Lovely Professional University, Punjab

Course Code	Course Title	Lectures	Tutorials	Practicals	Credits	
MTH302	PROBABILITY AND STATISTICS	3	0	0	3	
Course Weightage	ATT: 5 CA: 25 MTT: 20 ETT: 50					
Course Focus	EMPLOYABILITY					

Course Outcomes :Through this course students should be able to

CO1 :: recall the concept of random variables and its distribution functions.

CO2 :: recognize relationships among the variables through correlation and regression.

CO3 :: apply probability distributions to find the solution of different engineering problems.

CO4 :: describe sample, population and statistical inference.

CO5 :: understand hypothesis testing and its applications.

	TextBooks (T)		
Sr No	**Title**	**Author**	**Publisher Name**
T-1	PROBABILITY AND STATISTICS FOR ENGINEERS AND SCIENTISTS	RONALD E. WALPOLE, RAYMOND H. MYERS,SHARON L. MYERS, AND KEYING YE	PEARSON

	Reference Books (R)		
Sr No	**Title**	**Author**	**Publisher Name**
R-1	PROBABILITY STATISTICS AND RANDAM PROCESSES	T VEERARAJAN	MCGRAW HILL EDUCATION
R-2	FUNDAMENTALS OF MATHEMATICAL STATISTICS	S.C.GUPTA AND V.K.KAPOOR	SULTAN CHAND & SONS (P) LTD.

Relevant Websites (RW)		
Sr No	**(Web address) (only if relevant to the course)**	**Salient Features**
RW-1	https://www.khanacademy.org/math/ap-statistics/random-variables-ap	Random variables and its Characterization
RW-2	https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/scatterplots-and-correlation/a/correlation-coefficient-review	Correlation and Regressions
RW-3	https://www.khanacademy.org/math/ap-statistics/random-variables-ap	Special distributions (discrete and continuous)

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| RW-4 | https://www.khanacademy.org/math/ap-statistics/random-variables-ap | The Central Limit Theorem |
| RW-5 | https://www.khanacademy.org/math/statistics-probability/significance-tests-onesample/idea-of-significance-tests/e/hypothesis-testing-with-simulations | Hypothesis Testing |

Audio Visual Aids (AV)

Sr No	(AV aids) (only if relevant to the course)	Salient Features
AV-1	https://www.youtube.com/watch?v=zujeSyREcQ4	Random variables and its Characterization
AV-2	https://www.youtube.com/watch?v=WMUMc2QJrPQ	Correlation and Regression
AV-3	https://www.youtube.com/watch?v=6x1pL9Yov1k	Discrete probability distributions
AV-4	https://www.youtube.com/watch?v=wcexipNgbhs	Special Continuous Distributions
AV-5	https://www.youtube.com/watch?v=pu2OzGhv1HI	Point Estimation
AV-6	https://www.youtube.com/watch?v=-FtlH4svqx4	Hypothesis Testing
AV-7	https://www.youtube.com/watch?v=ugidzgLMZyA	Spearman's Rank correlation coefficient
AV-8	https://www.youtube.com/watch?v=-b5yWSQ_9Sw	geometric distribution
AV-9	https://www.youtube.com/watch?v=PjihjKfBuzc	exponential distribution and its properties
AV-10	https://www.youtube.com/watch?v=2QeDRsxSF9M&t=449s	chi square test for goodness of fit

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

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	Random Variables and Probability Distributions(discrete and continuous random variables and their distribution functions)	T-1 R-2	RW-1 AV-1	discrete and continuous random variables and their distribution functions	understand discrete and continuous random variables and their distribution functions	Discussion along with white board work.	

