Course title: Statistics for the life sciences			
Course code: BBP112	**No. of credits:** 3	**L-T-P:** 28-14-0	**Learning hours:** 42
Pre-requisite course code and title (if any): None			
Department: Department of Biotechnology			
Course coordinator: Dr. Prateek Sharma	**Course instructor** Dr. Prateek Sharma		
Contact details: prateeks@teri.res.in			
Course type: Core	**Course offered in:** Semester 2		

Course description:

Most of the research in the area of life sciences involves primary data generation through experimentation. When one is confronted with a new problem that involves the collection and analysis of data, two crucial questions exist: "How will using statistics help this problem?" and "Which techniques should be used?" The course has been designed and intended to help budding life scientists to answer these questions. The course is about how to extract information from data and how informative data are generated in the first place. Analysing data is part science, part craft and part art. An effort has been made through this course to provide some useful tools 'to get to the grips' of biological phenomena and problems and to encourage the students to develop the necessary craft and art.

Course objectives:

- Appreciate stochastic nature of biological phenomena and need for studying statistical methods
- Become mindful of a wide range of applications of statistics in life sciences
- Understand the relation between probability and statistics

Course contents

Module	Topic	L	T	P
1	Introduction Relevance of statistics, mathematical models – deterministic and stochastic; random variables; populations and samples; parameters and statistics.	1		
2	Review of basic concepts Measurement theory, levels of measurement; numerical measures of data; graphical presentation of data; Chebyshev's theorem; measurement uncertainty. Probability theory Probability concepts; axioms of probability; probability distribution functions and their applications – discrete and continuous distributions.	3 3	2 2	
3	Data sampling Types of sampling designs –probability and non-probability sampling; sampling theory, sampling distributions; parameter estimation, point and interval estimates; confidence interval estimation of – means, differences of means, proportions, difference of proportions, variances, ratio of variances;	8	4	
4	Tests of hypothesis Hypothesis testing – parametric and non-parametric tests (concerning means, differences of means, proportions, difference of proportions, variances, ratio of variances)	8	4	
5	Quality assurance and quality control Quality assurance, internal and external quality control; control charts – description and theory, application and limitations.	2	1	
6	Correlation and simple regression analysis Correlation analysis: graphical analysis, bivariate correlation, covariance, correlation coefficient, distribution of correlation coefficient and its statistical significance. Simple regression analysis: assumptions and definitions, principle of least squares, regression parameters their distribution and statistical significance, applications in process description and prediction	3	1	

	Total	**28**	**14**	

Evaluation criteria:

- 2 minor test: 20% each
- Tutorials: 20%
- Major test: 40%

Learning outcomes:

- Distinguish between a deterministic and stochastic process and situations under which the statistical methods are to be applied
- Develop an intuitive statistical sense
- Analyse, model and quantify uncertainty
- Extract information and draw scientific inference from the data to solve problems related to life sciences
- Develop probabilistic models for predicting outcomes of stochastic processes related to life sciences
- Apply the concepts of inferential statistics and to take informed decisions under conditions of uncertainty

Materials:
Textbooks

1. Daniel, W.W. (2010). *Biostatistics: Concepts and Methodology for Health Sciences*. Wiley-India.
2. Hoshmand A.R. (1997) *Statistical Methods for Environmental and Agricultural Sciences*, CRC Press, Boca Raton, FL.
3. Samuels, M.L., Witmer, J.A. and Schaffner, A. (2012). *Statistics for the Life Sciences*. Pearson, Boston, MA, USA.
4. Sokal, R.R. and Rohlf, F.J. (2012). *Biometry*. W.H. Freeman and Company, New York, USA.

Suggested Readings

1. Caulcutt R. and Boddy R. (1983) *Statistics for Analytical Chemists*, Chapman & Hall, London.
2. Fisher L.D. and Van Belle G. (1993) *Biostatistics: A Methodology for the Health Sciences*, John Wiley & Sons, New York.
3. Meier P.C. and Zund R.E. (1993) *Statistical Methods in Analytical Chemistry*, John Wiley & Sons, New York.
4. Piegorsch W.W. and Bailer A.J. (1997) *Statistics for Environmental Biology and Toxicology*, Chapman & Hall, New York.

Journals

1. Applied Statistics
2. Biometrika
3. Journal of the American Statistical Association
4. Statistical Science
5. The American Statistician

Additional information (if any):

Student responsibilities:

1Timely submission of assignments
2.Regular feedback.
3. Study of relevant research articles as suggested by the instructor.