MUST KNOW CONCEPTS

MKC

MATHS

2021-22

Course Code & Course Name : 19BSS25 / Statistics and Queueing Model

Year/Sem/Sec : II /IV / ECE

S.No	Term	Notation (Symbol)	Concept / Definition / Meaning / Units / Equation / Expression	Units
		Unit – I Testing of Hypothesis		
1	Population		A set of objects or mainly the set of numbers which are measurements or observations pertaining to the objects.	
2	Symbols for Population of parameter	N	Population size	
		μ	Population mean	
		σ	Population standard deviation	
3	Sampling		A part selected from the population is called sample. The process of selection of a sample is called sampling.	
4	Symbols for sample Statistic	n	Sample size	
		$\bar{x}$	Sample mean	
		S	Sample standard deviation	
5	Parameters		The statistical constants of the population, such as mean(μ), standard deviation(σ) are called parameters. Parameters are denoted by Greek letters.	
6	Standard Error		Standard error is the standard deviation of the sampling distribution. For assessing the difference between the expected value and observed value.	
7	Test of Significance		The deviation between the observed sample statistic and the hypothetical parameter value.	
8	Null Hypothesis	H_0	Null Hypothesis is the hypothesis of no difference.	
9	Alternative Hypothesis	H_1	Any hypothesis which is complementary to the null hypothesis.	
10	Critical region(or)Region of Rejection		A region corresponding to statistic *t*, in sample space S which amounts to rejection of null hypothesis.	

11	Level of significance		The probability that the value of the statistic lies in the critical region.	
12	Steps involved in testing of hypothesis		• Set up a null hypothesis H_0 and alternative hypothesis H_1 • Select the appropriate level of significance • Compute the statistic $Z = \frac{t-E(t)}{sE(t)}$ under H_0 • We compare the calculatez with critical value z_α at given level of significance (α).	
13	t- test	$t = \frac{\bar{x}-\mu}{(\frac{s}{\sqrt{n}})}$	It is used to test the significance of the difference of the mean of a random sample and the mean of the population. It is used to test the significance of the difference between two sample means.	
14	Properties of t-distribution		• The probability curve of the t- distribution is similar to the standard normal curve and is symmetric about t=0, bell-shaped and asymptotic. • t- distribution tends to the standard normal distribution.	
15	Range of t-distribution		The range of t- distribution is $-\infty$to ∞.	
16	Chi-Square test for Goodness	$\chi^2 = \sum \frac{(O-E)^2}{E}$	• It is used to test the goodness of fit • To test the independence of attributes • To test if the hypothetical value of the population variance is σ^2.	
17	Type-I and Type-II Errors		Type-I: Rejecting H_0 when H_0 is true Type-II: Accepting H_0 when H_0 is false.	
18	Sampling Distributions		A Sampling Distribution is a probability distribution of a statistic obtained through a large number of samples drawn from a specific population.	
19	2×2 contingency table	$\begin{matrix} a & b \\ c & d \end{matrix}$	$\chi^2 = \frac{(a+b+c+d)(ad-bc)^2}{(a+c)(b+d)(a+b)(c+d)}$	
20	p×q contingency table		Degrees of freedom is (p-1)(q-1)	
21	Property of F-distribution		The square of the t- variate with n degrees of freedom follows a F- distribution with 1 and n degrees of freedom.	
22	Mean for F-distribution		$\frac{v_2}{(v_2-2)}(v_2 > 2)$	
23	Variance F-distribution-		$\frac{2v_2^2(v_1+v_2-2)}{v_1(v_2-2)^2(v_2-4)}(v_2 > 4)$	

