K. T. S. P. Mandal's
Hutatma Rajguru Mahavidyalaya , Rajgurunagar
Department Of Statistics
Teaching Plan
Academic Year 2021-22
Term- I

Sr.No	Class	Paper	Name of Teacher
1	F.Y.B.Sc	Descriptive Statistics I	Thorat S.R.
2	F.Y.B.Sc	Discrete Probability	Thorat S.R.
3	S.Y.B.Sc	Discrete Probability Distributions and Time series	Thorat S.R.
4	S.Y.B.Sc	Continuous Probability Distributions	Thorat S.R.

Paper : Descriptive Statistics I. **Class: F.Y.B.Sc**

Month	Topic	Subtopic
Sept /Oct 2021	1**. Introduction to Statistics**	1.1 Meaning of Statistics as a Science. 1.2 Importance of Statistics. 1.3 Scope of Statistics: 1.4 Statistical organizations in India and their functions:
	2. Population and Sample	2.1 Types of characteristics: 2.2 Types of data: 2.3 Notion of a statistical population 2.4 Methods of sampling
	3.Presentation of data	3.1 Classification 3.2 Frequency Distribution 3.3 Methods of classification 3.4 Cumulative frequencies

		3.5 Relative frequency 3.6 Guidelines for choice of classes 3.7 Graphical representation of statistical data 3.8 Stem and leaf chart 3.9 Data Analysis and interpretation
Oct 2021 **Nov 2021**	**4. Measures of central tendency** **5. Measures of Dispersion**	4.1 Introduction 4.2 Objectives of Measures of Central Tendency 4.3 Arithmetic Mean (A.M.) 4.4 Trimmed mean 4.5 Median 4.7 Geometric mean 4.8 Mode Harmonic mean 4.9 Weighted means 4.9 Partition values 4.10 Box and whisker plot 5.1 Introduction 5.2 Measures of Dispersion 5.3 Range and Coefficient of range 5.4 Quartile deviation
Dec 2021 **Jan 2022**	 **6. Moments** **7. Measures of skewness and Kurtosis**	5.5 Mean deviation and coefficient of mean deviation 5.6 Mean square deviation 5.7 Variance , standard deviation , coefficient of variation 6.1 Raw moments (m'r) for ungrouped and grouped data 6.2 Central moments (mr) for ungrouped and grouped data 6.3 Relations between central moments and raw moments, upto 4-th order 7.1 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution. 7.2 Bowley's coefficient of skewness

Jan 2022		7.3 Karl Pearson's coefficient of skewness. 7.4 Measures of skewness based on moments ($\beta 1, \gamma 1$). 7.4 Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions. 7.5 Measures of kurtosis based on moments ($\beta 2, \gamma 2$).
	8. Theory of Attributes	8.1 Attributes: 8.2 Consistency of data upto 2 attributes. 8.3 Concepts of independence and association of two attributes. 8.4 Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation.

Paper : Discrete Probability and Probability Distributions I

Class: F.Y.B.Sc

Month	Topic	Subtopic
Sept/Oct 2021	**1. Basics of Probability**	1.1 Experiments/Models, Ideas of deterministic and non-deterministic models. Random Experiment, concept of statistical regularity. 1.2 Definitions of - (i) Sample space, (ii) Discrete sample space: finite and countably infinite, (iii) Event, (iv) Elementary event, (v) Complement of an event. (vi) Certain event (vii) Impossible event Concept of occurrence of an event. Algebra of events and its representation in set theory notation. Occurrence of following events. (i) at least one of the given events, (ii) none of the given events, (iii) all of the given events, (iv) mutually exclusive events, (v) mutually exhaustive events, (vi) exactly one event out of the given events. 1.3 Classical definition of probability and its limitations. Probability model, probability of an event, equiprobable and non-equiprobable sample space, 1.4 Axiomatic definition of probability. Theorems And results on probability with proofs based on axoomatic approach. Such as, $P(A \cup B) = P(A)+P(B)- P(A \cap B)$ Generalisation $P(A \cup B \cup C), 0 \leq P(A) \leq 1, P(A)+P(A')=1, P(\phi)=0$, $P(A) \leq P(B)$ if A is subset of B,Boole's inequality

