MANGALORE UNIVERSITY

MSc Medical Physics

MPS 454: Biostatistics, Biomathematics & Computers

Teaching hours: Each Unit – 12 h

Objective:

To make the students understand the basic principles and concepts in statistics and to apply various statistical techniques and hypothesis testing for applications in bioscience. Familiarise the student on the theory, propagation and quantitation of various errors and analysis of variance and equipping themwith all the mathematical skills including preliminary knowledge on concepts such as LAN, WAN, internet protocol, internet interactive communication and World Wide Web,concept of programming etc.

Outcomes:

- The student will understand the basic principal and concepts in statistics and statistical methods and apply the knowledge in data analysis and interpretation of biological data and hypothesis testing.
- The student will learn about various types of errors and its propagation and quantitate the error in their experimental findings.
- The students will be able to perform analysis of variation (ANOVA).
- The student will develop mathematical skill in set theory, determinant, matrix theory differential and integral calculus as well as develop understanding of various mathematical functions.
- They will acquire knowledge on Fourier transform, vector algebra and coordination geometry.
- The students learn the basics of computer and computer operations covering hardware and software, algorithms of micro & mini computers and workstation and also acquire overall concept and knowledge on design principals and theory of network such as LAN, WAN, internet interactive communication, internet protocols, word wide web and programming concepts.

Unit I: Basic Concepts & Descriptive Statistics

Biostatistics terminology, variables in biology, Levels and measurements of biologicaldata, Classification, tabulation and frequency distribution of the data, graphicalrepresentation by histogram. Polygon, Ogive curve and pie diagram.Measures of central tendency [Mean(Arithmetic,Harmonic and Geometric), Median,Mode] Measures of dispersion (Range, quartile deviation, mean deviation, standarddeviation, coefficient of variation), Comparison of two CVs; Skewness; KurtosisElements of probability theory:- axiomatic definition; Addition theorem; Conditionalprobability; Bayes theorem; Random variable; Mathematical expectation probabilitydistribution - binomial, Poisson and normal distribution; Sampling-

parameter, statistic andstandard error; Census - sampling methods; Probability and non-probability sampling;Purposive sampling; Simple random• sampling; Stratified sampling. Correlation and regression, Positive and Negative correlation and calculation of Karl-Peasrsons Co-efficient of correlation, Spearman‘s rank correlation, Partial and multiplecorrelation, regression analysis; Sample linear and nonlinear regression; multipleregression, regression equation, Calculation of an unknown variable using regression equation, Probit and logit analysis, Types of estimation, Confidence interval level ofconfidence. Confidence interval estimate of mean and of proportion.

Unit II: Errors in measurements & Statistical Analysis.

Errors, Accuracy, Precision, general theory of Errors, Classification, standard errors.Ways of expression of precision, Accuracy detection of determinates errors, Statisticalanalysis of biochemical data with spread sheet applications, Use of statistical packages,Data management with computerBasic idea of significance test –Hypothesis testing. , Null and alternative hypothesis;Large sample tests(z-test); Test of significance of single and two sample means; Testing of single and two proportions - Small sample tests: F-test — testing of single mean;Testing of two sample means using independent t test, paired t test; ANOVA and Chi-Square Tests: One-way and two-way ANOVA – Latin Square tests for association andgoodness of fit; testing linkage; segregation ratio.

Unit III: Biomathematics I

Sets & symbolic logic: Finite set, infinite set, null or void set, subset, Intervals; closedand open, universal set, operations of set. Relations and functions;Power functions &Polynomials, limits and continuity, Arithmetic and Geometric Series, Binomial Theorem.Permutation and combinations;Determinants: Definition, properties associated withdeterminants, Crammer rule condition of consistency, evaluations of 3 x 3 determinants,simultaneous equations and inversion. Interpolation and polynomial fitting.Matrices: Definitions and types of matrices, properties of matrices, addition, subtractionof matrices, matrix multiplication, elementary transformation, Adjointmatrix,inverseofmatrices; matrices manipulations Special square matrices, Determinant of a squarematrix, Inverse of a matrix, rank of a matrix, Eigen vectors and eigen values,diagonalization;Logarithmic and exponential functions, domain and range.2D Coordinate Geometry: Equation of a line, circle, ellipse, parabola, and hyperbola.3Dgeometry: Equation of sphere, cone;Graphical representations: Linear scales, nonlinearscales, Semi logarithmic, triangular, nomography, pictorial presentations.

