I.E.S/ISS EXAM-2022

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T.B.C. : GVP-B-STSS

Test Booklet Series

A

Serial

1005621

TEST BOOKLET

STATISTICS

Paper II

Time Allowed : Two Hours *Maximum Marks : 200*

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.
4. This Test Booklet contains **80** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet***. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**

    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.

    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. Let $Y = X\beta + \varepsilon$, where Y is $n \times 1$ vector of response, X is $n \times k\ (n > k)$ matrix of predictors, β is $k \times 1$ vector of unknown coefficients to be estimated and ε is $n \times 1$ vector of random errors. Further ε is $N(0, \sigma^2 I)$. The distribution of $\hat{Y}$ is :

(a) $N(X\beta, \sigma^2)$

(b) $N(X\beta, X(X'X)^{-1} X'\sigma^2)$

(c) $N(X\beta, (X'X)^{-1} \sigma^2)$

(d) $N(X\beta, (X'X)^{-1} X'\sigma^2)$

2. An ecologist takes data (X_i, Y_i); $i = 1, 2, 3, \ldots n$ where X_i is the size of an area and Y_i is the number of moss plants in the area. We model the data by $Y_i \sim$ Poisson (θx_i); Y_i's are independent. The least square estimator and the MLE of θ are respectively :

(a) $\left(\frac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} X_i}, \frac{\sum_{i=1}^{n} X_i Y_i}{\sum_{i=1}^{n} X_i^2}\right)$

(b) $\left(\frac{\sum_{i=1}^{n} X_i Y_i}{\sum_{i=1}^{n} X_i^2}, \frac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} X_i}\right)$

(c) $\left(\frac{\overline{Y}}{\overline{X}}, \frac{\text{Cov}(X, Y)}{V(X)}\right)$

(d) $\left(\frac{\text{Cov}(X, Y)}{V(X)}, \frac{\overline{Y}}{\overline{X}}\right)$

3. Let A be any $n \times m$ matrix with A^- as any generalized inverse of it. Further, let $H = AA^-$ and $T = A^- A$. Then which one of the following is correct ?

(a) Only H is an idempotent matrix

(b) Only T is an idempotent matrix

(c) Both H and T are idempotent matrices

(d) Neither H nor T is an idempotent matrix

4. Let A be a matrix of order $n \times p$ with A^- as any generalized inverse of it. Let $(A'A)^-$ be any generalized inverse of $A'A$, then which of the following are correct ?

1. $(A')^- = (A^-)'$
2. $A^- = (A'A)^- A'$
3. Rank (A^-A) = rank (AA^-)

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

5. Let A be any matrix of order $n \times m$. Consider the following statements for its Moore-Penrose inverse A^+ :

1. $A^+ = (A'A)^+ A'$
2. A^+ is unique

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

6. Let X_i, Y_i and Z_i; $i = 1, 2, 3$ be nine independent observations with common variance σ^2, and $E(X_i) = \theta_1$, $E(Y_i) = \theta_2$, $E(Z_i) = \theta_1 - \theta_2$; $i = 1, 2, 3$. If $\hat{\theta}_1$ and $\hat{\theta}_2$ denote the BLUEs of θ_1 and θ_2 respectively, then which one of the following is correct ?

(a) $V(\hat{\theta}_1) > V(\hat{\theta}_2)$

(b) $V(\hat{\theta}_1) = V(\hat{\theta}_2)$

(c) $V(\hat{\theta}_1) < V(\hat{\theta}_2)$

(d) $V(\hat{\theta}_1) \geq V(\hat{\theta}_2)$

7. Consider two-way classified data with 5 levels of factor A, 6 levels of factor B and 4 observations per cell. The degrees of freedom for error are :

(a) 120

(b) 100

(c) 96

(d) 90

8. For a two-way classified random effect model with p levels of factor A and q levels of factor B having m observations per cell, the estimate of variance component $\hat{\sigma}^2_A$ is given by :

(a) $\dfrac{MSA - MS(AB)}{qm}$

(b) $\dfrac{MSB - MS(AB)}{pm}$

(c) $\dfrac{MSA - MSB}{pq}$

(d) $\dfrac{MSA + MSB}{pq}$

*Consider the following for the next **two (02)** items :*

The moisture content of three types of cheese made by two methods was recorded. Two pieces of cheese were measured for each type and for each method. Let the method be designated as factor A and type as factor B. The sum of squares for factor A, factor B and error are respectively 0·114075, 25·900117 and 0·661950.

