

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
 Sixth Semester B.Sc Statistics Degree Examination, March /April 2019
 ST6B10 – Time Series and Index Numbers
 (2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

PART A

(Answer ALL the questions. Each carries 1 mark.)

Fill in the blanks (Questions 1-6)

1. Laspeyre's index uses the quantities as weights.
2. Combining of two series of indices with different base periods into one series with common base period is known as.....
3. ----- describes the procedures of assigning numbers to various degrees of opinion, attitude and other concepts.
4. The price index as the arithmetic mean of Laspeyre's and Paache's indices was expounded by.....
5. Non-centered moving averages are due to.....
6. is known as economic barometers.

Multiple Choice Questions (Questions 7-12)

7. Factor reversal test permits the interchange of
 a) base year (b) price & quantity (c) weights (d) none of these
8. Least square estimates of parameter of a trend line
 (a) have minimum variance (b) are unbiased
 (c) can exactly be obtained (d) all the above
9. Linear trend of a time series indicates towards:
 a) constant rate of change b) constant rate of growth
 c) change in geometric progression d) All the above
10. Method of least squares to fit in the trend is applicable only if the trend is
 (a) linear (b) parabolic (c) both (a) and (b) (d) neither (a) nor (b)
11. A time series consists of:
 (a) One component (b) Two components
 (c) Three components (d) Four components
12. Which index satisfies factor reversal test?
 (a) Laspeyre's index (b) Paasche's index (c) Fisher's index (d) Kelly's index

(12 x 1 =12 Marks)

PART B

(Answer any SEVEN questions. Each carries 2 marks.)

13. What is chain base index numbers?
14. What is meant by consumer price index?
15. What is meant by trend of a time series.
16. Define splicing.
17. Explain Lorenz curve.
18. What are irregular variations?
19. What is deflating?
20. Distinguish between simple index number and weighted index number
21. Give example for seasonal and cyclic variation.

(7 x 2 = 14 Marks)

PART C

(Answer any SIX questions. Each carries 5 marks.)

22. Explain the use of index numbers. Also mention their limitations.
23. Discuss mathematical models for a time series analysis.
24. Explain how the 'principle of least squares' used to estimate trend in a time series.
25. What is Gini's coefficient? Give interpretations of the values obtained from this measure.
26. Explain time reversal test and factor reversal test.
27. Define lognormal distribution and state its properties.
28. Explain the limitations of scales in attitude measurements.
29. Explain Likert scale of attitude measurement.

(6 x 5 = 30 Marks)

PART D

(Answer any THREE questions. Each carries 8 marks)

30. Explain the link – relative method of measuring seasonal indices of a time series.
31. Describe Pareto's law of income distribution. Explain the fitting of Pareto's law.
32. When one comes across the problem of base shifting and how can it be tackled?
33. Discuss various problems involved in construction of index numbers.
34. What are the four scales of measurement. Explain. Also discuss the possible sources of error in measurement.

(3 x 8=24 Marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
Sixth Semester B.Sc Statistics Degree Examination, March /April 2019

ST6E03 – Reliability Theory

(2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

Part A

(Answer all questions; each question carries 1 mark)

Multiple Choice Questions (Questions 1-6)

- The dual of 2-out of-4 structure is
 - 2-out of-4 structure
 - 1 – out of –4 structure
 - 3 – out of –4 structure
 - Parallel structure of 4 components
- The structure function of *series system* is
 - $\phi(x) = \max(x_1, x_2, \dots, x_n)$
 - $\phi(x) = \min(x_1, x_2, \dots, x_n)$
 - $\phi(x) = (x_1 + x_2 + \dots + x_n)$
 - $\phi(x) = (x_n - x_1)$
- For a coherent system which of the following is true
 - A component may be relevant
 - Each of the component is relevant
 - No component is relevant
 - At least two components are relevant
- Reliability of a system can be defined as
 - $E[\phi(x)]$
 - $1 - E[\phi(x)]$
 - $E[\phi(x)] - 1$
 - $E[\phi^2(x)]$
- Reliability of three identical component series system is
 - p^3
 - $1 - p^3$
 - $p(1 - p)^3$
 - $1 - (1 - p)^3$
- If $\mu = 1$, then the failure rate of $\exp(\mu)$ is
 - 0
 - 1
 - e
 - e^{-1}

Fill in the blanks (Questions 7-12)

- 1-out of -3 system is a _____ system.
- Reliability of a 3- component parallel system is _____.
- The number of components in a system is called _____ of the system.
- The dual structure of _____ structure is a parallel structure.
- In Poisson distribution mean is _____ variance.
- The function $\frac{f(t)}{1-F(t)}$ is called _____.

