

INDIAN STATISTICAL INSTITUTE

STUDENTS' BROCHURE

**POST-GRADUATE DIPLOMA
IN
STATISTICAL METHODS WITH ANALYTICS**

2014 - 2015



**NORTH-EAST CENTRE,
TEZPUR UNIVERSITY CAMPUS, SAIC BUILDING
TEZPUR, ASSAM – 784028**

POST-GRADUATE DIPLOMA IN STATISTICAL METHODS WITH ANALYTICS

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Post- Graduate Diploma in Statistical Methods and Analytics

The programme is offered at the North-East Centre, Tezpur, Assam **exclusively** for **domiciled North-East students**. The duration of the programme is **one year**.

1. General Information

1.1 Scope

The course is intended to provide students with a comprehensive and rigorous training in basic theory and applications of Statistical Methods and Analytics, in addition to some exposure to Mathematics and Computer Science. It is so designed that on successful completion, the students would be able to take up jobs as statisticians in such departments of government and industries where application of Statistics is required.

1.2. Placement

A prestigious multinational IT consultation and services company has agreed to directly recruit all students securing an aggregate of 60% or above in the programme in a single attempt. The students passing the programme with less than 60% aggregate marks may also be considered for placement.

1.3. Eligibility

In order to be eligible for admission to this programme, a student must have a 3-year Bachelor's degree with Mathematics/Statistics/Economics as one of the subjects and a domicile certificate of North-Eastern states from a recognized authority. Any student who is asked to discontinue the programme is not eligible for readmission in to this programme.

1.4. Stipend and Contingency grant

There is no tuition fee. Each student admitted to this programme will receive a monthly stipend of Rs 2000/- for a period of eleven months, and an annual contingency/book grant of Rs 2000/-. In the first instance, stipends would be granted for the first semester only, and renewed if the progress of the student is found to be satisfactory. Stipend granted to a student may be reduced or fully withdrawn if the academic progress, attendance in class or character and conduct of the student are not found satisfactory (Further details in Section 1.15).

1.5. Selection Procedure

Selection is based on the performances in written test and interview. Past academic records may also be taken into consideration. The written test will comprise multiple-choice questions in Mathematics at pass/minor level of Bachelor's degree.

1.6. Course Structure

The one-year programme consists of a total of 10 courses distributed as five courses per semester.

SEMESTER I

1. Basic Mathematics
2. Probability Theory
3. Statistical Methods
4. Numerical Methods and Optimization
5. Introduction to Packages: R, S and SAS

SEMESTER II

1. Computer Intensive Statistical methods
2. Regression & Time Series
3. Statistical Machine Learning & Statistical Finance
4. Clinical Trials & Actuarial Methods
5. Project

The project work is likely to extend through summer.

All students may be required to spend one week at the headquarters of the institute (Kolkata) at the end of Semester I.

1.7. Examinations and Scores

All the courses in Semester I are **Non-Module-Based** Courses. Courses 2, 3, and 4 in Semester II are **Module-Based** Courses, each consisting of **two** modules.

Non -Module-Based Courses

The final (semester) examination in a course is held at the end of the semester. Besides, there is a mid-semester examination in each course. The calendar for the semester is announced in advance. The composite score in a course is a weighted average of the scores in the mid-semester and semester examinations, class tests, homework, assignments, and /or project work in that course; the weights are announced beforehand by the Dean of Studies, or the In-Charge, Students' Academic Affairs or the Class Teacher, in consultation with the teacher concerned. *The minimum composite score to pass a course is 35%.*

Module-Based Courses

There will be one examination at the end of the module for each of the two modules for any Module-Based course. Weightage to be given to homework, assignments, class tests etc. for any module would be decided by the concerned teacher, and announced beforehand. The score in a module is a weighted average of the scores in the internal assessments and the end of the module examination. Equal weightage will be given to the two modules for computing the composite score of the course. *The minimum composite score to pass a course is 35%.*

