

- 9) According to _____ increase in protein decreases the fertility rate.
- Thomas Double Day's diet theory
 - Jouse De Castro's Protein Consumption theory
 - Pearl and Reed's logistic curve theory
 - Karl Marx theory of surplus population.
- 10) Which of the following is a Socio-Economic theory of population?
- Thomas Double Day's diet theory
 - Jouse De Castro's Protein Consumption theory
 - Pearl and Reed's logistic curve theory
 - Karl Marx theory of surplus population.

B) Fill in the blanks:**06**

- Census in India was started in the year _____.
- Base period contains the number of years between _____ and _____.
- Geometric change is _____ method of population projection.
- _____ is the secondary source of demographic data.
- According to Karl Marx, problem of population arises only in _____ society.
- Immigration and emigration are related to _____ migration.

Q.2 Answer the following.**16**

- Define any two fertility rates and write its merits.
- Write a short note on sample survey as a source of demographic data.
- State and explain Karl Marx theory of surplus population.
- Discuss relationship demography and other disciplines.

Q.3 Answer the following.

- Describe trend extrapolation methods of population projections. **08**
- Define infant mortality rate. Describe endogenous and exogenous factors affecting IMR. **08**

Q.4 Answer the following.

- State and explain Optimum theory of population. **08**
- Discuss the methods of related socio-economic projections. **08**

Q.5 Answer the following.

- Define **08**
 - Crude death rate
 - Specific death rates
 - Standardized death rates.
- Discuss merits and de-merits of NFHS-I and II. **08**

Q.6 Answer the following.

- Describe methods of estimation of net internal migration. **08**
- Discuss population policies in India. **08**

Q.7 Answer the following.

- State and Explain any one Biological theory of population. **08**
- State and explain Fei - Ranis model of rural urban migration. **08**

Seat No.	
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M.Sc. (Semester - IV) (New) (CBCS) Examination: March/April-2024
BIOSTATISTICS
Survival Analysis (MSC22403)

Day & Date: Tuesday, 14-05-2024
 Time: 03:00 PM To 06:00 PM

Max. Marks: 80

- Instructions:** 1) Q. Nos. 1 and 2 are compulsory.
 2) Attempt any three questions from Q. No. 3 to Q. No. 7
 3) Figure to right indicate full marks.

Q.1 A) Choose correct alternatives. 10

- 1) In a series system of five components, the entire system will fail if _____.
 a) any two components fail b) any three components fail
 c) any one component fails d) all components fail

- 2) Let P_i is the reliability of i^{th} component then reliability of series system of n independent components is _____.
 a) $\prod_{i=1}^n p_i$ b) $\prod_{i=1}^n p_i$
 c) $\sum_{i=1}^n p_i$ d) $\prod_{i=1}^n (1 - p_i)$

- 3) A component has hazard rate $h(t) = 1/\sqrt{t}$ then the reliability function $R(t)$ is _____.
 a) e^{-2t} b) $e^{-\sqrt{t/2}}$
 c) $e^{-t/\sqrt{2}}$ d) $e^{-t/2}$

- 4) Which of the following rate function corresponds to DFR distribution?
 a) $h(t) = t$ b) $h(t) = e^{-t}$
 c) $h(t) = e^t$ d) $h(t) = te^t$

- 5) Survival function is defined _____.
 a) only for discrete distributions
 b) only for continuous distributions
 c) both for discrete and continuous distributions
 d) neither for discrete nor continuous distributions

- 6) Actuarial method of estimation of survival function is used when data consists of _____.
 a) only censored observations
 b) only uncensored observations
 c) complete data
 d) all the above

- 7) Censoring technique is used for reducing _____.
 a) time of experiment b) cost of experiment
 c) number of failures d) None of the above

- 8) The graph of bath-tube curve represents _____.
 - a) failure rate versus mean
 - b) failure rate versus time
 - c) failure rate versus distance
 - d) failure rate versus velocity
- 9) Log-rank test for equality of two distributions is based on ____ data.
 - a) left censored
 - b) right censored
 - c) type I censoring
 - d) type II censoring
- 10) Kaplan and Meier have derived as an estimator of _____.
 - a) survival function
 - b) Hazard function
 - c) distribution function
 - d) cumulative Hazard function

B) Fill in the blanks. 06

- 1) Reliability of a system always lies between _____.
- 2) As the number of components n increases, the reliability of parallel system _____.
- 3) A life time distribution F having finite mean is said to be NWUE for $t > 0$, if _____.
- 4) A sequence of (2×2) contingency tables is used in _____.
- 5) Product limit estimator of survival function is developed by _____.
- 6) In type I censoring, the number of uncensored observations has _____ distribution.

Q.2 Answer the following. 16

- a) Define k-out-of-n system. Obtain reliability of this system.
- b) Define mean time to failure (MTTF) and mean residual life (MRL) function.
- c) Explain the concept of random censoring giving one example.
- d) Describe Cox's proportional hazard model.

Q.3 Answer the following.

- a) Define reliability of a component and reliability of a system. Obtain the reliability of series and parallel systems of n independent components. 08
- b) Define Hazard function and survival function. Obtain the same for an exponential distribution. 08

Q.4 Answer the following.

- a) Define NBU and NBUE class of distributions. Prove that $F \in IFRA \Rightarrow F \in NBU$. 08
- b) If failure time of an item has the distribution 08

$$f(t) = \frac{\lambda^\alpha}{\Gamma^\alpha} t^{\alpha-1} e^{-\lambda t}, t > 0, \lambda, \alpha > 0.$$
 Examine whether it belongs to IFR or DFR .

Q.5 Answer the following.

- a) Define dual of a structure function. Obtain the dual of k-out-of-n system. 08
- b) Discuss maximum likelihood estimation of parameters of a Weibull distribution based on complete data. 08

Q.6 Answer the following.

- a) Obtain the actuarial estimator of the survival function. Clearly state the assumption that you need to make. 08
- b) Obtain MLE of the mean (θ) of an exponential distribution based on type II censoring. 08

Q.7 Answer the following.

- a) Describe Kaplan-Meier estimator and derive an expression for the same. 08
- b) Describe Mantel-Haenzel test. 08