3rd proof (4-1-2026)

TOPIC-WISE QUESTION BANK WITH MODEL QUESTION PAPERS

STATISTICS

SEMESTER-IV

West Bengal Council of Higher Secondary Education
Vidyasagar Bhavan, 9/2, Block DJ, Sector-II, Salt Lake, Kolkata - 700 091
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Preface

West Bengal Council of Higher Secondary Education (WBCHSE) Model Question Paper Books for 2nd & 4th Semester Examinations

It gives me immense pleasure to present this series of Model Question Paper Books across 27 subjects, prepared and published by the West Bengal Council of Higher Secondary Education for the 2nd and 4th Semester (Even Semester) examinations. These volumes have been designed with a clear objective to support our learners with structured guidance, comprehensive practice materials, and enhanced clarity regarding the examination pattern under the semester system.

Each book in this series contains two model question papers in both English and Bengali, reflecting the Council's commitment to linguistic inclusivity and accessibility. The bilingual format ensures that students from diverse academic backgrounds can engage comfortably with the material and gain confidence in their preparation. Alongside the model papers, a carefully curated chapter-wise and topic-wise question bank has been included to provide systematic practice opportunities. This feature will help students strengthen their conceptual understanding, identify areas requiring further attention, and build the analytical skills essential for academic success.

The transition to a semester-based evaluation framework places renewed emphasis on continuous learning and holistic assessment. These Model Question Paper Books are intended to be an effective academic companion for students as they navigate this structure. By offering clear examples of question types, balanced coverage of the curriculum, and ample opportunities for practice, we aim to foster a learning environment that encourages discipline, curiosity, and deeper engagement with each subject.

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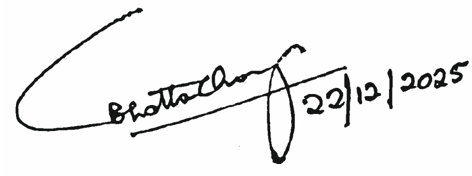
I extend my sincere appreciation to the subject experts, teachers, editors, translators, and Council officials who have worked diligently to prepare these volumes with accuracy, clarity, and pedagogical insight. Their efforts reflect our collective commitment to strengthening the academic foundation of every Higher Secondary learner in West Bengal.

I am confident that this series will prove valuable to students, educators, and institutions alike. I warmly encourage all learners to make the best use of these resources, approach their studies with sincerity, and strive for excellence in the forthcoming examinations.



December, 2025
Vidyasagar Bhavan, Kolkata

Prof. (Dr.) Chiranjib Bhattacharjee
President
W.B. Council of H.S. Education

From the Secretary's Desk

Question banks are crucial for both educatiors and education seckers, offering a large, organised pool of questions to create varied, balanced and fair exams efficiently, while helping students to practices, understand exam formats, build confidence and focus revision on key topics through repeated and randemized testing.

For Educators :- *(Assessment & Efficiency)*

- Saves time
- Ensures Fairness and Balance
- Reduces practice of unfair means
- Improves Quality

For Students :- *(Learning & Preparation)*

- Familiarizes with Exam Patterns
- Boosts Confidene
- Aids Revision
- Develops Answering Skills

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West Bengal Council of Higher Secondary Education has taken up the noble responsibility of publishing updated and appropriate Model Question Banks for all the major subjects included in its curriculum. I, as the Secretary of WBCHSE, with this endeavour services the purpose of million of minds and aids to their learning process.

December, 2025
Vidyasagar Bhavan, Kolkata

Dr. Priyadarshani Mallick
Secretary
W.B. Council of H.S. Education

Question Pattern [Short Answer Questions, Descriptive Questions) **Marks : 35**

TOPIC	SHORT ANSWER TYPE QUESTIONS Type 1 (2 marks)	SHORT ANSWER TYPE QUESTIONS Type 2 (3 marks)	DESCRIPTIVE TYPE QUESTIONS (5 marks)	TOTAL
Unit 1	**1X2=2** [1 out of 2 questions]	**1X3=3** [1 out of 2 questions]	**1X5=5** [1 out of 2 questions]	**10**
Unit 2	**1X2=2** [1 out of 2 questions]	–	**1X5=5** [1 out of 2 questions]	**07**
Unit 3	**1X2=2** [1 out of 2 questions]	**1X3=3** [1 out of 2 questions]	–	**05**
Unit 4	**1X2=2** [1 out of 2 questions]	–	–	**02**
Unit 5	–	**1X3=3** [1 out of 2 questions]	–	**03**
Unit 6	**1X2=2** [1 out of 2 questions]	**1X3=3** [1 out of 2 questions]	–	**05**
Unit 7	–	**1X3=3** [1 out of 2 questions]	–	**03**
TOTAL	**10**	**15**	**10**	**35**

