriculum will consist of discipline specific courses, and 36.50% will consist of compulsory courses and general courses offered through other departments.

For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision Committee for Statistics in a meeting held on November 19 – 20, 2007 at
HEC Islamabad revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR. RIAZ-UL-HAQ TARIQ  
Member Academics

June 2008
CURRICULUM DEVELOPMENT

STAGE-I

CURRI. UNDER CONSIDERATION

COLLECTION OF REC.

CONS. OF CRC.

PREP. OF DRAFT BY CRC

STAGE-II

CURRI. IN DRAFT STAGE

APPRAISAL OF 1ST DRAFT BY EXP. OF COL./UNIV.

FINALIZATION OF DRAFT BY CRC

APPROVAL OF CURRI. BY V.C.C.

STAGE-III

FINAL STAGE

PREP. OF FINAL CURRI.

INCORPORATION OF REC. OF V.C.C.

STAGE-IV

FOLLOW UP STUDY

QUESTIONNAIRE

COMMENTS

PRINTING OF CURRI.

REVIEW

IMPLE. OF CURRI.

BACK TO STAGE-I

STAGE-IV

ORIENTATION COURSES

Abbreviations Used:
CRC. Curriculum Revision Committee
VCC. Vice-Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
INTRODUCTION

A meeting of National Curriculum Revision Committee in Statistics was held on November 19-20, 2007 at HEC, Islamabad. The following attended the meeting:-

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prof. Dr. Munir Akhtar, Chairman, Department of Statistics, Islamia University, Bahawalpur</td>
<td>Convener</td>
</tr>
<tr>
<td>2</td>
<td>Prof. Asim Jamal Siddiqui, Chairman, Department of Statistics, University of Karachi, Karachi</td>
<td>Member</td>
</tr>
<tr>
<td>3</td>
<td>Prof. Dr. Muhammad Aslam, Chairman, Department of Statistics, Quaid-e-Azam University, Islamabad</td>
<td>Member</td>
</tr>
<tr>
<td>4</td>
<td>Prof. Dr. Faqir Muhammad, Chairman, Department of Statistics &amp; Mathematics, Allama Iqbal Open University, Islamabad</td>
<td>Member</td>
</tr>
<tr>
<td>5</td>
<td>Prof. Dr. M. Khalid Pervaiz, Dean, Faculty of Arts &amp; Social Sciences, Government College University, Lahore</td>
<td>Member</td>
</tr>
<tr>
<td>6</td>
<td>Mr. S. Sajjad Hussain Bokhari, Chairman, Department of Statistics, Gomal University, D.I.Khan</td>
<td>Member</td>
</tr>
<tr>
<td>7</td>
<td>Prof. Raja Muhammad Ilyas Rajput, Chairman, Department of Statistics, University of Sindh, Jamshoro</td>
<td>Member</td>
</tr>
<tr>
<td>8</td>
<td>Prof. Dr. Arif Zaman, Department of Computer Science, Lahore University of Management Science, Opposite Sector U, Defense House authority, Lahore</td>
<td>Member</td>
</tr>
<tr>
<td>9</td>
<td>Dr. Ayesha Roohi, Associate Professor, Lahore College for Women University, Jail Road, Lahore</td>
<td>Member</td>
</tr>
<tr>
<td>10</td>
<td>Prof. Muhammad Iqbal Kasi, Chairman, Department of Statistics, University of Balochistan, Quetta</td>
<td>Member</td>
</tr>
<tr>
<td>11</td>
<td>Prof. Dr. Salahuddin, Department of Statistics, University of Peshawar, Peshawar</td>
<td>Member/Secretary</td>
</tr>
</tbody>
</table>
The meeting started with the recitation of Holy Quran by Mr. Shafiullah Khan, Assistant Director (Curriculum) HEC. Prof. Dr. Riaz-ul-Haq Tariq, Member (Academics) briefed the participants about the overall structure of approved unified template/scheme of studies for BS 4-YEAR programme and asked them to adjust the revised Curriculum in Statistics (2006) with that template. He also asked the participants to incorporate latest books in various courses which are easily available in the market and also identify Text Books in each course. After this Mr. Shafiullah Khan requested the participants to select Convener and Secretary of the meeting. The forum unanimously selected Prof. Dr. Munir Akhtar as Convener and Prof. Dr. Salahuddin as Secretary.

