A

062/21

Question Booklet Alpha Code

A

Question Booklet Sl. No.

Total Number of Questions : 100	**Time : 75 Minutes**
Maximum Marks : 100	

INSTRUCTIONS TO CANDIDATES

1. The Question Paper will be given in the form of a Question Booklet. There will be four versions of Question Booklets with Question Booklet Alpha Code viz. **A, B, C** & **D**.
2. The Question Booklet Alpha Code will be printed on the top left margin of the facing sheet of the Question Booklet.
3. The Question Booklet Alpha Code allotted to you will be noted in your seating position in the Examination Hall.
4. If you get a Question Booklet where the alpha code does not match to the allotted alpha code in the seating position, please draw the attention of the Invigilator IMMEDIATELY.
5. The Question Booklet Serial Number is printed on the top right margin of the facing sheet. If your Question Booklet is un-numbered, please get it replaced by new Question Booklet with same alpha code.
6. The Question Booklet will be sealed at the middle of the right margin. Candidate should not open the Question Booklet, until the indication is given to start answering.
7. Immediately after the commencement of the examination, the candidate should check that the Question Booklet supplied to him/her contains all the 100 questions in serial order. The Question Booklet does not have unprinted or torn or missing pages and if so he/she should bring it to the notice of the Invigilator and get it replaced by a complete booklet with same alpha code. This is most important.
8. A blank sheet of paper is attached to the Question Booklet. This may be used for rough work.
9. **Please read carefully all the instructions on the reverse of the Answer Sheet before marking your answers.**
10. Each question is provided with four choices **(A), (B), (C)** and **(D)** having one correct answer. Choose the correct answer and darken the bubble corresponding to the question number using Blue or Black Ball Point Pen in the OMR Answer Sheet.
11. **Each correct answer carries 1 mark and for each wrong answer 1/3 mark will be deducted. No negative mark for unattended questions.**
12. No candidate will be allowed to leave the examination hall till the end of the session and without handing over his/her Answer Sheet to the Invigilator. Candidates should ensure that the Invigilator has verified all the entries in the Register Number Coding Sheet and that the Invigilator has affixed his/her signature in the space provided.
13. Strict compliance of instructions is essential. Any malpractice or attempt to commit any kind of malpractice in the Examination will result in the disqualification of the candidate.

1. F(x) is a distribution function, then which of the following is not a distribution function ?
   A) $(F(x))^2$
   B) $1 – [1 – F(x)]^5$
   C) $1 – 3F(x) + (F(x))^3$
   D) $1 – [1 – F(x)]^2$

2. The probability generating function of a random variable X is $P_X(t) = \frac{0.1}{1-0.9t}, |t| \le 1$, then the mean of X is
   A) 1
   B) 1/9
   C) 0.9
   D) 9

3. Let the discrete random variables X and Y have the joint probability mass function
   $P[X = x, Y = y] = \frac{e^{-2}}{x!\,y!};\ \begin{matrix} x = 0, 1, 2, \dots \\ y = 0, 1, 2, \dots \end{matrix}$
   which of the following is true ?
   A) Marginal distribution of X is Poisson with mean 2
   B) E(Y) = 2
   C) P[Y = K] = (K + 1) P[Y = K + 1], K = 0, 1, 2, . . .
   D) $P[X > 0/Y \le 1] = 1 – e^{-2}$

4. Let X be a random variable having the p.d.f. $f(x) = \frac{1}{\beta} e^{-x/\beta}, x > 0, \beta > 0$, then Y = $\sqrt{X}$ follows
   A) Normal
   B) Gamma
   C) Weibull
   D) Beta

5. A telephone operator on an average handles 4 calls every 2 minutes. What is the probability that there will be no calls in the next minute ?
   A) e^{-2}
   B) $\frac{1}{e^{-2}}$
   C) e^4
   D) e^0

6. Let $X_1, X_2, \dots, X_n$ be independent and identically distributed random variables following U[0, 1] distribution. Let $X_{(1)}$ denote the first order statistic. Then the mean of $X_{(1)}$ is given by
   A) $\frac{1}{n+1}$
   B) n + 1
   C) $\frac{1}{(n+1)^2}$
   D) $(n + 1)^2$

7. Let X and Y be two independent standard normal variates. Let W = – X and Z = – Y, then which of the following pairs is not distributed as bivariate normal distribution ?
   A) (X, Y)
   B) (X, Z)
   C) (W, Y)
   D) (X, W)

8. Let $X_1, X_2, \dots, X_n$ be a random sample from $N_p(\mu, \Sigma)$ population. To test $H_0 : \mu = \mu_0$ against $H_1 : \mu \ne \mu_0$, the correct relationship between the likelihood ratio test statistic Λ and Hotelling's T^2 statistic is
   A) $\Lambda^{2/n} = \frac{n-1}{n-1+T^2}$
   B) $\Lambda^{n/2} = \frac{n-1}{n-1+T^2}$
   C) $\Lambda^{2/n} = \frac{n-1+T^2}{n-1}$
   D) $\Lambda^{n/2} = \frac{n-1+T^2}{n-1}$