24	F- test		It is used to whether two independent samples have been drawn from the normal populations variance σ^2. with the same	
25	Range of F-distribution		The range of F- distribution is 1 to∞.	
Unit – II Design of Experiments				
26	Basic Principles in the Design of Experiment		i) Randomization ii)Replication iii)Local control(error control)	
27	Randomizatio n		A set of objects is said to be randomized, when they are arranged in random order.	
28	Replication		The independent execution of an experiment more than once is called replication.	
29	Complete Block Designs		i)Completely Randomized Design ii)Randomized Block Design iii)Latin Square Design	
30	Explanation of ANOVA		Analysis of variance is the separation of variance ascribable to one group of causes from the variance ascribable to other groups.	
31	One Way Classification		One-way classification observations are classified according to one factor.	
32	Mean sum of Squares for One Way Classification		i) MSC=SSC/C-1 (between columns) ii) MSE=SSE/N-C (within columns)	
33	Variance Ratio		F =SSC/MSE or $F = MSE/MSC$	
34	Two Way Classification		Two way classification of analysis of variance, we consider one classification along column-wise and the other along row-wise.	
35	Variance Ratio		$(i) F_c = \frac{MSC}{MSE}$ $(ii)\ F_R = \frac{MSR}{MSE}$	
36	Latin Square		According to columns, rows and varieties are arranged in a square known as Latin Square.	
37	Merits of Latin Square		i) It controls variability in two directions ii) Analysis of the design is simple and straight forward and is a three way classification of analysis of variance.	
38	Demerits of Latin Square		i) This process is not as simple as in RBD ii) The number of treatments should be equal to the number of rows and number of columns.	

39	MSS for Latin Square between Columns		i) Between Columns MSC=SSC/(K-1)	
40	MSS for Latin Square between Rows		ii) Between Rows MSR=SSR/(K-1)	
41	MSS for Latin Square between Treatments		iii) Between Treatments MSE=SSK/(K-1)	
42	Variance Ratio		$F_T = \frac{MSK}{MSE}$	
43	Assumptions in Analysis of Variance		i) Normality ii) Homogeneity iii) Independence of error.	
44	Treatment in Analysis of Variance		The word treatment in analysis of variance is used to refer any factor in the experiment that is controlled at different levels or values.	
45	Definition of Mean Sum of Squares	M.S.S	The sum of square divided by its degrees of freedom gives the corresponding variance or the mean sum of squares.	
46	Uses of Analysis of Variance		i) It helps to find out the F-test. ii) Between the samples, we can find the variances.	
47	Design of an Experiment		The logical construction of the experiment in which the degree of uncertainty with which the inference is drawn may be well defined.	
48	Advantages of a Completely Randomized Experimental Design		i) It is easy to lay out the design ii) It allows for complete flexibility. Any number of factor classes and replications may be used.	
49	Completely Randomized Design	CRD	i) The analysis of the design is simple as it results in a one-way classification analysis of variance. ii) Analysis can be performed, if some observation are missing.	
50	Repetition (or) Replication		The replication or repetition of an experiment unit is also necessary. Randomization must be invariably accompanied by sufficient replication.	

Unit – III Statistical Control Charts				
51	Control charts		A control chart provides a basis of deciding whether the variation in the output is due to random causes.	
52	Symbols for Control charts	CL	Control Limit	
		LCL	Lower control limit	
		UCL	Upper control Limit	
53	Types		Control chart with variables Control chart with attributes	
54	Control Chart with variables	$\bar{x}$	Sample mean	
		R	Range	
55	Control chart with attributes	p, c and np	Probability values of Raw data	
56	Standard Error		Standard error is the standard deviation of the sampling distribution. For assessing the difference between the expected value and observed value.	
57	Value of Control Limits		D_3, D_4. Are determined by Statistical table	
58	Two Category of control chart		Number of defectives Fraction of defectives	
59	Good Estimate		Sample of size less than 20 of Range	
60	Under Control		No points are more than UCL and Less than LCL	
61	Level of significance		The probability that the value of the statistic lies in the critical region.	
62	Out of Control		At least one point more than UCL and less than LCL	
63	Table values depending upon		n	

64	S Chart		Control Chart with Standard Deviation	
65	State of Control		Between 3.63 and 21.09	
66	Mean of np chart		np	
67	S.D of np chart		$\sqrt{npq}$	
68	np Chart		Number of defectives	
69	P chart		Proportion of defectives	
70	C chart		Number of defects in a unit	
71	Mean of p chart		X/n	
72	S.D of p chart		$\sqrt{pq/n}$	
73	Mean of c chart		λ	
74	S.D of c chart		$\sqrt{\lambda}$	