Back- Paper Examination

For both types of courses, if the composite score of a student falls short of 45% in a course, the student may take a back-paper examination to improve the score. **At most one** back-paper examination is allowed in each course. Moreover, a student can take at most **two** back-paper examinations in the first semester and at most **one** in the second semester. The decision to allow a student to appear for the back-paper examination is taken by the appropriate Teachers' Committee. The back-paper examination covers the entire syllabus of the course. In case of back-paper examination in a module-based course, there would be one single question paper covering both the modules with equal distribution of marks over the two modules. The total score obtained in a back-paper examination of any module-based course would be the total of marks obtained in the two modules.

When a student takes a back-paper examination in any of these two types of courses, his/her final score in that course is the higher of the back-paper score and the earlier composite score, subject to a maximum of 45%.

A student may take more than the allotted quota of back-paper examinations in a given academic year, and decide at the end of the academic year which of the back-paper examination scores should be disregarded.

Compensatory Paper Examination

A student who gets less than 35% in at most one course even after the back-paper examination in *any* semester, but 60% or more in average in the other courses in that semester, is allowed to appear for a compensatory paper examination. In case of a module-based course, there would be one single question paper, like the back-paper examination, covering all the two modules with equal distribution of marks over the two modules. A student would be allowed to appear in **at most one** compensatory paper in the entire programme. Maximum marks obtainable in a compensatory paper would be 35%. In the second semester, a student would have to choose between the compensatory paper examination and the possibility of repeating the programme. He/she would not be allowed to take both. A student would have to discontinue the programme if he/she scores less than 35% in the compensatory paper in any semester.

Supplementary Examination

If a student misses the mid-semester or semester examination of a course or the examination for a module of a module-based course due to medical or family emergency, the Teachers' Committee may, on an adequately documented representation from the student, allow him/her to take a supplementary examination in the course for the missed examination. The supplementary semester examination for a non-module-based course is held at the same time as the back-paper examination for the semester and the student taking the supplementary semester examination in a course is not allowed to take any further back paper examination in that course. For a module-based course, the supplementary examination is held at a convenient time. The maximum that a student can score in a supplementary examination is 60%. Unlike the back-paper examination, the score in the supplementary examination is used along with other scores to arrive at the composite score.

There will be supplementary examination for mid-semester, semester, back-paper and compensatory examinations within a month of the examination missed by a student due to medical or family emergency. The student should submit a written application to the Dean of Studies or the In-Charge, Academic Affairs for appearing in the supplementary examination, enclosing supporting documents. On receipt of such application from a student with supporting documents, the Dean of Studies or the In-Charge, Academic Affairs, in consultation with the relevant Teachers' Committee, will decide whether such examination will be allowed. The student can score at most 60% in the supplementary examinations of mid-semester and semester examinations. For the back-paper or the compensatory papers, the maximum the student can score in the supplementary examination is 45% or 35% respectively.

1.8. Satisfactory Conduct

A student is also required to maintain satisfactory conduct as a necessary condition for taking semester examination, for promotion and award of diploma. Failing to follow the examination guidelines, copying in examination, rowdyism, other breach of discipline of the Institute, unlawful/unethical behaviour and the like are regarded as **unsatisfactory conduct**. Violation of such nature is likely to attract punishments such as withholding promotion / award of diploma, withdrawing stipend and/or expulsion from the hostel / Institute.

Ragging is banned in the Institute. If any incident of ragging comes to the notice of the authorities, the concerned student shall be given liberty to explain, and if his/her explanation is not found to be satisfactory, he/she may be expelled from the institute. The punishment may also take the shape of

- i) suspension from the Institute for a limited period,**
- ii) suspension from the classes for a limited period,**
- iii) withholding stipend/fellowship or other benefits,**
- iv) withholding results,**
- v) suspension or expulsion from hostel and the likes.**

Local laws governing ragging are also applicable to the students of the Institute.