9. Let X and Y be two chisquare random variables with respective degrees of freedom n and m. Then which of the following is always true ?
   A) X + Y follows chisquare distribution with m + n degrees of freedom
   B) $\frac{m}{n}\frac{X}{Y}$ follows an F distribution with (n, m) degrees of freedom
   C) E(X + Y) = m + n
   D) $E\left(\frac{m}{n}\frac{X}{Y}\right) = \frac{n}{n-2}, n > 2$

10. Let $X_1, X_2, \ldots, X_n, Y_1, Y_2, \ldots Y_m$ be independent and identically distributed $N(\mu, \sigma^2)$ random variables. Let $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$ and $\overline{Y} = \frac{1}{m}\sum_{i=1}^{m} Y_i$. If $\frac{K\left(\overline{X} - \overline{Y}\right)}{\sqrt{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2 + \sum_{i=1}^{m}\left(Y_i - \overline{Y}\right)^2}}$ has a t-distribution with $m + n - 2$ degrees of freedom, then the value of K is

A) $\frac{mn}{(m+n)(m+n-2)}$

B) $\frac{\sqrt{(m+n-2)\,mn}}{\sqrt{m+n}}$

C) $\frac{\sqrt{m+n}}{\sqrt{(m+n-2)mn}}$

D) $\frac{\sqrt{mn}}{\sqrt{(m+n)(m+n-2)}}$

11. Let ϕ_1 and ϕ_2 be characteristic functions of two independent random variables X and Y, which of the following is a characteristic function ?

A) $\phi_1 + \phi_2$ B) $\phi_1 \phi_2$ C) $\frac{\phi_1}{\phi_2}$ D) $\left|\frac{\phi_1}{\phi_2}\right|$

12. Let $F(x), x \in R'$ be a distribution function which is continuous. Consider two sets of distribution functions $\{F_n, n \geq 1\}$ and $\{G_n, n \geq 1\}$, where $F_n(x) = F(x + n)$, $G_n(x) = F(x + (-1)^n n)$. Then which of the following statements is/are true ?

1. $F_n(x)$ converges to a distribution function.
2. $F_n(x)$ converges but not to a distribution function.
3. $G_n(x)$ converges to a distribution function.
4. $G_n(x)$ converges but not to a distribution function.

A) 1 and 3 B) 1 and 4 C) 1 only D) 2 only

13. Let $X_1, X_2, \ldots$ be a sequence of independent and identically distributed U(0, 1) random variables. Let $Y_i = -2 \log (1 - X_i)$ and $Z_n = \frac{1}{n}\sum_{i=1}^{n} Y_i$. If the distribution of $\frac{\sqrt{n}(Z_n - 2)}{K}$ converges to N(0, 1) as $n \to \infty$, then a possible value of K is

A) 1 B) $\frac{1}{2}$ C) 2 D) $\sqrt{2}$

14. For detecting Covid-19 a certain test gives correct diagnosis with probability 0.98. It is known that 2% of the population suffers from the disease. If a randomly selected individual from this population tests positive, then the probability that the selected individual actually has the disease is

A) 0.5 B) 0.2 C) 0.1 D) 0.6

15. Let $X_1, X_2, \ldots$ be a sequence of independent and identically distributed random variables such that $P[X_1 = 0] = \frac{2}{3} = 1 - P[X_1 = 1]$. Define $U_n = \frac{1}{n}\sum_{i=1}^{n} X_i$ and $V_n = \frac{1}{n}\sum_{i=1}^{n} (1 - X_i)^2$. Then which of the following statements is true ?

A) $U_n \xrightarrow{P} \frac{1}{3}$ and $V_n \xrightarrow{P} \frac{1}{3}$

B) $U_n \xrightarrow{P} \frac{2}{3}$ and $V_n \xrightarrow{P} \frac{1}{3}$

C) $U_n \xrightarrow{P} 2/3$ and $V_n \xrightarrow{P} 2/3$

D) $U_n \xrightarrow{P} 1/3$ and $V_n \xrightarrow{P} 2/3$

16. Suppose that the probability of a dry day following a rainy day is 2/3 and that the probability of a rainy day following a dry day is 1/4. Given that April 15 is a dry day, what is the probability that April 17 is a rainy day ?

A) $\frac{35}{48}$ B) $\frac{13}{48}$ C) $\frac{11}{18}$ D) $\frac{5}{18}$

17. Suppose that customers arrive at a service counter in accordance with a Poisson process with mean rate of 3 per minute. Then the probability that the interval between two successive arrivals is more than 1 minute is

A) $e^{-1/3}$ B) e^{3} C) e^{-3} D) $e^{2/3}$

18. Let the distribution of the number of offsprings in a branching process be geometric with probability $p_K = \frac{1}{3}\left(\frac{2}{3}\right)^K$, K = 0, 1, 2,. . . , then the probability of ultimate extinction is

A) $\frac{1}{3}$ B) $\frac{1}{2}$ C) $\frac{2}{3}$ D) 1

19. Let $\{X_n, n \geq 0\}$ be a Markov chain with states j = 0, 1, 2, . . . Let $p_{jj}^{(n)} = P[X_{n+m} = j / X_m = j]$ and $p_{jK}^{(n)} = P[X_{n+m} = K / X_m = j]$. Then which of the following statements is not true ?

