ENTRANCE TEST to M.Sc. STATISTICS PROGRAM of the UNIVERSITY OF MYSORE

ELIGIBILITY for admission to M.Sc. Statistics program of the University of Mysore:

B.Sc. (Bachelor of Science) with Statistics and Mathematics as major/ optional/core subjects with 45% aggregate marks in Statistics OR B.Sc. with Mathematics as major/ optional/core with 60% aggregate in Mathematics OR any B.E. (Bachelor of Engineering) graduate having Mathematics syllabi equivalent to that of V.T.U. (Vishweshwaraya Technological University, Karnataka) with 60% aggregate marks in Mathematics.

ELIGIBILITY to write the entrance test: Any candidate who is appearing in the final semester of any of the courses mentioned above OR who has the qualifications as given above.

SYLLABUS for ENTRANCE TEST to M.Sc. STATISTICS of the University of Mysore

Unit 1: Elements of Calculus: Real valued sequences and series, convergence / divergence of sequences and series, comparison test, real valued functions, limit and continuity, power series, Differential and Integral Calculus - Differentiability, Rolle,s theorem, Mean value theorem and Taylor / Maclaurin expansions, higher order derivatives and partial derivatives, maxima and minima of functions of one variable. Riemann integrals: Definition, properties, integrability of continuous and monotone functions, mean value theorem, fundamental theorem of integral calculus, Beta and Gamma integrals, functions of two variables, double integrals.

Unit 2: Elements of Linear Algebra: Vector space, subspace, dimension of a vector space, real valued matrices, rank, determinant and inverse of a matrix, properties of square, diagonal and symmetric matrices, characteristic roots and vectors of a matrix, simultaneous linear equations,

Unit 3: Elements of descriptive statistics: Primary and secondary data, types of variables, population and sample. Organization and presentation of data - tabulation, frequency distribution, graphical representations, box plots, scatter plots. measures of central tendency - arithmetic mean, trimmed mean, geometric mean, harmonic mean, weighted mean, mode, median, quantiles, quartiles, deciles, percentiles, measures of variation - range, mean absolute deviation from mean and median, variance, standard deviation, quartile deviation, coefficient of variation, moments, skewness, kurtosis.

Unit 4: Elements of probability and distribution theory– definition and consequences of classical and axiomatic definition, trial, outcomes, outcome space, simple and composite events, mutually exclusive and exhaustive events, computation of probability under finite sample space, addition rule, conditional probability, independent events, multiplication Law, Bayes' theorem and applications. Discrete and continuous random variables: Discrete random variables, distribution function, probability mass function, expectation, moments, moment generating function, probability generating function, standard discrete distributions with properties and applications - Bernoulli, binomial, discrete uniform, Poisson, geometric, negative binomial, hypergeometric, trinomial. Continuous random variables, probability density function, marginal and conditional distribution and density, standard continuous distributions - uniform, exponential, normal, gamma, beta, Cauchy - properties and their applications.

Unit 5: Bivariate data - scatter diagram, principle of least squares, Fftting linear, quadratic, exponential and geometric curves. Karl Pearson's coefficient of correlation and its properties, simple linear regression equation, estimation of regression coefficients and their properties, Spearman's rank correlation coefficient, trivariate data, partial and multiple correlation, coefficients and properties, multiple linear regression, bivariate normal distribution and properties.

Unit 6: Chebychev's and Markov's inequalities. Concepts of convergence in distribution and convergence in probability. Weak laws of large numbers (statement only) with applications. Poisson and normal approximation to binomial. Central limit theorem for independent, identically distributed random variables (statement only). Square root transformation and arcsine transformation (statement only). Transformations of random variables (one and two variables case) - sampling distributions – Chi-square, t and F. Distribution of the sample mean and sample variance.