	2.Conditional Probability and Baye's theorem	2.1 Definition of conditional probability of an event. Definition of independence of two events $P(A \cap B) = P(A) \cdot P(B)$ Pairwise independence and mutual independencefor three events Multiplication theorem $P(A \cap B) = P(A) \cdot P(B\|A)$. Generalization to $P(A \cap B \cap C)$.
Nov 2021 **Dec 2021**	**3. Univariate Probability Distributions (Defined on Discrete Sample Space)** **4. Mathematical Expectation (Univariate Random Variable)**	2.2 Partition of the sample space Proof of Bayes' theorem. Applications of Bayes' theorem in real life True Positive, False positive and sensitivity of test as application of Baye's theorem. 3.1 Concept and definition of a discrete random variable. 3.2 Probability mass function (p.m.f.) and cumulative distribution function (c.d.f.), $F(\cdot)$ of discrete random variable, properties of c.d.f.. 3.3 Mode and median of a univariate discrete probability distribution 4.1 Definition of expectation (Mean) of a random variable, expectation of a function of a random variable, m.g.f. and c.g.f. Properties of m.g.f and c.g.f. 4.2 Definitions of variance, standard deviation (s.d.) and Coefficient of variation (c.v.) of univariate probability distribution, effect of change of origin and scale on mean, variance and s.d. 4.3 Definition of raw, central and factorial raw moments of univariate probability Distributions and their interrelations 4.4 Coefficients of skewness and kurtosis based on moments.

Jan 2022	**5. Some Standard Discrete Probability Distributions - I**	5.1 Degenerate distribution, mean and variance 5.2 Uniform discrete distribution, p.m.f., c.d.f., mean, variance, real life situations, comments on mode and median 5.3 Bernoulli Distribution: p.m.f., mean, variance 5.4 Binomial Distribution: p.m.f., mean, variance 5.5 Hypergeometric Distribution : p.m.f., Computation of probability, situations where this distribution is applicable, binomial approximation to hypergeometric probabilities, mean and variance of the distribution

Paper : Discrete Probability Distributions and Time series
Class: S.Y.B.Sc (Sem-III)

Month	Topic	Subtopic	No. of Lectures
Oct 2021	**1. Statndard Discrete Distributions**	**1.1 Negative Binomial Distribution:** Probability mass function (p. m. f.) Notation: X ~ NB (k, p). Nature of p. m. f., negative binomial distribution as a waiting time distribution, M.G.F., C.G.F., mean, variance, skewness, kurtosis (recurrence relation between moments is not expected). Relation between geometric and negative binomial distribution. Poisson approximation to negative binomial distribution. Real life	**08**
Oct/Nov 2021		**1.2 Multinomial Distribution:** Probability Mass function, Notation use of MGF to obtain means, variances, covariances, total correlation coefficients, multiple and partial correlation coefficients for k= 3, univariate marginal distribution, distribution of $X_i + X_j$, conditional distribution of X_i given $X_i + X_j = r$, variance – covariance matrix, rank of variance – covariance matrix and its interpretation and real life situations and applications.	**10**
Dec 2021/ Jan 2022		**1.3 Truncated Distributions:** Concept of Truncated distribution, truncation to the right, left and on both sides. Binomial distribution B(n, p) left truncated at X=0 (value zero is discarded), its p.m.f., mean, variance . Poisson distribution P(m) left truncated at X=0 (value zero is discarded), its p.m.f. , mean, variance. Real life situations and applications.	**07**

Jan/ Feb 2022	**2.Time Series:**	2.1 Meaning and utility of time series, Components of time series: trend, seasonal variations, cyclical variations, irregular (error) fluctuations or noise. 2.2 Exploratory data analysis: Time series plot to (i) check any trend, seasonality in the time series (ii) learn how to capture trend. 2.3 Methods of trend estimation and smoothing: (i) moving average, (ii) curve fitting by least square principle, (iii) exponential smoothing. 2.4 Measurement of seasonal variations : i) simple average method, ii) ratio to moving average method, iii) ratio to trend where trend is calculated by method of least squares. 2.5 Choosing parameters for smoothing and forecasting. 2.6 Forecasting based on exponential smoothing. 2.7 Double exponential smoothing i.e. Holt-Winters method 2.8 Fitting of autoregressive model AR (1), plotting of residuals. 2.9 Data Analysis of Real Life Time Series:	13

