SOLAPUR UNIVERSITY, SOLAPUR.

Revised Semester Pattern Syllabus

B.Sc. Part-II (Sem. III &IV)

STATISTICS

(W.E.F. June, 2014)

SOLAPUR UNIVERSITY, SOLAPUR

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B.Sc. Part-II

STATISTICS

(w.e.f. June 2014)

B.Sc. II (Statistics) (Honors) Revised Semester Pattern Syllabus to be introduced from June, 2014. This syllabus of Statistics carries 300 marks. In semester –III , University Examination of Theory Paper –V & Paper-VI and in semester – IV , University Examination of Theory Paper –VII & Paper-VIII. The University examination of Practical Paper –II and Paper –III will be held annually. The distribution of marks is as below.

Semester –III

- Statistics Paper-V: Continuous Probability Distributions –I (50 Marks)

- Statistics Paper-VI: Discrete Probability Distribution and Statistical Methods (50 Marks)

Semester- IV

- Statistics Paper VII: Continuous Probability Distributions-II (50 Marks)
- Statistics Paper VIII: Applied Statistics (50 Marks)

Annual Practical Examination

- Statistics Practical Paper –II (50 Marks)
- Statistics Practical Paper –III (50 Marks) (100 Marks)

Note: (1) Total teaching periods for two theory papers in each semester are six per week.

(2) Teaching periods for practical paper-II and paper-III are four periods per paper week per batch of 16 students.

Duration of University Examinations:

1) For each theory paper, duration is of two hours.
2) For Practical Paper-II , four hours for a batch of 16 students annually.
3) For Practical Paper-III , four hours for a batch of 16 students annually.

SOLAPUR UNIVERSITY, SOLAPUR

Revised Semester Pattern Syllabus

B.Sc. Part-II
STATISTICS
(w.e.f. June 2014)

Objectives :

The main objective of this course is to introduce semester system to the students which covers the basic concepts of continuous univariate, bivariate distributions, sampling theory. Study of some standard discrete and continuous distributions, exact sampling distribution, correlation and regression analysis, test of significance and applied statistics.

By the end of course, students are expected to:

i. Distinguish between discrete and continuous probability distributions.

ii. Find the probabilities of various distributions.

iii. Know the relations among the different distributions.

iv. Know some standard discrete and continuous probability distributions with real life situations

v. Understand the concept of multinomial distribution.

vi. Concepts of Demography.

vii. Know the elementary Knowledge of sampling theory.

viii. Apply of the small sample tests and large sample tests in various situations.

ix. Apply the S.Q.C techniques in industrial field.

x. Know the multiple regression, multiple and partial correlation coefficients.

SEMESTER-III

STATISTICS PAPER-V: Continuous Probability Distributions- I

1. Continuous Univariate Distributions (12)

1.1 Definition of the continuous sample space with illustrations, definition of continuous random variable (r.v.), probability density function (p.d.f.) and cumulative distribution function (c.d.f.) of continuous r.v., properties of cumulative distribution function (without proof) , sketch of p.d.f. and c.d.f.

1.2 Expectation of a continuous r.v., expectation of a function of a continuous r.v, mean, median, mode, quantiles (partition values), harmonic mean, variance, raw, central and factorial moments, skewness, kurtosis.

1.3 Moment generating function (m.g.f.) $M_x(t)$: definition.

Properties of m.g.f.:

i) Standardization property $M_x(0) = 1$

ii) Uniqueness property of m.g.f (if exists), (without proof).

iii) Effect of change of origin and scale.

Generation of raw, central and factorial moments (up to 4^{th} order) using m.g.f.

1.4 Examples.

2. Continuous Bivariate Distributions (12)

2.1 Definition of bivariate continuous r.v. (X,Y), joint p.d.f, marginal and conditional distributions. Evaluation of probabilities of various regions.