1. State j is persistent iff $\sum_{n=0}^{\infty} p_{jj}^{(n)} = \infty$.
2. If state j is transient, then $p_{jj}^{(n)} \to 0$ as $n \to \infty$.
3. If K is a transient state and j is an arbitrary state, then $\lim_{n\to\infty} p_{jK}^{(n)} = 1$.
4. State j is transient if $\sum_{n=0}^{\infty} p_{jj}^{(n)} < \infty$.

A) 1 only B) 1 and 3 C) 2 only D) 3 only

20. The transition probability matrix of a Markov chain $\{X_n, n = 1, 2, . . . \}$ having 3 states 1, 2 and 3 is $P = \begin{bmatrix} 0.1 & 0.5 & 0.4 \\ 0.6 & 0.2 & 0.2 \\ 0.3 & 0.4 & 0.3 \end{bmatrix}$ and the initial distribution is $\pi_0 = (0.7\ \ 0.2\ \ 0.1)$. Then $P[X_3 = 2, X_2 = 3, X_1 = 3, X_0 = 2]$ is

A) 0.0336 B) 0.048 C) 0.279 D) 0.0048

21. Let T_n be an unbiased and consistent estimator of a parameter θ, then as an estimator of θ^2, T_n^2 is

A) Unbiased and consistent
B) Biased and not consistent
C) Biased and consistent
D) Unbiased and not consistent

22. Let $X_1, X_2, \ldots X_n$ be a random sample taken from a Poisson distribution with parameter λ. Define $I(\lambda) = -E\left[\frac{2^2 \log f}{2\lambda^2}\right]$. Then the variance of an unbiased estimator of $I(\lambda)$ is larger than

A) $\frac{\lambda}{n}$ B) $\frac{1}{n\lambda^3}$ C) $\frac{1}{n\lambda}$ D) $n\lambda$

23. Suppose $X_1, X_2, \ldots X_n$ are n observations drawn randomly from the population having the p.d.f. $f(x,\theta) = \frac{x^2}{2\theta^3} \exp\left(\frac{-x}{\theta}\right); 0 < x < \infty$ where $\theta > 0$, then an approximate $(1 - \alpha)$ level confidence interval for θ based on the maximum likelihood estimator of θ namely $\hat{\theta} = \frac{\overline{X}}{3}$ is

A) $\left[\hat{\theta} - Z_{\alpha/2}\sqrt{\frac{\hat{\theta}^2}{3n}},\ \hat{\theta} + Z_{\alpha/2}\sqrt{\frac{\hat{\theta}^2}{3n}}\right]$ B) $\left[\hat{\theta} - Z_{\alpha/2}\sqrt{\frac{\hat{\theta}^2}{n}},\ \hat{\theta} + Z_{\alpha/2}\sqrt{\frac{\hat{\theta}^2}{n}}\right]$

C) $\left[\hat{\theta} - Z_{\alpha/2}\sqrt{\frac{3n}{\hat{\theta}^2}},\ \hat{\theta} + Z_{\alpha/2}\sqrt{\frac{3n}{\hat{\theta}^2}}\right]$ D) $\left[\hat{\theta} - Z_{\alpha/2}\sqrt{\frac{n}{\hat{\theta}^2}},\ \hat{\theta} + Z_{\alpha/2}\sqrt{\frac{n}{\hat{\theta}^2}}\right]$

24. Let $X_1, X_2, \ldots, X_n$ be independent random variables with X_i following $N(i\mu, \sigma^2)$ distribution, $i = 1, 2, \ldots n$. Then the maximum likelihood estimator of μ is

A) $\frac{2\sum X_i}{n+1}$ B) $\frac{\sum_{i=1}^{n} iX_i}{\sum_{i=1}^{n} i}$ C) $\frac{\sum_{i=1}^{n} iX_i}{\sum_{i=1}^{n} i^2}$ D) $\frac{\sum_{i=1}^{n} X_i}{\sum_{i=1}^{n} i^2}$

25. Let $X_1, X_2, \ldots X_n$ be a random sample from a continuous distribution with probability density function $F(x) = \frac{1}{4}\left[e^{-|x-\mu|} + e^{-|x-2\mu|}\right], -\infty < x < \infty, -\infty < \mu < \infty$.

Let $T = X_1 + X_2 + \ldots + X_n$. Then which of the following is an unbiased estimator of μ ?