STATISTICS

Class XII Semester 4

Model Question Paper - I

Time: 2 Hours **Full Marks: 35**

[The symbols and notations used bear the usual significance]

Section -A 2×5=10

1. Answer any one question out of two questions:

A) Show that $m_{yx} \le m_{xy}$ where m_{yx} and m_{xy} are slopes of the regression lines *y* on *x* and *x* on *y* respectively and when x and y are positively correlated.

B) If x and y are uncorrelated variables and their standard deviations are 3 and 4 respectively, find the correlation coefficient between 5x + 2y and 2x - 5y.

2. Answer any one question out of two questions:

A) If $\Phi(x)$ is the distribution function of standard normal distribution, show that $\Phi(-x) = 1 - \Phi(x)$, $x > 0$

B) Find the median of rectangular [a, b] distribution.

3. Answer any one question out of two questions:

A) Give examples for each case where 'sampling' is must and where 'complete enumeration' is must.

B) Show that if n numbers are drawn at random without replacement from the set $\{1, 2, .., N\}$ then $\text{Var}(\bar{x}) = \frac{(N+1)(N-n)}{12n}$

4. Answer any one question out of two questions:

A) Mention the mean and variance of χ^2 distribution with (n–1) d.f.

B) Write down the p.d.f. of t distribution with n d.f.

5. Answer any one question out of two questions:

A) Distinguish between 'one-sided test' and 'two-sided test'

B) What are large sample tests and small sample tests?

Section -B 3×5=15

6. Answer any one question out of two questions:

A) What is called the standard error of estimate of y from it's linear regression on x? Show that it's value equals to $\sqrt{s_y^2(1-r^2)}$. Hence show that $-1 \leq r \leq 1$.

B) If x_1, x_2 and x_3 are pair-wise uncorrelated variables with same standard deviation, find the value of correlation coefficient between x_1+x_2 and x_2+x_3.

7. Answer any one question out of two questions:

A) Distinguish SRSWR and SRSWOR method in sampling theory.

B) Prove that the probability that a specified member of the population of N members is included in the chosen sample of size n is $1-\left(1-\frac{1}{N}\right)^{n}$ $or\,\frac{n}{N}$ or according as the sampling is SRSWR or SRSWOR.

8. Answer any one question out of two questions:

A) Let (x_1, x_2, x_3,..............x_n) be a random sample of size n drawn from $N(\mu,\sigma^2)$. Obtain the moment estimator of parameters. Hence check unbiasedness of these parameters.

B) If x_1, x_2, x_3, x_4, x_5, x_6 be an independent simple random sample from a normal population with unknown variance σ^2, find k so that k [$(x_1 - x_2)^2 + (x_3 - x_4)^2 + (x_5 - x_6)^2$] is an unbiased estimator of σ^2.

9. Answer any one question out of two questions:

A) What are 'Type - I error' and 'Type - II error' in connection with testing of hypothesis? If probability of one decreases what will be the behaviour of the other probability? Then how will you control the situations to minimise both the probabilities of errors?

B) A random sample of size 20 from a normal population gives a sample mean 42 and a sample standard deviation 6. Test the hypothesis that the population standard deviation is 9 against the alternative that it is greater than 9.

[Given that $\chi^2_{0.05,20} = 31.410$ and $\chi^2_{0.05,19} = 30.144$]

10. Answer any one question out of two questions:

A) Describe the construction of mean chart when standards are not given but means and ranges of samples drawn from different rational subgroups are available.

B) Why 3-σ limits are used in control chart of SQC?