75	C chart is used when.		Average of c ≥4	
Unit – IV Queueing Models				
76	Queueing Model	M/M/1:∞/FCFS	Single server Queueing model	
77	Queueing Model	M/M/1:∞/FCFS	∞ stands for infinite number of arrivals	
78	Queueing Model	M/M/1:∞/FCFS	FCFS – First Come First Serve	
79	Queueing Model	M/M/1:k/FCFS	k stands for finite number of arrivals	
80	Queueing Model	M/G/1:∞/FCFS	General time distribution introduced.	
81	Kendall		Symbolic notation of queueing model	
82	Exponential		Interval between two consecutive arrival of Poisson Process.	
83	Average number of customers	M/M/1:∞/FCFS	$\frac{\lambda}{\mu - \lambda}$	
84	Service rate	M/M/1:∞/FCFS	μ	
85	Behavior of the system		Independent of time then is called steady state	

86	"e" stands for	(a/b/c:d/e)	Queue discipline	
87	Probability number of customers in the system		1-(λ/μ)	
88	Probability number of n customers in the system		$(\lambda/\mu)P_0$	
89	Mean of Poisson Process		λt	
90	System is idle		P_0	
91	Queueing model	P_n	System is busy	
92	Traffic intensity		(λ/μ)	
93	Blocking		A customer who leaves the queue because the queue is too long	
94	Solutions for queueing model		Ls, Lq, Ws, Wq	
95	Kendall notation		(a/b/c:d/e)	
96	LCFS		Last come first served	
97	SIRO		Service in random order	
98	GD		General time dicipiline	

99	Little’s formula		Relation between Ls, Lq, Ws, Wq	
100	Little’s formula	Ls	λWs	
		Lq	λWq	
		Ws	Wq+(1/ μ)	
		Wq	(1/ λ)Lq	
Unit – V Advanced Queueing Models				
101	Queue		Queue is a line or sequence of people or vehicles awaiting their turn to be attended or to proceed.	
102	Application of Queueing models		Design and analyze computer communication networks	
103	Arrival Pattern	λ	The arrival pattern is measured by the mean arrival rate or inter arrival time.Arrival follows poisson process.	
104	Service rate	μ	Service time distribution is assumed to be exponential and mean service rate is usually denoted by μ.	
105	Probability of n customer’s in the system in Model-I	$P_n(t)$	$P_n(t) = \left(\frac{\lambda}{\mu}\right)^n (1 - \frac{\lambda}{\mu})$	
106	Average waiting time of a customer’s in the system in Model-I	W_s	$W_s = \frac{1}{\mu-\lambda}$	
107	System Capacity		There is limited waiting space in some queuing process so that when the queue becomes large, further customers cannot be allowed to join the queue, until space is available after completion of service. Thus there is a finite limit of the system size.	
108	Queue Discipline		This is the manner by which customers are selected for service when a queue has formed.	

109	Most common Queue Discipline		FIFO or FCFS(First In First Out (or)First come First Service) LIFO or LCFS (Last In First Out (or)Last come First Service) SIRO(Service in Random Order) and PIR(Priority in Section)	
110	Kendal's Notation	$(a/b/c):(d/e)$	a = Probability law for the arrival (or inter arrival time) time. b = Probability law according to which the customers are being served c = Number of service stations d = The maximum number allowed in the system (in service and waiting)	
111	Queueing Model-I	$(M/M/I):(\infty/FCFS)$	Single server Queueing Model with infinite number of capacity. Inter arrival time and service time follows exponential distribution.	
112	Queueing Model-II	$(M/M/I):(N/FCFS)$	Single service Model with finite number of capacity. Inter arrival time and service time follows exponential distribution.	
113	Queueing Model-III	$(M/M/C):(\infty/FCFS)$	Multi server Queuing Model with infinite number of capacity. Inter arrival time and service time follows exponential distribution.	
114	Queueing Model-IV	$(M/M/C):(N/FCFS)$	Multi server Queuing Model with infinite number of capacity. Inter arrival time and service time follows exponential distribution.	
115	Customer's behavior		A customer generally behave in four ways. (i). Balking (ii). Reneging (iii). Jockeying	
116	Balking		A customer may leave the queue, if there is no waiting space	
117	Reneging		This occurs when the waiting customer leaves the queue due to impatience	
118	Jockeying		Customers may jump from one waiting line to another	