The students are also required to abide by the following guidelines during the examinations:

- i) Students are required to take their seats according to the seating arrangement displayed. If any student takes a seat not allotted to him/her, he/she may be asked by the invigilator to hand over the answer script (i.e., discontinue the examination) and leave the examination hall.
- ii) Students are not allowed to carry inside the examination hall any mobile phone with them—even in switched-off mode. Calculators, books and notes will be allowed inside the examination hall only if these are so allowed by the teacher(s) concerned (i.e., the teacher(s) of the course), or if the question paper is an open-note/open-book one. Even in such cases, these articles cannot be shared.

iii) No student is allowed to leave the examination hall without permission from the invigilator(s). Further, students cannot leave the examination hall during the first 30 minutes of any examination. Under no circumstances, two or more students writing the same paper can go outside together.

iv) Students should ensure that the main answer booklet and any extra loose sheet bear the signature of the invigilator with date. Any discrepancy should be brought to the notice of the invigilator immediately. Presence of any unsigned or undated sheet in the answer script will render it (i.e., the unsigned or undated sheet) to be cancelled, and this may lead to charges of violation of the examination rules.

v) **Any student caught cheating or violating examination rules will get 'Zero' in that examination. If the offence is in a back-paper examination, the student will get 'Zero' in the back-paper.** (The other conditions for promotion, as mentioned in Section 1.9 below, will continue to hold). The decisions regarding promotion in Section 1.9 and final result in Section 1.10 are arrived at after taking in to account the violation, if any, of the satisfactory conduct by the student, as described in this section.

1.9. Promotion

A student is considered for promotion to the second semester of the programme only when his/her conduct has been satisfactory. Subject to the above condition, a student is promoted from first semester to second semester if

- i) the number of composite scores less than 45% is at most **two**, and
- ii) **no** composite score in a course is less than 35%.

Otherwise, a student is **not promoted** to the second semester and he/she is asked to discontinue the programme.

1.10. Final Result

At the end of the second semester, the overall average of the percentage composite scores in *all the courses taken in the two-semester* programme is computed for each student. The student is awarded the post-graduate diploma in one of the following categories according to the criteria he/she satisfies provided, in the second semester,

- i) he/she **does not have** a composite score of less than 35% in any course,
- ii) the number of scores less than 45% is at most **one**, and
- iii) his/her conduct is satisfactory.

Post-Graduate Diploma in Statistical Methods with Applications: passed in First Division with Distinction if

- i) the overall average score is at least 75%, and
- ii) the composite score in at most **one** course is less than 45%.

Post-Graduate Diploma in Statistical Methods with Applications: passed with First Division if

- i) the overall average score is at least 60%,
- ii) the composite score in at most **one** course is less than 45%, and
- iii) not obtained First Division with Distinction.

Post-Graduate Diploma in Statistical Methods with Applications: passed with Second Division if

- i) the overall average score is at least 45%,
- ii) the composite score in at most **two** courses is less than 45%, and
- iii) not obtained First Division with Distinction or First Division.

All others students are considered to have failed. A student who fails but obtains at least 35% average score in the second semester, and have satisfactory conduct is allowed to repeat the programme without

any stipend all throughout the year **provided that he/she has not taken the option of a compensatory paper examination in the second semester**. A student is not given more than one chance to repeat.

1.11. Award of Certificate

A student passing the Diploma is given a certificate which includes

- i) the list of all courses taken along with the respective composite scores, and
- ii) the category (Passed with Distinction or Passed) of his/her final result.

The certificate is awarded in the Annual Convocation of the Institute following the semester II examinations.

1.12. Prizes and Medals

Students are awarded prizes in form of book awards for good academic performances in each semester as decided by the Teachers' Committee.

1.13. Class-Teacher

One of the instructors of a class is designated as the Class Teacher. Students are required to meet their respective Class Teachers periodically to get their academic performance reviewed, and to discuss their problems regarding courses.