<u>Section - C</u> **5 x 2 = 10**

11. Answer any one question out of two questions:

A) Prove that Spearman's rank correlation coefficient lies between 1 and +1. When will it be -1 or +1?

B) Derive the linear regression equation of y on x on the basis of n paired observation of (x, y).

12. Answer any one question out of two questions:

A) If X ~ N (μ, σ^2), then show that

$$\mu_r = \begin{cases} 0 & \text{when } r \text{ is odd} \\ (r-1)(r-3) \cdots \ldots .3.1.\sigma^r & \text{when } r \text{ is even} \end{cases}$$

B) The length of bolts produced by a machine is normally distributed with mean 4 and s.d. 0.5. A bolt is defective if its length does not lie in the interval (3.8, 4.3). Find the percentage of defective bolts produced by the machine.

[Given that, $\frac{1}{\sqrt{2\pi}}\int_o^p e^{-t^2/2}\,dt = 0.2257$ or 0.1554 according as ‘ p’ = 0.6 or 0.4]

STATISTICS

Class XII Semester 4

Model Question Paper - II

Full Marks: 35 **Time: 2 Hours**

[The symbols and notations used bear the usual significance)

Section -A **2 x 5 = 10**

1. Answer any one question out of two questions:

A) A regression line has a slope of 4. If the mean values of independent and dependent variable are 1 and 10 respectively, find out the value of the intercept.

B) Show that numerical value of correlation coefficient cannot exceed the numerical value of the arithmetic mean of the regression coefficients.

2. Answer any one question out of two questions:

A) Show that normal distribution is symmetric about median.

B) Find the standard deviation of the random variable, where $X \sim R\left[\frac{-\theta}{2}, \frac{\theta}{2}\right]$

3. Answer any one question out of two questions:

A) Distinguish between a random and non-random sample.

B) Define 'statistic' and 'sampling distribution of a statistic'.

4. Answer any one question out of two questions:

A) Write down the p.d.f. of of χ^2 distribution with $(n-1)$ d.f.

B) Mention the mean and variance of t distribution with n d.f.

5. Answer any one question out of two questions:

A) Define a composite hypothesis. Give example.

B) What is the 'level of significance' of a tests? Define power of a test.

Section -B **3 x 5 = 15**

6. Answer any one question out of two questions:

A) What do you mean by scatter diagram? Mention it's uses.

B) Find angles between two regression lines. Interpret the situations when $r = \pm 1$ and $r = 0$.

7. Answer any one question out of two questions:

A) Describe how you would select a random sample without replacement of 2 boys from a group of 6 boys by tossing a fair coin.

B) What do you mean by 'validity' and 'optimisation' in sampling theory?

8. Answer any one question out of two questions:

A) Suppose X and Y are independent random variables with common unknown means μ and known variances unity. Let $T=aX+bY$ be an estimator of μ. What choice of a and b should we give, so that T will be MVUE of μ?.

B) If $X \sim Bin(n, p)$, p being unknown, find an unbiased estimator of p^2 $(n > 1)$.

9. Answer any one question out of two questions:

A) A bag contains 8 dice of which an unknown number 'm' are so biased that they always show up six and the rest are unbiased. To test the hypothesis $H_o: m = 2$ against the alternative hypothesis $H_1 : m = 1$, the following procedure is suggested: Throw the 8 dice and if the number of sixes is less than or equal to 3, reject H_o; otherwise accept H_o. Find the probabilities of type I and type -II errors of the test.

B) Describe the test procedure for mean (μ) of a Normal distribution when variance (σ^2) is known.

10. Answer any one question out of two questions:

A) Describe the procedure of construction of range chart, in both cases when standards are given and not given.

B) Distinguish between 'process control' and 'lot control' in SQC.

Section - C **5 x 2 = 10**

11. Answer any one question out of two questions:

A) Prove that $-1 \leq r \leq 1$. When will it be -1 and $+1$?

B) Examine the effect of change of origins and scales of the variables on regression coefficients.

