

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fifth Semester B.Sc Statistics(Open Course) Degree Examination, November 2019

BSTA5D02 – Basic Statistics

(2017 Admission onwards)

Time: 2 hours

Max. Marks: 40

PART-A**Answer all questions. Each question carries one mark**

1. Write the formula for calculating standard deviation for a frequency distribution.
2. Distinguish between discrete and continuous random variable with example.
3. Find the coefficient of variation of a series if its arithmetic mean is 20 and variance is 25.
4. State axiomatic definition of probability.
5. What is meant by sample?

(5 x 1 = 5 marks)**PART-B****Answer all questions. Each question carries two marks**

6. Explain merits and demerits of arithmetic mean as a measure of central tendency.
7. What is scatter diagram? How one can identify the different types of correlation using scatter diagram.
8. Explain conditional probability.
9. Distinguish between census sample survey.
10. State principle of least square.

(5 x 2 = 10 marks)**PART-C****Answer any three questions. Each question carries five marks**

11. Distinguish between arithmetic mean and weighted arithmetic mean.
12. Explain simple random sampling with replacement and without replacement.
13. What is the difference between absolute measures of dispersion and relative measures of dispersion?
14. State addition theorem of probability. In a running race the odds that A will win are 2 to 3 and the odds that B will win are 1 to 4. Find the probability that A or B wins the race.
15. What is Karl Pearson's coefficient of correlation? Show that correlation coefficient is independent of change of origin and scale.

(3 x 5 = 15 marks)

PART-D

(Answer any one question. Each question carries ten marks)

16. Find the mean and standard deviation of the following data:

| | | | | | | | |
|---------------|-------|-------|-------|-------|-------|-------|-------|
| Age in years | 20-30 | 30-40 | 40-50 | 50-60 | 60-70 | 70-80 | 80-90 |
| No.of members | 3 | 61 | 132 | 153 | 140 | 51 | 2 |

17. Explain principle steps in a sample survey.
18. What you meant by curve fitting of a data. Fit straight line for the following data

| | | | | | | |
|---|-----|---|-----|---|---|---|
| X | 1 | 2 | 3 | 4 | 6 | 8 |
| Y | 2.4 | 3 | 3.6 | 4 | 5 | 6 |

(1 x 10 = 10 marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fifth Semester B.Sc Statistics Degree Examination, November 2019

BSTA5B08 – Statistical Quality Control

(2017 Admission onwards)

Time: 3 hours

Max. M

Part A**Answer all the questions. Each question has ONE mark.****Fill in the blanks (Questions 1-7)**

1. Quality is inversely proportional to
2. Quality characteristics that are measured on a numerical scale called
3. The poorest level of quality that the consumer is willing to accept in an individual
4. is the ratio of the number of nonconforming items in a population to the total number of items in that population
5. The average value of the quality characteristics corresponding to in-control state is represented by in the control charts.
6. The full form of the CUSUM control charts.....
7. Who did first introduce the EWMA charts?

Multiple Choice Questions (Questions 8-12)

8. Causes of variations that can be controlled are
 - (a) chance causes
 - (b) assignable causes
 - (c) removable causes
 - (d) none of the above
9. The control limits determined by the consumer or management are called
 - (a) control limits
 - (b) natural tolerance limits
 - (c) specification limits
 - (d) none of the above
10. Chart used for number of defects is based on ---- distribution
 - (a) Bernoulli distribution
 - (b) Binomial distribution
 - (c) Normal distribution
 - (d) Poisson distribution
11. A sampling plan in which we take a decision based on one sample only is called
 - (a) single sampling plan
 - (b) double sampling plan
 - (c) multiple sampling plan
 - (d) sequential sampling plan

12. Which of these control charts is useful for detecting smaller shifts
- (a) c chart (b) CUSUM chart
(c) median chart (d) all the above

(12 x 1 = 12 Marks)

Part B

Answer any Seven questions. Each question has TWO marks.