The agenda item was discussed. After a thorough discussion the following scheme of studies for BS (4-YEAR) programme was approved.
### FRAME WORK FOR BS (4-YEAR) IN STATISTICS

#### LAYOUT

<table>
<thead>
<tr>
<th>Compulsory Requirements</th>
<th>General Courses to be chosen from other departments</th>
<th>Discipline Specific Foundation Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>(the student has no choice)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>9 courses</strong></td>
<td><strong>7-8 courses</strong></td>
<td><strong>9-10 courses</strong></td>
</tr>
<tr>
<td>25 Credit hours</td>
<td>21-24 Cr. Hours</td>
<td>30-33 Credit hours</td>
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</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Cr. hr</th>
<th>Subject</th>
<th>Cr. hr</th>
<th>Subject</th>
<th>Cr. hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ENGLISH I</td>
<td>3</td>
<td>1. Psychology</td>
<td>3</td>
<td>1. Introductory Statistics</td>
<td>3</td>
</tr>
<tr>
<td>2. ENGLISH II</td>
<td>3</td>
<td>2. Philosophy</td>
<td>3</td>
<td>2. Introduction to Probability</td>
<td>3</td>
</tr>
<tr>
<td>4. COMMUNICATION SKILL</td>
<td>4</td>
<td>4. International Relations</td>
<td>3</td>
<td>4. Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>5. PAKISTAN STUDIES</td>
<td>2</td>
<td>5. Mass</td>
<td>3</td>
<td>5. Introduction to Regression Analysis &amp; Experimental Design</td>
<td>3</td>
</tr>
<tr>
<td>8. CALCULUS-II</td>
<td>3</td>
<td>8. Business Administration (Entrepreneurship)</td>
<td>3</td>
<td>8. Sampling Technique-I</td>
<td>4</td>
</tr>
<tr>
<td>9. INTRODUCTION TO COMPUTER</td>
<td></td>
<td>9. OR * from the list of general courses</td>
<td></td>
<td>9. Statistical Packages</td>
<td>3</td>
</tr>
</tbody>
</table>

| | | | | |
| | | | | |
| **25** | **21** | **28** | | |

#### Major courses including research project/internship

<table>
<thead>
<tr>
<th>Subject</th>
<th>Cr. hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Regression Analysis</td>
<td>4</td>
</tr>
<tr>
<td>2. Design &amp; Analysis of Experiment-I</td>
<td>4</td>
</tr>
<tr>
<td>3. Probability and Probability Distribution-II</td>
<td>3</td>
</tr>
<tr>
<td>4. Sampling Techniques-II</td>
<td>4</td>
</tr>
<tr>
<td>5. Econometrics</td>
<td>4</td>
</tr>
<tr>
<td>6. Design &amp; Analysis of Experiment-II</td>
<td>4</td>
</tr>
<tr>
<td>7. Non Parametric Methods</td>
<td>3</td>
</tr>
<tr>
<td>8. Statistical Inference-I</td>
<td>3</td>
</tr>
<tr>
<td>9. Applied Multivariate Analysis</td>
<td>4</td>
</tr>
<tr>
<td>10. Research Methods / Internship</td>
<td>3</td>
</tr>
<tr>
<td>11. Population Studies</td>
<td>4</td>
</tr>
<tr>
<td>12. Statistical Inference-II</td>
<td>3</td>
</tr>
<tr>
<td>13. Project</td>
<td>3</td>
</tr>
</tbody>
</table>