Part B

(Answer any seven questions; each question carries 2 marks)

13. What do you mean by series system?
14. Define a bridge structure with an example.
15. Define coherent system.
16. Define minimal path sets.
17. What are dual coherent structures?
18. What do you mean by pivotal decomposition of a structural function?
19. Discuss the role of Poisson distribution in reliability theory.
20. Show that the hazard function uniquely determines the reliability function.
21. Define Exponential distribution. State its mean and variance

(7 x 2 = 14 Marks)

Part C

(Answer any six questions; each question carries 5 marks)

22. When do you say that a component is relevant to the structure ϕ . Give *one* example.
23. Derive the reliability of 2-out of-3 structure.
24. Let $\phi(x_1, x_2) = x_1 x_2$ be the structure function of a series system of two components. Write down the pivotal decomposition of the structure function.
25. Prove that a minimal path set of coherent system is a minimal cut set of the dual system.
26. What do you mean by modules of a coherent system.
27. Define hazard rate. Find hazard rate of exponential distribution.
28. State and prove memory less property of exponential distribution.
29. Derive the relationship between cumulative hazard rate with reliability function.

(6 x 5 = 30 Marks)

Part D

(Answer any three questions; each question carries 8 marks)

30. With usual notation show that for a structure function ϕ order n ,
$$\phi(\mathbf{x}) = x_i \phi(\mathbf{1}_i, \mathbf{x}) + (1 - x_i) \phi(\mathbf{0}_i, \mathbf{x})$$
 for all \mathbf{x} ($i=1, 2, \dots, n$)
31. Explain Inclusion Exclusion method for finding reliability.
32. Let $\phi(\underline{x})$ be the structure function of a coherent system of order n . Then show

$$\text{that } \prod_{i=1}^n x_i \leq \phi(\underline{x}) \leq \prod_{i=1}^n x_i .$$

33. Prove that we obtain a better system by introducing redundancy at component level than by introducing redundancy at system level.
34. Define IFR and IFR classes of Distributions. Illustrate with example.

(3 x 8 = 24 Marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
Sixth Semester B.Sc Statistics Degree Examination, March /April 2019
ST6B11 – Design of Experiments
(2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

Part A**(Answer all questions; each question carries 1 mark)**

1. Give the least square estimate of σ^2 of the linear model $Y = A\beta + e$
2. Estimate sum of square of above linear model is
3. Precision of the experiment is inversely proportional to
4. The experimental error is controlled through the principle of
5. Total number of parameters to be estimated in RBD with 3 treatments and 3 blocks are..
6. RBD controls variation.

State true or false

7. Analysis of variance utilizes z-test.
8. Randomization is used to control known variations.
9. The missing observation in an RBD is obtained by minimizing variance.
10. Replication is one of the principal of local control.
11. Confounding is a size reduction technique.
12. In the case of 4 x 4 LSD the error degrees of freedom is 15. (12 x 1= 12 Marks)

Part B**(Answer any seven questions; each question carries 2 marks)**

13. What do you mean by Gauss-Markoff setup?
14. Derive the least square estimate of β in the linear model $Y = A\beta + C$.
15. What is contrast? Give an example.
16. Define (i) Experimental units (ii) local control
17. Distinguish between the analysis of variance with single and multiple observations per cell.
18. Briefly describe the procedure of testing equality of all possible pairs of treatments in CRD.
19. Give the expression for estimating missing value in LSD.
20. Describe Latin square design and discuss its merits and demerits
21. Explain factorial experiments with an example.

(7x2=14 Marks)

Part C

(Answer any six questions; each question carries 5 marks)

22. State and prove the necessary and sufficient condition for estimability of parametric function.
23. Let y_1, y_2, y_3 are three independent random variables with common variance σ^2 . $E(y_1) = \beta_1, E(y_2) = \beta_2 - \beta_1$ and $E(y_3) = \beta_2$. Examine the whether $\beta_1 - \beta_2$ is estimable. Obtain the BLUE.
24. Explain the need of design of experiments. Discuss the applications of design of experiments.
25. Describe the analysis of RBD. Discuss its advantages
26. Compare the efficiency of LSD over RBD.
27. Develop the analysis of 2^3 factorial experiments.
28. Define ANCOVA. Give an example.
29. What is confounding? When confounded designs are used?