Paper : Continuous Probability Distributions-I Class: S.Y.B.Sc (Sem-III)

Month	Topic	Subtopic	No. of Lectures
Oct / Nov 2021	**1.Continuous Univariate Distributions:**	1.1 Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f. (without proof), probabilities of events related to random variable. 1.2 Expectation of continuous r.v., expectation of function of r.v. E[g(X)], mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis. 1.3 Moment generating function(M.G.F.):Definition and properties,cumulant generating function (C. G. F.) : definition, properties. 1.4 Mode, median, quartiles. 1.5 Probability distribution of function of r. v.: $Y = g(X)$ using i) Jacobian of transformation for g(.) monotonic function and one-to-one, on to functions, ii) Distribution function for $Y = X^2$, $Y = \|X\|$ etc., iii) M.G.F. of g(X).	10
Nov /Dec 2021	**2.Continuous Bivariate Distributions:**	2.1 Continuous bivariate random vector or variable b(X, Y): Joint p. d. f. , joint c. d. f , properties (without proof), probabilities of events related to r.v. (events in terms of regions bounded by regular curves, circles, straight lines). Marginal and conditional distributions. 2.2 Expectation of r.v., expectation of function of r.v. E[g(X, Y)], joint moments, Cov (X,Y), Corr (X, Y), conditional mean, conditional variance, $E[E(X\|Y = y)] = E(X)$, regression as a conditional expectation.	09

		2.3 Independence of r. v. (X, Y) and its extension to k dimensional r. v. Theorems on expectation: i) E(X + Y) = E(X) + E(Y), (ii) E(XY) = E(X) E(Y), if X and Y are independent, generalization to k variables. E(aX + bY + c), Var (aX + bY + c). 2.4 M.G.F. : $M_{X,Y}(t_1, t_2)$, properties, M.G.F. of marginal distribution of r. v.s., properties $M_{X,Y}(t_1, t_2) = M_X(t_1, 0)\, M_Y(0, t_2)$, if X and Y are independent r. v.s., $M_{X+Y}(t) = M_{X,Y}(t, t)$, $M_{X+Y}(t) = M_X(t)\, M_Y(t)$ if X and Y are independent r.v.s. 2.5 Probability distribution of transformation of bivariate $U = f_1(X, Y)$, $V = f_2(X, Y)$.	
Dec 2021	**3.Standard Univariate Continuous Distributions:**	**3.1 Uniform or Rectangular Distribution:** Probability density function (p.d.f.) Notation : X ~ U[a, b] . p. d. f., sketch of p. d. f., c. d. f., mean, variance, symmetry. Distribution of i) $X - a$, ii) $b - X$, iii) Y = F(X), where F(X) is the c. d. f. of continuous r. v. X. Application of the result to model sampling.	**04**
Dec 2021/ Jan 2022		**3.2 Normal Distribution:** p. d. f. curve, identification of scale and location parameters, nature of probability curve, mean, variance, M.G.F., C.G.F., central moments, cumulants, b_1 , b_2 , g_1, g_2 , median, mode, quartiles, mean deviation, additive property, computations of normal probabilities using normal probability integral tables, probability distribution of : i) $X - m$,	**10**

		ii) aX + b, iii) aX + bY + c, iv) X^2 , where X and Y are independent normal variates. Probability distribution of $\bar{X}$, the mean of n i. i. d. $N(m, s^2)$ r. v s. Normal probability plot, q-q plot to test normality. Model sampling from Normal distribution using (i) Distribution function method and (ii) Box-Muller transformation as an application of simulation. Statement and proof of central limit theorem (CLT) for i. i. d. r. v. s with finite positive variance.(Proof should be using M.G.F.) Its illustration for Poisson and Binomial distributions.	
Jan/Feb 2022		1.1 Continuous sample space: Definition, illustrations. Continuous random variable: Definition, probability density function (p.d.f.), cumulative distribution function (c.d.f.), properties of c.d.f. (without proof), probabilities of events related to random variable. 1.2 Expectation of continuous r.v., expectation of function of r.v. E[g(X)], mean, variance, geometric mean, harmonic mean, raw and central moments, skewness, kurtosis. 1.3 Moment generating function(M.G.F.):Definition and properties,cumulant generating function (C. G. F.) : definition, properties. 1.4 Mode, median, quartiles. 1.5 Probability distribution of function of r. v.: Y = g(X) using i) Jacobian of transformation for g(.) monotonic function and one-to-one, on to functions, ii) Distribution function for $Y = X^2$, Y = |X| etc., iii) M.G.F. of g(X).	**04**