A) $\frac{T}{2n}$ B) $\frac{T}{3n}$ C) $\frac{3T}{2n}$ D) $\frac{2T}{3n}$

26. Let $X_1, X_2, \ldots X_n$ be a random sample from $U(0, \theta)$. Define $X_{(n)} = \text{Max}\{X_1, X_2, \ldots X_n\}$. To test $H_0 : \theta = \theta_0$ against $H_1 : \theta = \theta_1$, $(\theta_1 > \theta_0)$, consider the test function $\phi(x) = \begin{cases} 1 & \text{if } X_{(n)} > \theta_0 \\ \alpha & \text{if } 0 < X_{(n)} < \theta_0 \end{cases}$, then the size and power of the test are respectively

A) $(\alpha, 1 - \alpha)$ B) $(\alpha/2, 1 - \alpha)$

C) $\left(\alpha, 1 - \left(\frac{\theta_0}{\theta_1}\right)^n (1 - \alpha)\right)$ D) $\left((1 - \alpha), 1 - \left(\frac{\theta_0}{\theta_1}\right)^n (1 - \alpha)\right)$

27. Let $X_1, X_2, \ldots X_n$ be a random sample from $N(0, \sigma^2)$; $\sigma > 0$. Which of the following testing problems has the region $\left\{(x_1, x_2, \ldots, x_n) \in R^n : \sum_{i=1}^{n} x_i^2 \geq \chi^2_{n, \alpha}\right\}$ as the most powerful critical region of level α, where $\chi^2_{n, \alpha}$ denotes the upper α quantile of a χ^2 distribution with n degrees of freedom.

A) $H_0 : \sigma^2 = 1$ against $H_1 : \sigma^2 = 2$
B) $H_0 : \sigma^2 = 2$ against $H_1 : \sigma^2 = 4$
C) $H_0 : \sigma^2 = 2$ against $H_1 : \sigma^2 = 1$
D) $H_0 : \sigma^2 = 1$ against $H_1 : \sigma^2 = 0.5$

28. Let $X_1, X_2, \ldots X_n$ be a random sample from $f(x, \theta) = \theta x^{\theta - 1}$, $0 < x < 1$, $\theta > 0$. For testing $H_0 : \theta \leq \theta_0$ against $H_1 : \theta > \theta_0$, a uniformly most powerful test of size α reject H_0 if

A) $X_{(n)} > C$, $X_{(n)} = Max(X_1, X_2, \ldots, X_n)$
B) $X_{(1)} > C$, $X_{(1)} = Min(X_1, X_2, \ldots, X_n)$
C) $\prod_{i=1}^{n} X_i > C$, C a constant
D) $\sum_{i=1}^{n} X_i > C$, C a constant

29. Let $X_1, X_2, \ldots, X_n$ be a random sample from a population having p.d.f.

$f(x, \theta) = \theta e^{-\theta x}$, $x > 0$, $\theta > 0$. To test $H_0 : \theta = \theta_0$ against $H_1 : \theta > \theta_0$ the critical region of the likelihood ratio test is of the form

A) $\overline{X} \geq C$
B) $\overline{X} \leq C$
C) $X_{(1)} \leq C$
D) $X_{(1)} > C$

30. For the SPRT of strength (α, β) which of the following inequalities is satisfied by the stopping bounds A and B (A > B)

A) $\frac{\alpha}{1-\beta} \leq \frac{1}{A}, \frac{\beta}{1-\alpha} \leq B$
B) $\frac{1-\beta}{\alpha} \leq \frac{1}{A}, \frac{\beta}{1-\alpha} \leq \frac{1}{B}$
C) $\frac{1-\beta}{\alpha} \geq \frac{1}{A}, \frac{\beta}{1-\alpha} \leq \frac{1}{B}$
D) $\frac{\alpha}{1-\beta} \geq \frac{1}{A}, \frac{1-\alpha}{\beta} \geq B$

31. In simple random sampling with replacement of fixed sample size n from a population of size N, the probability that a particular unit is selected atleast once in a sample is

A) $\left(1-\frac{1}{N}\right)^n$
B) $1-\left(1-\frac{1}{N}\right)^n$
C) $\left(\frac{1}{N}\right)^n$
D) $1-\frac{1}{N^n}$

32. From a population of size 14, a sample of 5 units is to be selected by circular systematic sampling. Let the first number selected at random be 7. Which other units are to be included in the sample ?

A) 7, 10, 13, 1, 4
B) 7, 11, 1, 5, 9
C) 7, 11, 1, 4, 8
D) 7, 10, 13, 2, 5

33. If ρ is the intra class correlation, then cluster sampling is more efficient than simple random sampling when

A) $\rho = 0$
B) $\rho > 0$
C) $\rho = 1$
D) $\rho < 0$

34. With usual notations, in simple random sampling, bias of the ratio estimator $\hat{R}$ is given by

A) $\frac{-cov(\hat{R}, \bar{x}),}{\overline{X}}$
B) $\frac{1-f}{n}(C_x^2 - \rho C_x C_y)$
C) $-cov(\hat{R}, \bar{x})$
D) $\frac{1-f}{n} C_x^2$

35. A population of size 1120 is divided into 3 strata of sizes 320, 440, 360 having variances 9, 4, 36 respectively. To draw a stratified random sample of size 100, under optimal allocation the sample sizes to be drawn from the stratas in the order are

A) 16, 10, 74 B) 28, 40, 32 C) 24, 22, 54 D) 20, 50, 30

36. In a Gauss Markov model $(Y, X\beta, \sigma^2 I)$ with rank of $X_{n \times p}$ equal to p, the distribution of the statistic $S = \min_{\beta} (Y - X\beta)' (Y - X\beta)$ is