(6x5=30 Marks)

Part D

(Answer any three questions; each question carries 8 marks)

30. Describe the basic principles of experimentation and explain their need with examples.
31. (a) Describe two way classification for ANOVA.
(b) The following data representing the number of units of produce per day turned out by five workers using four machines, set-up the ANOVA table.

	Machine Type			
Worker	A	B	C	D
I	24	18	27	16
II	26	20	32	23
III	14	16	24	12
IV	23	18	26	13
V	18	22	29	19

32. Define concomitant variable. Explain ANCOVA for one way classified data with one concomitant variable.
33. Explain missing plot technique. Suppose that in an RBD, one observation is missing. How do you estimate it? What are the modifications to be made in the analysis of variance?
34. What is Duncan's multiple range tests. Illustrate with an example.

(3x8=24 Marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
 Sixth Semester B.Sc Statistics Degree Examination, March /April 2019
 ST6B12 – Population Studies and Actuarial Science
 (2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

PART-A

Answer all questions. Each question carries one mark

1. If age is given as 0-1, 1-4, 5-9, 10-14, 15-19,, in a life table, such a life table is known as:
 a) Complete life table b) Abridged life table c) Curtate life table d) None of these
2. If l_{60} and d_{60} in a life table are 400 and 250 respectively, then $l_{65} = \dots$
 a) 150 b) 650 c) 25/40 d) 40/25
3. In the words of, life table is the biometer of the population.
 a) Arthur Newsholme b) A.J Lotka c) Benjamin d) William Farr
4. If T_{65} and ${}_5L_{60}$ in a life table are 23000 and 1000 respectively, then $\dots = T_{60} \dots$
 a) 22000 b) 24000 c) -22000 d) 10/23
5. The condition which may increase the chance of the loss is referred as:
 a) Risk b) Hazard c) Peril d) None of these
6. Which office in the Central Government in our Country is responsible for conducting the population census in our country?
7. The highest level of cover in a Motor Insurance is known as
8. The average number of deaths occurred among 1000 persons in a year in a given population is known as ...
9. Death rate computed for a particular specified section of the population is termed as
10. The average number of years lived by a person after age x in a life table is usually denoted by the symbol ...
11. The number of new born babies in a life table is usually known as the ... of the life table
12. For a stable population, the number of births should always be equal to number of deaths (True/False).

(12 x 1= 12Marks)

PART-B

Answer any seven questions. Each question carries two marks.

- 13. Define sex ratio.
- 14. Define peril.
- 15. What is Pearl's vital index?
- 16. Define 'n-year endowment insurance'
- 17. Define general marital fertility rate.
- 18. Define crude death rate.
- 19. Define indemnity.
- 20. Define force of mortality.
- 21. Define l_x .

(7 x 2= 14 Marks)

PART-C

Answer any six questions. Each question carries five marks.

- 22. Explain about principles of insurance.
- 23. Describe the indirect method of standardizing death rates.
- 24. Define Crude birth rate. List out its advantages and disadvantages.
- 25. Explain various uses of life tables.
- 26. What do mean by abridged life table. Explain Reed Merrel's method.
- 27. Fill in the blanks in a portion of life table given below.

Age	l_x	d_x	p_x	q_x	L_x	T_x	e_x^0
4	96000	550	-	-	-	4850300	-
5	-	400	-	-	-	-	-

- 28. Define Age Specific Fertility Rates. State its merits and demerits.
- 29. Distinguish between GRR and NRR.

(6 x 5= 30Marks)

PART-D

Answer any three questions. Each question carries eight marks.

- 30. Explain the various sources of vital statistics and the important uses of vital statistics.
- 31. Explain the benefits and cost of insurance to society.
- 32. Calculate the crude and standardized death rates for the local population from the following data and compare them with crude death rate of the standard population.

Age group	Standard population	Deaths	Local population	Deaths
0-10	600	18	400	16
10-20	1000	5	1500	6
20-60	3000	24	2400	24
60-100	400	20	700	21

- 33. Explain the assumptions, descriptions and construction of life tables.
- 34. Explain (i) Fire Insurance (ii) Marine Insurance and (iii) Miscellaneous Insurance

(3 x 8= 24Marks)

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Reg. No:.....