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Week 1	Lecture 2	Random Variables and Probability Distributions(discrete and continuous random variables and their distribution functions)	T-1 R-2	RW-1 AV-1	discrete and continuous random variables and their distribution functions	understand discrete and continuous random variables and their distribution functions	Discussion along with white board work.	
	Lecture 3	Random Variables and Probability Distributions(joint probability distributions)	T-1 R-2		joint probability distributions	understand joint probability distribution for the two dimensional random variable	Discussion along with white board work.	
Week 2	Lecture 4	Random Variables and Probability Distributions(mean, variance and covariance of random variables)	T-1 R-2		mean, variance and covariance of random variables	learn mean ,variance and covariance of random variables and its properties	Lecture 5 will be in class activity where in primary data will be collected from students response (for example data of the frequency of digits 0-9 in the last digit of their mobile number) Based on that data student will construct probability distribution function and cumulative distribution function and will calculate its mean and variance. In the end online quiz based on the activity will be done.	

Week	Lecture	Topic						
Week 2	Lecture 5	Random Variables and Probability Distributions(mean, variance and covariance of random variables)	T-1 R-2		mean, variance and covariance of random variables	learn mean ,variance and covariance of random variables and its properties	Lecture 5 will be in class activity where in primary data will be collected from students response (for example data of the frequency of digits 0-9 in the last digit of their mobile number) Based on that data student will construct probability distribution function and cumulative distribution function and will calculate its mean and variance. In the end online quiz based on the activity will be done.	
	Lecture 6	Random Variables and Probability Distributions(Chebyshev's theorem(without proof))	T-1 R-1 R-2		Chebyshev's theorem (without proof)	learn the utility of cheveshev's theorem in the study of probability distributions	Discussion along with white board work.	
Week 3	Lecture 7	Correlation and Linear regression(scatter plots)	T-1 R-1 R-2		Scatter plots and Coefficient of Correlation and its properties	Learn about the scatter plots to find the kind of correlation between two random variables.	Discussion along with white board work and problem solving	
		Correlation and Linear regression(correlation coefficient and its properties)	T-1 R-1 R-2	RW-2 AV-2	Scatter plots and Coefficient of Correlation and its properties	Learn about the scatter plots to find the kind of correlation between two random variables and its properties.	Discussion along with white board work and problem solving	

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Week 3	Lecture 8	Correlation and Linear regression(Karl Pearson's correlation coefficient)	T-1 R-1 R-2	AV-7	arl Pearson's correlation coefficient,Spearman's rank correlation coefficient	learn methods to find correlation coefficient given by Karl Pearson and by Spearman to find rank correlation coefficient		
		Correlation and Linear regression(Spearman's rank correlation coefficient)	T-1 R-1 R-2	AV-7	arl Pearson's correlation coefficient,Spearman's rank correlation coefficient	learn methods to find correlation coefficient given by Karl Pearson and by Spearman to find rank correlation coefficient	Lecture 9 will be activity based where the data will be provided to the students (for example data on age and salary). Scatter plot of the data of age and salary will done on excel to get the correlation between age and salary. Post activity discussion will be done and quiz will be conducted on the basis of activity.	
	Lecture 9	Correlation and Linear regression(Karl Pearson's correlation coefficient)	T-1 R-1 R-2	AV-7	arl Pearson's correlation coefficient,Spearman's rank correlation coefficient	learn methods to find correlation coefficient given by Karl Pearson and by Spearman to find rank correlation coefficient		

Week 3	Lecture 9	Correlation and Linear regression(Spearman's rank correlation coefficient)	T-1 R-1 R-2	AV-7	arl Pearson's correlation coefficient,Spearman's rank correlation coefficient	learn methods to find correlation coefficient given by Karl Pearson and by Spearman to find rank correlation coefficient	Lecture 9 will be activity based where the data will be provided to the students (for example data on age and salary). Scatter plot of the data of age and salary will done on excel to get the correlation between age and salary. Post activity discussion will be done and quiz will be conducted on the basis of activity.	
Week 4	Lecture 10				Test 1			
	Lecture 11	Correlation and Linear regression(Linear regression and its properties)	T-1 R-1 R-2		Linear regression and its properties	understand Linear Regression and Properties of Regression Coefficients	Lecture 12 will be activity based on the bivariate data for Regression Analysis (for example regression analysis between Temperature and Units sold of tea, Price and Units sold of tea) that will be performed using excel and post activity discussion will be done based on the results obtained	