A) F distribution with (n – p, p) degrees of freedom

B) F distribution with (p, n – p) degrees of freedom

C) $\sigma^2 \chi^2$ with p degrees of freedom

D) $\sigma^2 \chi^2$ with n – p degrees of freedom

37. Consider a BIBD with usual parameters v, b, r, k, λ. Let $N = (n_{ij})_{b \times v}$ be the incidence matrix, where n_{ij} is the number of times the j^{th} treatment occurs in i^{th} block. Then determinant of $N'N$ is

A) $rk(r - \lambda)^v$ B) $rk(r - \lambda)^{v-1}$ C) $\frac{r}{k}(r - \lambda)^{v-1}$ D) $\frac{k}{r}(r - \lambda)^{v-1}$

38. Let y_1, y_2 and y_3 be independent random variables with a common variance σ^2 and expectations given by $E(y_1) = \theta_1 + \theta_3$, $E(y_2) = \theta_2 + \theta_3$ and $E(y_3) = \theta_1 + \theta_3$. Then which of the following is true ?

A) $\theta_1 - \theta_3$ is estimable B) θ_1 is estimable C) $\theta_1 + \theta_3$ is estimable D) θ_3 is estimable

39. If in an LSD (Latin Square Design) with 7 treatments, a treatment is added, the increase in error degrees of freedom will be

A) 12 B) 10 C) 42 D) 30

40. A 2^4 factorial experiment is conducted in blocks of size 2^2. If each treatment is replicated 2 times, the number of blocks required will be

A) 12 B) 8 C) 24 D) 16

41. Correctly match the Census of India 2011 population enumeration series with data using the codes given below the lists.

i. B-series	a. Fertility data
ii. C-series	b. Data on Migration
iii. D-series	c. Age data
iv. F-series	d. Data on workers

Codes :

	i	ii	iii	iv
A)	a	b	c	d
B)	d	c	b	a
C)	b	c	d	a
D)	d	a	b	c

42. Using dual record system, the Sample Registration System (SRS) provides estimates on

A) Mortality, Fertility and Migration B) Mortality and Cause of death

C) Mortality and Fertility D) Mortality, Fertility and Cause of death

43. The Registration of Births and Deaths Act to make the registration of births, still births and deaths compulsory was passed in

A) 1972 B) 1969 C) 1960 D) 1946

44. Whipple's index measures the
   A) Digit preference for reporting age ending 0 only
   B) Digit preference for reporting age ending 5 only
   C) Digit preference for reporting age ending 0 or 5
   D) Digit preference for reporting age ending 0 and 5

45. Chandrasekhar and Deming's dual record system followed by Sample Registration System (SRS) involves
   A) Continuous enumeration and retrospective half-yearly survey
   B) Continuous enumeration or retrospective half-yearly surveys
   C) Continuous enumeration and retrospective yearly survey
   D) Either continuous enumeration or retrospective half-yearly survey

46. What was the population sex ratio (females per 1000 males) in Kerala as per the Census of India 2011 ?
   A) 1043   B) 922   C) 1084   D) 959

47. As per the Sample Registration System (SRS) report 2018, what was the rural-urban differential in Total Fertility Rate (TFR) in Kerala ?
   A) Rural – TFR = Urban – TFR
   B) Rural – TFR $\geq$ Urban – TFR
   C) Rural – TFR $\leq$ Urban – TFR
   D) Rural – TFR = 1.2 times of Urban – TFR

48. Arrange in descending order, the following districts of Kerala as per the Census of India 2011 literacy rate.
   i. Idukki
   ii. Kasaragod
   iii. Wayanad
   iv. Palakkad
   A) iii, i, iv, ii   B) i, ii, iii, iv   C) iv, i, iii, ii   D) i, ii, iv, iii

49. Parity Progression Ratio (PPR) is which measure of fertility ?
   A) Time measure of fertility   B) Period measure of fertility
   C) Instant measure of fertility   D) Cohort measure of fertility

50. Cohort component model of population projection is based on which mathematical function ?
   A) Discrete timed model   B) Continuous time model
   C) Poisson model   D) Bayesian model

51. Which one of the following is a measure of Reproduction ?
   A) Total Fertility Rate   B) General Reproduction Rate
   C) Gross Reproduction Rate   D) Total Reproduction Rate

52. What is the relationship between Total Fertility Rate (TFR) and Gross Reproduction Rate (GRR) ?
   A) TFR = GRR/(1 + Sex Ratio at Birth)   B) TFR = GRR * (1 + Sex Ratio at Birth)
   C) TFR = GRR * Sex Ratio at Birth   D) TFR = GRR/Sex Ratio at Birth

53. Which population is included in the denominator of General Marriage Rate (GMR) ?
   A) Mid-year population of Particular Sex
   B) Mid-year population of single, widowed and divorced of age 15 – 50 year of Particular Sex
   C) Mid-year unmarried population of Particular Sex of age 15 – 50 year of Particular Sex
   D) Mid-year population of single, widowed and divorced of Particular Sex

