Lovely Professional University, Punjab

Course Code	Course Title	Course Planner
MTH302	PROBABILITY AND STATISTICS	11033::Dr. Kulwinder Singh

Course Outcomes :Through this course students should be able to

CO1 :: recall the basic principles of probability and Bayes theorem.

CO2 :: visualize and use the concept of random variables to find the probability of an event.

CO3 :: use of some important distributions to find the probabilities.

CO4 :: develop and test the hypothesis based on the nature of a problem.

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	FUNDAMENTALS OF MATHEMATICAL STATISTICS	S.C.GUPTA AND V.K.KAPOOR	SULTAN CHAND & SONS (P) LTD.

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	PROBABILITY STATISTICS AND RANDAM PROCESSES	T VEERARAJAN	MCGRAW HILL EDUCATION

Other Reading (OR)	
Sr No	**Journals articles as Compulsary reading (specific articles, complete reference)**
OR-1	http://www.gs.washington.edu/academics/courses/akey/56008/lecture/lecture5.pdf ,

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	https://www.investopedia.com/terms/h/hypothesistesting.asp	Hypothesis Testing
RW-2	https://www.analyticsvidhya.com/blog/2021/05/complete-guide-to-point-estimators-in-statistics-for-data-science/	Point Estimation
RW-3	https://www.investopedia.com/terms/p/probabilitydistribution.asp	Probability Distributions
RW-4	https://www.geeksforgeeks.org/random-variable/#:~:text=Random%20variable%20is%20basically%20a,given%20probabilities%20of%20different%20outcomes.	Random variables and its Characterization

| RW-5 | https://www.mathsisfun.com/data/probability.html | It explain the concept of probability in easy-to-learn manner |

Audio Visual Aids (AV)

Sr No	(AV aids) (only if relevant to the course)	Salient Features
AV-1	https://www.youtube.com/watch?v=6x1pL9Yov1k	Discrete probability distributions
AV-2	https://www.youtube.com/watch?v=flqhlM2bZWc	Point Estimation
AV-3	https://www.youtube.com/watch?v=VK-rnA3-41c	Hypothesis Testing
AV-4	https://www.youtube.com/watch?v=z7kMeJQWr4Y	Explain the concept of Correlation and regression

LTP week distribution: (LTP Weeks)	
Weeks before MTE	7
Weeks After MTE	7
Spill Over (Lecture)	7

Detailed Plan For Lectures

Week Number	Lecture Number	Broad Topic(Sub Topic)	Chapters/Sections of Text/reference books	Other Readings, Relevant Websites, Audio Visual Aids, software and Virtual Labs	Lecture Description	Learning Outcomes	Pedagogical Tool Demonstration/ Case Study / Images / animation / ppt etc. Planned	Live Examples
Week 1	Lecture 1	Basics of Probability (Probability of an Event)	T-1	RW-5	Introduction to the course by lecture zero and Basic terminology,definition of probability	Students will get familiar with basic terms of Probability theory and its importance	Power point presentation and Discussion	To determine the likelihood that it will rain, snow or hail. For example, if there's a 60-percent chance of rain, then the weather conditions are such that 60 out of 100 days with similar conditions, it has rained. You may decide to wear closed-toed shoes rather than sandals or take an umbrella to work.

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Week 1	Lecture 2	Basics of Probability(Rules of Probability)	T-1		Lecture 2: Various rules and addition theorem of probability Lecture 3: Conditional Probability and Independent Events, Multiplication theorem of probability	Students will able to learn various rules and theorem of probability.	Discussion along with white board work.	Probability of selection when an applicant applied for job in two different firm, when probability of selecting in each firm is given
		Basics of Probability (Conditional Probability and Independent Events)	T-1		Lecture 2: Various rules and addition theorem of probability. Lecture 3: Conditional Probability and Independent Events, Multiplication theorem of probability	Students will able to learn various rules and theorem of probability.	Discussion along with white board work.	Probability of selection when an applicant applied for job in two different firm, when probability of selecting in each firm is given
	Lecture 3	Basics of Probability(Rules of Probability)	T-1		Lecture 2: Various rules and addition theorem of probability Lecture 3: Conditional Probability and Independent Events, Multiplication theorem of probability	Students will able to learn various rules and theorem of probability.	Discussion along with white board work.	Probability of selection when an applicant applied for job in two different firm, when probability of selecting in each firm is given
		Basics of Probability (Conditional Probability and Independent Events)	T-1		Lecture 2: Various rules and addition theorem of probability. Lecture 3: Conditional Probability and Independent Events, Multiplication theorem of probability	Students will able to learn various rules and theorem of probability.	Discussion along with white board work.	Probability of selection when an applicant applied for job in two different firm, when probability of selecting in each firm is given
Week 2	Lecture 4	Basics of Probability(Bayes theorem)	T-1		Bayes theorem	Students will able to learn Bayes theorem and its Application.	Discussion along with white board work.	Probability of a randomly selected defected product produced in three factories and are stocked at a same placed

