Yashavantrao Chavan Institute of Science, Satara.
Department of Statistics
STATISTICS
Probability Distribution –II (BST-601)
Subject Code :-14010
Question Bank

1. Define following Term/Answer in one sentence. (2-Marks)

1) Define: (i) Convergence in distribution (ii) Convergence in mean.
2) Define Index set and State space.
3) Define Communicative state with example.
4) Define Counting Process.
5) If arrivals of a queue are completely random then write the distribution of number of arrivals in fixed interval of time.
6) Define Weak Law of Large Number.
7) Define Unconditional probabilities.
8) Write properties of communicative state and define communicative class.
9) Define Stochastic Process.
10) Define the distribution of arrival and inter arrival time.
11) Define Convergence in probability and corresponding results.
12) Write the Chapman Kolmogorov Equation.
13) Define Accessible State with example.
14) Which queue discipline is used for loading and unloading goods?
15) Define Markov chain.
16) Define Central Limit Theorem
17) Define Classification of stochastic process.
18) Define Stationary Stochastic process
19) Define Normal stochastic process
20) Define Time Homogeneous Markov chain
21) Define Independent Increment and Stationary Increment

22) Define balking with an example.

23) Define the distribution of pure death process.

24) Define the distribution of pure birth process.

25) Define convergence in distribution.

Q.2) Attempt the following question. (10 Marks)

1) Let $X_n, n \geq 0$ be Markvo chain with state space S={0,1,2} with initial distribution $\{\frac{1}{4}, \frac{1}{2}, \frac{1}{4}\}$ and one step transition matrix $\begin{bmatrix} 1/4 & 3/4 & 0 \\ 1/3 & 1/3 & 1/3 \\ 0 & 1/4 & 3/4 \end{bmatrix}$.

Compute (i) $P(X_2 = 2/\ X_0 = 0)$ (ii) $P(X_0 = 0, X_1 = 1, X_2 = 1\ )$

2) Describe a model M/M/1 using (∞/FCFS) queue discipline.

3) Write a note on (i) Birth and Death Process (ii) Pure Birth Process

4) In a service department operated by one server, on an average 8 customers arrive in every 5 minutes while the server can serve 10 customers in the same time assuming Poisson distribution and exponential distribution for service rate.

Determine: a) Average number of customers in the system.

b) Average number of customers in the queue.

c) Average time a customer spends in the system.

d) Average time a customer waits before being served.

5) Define Poisson Process with proof of equivalence of two definitions.

6) Define: (i)Transition probability matrix (ii) Recurrent state

(iii) Transient state (iv) Periodic state (v) Ergodic state

7) Suppose that probability of dry day after rainy day is 3/4 and that of rainy day after dry day is 2/3. Let X_n be state of process after nth day write

state space and one step TPM of process $\{X_n, n \geq 1\}$. Also find probability that second day is dry given that initial day is dry.

8) Let $\{X_n, n \geq 1\}$ be a markov chain with state space S={1,2,3,4} and TPM

$$P = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} 1/3 & 2/3 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1/2 & 0 & 1/2 & 0 \\ 0 & 0 & 1/2 & 1/2 \end{bmatrix} \end{array}$$

Classified the states as recurrence or transient

9) At barber's shop,the customers arrive at the average interval of 6 minutes and the barber takes on an average 5 minutes for serving the person. Calculate:
   a) Probability of finding more than 3 customers in the system.
   b) Probability of finding 3 or more than 3 customers in system.
   c) Chances that customer is required to wait more than 30 minutes in the system.
   d) Chances that customer is required to wait more than 30 minutes in the queue.

10) Obtain stationary distribution of a Markvo chain whose TPM is

$$P = \begin{bmatrix} 1/4 & 3/4 & 0 \\ 1/3 & 1/3 & 1/3 \\ 0 & 1/4 & 3/4 \end{bmatrix}$$

Q.3) Attempt the following question. (5 Marks)

1) State and prove Weak Law of Large Number.

2) Let $\{X_n\}$be a sequence of r.v. with p.m.f. $P(X_n = 1) = \frac{1}{n}$; $P(X_n = 0) = 1 - \frac{1}{n}$. Show that X_n converges to 0 in mean square.

P.T.O.

