UPSC IFS Statistics Syllabus
Paper - I
Probability :

- Sample space and events
- probability measure and probability space
- random variable as a measurable function
- distribution function of a random variable
- discrete and continuous-type random variable
- probability mass function, probability density function
- vector-valued random variable
- marginal and conditional distributions
- stochastic independence of events and of random variables
- expectation and moments of a random variable
- conditional expectation
- convergence of a sequence of random variable in distribution in probability
- pth mean and almost every where
- criteria and inter-relations
- Borel-Cantelli lemma
- Chebyshev's and Khinchine's weak laws of large numbers
- strong law of large numbers and Kolmogorov's theorems
- Glivenko-Cantelli theorem
- probability generating function
- characteristic function
- inversion theorem
- Laplace transform
- related uniqueness and continuity theorems
- determination of distribution by its moments
- Linderberg and Levy forms of central limit theorem
- standard discrete and continuous probability distributions
- their interrelations and limiting cases
- simple properties of finite Markov chains

Statistical Inference :

- Consistency
- Unbiasedness

- Efficiency
- Sufficiency
- minimal sufficiency
- completeness
- ancillary statistic
- factorization theorem
- exponential family of distribution and its properties
- uniformly minimum variance unbiased (UMVU) estimation
- Rao-Blackwell and Lehmann- Scheffe theorems
- Cramer-Rao inequality for single and several-parameter family of distributions
- minimum variance bound estimator and its properties
- modifications and extensions of Cramer-Rao inequality
- Chapman-Robbins inequality, Bhattacharya's bounds
- estimation by methods of moments, maximum likelihood
- least squares
- minimum chisquare
- modified minimum chi-square properties of maximum likelihood
- other estimators,
- idea of asymptotic efficiency
- idea of prior and posterior distributions
- Bayes
- estimators
- Non-randomised and randomised tests
- critical function
- MP tests
- Neyman- Pearson lemma
- UMP tests, monotone likelihood ratio
- generalised Neyman- Pearson lemma
- similar and unbiased tests
- UMPU tests for single and severalparameter families of distributions
- likelihood rotates and its large sample properties
- chi-square goodness of fit test and its asymptotic distribution.
- Confidence bounds and its relation with tests
- uniformly most accurate (UMA) and UMA unbiased confidence bounds.
- Kolmogorov's test for goodness of fit and its consistency
- sign test and its optimality
- Wilcoxon signed-ranks test and its consistency
- Kolmogorov-Smirnov twosample test
- run test
- Wilcoxon-Mann- Whitney test and median test
- their consistency and asymptotic normality
- Wald's SPRT and its properties
- OC and ASN functions

- Wald's fundamental identity
- sequential estimation

Linear Inference and Multivariate Analysis :

- Linear statistical models
- theory of least squares and analysis of variance
- Gauss- Markoff theory
- normal equations
- least squares estimates and their precision
- test of significance and interval estimates based on least squares theory in one-

way,two-way and three-way classified data

- regression analysis
- linear regression
- curvilinear regression and orthogonal polynomials
- multiple regression
- multiple and partial correlations
- regression diagnostics and sensitivity analysis
- calibration problems
- estimation of variance and covariance components
- MINQUE theory
- multivariate normal distribution
- Mahalanobis
- D2 and Hotelling's T2 statistics and their applications and properties
- discriminant analysis
- canonical correlations
- one-way MANOVA
- principal component analysis
- elements of factor analysis

Sampling Theory and Design of Experiments :

- An outline of fixed-population and superpopulation approaches,
- distinctive features of finite population sampling
- probability sampling designs
- simple random sampling with and without replacement
- stratified random sampling
- systematic sampling and its efficacy for structural populations
- cluster sampling
- two-stage and multi-stage sampling
- ratio and regression
- methods of estimation involving one or more auxiliary variables
- two-phase sampling
- probability proportional to size sampling with and without replacement
- the Hansen-Hurwitz and the Horvitz-Thompson estimator
- nonnegative variance estimation with reference to the Horvitz-Thompson estimators non-sampling errors

- Warner's randomised response technique for sensitive characteristics.
- Fixed effects model (two-way classification) random and mixed effects models (two-way classification with equal number of observation per cell), CRD, RBD, LSD and their analysis, incomplete block designs, concepts of orthogonality and balance, BIBD, missing plot technique, factorial designs: 2n, 32 and 33, confounding in factorial experiments, splitplot and simple lattice designs.