Prof .Thorat S.R.

Sr.No.	Class	Paper	Name of Teacher
1	F.Y.B.C.S.	Descriptive Statistics-I	Wayal V.M.
2	F.Y.B.C.S.	Mathematical Statistics	Wayal V.M.
3	F.Y.B.B.A (C.A)	Business Statistics	Wayal V.M.

Paper : Descriptive Statistics-I **Class: F.Y.B.Sc(Computer Science)**

Month	Topic	Subtopic	No. of Lectures
Oct -Nov 2021	**1.Data Condensation and Presentation of data**	1.1 Meaning of Statistics as a Science. 1.2 Importance of Statistics. 1.3 Scope of Statistics: 1.4 Data Condensation: Types of data, attributes & variables 1.5. Graphical representation of statistical data Histogram, Ogive curves, Stem and leaf chart	10
Nov -Dec 2021	**2. Descriptive Statistics**	2.1 **Measures of central tendency** 2.2 Objectives of Measures of Central Tendency 2.3 Arithmetic Mean (A.M.) 2.4 Trimmed mean 2.5 Median & mode: Definition, Formula, merits & Demerits, graphical method for computation 2.6 Empirical relation 2.7 Partition values 2.8 Box and whisker plot	15

		2.9 Measures of Dispersion Introduction 2.10 Measures of Dispersion 2.11 Range and Coefficient of range 2.12 Quartile deviation 2.13 Mean deviation and coefficient of mean deviation 2.14 Mean square deviation 2.15 Variance , standard deviation , coefficient of variation	
Dec 2021 - Jan 2022	**3. Moments, Skewness and Kurtosis**	**Moments:** 3.1 Raw moments (m'r) for ungrouped and grouped data 3.2 Central moments (mr) for ungrouped and grouped data 3.3 Relations between central moments and raw moments, upto 4-th order 3.4 Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution. 3.5 Bowley's coefficient of skewness 3.6 Karl Pearson's coefficient of skewness. 3.7 Measures of skewness based on moments ($\beta 1, \gamma 1$). 3.8 Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions. 3.9 Measures of kurtosis based on moments ($\beta 2, \gamma 2$).	**10**

Feb 2022	**4. Theory of Attributes**	4.1 Attributes: 4.2 Consistency of data upto 2 attributes. 4.3 Concepts of independence and association of two attributes. 4.4 Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, interpretation.	6

Paper : Mathematical Statistics **Class: F.Y.B.Sc(Computer Science)**

Sr. No.	Month	Topic	No. of lectures
1	Oct-Nov 2021	**1. Theory of Probability** 1.1 Counting Principles, Permutation, and Combination. 1.2 Deterministic and non-determination models. 1.3 Random Experiment, Sample Spaces (Discrete and continuous) 1.4 Events: Types of events, Operations on events. 1.5 Probability - classical definition, probability models, axioms of probability, probability of an event. 1.6 Theorems of probability (without proof) i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(\Phi) = 0$ iv)$P(A) \leq P(B)$ when A□B iv) P(A *U* B) = P(A) + P(B) - P(A□B) 1.7 Numerical problems related to real life situations.	10
2	Nov-Dec 2021	**2. Conditional Probability and Independence** 2.1Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B)=P(A).P(B\|A)$ 2.2 Bayes' theorem (without proof). True positive , false positive and sensitivity of test as application of Bayes' theorem. s 2.3 Concept of Posterior probability, problems on posterior probability. 2.4 Concept and definition of independence of two events. 2.5 Numerical problems related to real life situations.	9