2.2 Expectation of function of continuous bivariate r.v. g(X,Y), means, variances, covariance, correlation coefficient, conditional expectation, conditional variance, proof of E[E(X/Y=y)]=E(X), regression as conditional expectation.

2.3 Concept of independence of continuous r.vs.

Theorems on expectation :

i) $E(X+Y) = E(X) + E(Y)$

ii) $E(XY) = E(X).E(Y)$, when X and Y are independent.

M.g.f. of sum of two independent r.v.s as a product of their m.g.f.s (without proof), extension to several variables.

2.4 Examples.

3. Transformation of random variables **(7)**

3.1 Transformation of continuous univariate r.v.: Distribution of Y=g(X) (where g is monotonic and non-monotonic function), application of m.g.f. in transformation of a continuous r.v.

3.2 Transformation of continuous bivariate r.v.s : Distribution of bivaraite r.v.'s using Jacobian of transformation.

3.3 Examples.

4. Uniform Distribution **(7)**

Probability density function:

$$f(x)=\begin{cases}\dfrac{1}{b-a}, & a<x<b\\ 0, & \text{otherwise}\end{cases}$$

Notation : X~U(a,b).

Sketch of p.d.f for various values of parameters, c.d.f, mean, variance, m.g.f., moments, β_1 and β_2 coefficients and hence nature of distribution.

Distribution of i) $Y=\dfrac{X-a}{b-a}$ ii) $Y=\dfrac{b-X}{b-a}$ iii) Y=F(x) , where F(x) is c.d.f. of any continuous r.v. X.

5. Exponential Distribution **(7)**

Probability density function (one parameter):

$$f(x)=\begin{cases}\theta e^{-\theta x}, & x>0,\theta>0\\ 0, & \text{otherwise}\end{cases}$$

Notation : X~Exp(θ).

Sketch of p.d.f for various values of parameters, c.d.f, m.g.f, mean, variance, moments, β_1 and β_2 coefficients and hence nature of distribution, median, quantiles, lack of memory property, distribution of $-(1/\theta)\log X$, $-(1/\theta)\log(1-X)$, where X~U(0,1).

Exponential distribution with scale (θ) and location (μ) parameters with p.d.f.:

$$f(x)=\begin{cases}\theta e^{-\theta(x-\mu)}, & x>\mu,\theta>0,\mu>0\\ 0, & \text{otherwise}\end{cases}$$

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STATISTICS PAPER VI: Discrete Probability Distributions and Statistical Methods

1. Poisson Distribution (8)

Probability mass function:

$$P(X = x) = \begin{cases} \dfrac{e^{-\lambda}\lambda^{x}}{x!}, & x = 0,1,2,\ldots;\lambda > 0 \\ 0, & \text{otherwise} \end{cases}$$

Notation: $X \sim P(\lambda)$.

Mean, variance, moments (up to fourth order), probability generating function (p.g.f), recurrence relation for Poisson probabilities, additive property, conditional distribution of X given X+Y where X and Y are independent r.vs. Poisson distribution as a limiting case of binomial distribution, illustration of Poisson distribution in real life situations and examples.

2. Geometric and Waiting Time Distributions (8)

2.1 Geometric Distribution:

Probability mass function (p.m.f.)

$$P(X = x) = \begin{cases} q^{x}p, & x = 0,1,2,\ldots;0 < p \le 1,\ q = 1-p \\ 0, & \text{otherwise} \end{cases}$$

where X denotes number of failures before first success.

Notation : $X \sim G(p)$.

Mean, variance, distribution function, p.g.f., lack of memory property.

2.2 Waiting Time Distribution

Probability mass function:

$$P(Y = y) = \begin{cases} q^{y-1}p, & y = 1,2,\ldots;\ 0 < p \le 1, q = 1-p \\ 0, & \text{otherwise} \end{cases}$$

Mean, variance and p.g.f. by using relation with geometric.

Examples.

