Semester: 1	
Programme: MOLECULAR MEDICAL MICROBIOLOGY (PGD MMM)	
Course: Bio-Statistics	
Paper code: DMMB5103	**Credits: 4**
Hours/week: 4	
Number of weeks per semester: 10	
Category: Core/MDC/SEC/VAC:	
Theory / Practical / Composite: Theory	
No of Module: 2	

Course Outcome:

1. **Remember** the fundamental definitions of descriptive statistics, the basic laws of probability, and the properties of discrete and continuous distributions such as Binomial, Poisson, and Gaussian.
2. **Understand** the conceptual framework of sampling distributions, the logic of hypothesis testing (including Null vs. Alternative and Type-1 vs. Type-2 errors), and the principles of Bayesian inference.
3. **Apply** measures of central tendency, regression techniques, and laws of probability to summarize datasets and perform calculations on random variables in medical contexts.
4. **Analyze** diagnostic data using contingency tables, odds ratios, and performance metrics—such as sensitivity, specificity, and confusion matrices—to identify patterns and risks.
5. **Evaluate** the strength of medical research conclusions and the effectiveness of predictive models using p-values, power of tests, confidence intervals, and ROC curves.
6. **Create** integrated statistical research frameworks by synthesizing descriptive analysis, probabilistic modeling, and inferential testing to draw valid conclusions from complex biological and medical datasets.

Prerequisites: ***Basic knowledge about any prior course***

SYLLABUS

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
Module 1 / Unit 1	Descriptive Statistics: Population and sample. Classification of data. Collection, tabulation and graphical representation of data. Frequency distributions. Measures of central tendency (Mean, Median and Mode). Regression. Contingency table. Odds ratio and relative risk.	10	CO1, CO3, CO4, CO6	K1, K3, K4, K6
Module 1 / Unit 2	Regression analysis: Logistic regression, confusion matrix and ROC curve. Sensitivity, Specificity, PPV, NPV.	10	CO3, CO4, CO5	K3, K4, K5
Module 2 / Unit 1	Probability: Addition and multiplication laws of probability, conditional probability, Bayes Theorem. Random variable. Binomial, Poisson, Gaussian, and exponential distributions. Bivariate	10	CO1, CO2, CO3, CO6	K1, K2, K3, K6

	Probability distribution, Bivariate Normal: properties.			
Module 2 / Unit 2	Sampling and Inference: Statistic and its sampling distribution. Standard error of the Statistic. Chi-square, t and F distribution. Confidence intervals of mean and variance. Hypothesis testing- Simple and Composite Hypothesis, Null and alternative Hypothesis, Type-1 and Type-2 errors, Level of Significance, Power, Critical Region, p value. Testing of mean variance and association.	10	CO1, CO2, CO5, CO6	K1, K2, K5, K6

Text Books

1. Fundamentals of Statistics Vol-I by A.M. Gun, M.K. Gupta, and B. Dasgupta.
2. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
3. Ismay, C. and Kim, A.Y., Statistical Inference via Data Science, A Modern Dive into R and the Tidyverse, CRC Press Taylor and Francis group, 2020.
4. Moulin, P. and Venugopal, V.V., Statistical Inference for Engineers and Data Scientists, Cambridge University Press.

Suggested readings

1. Ilstrup DM. Statistical methods in microbiology. Clin Microbiol Rev. 1990 Jul;3(3):219-26. doi: 10.1128/CMR.3.3.219. PMID: 2200604; PMCID: PMC358156
2. Dakhale GN, Hiware SK, Shinde AT, Mahatme MS. Basic biostatistics for post-graduate students. Indian J Pharmacol. 2012 Jul-Aug;44(4):435-42. doi: 10.4103/0253-7613.99297. PMID: 23087501; PMCID: PMC3469943.
3. Yan F, Robert M, Li Y. Statistical methods and common problems in medical or biomedical science research. Int J Physiol Pathophysiol Pharmacol. 2017 Nov 1;9(5):157-163. PMID: 29209453; PMCID: PMC5698693.

Web Resources

1. GraphPad QuickCalcs: https://www.graphpad.com/quickcalcs/

Evaluation	Total Marks: 100 CIA: 20 Marks End semester Exam: 80 Marks	
Paper Structure for Theory Semester Exam Module:	**Module 1:** 40 Marks	**Module 2:** 40 Marks
	MCQ (2 marks each): Answer any 10 out of 12 **Short question (5 marks each):** Answer any 4 out of 6	**MCQ (2 marks each):** Answer any 10 out of 12 **Short question (5 marks each):** Answer any 4 out of 6

Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
CO1	**Remember** the fundamental definitions of descriptive statistics, the basic laws of probability, and the properties of discrete and continuous distributions such as Binomial, Poisson, and Gaussian.	K1

CO2	**Understand** the conceptual framework of sampling distributions, the logic of hypothesis testing (including Null vs. Alternative and Type-1 vs. Type-2 errors), and the principles of Bayesian inference.	K2
CO3	**Apply** measures of central tendency, regression techniques, and laws of probability to summarize datasets and perform calculations on random variables in medical contexts.	K3
CO4	**Analyze** diagnostic data using contingency tables, odds ratios, and performance metrics—such as sensitivity, specificity, and confusion matrices—to identify patterns and risks.	K4
CO5	**Evaluate** the strength of medical research conclusions and the effectiveness of predictive models using p-values, power of tests, confidence intervals, and ROC curves.	K5
CO6	**Create** integrated statistical research frameworks by synthesizing descriptive analysis, probabilistic modeling, and inferential testing to draw valid conclusions from complex biological and medical datasets.	K6