9. The mean squares for method and error are respectively :

(a) 0·114075 and 0·110325

(b) 0·057037 and 0·110325

(c) 0·114075 and 0·08274375

(d) 0·057037 and 0·08274375

10. The values of F-statistic for factors A and B are respectively :

(a) 1·034 and 78·2539

(b) 0·51699 and 117·381

(c) 1·034 and 117·381

(d) 0·51699 and 78·2539

11. Let Y represent tensile strength of a cable of diameter X mm. If $Y = CX^2$ for some constant C and density function of X is given by

$$f(x) = \begin{cases} \dfrac{1}{\theta}, & 5 < x < 5 + \theta \\ 0, & \text{otherwise} \end{cases}$$

what is the unbiased estimate of θ^2 ?

(a) $3X - 5$

(b) $X^2 - 5$

(c) $3(X - 5)^2$

(d) $3(X^2 - 5)$

12. Which of the following assertions is/are correct ?

1. Maximum Likelihood Estimate of Poisson mean λ is unbiased, sufficient and consistent estimate for λ.

2. For $X \sim U(0, \theta)$, maximum likelihood estimate of θ is a biased, consistent and sufficient estimate for θ.

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

13. Consider the following statements :

1. For an exponential random variable with mean θ, $\left(\frac{n}{n+1}\right)\bar{X}^2$ is unbiased for θ^2.

2. For a Bernoulli random variable with parameter p, $\frac{\left(\sum x_i\right)^2}{n^2}$ is unbiased for p^2.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

14. Let $X_1, X_2, X_3, \ldots X_n$ be i.i.d. random variables from f(x), where $f(x) = (\theta + 1)\, x^{\theta}$; $0 < x < 1$, $\theta > -1$. The UMVUE of θ is :

(a) $-\frac{(n-1)}{\sum ln\, x_i} - 1$

(b) $-\frac{\sum ln\, x_i}{n-1} - 1$

(c) $\frac{(n-1)}{\sum ln\, x_i} - 1$

(d) $-\frac{(n-1)}{\sum ln\, x_i} + 1$

15. Let $X_1, X_2, X_3, \ldots X_m$ be i.i.d. random variables with B(n, p). The CR lower bound for the variance of an unbiased estimator of $\frac{p}{1+p}$ is :

(a) $\frac{pq}{mn}$

(b) $\frac{pq}{(1+p)^2\, m}$

(c) $\frac{pq}{(1+p)^4\, mn}$

(d) $\frac{pq}{(1+q)^2\, m}$

16. Suppose waiting time at a vaccination centre queue is modelled by a normal distribution. A random sample of 16 adults showed a mean waiting time of 40 minutes with a standard deviation of 8 minutes. What is the 95% confidence interval for the true waiting time in this queue ? [Given that $t_{15,\, 0{\cdot}025} = 2{\cdot}13$]

(a) [35·6, 44·4]

(b) [25·7, 54·3]

(c) [30·3, 50·7]

(d) [35·7, 40·3]

17. Time to failure of an electric tube follows the density function $f(x) = \begin{cases} \frac{1}{\theta} e^{-\frac{x}{\theta}}, & x > 0 \\ 0, & \text{otherwise} \end{cases}$

For testing $H_0 : \theta \geq 5$ against the alternative $H_1 : \theta < 5$, what is the power function of the critical region $C = (\bar{X} \leq k)$ for a sample of size 2 ?

(a) $1 - \left(1 + \frac{2k}{\theta}\right) e^{-\frac{2k}{\theta}}$

(b) $1 - (\theta + 2k)\, e^{-2k\theta}$

(c) $(\theta - 2k)\, e^{-2k\theta}$

(d) $1 - \left(1 - \frac{2k}{\theta}\right) e^{-\frac{2k}{\theta}}$

18. The statistics $T = t(x)$ will be sufficient for parameter θ iff the joint density/mass function of the sample values $x_1, x_2, x_3, \ldots x_n$ can be expressed in the form $f(x; \theta) = g_\theta[t(x)].h(x)$ where $g_\theta[t(x)]$ depends on θ and $t(x_1, x_2, x_3, \ldots x_n)$ and $h(x)$ is independent of θ. This theorem is known as :

(a) Neyman-Pearson theorem

(b) Rao-Blackwell theorem

(c) Factorization theorem

(d) Cramer-Rao theorem

19. Consider a random sample $x_1, x_2, x_3, \ldots x_n$ from normal distribution with zero mean and variance σ^2. For testing the null hypothesis $H_0 : \sigma = \sigma_0$ against the alternative hypothesis $H_1 : \sigma = \sigma_1 (\sigma_0 > \sigma_1)$, the best critical region will take the form :