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| **46** | | | | |

#### Elective Courses within the major

<table>
<thead>
<tr>
<th>Subject</th>
<th>Cr. hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Operation Research</td>
<td>3</td>
</tr>
<tr>
<td>2. Stochastic Process</td>
<td>3</td>
</tr>
<tr>
<td>3. Reliability Analysis</td>
<td>3</td>
</tr>
<tr>
<td>4. Time Series and Forecasting</td>
<td>3</td>
</tr>
<tr>
<td>OR * from the list of elective courses.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Cr. hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Population Studies</td>
<td>4</td>
</tr>
<tr>
<td>2. Statistical Inference-II</td>
<td>3</td>
</tr>
<tr>
<td>3. Project</td>
<td>3</td>
</tr>
</tbody>
</table>

| | | | | |
| | | | | |
| **46** | | | | |

| | | | | |
| | | | | |
| **10** | | | | |
# MODEL SCHEME OF STUDIES FOR BS (4-YEAR) IN STATISTICS

<table>
<thead>
<tr>
<th>Semester / Year</th>
<th>Name of Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>English-I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Pakistan Studies</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Calculus-I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introductory Statistics (F-1) STAT-101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Second</td>
<td>English-II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Islamic Studies/Ethics</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Calculus-II</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-III</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-IV</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Probability Distributions (F-2) STAT-102</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Third</td>
<td>English-III</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Computer</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-V</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-VI</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Basic Statistical Inference (F-3) STAT-201</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Fourth</td>
<td>Communication Skill</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General-VIII</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Linear Algebra (F-9)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Regression Analysis &amp; Experimental Design (F-4) STAT-202</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Applied Statistics (F-5) STAT-203</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Fifth</td>
<td>Probability &amp; Probability Distribution-1 (F-6) STAT-301</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sampling Technique-I (F-7) STAT-303</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Design &amp; Analysis of Experiment-I (M-2) STAT-305</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Regression Analysis (M-1) STAT-307</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Statistical Packages (F-8) STAT-313</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Sixth</td>
<td>Probability and Probability Distribution-II (M-3) STAT-302</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sampling Techniques-II (M-4) STAT-304</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Design &amp; Analysis of Experiment-II (M-6) STAT-306</td>
<td>4</td>
</tr>
</tbody>
</table>
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.
**LIST OF GENERAL COURSES FOR STATISTICS**

Seven courses are to be selected from the following list of courses, according to available facilities and faculty of the Universities.

1. Psychology         3 credit hrs
2. Philosophy         “
3. Economics          “
4. International Relations  “
5. Mass Communications “
6. Sociology          “
7. Business Administration (Entrepreneurship) “
9. Environmental Sciences “
11. Basic Financial Management “
12. History of Human Civilization “
13. Introduction to Biology “
14. Foreign Language other than English (Like French, German, Chinese etc).
15. Introduction to Physics “
16. Advanced Calculus  “

Any other subject depending upon the expertise available.

**Elective Courses for BS (4-Year) Programme for Statistics**

1. Operation Research STAT-406
2. Stochastic Process STAT-407
3. Reliability Analysis STAT-408
4. Time Series and Forecasting STAT-409
5. Decision Theory   STAT-410
6. Robust Methods    STAT-411
7. Official Statistics STAT-412
8. Survival Analysis  STAT-413
10. Data Mining       STAT-415
11. Actuarial Statistics-I STAT-416
12. Actuarial Statistics-II STAT-417
13. Mathematical Models and Simulation STAT-418
14. Categorical Data Analysis STAT-419
15. Numerical Methods STAT-421
16. Bayesian Statistics STAT-422
17. Statistical Quality Control STAT-423
DETAILS OF THE COURSES

The proposed outlines of the BS (4-YEAR) programme in Statistics are as follows:

STAT-101 Introductory Statistics


Probability Concepts, Addition and Multiplication rules, Bivariate frequency tables, joint and marginal probabilities, Conditional probability and independence, Bayes’ rule.

Books Recommended


* (Text Book)

STAT-102 Introduction to Probability Distributions


**Pre-requisite:** STAT-101

**Books Recommended**

* (Text Book)

**STAT-201 Basic Statistical Inference**

Pre-Requisite- STAT-102

Books Recommended

* (Text Book)

STAT-202 Introduction to Regression Analysis and Experimental Design


One-Way and Two-Way Analysis of Variance
Design of Experiments, Basic Principles of Design of Experiments, Description, Layout and Analysis of Completely Randomized Design, Randomized Complete Block Design and Latin Square Design. Multiple Comparisons (LSD and Duncan’s test). Introduction to Non-Parametric Statistical Methods,

Pre-Requisite: STAT-101

Books Recommended

STAT-203 Applied Statistics


Index numbers: construction and uses of index numbers, un-weighted index numbers (simple aggregative index, average of relative price index numbers). Weighted index numbers (Laspeyres, Paaches and Fishers ideal index numbers). Consumer price index (CPI) and Sensitive Price Indicators.