Paper – II

I. Industrial Statistics:

- Process and product control
- general theory of control charts
- different types of control charts for variables and attributes, X, R, s, p, np and c charts
- cumulative sum chart
- V-mask
- single, double, multiple and sequential sampling plans for attributes
- OC, ASN, AQQ and ATI curves
- concepts of producer's and consumer's risks
- AQL
- LTPD and AOQL
- sampling plans for variables
- use of Dodge-Roming and Military Standard tables
- Concepts of reliability
- maintainability and availability
- reliability of series and parallel systems and other simple configurations
- renewal density and renewal function
- survival models (exponential, Weibull, lognormal, Rayleigh, and bath-tub)
- different types of redundancy and use of redundancy in reliability improvement
- Problems in lifetesting censored and truncated experiments for exponential models.

II. Optimization Techniques:

- Different types of models in Operational Research
- their construction and general methods of solution
- simulation and Monte-Carlo methods
- the structure and formulation of linear programming (LP) problem
- simple LP model and its graphical solution
- the simplex procedure
- the two-phase method and the Mtechnique with artificial variables
- the duality theory of LP and its economic interpretation, sensitivity analysis, transportation and assignment problems
- rectangular games
- two-person zero- sum games

- method of solution (graphical and algebraic).
- Replacement of failing or deteriorating items
- group and individual replacement policies
- concept of scientific inventory management
- analytical structure of inventory problems
- simple models with deterministic and stochastic demand with and without lead time
- storage models with particular reference to dam type.
- Homogeneous discrete-time Markov chains
- transition probability matrix
- classification of states and ergodic theorems
- homogeneous continuoustime Markov chains
- Poisson process
- elements of queuing theory
- M/M/1, M/M/K, G/M/1 and M/G/1 queues
- Solution of statistical problems on computers using well-known statistical software packages like SPSS.

III. Quantitative Economics and Official Statistics :

- Determination of trend, seasonal and cyclical components,
- Box-Jenkins method
- tests for stationery of series
- ARIMA models and determination of orders of autoregressive and moving average components, forecasting.
- Commonly used index numbers
- Laspeyre's, Paashe's and Fisher's ideal Index numbers
- chain-base index numbers
- uses and limitations of index number
- index number of wholesale prices
- consumer price index number
- index numbers of agricultural and industrial production
- test for index numbers like proportionality test
- timereversal test
- factor-reversal test
- circular test and dimensional invariance test
- General linear model
- ordinary least squares and generalised least squares methods of estimation
- problem of multicollinearity
- consequences and solutions of multi-collinearity
- autocorrelation and its consequences
- heteroscedasticity of disturbances and its testing
- test for independence of disturbances
- Zellner's seemingly unrelated regression equation model and its estimation
- concept ofstructure and model for simultaneousequations

- problem of identification-rank and order conditions of identifiability
- twostageleast squares method of estimation
- Present official statistical system in India relating to population
- Agriculture
- industrial production
- trade and prices
- methods of collection of official statistics
- their reliability and limitation and the principal publications containing such statistics various official agencies responsible for data collection and their main functions.

IV. Demography and Psychometry :

- Demographic data from census, registration
- NSS and other surveys, and their limitation and uses
- Definition
- construction and uses of vital rates and ratios
- measures of fertility
- reproduction rates, morbidity rate
- standardized death rate
- complete and abridged life tables
- construction of life tables from vital statistics and census returns
- uses of life tables
- logistic and other population growth curve
- fitting a logistic curve
- population projection
- stable population theory
- uses of stable population
- quasi-stable population techniques in estimation of demographic parameters
- morbidity and its measurement
- standard classification by cause of death
- health surveys and use of hospital statistics.
- Method of standardisation of scales and tests
- Z-scores, standard scores
- Tscores, percentile scores
- intelligence quotient and its measurement and uses
- validity of test scores and its determination
- use of factor analysis and path analysis in psychometry