1.14. Attendance

Every student is expected to attend all the classes. If he/she is absent, he/she must apply for leave to the Dean of Studies or the Academic Coordinator. Failing to do so may result in disciplinary action.

1.15. Stipend

Stipend, if awarded at the time of admission, is valid initially for the first semester only. The amount of stipend to be awarded in the second semester will depend on academic performance and conduct, as specified below, provided the requirements for continuation of the academic programme (excluding repetition) are satisfied.

Performance in course work:

The composite scores considered for the following performance criteria are the composite scores after the respective back-paper examinations

- i) If all the requirements for continuation of the programme are satisfied, and the average composite score is at least 60% and the number of courses with scores less than 45% is at most **two** in the first semester, then the full value of the stipend is awarded in the second semester.
- ii) If all the requirements for continuation of the programme are satisfied, and the average composite score is at least 45% and the number of courses with scores less than 45% is at most **one** in the first semester, then the half value of the stipend is awarded in the second semester.
- iii) In all cases other than (i) and (ii) above, no stipend is awarded in the second semester.

Attendance:

If the overall attendance in all courses in the first semester is less than 75%, no stipend is awarded in the following semester.

Conduct:

The Dean of Studies, or the In-Charge, Students 'Academic Affairs or the Class Teacher, at any time, in consultation with the respective Teachers' Committee, may withdraw the stipend of a student fully for a specific period if his/her conduct in the campus is found to be unsatisfactory.

Note: The net amount of the stipend to be awarded is determined by simultaneous and concurrent application of all clauses described above; but, in no case, the amount of stipend to be awarded or to be withdrawn should exceed 100% of the prescribed amount of stipend. Stipends are given after the end of each month for eleven months in the academic year. The first stipend is given two months after

admission with retrospective effect provided the student continues in the Diploma programme for at least two months. Contingency grants can be used for purchasing a scientific calculator and other required accessories for the practical class, text books and supplementary text books and for getting Photostat copies of required academic material. All such expenditure should be approved by the Class Teacher. No contingency grants are given in the first two months after admission.

1.16. Library Rules

Each student is allowed to use the reading room facilities in the library and allowed access to the stacks. Students have to pay a security deposit of Rs 1000/- in order to avail himself/herself of the borrowing facility. A student can borrow at most four books at a time. Fine is charged if any book is not returned by the due date stamped on the issue-slip. The library rules and other details are available in the library.

1.17 Hostel Facilities

Hostel Accommodation will be provided to all the students. A student has to pay Rs. 605/- as caution deposit and Rs. 50/- towards monthly room rent.

1.18 Change of Rules

The Institute reserves the right to make changes in the above rules, course structure and the syllabi as and when needed.

2. Curriculum

SEMESTER I

1. Basic Mathematics
2. Probability Theory
3. Statistical Methods
4. Numerical Methods and Optimization
5. Introduction to Packages: R, S and SAS

SEMESTER II

1. Computer Intensive Statistical methods
2. Regression & Time Series
3. Statistical Machine Learning & Statistical Finance
4. Clinical Trials & Actuarial Methods
5. Project

2.1. Brief Syllabi of Courses

Semester I

1. Basic Mathematics

Calculus

Set theory: sets, set operations, functions, equivalence of sets, finite and infinite sets, countable and uncountable sets with examples (2)

Real numbers: field properties and order properties, representation as points on real line, sup and inf, completeness, rationals and irrationals and their properties, intervals (2)

Sequences and Series: limits of sequences, properties, sandwich theorem, bounded and monotone sequences, subsequences, Cauchy criterion (statement only), convergence of series, tests of convergence (Standard tests like comparison, ratio, root tests etc) (6)

Functions: limits and continuity of functions, right and left limits, simple properties (sum, difference, product, composition, etc.), differentiability and simple properties, chain rule, monotonicity and convexity of functions, mean-value theorem (statement only, geometric interpretation of the theorem), maxima-minima, Taylor theorem (statement only) (10)