13. Distinguish between process control and product control.
14. Distinguish between multiple sampling plan and sequential sampling plan.
15. What is the importance of OC curve?
16. Define AOQ and AOQL.
17. Write the significance of extreme value charts.
18. Distinguish between sampling plan with single and double specification limits.
19. Briefly explain median chart?
20. List various process capability ratios.
21. What is V mask?

(7 x 2 = 14 Marks)

Part C

Answer any Six questions. Each question has FIVE marks.

22. Discuss the various dimensions of quality.
23. Explain the procedure for constructing S chart? When do we prefer S chart over R chart?
24. What is the significance of chain sampling? Write any two situations where this method is useful.
25. Explain double sampling plan.
26. During an examination of equal lengths of clothes the following numbers of defects were observed 2, 3, 4, 0, 5, 6, 7, 4, 3, 2. Draw a control chart for the number of defects and comment whether the process is under control.
27. Compare the GSP-I and CSP-II plans.
28. Discuss process capability analysis.
29. Explain EWMA control chart.

(6 x 5 = 30 Marks)

Part D

Answer any Three questions. Each question has EIGHT marks.

30. Describe Single sampling plan. Explain its merits and demerits. Also explain the construction of its OC curve.
31. Construct control chart of mean and range for the following data and comment on the state of control.

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|----|----|----|----|----|----|-----|----|----|----|----|-----|
| Sample values | 42 | 46 | 66 | 36 | 57 | 77 | 87 | 45 | 45 | 66 | 87 | 66 |
| | 64 | 53 | 81 | 87 | 99 | 89 | 56 | 78 | 78 | 55 | 57 | 120 |
| | 44 | 75 | 34 | 60 | 46 | 56 | 39 | 34 | 98 | 48 | 77 | 33 |
| | 75 | 89 | 4 | 79 | 77 | 48 | 121 | 98 | 39 | 88 | 55 | 55 |
| | 86 | 44 | 75 | 66 | 44 | 40 | 56 | 65 | 65 | 64 | 97 | 66 |

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

32. The number of nonconforming switches in samples of size 150 are given below. Construct a fraction nonconforming control chart for these data. Does the process appear to be in control?

| Sample number | No. of non-conforming switches | Sample number | No. of non-conforming switches |
|---------------|--------------------------------|---------------|--------------------------------|
| 1 | 7 | 11 | 6 |
| 2 | 4 | 12 | 15 |
| 3 | 4 | 13 | 0 |
| 4 | 1 | 14 | 9 |
| 5 | 3 | 15 | 5 |
| 6 | 6 | 16 | 1 |
| 7 | 8 | 17 | 4 |
| 8 | 10 | 18 | 5 |
| 9 | 5 | 19 | 7 |
| 10 | 2 | 20 | 12 |

33. Explain the significance of CUSUM chart. Describe the role of tabular CUSUM for monitoring the process mean.
34. Explain the construction of sampling plan for variables when AQL and LTPD along with the consumer's and producer's risk are given.

(3 x 8 = 24 Marks)

31. The population values are 1,5,8,12,15 and 19. Show that sample mean \bar{y} is an unbiased estimator of \bar{Y} by choosing $n = 3$ and enumerating all possible samples.

Also verify that
$$V(\bar{y}) = \frac{N-n}{N} \frac{S^2}{n}.$$

32. Obtain the expression for the sample size n_h for the h^{th} stratum under optimal allocation in stratified random sampling assuming a cost function.

33. Obtain the relative efficiency of systematic sampling with stratified sampling for the following data:

| Strata | Systematic Samples | | | | |
|--------|--------------------|----|----|----|----|
| | 1 | 2 | 3 | 4 | 5 |
| 1 | 17 | 19 | 21 | 23 | 25 |
| 2 | 27 | 29 | 31 | 33 | 35 |
| 3 | 37 | 39 | 41 | 43 | 45 |
| 4 | 47 | 49 | 51 | 53 | 55 |

34. In cluster sampling, derive the variance of the estimate of the population mean in terms of intra-cluster correlation coefficient.