Unit IV: Biomathematics II

Differential Calculus: Function, Limit, Continuity and Differentiability, Derivative andits physical significance, basic rules for differentiation (without derivation),Differentiation of standard functions, Method of Differentiation, Derivative of simplealgebraic and trigonometric functions , Maxima and Minima, exact and inexactdifferentiation with specific emphasis on thermodynamic properties, partialdifferentiation. Curve sketchingIntegral Calculus: Basic rules for integration (without derivations), definite andindefiniteintegrals,geometric meaning of integration, applications in the biology andchemistry.Solutions to quadratic and cubic equations.Integration of some standardfunctions.Integration by substitution, by parts, by partial fraction.Applications of Integralcalculus in biology.Definite integral. Ordinary differential equations (first order) - example from biology.

Vectors: Vector algebra, coordinate systems, Basic vectors and components, Scalar andvector multiplications, Reciprocal vectors, coordinate transformations.Vectordifferentialcalculus: curves, arc length, tangent, curvature, velocity & acceleration, directionalderivative, transformation of coordinate systems and vector components, divergence andcurl of vector field. Relations & Functions: Linear, periodic, logarithmic, exponential,Quadratic functions. Mapping & Cartesian product.periodic functions and conversion ofdifferent co-ordinate system; Their application in Biology.Partial differential equations: Introduction to partial derivatives & Ordinary DifferentialEquation of the first order. Fourier transform and inverse Fourier transform.

Unit V: Computer fundamentals.

Computer system at a glance processor (CPU, ALU) Memory (ROM, RAM,CACHE data and address bus) Storage, Input & Output devices, Computer peripherals,Binary code and binary system, Algorithms and Flow charts, Software &Hardware,Operating systems (Dos, Windows) Application software‘s (MS-office) Super computer,Mainframe computers, Mini computers, Micro computers, Workstation, Concept ofmultimedia and its applications. Network concepts (LAN, WAN, MODEM, Fibre OpticsNetwork) and its topology, Network media and hardware.Design and application ofmodern data communication over telephone lines and Digital telephone lines.Internetprotocols HTML, XML, WWW (World wide webs) Internet connectivity, search engines.Interactive communication on Internet, Programming concepts in C^{++}, Introduction toBioperl, Biojava, Bioxml.

Reference Books

- P. W. Arora, P.K. Malhan (2002), Biostatistics, Himalayas pub. House, Mumbai.
- P. S. S. SurnderRao and J. Richard (1996), An introduction to Biostatistics, Prentice Hall of India.
- Manisha Dixit (2000), Internet an Introduction, Tata McGraw-Hill.
- Timontry J. O'Leary, Linda I. O'Leary (1999), Microsoft windows 98, Tata McGraw Hill.
- Timothy J. O'Leary, Linda I. O' Leary (2000), Microsoft office-2000, Tata McGraw Hill.
- Pitter Norton's (1999), Introduction to Computers, Tata McGraw Hill.
- Campbell R.C. (1974), Statistics for biologist, Cambridge University Press.
- Bliss C. I.K. (1967), Statistics in biology vol. 1 Mac-Graw Hill.
- Wardlaw, A.C (1985), Practical Statistics for Experimental biologist.
- Bailey, (2000), Statistical Method in biology.
- Daniel Wayle W., Biostatistics (A foundations for analysis in health sciences).
- Khan, Fundamental of Biostatistics.
- Lachin, Biostatistical Method.

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