Name:

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
 Sixth Semester B.Sc Statistics Degree Examination, March /April 2019
 ST6B13 – Linear Regression Analysis
 (2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

Part A**Answer all questions. Each carries 1 mark**

1. The unbiased estimate of the variance of the residual term is
2. The least square estimate of β_0 is
3. The coefficient of any independent variable in a multiple linear regression equation is called
 - a. simple regression coefficient
 - b. multiple regression coefficient
 - c. partial regression coefficient
 - d. none of the above
4. If one regression coefficient is negative, the other would be
5. Correlation coefficient is an appropriate measure of the relationship between two variables, only when the functional relationship between them is
 - a. Linear
 - b. Nonlinear
 - c. Parabolic
 - d. None of the above.
6. If $\beta_{YX} > 1$, β_{XY} is
 - a. less than 1
 - b. greater than 1
 - c. equal to 1
 - d. equal to 0.
7. In the regression line $Y = \beta_0 + \beta_1 X + \epsilon_i$, β_1 is the of the regression line.
8. What is the point at which the two lines of regressions intersect?
9. If the two variables of the simple regression are measured from their means, the lines of regression pass through
10. The geometric mean of the two regression coefficient is same as the
11. The general form of a logistic regression model is
12. There will be only one regression line if the correlation coefficient r between the variables is
 - a. +1
 - b. -1
 - c. either +1 or -1
 - d. very low.

(12 x 1=12 marks)

Part B

Answer any 7 questions. Each carries 2 marks.

13. What are the assumptions about the error term in the regression model?
14. How do you interpret the value of the regression coefficient?
15. Write down the expression for variance of the estimators of the parameters in the model
$$Y_i = \beta_0 + \beta_1 X_i + \epsilon_i.$$
16. Define the coefficient of determination.
17. Write down the ANOVA table for regression with k independent variables.
18. Write down the expression for the tangent of the angle between the two regression lines.
19. Give the expression for the 95% confidence of the regression coefficient of y on x.
20. Explain the method of fitting a parabola.
21. Define logistic regression.

(7 x 2=14marks)

Part C

Answer any six questions. Each carries 5 marks.

22. Explain the uses of correlation and regression in statistical data analysis.
23. How will you test the significance of the regression coefficients?
24. What is scatter diagram. Depict different types of correlation that may exist between two variables with the help of scatter diagram.
25. Explain the concept of logistic regression.
26. Derive the expression for the 95% confidence interval for the regression coefficient in simple linear regression model.
27. Explain logistic regression models for binary output data.
28. Show that least square estimator of β is an unbiased estimator of β for a multiple regression model.
29. Obtain the least square estimates of regression parameters in simple linear regression model.

(6 x 5 = 30marks)

Part D

Answer any three questions. Each question carries 8 marks.

30. Prove that the least square estimators of a simple linear regression equation are BLUE's.
31. Crickets make their chirping sounds by rapidly sliding one wing over the other. The faster they move their wings, the higher the number of chirping sounds that are produced. Scientists have noticed that crickets move their wings faster in warm temperatures than in cold temperatures. Therefore, by listening to the pitch of the chirp of crickets, it is possible to tell the temperature of the air. The following table gives the number of cricket chirps per 13 seconds recorded at 10 different temperatures.

Temperature	60	66	70	73	78	80	82	87	90	92
Number of chirps	20	25	31	33	36	39	42	48	49	52

Fit regression line of number of chirps on temperature discuss its usefulness.

32. The following data represent weights of cigarettes (g) from different manufacturers and their nicotine contents (mg).

Weight	15.8	14.9	9.0	4.5	15.0	17.0	8.6	12.0	4.1	16.0
Nicotine	0.957	0.886	0.852	0.911	0.889	0.919	0.969	1.118	0.946	1.094

Plot the points and graph the line. Do you think the linear regression is appropriate?

33. A study is conducted to estimate the demand for housing (y) based on current interest rate X_1 and the rate of unemployment X_2 . The data in Table 8.6.1 are obtained. Fit the multiple regression model of Y on x_1 and x_2 .