Time Series Analysis: Components of time series and their isolation.

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.)

Pre-Requisite: STAT-101

Books Recommended

* (Text Book)

STAT-204 Statistical Packages

Introduction to Minitab, data manipulation in Minitab, graphical representation in Minitab, Qualitatively and Quantitative data presentation and analyzing data in Minitab, Programming in Minitab
Introduction of SPSS, data manipulation in SPSS, simple arithmetic in SPSS, SPSS function related to probability distributions, SPSS modules, simple graphing in SPSS.
Analysis using SPSS syntax programming. (Use of SPSS, Minitab, Matlab, Statistica is based upon the availability of Software)

Pre-Requisite: STAT-201

Books Recommended


STAT-301 Probability and Probability Distributions-I


**Pre-Requisite: STAT-102**

**Books Recommended**


* (Text Book)

**STAT-303 Sampling Techniques-I**

Note: Practicals of this course shall include visits of the students to various national statistical organizations and a report submitted to this effect.

Pre-Requisite: STAT-203

Books Recommended


STAT-307 Regression Analysis


Pre-Requisite: STAT-203

Books Recommended

* (Text Book)

STAT-305  Design and Analysis of Experiments-I


Completely Randomized, Randomized Complete Block, Latin square, Graeco-Latin square and cross-over designs. Missing observations. Relative efficiency of designs. Estimation of mean squares and their expectations. Multiple Comparisons.

Analysis of covariance in CR, RCB designs. Estimation of missing values in analysis of covariance.

Pre-Requisite: STAT-202

Books Recommended

* (Text Book)

STAT-310 Non-Parametric Methods

Location estimates for single samples: The sign test, modified sign test, Wilcoxon signed rank test, confidence interval based on these tests. Runs test for randomness.


Pre-Requisite: STAT-202,301

Books Recommended
* (Text Book)

**STAT-302 Probability and Probability Distributions-II**


**Pre-Requisite: STAT-301**

**Books Recommended**

* (Text Books)
STAT-304 Sampling Techniques-II

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. 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-303

Books Recommended

8. Various publications of FBS, ACO and PCO.
* (Text Book)

STAT-308 Econometrics

Pre-Requisite: STAT-307

Books Recommended

* (Text Book)

STAT-306  Design and Analysis of Experiments-II

Factorial Experiments: $2^k$, $3^k$ 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 - Lattice designs, lattice square and Youden squares, PBIBD with recovery of intra-block information.

Pre-Requisite: STAT-305

Books Recommended


25
* (Text Book)

STAT-311 Population Studies


Pre-Requisite: STAT-201 & 202

Books Recommended

4. Govt. of Pakistan (1998), National, Provincial and District census reports and other supplementary reports with respect to 1998 census; PCO, Islamabad.
   * (Text Book)

STAT-401 Statistical Inference-I

Pre-Requisite: STAT-302

Books Recommended


* (Text Book)

STAT-403 Applied Multivariate Analysis


Pre-Requisite: STAT-302

Books Recommended

*(Text Book)

STAT-405 Survey and Research Methods

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.

PRACTICAL:

Survey of Literature on a Given Topic, Collection of References from Various Sources Including SD-ROM Data Base. Collection of Primary and Secondary Data, Arrangement of Primary and Secondary Data, Preparation of Scientific Report for Publication, if Possible

Pre-Requisite: STAT-304

Books Recommended

STAT-402  Statistical Inference-II

Interval Estimation: Pivotal and other methods of finding confidence interval, confidence interval in large samples, shortest confidence interval, optimum confidence interval. Bayes' Interval estimation.