3) A salesman works in 3 cities A, B and C. He never sells in a same city on two successive days if he sells in a city A next day he will sale in a city B however if he sells either in B or C next day he is twice likely to sale in a city A as the other City. Find TPM.
4) Explain briefly the classification of queuing system.
5) Define: (1) Queuing theory (2) Balking (3) Collusion.
6) Define Independent and Stationary Increment with example.
7) State and prove Central Limit Theorem.
8) Let $\{X_n\}$be a sequence of r.v. with p.m.f. P($X_n = 1$) $= \frac{1}{n}$; P($X_n = -1$) $= 1 - \frac{1}{n}$. Show that X_n does not converges in mean square.
9) Man has 4 pair of socks which he changes every day choosing at random 1 of 3 not where previous day. Let Ei be the event he wears ith pair (i=1,2,3,4). Obtain one step TPM.
10) Write a brief summary of various types of queuing models.
11) Write a note on Yule Furry process.
12) Write a note on Central Limit Theorem.
13) Let $\{X_n, n \geq 1\}$be a sequence of r.v. X with common distribution B(1, p). Show that WLLN is holds.
14) Define :(i) Irreducible Marko Chain (ii) Persistent state (iii) Transient state.
15) Describe briefly the main characteristics of queuing system.
16) Write a note on Probability distribution in queuing system.
17) Define Yule Furry process and write situation where it apply.
18) Explain the relationships among system characteristics.
19) Write definition 1 and definition 2 of Poisson process.
20) State and prove distribution of arrival time.

B. Sc. III General Science Semester VI Examination,
STATISTICS
Statistical Inference - II (BST 602)
Question Bank

Q.1. Following Questions [2 Marks]

1. What is the pivotal quantity?

2. Define term composite Hypothesis.

3. Define term P – value

4. What is the purpose of Kolmogorov Smirnov test.

5. Define Sequential probability ratio test (SPRT).

6. What is the confidence interval?

7. What is the critical region?

8. Define term most powerful test.

9. What is the non-parametric alternative for t-test?

10. What is the distribution of pivotal quantity while constructing confidence interval for the mean of normal distribution with known variance?

11. Define term power of the test.

12. Define uniformly most power powerful test.

13. What is the non-parametric test?

14. Define simple hypothesis

15. What is the likelihood ratio test.

16. What is the distribution of pivotal quantity while constructing confidence interval for the mean of normal distribution with known variance?

17. Define type-I error and type-II error.

18. Let X1, X2, X3 …., Xn be r.s. from exp(Ɵ) then what is the confidence interval for Ɵ?

19. What is the difference between parametric and non – parametric test?

20. Define term p-value.

21. What is the level of significance?

22. Let X1, X2,….Xn be r.s. from N(5, σ^2) then what is length of confidence interval for σ^2.

23. State Neyman-Person lemma (NP-Lemma)

24. What is the purpose of run test for one sample?

25. What is the purpose of one sample sign test?

Q.2. Answer the following (5 Marks)

1. Obtain MP test for testing Ho: Θ = Θo against H1: Θ = Θ1 (Θ1 < Θo) based on a random sample of size n from binomial distribution with parameter n and Θ.
2. Explain the procedure of Mann – Whitney U -test.
3. Describe the procedure of Wald's SPRT.
4. Explain the following term
   - i) Interval Estimation
   - ii) Statistic and parameter
   - iv) Estimate and estimator
5. The single observation taken from exponential distribution with mean Θ to test Ho : Θ = 1 against Θ = 2. Ho is rejected if observations is greater than or equal to 1.5 find p(type I error) and power of the test.
6. Let X_1, X_2, …., X_n be r.s. from exponential distribution with mean Θ. Determine 95% confidence interval for Θ.
7. Construct the (1-α)% confidence interval for the mean of normal distribution when variance of normal distribution is unknown.
8. Derive the MP test to test Ho: Θ = Θo against H1: Θ = Θ1 when r.s of size n drawn from exponential distribution with parameter Θ.
9. Construct SPRT of strength (α,β) for testing Ho: Θ = Θo against H1: Θ= Θ1 (Θ1 > Θo) based on sample drawn from B(1, Θ)
10. Explain the procedure of signed rank test.

11. A single observation taken from U(0, Θ) is taken for testing Ho : Θ = 1 against H1: Θ=2. Null hypothesis is rejected if observation is greater than or equal to 0.8. Find probabilities of type I and type II errors.