(a) $C = \{x : \sqrt{\Sigma x_i^2} \leq a_\alpha\}$

(b) $C = \{x : \sqrt{\Sigma x_i^2} \geq a_\alpha\}$

(c) $C = \{x : \Sigma x_i^2 \leq a_\alpha\}$

(d) $C = \{x : \Sigma x_i^2 \geq a_\alpha\}$

20. Let $x_1, x_2, x_3, \ldots x_{100}$ be a random sample of size 100 from the population having pdf $f(x) = \theta e^{-x\theta}$; $0 < x < \infty$. 95% confidence limits for θ will be :

(a) $\frac{1}{\bar{x}} \pm \frac{1{\cdot}96}{\bar{x}}$

(b) $\frac{1}{\bar{x}} \pm \frac{0{\cdot}196}{\bar{x}}$

(c) $\frac{1}{\bar{x}} \pm \frac{19{\cdot}6}{\bar{x}}$

(d) $\frac{1}{\bar{x}} \pm \frac{0{\cdot}0196}{\bar{x}}$

Consider the following for the next ***two (02)*** *items :*

In general linear model $Y = X\beta + \varepsilon$ where Y is $n \times 1$, X is $n \times k$, β is $k \times 1$ and ε is $n \times 1$. Further ε is $N(0, \sigma^2 I)$. Let e be an $n \times 1$ vector of residuals. Let $P = X(X'X)^{-1}X' = [p_{ij}]$ where $p_{ii} = x_i' (X'X)^{-1} x_i$ and $p_{ij} = x_i' (X'X)^{-1} x_j$; x_i' is the i^{th} row of X.

21. What is the range of p_{ii} ?

(a) $0 \leq p_{ii} \leq 2$

(b) $0 \leq p_{ii} \leq 0{\cdot}5$

(c) $-1 \leq p_{ii} \leq 1$

(d) $0 \leq p_{ii} \leq 1$

22. What is the correlation coefficient between e_i and e_j ?

(a) $\frac{p_{ij}}{\sqrt{(1-p_{ii})(1-p_{jj})}}$

(b) $\frac{-p_{ij}}{\sqrt{(1-p_{ii})(1-p_{jj})}}$

(c) $\frac{p_{ii}}{\sqrt{(1-p_{ij})(1-p_{jj})}}$

(d) $\frac{p_{jj}}{\sqrt{(1-p_{ij})(1-p_{ii})}}$

23. Three methods A, B and C of packing frozen foods were compared. The response variable was ascorbic acid (mg/100 g). The data was collected by taking seven observations for each of the methods. The sum of squares due to treatments and that due to total are 147·3456 and 202·3126 respectively. What is the value of F-statistic ?

(a) 24·1256

(b) 24·0156

(c) 23·5216

(d) 23·1256

Consider the following for the next ***two (02)*** *items that follow :*

Let X_i, Y_i and Z_i where i = 1, 2, 3, 4 be twelve independent observations with common variance σ^2, and $E(X_i) = \theta_1$, $E(Y_i) = \theta_2$ and $E(Z_i) = \theta_1 + \theta_2$; i = 1, 2, 3, 4. Let $X = \sum_{i=1}^{4} X_i$, $Y = \sum_{i=1}^{4} Y_i$ and $Z = \sum_{i=1}^{4} Z_i$.

24. What is the BLUE of θ_1 equal to ?

(a) $\frac{1}{12}[2X - Y + Z]$

(b) $\frac{1}{12}[X - Y + 2Z]$

(c) $\frac{1}{12}[-X + 2Y + Z]$

(d) $\frac{1}{12}[X - 2Y + Z]$

25. What is the BLUE of θ_2 equal to ?

(a) $\frac{1}{12}[2X - Y + Z]$

(b) $\frac{1}{12}[X - Y + 2Z]$

(c) $\frac{1}{12}[-X + 2Y + Z]$

(d) $\frac{1}{12}[X - 2Y + Z]$

26. Consider a one-way classification model $Y_{ij} = \mu + \alpha_i + e_{ij}$ where i = 1, 2, 3, ... k; j = 1, 2, 3, ... n and $e_{ij} \sim N(0, \sigma^2)$. Assume that $N = \sum_{i=1}^{k} n_i$. We are testing the hypothesis $H_0 : \alpha_1 = \alpha_2 = ... = \alpha_k = \alpha$ (say). Consider the ANOVA table for this classification :

Source	Degrees of freedom
Treatment	u
Error	v
Total	N – 1

What are the values of u and v respectively ?