54. Which population is included in the denominator of Still Birth Rate (SBR) ?
   A) Number of live births
   B) Number of pregnancies
   C) Number of live births, abortions and still births
   D) Number of live births and still births

55. Which one of the following is the assumption to calculate Singulate Mean Age at Marriage (SMAM) ?
   A) Marriage age population is close to migration
   B) No mortality differentials by sex in marriage age population
   C) No mortality differentials by marital status
   D) No migration differentials by sex in marriage age population

56. Crude Death Rate (CDR) is ________ of Age Specific Death Rate (ASDR).
   A) Weighted sum B) Sum
   C) Average D) Weighted average

57. Under a constant annual growth rate of 0.03, the population will double in
   A) 69.3 years B) 22.1 years C) 23.1 years D) 21.1 years

58. Calculate adjusted infant mortality rate per thousand live births for the year 2011 using the following informations :

Year	**Live Births**	**Infant deaths**	
2011	B_{2011} = 344, 989	D'_{2011} = 13,812	D''_{2011} = 4,434
2012	B_{2012} = 341, 324	D'_{2012} = 12,183	D''_{2012} = 3,847

Where – B_{2011} Births in 2011
B_{2012} Births in 2012
D'_{2011} Infant deaths in 2011 from the births in 2011
D''_{2011} Infant deaths in 2011 from the births in 2010
D'_{2012} Infant deaths in 2012 from the births in 2012
D''_{2012} Infant deaths in 2012 from the births in 2011

   A) 51.2 B) 52.9 C) 50.1 D) 48.3

59. What is the probability of surviving k years for persons in the age group x to x + n in abridge life table ?
   A) $\frac{l_x}{l_{x+k}}$ B) $\frac{l_x}{{}_nL_{x+k}}$ C) $\frac{{}_nL_x}{{}_nL_{x+k}}$ D) $\frac{{}_nL_{x+k}}{{}_nL_x}$

60. Number of years that a newborn can expect to live between ages x and y in a life table is equal to
   A) $(T_x - T_y)/l_0$ B) $(l_x - l_y)/l_0$ C) $(T_x - T_y)/T_0$ D) $(L_x - L_y)/L_0$

61. A stable population will emerge if the following conditions prevail for a long enough period
   A) Age-specific death rates are constant and age-specific rates of net migration are zero
   B) Age-specific death rates are constant, the growth rate in the annual number of births is constant and age-specific rates of net migration are zero
   C) Age-specific death rates are constant and the growth rate in the annual number of births is constant
   D) Age-specific death rates are constant, the growth rate in the annual number of births is zero and age-specific rates of net migration are zero

62. Which of the following is/are preventive checks to population growth ?
   i. Abstinence
   ii. Contraception
   iii. Poverty
   iv. Abortion
   v. Starvation

   A) All of the above B) Only i, ii and iii C) Only i, ii and iv D) Only iii, iv and v

63. Which of the following is/are contraception variable of the Proximate Determinants of Fertility ?
   i. Permanent celibacy
   ii. Coital frequency
   iii. Fecundity or infecundity
   iv. Use or non-use of contraception

   A) Only iv B) Only ii, iii and iv C) Only i, ii and iii D) Only iii and iv

64. Who has proposed the concept of migration – "Between the desire to move and actual decision to do so there also may be intervening obstacles".
   A) E. Lee B) M.P. Todaro C) S.A. Stouffer D) E.G. Ravenstein

65. Over a period of time stable population become stationary population if
   A) Population growth rate remains constant
   B) Population growth rate remains zero
   C) Population growth rate remains one
   D) Population growth rate remains negative

66. How to calculate population momentum if
   N^F = Total number of females in the population
   N^M = Total number of males in the population
   N_S^F = Total number of females in the ultimate population
   N_S^M = Total number of males in the ultimate population

   A) $\frac{N_S^F * N_S^M}{N^F * N^M}$ B) $\frac{N_S^F / N_S^M}{N^F / N^M}$ C) $\frac{N_S^F - N_S^M}{N^F - N^M}$ D) $\frac{N_S^F + N_S^M}{N^F + N^M}$

67. As compared with the West region life table, the South Asian model life table's pattern of mortality shows relatively very high rates _______ and very rates again at the oldest ages, with correspondingly lower mortality for the prime age-groups.
   A) Under age 18 B) Under age 19 C) Under age 15 D) Under age 20

68. Proportional mortality rate from a specific disease is defined as
   A) $\frac{\text{Number of deaths from a specific disease in a year}}{\text{Total deaths from all causes in that year}} \times 100$

   B) $\frac{\text{Number of deaths from a specific disease in a year}}{\text{Total number of deaths from all other causes in that year}} \times 100$

   C) $\frac{\text{Number of deaths from a specific disease in a year}}{\text{Total population at risk of disease in a year}} \times 100$

   D) $\frac{\text{Number of deaths from a specific disease in a year}}{\text{Mid year population}} \times 100$

69. Epidemiology is defined as "The study of the distribution and determinants of health-related states or events in specified proportions and the application of this study to the control of health problems". Who gave this definition ?