Integration: Sketch of the idea (without complete details) of Riemann integration, fundamental theorem of calculus (statement only), properties of integral, change of variable (4)

2-variable calculus: continuity, partial derivatives, double integrals, iterated integration, Jacobian rule, differentiation under integration (statement only) (6)

References:

1. Calculus (Vol I & II) - Apostol, T.
2. Introduction to Real Analysis - Bartle, R.G. and Sherbert, D.R.
3. Introduction to Calculus and Analysis (Vol I & II) – Courant, R. and John, F.
4. Principles of Real Analysis - Rudin, W.

Linear Algebra

Introduction to matrices: System of linear equations, matrix representation, basic matrix operations (2)
Vector spaces: Definition and examples, subspaces, linear independence, basis of a vector space (2)
Matrix theory: matrices as linear transformation, elementary operations and elementary matrices, rank, nullity, trace, inverse and determinants of matrices, solutions of system of linear equations (12)
Spectral theory: eigenvalues and eigenvectors of matrices, decomposition of matrices, quadratic forms and definiteness of a matrix (with applications in Statistics) (6)

References:

1. Matrix Theory and Linear Algebra – Hernstein, I.N. and Winter, D.J.
2. Matrix Algebra – Gentle, J. E.
3. Matrix Computations – Golub, G.H. and Van Loan, C.F.
4. Introduction to Linear Algebra – Mirsky, L.

2. Probability Theory

Elementary concepts of probability: experiments, outcomes, sample space, events. (8)
Conditional probability, independence, Bayes theorem. (6)
Random variable, probability distribution and properties; probability mass/density function, cumulative distribution function, expectation, variance, moments. (8)
Binomial, Poisson, Negative Binomial, Hypergeometric, Uniform, Normal and Exponential distributions. (8)
Chebyshev's inequality, weak law of large numbers, central limit theorem (statement). (2)
Distribution of a function of a random variable. (4)
Bivariate distribution; joint, marginal and conditional distributions, moments, covariance, correlation coefficient. (8)
Independent random variables and their sums. Transformation of two random variables. (6)
Sampling distributions: chi-square, t, F. (4)

References:

1. A First Course in Probability - Ross, S.
2. Elementary Probability Theory – Chung, K. L.
3. Introduction to Probability – Roussas, G.
4. Probability- Pitman, J.

3. Statistical Methods

Different types of statistical problems and related data analysis. (2)
Concept of population, sample and statistical inference through examples. (2)
Summarization of univariate data; graphical methods, measures of location, spread, skewness and kurtosis; outliers and robust measures. (14)
Empirical distribution, extension to censored data: Kaplan-Meier estimate. (5)
Analysis of discrete and continuous data, fitting probability distributions, goodness of fit, graphical methods of verifying the fit. (10)
Concept of estimation (point and interval) with examples. Concept of testing of hypotheses; significance level, size, power and p-value. (12)

One and two sample t-tests, paired t-test, nonparametric tests. One and two sample tests for proportions.(12)

References:

1. Introductory Statistics – Ross, S
2. Statistics – Freedman, D., Pisani R. and Purves, R.
3. Applied General Statistics – Croxton, F.E. and Cowden, D. J.
4. Statistics: A Guide to the Unknown –Tanur, J.M. (ed.).
5. Statistics: A New Approach- Wallis, W.A. and Roberts, H.V.

4. Numerical Methods and Optimization

Numerical Methods

Significant digits, round-off errors. Finite computational processes and computational errors. Loss of significant digits. (4)

Solution of nonlinear equation in one variable. Separation of roots and initial approximation. (4)

Improvement of the initial solution using methods of bisection, Regula Falsi and Newton-Raphson.(10)

Fixed point iterative schemes. Errors. Order of convergence and degree of precision.(6)

Optimization

Lagrange method of multipliers, maxima and minima of differentiable functions.(6)

Linear programming: simplex method, dual simplex method, sensitivity.(12)

Unconstrained optimization: Newton, Quasi-Newton method. (8)

Computational methods of optimization. (6)

References:

1. Numerical Analysis for Statisticians– Lange, K.
2. Elementary Numerical Analysis: An Algorithmic Approach- Conte, S.D. and de Boor, C.
3. Operations Research: An Introduction – Taha, H. A.
4. Optimization – Lange, K.