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Week 4	Lecture 12	Correlation and Linear regression(Linear regression and its properties)	T-1 R-1 R-2		Linear regression and its properties	understand Linear Regression and Properties of Regression Coefficients	Lecture 12 will be activity based on the bivariate data for Regression Analysis (for example regression analysis between Temperature and Units sold of tea, Price and Units sold of tea) that will be performed using excel and post activity discussion will be done based on the results obtained	
Week 5	Lecture 13	Special Discrete Distributions(bernoulli process)	T-1 R-2	RW-3 AV-3	the Bernoulli process and binomial distribution	learn the Bernoulli process and binomial distribution	Discussion along with white board work.	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.
		Special Discrete Distributions(binomial distribution)	T-1 R-2	RW-3 AV-3	the Bernoulli process and binomial distribution	learn the Bernoulli process and binomial distribution	Lecture 14 will be activity based where MCQ questionnaire will be shared with students prior to the lecture to get the data on number of correct answers and it will used for the demonstration of the binomial distribution.In the end online quiz based on the activity will be done.	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	Lecture	Topic						
Week 5	Lecture 14	Special Discrete Distributions(bernoulli process)	T-1 R-2	RW-3 AV-3	the Bernoulli process and binomial distribution	learn the Bernoulli process and binomial distribution	Discussion along with white board work.	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.
		Special Discrete Distributions(binomial distribution)	T-1 R-2	RW-3 AV-3	the Bernoulli process and binomial distribution	learn the Bernoulli process and binomial distribution	Lecture 14 will be activity based where MCQ questionnaire will be shared with students prior to the lecture to get the data on number of correct answers and it will used for the demonstration of the binomial distribution.In the end online quiz based on the activity will be done.	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 15	Special Discrete Distributions(negative binomial distribution)	T-1 R-2	AV-8	negative binomial distribution and geometric distribution	learn negative binomial distribution and geometric distribution of a random variable	Discussion along with white board work.	
		Special Discrete Distributions(geometric distribution)	T-1 R-2	AV-8	negative binomial distribution and geometric distribution	learn negative binomial distribution and geometric distribution of a random variable	Discussion along with white board work.	
Week 6	Lecture 16				Test 2			
	Lecture 17	Special Discrete Distributions(poisson distribution)	T-1 R-2	RW-3 AV-3	Poisson distribution	learn the Poisson distribution and the Poisson process	Discussion along with white board work.	
	Lecture 18	Special Discrete Distributions(poisson distribution)	T-1 R-2	RW-3 AV-3	Poisson distribution	learn the Poisson distribution and the Poisson process	Discussion along with white board work.	

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Week 7	Lecture 19	Special Discrete Distributions(moment generating function (without proof) of the above mentioned distributions.)	T-1 R-2		moment generating function (without proof) of binomial, negative binomial, geometric and poisson distribution	learn about mgf of the discrete probability distributions and its use in problem solving	Discussion along with white board work.	
				SPILL OVER				
Week 7	Lecture 21				Spill Over			
				MID-TERM				
Week 8	Lecture 22	Special Continuous Distributions(normal distribution)	T-1 R-2	RW-3 AV-4	normal distribution	understand the normal distribution for the continuous random variable random	Lecture 24 will be activity based where the secondary data will be shared with student for the graphical analysis and identification of normally distributed property using excel tool. Post activity discussion will be done and question will be asked on the basis of the activity	
	Lecture 23	Special Continuous Distributions(normal distribution)	T-1 R-2	RW-3 AV-4	normal distribution	understand the normal distribution for the continuous random variable random	Lecture 24 will be activity based where the secondary data will be shared with student for the graphical analysis and identification of normally distributed property using excel tool. Post activity discussion will be done and question will be asked on the basis of the activity	