12. Obtain MP test for testing Ho : $\lambda = \lambda o$ against H1 : $\lambda = \lambda 1$ ($\lambda 1 < \lambda o$) based on a random sample of size n from poison distribution with parameter λ.
13. Explain Kolmogorov-smirnov (k-s) test.
14. Let X1, X2 ….. Xn be random sample from N(μ, σ^2) . determine 95% Confidence interval for μ when σ^2 is known.
15. Construct SPRT of strength (α,β) for testing Ho: Θ = 0 against H1: Θ=1 based on sample drawn from N(Θ,1)
16. Explain the procedure of median test.
17. A single observation taken from U(0, Θ) is taken for testing Ho : Θ = 1 against H1: Θ=2. Null hypothesis is rejected if observation is greater than or equal to 0.6. Find probabilities of type I error and power of the test.
18. Explain the procedure of run test for two samples.
19. Obtain MP test for testing Ho : Θ = Θo against H1 : Θ = Θ1 Θ1 > Θo) based on a random sample of size n from exponential distribution with mean 1/Θ.
20. Let X1, X2 ….. Xn be random sample from N(μ, σ^2) determine 95% Confidence interval for μ when σ^2 is unknown.

Q.3. Answer the following (10 Marks)

1. State and prove Neyman – Pearson Lemma.
2. Describe likelihood ratio test. Develop L.R. test for testing Ho : $\sigma^2 = \sigma_o^2$ against H1: $\sigma^2 \neq \sigma_o^2$ based on n observations from normal distribution N(μ , σ^2) when μ is known.

3. Let (X_i, Y_i) i = 1,2,3 ….., n be random sample n from bivariate normal distribution BN(μ_1, μ_2, $\sigma_1^2, \sigma_2^2, \rho$) , determine 95% confidence interval for (μ_1-μ_2) when,
   i) $\sigma_1^2, \sigma_2^2, \rho$ *known.*
   ii) $\sigma_1^2, \sigma_2^2, \rho$ *unknown.*
4. Describe likelihood ratio test. Develop L.R. test for testing Ho : $\mu = \mu o$ against H1: $\mu \neq \mu o$ based on n observations from normal distribution N(μ , σ^2) when σ^2 known.
5. Let X1,X2 ….., X_{n1} be random sample from N($\mu 1$, σ_1^2) and Y1, Y2, ….., X_{n2} be random sample from N($\mu 2$, σ_2^2) these two samples are from two independent normal population determine 95% confidence interval for $\frac{\sigma_1^2}{\sigma_2^2}$

   Case - I : $\mu 1$ and $\mu 2$ both are known.

   Case -II : $\mu 1$ and $\mu 2$ both are unknown.
6. Explain the following non parametric test.
   i) Run test for one sample.
   ii) Sign test for single sample.
   iii) K-S test.
7. Let X_1, X_2 ….., X_{n1} be random sample from N(μ_1 , σ_1^2) and Y_1, Y_2, ….., X_{n2} be random sample from N(μ_2 , σ_2^2) these two samples are from two independent normal population determine 95% confidence interval for (μ_1 - μ_2). When σ_1^2 and σ_2^2 both are unknown.
8. Let X1,X2 ….., X_n be random sample from N(μ , σ^2) determine 95% confidence interval for variance σ^2

   i) μ is known

   ii) μ is unknown
9. Let X1,X2 ….., X_n be random sample from N(μ , σ^2) determine 95% confidence interval for variance μ

   i) σ^2 is known

ii) σ^2 is unknown

10. Obtain UMP test for testing Ho : $\Theta = \Theta o$ v/s H_1: $\Theta = \Theta 1 > \Theta o$ based on r.s. of size n drawn from exponential distribution with mean Θ.

Industrial Statistics (BST-603)

Short Questions

1. Define quality from manufacturer's perspective.
2. Explain the concept of Acceptance Quality Level (AQL)
3. Define the Producer's Risk in terms of Statistical manufacturing process.
4. State the control limits for moving average charts.
5. Explain the gole of Six-Sigma.
6. Distinguish between chance causes and assignable causes in process control.
7. Explain the concept of Process Average Fraction Defective.
8. Define the Consumer's Risk in terms of Statistical manufacturing process.
9. Explain the "Reliability" in the view of dimensions of quality.
10. State any four principles of Six-Sigma.
11. Define Average Outgoing quality.
12. In Statistical process control DMAIC and PDCA stands for.
13. Define the Consumer's Risk in terms of Statistical manufacturing process.
14. Explain the "Serviceability" in the view of dimensions of quality.
15. State any four advantages of Six-Sigma