119	Priorities		In certain applications some customers are served before others regardless of their order of arrival.	
120	Transient State		A system is said to be in transient State when its operating characteristics are dependent on time	
121	Steady state		A system is said to be in transient State when the behavior of the system are independent on time	
122	Queueing System		(i) The input (or) Arrival Pattern (ii) The Service Mechanism (iii) The Queue Discipline (iv) Customer's Behavior	
123	Non-Markovian Queueing Model		If the arrivals and Departure do not follow Poisson distribution ,then the study of those models become difficult.So we have use Non-Markovian queuing model $(M/G/I);(\infty/GD)$,where M indicates the number of arrivals in time t which follows a Poisson Process.	
124	Little's Formula		Relationship between L_s ,L_q ,W_s & W_q is called Little's formula..	
125	Traffic Intensity	ρ	$\rho = \frac{\lambda}{\mu}$ (to calculate busy time)	

Placement Questions				
126	Permutation	nPr	Permutation is defined as **arrangement** of r things that can be done out of total n things. This is denoted by nPr.	
127	Combination	nCr	Combination is defined as **selection** of r things that can be done out of total n things. This is denoted by nCr.	
128	Average		$\frac{\textit{Sum of quantities}}{\text{Number of quantities}}$	
129	Ratio		A ratio is the comparison of two homogeneous quantities, or a ratio is the division of two quantities a and b having the same units. It is denoted by a:b	

130	Arithmetic Progression	AP	Arithmetic progression(AP) or arithmetic sequence is a sequence of numbers in which each term after the first is obtained by adding a constant.	
131	Geometric Progression	GP	Geometric Progression of non-zero numbers in which the ratio of any term and its preceding term is always constant.	
132	Prime Number		A prime number is a natural number greater than 1 that has no positive divisors other than 1 and itself.	
133	L.C.M		L.C.M. is the least non-zero number in common multiples of two or more numbers.	
134	Methods of L.C.M		i) Factorization Method. ii) Division Method.	
135	H.C.F		The highest common factor of two or more numbers is the greatest number which divides each of them exactly without any remainder.	
136	Reciprocal or Inverse Ratio		If the antecedent and consequent of a ratio interchange their places.The new ratio is called the inverse ratio of the first ratio.	
137	Selling Price	SP	The price at which goods are sold is called the selling price.	
138	Cost Price	CP	The price at which goods are bought is called the cost price	
139	Market Value		The stock of different companies are sold and bought in the open market through brokers at stock-exchanges.	
140	Profit	Profit = SP - CP	When the selling price is more than the cost price, then the trader makes a profit.	
141	Loss	Loss = CP - SP	When the selling price is less than the cost price, then the trader makes a loss.	
142	Stock Capital		The total amount of money needed to run the company is called the stock capital	
143	Shares or Stock		The whole capital is divided into small units, called shares or stock.	
144	Simple Interest	$SI = \frac{PNR}{100}$	P – Initial principal balance N – Number of years R - Interest rate	
145	Compound Interest		Compound interest is calculated on the principal amount and also on the accumulated interest of previous periods, and can thus be regarded as “interest on interest”.	
146	Mean Price		The cost of a unit quantity of the mixture is called the mean price.	
147	Odd one out		A person or thing that is different from or kept apart from others that form a group or set is called as odd one out	
148	Speed		$\text{Speed} = \frac{\text{Distance}}{Time}$	
149	Time		$\text{Time} = \frac{\text{Distance}}{Speed}$	

150	Face Value		The value of a share or stock printed on the share-certificate is called its Face Value or Nominal Value or Par Value	

Faculty Team Prepared **Signatures**

1. **P.M.SARAVANAN**
2. **M.SARANYA** **HOD**