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Week	Lecture	Topic						
Week 8	Lecture 24	Special Continuous Distributions(normal distribution)	T-1 R-2	RW-3 AV-4	normal distribution	understand the normal distribution for the continuous random variable random	Lecture 24 will be activity based where the secondary data will be shared with student for the graphical analysis and identification of normally distributed property using excel tool. Post activity discussion will be done and question will be asked on the basis of the activity	
Week 9	Lecture 25	Special Continuous Distributions(gamma distribution)	T-1 R-2	AV-9	gamma distribution, exponential distribution	learn gamma distribution and the exponential distribution of continuous random variable	Discussion along with white board work.	
		Special Continuous Distributions(exponential distribution)	T-1 R-2	AV-9	gamma distribution, exponential distribution	learn gamma distribution and the exponential distribution of continuous random variable	Discussion along with white board work.	
	Lecture 26	Special Continuous Distributions(moment generating function (without proof) of the above mentioned distributions.)	T-1 R-2		moment generating functions (without proof) Normal, gamma and exponential distributions	learn the use of mgf of normal, gamma and exponential distributions in problem solving	Discussion along with white board work.	
	Lecture 27	Point Estimation and the Central Limit Theorem(the central limit theorem (without proof))	T-1 R-1 R-2	RW-4	the central limit theorem (without proof)	understand the use of the Central Limit theorem	Lecture 27 will be activity based for the analysis and demonstration of Central limit theorem from the large data using excel. Post activity discussion will be done along with quiz .	

Week	Lecture	Topic	Reference	RW/AV	Pedagogy (concept)	Learning outcome	Pedagogy tool	
Week 10	Lecture 28	Point Estimation and the Central Limit Theorem(the central limit theorem (without proof))	T-1 R-1 R-2	RW-4	the central limit theorem (without proof)	understand the use of the Central Limit theorem	Lecture 27 will be activity based for the analysis and demonstration of Central limit theorem from the large data using excel. Post activity discussion will be done along with quiz .	
	Lecture 29	Point Estimation and the Central Limit Theorem (consistent estimator)	T-1 R-2	AV-5	unbiased estimator and consistent estimator	learn the unbiased estimators and consistent estimator	Discussion along with white board work.	
	Lecture 30	Point Estimation and the Central Limit Theorem (consistent estimator)	T-1 R-2	AV-5	unbiased estimator and consistent estimator	learn the unbiased estimators and consistent estimator	Discussion along with white board work.	
Week 11	Lecture 31	Point Estimation and the Central Limit Theorem (efficient and sufficient estimator)	T-1 R-2	AV-5	efficient and sufficient estimator	learn about efficient and sufficient estimator	Discussion along with white board work.	
	Lecture 32	Point Estimation and the Central Limit Theorem (maximum likelihood estimation)	T-1 R-2		maximum likelihood estimation	learn the maximum likelihood estimation using likelihood function	discussion along with white board work and problem solving.	
	Lecture 33	Testing of Hypothesis(types of error)	T-1 R-2	RW-5 AV-6	types of Error	learn the types of error in sampling theory	Discussion along with white board work and problem solving.	
Week 12	Lecture 34				Test 3			
	Lecture 35	Testing of Hypothesis(Z-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Discussion along with white board work and problem solving.	

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Week 12	Lecture 35	Testing of Hypothesis (Student's t-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Lecture 37 will be activity based where the data will be shared with the student to determine if there is a significant difference between the means of two groups and how they are related using t-test or z-test [for example the data of CA marks of two sections (or two groups of same section)] . In the end online quiz based on the activity will be done.	
	Lecture 36	Testing of Hypothesis(Z-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Discussion along with white board work and problem solving.	
		Testing of Hypothesis (Student's t-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Lecture 37 will be activity based where the data will be shared with the student to determine if there is a significant difference between the means of two groups and how they are related using t-test or z-test [for example the data of CA marks of two sections (or two groups of same section)] . In the end online quiz based on the activity will be done.	

