BT2022 | BIOSTATISTICS

Course contents

Random variable, concept of probability and probability density function, population, sample, estimates and parameters; Expectation operator formalism, independent and identically distributed random variables; Laplace theory of errors; Characteristic function and moments of probability density function; moment and cumulant generating function; Pearson type I, II, II, IV and V type distributions; Differential and statistical equation of normal density function; Standard normal deviate; Elementary convergence theorems; Law of large numbers (LLN) and central limit theorem (CLT).

Student's theory on the probable error of the sample means derived from normal populations; Distribution of sample means and variances derived from normal populations; Student theorem, Chi-square and t-distributions; Probable range of population mean and variance; Fisher F distribution on the ratio of sample variances derived from normal population; Statistical comparison of two different sample means or sample variances; Formulation of null and alternate hypothesis; Test of significance and confidence level; Type I and II errors; t-test, F-test and Chi-square tests; Multiple comparison problem; Concept of family wise error rate (FWER) and false discovery rate (FDR); Control of FDR, Bonferroni and Benjamini procedures; Multidimensional statistics; bootstrap methods. Correlation and regression; Linear and nonlinear regression of two variables; Multiple linear regression analysis; Pearson linear least square fitting procedure and nonlinear least square fitting using Marquardt-Levenberg algorithm.

Design of experiments in biology; completely randomized design (CRD); Randomized block design (RBD). Development and Application of statistical workflows; Microarray data analysis.

Stochastic processes, Langevin equation; Brownian motion; Fluctuation dissipation theorem; stochastic chemical kinetics; Master equations; Gillespie algorithm. Stochastic gene expression.

References

Introduction to mathematical statistics by Hogg, McKean and Craig; Pearson; 2014.
Design and Analysis of Experiments by Montgomery (Wiley), 2014.
Probable error of the mean by Student, Biometrika, vol. 6, pp 1-25.
Handbook of mathematical functions by Abramowitz and Stegun (1972) Dover.
Handbook of stochastic methods by Gardiner, Springer, 2004.
Theory of errors of observations by Airy (1875) Macmillan & Co.

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