Unit 7: Meaning of statistical inference, population, sample, parameter, estimator, estimate. Properties of estimators - unbiasedness, relative efficiency. Methods of estimation - method of moments and method of maximum likelihood and their properties. Interval estimation - confidence intervals for means, difference between means, proportions, difference between proportions, variance and ratio of two variances. Statistical hypotheses - null and nlternative, simple and composite. Two types of errors, level of significance and power of a test, use of p-value. Critical region and critical function. Most powerful tests, Neyman-Pearson theorem for the continuous case, MLR property, UMP tests. Likelihood ratio tests for the mean of normal distribution, Student t-test - mean and difference between means. Test for significance of correlation coefficient. Large sample tests for equality of two means (variances same), the variance, equality of two variances, proportions. Chi-square tests for independence of attributes in contingency tables and for Goodness-of-fit. Nonparametric tests - sign, median, Mann-Whitney U, run and Spearman's rank correlation test.

Unit 8: Introduction to sampling techniques. Problems associated with sample survey. Advantages of sampling vis-a-vis complete enumeration. Basic sampling designs. Simple random sampling with and without replacement and their properties. Methods of selecting a simple random sample. Estimation of population mean, total and proportion.. Standard error and estimation of standard errors. Confidence limits for population mean and total. Estimation of sample size. Stratified random sampling with SRSWR and SRSWOR. Estimation of population mean and total, standard error of estimators and estimation of standard errors. Allocation - Proportional, Neyman and optimum allocations for fixed precision. Comparisons between stratified sampling and SRWOR in terms of precision and in terms of costs. Practical difficulties in adopting optimum allocations. Systematic sampling: Advantages and limitations, estimation of the population mean and standard error of the estimator. Comparison of the systematic sampling (N = nk) with SRSWOR and stratified sampling. Concept of sampling variance and its estimation. Non sampling errors.

Unit 9: Gauss-Markov model and Gauss-Markov theorem (statement only), analysis of variance (fixed effects only). Analysis of one-way and two-way classified data. Need for design of experiments, fundamental principle of design of experiments, basic designs:
CRD, RBD and LSD and least squares estimators of parameters, hypothesis and test procedure and ANOVA table. Missing plot technique-single observation missing in RBD. Estimation of missing observation by minimizing error sum of squares and analysis. Factorial experiment, 2-squared and 2-cubed factorials - main effects and interactions, their best estimates and testing the significance when underlying design is RBD, Yates' algorithm.

Unit 10: Acquaintance with working of NSSO and other agencies undertaking sample surveys (questionnaires, sampling design, method followed in field investigation, principal finding, etc.) Indian Applied Statistical system: Methods of collection of official Statistics- National sample survey(NSS), Central Statistical Organisation (CSO). Contribution of Mahalanobis to the development of sample survey theory. Index numbers. Meaning and uses, selection of items to be included. Choice of the base, mathematical formulae for computation of index numbers-based on arithmetic mean, Laspeyree, Paasche, Marshall-Edgeworth, Fisher's ideal Index numbers, weighted group index number, Time reversal, Factor reversal and circular tests, cost of living index numbers. Time Series Analysis: components of time series, measurement of trend by the method of moving averages, measurement of seasonal variation by the method of ratio to trend, measurements of cyclic variation. Demographic Methods: Sources of demographic data - census, registration, special

demographic surveys, institutional data collection, limitations and uses in demographic studies, measurement of mortality- crude, specific and standardized death rates, infant mortality rates. Fertility, Measurement of fertility - crude birth rate, age specific, general and total fertility rates. Reproduction rates – Net Reproduction Rate. Life table - components of a life table, forces of mortality and expectation of life table, construction of a life table, abridged life table due to Reed and Merrell, uses of life tables. Population growth - growth and rate of growth of population based on births, deaths and cross migrations. Population projection using logistic curve. Law of demand and supply, Price Elasticity of demand, Pareto distribution and application, fitting of pareto's Law. Lognormal distribution and its properties, Lorenz curve and estimation of elasticity from time series data. Gini's coefficient.