Pre-Requisite: STAT-401

Books Recommended

* (Text Book)

STAT-422  PROJECT

ELECTIVE COURSES

STAT-406  Operations Research

Books Recommended:


* (Text Book)

STAT-407 Stochastic Processes


Books Recommended

* (Text Book)

STAT-408  Reliability Analysis


Books Recommended

* (Text Book)

STAT-409  Time Series Analysis and Forecasting

Stochastic Process, Stationary Time-Series, Exponential smoothing techniques, auto-correlation and auto-covariance, estimates functions and standard error of the auto-correlation function (ACF) and PACF, Periodogram, spectral density functions, comparison with ACF, Linear stationary models: Auto regressive, Moving Average and mixed models, Non-stationary models, general ARIMA notation and models, minimum mean square forecasting. ARIMA Seasonal Models.
Books Recommended


* (Text Book)

STAT-410 Decision Theory


Books Recommended


* (Text Book)
STAT-411  Robust Methods


Books Recommended

   * (Text Book)

STAT-412  Official Statistics

Books Recommended:


STAT-413 Survival Analysis

Special features of Survival data: Patient time and study time, Survival function and hazard function, Time dependent and censored survival data. Nonparametric procedures: Estimation of Survival function, hazard function, median and percentiles of Survival times. Confidence interval and comparison of group; stratified and log-rank tests for trend. Modeling of Survival data; hazard function modeling; its tests and confidence interval. The Waybill model for survival data. Exploratory data analysis and other models. Sample size requirement for survival study. Computer software for Survival analysis; any available software like SAS, BMDP, SPSS, GLIM, GENSTAT or S-plus.

Books Recommended


* (Text Book)

STAT-414 Biostatistics

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

* (Text Book)

STAT-415 Data Mining

Introduction to databases, including simple and relational databases; data warehouses. Review of classification methods from multivariate analysis; classification and decision trees. 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 from moderate to high dimensional input spaces; artificial neural networks and extensions of regression models, regression trees. Association rules and prediction; applications to electronic commerce.

Books Recommended

* (Text Book)

STAT-416 Actuarial Statistics-I

Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curate future lifetime, force of mortality.
Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations.

Distribution of aggregate claims, compound Poisson distribution and its applications.

Books Recommended


STAT-417 Actuarial Statistics-II

Principles of compound interest: Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor, continuous compounding.

Life insurance: Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance, recursions, commutation functions.

Life annuities: Single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities-immediate and apportionable annuities-due.

Net premiums: Continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation type benefits.
Payment premiums, apportionable premiums, commutation functions, accumulation type benefits.

Net premium reserves: Continuous and discrete net premium reserve, reserves on a semi-continuous basis, reserves based on true monthly premiums, reserves on an apportionable or discounted continuous basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.

Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses.

Claim amount distributions, approximating the individual model, stop-loss insurance.

Books Recommended


STAT-418 Mathematical Modeling and Simulation

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 variates and antithetic variables.

Books Recommended:

* (Text Book)

STAT-419 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


STAT-422 Bayesian Statistics

Prior information, Prior distributions, Methods of elicitation of prior distributions, Posterior distributions: The posterior means, medians (Bayes estimators under loss functions) and variances of univariate and bivariate posterior distributions, Noninformative priors: Methods of elicitation of noninformative priors, Bayesian Hypotheses Testing: Bayes factor; The highest density region; Posterior probability of the hypothesis.

Books Recommended


STAT-423  Statistical Quality Management


Acceptance sampling for attributes and variables.


Pre-Requisite: STAT-301

Books Recommended

Recommendations

The following recommendations were made by the committee to enhance the teaching and application of Statistics:

1. Departments of Statistics in the universities should make efforts to interact with the statistical organizations, industry and other users of statistics in the public and private sector.

2. Internship should be funded by the HEC and offered to students in the 7th semester in B.S programme.

3. Most of the courses must involve problem solving using computers.

4. Highly qualified statisticians are in short supply in Pakistan. There is a need of giving extra quota for statistics students for higher education in foreign countries leading to Ph.D. degree. HEC is therefore, impressed upon to give extra scholarships to statistics graduates.

5. The committee strongly recommends the creation of “Department of Biostatistics” for teaching and research guidance at all medical colleges/universities and the post of biostatistician in all hospitals.

6. Practicals conducted during the first 2 years for BS programme should be in the form of case studies. Secondary data published by different organizations may be used in such case studies.