Long Questions

1. Explain any ten Deming philosophy is an important framework for implementing quality and productivity improvement with example.
2. Explain the concept of PDCA cycle with illustration.
3. Derive the control limits for EWMA control chart
4. Derive the expression for tabular or algorithmic CUSUM for Monitoring the Process Mean.
5. Explain the concept of Average Outgoing Quality (AOQ) for acceptance sampling plan.
6. Discuss the various steps involved in single sampling plan.
7. What are advantages of Lean process?
8. Explain the role Spaghetti diagram in statistical process control.
9. Describe the "Define" Phase of DMAIC framework
10. State various philosophy proposed by Deming for implementing quality and productivity improvement.
11. Explain the process of double sampling plan and its advantages.
12. Explain the concept of OC curve and its use in statistical process control
13. Derive the expression for moving average control chart.
14. Explain the concept of Average Outgoing Quality (AOQ) for rectifying inspection sampling plan.
15. Explain the role of scatter diagram in process quality improvement.
16. Explain the **Key Elements of Lean Six Sigma.**

17. Distinguish between the value added activity and non-value added activity in lean process of quality improvement.
18. Describe the “Analysis” Phase of DMAIC framework
19. Drive the expression for ASN and ANI for Double Sampling Plan.
20. Explain various phases of DMAIC cycle.
21. Define quality and discuss the eight dimensions of quality.
22. Derive the expression for CUSUM control chart.
23. Explain the concept of cause effect diagram and its use in quality improvement process.
24. Explain the role of Pareto chart in process quality improvement.
25. Explain the advantages of double sapling plan**.**
26. Distinguish between the value added activity and non-value added activity in lean process of quality improvement.
27. Describe the “Design” Phase of DMAIC framework

Paper-BST-604-Sampling Methods

Question Bank

ATTEMPT THE FOLLOWING: **(2M)**

1) Explain the term Population and Sample.
2) What is random sampling?
3) Define the term 'sampling strategy'.
4) State difference between sampling methods and census method.
5) Explain the term sampling Design with a suitable example.
6) Give an example where SRS is not suitable.
7) In SRSWOR, Show that the probability of drawing the specified unit at every draw is same.
8) Prove that the probability of sample is selected by SRSWOR method is $1/\binom{N}{n}$
9) With usual notations prove that $V(\bar{y}_n)_{SRSWR} \geq V(\bar{y}_n)_{SRSWOR}$
10) What is need of stratification?
11) Explain equal allocation is stratified sampling.
12) What is allocation of sample size in stratified random sampling?
13) Write confidence interval for population mean in stratified random sampling.
14) What is the idea of circular systematic sampling?
15) Write the comparison between Systematic sampling and SRSWOR.
16) Consider population of size 100 with S^2=100, SRSWOR of size drown from it. Obtain standard error of sample mean.
17) What is dichotomous population?
18) Distinguish between Ratio and Regression estimators.
19) Define simple regression estimator of population mean and total.
20) Write the comparison of regression estimator with SRSWOR.
21) State the comparison of regression estimator with SRSWR method.
22) State the relationship between systematic sampling and cluster sampling.
23) Explain the method of cluster sampling.
24) Explain the concept of multiphase sampling.
25) Explain the purpose of multiphase sampling.
26) Explain the purpose of double sampling.
27) What is multistage sampling?
28) State advantages of two stage sampling.
29) What are sources of non-sampling errors?

Short Answer Question

1) Advantages of sampling method over census method.
2) Characteristics of good questionnaire.
3) Planning, Execution and analysis of sample survey.
4) Under SRSWR/SRSWOR sample mean is an unbiased estimator of population mean.
5) Differentiate SRSWR and SRSWOR
6) Prove that $N\overline{yn}$ is an unbiased estimator of population total.
7) In SRSWR sample mean square is an unbiased estimator of population Variance.

8) Show that SRSWOR gives more precise result than SRSWR
9) In SRSWR obtain an unbiased estimator of Var(p)
10) Obtain an expression for sample size if it is sufficiently large.
11) Obtain an formula for variance of sample mean under stratified sampling.
12) Prove that Neyman allocation is better than proportional allocation.
13) Compare systematic sample with SRSWOR
14) Explain concept of Circular systematic sampling.
15) Systematic sampling as particular case of cluster sampling.
16) Real life situation in cluster sampling.
17) Concept of two stage and multi stage sampling.
18) Explain the following term
    a) Sampling error
    b) Non sampling error
19) Define the following

a) Population
b) Sample.
c) Sampling Unit.
d) Sampling Frame.

