Second Semester
Core Course - Paper- III
Statistical computing using C & R

TOTAL MARKS – 100
(Theory – 70, Practical-30)

Unit I (Introduction to C)

Historical development of C language. Structure of a C program. Various steps involved from writing to execution of C program.

Variables & data types: Identifiers. Fundamental data types (**char, int, long, float, double & long double**). Declaration of variables. Scope of variables. Initialization of variables.

Constants: Floating point number. Defined constants.

Operators: Assignment. Arithmetic (+ , - , * , / , %). Compound assignment (+= , -= , *= , /= , %= , >>= , <<= , &= , ^= , |=). Increase and decrease (++, --). Relational and equality operators (==, !=, >, <, >=, <=). Logical operators (!, &&, ||). Conditional operator (?). Comma operator (,). Precedence of operators.

Basic Input/Output: *printf(), scanf(), getchar(), putchar(), getche()*.

Control Structures: **if** and **else, while** loop, **do-while** loop, **for** loop, **break, continue, goto, exit & switch.**

Unit II (Functions in C)

Functions: Scope of variables. Declaring functions. Arguments passed by value and by reference. Recursivity.

Standard library functions for statistical programs: *abs(), fabs(), pow(), exp(), sin(), cos(), tan(), asin(), acos(), atan(), atan2(), log(), log10(), rand(), srand(), sqrt(), fmod(), modf(), floor(), ceil(), strcmp()*.

Other useful library functions: *strcat(), strcmp(), strcpy(), time()*.

Unit III (Advanced C programming)

Arrays: Initializing arrays. Accessing the values of an array. Multidimensional arrays. Arrays as parameters.

Pointers: Reference operator(&). Dereference operator(*). Declaring variables of pointer types. Pointers and arrays. Pointer initialization. Pointer arithmetics. Pointers to pointers. Pointers to functions.

Dynamic memory allocation, Use of *malloc(), calloc(),realloc(), memcpy(), free()* functions.

File Handling. Use of *fopen(), fclose(), getc(), fgetc(), putc(), fputc(), fscanf(), fprintf(), fseek(), ftell(), rewind()* functions.

Unit IV (Basic Concepts of R Programming)

Introduction and preliminaries. Simple manipulations; numbers and vectors. Objects, their modes and attributes. Arrays and matrices. Lists and data frames. Reading data from files.

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Probability distributions. Grouping, loops and conditional execution. Writing user-defined functions. Statistical models in R. Graphical procedures. Packages.

Practical

List of Practical ***(Computational tools: C / R programming)***

1. Graphical representation of non-frequency data (Bar-Diagram, Line-Diagram, Pie chart).
2. Construction of frequency distribution (Grouped & Ungrouped).
3. Graphical representation of frequency data (Histogram, Frequency polygon, Ogives, Boxplots).
4. Summary statistics.
5. Pearson's correlation coefficient & Linear regression.
6. Spearman's rank correlation coefficient.
7. Kendall's correlation coefficient.
8. Curve fitting by least square method: Linear, Polynomial, Inverse, Exponential and Growth curve.
9. Interpolation by Newton's forward, Newton's backward & Lagrange's interpolation formulae.
10. Numerical Integration by Trapezoidal & Simpson's one-third rules.
11. Numerical solutions of univariate equations by Bisection, Iteration & Newton-Raphson methods.
12. Determinant of Matrix.
13. Inversion of Matrix.
14. Solution of a system of linear equations.
15. Computation of Characteristic roots and vectors.

Suggested Reading

1. Yashavant P. Kanetkar: Let Us C, BPB Publications.
2. Byron Gottfried: PROGRAMMING WITH C, SCHAUM'S OUTLINE SERIES, McGRAW-HILL
3. William H. Press, Brian P. Flannery, Saul A. Teukolsky, William T. Vetterling: Numerical Recipes in C: The Art of Scientific Computing, CAMBRIDGE UNIVERSITY PRESS.
4. "R Manuals" in R software.

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Second Semester
Core Course - Paper- IV
Random variable & Probability Distributions

TOTAL MARKS – 100
(Theory – 70, Practical-30)

Unit I (Random variable, Expectation & Generating functions)
Definition of discrete and continuous random variables. Probability mass function (p.m.f.). Probability density function (p.d.f). Cumulative distribution function (c.d.f.) and its properties. Expectation and moments, Theorem on sum and product of expectations of variables. Bi-variate frequency distribution. The p.m.f., p.d.f. and c.d.f. in the bivariate case. Marginal and conditional distributions. Independence, conditional expectation and conditional variance. Cauchy-Schwarz inequality.

Moment generating function (m.g.f.). Probability generating function (p.g.f). Characteristic function (Definition and properties only).

Unit II (Discrete Probability distributions)
Uniform, Bernoulli, Binomial, Poisson, Hypergeometric, Negative Binomial, Geometric and Power Series distributions.

Unit III (Continuous Probability distributions)
Uniform, Exponential, Normal, Gamma, Beta, Laplace, Log-normal, Weibull, Cauchy, Logistic, Pareto and Bivariate normal distributions.

Unit IV (Convergence & Truncated distributions)
Convergence in probability (Definition only). Convergence in distribution (Definition only). Tchebycheff's Inequality. Weak law of large numbers. Bernoulli's law of large numbers. Central limit theorem (Statement only). De-Moiver-Laplace Theorem. Normal approximation to Poisson distribution.

Truncated distributions: Binomial, Poisson, Exponential and Normal distributions.

Practical

List of Practical ***(Computational tools: Electronic Calculator, Spreadsheet Softwares & C/R programming)***

1. Numerical problems based on random variables & Expectation.
2. Numerical problems based on Bi-variate frequency distribution.
3. Fitting of discrete probability distributions: Binomial, Poisson & Geometric.
4. Fitting of continuous probability distributions: Exponential, Normal, Log-normal, Gamma & Weibull.

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5. Numerical problems based on discrete probability distributions.
6. Numerical problems based on continuous probability distributions.

Suggested Reading

1. Goon A.M., Gupta M.K. & Dasgupta B. (2002): Fundamentals of Statistics (Vol-I), World Press, Kolkata.
2. Goon A.M., Gupta M.K. & Dasgupta B. (1994): An Outline of Statistical Theory (Vol-I), World Press, Kolkata.
3. Rohatgi V.K. (1984): An Introduction to Probability Theory & Mathematical Statistics, John Wiley.
4. Kendall M.G. & Stuart A. (1966): Advanced Theory of Statistics (Vol-I & II).
5. Gupta S. C., Kapoor V. K.: Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

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