7. Statistics at the intermediate (F.A./F.Sc.) level should also be taught in all the colleges of all the provinces.

8. Each university should create a Centre of Excellence so that a student who wishes to specialize in a specific field should know the best possible university to join.

9. Refresher courses at post-graduate level should be regularly arranged by the HEC.

10. HEC may support universities for the development of computer labs, departmental libraries, students and staff participation in seminars.
Annexure “A”

COMPULSORY COURSES IN ENGLISH FOR BS
(4 YEAR) IN BASIC & SOCIAL SCIENCES

English I (Functional English)

Objectives: Enhance language skills and develop critical thinking.

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension
Answers to questions on a given text

Discussion
General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening
To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills
Urdu to English

Paragraph writing
Topics to be chosen at the discretion of the teacher

Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. Functional English
   a) Grammar

b) Writing

c) Reading/Comprehension

d) Speaking

**English II (Communication Skills)**

**Objectives:** Enable the students to meet their real life communication needs.

**Course Contents**

- **Paragraph writing**
  Practice in writing a good, unified and coherent paragraph

- **Essay writing**
  Introduction

- **CV and job application**
  Translation skills
  Urdu to English

- **Study skills**
  Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

- **Academic skills**
  Letter/memo writing, minutes of meetings, use of library and internet

- **Presentation skills**
  Personality development (emphasis on content, style and pronunciation)

*Note: documentaries to be shown for discussion and review*
Recommended books:

Communication Skills

a) Grammar

b) Writing

c) Reading
2. Reading and Study Skills by John Langan
3. Study Skills by Riachard Yorky.

English III (Technical Writing and Presentation Skills)

Objectives: Enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building
Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

b) Presentation Skills

c) Reading
The Mercury Reader. A Custom Publication. Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shire Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).
Annexure “B”

Pakistan Studies (Compulsory)

Introduction/Objectives

- Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan.
- Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline

1. Historical Perspective
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and geo-physical features.

2. Government and Politics in Pakistan
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. Contemporary Pakistan
   a. Economic institutions and issues
   b. Society and social structure
   c. Ethnicity
   d. Foreign policy of Pakistan and challenges
e. Futuristic outlook of Pakistan

Books Recommended

Annexure “C”

ISLAMIC STUDIES
(Compulsory)

Objectives:
This course is aimed at:
1. To provide basic information about Islamic Studies
2. To enhance understanding of the students regarding Islamic Civilization
3. To improve students’ skill to perform prayers and other worships
4. To enhance the skill of the students for understanding of issues related to faith and religious life.

Detail of Courses

Introduction to Quranic Studies
1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul-Quran

Study of Selected Text of Holy Quran
1. Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2. Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3. Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4. Verses of Surah Al-Furqan Related to Social Ethics (Verse No.63-77)
5. Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

Study of Selected Text of Holy Quran
1. Verses of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No.6,21,40,56,57,58.)
2. Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3. Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

Seerat of Holy Prophet (S.A.W) I
1. Life of Muhammad Bin Abdullah (Before Prophet Hood)
2. Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

Selected Study from Text of Hadith

Introduction To Islamic Law & Jurisprudence

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

Islamic Culture & Civilization

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

Islam & Science

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science

Islamic Economic System

1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

Political System of Islam

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

Islamic History
1) Period of Khlaft-E-Rashida
2) Period of Ummayyads
3) Period of Abbasids

Social System of Islam
1) Basic Concepts Of Social System Of Islam
2) Elements Of Family
3) Ethical Values Of Islam

Reference Books:
1) Hameed ullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2) Hameed ullah Muhammad, “Muslim Conduct of State”
3) Hameed ullah Muhammad, “Introduction to Islam”
4) Mulana Muhammad Yousaf Islahi,”
6) Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
9) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)
Annexure “D”

Note: One course will be selected from the following six courses of Mathematics.

COMPULSORY MATHEMATICS COURSES FOR BS (4 YEAR)

(FOR STUDENTS NOT MAJORING IN MATHEMATICS)

1. MATHEMATICS I (ALGEBRA)

Prerequisite(s): Mathematics at secondary level
Credit Hours: 3 + 0

Specific Objectives of the Course: To prepare the students, not majoring in mathematics, with the essential tools of algebra to apply the concepts and the techniques in their respective disciplines.