5. Introduction to Packages: R, S and SAS

Introduction to packages: overview of packages, data handling, input-output operations. (10)

Basic programming: data types, arrays, loops etc.; functions and graphics.(10)

Introduction to SAS programming. (10)

Statistical computations - data summary and graphical display of data, basic statistics. (8)

Simulations from probability distributions, comparisons of distributions, Q-Q and P-P plots.(10)

Matrix computations - basic operations, finding determinant, inverse, eigen roots and eigen vectors of a matrix, matrix decomposition, solving system of equations. (8)

References:

1. A Handbook of Statistical Analysis using R – Everitt, B. S. and Hothorn, T.
2. A Handbook of Statistical Analysis using SAS – Der, Geoff, Everitt, B. S.
3. Modern Applied Statistics with S-PLUS – Venables, W.N. and Ripley, B. D.
4. Numerical Analysis for Statisticians– Lange, K.

Semester II

1. Computer Intensive Statistical Methods

Statistical inference - likelihood based, Bayesian.(10)

Categorical data analysis: contingency tables, measures of association, test of independence.(4)

Principal component analysis. (3)

Simulation: acceptance/rejection sampling; importance sampling. (6)

Introduction to discrete time Markov chains, finite state space and countable state space. Markov chain Monte Carlo (MCMC) methods and simulation of Markov chains, applications in statistics of the MCMC methods. (20)

Histogram and kernel smoothing; density estimation; nonparametric regression. (9)

Bootstrap and resampling. (6)

Illustration of the methodology with real data.

References:

1. Computational Statistics – Gentle, J. E.
2. Computational Statistics – Givens, G.H. and Hoeting, J. A.
3. Statistical Computing – Kennedy, W.J. and Gentle, J.E.
4. Handbook of Computational Statistics – Gentle, J.E., Hardle, W. and Mori, Y.
5. Statistical Computing: Existing Methods & Recent Developments – Basu,A. and Kundu,D.
6. Resampling Methods: A Practical Guide to Data Analysis – Good, P.I.
7. Simulation and Monte Carlo Method - Rubinstein, R.Y.
8. Smoothing Methods in Statistics – Simonoff, J.S.

2. Regression & Time Series

Regression

Classical Linear Regression Model (2).OLS method of estimation; tests of hypotheses (6)

Use of dummy variables in regression (1); residuals and fitted values (3).Variable selection. (3)

Validation of assumptions using graphical techniques. (7)

Logistic regression; odds ratio, concordance-discordance measures. (7)

Illustration of the methodology with real data.

References:

1. Introduction to Linear Regression Analysis – Montgomery, D. C., Peck, E. and Vinning, G.
2. Regression Analysis by Examples - Chatterjee S. and Hadi, G.
3. Applied Linear Regression – Weisberg, S.
4. Applied Regression Analysis – Draper, N.R. and Smith, H.
5. Applied Logistic Regression – Hosmer, D.W. and Lemeshow, S.

Time series

Exploratory analysis and graphical display; trend, seasonal and cyclical components. Smoothing: exponential and MA. (6)

Stationary Time Series: AR, MA and ARMA models; Box-Jenkins correlogram analysis, ACF and PACF, choice of AR and MA orders. (10)

Non-Stationary Time Series: introduction to ARIMA model; deterministic and stochastic trends; introduction to ARCH models. (6)

Forecasting: basic tools, using exponential smoothing and Box-Jenkins method. Residual analysis. (6)

Illustration of the methodology with real data.