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Week 2	Lecture 5	Random variables and its Characterization(Discrete and continuous random variables(in one dimension) and their distribution functions)	T-1	RW-4	Lecture 5:Distribution function , discrete and continuous random variable. Lecture 6:Probability mass function and distribution function of discrete random variable. Lecture 7: Probability density function and distribution function of a continuous random variable.	Students will learn random variable, types of random variable, Probability mass and density functions of random variables.	Discussion along with white board work.	calculation of Probability of waiting time by any person for a bus at ta bus stop which is observed to be random phenomenon(X) with given probability density function.
	Lecture 6	Random variables and its Characterization(Discrete and continuous random variables(in one dimension) and their distribution functions)	T-1	RW-4	Lecture 5:Distribution function , discrete and continuous random variable. Lecture 6:Probability mass function and distribution function of discrete random variable. Lecture 7: Probability density function and distribution function of a continuous random variable.	Students will learn random variable, types of random variable, Probability mass and density functions of random variables.	Discussion along with white board work.	calculation of Probability of waiting time by any person for a bus at ta bus stop which is observed to be random phenomenon(X) with given probability density function.
Week 3	Lecture 7	Random variables and its Characterization(Discrete and continuous random variables(in one dimension) and their distribution functions)	T-1	RW-4	Lecture 5:Distribution function , discrete and continuous random variable. Lecture 6:Probability mass function and distribution function of discrete random variable. Lecture 7: Probability density function and distribution function of a continuous random variable.	Students will learn random variable, types of random variable, Probability mass and density functions of random variables.	Discussion along with white board work.	calculation of Probability of waiting time by any person for a bus at ta bus stop which is observed to be random phenomenon(X) with given probability density function.
	Lecture 8	Random variables and its Characterization (Expectation and Variance of a random variable)	T-1		Expectation and variance of single (Discrete and continuous) random variables.	Students will be able to learn mean and variance of a random variable	Discussion along with white board work.	
	Lecture 9				Online Assignment			

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Week 4	Lecture 10	Random variables and its Characterization(Moments and Moment generating function of a random variable)	T-1		Lecture 10: Moment generating function and rth moments of a random variable. Lecture 11: Properties of moment generating function of a random variable.	Students will learn concept of Moment, Moment generating functions and its application.	Discussion along with white board work and problem solving.	
	Lecture 11	Random variables and its Characterization(Moments and Moment generating function of a random variable)	T-1		Lecture 10: Moment generating function and rth moments of a random variable. Lecture 11: Properties of moment generating function of a random variable.	Students will learn concept of Moment, Moment generating functions and its application.	Discussion along with white board work and problem solving.	
	Lecture 12	Probability Distributions (Binomial Distribution)	T-1	RW-3 AV-1	Lecture 12:Binomial distribution and its moments. Lecture 13:Mode and moment generating function of Binomial distribution.	Students will be able to solve the problem based on the Binomial distribution	Discussion along with white board work and problem solving.	Multiple Choice test problem with only one correct option of each question, Probability of winning or loosing a player when two player playing more than one game.
		Probability Distributions (Moments and Moment generating function of Binomial Distribution)	T-1		Lecture 12:Binomial distribution and its moments. Lecture 13:Mode and moment generating function of Binomial distribution.	Students will be able to solve the problem based on the Binomial distribution	Discussion along with white board work and problem solving.	Multiple Choice test problem with only one correct option of each question, Probability of winning or loosing a player when two player playing more than one game.