A) Greenwood B) W.H. Frost C) John M. Last D) Parkin

70. Attributable Risk (AR) is defined as

A) $\dfrac{\text{Incidence of disease rate among exposed} - \text{incidence of disease rate among non exposed}}{\text{Incidence rate among non exposed}} \times 100$

B) $\dfrac{\text{Incidence of disease rate among exposed} - \text{incidence of disease rate among non exposed}}{\text{Incidence rate among exposed}} \times 100$

C) $\dfrac{\text{Incidence of disease among exposed}}{\text{Incidence rate among exposed and non exposed}} \times 100$

D) $\dfrac{\text{Total incidence rate among exposed}}{\text{Incidence rate among non exposed}} \times 100$

71. Which one of the following is the objective of National Population Policy 2000 ?

A) Reduce maternal mortality ratio below 110 per 100,000 live births
B) Reduce maternal mortality ratio below 120 per 100,000 live births
C) Reduce maternal mortality ratio below 130 per 100,000 live births
D) Reduce maternal mortality ratio below 100 per 100,000 live births

72. What includes the denominator of incidence rate of a disease over a specified period of time ?

A) Total number of contacts
B) Population at start of time interval
C) Average population during time interval
D) Population at the same specified point in time

73. According to National Family Health Survey 2015-16, what percentage of women aged 15 – 49 were anaemic in Kerala ?

A) 47.3 B) 28.9 C) 34.3 D) 39.1

74. Rank the States in ascending order of their Population Density according to the Census of India 2011.

A) Gujarat, Andhra Pradesh, Karnataka, Orissa
B) Gujarat, Orissa, Andhra Pradesh, Karnataka
C) Orissa, Karnataka, Andhra Pradesh, Gujarat
D) Orissa, Gujarat, Andhra Pradesh, Karnataka

75. According to Longitudinal Aging Study of India 2017 – 18, arrange the states in ascending order of self-reported prevalence of diagnosed cardiovascular disease among older adults aged 45 and above

A) Goa, Kerala, Jammu and Kashmir, Chandigarh
B) Goa, Jammu and Kashmir, Chandigarh, Kerala
C) Jammu and Kashmir, Chandigarh, Goa, Kerala
D) Kerala, Goa, Jammu and Kashmir, Chandigarh

76. According to SRS based Abridged Life Tables 2014 – 18, what is the expectation of life at age 60 of total population in Kerala ?
   A) 15 years B) 19 years C) 20 years D) 21 years

77. Annapurna Scheme provides
   A) Food security for senior citizen
   B) Food security for all women of reproductive age group
   C) Food security for women of reproductive age group and senior citizen
   D) Food security for all living below poverty line

78. Which one of the following Goal of Sustainable Development Goal (SDG) talk about "Reduced Inequalities" ?
   A) Goal – 7 B) Goal – 8 C) Goal – 9 D) Goal – 10

79. Which of the following is/are key feature of Kangaroo mother care ?
   i. Early, continuous and prolonged skin-to-skin contact between the mother and the baby
   ii. Start breast feeding within one hour of birth
   iii. Exclusive breast feeding (ideally)
   iv. Keep baby in incubator just after birth
   A) Only i B) Only ii and iv C) Only i and iii D) Only i and iv

80. According to National Family Health Survey (2015-16) which one of the following State have highest level of unmet need for family planning among currently married women of reproductive age group ?
   A) West Bengal B) Kerala C) Rajasthan D) Andhra Pradesh

81. Let $a_n = \sqrt{n+1} - \sqrt{n}$. Choose the correct statement.
   A) The sequence $\{a_n\}$ converges
   B) $\{a_n\}$ is an increasing sequence
   C) The series $\sum_{n=1}^{\infty} a_n$ converges
   D) Partial sums of $\sum_{n=1}^{\infty} a_n$'s are bounded

82. Choose the divergent series whose n^{th} term is
   A) $\frac{n!}{n^n}$ B) $\frac{1}{n^n}$ C) $\sqrt{\frac{n-1}{n^3+1}}$ D) $\frac{n^3+5}{3^n+2}$

83. The function $h(x) = \begin{Bmatrix} 1-x & \text{if} & x \in Q \\ x & \text{if} & x \notin Q \end{Bmatrix}$, where Q denotes the set of all rational numbers, is
   A) Continuous on $\mathbb{R}$
   B) Continuous at x = 0
   C) Continuous at $x = 1/2$
   D) Nowhere continuous

84. Which of the following functions is uniformly continuous on (0, 1) ?
   A) $f(x) = \frac{1}{x}$
   B) $f(x) = \frac{\sin x}{x}$
   C) $f(x) = \frac{1}{1-x}$
   D) $f(x) = \sin\left(1/x\right)$

85. What is the largest possible value of f(10), where f is differentiable on the interval [0,10] with f(0) = 10 and $f'(x) \leq 3 \ \forall \ x \in [0, 10]$?
   A) 20 B) 30 C) 40 D) 50

86. Let f be a real valued function on [a, b] such that f is differentiable on (a, b) and both $f(a^+)$ and $f(b^-)$ exist. Then there exists $c \in (a, b)$ such that