Y	x_1	x_2
65	9.0	10.0
59	9.3	8.0
80	8.9	8.2
90	9.1	7.7
100	9.0	7.1
105	8.7	7.2

34. It is believed that exposure to solar radiation increases the pathogenesis of melanoma.

Suppose that the following data give sunspot relative number and age-adjusted total incidence (incidence is the number of cases per 100,000 population) for 8 different years in a certain region.

Sunspot relative number	104	12	40	75	110	180	175	30
Incidence total	4.7	1.9	3.8	2.9	0.9	2.7	3.9	1.6

Test for the significance of regression coefficient of incidence total on sunspot relative number.

(3 x 8=24marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
 Sixth Semester B.Sc Statistics Degree Examination, March /April 2019
 ST6B14(P) – Practical II
 (2016 Admission onwards)

Time: 3 hours

Max. Marks: 80

Use of calculator and statistical table is permitted.

Answer any four questions.

Each question carries 20 marks.

1. Use simplex method to solve the following LPP.

$$\text{Maximize } Z = 5x_1 + x_2$$

$$\text{Subject to : } 2x_1 + 5x_2 \leq 9$$

$$3x_1 + x_2 \leq 7$$

$$x_1 \geq 0, x_2 \geq 0$$

2. a) Estimate the missing value in the following Latin square design.

B	D	A	C
10	8	12	19
D	—	C	B
6		18	12
A	C	B	D
5	21	22	10
C	B	D	A
27	17	12	7

- b) Number of defectives in 10 independent samples of varying sizes from a production process is given below. Draw the control chart for fraction of defectives and comment on it.

Sample No.	1	2	3	4	5	6	7	8	9	10
Sample size	1975	1475	1375	1325	1225	1735	1850	1930	3100	1550
Number of defectives	420	423	212	335	221	22	276	302	334	300

3. a) Plot the original and trend values by finding four yearly moving averages for the following data.

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Price	580	542	572	680	692	708	615	700	706	652	590	528

b) Following table gives the sample means and sample ranges of 7 samples of size 5 each. Draw mean and range charts and comment on the state of control.

Sample No.	1	2	3	4	5	6	7
Mean	41.8	48.1	37.5	42.8	46	39.2	43.1
Range	5.1	6	5.3	6.8	7	4	8.1

$$(A_2 = 0.577, D_3 = 0, D_4 = 2.115)$$

4. a) Complete the following table for the analysis of variance and expected mean squares of a fixed effects Randomized block design.

Sources of variation	Sum of squares	Degrees of freedom	Mean square	Expected mean square
Blocks	28.2	5	—	—
Treatments	—	4	—	—
Error	—	—	3.2	—
total	88.4	—	—	—

- b) Using the following data verify the statement that “Marshall-Edgeworth’s index number is a good approximation to Fisher’s ideal index number”.

Commodity	BASE YEAR		CURRENT YEAR	
	Price	Quantity	Price	Quantity
A	7.2	500	11.3	580
B	3.0	120	4.0	150
C	5.2	72	9.1	85
D	10.4	36	13.2	23

5. a) Fit a quadratic trend for the following data using the method of least squares and estimate the value for the year 2017.

Year	2010	2011	2012	2013	2014	2015	2016
Value	5	7	11	17	33	52	72

- b) An office has four workers, and four jobs have to be performed. Time each worker would take to complete each task is given in the effectiveness matrix. How the tasks should be assigned to each worker so as to minimize the total man-hour?

JOBS	WORKERS			
	A	B	C	D
I	5	20	13	9
II	11	26	8	22
III	32	13	12	10
IV	16	21	18	6

6. a) A manufacturing firm has three plants P_1 , P_2 and P_3 . These plants have produced 60, 35 and 40 respectively during this month. The firm had made a commitment to sell 22 units, 45 units, 20 units and 30 units to customers A, B, C and D respectively. The transportation costs (in rupees) from the plants to the customers are as follows:

Factory	A	B	C	D
P_1	4	1	3	4
P_2	2	3	2	3
P_3	3	5	2	4

Determine the optimum distribution for this company to minimize transportation costs.

- b) Calculate seasonal indices by the ratio - to - moving average method (assuming multiplicative model) for the given data

Year \ Quarter	Q ₁	Q ₂	Q ₃	Q ₄
	2008	55	49	36
2009	61	39	37	56
2010	66	48	42	59
2011	73	51	44	65

(4 x 20 = 80 Marks)