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.

Quadratic Equations: Solution of quadratic equations, qualitative analysis of roots of a quadratic equations, equations reducible to quadratic equations, cube roots of unity, relation between roots and coefficients of quadratic equations.


Recommended Books:
Dolciani MP, Wooton W, Beekenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton & Mifflin,

Boston (suggested text)
Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston
2. **MATHEMATICS II (CALCULUS)**

**Prerequisite(s):** Mathematics I (Algebra)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of calculus to apply the concepts and the techniques in their respective disciplines.

**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:**


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

3. **MATHEMATICS III (GEOMETRY)**

**Prerequisite(s):** Mathematics II (Calculus)

**Credit Hours:** 3 + 0

**Specific Objectives of the Course:** To prepare the students, not majoring in mathematics, with the essential tools of geometry to apply the concepts and the techniques in their respective disciplines.
Course Outline:

Geometry in Two Dimensions: Cartesian-coördinate mesh, slope of a line, equation of a line, parallel and perpendicular lines, various forms of equation of a line, intersection of two lines, angle between two lines, distance between two points, distance between a point and a line.

Circle: Equation of a circle, circles determined by various conditions, intersection of lines and circles, locus of a point in various conditions.

Conic Sections: Parabola, ellipse, hyperbola, the general-second-degree equation

Recommended Books:

Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston

4. COURSE FOR NON-MATHEMATICS MAJORS IN SOCIAL SCIENCES

Title of subject: MATHEMATICS
Discipline: BS (Social Sciences).
Pre-requisites: SSC (Metric) level Mathematics
Credit Hours: 03 + 00
Minimum Contact Hours: 40
Assessment: written examination;
Effective: 2008 and onward

Aims: To give the basic knowledge of Mathematics and prepare the students not majoring in mathematics.

Objectives: After completion of this course the student should be able to:

- Understand the use of the essential tools of basic mathematics;
- Apply the concepts and the techniques in their respective disciplines;
- Model the effects non-isothermal problems through different domains;
Contents:


Books Recommended:


5. **MATHEMATICS FOR CHEMISTRY**

**Credit Hours:** 3

**Prerequisites:** Mathematics at Secondary level

**Specific Objectives of Course:** To prepare the students not majoring in mathematics with the essential tools of Calculus to apply the concepts and the techniques in their respective disciplines.

**Course Outline:**


**Recommended Books:**


6. **MATHEMATICS FOR PHYSICS**

**Contents**

1. Preliminary calculus.
   - Differentiation
     Differentiation from first principles; products; the chain rule; quotients; implicit differentiation; logarithmic differentiation;
Leibnitz' theorem; special points of a function; theorems of differentiation.

Integration
Integration from first principles; the inverse of differentiation; integration by inspection; sinusoidal function; logarithmic integration; integration using partial fractions; substitution method; integration by parts; reduction formulae; infinite and improper integrals; plane polar coordinates; integral inequalities; applications of integration.

2. **Complex numbers and hyperbolic functions**

- The need for complex numbers
- Manipulation of complex numbers
  - Additions and subtraction; modulus and argument; multiplication; complex conjugate; division
- Polar representation of complex numbers
  - Multiplication and division in polar form
- de Moivre’s theorem
  - Trigonometrical identities; finding the nth roots of unity; solving polynomial equations
- Complex logarithms and complex powers
- Applications to differentiation and integration
- Hyperbolic functions
  - Definitions; hyperbolic-trigonometric analogies; identities of hyperbolic functions; solving hyperbolic equations; inverses of hyperbolic functions; calculus of hyperbolic functions

3. **Series and limits**

- Series
- Summation of series
  - Arithmetic series; geometric series; arithmetico-geometric series; the difference method; series involving natural numbers; transformation of series
- Convergence of infinite series
  - Absolute and conditional convergence; convergence of a series containing only real positive terms; alternating series test
- Operations with series
- Power series
  - Convergence of power series; operations with power series
• Taylor series
  Taylor’s theorem; approximation errors in Taylor series; standard Maclaurin series
• Evaluation of limits