(a) k, N – k – 1

(b) k – 2, N – k + 1

(c) k – 1, N – k

(d) k – 3, N – k + 2

27. Consider a two-way classification with r observations per cell $Y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_{ij} + e_{ijk}$, where i = 1, 2, ... p; j = 1, 2, ... q; k = 1, 2, ... r. Consider the ANOVA table for this classification :

Source	*Degrees of freedom*
Due to α	t
Due to β	u
Interaction	v
Error	w
Total	pqr – 1

What are the values of t, u, v and w respectively ?

(a) p – 1, q – 1, (p – 1) (q – 1), pq (r – 1)

(b) q – 1, p – 1, (p – 1) (q – 1), pq (r – 1)

(c) r – 1, q – 1, (r – 1) (q – 1), pq (r – 1)

(d) p – 1, r – 1, (r – 1) (p – 1), pq (r – 1)

28. In a Randomized Block Design with 4 blocks and 5 treatments having one missing observation, the error degrees of freedom are :

(a) 12

(b) 11

(c) 10

(d) 9

*Consider the following for the next **two (02)** items that follow :*

Consider the Gauss-Markov linear model

$$E(y_1) = \beta_1 - \beta_3$$

$$E(y_2) = 2\beta_1$$

$$E(y_3) = \beta_1 + \beta_2$$

with $V(y_i) = \sigma^2$, $Cov(y_i, y_j) = 0$ for $i \neq j$.

29. Consider the following statements :

1. The best linear unbiased estimator of β_1 is $\hat{\beta}_1 = \frac{1}{6}(y_1 + 2y_2 + y_3)$.
2. The best linear unbiased estimator of β_2 is $\hat{\beta}_2 = \frac{1}{2}(y_1 + y_3)$.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

30. The residual sum of squares is given by :

(a) $\frac{1}{3}(y_1 + y_2 + y_3)^2$
(b) $\frac{1}{2}(y_1 + y_2 - y_3)^2$
(c) $\frac{1}{2}(y_1 - y_2 + y_3)^2$
(d) $\frac{1}{3}(y_1 - y_2 + y_3)^2$

*Consider the following for the next **two (02)** items that follow :*

Let X have a pdf of the form $f(x, \theta) = \theta x^{\theta - 1}$; $0 < x < 1$.

31. What is the significance level of the test to test $H_0 : \theta = 1$ against $H_1 : \theta = 2$ using a random sample X_1, X_2 of size 2 by taking the critical region $w = \left\{(x_1, x_2) : \frac{3}{4x_1} \leq x_2\right\}$?

(a) $ln\ 3$
(b) $ln\ 3 - ln\ 4$
(c) $ln\ 4$
(d) $ln\ 4 - ln\ 3$

32. What is the power function of the test to test $H_0 : \theta = 2$ against $H_1 : \theta = 3$ using a random sample X_1, X_2 of size 2 by taking the critical region $w = \left\{(x_1, x_2) : \frac{3}{4x_1} \leq x_2\right\}$?

(a) $\frac{7}{16} + \frac{9}{8} ln\left(\frac{3}{4}\right)$
(b) $\frac{7}{16} - \frac{9}{8} ln\left(\frac{3}{4}\right)$
(c) $\frac{37}{64} + \frac{81}{64} ln\left(\frac{3}{4}\right)$
(d) $\frac{37}{64} - \frac{81}{64} ln\left(\frac{3}{4}\right)$

33. Let T_1 be an MVUE of θ and T_2 be any other unbiased estimator of θ, such that the correlation coefficient between T_1 and T_2 is 0·75. What is the efficiency of T_2 ?

(a) $\frac{\sqrt{3}}{2}$
(b) $\frac{3}{\sqrt{2}}$
(c) $\frac{16}{9}$
(d) $\frac{9}{16}$

34. An MVB estimator for a function of parameter θ, say $\gamma(\theta)$ exists if and only if :

(a) $\frac{\partial}{\partial\theta}(ln\ L) = \frac{t - \alpha(\theta)}{\gamma(\theta)}$

(b) $\frac{\partial}{\partial\theta}(ln\ L) = \frac{1}{\gamma(\theta)}$

(c) $\frac{\partial}{\partial\theta}(ln\ L) = \frac{\alpha(\theta)}{t - \gamma(\theta)}$

(d) there exists a sufficient estimator for $\gamma(\theta)$

[Here $\alpha(\theta)$ is any function of θ]

35. Let $X_1, X_2, X_3, \ldots X_n$ be a random sample from normal population with mean 0 and variance σ^2. Let $T = \frac{\sum x_i^2}{n}$. Then which one of the following is correct ?