12. Answer any one question out of two questions:

A) For a normal distribution with mean 0 and standard deviation σ, establish the following recursion relation for the central moments: $\mu_{2r+2} = \sigma^3 \frac{d\mu_{2r}}{d\sigma} + \sigma^2 \mu_{2r}$

B) Explain whether the following function can be considered as a p.d.f.

$$f(x) = \frac{5}{\sqrt{\pi}} e^{-25x^2}, -\infty < x < \infty.$$

If so, write down its name, parameters and four important properties.

[The symbols and notations used bear the usual significance]

Unit - 1

A. Short answer type questions (2 marks each):

1. What do you mean by *correlation*?

2. What are the limitations of the correlation coefficient as a measure of association between two variables?

3. Draw scatter diagrams in cases of perfect linear correlation between two variables.

4. What is ranking? What is rank correlation?

5. Define Spearman's Rank Correlation Coefficient.

6. Mention the uses of rank correlation.

7. If two variables x and y are related as $y = a + bx$, where a and b ($\neq 0$) being constants find the correlation coefficient between x and y.

8. If $ax + by + c = 0 \ \ (a \neq 0, b \neq 0)$ is the relation between two variables x and y, then find the correlation coefficient between x and y.

9. If Var (x) = 9, Var (y) = 4 and Var(x – y) = Var(x), then find the correlation coefficient between x and y.

10. Show that for two variables x and y, $Cov(x, y) \leq \frac{Var(x) + Var(y)}{2}$

11. The correlation coefficient obtained on the basis of ranks of n students in two subjects is 0.8, while the sum of squares of the rank differences is 4. Find the value of n.

12. Prove that $r_{xy} \gtrless 0$, according as Var (x + y) $\gtrless$ Var(x - y).

13. If the lines of regression of y on x and of x on y are respectively $a_1x+b_1y+c_1=0$ and $a_2x+b_2y+c_2=0$ show that a_2b_1, cannot be less than a_1b_2.

14. For two variables x and y with the same mean, the two regression equations are $y = ax + b$ and $x = \alpha y + \beta$. Show that $\frac{b}{\beta} = \frac{1-a}{1-\alpha}$

15. The coefficient of rank correlation between marks in Mathematics and Statistics as obtained by 10 students was found to be 0.6. It was later detected that the difference in ranks in the two subjects as secured by one student was taken as 4 in place of 6 by mistake. Find the correct coefficient of rank correlation.

16. Let x^l and y^l respectively denote the deviations of the variables x and y from their corresponding means. Find the number of pairs of values on the basis of following data:

$$\sum x'y' = 120,\ \sum (y')^2 = 90,\ \text{s.d. of } x' = 8,\ r_{xy} = 0.5$$

17. Suppose for n pairs of values of two variables x and y, the regression coefficient of y on x is 0.16. If the values of x are multiplied by 20, find the new value of the regression coefficient.

B. Short answer type questions (3 marks each):

1. Examine the effect of change of bases and scales of the variables on correlation coefficient.

2. In case of perfect disagreement show that Spearman's rank correlation coefficient is equal to -1.

3. If u_i and v_i represent the ranks of i^{th} individual, i = 1 (1) n, in two characters, show that

$$\text{cov}(u,v) = \frac{n^2-1}{12} - \frac{1}{2n}\sum_{i=1}^{n} d_i^2 \text{, where } d_i = u_i - v_i$$

4. If $u = x - a$ and $v = \frac{y-b}{c}$, where a, b, c are constants and $c \neq 0$, prove that $r_{xy} = \pm r_{uv}$, according as c is positive and negative.

5. Using Cauchy - Schwarz inequality, prove that $-1 \leq r \leq 1$.

6. If x and y are two independent variables with zero means and common variance then prove that correlation coefficient between $u = lx + my$ and $v = mx + ly$ is given by $\frac{2lm}{l^2+m^2}$

7. Two variables x and y take the values as shown below:

x:	-3	-2	-1	0	1	2	3
y:	6	1	-2	-3	-2	1	6

Show that $r_{xy} = 0$. Are x and y independent? If not, what is the reason for r_{xy} being zero?

8. Suppose $u = cx + dy$, $v = cx - dy$ and r is the correlation coefficient between x and y. If u and v are uncorrelated, prove that $s_u s_v = 2cd s_x s_y \sqrt{1-r^2}$

9. If x and y are two positively correlated variables with variances 4 and 9 respectively, find the value of the constant c such that $(x + cy)$ and $(x + \frac{2}{3}y)$ are uncorrelated.