4. Partial differentiation
• Definition of the partial derivative
• The total differential and total derivative
• Exact and inexact differentials
• Useful theorems of partial differentiation
• The chain rule
• Change of variables
• Taylor’s theorem for many-variable functions
• Stationary values of many-variable functions
• Stationary values under constraints

5. Multiple integrals
• Double integrals
• Triple integrals
• Applications of multiple integrals
  Areas and volumes; masses, centers of mass and centroids; Pappus’ theorems; moments of inertia; mean values of functions
• Change of variables in multiple integrals
• Change of variables in double integrals;

6. Vector algebra
• Scalars and vectors
• Addition and subtraction of vectors
• Multiplication by a scalar
• Basis vectors and components
• Magnitude of a vector
• Multiplication of vectors
  Scalar product; vector product; scalar triple product; vector triple product
• Equations of lines and planes
  Equation of a line; equation of a plane
• Using vectors to find distances
  Point to line; point to plane; line to line; line to plane
• Reciprocal vectors

7. Matrices and vector spaces
• Vectors spaces
Basic vectors; the inner product; some useful inequalities

- Matrices
- The complex and Hermitian conjugates of a matrix
- The determinant of a matrix
  Properties of determinants
- The inverse of a matrix
- The rank of a matrix
- Simultaneous linear equations
  \( N \) simultaneous linear equations in \( N \) unknowns

- Special square matrices
  Diagonal; symmetric and antisymmetric; orthogonal; Hermitian; unitary normal

- Eigen vectors and eigen values
  Of a normal matrix; of Hermitian and anti-Hermitian matrices; of a unitary matrix; of a general square matrix

- Determination of eigen values and eigen vectors
  Degenerate eigen values

8. Vector calculus

- Differentiation of vectors
  Composite vector expressions; differential of a vector

- Integration of vectors

- Space curves

- Vector functions of several arguments

- Surfaces

- Scalar and vector fields

- Vector operators
  Gradient of a scalar field; divergence of a vector field; curl of a vector field

- Vector operator formulae
  Vector operators acting on sums and products; combinations of grad, div and curl

- Cylindrical and spherical polar coordinates
  Cylindrical polar coordinates; spherical polar coordinates
INTRODUCTION TO STATISTICS

Credit hrs: 3(3-0)

Unit 1. What is Statistics?

Unit 2. Presentation of Data
Introduction, basic principles of classification and Tabulation, Constructing of a frequency distribution, Relative and Cumulative frequency distribution, Diagrams, Graphs and their Construction, Bar charts, Pie chart, Histogram, Frequency polygon and Frequency curve, Cumulative Frequency Polygon or Ogive, Historigram, Ogive for Discrete Variable. Types of frequency curves. Exercises.

Unit 3. Measures of Central Tendency
Introduction, Different types of Averages, Quantiles, The Mode, Empirical Relation between Mean, Median and mode, Relative Merits and Demerits of various Averages, properties of Good Average, Box and Whisker Plot, Stem and Leaf Display, definition of outliers and their detection. Exercises.

Unit 4. Measures of Dispersion

Unit 5. Probability and Probability Distributions
Discrete and continuous distributions: Binomial, Poisson and Normal Distribution. Exercises

Unit 6. Sampling and Sampling Distributions
Introduction, sample design and sampling frame, bias, sampling and non sampling errors, sampling with and without replacement, probability and non-probability sampling, Sampling distributions for single mean and proportion, Difference of means and proportions. Exercises.
Unit 7. Hypothesis Testing
   Introduction, Statistical problem, null and alternative hypothesis, Type-I and Type-II errors, level of significance, Test statistics, acceptance and rejection regions, general procedure for testing of hypothesis. Exercises.

Unit 8. Testing of Hypothesis-Single Population
   Introduction, Testing of hypothesis and confidence interval about the population mean and proportion for small and large samples, Exercises

Unit 9. Testing of Hypotheses-Two or more Populations
   Introduction, Testing of hypothesis and confidence intervals about the difference of population means and proportions for small and large samples, Analysis of Variance and ANOVA Table. Exercises

Unit 10. Testing of Hypothesis-Independence of Attributes

Unit 11. Regression and Correlation

Recommended Books