(a) T is MLE of σ^2 but does not attain CRLB.

(b) T is biased estimator of σ^2 but attains CRLB.

(c) T is MLE of σ^2 and attains CRLB.

(d) T is biased for σ^2 but not MLE of σ^2.

36. Let X_1 and X_2 be two independent variables. Define $T_1 = X_1 + 2X_2$ as statistic for θ in Bernoulli (θ) distribution, where $0 < \theta < 1$ and $T_2 = X_1 + 2X_2$ as statistic for λ in Poisson (λ) distribution, where $\lambda > 0$. Then which one of the following is correct ?

(a) T_1 is sufficient for θ and T_2 is sufficient for λ.

(b) T_1 is sufficient for θ but T_2 is not sufficient for λ.

(c) T_1 is not sufficient for θ but T_2 is sufficient for λ.

(d) T_1 is not sufficient for θ as well as T_2 is not sufficient for λ.

37. Let X_1 and X_2 be two iid random variables having the discrete uniform distribution on {1, 2, 3, ..., N}, where N is unknown. Let $T = \max(X_1, X_2)$. Then which one of the following is correct ?

(a) $X_1 + X_2$ is sufficient for N but T is not sufficient for N

(b) T is sufficient for N but $X_1 + X_2$ is not sufficient for N

(c) Both T and $X_1 + X_2$ are sufficient for N

(d) Neither T nor $X_1 + X_2$ is sufficient for N

38. Consider the problem of testing $H_0 : \mu = 0$ against $H_1 : \mu \neq 0$, based on random sample of size n taken from $N(\mu, \sigma^2)$ normal distribution where σ^2 is unknown. Consider the transformation $Y = bX$, $b \neq 0$. Which one of the following statements is correct ?

(a) Sample space will change and hence UMPU similar test will change and hence does not remain invariant under the transformation.

(b) Parametric space will change and hence UMPU similar test does not remain invariant under the transformation.

(c) Sample space will change but parametric space remains unchanged and hence UMPU similar test remains invariant under the transformation.

(d) Sample space as well as parametric space remain unchanged and UMPU similar test becomes invariant under the transformation.

*Consider the following for the next **two (02)** items that follow :*

Consider the problem of testing $H_0 : \theta = \theta_0$ against $H_1 : \theta = \theta_1$ for the probability distribution given below :

X	0	1	2	3
$P_{\theta_0}(x)$	1/4	1/4	1/4	1/4
$P_{\theta_1}(x)$	0·20	0·40	0·25	0·15

The null hypothesis is rejected if $X = 0$ is observed. It is further rejected when tossing of two unbiased coins gives both the heads for $X = 1$.

39. What is the probability of type-I error of the test ?

(a) $\frac{3}{10}$

(b) $\frac{5}{16}$

(c) $\frac{7}{10}$

(d) $\frac{1}{4}$

40. What is the probability of type-II error of the test ?

(a) $\frac{3}{10}$

(b) $\frac{5}{16}$

(c) $\frac{7}{10}$

(d) $\frac{1}{4}$

41. Which of the following reasons can result in privacy breaches even in aggregate-level data (not unit level data or micro data) derived from data collected in surveys or census ?

1. Aggregated data given state-wise
2. Dealing with very small areas
3. Dealing with rare sub-populations

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

42. Subjects covered under 76th round of NSSO are Disability, Drinking water, Sanitation, Hygiene and Housing conditions. Which agency is responsible for finalising subjects to be covered in NSS survey ?

(a) NSSO

(b) CSO

(c) NSC

(d) NITI Aayog

43. Which of the following indicators from National Indicator Framework would help in monitoring Goal 4, namely 'Ensure inclusive and equitable quality education and promote lifelong learning opportunity for all' ?

1. Proportion of computer literate adults.
2. Number of persons treated in de-addiction centres.
3. Enrolment ratio of children with disabilities.
4. Percentage of agriculture 'mandis' enrolled in e-market.