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Week 13	Lecture 37	Testing of Hypothesis(Z-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Discussion along with white board work and problem solving.	
		Testing of Hypothesis (Student's t-test for single mean and difference of means)	T-1 R-2	AV-6	Z-test and t-test for single mean and difference of means	learn to implement the z-test and t-test for single and difference of mean	Lecture 37 will be activity based where the data will be shared with the student to determine if there is a significant difference between the means of two groups and how they are related using t-test or z-test [for example the data of CA marks of two sections (or two groups of same section)] . In the end online quiz based on the activity will be done.	
	Lecture 38	Testing of Hypothesis(F-test)	T-1 R-2		F-test	learn about F-test in sampling distribution	Discussion along with white board work and problem solving	
	Lecture 39	Testing of Hypothesis(Chi-square test for goodness of fit)	R-2	AV-10	Chi-square test for goodness of fit	to learn the Chi-square test for goodness of fit	Lecture 40 will be based on the activity , for example students will test the hypothesis that digits 0-9 are uniformly distributed at the last digit of mobile number using the Chi- square test. Post activity discussion will be done and quiz will be conducted on the basis of activity.	

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Week 14	Lecture 40	Testing of Hypothesis(Chi-square test for goodness of fit)	R-2	AV-10	Chi-square test for goodness of fit	to learn the Chi-square test for goodness of fit	Lecture 40 will be based on the activity , for example students will test the hypothesis that digits 0-9 are uniformly distributed at the last digit of mobile number using the Chi- square test. Post activity discussion will be done and quiz will be conducted on the basis of activity.	
				SPILL OVER				
Week 14	Lecture 42				Spill Over			
Week 15	Lecture 43				Spill Over			
	Lecture 44				Spill Over			
	Lecture 45				Spill Over			

Scheme for CA:

CA Category of this Course Code is:A0203 (2 best out of 3)

Component	Weightage (%)	Mapped CO(s)
Test 3	50	CO1, CO2, CO3, CO4
Test 1	50	CO1
Test 2	50	CO2, CO3

Details of Academic Task(s)

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Academic Task	Objective	Detail of Academic Task	Nature of Academic Task (group/individuals)	Academic Task Mode	Marks	Allottment / submission Week
Test 1	To check the understanding of the students about random variables and its distribution functions	discrete and continuous random variables and their distribution functions, joint probability distributions, mean, variance and covariance of random variables, Chebyshev's theorem (without proof)	Individual	Offline	30	3 / 4
Test 2	To test the understanding of students in correlation and linear regression and some discrete distributions.	scatter plots, correlation coefficient and its properties, Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient, Linear regression and its properties.the Bernoulli process, binomial distribution.	Individual	Offline	30	5 / 6
Test 3	To check the understanding and ability of the students to handle data and to apply suitable tool.	data will be provided to student and on the basis of the data student need to perform certain tasks to provide the answers to the questionnaire (It will be based on all the activities discussed till 11th week)	Individual	Offline	30	11 / 12

MOOCs/ Certification etc. mapped with the Academic Task(s)

Academic Task	Name Of Certification/Online Course/Test/Competition mapped	Type	Offered By Organisation
Test 1	PROBABILITY AND STATISTICS	MOOCs	NPTEL
Test 2	PROBABILITY AND STATISTICS	MOOCs	NPTEL
Test 3	PROBABILITY AND STATISTICS	MOOCs	NPTEL

Where MOOCs/ Certification etc. are mapped with Academic Tasks:

1. Students have choice to appear for Academic Task or MOOCs etc.
2. The student may appear for both, In this case best obtained marks will be considered.

MOOCs/ Certification etc. not-mapped with the Academic Task(s) (Available for students for better learning/ will get students ready for)

Name Of Certification/Online Course/Test/Competition mapped	Type	Offered By Organisation
GATE	Test/Examination	IIT

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