(3x8=24 Marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE
 Fifth Semester B.Sc Statistics Degree Examination, November 2019
BSTA5B07 – Sample Surveys
 (2017 Admission onwards)

Time: 3 hours

Max. Marks: 80

Part A

(Answer all questions; each question carries 1 mark)

Fill in the blanks (Questions 1-6)

1. Any real valued function of the population values is known as
2. When the investigator selects a sample according to his personal interest, it is called.....
3. In SRSWOR probability of getting a specified sample is:.....
4. In SRSWR the correlation coefficient between any two members of the sample, $\rho_{(x,y)} = \dots\dots\dots$
5. In stratified random sampling if n_1, n_2, \dots, n_l are chosen such that $V(\bar{y}_{st})$ in minimum for a fixed sample size 'n', then the allocation is known as
6. If $N = nk$, the probability of selecting a systematic sample is.....

Multiple Choice Questions (Questions 7-12)

7. The list of sampling units is known as:

| | |
|-------------------|-----------------------|
| (a) The Frame | (b) Sampling Design |
| (c) Sample Values | (d) Population Values |
8. An unbiased estimator of the population total in the case of SRSWOR is:

| | |
|--------------------------|--------------------------|
| (a) $\hat{Y} = N\bar{y}$ | (b) $\hat{Y} = N\bar{Y}$ |
| (c) \bar{y} | (d) \bar{Y} |
9. Sampling fraction is given by:

| | |
|-----------------------|-----------------------|
| (a) $f = \frac{n}{N}$ | (b) $f = \frac{N}{n}$ |
| (c) $f = \frac{1}{n}$ | (d) $f = \frac{1}{N}$ |
10. Which of the following is true?

| | |
|--|--|
| (a) $V_{ran} \leq V_{prop} \leq V_{opt}$ | (b) $V_{prop} \leq V_{ran} \leq V_{opt}$ |
| (c) $V_{prop} \leq V_{opt} \leq V_{ran}$ | (d) $V_{opt} \leq V_{prop} \leq V_{ran}$ |

Part C

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

22. Distinguish between sampling and non-sampling errors. How do you control non-sampling errors?
23. Explain how you would select a random sample of 11 households from a list of 112 households in a village.
24. Show that for SRSWOR the sample variance $s^2 = \frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2$ is an unbiased estimator of the population variance $S^2 = \frac{1}{N-1} \sum_{i=1}^N (Y_i - \bar{Y})^2$.
25. Show that in stratified random sampling, $\bar{y}_{st} = \frac{\sum_{h=1}^L N_h \bar{y}_h}{N}$ is an unbiased estimator of the population mean \bar{Y} . What is the variance of \bar{y}_{st} ?
26. Show that in stratified random sampling $V(\bar{y}_{st})$ is minimum for fixed total size of the sample 'n' if $n_h \propto N_h S_h$
27. A circular systematic sample of 10 houses from a residential area was selected with sampling interval 5. The average income per month in rupees in the selected families were obtained as follows:
30000, 55000, 48000, 152000, 96000, 4500, 12000, 37000, 82000, 11000
Find an unbiased estimate of the average income per family in that area.
28. Prove that the variance of the mean of a systematic sample is
- $$V(\bar{y}_{sy}) = \frac{N-1}{N} S^2 - \frac{k(n-1)}{N} S_{w_{sy}}^2$$
- where $S_{w_{sy}}^2 = \frac{1}{k(n-1)} \sum_{i=1}^k \sum_{j=1}^n (y_{ij} - \bar{y}_{i.})^2$
29. Give an unbiased estimator of population total based on cluster sampling where the clusters are of equal size. What is the variance of your estimator?

(6x5=30 Marks)

Part D

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

30. Suppose you are requested to conduct a sample survey to make a study on family expenditure in Kerala. Describe various steps in planning and execution of this sample survey

17. Explain chi-square test in R with an example.
18. Explain the argument legend in a hist function.
19. Find a real root of the equation $x^3 - 6x^2 + 11x - 6 = 0$.
20. Briefly describe Newton's divided difference formula?
21. Briefly explain Honer's method.