10. The standard deviation of two variables x and y are 5 and 6 respectively and the correlation coefficient between them is 0.5, find regression coefficient of x on (x + y)

11. The regression line of x on y is given by $x = a + \frac{y}{b}$. If the variance of y is one-quarter of the variance of x and correlation coefficient between x and y is 0.4, find b.

12. If x and y are correlated variables such their respective standard deviations are 4 and 5 and the standard deviation of $(2x - 3y)$ is 11, find the correlation coefficient between $(x + y)$ and $(x - y)$

13. If x_1 and x_2 are two variables such that each of them has variance s^2 and the correlation coefficient between them is r then prove that Var $(\frac{x_1 + x_2}{2}) = \frac{s^2}{2}(1+r)$. Hence show that $r \geq -1$

14. Write down the equations of the two linear regression lines and mention which is used in what situation. Explain why the two lines are usually different.

15. Show that Var $(e) = (1-r^2)\, s_y^{\,2}$. Hence interpret the case when $r = 0$

16. Show that the correlation between 'y' and its predicted value 'Y' (obtained from linear regression equation of 'y' on 'x') is non-negative and numerically equal to the correlation between 'y' on 'x'.

17. If Var(x) = Var(y) and $r_{xy}=r$, find regression coefficient of x and $x + y$ and that of $(x + y)$ on x. Hence find $r_{x(x+y)}$.

18. If x and y are two variables having $\bar{x}-\bar{y}=0$ and $s_x=s_y=1$, and $r_{(ax+by)(bx+ay)}=\frac{1+2ab}{a^2+b^2}$ then, show that $r_{xy}=\frac{a^2+b^2}{(a^2-b^2)^2-2ab}$

19. Given the differences (x_i-y_i) for a set of n -pairs of values of variables x and y, along with $\bar{x}, \bar{y}$, s_x *and* s_y. How can you find r_{xy} and the two regression lines?

20. If $u=x\ \cos\alpha+y\ \sin\alpha$ and $v=y\ \cos\alpha - x\ \sin\ \alpha$ and the variables u and v are uncorrelated, then prove that

$$\tan 2\alpha = \frac{r_{xy}s_x s_y}{s_x^2 - s_y^2}$$

21. Find the value of 'k' so that correlation coefficient between (x - ky) and (x + y) is maximum where x and y are two independent variables, each with mean zero and variance unity.

C. Descriptive type questions (5 marks each):

1. If x and y are two uncorrelated variables, then show that $r=r_1^2-r_2^2$, where r_1, r_2 and r respectively denote the correlation coefficient between $x, x+y; y, x+y$ and $x+y, x-y$.

2. Suppose $u=ax+by$, $v=cx+dy$ and r is the correlation coefficient between x and y. If u and v are uncorrelated, prove that $s_u s_v=(ad-bc)\ s_x s_y\sqrt{1-r^2}$.

3. If x and y are two uncorrelated variables having $\bar{x} = \bar{y} = 0$ and standard deviation s_x and s_y respectively, show that for $u = x\cos\alpha + y\sin\alpha$ and $v = y\cos\alpha$ - x sin α

$$r_{uv} = \frac{s_y^2 - s_x^2}{\left\{\left(s_x^2 - s_y^2\right)^2 + 4s_x^2 s_y^2 \cos ec^2 2\alpha\right\}^{\frac{1}{2}}}$$

4. What are the regression coefficients in bivariate data? Prove that the regression coefficients do not depend on change of origin but depend on change of scale.