Select the correct answer using the code given below :

(a) 2 and 4 only

(b) 1 and 3 only

(c) 1, 2 and 3 only

(d) 1, 2, 3 and 4

44. Which of the divisions are parts of Central Statistics Office ?

1. National Accounts Division
2. Economics Statistics Division
3. Field Operation Division

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

45. Consider the following in respect of National and International official statistical systems :

1. They use absolute numbers, percentages, ratios and pictograms.
2. They only count physical quantities.
3. They estimate from sampling where exact counting is not possible.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

46. Consider the following in respect of Gross Domestic Product (GDP) :

1. It refers to market value of all final goods and services within a country in a given period.
2. It is measured at current and constant prices.
3. It is a measure of economic welfare.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

47. Which one of the following is ***not*** a Sustainable Development Goal (SDG) ?

(a) Affordable and clean energy

(b) Promote regulated use of AI

(c) Peace, Justice and Strong Institutions

(d) Climate Action

48. Consider the following pairs :

	Index Number		*Department / Office*
1.	Consumer Price Index (Rural, Urban, Combined)	—	Labour Bureau
2.	Consumer Price Index (Agricultural Labour	—	National Statistical Office
3.	Wholesale Price Index	—	Office of Economic Adviser

How many pairs are correctly matched ?

(a) None of the pairs

(b) Only one pair

(c) Only two pairs

(d) All three pairs

49. Which organization at the central level is responsible to coordinate and unify the activity of death registration in India ?

(a) Ministry of Health and Family Welfare

(b) Office of Registrar General of India

(c) National Statistical Office

(d) None of the above

50. Consider the following statements :

1. The basic unit of data collection in the Agriculture Census is operational holding.
2. Population Census comes under Concurrent list.
3. The periodicity of economic census is ten years.

Which of the above statements is/are correct ?

(a) 1 only

(b) 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

51. Let a random variable X have the following probability distribution under $H_0 : \theta = \theta_0$ against $H_1 : \theta = \theta_1$:

X	– 1	1	2
$P_{\theta_0}(x)$	1/3	1/3	1/3
$P_{\theta_1}(x)$	1/4	1/4	1/2

To test sequentially the hypothesis H_0 against H_1, it is decided to continue the procedure as long as $-\frac{n+1}{2} < S_n < \frac{n+2}{2}$, where $S_n = \sum_{i=1}^{n} X_i$. Then the probability under H_1 that the procedure will terminate with the second observation, is :

(a) 1/9

(b) 1/8

(c) 1/3

(d) 1/2

52. A test of level α is said to be an unbiased test if its power is :

(a) equal to the level of significance

(b) less than the level of significance

(c) greater than probability of type-II error

(d) greater than the level of significance

53. Consider the following pairs :

1.	Likelihood ratio test	—	Construction of tests for a composite hypothesis
2.	Most powerful test	—	Test of confirmation of a set of observations to a given distribution
3.	Chi-square test	—	Agreement of a set of observed frequencies with corresponding expected frequencies
4	Run test	—	A distribution free test of randomness

How many pairs are correctly matched ?

(a) Only one pair

(b) Only two pairs

(c) Only three pairs

(d) All four pairs

54. Consider the following pairs :

1.	Power function	—	Uniformly most powerful test
2.	Size of the test	—	Larger of the two types of errors
3.	Neyman-Pearson Lemma	—	Maximum power for a fixed level of Type-I error
4	Randomised tests	—	Tests not based on the sample observations

How many pairs are ***not*** correctly matched ?

(a) Only one pair

(b) Only two pairs

(c) Only three pairs

(d) All four pairs

55. Let $X_1, X_2, X_3, \ldots X_n$ be a random sample of size n from $N(\mu, \sigma^2)$ where μ is unknown. Then the most efficient biased estimator for μ is :

(a) $\bar{x}$

(b) $n\bar{x}$

(c) $\frac{n}{n+1}\bar{x}$

(d) $\frac{n+1}{n}\bar{x}$

56. Suppose the survival times of patients of a bladder disorder can be modelled by the exponential distribution such that the average time a patient survives is λ. Consider the following statements :

1. 50% of patients will die by the time $\lambda \log_e 2$.
2. 25% of patients will die by the time $\lambda \log_e\left(\frac{4}{3}\right)$.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

57. Consider the following statements with regard to Maximum Likelihood Estimator :

1. It may not be unbiased.
2. It may not in general be unique.
3. It leads to a consistent estimate which has an asymptotic normal distribution, under some conditions.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

58. For independent Poisson random variables with parameter λ, which one of the following is sufficient statistic ?

(a) $(X_1, \Pi_{i=2}^{n} X_i)$

(b) $\frac{X_1}{X_2}$

(c) $\frac{X_1}{\Sigma_{i=1}^{n} X_i}$

(d) $(X_1, \Sigma_{i=2}^{n} X_i)$

59. For independent Bernoulli random variables, which of the following is/are sufficient statistic for p, such that

$P(X_i = 1) = p = 1 - P(X_i = 0);\ i = 1, 2, 3$?