References:

1. Introduction to Time Series and Forecasting – Brockwell, P. and Davis R. A.

2. Analysis of Time Series – Chatfield, C.
3. Time Series Analysis and Its Applications with R – Shumway, R.H. and Stoffer, D.S.
4. Intro. to Time Series Analysis & Forecasting – Montgomery, D.C., Jennings, C.L., Kulachi, M.
5. Forecasting: Methods and Applications – Makridakis, S.G., Wheelwright, S.C. and Hyndman, R.J.

3. Statistical Machine Learning & Statistical Finance

Statistical Machine Learning

Unsupervised learning: clustering procedures (hierarchical and non-hierarchical); association rules. (6)

Supervised learning: Linear discriminant analysis; Bayesian classifier, nearest neighbor classifier. Tree based classification methods; predictive modeling using decision trees. Entropy based classifier. (12)

Support vector machine. Boosting and adaptive boosting algorithm. (6)

Assessment and model selection: bias-variance trade off, training error rate, criteria of selection (AIC, BIC), cross validation. (4)

Applications in information retrieval and text analysis. Illustration of the methodology with real data.

References:

1. The Elements of Statistical Learning: data Mining, Inference and Prediction – Hastie, T. Tibshirani, J.H. and Friedman, J.H.
2. Data Mining: Concepts and Techniques – Han, J. and Kamber, M.
3. Machine Learning – Mitchell, T.M.
4. Statistical and Machine-Learning Data Mining – Ratner, B.
5. Classification and Regression Trees – Breiman, L. et al

Statistical Finance

Derivatives: forward and future contracts. Markets, prices, arbitrage. Complete market, market risk and credit risks in the use of derivatives. (4)

Options markets, properties of stock option prices; American and European options. (4)

Binomial model: One-step and two-step models; Risk neutral valuation. (4)

Volatility; value at risk. (4)

Behaviour of stock prices: Conditional expectation and properties. (6)

Options on stock indices; currencies and futures; Some exotic equity and foreign exchange derivatives; Interest rate derivatives.(8)

Illustration of the methodology with real data.

References:

1. Options, Futures and other derivatives – Hull, John
2. Financial Calculus - Baxter, M. and Rennie, A.
3. Risk-Neutral Valuation - Bingham, N. and Keisel, R.

4. Clinical Trials & Actuarial Methods

Clinical Trials

Introduction to clinical trials; bias and random error in clinical studies; conduct of clinical trials, selection of subjects, ethical issues, outcome measures, protocols. (6)

Different Phases; comparative and controlled trials; random allocation. (4)

Design of clinical trials: parallel group designs; crossover designs; symmetric designs; adaptive designs; group sequential designs. (8)

Design of phase I, II and III trials. (4)

Bioequivalence trials. (3)

Power and sample size determination. (3)

Illustration of the methodology with real data.

References:

1. Clinical Trials: A Practical Approach – Pocock, S.
2. Fundamentals of Clinical Trials – Friedman, L.M, Furburg, C. and Demets, D.L.
3. Clinical Trials: A Methodological Perspective – Piantadosi, S
4. The Design and Analysis of Sequential Clinical Trials – Whitehead, J

Actuarial Methods

General Insurance: Loss models; parametric estimation. (3) Re-insurance and deductibles. (2)
Collective and individual risk models for aggregate loss. (4) No Claims Discount systems (3) Ruin theory (statement of the problem) (2)

Life Insurance: Introduction to survival analysis (1).

Complete and curtate future lives; force of mortality and hazard rate (2).

Life tables (3). Present values of insurances and annuities (6). Premium (2).

Illustration of the methodology with real data.

References:

1. Statistical and Probabilistic Methods in Actuarial Science – Boland, P.J.
2. Loss Models: From Data to Decisions – Klugman, S.A, Panier, H.H., Wilmot, G. E
3. Life Contingencies – Spurgeon, E.T.

5. Project

Under joint supervision with TCS personnel. May be extended through summer, till end-June.