5. If $y = -1.2x$ and $x = -0.6y$ are the two regression lines, compute r_{xy} and Var(x): Var(y). Also find r_{xz} where z = y - x

6. The equation of two regression lines are 3x + 9y = 46 and 3y + 12x = 19, determine which one of these is the regression lines of x on y and which one of these is the regression lines of y on x. Find the means, correlation coefficient, and ratio of the variances of x and y

7. Derive Spearman's rank correlation coefficient when there are no ties.

8. If x' and y' deviations of the variables x and y from their means, s_1^2, s_2^2 are the variances of x and y, correlation coefficient between x and y is r and (x_i, y_i) for i = 1, 2,....,n are the n values of (x, y), then show that

$$r = 1 - \frac{1}{2n}\sum_{i=1}^{n}\left(\frac{x_i'}{s_1} - \frac{y_i'}{s_2}\right)^2 = -1 + \frac{1}{2n}\sum_{i=1}^{n}\left(\frac{x_i'}{s_1} + \frac{y_i'}{s_2}\right)^2$$

Hence prove that -1 ≤ r ≤ 1.

Unit - 2

A. Short answer type questions (2 marks each):

1. Show that normal distribution is symmetric about mean.

2. If $\phi(x)$ is the probability density function(p.d.f.) of standard normal distribution, show that $E\phi(x) = \dfrac{1}{2\sqrt{\pi}}$.

3. If for a random variable X following normal distribution $N(\mu,\sigma^2)$, $P(X > a) = P(X < b)$ find the relation between '*a*' and '*b*'.

4. If X is uniformly distributed over [1,2], find U so that $P(X > U + E(X)) = \dfrac{1}{6}$

5. Find variance of the uniform distribution having parameters a and b.

6. Find the point(s) of inflection of normal $N(\mu,\sigma^2)$ distribution.

7. If $f(x) = c\ e^{-(x-4)^2}, -\infty < x < \infty$ represents a p.d.f. of normal distribution, write the value of μ_4.

8. If the random variable X follows a normal distribution whose mean is 18 and s.d. 25, find the points of inflection and effective range of the distribution.

9. If for a random variable X following normal distribution N(0, I) and $P(0 \le X \le 1) = 0.3413$, then determine the value of $P(X > -1)$,

10. Show that if $X \sim N(0, 1)$, then $P(|X| > C) = 2[1 - \Phi(C)]$

11. Suppose X ~ N (μ, σ^2) and Q_1 = 1st Quartile and Q_3 = 3rd Quartile.

    Let Y be another random variable such that

$$Y = \begin{cases} 1 \text{ if } X < Q_1. \\ 2 \text{ if } Q_1 \le X < Q_3 \\ 3 \text{ if } X \ge Q_3 \end{cases}$$

    Compute Var(Y).

12. If X follows R($-\theta$, θ), find the correlation coefficient between X and X^2.

13. Show that rectangular distribution is symmetrical.

14. If X follows N(0, 1) find the correlation coefficient between X and X^2.

15. Find the mode of a N (μ, σ^2) distribution.

16. Find the median of a N (μ, σ^2) distribution.

17. Let X be a random variable following normal distribution with mean +1 and variance 4. Let Y be another normal variable with mean -1 and variance unknown. If P(X ≤ - 1) = P(Y ≥ 2) , find standard deviation of Y.

18. If X is uniformly distributed over $(0, \frac{\pi}{2})$ then compute the expectation of the function SinX.

19. Let X ~ N (μ, σ^2). If $\sigma^2 = \mu^2, (\mu > 0)$, express $P(X < -\mu / X < \mu)$ in terms of cumulative distribution function of N (0, 1)

20. Let $X \sim N(0, 1)$, then find $E\{|X|\}$

B. Descriptive type questions (5 marks each):

1. Show that for $N(\mu, \sigma^2)$ distribution ratio of quartile deviation and standard deviation is 67:100.

   [Given that $\int_0^{0.67} \sqrt{\frac{1}{2\pi}} e^{-\frac{t^2}{2}} dt = 0.25$]

2. Show that the mean deviation about mean of a normal distribution is $\sqrt{\frac{2}{\pi}}\sigma$, where σ being the standard deviation of the normal distribution.