3	**Jan 2022**	**3: Random Variable** 3.1 Definition of random variable (r.v.) , discrete and continuous random variable. 3.2 Definition of probability mass function (p.m.f.) of discrete r.v. and Probability density function of continuous r.v.. 3.3 Cumulative distribution function (c.d.f.) of discrete and continuous r.v. and their properties. (Characteristic properties only) 3.4 Definition of expectation and variance of discrete and continuous r.v., theorem on expectation and variance (statement only). 3.4 Determination of median and mode using p.m.f. only. 3.5 Numerical problems related to real life situations.	**09**
4	**Jan-Feb 2022**	**4 : Standard Discrete Distributions** 4.1Discrete Uniform Distribution: definition, mean, variance. 4.2 Binomial Distribution: definition, mean, variance, additive property, Bernoulli distribution as a particular case with n = 1. 4.3 Geometric Distribution (p.m.f $p(x) = pq^x$, x = 0,1,2.....): definition,mean, variance. 4.4 Poisson Distribution: definition, mean, variance, mode, additive property, limiting case of B(n, p) 4.5 Illustration of real life situations. 4.6 Numerical problems related to real life situations.	**12**

Paper : Business Statistics **Class: F.Y.B.B.A. (Sem-I)**

Month	Topic	Subtopic	No. of lectures
Oct 2021	**1.Concept of Statistics**	1.1 Meaning of Statistics as a Science. 1.2 Importance of Statistics. 1.3 Scope of Statistics: 1.4 Data Condensation: Types of data, attributes & variables 1.5. Graphical representation of statistical data Histogram, Ogive curves, Cumulative frequency curve	12
Nov- Dec 2021	**2. Measures of central tendency**	2.1 **Measures of central tendency** 2.2 Objectives of Measures of Central Tendency 2.3 Arithmetic Mean (A.M.) 2.4 Trimmed mean 2.5 Median & mode: Definition, Formula, merits & Demerits, graphical method for computation 2.6 Empirical relation 2.7 Partition values 2.8 Box and whisker plot	13
Dec 2021- Jan 2022	**3. Measures of Dispersion**	**Measures of Dispersion** Introduction 3.1Measures of Dispersion 3.2 Range and Coefficient of range 3.3Quartile deviation 3.4 Mean deviation and coefficient of mean deviation 3.5 Mean square deviation 3.6 Variance , standard deviation , coefficient of variation	**12**

Jan-Feb 2022	**4. Correlation and Regression**	4.1 Concept of Correlation 4.2 Types of correlation 4.3 Karl Pearson's coefficient of correlation 4.4 Meaning of Regression 4.5 Two regression equations 4.6 Numerical problems.	12

Prof V.M. Wayal

K. T. S. P. Mandal's
Hutatma Rajguru Mahavidyalaya , Rajgurunagar
Department Of Statistics
Teaching Plan
Academic Year 2021-22 Term II

Sr.No	Class	Paper	Name of Teacher
1	F.Y.B.Sc	Descriptive Statistics II	Thorat S.R.
2	F.Y.B.Sc	Discrete Probability Distributions	Thorat S.R.
3	S.Y.B.Sc	Test of Significance and Statistical Methods	Thorat S.R.

Paper : Descriptive Statistics II. **Class: F.Y.B.Sc**

Month	Topic	Subtopic
April/ May 2022	1**. Correlation**	1.1 Bivariate data, Scatter diagram and interpretation. 1.2 Concept of correlation between two variables 1.3 Covariance between two variables (m11) : 1.4 Karl Pearson's coefficient of correlation (r) 1.5 Spearman's rank correlation coefficient: compute Karl Pearson's correlation coefficient between ranks.
May 2022	**2. Fitting of Curve (Regression Line)**	2.1 Concept of dependent and independent variables. 2.2 Identification of response and predictor variables and relation between them. 2.3 Simple linear regression model: $Y= a + b X + \varepsilon$ 2.4 Concept of residual, plot of residual, coefficient of determination
May 2022	**3. Curve fitting**	3.1 Necessity and importance of drawing second degree curve.

