**STA 2205 STATISTICAL PROGRAMMING** (45 Contact Hours)

**Pre-Requisites:**

STA 2202: Computer Interactive Statistics & STA 2201: Probability and Statistics III

**1. Course Purpose**

To enable the student to use statistical programming software with its in-built macros/functions including performing simulations.

**2. Learning outcomes**

By the end of this course the student should be able to.

a) Write loops and user defined functions.
b) Perform error analysis.
c) Perform differentiation and integration using a computer programme.
d) Perform error analysis on the computer.
e) Generate pseudo random numbers and random variate values for discrete and continuous probability distributions using a computer program.
f) Perform a Monte Carlo simulation on the computer.
g) Use computer program to determine confidence intervals and to test hypotheses.

**3. Course Description**

Matrix computation: identity, determinant, inverse and matrix factorization, Matrix operations. Grouping, loops and conditional execution, User defined functions. Solutions of systems of linear equations. Error analysis: Mean squared Error. Calculus: Differentiation, Integration of univariate functions. Optimization: determining roots of equations, and local maxima and minima of univariate and multivariate functions. Pseudo random number generators. Generation of random variates: Discrete and continuous distributions. Monte Carlo simulation: Confidence interval and Power of a test Hypothesis testing: t-test(one sample and two samples for mean), F-test (one sample and two samples test for variance). Multiple Linear Regression: Estimation of model parameters, P-values. Linear Programming: Simplex method - bounded, un- boundedness, degenerate problems and constrained optimization confidence interval estimation: Mean, Median. Principle Component Analysis. Quality control: charting and statistical process control. Life- tables. S-plus/R will be used throughout.

**4. Course outline**

| **Week** | **Content** | Method |
|---|---|---|
| 1 | Crash course on R programming | Practical |
| 2 | Crash course on R programming | |
| 3 | Matrix algebra in R. Solutions of system of equations | Practical |
| 4 | Calculus in R: Differentiation and integration<br>Optimization of functions | Practical |
| 5 | Monte Carlo Simulation: Generation of random variates: Discrete and continuous distributions. | Practical |
| 6 | **Cat 1** | Practical |
| 7 | Hypothesis testing in R: t-test, anova, F-test | Practical |
| 8 | Linear regression in R | Practical |
| 9 | Linear programming | Practical |
| 10 | Principle Component Analysis (PCA) in R | Practical |
| 11 | Quality control in R | Practical |
| 12 | Cat 2 | Practical |

5. **Teaching Methodology**
   Lectures, Tutorials, Self-Reading, Discussions and Student Presentations.

6. **Instructional Material and Equipment**
   Black or White Boards, Chalk or White Board Markers, Dusters, Computer and Projector.

7. **Course Assessment**
   Assignments (5%), practicals (10%), CATs (15%), End of Semester Examination (70%).

8. **Course Text Books**

a) Crawley. *Statistics: An Introduction Using R*. John Wiley & Sons, ISBN 0-470-02297-3, 2005.
b) Robert J. Schalkoff. *Programming Languages And Methodologies*. Jones & Bartlett Publishers; ISBN-13: 9780763740597 ISBN: 0763740594, 2006.
c) Braun J., *A first course in Statistical Programming with R* Cambridge University Press, ISBN: 9780521872652, 2007.

9. **Course Journals**

a) Communication in Statistics - Simulation and Computing ISSN: 0361-0918.
b) Journal of Statistical Computation and Simulation, ISSN:0094-9655.
c) Computational Statistics and Data Analysis, ISSN: 0167-9473.

10. **Reference Text Books**

a) Bennett S. , McRobb S. & Farmer R. *Object-Oriented Systems Analysis and Design Using UML*. 3rd Edition. McGraw-Hill. ISBN-10: 0077110005 ISBN-13: 978-0077110000, 2006.
b) Braun W.J. and Murdoch D.J. , *A First Course in Statistical Programming with R*, Cambridge University Press, ISBN-10: 0521694248, 2007.
c) Jennifer A.H. and Geof H.G., *Computational Statistics*, Second Edition. ISBN-10:0470533315, 2012.

11. **Reference Journals**

[1]Communications in Statistics.Theory and Methods, ISSN: 0361-0926; ISSN: 1532-415X.
[2]Computational Statistics, ISSN: 0943-4062.