1. $X_1 + X_2 + X_3$
2. $X_1 + 2X_2 + X_3$

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

60. Let $X \sim N(\mu, \sigma^2)$ where μ is known. If a confidence interval for σ^2 is to be determined, then an appropriate pivot is :

(a) $(n-1)\frac{S^2}{\sigma^2}$

(b) $\sum_{i=1}^{n} \frac{(X_i - \mu)^2}{\sigma^2}$

(c) $\frac{(\bar{X} - \mu)\sqrt{n}}{\sigma}$

(d) $\frac{(\bar{X} - \mu)\sqrt{n}}{S}$

61. The mandate of National Statistical Commission is to :

1. Serve as a model and empowered body for all core statistical securities of the nation.
2. Evolve, monitor and enforce statistical priorities and standards.
3. Ensure statistical coordination.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

62. Consumer Price Index (CPI) is calculated for which of the following categories :

(a) Industrial workers, agricultural labourers and rural labourers and urban non-manual employees

(b) Organized workers, plantation labourers, unorganized workforce and non-rural migrant population

(c) Skilled labourers, unskilled workers, cultivators and agricultural workforce

(d) Office-goers, unemployed persons and housewives

63. Consider the following in respect of Index of Industrial Production (IIP) :

1. It measures the change in volume of industrial production of a representative basket.
2. It is used to analyse performance of various sectors of economy.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

64. Consider the following :

1. Relevance, impartiality and equal access
2. Professional standards and ethics
3. Accountability and transparency
4. Legislation
5. International cooperation

Which of the above are fundamental principles of Official Statistics ?

(a) 1, 2 and 3 only

(b) 2, 3, 4 and 5 only

(c) 1, 4 and 5 only

(d) 1, 2, 3, 4 and 5

65. Consider the following statements :

1. Laspeyres index uses current period quantity as weights.
2. Paasche index uses base period quantity as weights.
3. For the same set of data, Laspeyres index is greater than Paasche index.

Which of the statements given above are ***not*** correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

66. The most appropriate method for constructing index numbers is Fisher's Ideal Index method. It is referred to as an ideal because :

1. It is based on the geometric mean which is considered best average.
2. It satisfies both time reversal test and factor reversal test.
3. It takes into account both current and base year quantities as weights.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

67. Consider the following statements in respect of index numbers :

1. They help in framing of economic policies.
2. They help in assessing the purchasing power of money.
3. They are used for adjusting national income.

Which of the statements given above are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

*Consider the following data for the next **three (03)** items that follow :*

The sum of the products of prices and quantities for the current year 1 and base year 0 for five items are given below :

$\Sigma p_0q_0 = 782$, $\Sigma p_0q_1 = 1008$, $\Sigma p_1q_0 = 1084$, $\Sigma p_1q_1 = 1329$

68. What is the approximate value of Fisher's Ideal Price Index number P_{01} ?

(a) 125

(b) 128

(c) 130

(d) 135

69. What is the approximate value of Fisher's Ideal Price Index number P_{10} ?

(a) 64

(b) 74

(c) 81

(d) 85

70. What is the approximate value of Fisher's Ideal Quantity Index number Q_{01} ?

(a) 114

(b) 126

(c) 134

(d) 144

71. Let $x_1, x_2, x_3, \ldots x_n$ be a random sample taken from Gamma(α, β) having p.d.f.

$$f(x; \alpha, \beta) = \frac{e^{-\frac{x}{\beta}} x^{\alpha-1}}{\beta^{\alpha}\ \Gamma(\alpha)} ; 0 \le x < \infty ; \alpha, \beta > 0$$

The jointly sufficient statistic for α and β, are respectively :

(a) $\left(\Sigma x_i, \Pi x_i\right)$

(b) $\left(\Sigma x_i^2, \Pi x_i^2\right)$

(c) $\left(\Sigma x_i^2, \Pi x_i\right)$

(d) $\left(\Sigma x_i, \Pi x_i^2\right)$

*Consider the following for the next **two (02)** items that follow :*

Let $X_1, X_2, X_3, \ldots X_n$ be a random sample from uniform distribution U(0, θ).