		3.2 Fitting of second degree curve 3.3 Fitting of exponential Curve of the type $Y=ab^x$ and $Y=aX^b$
June 2022	**4. Index Number**	4.1 Introduction. 4.2 Definition and Meaning. 4.3 Problems/considerations in the construction of index numbers. 4.4 Simple and weighted price index 4.5 Simple and weighted price index 4.6 Laspeyre's, Paasche's and Fisher's Index numbers. 4.7 Consumer price index number (i) family budget method (ii) aggregate expenditure method. 4.3 Shifting of base, splicing, deflating, purchasing power. 4.4 Description of the BSE sensitivity and similar index numbers.

Paper : Discrete probability Distributions **Class:F.Y.B.Sc**

Month	Topic	Subtopic
April/ May 2022	**1. Some Standard Discrete Probability Distributions**	**1.1 Poisson distribution:** m.g.f. and c.g.f. Moments, mean, variance, skewness and kurtosis, Additive Property for Poisson distribution Conditional distribution of X given (X+Y) for Poisson distribution. **1.2 Geometric distribution:** Mean, variance, m.g.f. and c.g.f. Lack of memory Property.
June 2022	**2. Bivariate Discrete Probability Distribution**	2.1 Definition of two-dimensional discrete random variable, its joint p.m.f. and its distribution function and their properties 2.2 Concept of identically distributed random variables. 2.3 Computation of probabilities of events in bivariate probability distribution. 2.4 Concepts of marginal and conditional probability distributions. 2.5 Independence of two discrete random variables based on joint and marginal p.m.f.s
June 2022	**3.Mathematical Expectation (Bivariate Random Variable)**	3.1 Definition of raw and central moments, m.g.f, c.g.f. 3.2 Theorems on expectations .3.3 Conditional expectation. 3.4 Definitions of conditional mean and conditional variance. 3.5 Definition of covariance, coefficient of correlation, independence and uncorrelatedness of two variables. 3.6 Variance of linear combination of variables Var(aX + bY).Correlation coefficient

Paper : Test of Significance and Statistical Methods
Class: S.Y.B.Sc (Sem-IV)

Month	Topic	Subtopic
April/May 2022	**I) Tests of Hypothesis**	Statistics and parameters, statistical inference : problem of estimation and testing of hypothesis. Estimator and estimate. Unbiased estimator (definition and illustrations only). Statistical hypothesis, null and alternative hypothesis, Simple and composite hypothesis, one sided and two sided alternative hypothesis, critical region, type I error, type II error, power of the test, level of significance, p-value. Two sided confidence interval, finding probabilities of type I error and type II error when critical regions are specified . i) Test for population mean equal to specified value ii) Test of equality of two population mean iii) Test for population proportion equal to specified value. iv) Test for equality of two population proportions.
May 2022	**II) Multiple Linear Regression Model:**	Definition of multiple correlation coefficient $R_{Y.XX}$. Derivation of the expression for the multiple correlation coefficient. Properties of multiple correlation coefficient Interpretation of coefficient of multiple determination $^{1\,2}$ Definition of partial correlation coefficient Fitting of regression plane of Y on X_1 and X_2, by the method of least squares; obtaining normal equations, solutions of normal equations Residuals : Definition, order, derivation of variance, properties. Definition and interpretation of partial regression coefficients Properties of partial correlation coefficient:
June 2022	**III) Dempgraphy**	Vital events, vital statistics, methods of obtaining vital statistics, rates of vital events, sex ratios, dependency ratio. Death/Mortality rates: Crude death rate, specific (age,

		sex etc.) death rate, standardized death rate (direct and indirect), infant mortality rate. Fertility/Birth rate: Crude birth rate, general fertility rate, specific (age, sex etc.) fertility rates, total fertility rate. Growth/Reproduction rates : Gross reproduction rate, net reproduction rate. Interpretations of different rates, uses and applications. Trends in vital rates as revealed in the latest census.
June 2022	**IV) Queuing Model**	M/M/1: FIFO as an application of exponential distribution, Poisson distribution and geometric distribution : Inter arrival rate , service rate (μ), traffic intensity ,queue discipline probability distribution of number of customers in queue, average queue length, average waiting time in: i) queue, ii) system.

Thorat S.R.