3. If X follows rectangular distribution with parameters '-*a*' and '*a*', then show that all odd order central moments of X are equal to zero and the central moments of even orders of the random variable are given by $\mu_{2r} = \frac{a^{2r}}{(2r+1)}, r = 1,2,3,......$

4. Find even order ($2n^{th}$) central moment (μ_{2n}) of a normal distribution with mean μ and variance σ^2. Hence show that $\frac{\mu_{2n}}{\mu_{2n-2}} = (2n-1)\ \sigma^2, n \geq 1$

5. Show that, for a rectangular distribution, $MD_\mu : SD = \sqrt{3} : 2$

Unit - 3

A. Short answer type questions (2 marks each):

1. What do you mean by *population* and *sample*?
2. What is sampling? Why is sampling necessary?
3. What do you mean by *parameter* and *statistic*?
4. What are probability sampling and simple random sampling?
5. What are the different types of population?
6. What do you mean by 'hypothetical population'. Give example.
7. Distinguish between a random and non-random sample.
8. What are 'sampling errors' and 'non-sampling errors' in sampling theory?
9. Under which conditions the standard errors of the sample mean in both SRSWR and SRSWOR become equal?
10. If the standard error of the sample mean for SRSWR is twice that for SRSWOR, show that $4n = 3N + 1$, where n and N denote the sample size and population size respectively.
11. In SRSWOR, find out unbiased estimator of population mean.
12. What are finite population correction (f.p.c.) factors in SRSWOR?
13. What do you mean by random sampling number series? Name one random sampling number series.

B. Short answer type questions (3 marks each):

1. Describe the advantages of sampling over complete enumeration.

2. Let (x_1, x_2, x_3,......, x_n) be a random sample of size n drawn from a population with N members having μ and σ^2 as population mean and population variance respectively. Then show that for all $i, j (i \neq j); i = 1(1)n; j = 1(1)n$

   $$Cov(x_i, x_j) = \frac{-\sigma^2}{N-1}, \text{ in case SRSWOR}$$

3. For SRSWR, prove that Var $(\bar{x}) = \frac{\sigma^2}{n}$

4. How are random sampling numbers used in drawing simple random sample?

5. Define 'bias' in sample survey. Name the various types of bias that may arise in sample survey.

6. What is meant by the sampling fluctuation of statistic? How is it measured?

7. Consider a population of 4 members having values 4, 6, 6 and 9. Obtain random sample of size 2 drawn without replacements and derive the sampling distribution of the statistic sample mean $\bar{x}$.

Unit - 4

A. Short answer type questions (2 marks each):

1. What do you mean by degree of freedom in statistics?

2. Write down the p.d.f of chi-square distribution with n degrees of freedom.

3. State the mean and variance of t- distribution with n degrees of freedom.

4. State the p.d.f. of t distribution with (n-1) d.f.

5. Give the p.d.f. of F distribution with (n_1, n_2) d.f.

6. Mention the mean and variance of χ^2 distribution with (n-1) d.f.

7. State the expectation and variance of F distribution with (n_1, n_2) d.f.

Unit - 5

A. Short answer type questions (3 marks each):

1. Distinguish 'point estimation' and 'interval estimation'.

2. Can a parameter have a number of estimates? If so, which one would you prefer?

3. What do mean by MVUE? What is BLUE?

4. If T is an unbiased estimator of θ, show that in general, $\sqrt{T}$ and T^2 are biased estimators of $\sqrt{\theta}$ and θ^2 respectively.

5. Discuss the different properties of a good estimator.

6. If $x_1, x_2 \ldots\ldots\ldots x_n$ be a simple random sample drawn from a normal population N (θ, 1), then show that $(\bar{x}^2 - \frac{1}{n})$ is an unbiased estimator of θ^2.

7. Let $(x_1, x_2, x_3, \ldots\ldots\ldots\ldots\ldots x_n)$ be a random sample of size n drawn from a binomial population with parameters 'm' (known) and 'p'. Obtain the moment estimator of the parameter 'p'. Hence check unbiased of it.

8. When is an estimator said to be minimum-variance unbiased? If T_1, T_2 and T_3 are independent unbiased estimators of θ and their respective variances are in the ratio 1: 2:1, which one of the following estimators of θ would you prefer most?

$$\frac{T_1 + T_2}{2}, \frac{T_1 + T_2 + T_3}{3}, \frac{3T_1 - 4T_2 + 5T_3}{4}$$

9. Let $s^2 = \frac{1}{n-1}\sum_{i=1}^{N}\left(x_i - \bar{x}\right)^2$ be the sample variance with divisor (n-1), then prove that $E(s^2) = \frac{N}{N-1}\sigma^2$ in case SRSWOR

10. What do you mean by unbiased estimator? Show that sample mean is an unbiased estimator of population mean for Poisson distribution having parameter λ.

