Syllabus: JRF in Demography

Statistics : Notions of Sample Space and Probability, Conditional Probability, Bayes Theorem and Independence, Random Variable and Expectation, Moments, Standard Univariate Discrete and Continuous Distributions, Sampling Distribution of Statistics Based on Normal Samples, Central Limit Theorem, Approximation of Binomial to Normal, Poisson Law, Multinomial, Bivariate Normal and Multivariate Normal Distributions, Descriptive Statistical Measures, Graduation of Frequency Curves, Product Moment, Partial and Multiple Correlation, Regression (Simple and Multiple), Elementary Theory and Methods of Estimation (unbiasedness, minimum variance, sufficiency, maximum likelihood method, method of moments, least squares method), Tests of Hypotheses (basic concepts and simple applications of Neyman-Pearson Lemma), Confidence Intervals, Tests in Regression Analysis, Elements of Non-parametric Inference, Contingency Chi-square, ANOVA, Conventional Sampling Techniques, Ratio and Regression Methods of Estimation, Markov Processes, Multivariate Analysis.

Demography : Mortality Analysis, Life Table Construction and Its Application, Measures of Fertility and Reproduction, Population Estimation and Projections, Stable Population, Measures of Migration.

Sample Questions under RD-I

1. Show that for a binomial distribution with parameters (n, p), the following is true.

$$\mu_{r+1} = p\,(1 - p)\,(rn\,\mu_{r-1} + \frac{d\mu_r}{dp})$$

2. Write 'T' for true and 'F' for false for the following statements.
   a) The estimate of correlation coefficient may change due to change in scale and / or origin of measurement of the variables.
   b) The standard errors of the regression parameter estimates are likely to be low if there is multicollinearity problem

3. Suggest a suitable large-sample test for comparing the probabilities p_1 and p_2 corresponding to two categories of a population with k (>2) categories. (The sample frequencies f_i, i = 1, 2, ……, k may be assumed to be distributed in the multinomial form).

4. Show that for random sampling without replacements

$$\mathrm{Cov}(x_i, x_j) = -\frac{\sigma^2}{N-1}$$

The symbols have their usual meanings.

Sample Questions under RD-II

1. State the usual assumptions of a multiple linear regression and derive a testing procedure for the general linear hypothesis H_o : $R\beta - r = 0$ where R is a qxk matrix of known constants, with $q < k$, and r is a q – vector of known constants.

2. Show that the function

$$\varphi(r) = \int_{\alpha}^{\beta} e^{-r\alpha} p(a)m(a)da$$

with the symbols having their usual meanings, is monotonically decreasing and must be concave upwards throughout.

3. Describe various methods for obtaining inter-censal and post-censal estimates of population total.

4. If between age x and (x+t), ${}_tp_x$ is the probability of surviving and μ_{x+t} is the force of mortality, then prove that

$$\int_{0}^{w} {}_tp_x \mu_{x+t} dt = 1$$

where w is the ultimate age.