(7x2=14 Marks)

Part C

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

22. Discuss some of the advantages of R programming language.
23. Explain the procedure for finding mean of a grouped frequency distribution in R.
24. Write a short note on data accessing and indexing in R.
25. Explain methods for computing skewness and kurtosis of the data in R.
26. Describe Trapezoidal rule of numerical integration.
27. Evaluate $\int_1^3 \frac{1}{x} dx$, using Simpson's rule with 4 strips and 8 strips respectively.
28. Find the root of the equation $\cos x = 3x - 1$ correct to three decimal places using iteration method.
29. Explain Gauss elimination method for solving a system of linear equations.

(6x5=30 Marks)

Part D

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

30. Explain the construction of box plot, bar plots, pie diagram and stem and leaf diagram in R.
31. (a) Explain how to find interval estimate of the population mean in the following cases.
 - (i) When the population standard deviation is known
 - (ii) When population standard deviation is unknown.
 (b) Write the corresponding R commands.
32. (a) Write R command for one way ANOVA. Explain its arguments and also explain its output.
 (b) Explain how the non-parametric counterparts of one sample and two sample t-tests is conducted in R.
33. Briefly explain bisection method. Write down the R commands to find the root of $x^3 - 4x - 9 = 0$ correct to three decimal places using bisection method.
34. Derive Newton's forward difference formulae and find the sum of $S_n = 1^3 + 2^3 + \dots + 100^3$ using it. Also write down the R commands.

(3x8=24 Marks)

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Fifth Semester B.Sc Statistics Degree Examination, November 2019

BSTA5B05 – Mathematical Methods in Statistics – I

(2017 Admission onwards)

Time: 3 hours

Max. Marks: 80

PART A

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

1. If (a_n) and (b_n) are two sequences such that $a_n \leq b_n$ and $\lim a_n = a, \lim b_n = b, \forall n$, then _____
a) $a \leq b$ b) $a \geq b$ c) $a > b$ d) $a < b$
2. The value of $\lim_{n \rightarrow \infty} \frac{(3n+1)(n-2)}{n(n+3)}$ is
a) 3 b) 0 c) 2 d) 1
3. The sequence (r^n) converges if
a) $r > 1$ b) $r > 2$ c) $|r| < 1$ d) none of the above
4. A bounded sequence (x_n) is convergent iff
a) $\limsup(x_n) = \liminf(x_n)$
b) $\limsup(x_n) \neq \liminf(x_n)$
c) $\limsup(x_n) > \liminf(x_n)$
d) None of the above
5. The left hand limit of $f(x) = \begin{cases} \frac{|x-1|}{x^2-1}, & x \neq 1 \\ 0, & x = 1 \end{cases}$ at $x=1$
a) 0 b) $-1/2$ c) $1/2$ d) 1
6. The function $f(x) = x^2$ is _____
a) Continuous but not uniformly continuous
b) Neither continuous nor uniformly continuous
c) Uniformly continuous but not continuous
d) None of the above

PART C

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

22. Show that there is no rational number whose square is 2.
23. State and prove Triangle inequality.
24. State and prove the Density theorem.
25. Prove that every convergent sequence is bounded and has a unique limit.
26. State and prove squeeze theorem.
27. Show that a constant function k is integrable and $\int_a^b k \, dx = k(b-a)$.
28. Show that every bounded monotone sequence of real numbers is convergent.
29. Prove that every absolutely convergent series is convergent.

(6 x 5 = 30 Marks)

PART D

(Answer any *THREE* questions. Each question carries 8 marks)

30. If $X = (x_n)$ converges to x and $Z = (z_n)$ is a sequence of nonzero real numbers that converges to z and if $z \neq 0$, then show that the quotient sequence X/Z converges to x/z .
31. a) What is a Cauchy sequence? Give an example for Cauchy sequence.
b) Show that a sequence of real numbers is convergent iff it is a Cauchy sequence.
32. State and prove Bolzano-Weierstrass theorem.
33. If f_1 and f_2 are two bounded and integrable functions on $[a, b]$, then show that $f = f_1 + f_2$ is integrable on $[a, b]$ and $\int_a^b f_1 \, dx + \int_a^b f_2 \, dx = \int_a^b f \, dx$.
34. State and prove the first fundamental theorem of integral calculus.

(3 x 8 = 24 Marks)