A) $f(b) - f(a) = f'(c).(b - a)$
B) $f(b^-) - f(a) = f'(c).(b - a)$
C) $f(b) - f(a^+) = f'(c).(b - a)$
D) $f(b^-) - f(a^+) = f'(c).(b - a)$

87. $\lim_{x\to\infty}\left(\frac{x-1}{x+1}\right)^x =$

A) 1
B) $\frac{1}{e}$
C) $\frac{1}{e^2}$
D) e^2

88. $1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\ldots=$

A) $\frac{1}{e}$
B) $\log_e 2$
C) $\frac{1}{\pi}$
D) $\frac{1}{\sqrt{\pi}}$

89. Let $f : [0, 1] \to \mathbb{R}$ be defined by $f(x) = \begin{cases} \frac{1}{2^n} & \text{if } x \in \left(\frac{1}{2^{n+1}}, \frac{1}{2^n}\right) \text{ for some } n = 0, 1, 2\ldots \\ 0 & \text{otherwise} \end{cases}$. Then

$\int_0^1 f(x)\,dx =$

A) 1
B) $2/3$
C) $1/2$
D) $1/3$

90. If $f(x) = \int_0^{x^2} \cos\sqrt{t}\,dt$, then $f'(x) =$

A) 2xcosx
B) $\cos\sqrt{x}$
C) $\left(\cos\sqrt{x}\right)^2$
D) cosx

91. Which of the following is not a subspace of $M_n(\mathbb{R})$ = The space of all n × n matrices over $\mathbb{R}$?

A) $\{A \in M_n(\mathbb{R}); A = A^t\}$
B) $\{A \in M_n(\mathbb{R}); \det(A) = 0\}$
C) $\{A \in M_n(\mathbb{R});$ A is upper triangular$\}$
D) $\{A \in M_n(\mathbb{R});$ trace (A) = 0$\}$

92. Consider the vectors
X = (1, 0, 1, 0, 1)
Y = (0, 1, 0, 1, 0)
Z = (1, 1, 1, 1, 1)
U = {1, –1, 1, –1, 1)
The dimension of the subspace spanned by these 4 vectors in $\mathbb{R}^5$ is

A) 5
B) 4
C) 3
D) 2

93. Let $T : \mathbb{R}^3 \to \mathbb{R}^2$ be defined by T(x, y, z) = (x + y, x – z). Then which of the following forms a basis for the Kernel of T ?

A) {(1, –1, 0)}
B) {(1, 0, 1)}
C) {(1, –1, 1)}
D) {(1, 0, 1), (1, –1, 0)}

94. What is the dimension of the vector space of n × n real symmetric matrices with trace 0, over $\mathbb{R}$?

A) $\frac{n^2+n}{2}+1$
B) $\frac{n^2+n}{2}-1$
C) $\frac{n^2-n}{2}+1$
D) $\frac{n^2-n}{2}-1$

95. If $A = \begin{bmatrix} 1 & 2 & 1 & 1 \\ 0 & 2 & 4 & 1 \\ 2 & 6 & 6 & 3 \\ 4 & 6 & 0 & 3 \end{bmatrix}$, then rank (A^2) =

A) 1 B) 2 C) 3 D) 4

96. Let $\wp(x)$ denote the vector space of all real polynomials and $T : \wp(x) \to \wp(x)$ be the differential operator. Then

A) T is 1 – 1
B) T is onto
C) T is diagonalizable
D) T has no eigen values

97. Let $P_3(X)$ denote the vector space of all real polynomials of degree at most 3. Define $T : P_3(X) \to P_3(X)$ by $TP(X) = P(2X)$. Then the matrix of T w.r.t. the basis $\{1, X, X^2, X^3)$ is

A) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
B) $\begin{bmatrix} 0 & 1 & 2 & 3 \\ 1 & 2 & 3 & 0 \\ 2 & 3 & 0 & 1 \\ 3 & 0 & 1 & 2 \end{bmatrix}$
C) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 8 \end{bmatrix}$
D) $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 2 & 0 & 0 \\ 0 & 1 & 3 & 0 \\ 0 & 0 & 1 & 4 \end{bmatrix}$

98. Which of the following matrices is not diagonalizable over $\mathbb{R}$?

A) $\begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 2 \end{bmatrix}$
B) $\begin{bmatrix} 1 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
C) $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & 3 \\ 0 & 0 & 3 \end{bmatrix}$
D) $\begin{bmatrix} 1 & 0 & 0 \\ 1 & 2 & 0 \\ 1 & 2 & 3 \end{bmatrix}$

99. Let $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ and $V = \{P(A)$, where P is a polynomial with real coefficients$\}$. Then the dimension of V over $\mathbb{R}$ is

A) 4 B) 3 C) 2 D) 1

100. Let $M = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 1 & 4 \\ 3 & 0 & 2 \end{bmatrix}$. Choose the correct expression for evaluating M^{-1}.

A) $M^{-1} = M^2 - 5I$
B) $M^{-1} = M^2 + 5M - 5I$
C) $M^{-1} = M^2 - M - 3I$
D) $M^{-1} = M^2 - 5M + 5I$

Space for Rough Work