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Week 5	Lecture 13	Probability Distributions (Binomial Distribution)	T-1	RW-3 AV-1	Lecture 12:Binomial distribution and its moments. Lecture 13:Mode and moment generating function of Binomial distribution.	Students will be able to solve the problem based on the Binomial distribution	Discussion along with white board work and problem solving.	Multiple Choice test problem with only one correct option of each question, Probability of winning or loosing a player when two player playing more than one game.
		Probability Distributions (Moments and Moment generating function of Binomial Distribution)	T-1		Lecture 12:Binomial distribution and its moments. Lecture 13:Mode and moment generating function of Binomial distribution.	Students will be able to solve the problem based on the Binomial distribution	Discussion along with white board work and problem solving.	Multiple Choice test problem with only one correct option of each question, Probability of winning or loosing a player when two player playing more than one game.
	Lecture 14	Probability Distributions (Poisson Distribution)	T-1		Lecture 14:Poisson distribution and its moments. Lecture 15:Mode and moment generating function of Poisson distribution	Students will be able to solve the problem based on the Poisson distribution	Discussion along with white board work and problem solving.	
		Probability Distributions (Moments and Moment generating function of Poisson Distribution)	T-1		Lecture 14:Poisson distribution and its moments. Lecture 15:Mode and moment generating function of Poisson distribution	Students will be able to solve the problem based on the Poisson distribution	Discussion along with white board work and problem solving.	
	Lecture 15	Probability Distributions (Poisson Distribution)	T-1		Lecture 14:Poisson distribution and its moments. Lecture 15:Mode and moment generating function of Poisson distribution	Students will be able to solve the problem based on the Poisson distribution	Discussion along with white board work and problem solving.	
		Probability Distributions (Moments and Moment generating function of Poisson Distribution)	T-1		Lecture 14:Poisson distribution and its moments. Lecture 15:Mode and moment generating function of Poisson distribution	Students will be able to solve the problem based on the Poisson distribution	Discussion along with white board work and problem solving.	
Week 6	Lecture 16				Online Assignment			

Week 6	Lecture 17	Probability Distributions (Normal Distribution its Moments and M.G.F.)	T-1		Lecture 17: Basic concept,properties of Normal distribution and normal curve, Mode and median of Normal distribution. Lecture 18:Moment generating function and Moments of Normal distribution Lecture 19: Application of Normal distribution. .	Students will learn to recognise and solve problems based on Normal distribution	Discussion along with white board work and problem solving.	A radar unit is used to measure speeds of cars on a motorway. The speeds are normally distributed with a mean of 90 km/hr and a standard deviation of 10 km/hr. What is the probability that a car picked at random is travelling at more than 100 km/hr?
	Lecture 18	Probability Distributions (Normal Distribution its Moments and M.G.F.)	T-1		Lecture 17: Basic concept,properties of Normal distribution and normal curve, Mode and median of Normal distribution. Lecture 18:Moment generating function and Moments of Normal distribution Lecture 19: Application of Normal distribution. .	Students will learn to recognise and solve problems based on Normal distribution	Discussion along with white board work and problem solving.	A radar unit is used to measure speeds of cars on a motorway. The speeds are normally distributed with a mean of 90 km/hr and a standard deviation of 10 km/hr. What is the probability that a car picked at random is travelling at more than 100 km/hr?

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| Week 7 | Lecture 19 | Probability Distributions (Normal Distribution its Moments and M.G.F.) | T-1 | | Lecture 17: Basic concept,properties of Normal distribution and normal curve, Mode and median of Normal distribution. Lecture 18:Moment generating function and Moments of Normal distribution Lecture 19: Application of Normal distribution. . | Students will learn to recognise and solve problems based on Normal distribution | Discussion along with white board work and problem solving. | A radar unit is used to measure speeds of cars on a motorway. The speeds are normally distributed with a mean of 90 km/hr and a standard deviation of 10 km/hr. What is the probability that a car picked at random is travelling at more than 100 km/hr? |

SPILL OVER

| Week 7 | Lecture 20 | | | | Spill Over | | | |
| | Lecture 21 | | | | Spill Over | | | |

MID-TERM

Week 8	Lecture 22	Point Estimation(Definition ,Unbiased Estimators)	T-1	OR-1 RW-2 AV-2	Population, Sample, Random Sampling, Parameter and Statistic, Point Estimation, Characteristics of good Estimator, Unbiasedness.	Students will learn meaning and properties of good estimator and	Discussion along with whit board work.	
	Lecture 23	Point Estimation(Consistent Estimators)	T-1	OR-1	Consistency of an estimator	Student will learn one of the property of good estimator and able to verify it.	Discussion along with white board work and problem solving.	
	Lecture 24	Point Estimation(Efficiency of estimations)	T-1	OR-1	Efficiency of an Estimator.	Student will learn one of the property of good estimator and able to verify it.	Discussion along with white board work and problem solving	
Week 9	Lecture 25	Point Estimation(Sufficient Estimator)	T-1	OR-1	Sufficiency of an estimator	Student will learn one of the property of good estimator and able to verify it	Discussion along with white board work and problem solving.	
	Lecture 26	Point Estimation(MLE (Method of Maximum Liklihood))	T-1	OR-1	Method of Maximum Likelihood Estimation.	Students will learn one of the method of estimation	Discussion along with white board work.	