Let $T_1 = \frac{2}{n} \Sigma_{i=1}^{n} X_i$ and

$T_2 = \max (X_1, X_2, X_3, \ldots X_n)$.

72. Consider the following statements :

1. T_1 and T_2 are consistent estimators of θ.
2. T_1 and T_2 are unbiased estimators of θ.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

73. Consider the following statements :

1. T_1 is not sufficient but T_2 is sufficient estimator of θ.
2. T_1 is the method of moment estimator of θ.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

*Consider the following for the next **two (02)** items that follow :*

Let $X_1, X_2, X_3, \ldots X_n$ be a random sample from

$$f(x) = \begin{cases} \dfrac{1}{b-a}, & a \le x \le b \\ 0, & \text{otherwise} \end{cases}$$

74. The estimator for 'a' by method of moments is :

(a) $\overline{X} - \sqrt{\dfrac{\Sigma(X_i - \overline{X})^2}{n}}$

(b) $\overline{X} - \sqrt{\dfrac{2\,\Sigma(X_i - \overline{X})^2}{n}}$

(c) $\overline{X} - \sqrt{\dfrac{3\,\Sigma(X_i - \overline{X})^2}{n}}$

(d) $\overline{X} - 2\sqrt{\dfrac{\Sigma(X_i - \overline{X})^2}{n}}$

75. The estimator for 'b' by method of moments is :

(a) $\overline{X} + \sqrt{\dfrac{\Sigma(X_i - \overline{X})^2}{n}}$

(b) $\overline{X} + \sqrt{\dfrac{2\,\Sigma(X_i - \overline{X})^2}{n}}$

(c) $\overline{X} + \sqrt{\dfrac{3\,\Sigma(X_i - \overline{X})^2}{n}}$

(d) $\overline{X} + 2\sqrt{\dfrac{\Sigma(X_i - \overline{X})^2}{n}}$

76. Let $X_1, X_2, X_3, \ldots X_n$ be iid Bernoulli with parameter p. What is the Cramer-Rao Lower Bound for $\overline{X}$, where $E(\overline{X}) = p$?

(a) $\dfrac{n}{p}$

(b) $\dfrac{n}{p(p-1)}$

(c) $\dfrac{n}{p(1-p)}$

(d) $\dfrac{p(1-p)}{n}$

77. Let $X_1, X_2, X_3, \ldots X_n$ be a random sample of size 2 from Bernoulli distribution with pmf

$$f(x, \theta) = \begin{cases} \theta^x (1-\theta)^{1-x}; & x = 0, 1 \\ 0; & \text{otherwise} \end{cases}$$

What is the sufficient statistic for θ ?

(a) $X_1 - X_2$

(b) $X_1 X_2$

(c) $X_1 + X_2$

(d) $\dfrac{X_1}{X_2}$

78. Let $X_1, X_2, X_3, \ldots X_n$ be iid random variables with common pmf $P[X_i = k] = \dfrac{1}{N}$, $k = 1, 2, 3, \ldots N$; $i = 1, 2, 3, \ldots n$. What is the sufficient statistic for the family of joint pmfs P_N ?

(a) $\min(X_1, X_2, X_3, \ldots X_n)$

(b) $\max(X_1, X_2, X_3, \ldots X_n)$

(c) $[\min(X_1, X_2, X_3, \ldots X_n), \max(X_1, X_2, X_3, \ldots X_n)]$

(d) $X_1 + X_2 + X_3 + \ldots + X_n$

*Consider the following for the next **two (02)** items that follow :*

Let $X_1, X_2, X_3, \ldots X_n$ be a random sample of size n from $b(1, \theta)$, $0 < \theta < 1$ (Bernoulli) distribution. Let $Y = \Sigma X_i$ be complete sufficient statistic for θ.

79. UMVUE of θ is :

(a) $\dfrac{Y}{n}$

(b) $\dfrac{Y^2}{n}$

(c) $\dfrac{2Y}{n}$

(d) $\dfrac{Y}{2n}$

80. UMVUE of θ^2 is :

(a) $\dfrac{Y(Y-1)}{n(n+1)}$

(b) $\dfrac{Y(Y-1)}{n(n-1)}$

(c) $\dfrac{Y(Y+1)}{n(n+1)}$

(d) $\dfrac{Y(Y+1)}{n(n-1)}$

SPACE FOR ROUGH WORK

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