Long answer type question

1. Under SRSWOR sample mean square is an unbiased estimator of population mean square.
2. Under Neymans allocation prove that ni α NiSi obtain an expression for sample size.
3. Under stratified sampling obtain an expression for sample size to minimize variance when total cost is fixed.
4. Under stratified sampling obtain an expression for sample size to minimize total cost when variance is fixed.
5. Compare stratified random sampling with SRS/
   prove that $V_{srswor}(x) \geq P_{rop}(x) \geq V_{opt}(x)$
6. Under Systematic sampling obtain expression for variance of sample mean.
7. Compare systematic sampling with SRSWOR and stratified sampling in presence of linear trend.
8. In SRSWR (N, n), Obtain the expression for $V(\bar{y}_n)$.show that sample mean square is unbiased estimator of population variance.
9. Define SRS. Show that in SRSWOR (N, n) the probability of the specified unit include in sample is $\frac{n}{N}$.
10. Explain concept of systematic sampling. With usual notations show that in linear systematic sampling $V(\bar{y}_{sy}) = \frac{N-1}{Nn} S^2 [1+(n-1)\rho_{wsy}]$
11. With usual notations prove that $V(\bar{y}_n)_{SRSWOR} \geq V(\bar{y}_{sys}) \geq V(\bar{y}_{st})$
12. Derive expression for variance of regression estimator.
13. Explain Regression method. Prove that for large sample assuming SRSWOR, Variance of regression estimator is given by: $V(\hat{\bar{y}}_{reg}) = \frac{1-f}{n} S_y^2 (1-\rho^2)$
14. Compare systematic sampling with SRSWOR and stratified sampling in presence of linear trend.
15. Under SRSWOR obtain an expression for variance of sample mean.

B. Sc. III General Science Semester VI Examination,
STATISTICS
Entrepreneurship Development in Statistics (SECCST 607)
Question Bank

Q.1 **Answer the following. (2 Marks)**

1. How to read string from the terminal in C programming?
2. What are the elements of user define functions?
3. How to define pointer variable?
4. Define one dimensional array.
5. Define two-dimensional array.
6. How to define string in c programming language?
7. How to read string having blank spaces between the two words of string?
8. How to define two-dimensional array in C programming?
9. State the different types of the user defined functions?
10. How to concatenate two strings in C programming?
11. What is the recursion?
12. How to initialize one dimensional array having elements zero of size 10?
13. How to copy one string into another string in C programming?
14. How to measure length of the string?
15. What are different ways to initialize two-dimensional array?

Q.2 Answer the following (4 Marks)

1. Write a short note on one-dimensional array.
2. Write a program to find the factorial of positive integer.
3. Write a short note on pointer.
4. Write a C program to compute sum of first n natural numbers using array.
5. Write a short note on two-dimensional array.
6. Write a program to compute addition of two numbers using user define function.

7. Write a short note on a multidimensional array.

8. Write a program to print ASCII value of each lower case and upper case letter.

9. Write a c program to compute mean of 10 different numbers entered by users using array

10. Write a c program to compute S.D. of 10 different numbers entered by users using array.

11. Explain user define function with no argument no return value.

12. Explain user define function with argument but no return value.

13. Explain user define function with argument and with return value.

14. Explain user define function with argument but no return value.

15 Explain user define function with multiple return value.

Q.3 Answer the following (6 Marks)

1. What is the purpose of the following functions?

i) strcat( ) ii) strcmp( ) iii) strcpy( ) iv) strlen( )

2. Write a program to perform arithmetic operations using user define function.

3. Write a program to compute sum of squares of 5 different numbers entered by users using array.

4. The Write a program using a two-dimensional array to following information from the table below table and compute and print,

(a) Total value of sales by each girl.

(b) Total value of each item sold.

	Item - 1	Item - 2	Item-3
Salesperson-1	310	275	365
Salesperson-2	210	190	325
Salesperson-3	405	235	240

5. Explain the different types of user define functions in details.

6. Write a c program to arrange given n numbers in ascending order.
7. Write a c program to arrange given n numbers in descending order.
8. Write a c program to compute correlation coefficient.
9. Write a c program to compute covariance.
10. Write a c program to compute coefficient of variation.