11. Show that sample proportion defective is an unbiased estimator of population proportion defective.

12. Let $x_1, x_2, x_3, ..., x_n$ is simple random sample of size n drawn from infinite population with variance σ^2 and $\bar{x}$ is the sample mean. Show that $\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2$ is a biased estimator of σ^2.

13. $x_1, x_2, x_3, ..., x_n$ are random observations on a Bernoulli variable X taking the value 1 with probability θ and value 0 with probability (1-θ). Show that $\frac{t(t-1)}{n(n-1)}$ is an unbiased estimator of θ^2, where $t = \sum_{i=1}^{n} x_i$

14. If the sample observations are 2, 4, 6, 8, 10 from an infinite population with variance σ^2, determine an unbiased estimate of σ^2.

15. Based on random sample drawn from N(μ,1) population, verify whether (sample mean)^2 is an unbiased estimator of μ^2

16. If $(x_1, x_2, x_3, \ldots\ldots\ldots\ldots, x_n)$ be a random sample drawn from

$$f(x) = \frac{1}{\sqrt{2\pi\theta}} e^{\frac{-x^2}{2\theta}} ; -\infty < x < \infty$$

Show that $\frac{1}{n}\sum_{i=1}^{n} x_i^2$ is an unbiased estimator of θ.

Unit - 6

A. Short answer type questions (2 marks each):

1. Distinguish between 'simple hypothesis' and 'composite hypothesis'.
2. Distinguish between 'null hypothesis' and 'alternative hypothesis'.
3. Distinguish between 'type -I error' and 'type -II errors'.
4. When is a test said to be unbiased or biased?
5. What do you mean by 'critical region' and 'test-statistics'?

B. Short answer type questions (3 marks each):

1. What are Type - I and Type II errors? Find their relation with level of significance (α) and power of the (β) of the test.
2. What are the criteria of good test?
3. A coin is tested for unbiasedness. The hypothesis that it is unbiased is rejected if 9 or more tosses of the coin out of 10 tosses result in head. Can we take 1% as level of significance?
4. To examine the claim of a reputed publisher that m, the average number of misprints per page of a book, is 1, if a particular page of that book contains more than 2 misprints, then null hypothesis that m=1 is rejected. What is the probability of type-I error? Find the power of the test when the alternative hypothesis is m = 2. Given that $e^{-1} = 0.368$

5. Let p be the probability that a coin will fall head in a single toss in order to test $H_0 : p = \frac{1}{2}$ against $H_1 : p = \frac{3}{4}$. The coin is tossed 5 times and H_0 is rejected if more than 3 heads are obtained. Find the probability of type-I error and power of the test.

6. What procedure would you adopt for testing the hypothesis about mean of a normal distribution with an unknown variance, on the basis of a random sample?

7. Explain large sample test for Poisson mean.

8. A manufacturer claimed that at least 90% of the items which he supplied conformed to specifications. A random sample of 200 items showed that only 164 were up to the standard. Test his claim at 1% level of significance. [Given that $\tau_{0.01} = 1.645$]

9. Given $f(x) = \frac{1}{\theta}, 0 \le x \le \theta$

$= 0$, elsewhere,

to test the hypothesis $H_0 : \theta = 1$ against the alternative hypothesis $H_1 : \theta = 2$ on the basis of the single observation x. Find the probabilities of type-I error and type-II error if the critical region be $x > 0.5$.

Unit - 7

A. Short answer type questions (3 marks each):

1. What do you mean by 'statistical quality control (SQC)'? What is the main objective of SQC.

2. Write a short note on 'rational subgroup'.

3. What do you mean by 'assignable causes of variation', 'chance causes of variation' and 'rational subgroups' in statistical quality control?

4. Write down the control limits of a fraction defective(p) chart when standards are given and not given.

5. What do you mean by control chart of a variable and control chart of an attribute? Write down uses of control chart

6. Write down the control limits of a number defective(np) chart when standards are given and not given.