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Week	Lecture	Topic				Reading	Learning Outcome	Methodology	
Week 9	Lecture 27	Point Estimation(Properties of Maximum liklihood)	T-1			Properties of Maximum Likelihood Estimator	Student will learn one of the properties of Maximum Likelihood estimator and able to verify it.	Discussion along with white board work and problem solving.	
Week 10	Lecture 28	Hypothesis Testing(Types of Error)	T-1 R-1	RW-1 AV-3		Lecture 28: Sampling, distribution of statistic, Standard error, Null and alternate hypothesis, Type of error, Critical region. Lecture 29: level of significance, One Tailed and Two-Tailed test, Critical or significant values.	Student will learn basic concept of sample testing and errors in testing	Student will learn one of the properties of Maximum Likelihood estimator and able to verify it. Discussion along with white board work.	
	Lecture 29	Hypothesis Testing(Types of Error)	T-1 R-1	RW-1 AV-3		Lecture 28: Sampling, distribution of statistic, Standard error, Null and alternate hypothesis, Type of error, Critical region. Lecture 29: level of significance, One Tailed and Two-Tailed test, Critical or significant values.	Student will learn basic concept of sample testing and errors in testing	Student will learn one of the properties of Maximum Likelihood estimator and able to verify it. Discussion along with white board work.	
	Lecture 30	Hypothesis Testing(Z-test)	T-1 R-1			Test of significance of large sample.	Student will learn to to test of significance of large sample.	Problem solving	
Week 11	Lecture 31	Hypothesis Testing(Student t-test)	T-1 R-1			Test of significance of small sample (t-test for single mean and difference of the mean. Paired t-test for difference of the mean)	Student will learn to to test of significance of small sample.	Problem solving.	
	Lecture 32	Hypothesis Testing(F-test)	T-1 R-1			F- test for equality of two population variance from which two sample have been drawn.	Student will learn to test for equality of two population variance from which two sample have been drawn.	Problem solving	
	Lecture 33	Hypothesis Testing (Goodness of a Fit)	T-1 R-1			Chi-Square test, test of Goodness of Fit for testing discrepancy between theory and experiment.	Students will learn goodness of fit in various situation.	Problem solving.	

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Week 11	Lecture 33	Hypothesis Testing(Chi-Square Test)	T-1 R-1		Chi-Square test, test of Goodness of Fit for testing discrepancy between theory and experiment.	Students will learn goodness of fit in various situation.	Problem solving.	
Week 12	Lecture 34				Online Assignment			
	Lecture 35	Correlation and Regressions (Scatter plots)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40
		Correlation and Regressions (Coefficient of Correlation)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40
		Correlation and Regressions (Coefficient of Correlation for bi-variate data)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40
	Lecture 36	Correlation and Regressions (Scatter plots)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40
		Correlation and Regressions (Coefficient of Correlation)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40

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Week	Lecture	Topic			Details	Learning Outcome	Methodology	Real-life Application
Week 12	Lecture 36	Correlation and Regressions (Coefficient of Correlation for bi-variate data)	T-1 R-1	AV-4	Lecture 35: Introduction, Scatter diagram and Karl Pearson's Coefficient of Correlation. Lecture 36: Correlation Coefficient for bi variate frequency distribution	Students will be able to learn about bi-variate data,there representation on scatter plots and calculate the coefficient of the correlation.	Discussion along with white board work and problem solving.	Number of clients and Profits, Years of studying and Salary at age 40
Week 13	Lecture 37	Correlation and Regressions (Spearman's Rank Correlation Coefficient)	T-1 R-1	AV-4	Spearman's rank correlation coefficient(non-repeating and repeating rank).	Students will able to calculate rank correlation coefficient between the ranks of the data.	Discussion along with white board work and problem solving.	
	Lecture 38	Correlation and Regressions (Linear Regression)	T-1 R-1	AV-4	Linear regression of bi variate data.	Students will able to calculate regression equations of given bi variate data.	Discussion along with white board work and problem solving	
	Lecture 39	Correlation and Regressions (Properties of Regression Coefficients)	T-1 R-1		Properties of Correlation coefficient, change of scale and origin properties, relation between correlation coefficient and regression coefficient.	Students will able to solve problems based on properties of correlation coefficient	Discussion along with white board work and problem solving.	
Week 14	Lecture 40	Correlation and Regressions (Fitting of a curve)	T-1 R-1		Fitting of a quadratic, power and exponential curve	Students will able to fit a curve between the given bi-variate data.	Discussion along with white board work and problem solving.	
					SPILL OVER			
Week 14	Lecture 41				Spill Over			
	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

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