3. Negative Binomial and Multinomial Distributions (9)

3.1 Negative Binomial Distribution:

Probability mass function:

$$P(X=x)=\begin{cases} {}^{x+r-1}C_{r-1}\,p^{r}q^{x}\ , & x=0,1,2,\ldots;\ r>0,\quad 0<p\le 1,\quad q=1-p \\ 0\ , & \text{otherwise}\end{cases}$$

Notation : X ~ NB(r, p).

Geometric distribution is a particular case of Negative Binomial distribution, mean, variance, p.g.f., recurrence relation of probabilities, additive property of N.B.D., NB(r, p) as a sum of r i.i.d. geometric r.vs., illustration of Negative Binomial distribution in real life situations and simple examples.

3.2 Multinomial Distribution

P.m.f., m.g.f., means, variances and covariance using m.g.f. marginal distributions.

4. Multiple Linear Regression (for tri-variate case) (10)

4.1 Plane of regression, Yule's notation, correlation matrix.

4.2 Fitting of regression plane by method of least squares, definition of partial regression coefficients and their interpretation

4.3 Residual : definition, order, properties, derivation of mean and variance.

5. Multiple and Partial Correlations (10)

5.1 Definition of multiple correlation coefficient $R_{i.jk}$, derivation of formula for multiple correlation coefficient.

5.2 Properties of multiple correlation coefficient : i) $0 \le R_{i.jk} \le 1$ ii) $R_{i.jk} \ge |r_{ij}|$ iii) $R_{i.jk} \ge |r_{ik}|$, $i \ne j \ne k = 1,2,3.$

5.3 Interpretation of i) $R_{i.jk} = 1$ and ii) $R_{i.jk} = 0$

5.4 Definition of partial correlation coefficient $r_{ij.k}$, derivation of formula for $r_{ij.k}$

5.5 Properties of partial correlation coefficient i) $-1 \le r_{ij.k} \le 1$, ii) $b_{ij.k} * b_{ji.k} = r_{ij.k}^{2}$.

5.6 Consistency of r_{ij}'s

5.7 Examples and problems.

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SEMESTER -IV

STATISTICS PAPER VII: Continuous Probability Distributions-II

1. Gamma Distribution **(7)**

Probability density function: (Two Parameters)

$$f(x) = \begin{cases} \frac{\alpha^{\lambda}}{\Gamma\lambda} e^{-\alpha x} x^{\lambda-1} & , x > 0;\ \alpha > 0,\ \lambda > 0. \\ 0 & , \text{elsewhere} \end{cases}$$

Notation : X~G(α, λ), sketch of p.d.f for various values of parameters, special cases

i) α =1 ii) λ=1, mean, mode, variance, moments,β_1, β_2 , γ_1 and γ_2 coefficients, additive property, distribution of sum of i.i.d. exponential variates.

2. Beta Distribution of First Kind **(7)**

Probability density function:

$$f(x) = \begin{cases} \frac{1}{B(m,n)} x^{m-1}(1-x)^{n-1} & , 0 < x < 1;\ m, n > 0. \\ 0 & , \text{elsewhere} \end{cases}$$

Notation: X~β_1(m,n), sketch of p.d.f for various values of parameters, symmetry around mean when m = n, mean, harmonic mean, mode, variance, uniform distribution as a particular case when m = n = 1, distribution of (1-X).

3. Beta Distribution of Second Kind **(7)**

Probability density function:

$$f(x) = \begin{cases} \frac{1}{B(m,n)} \frac{x^{m-1}}{(1+x)^{m+n}} & , 0 < x < \infty;\ m, n > 0. \\ 0 & , \text{elsewhere} \end{cases}$$

Notation: X~β_2(m,n), mean, harmonic mean, mode, variance, uniform distribution of 1/X. Relation between beta distribution of 1st kind and beta distribution of 2nd kind. Distribution of X+Y, X/Y, and X/(X+Y), where X and Y are independent gamma variates.

4. Normal Distribution **(10)**

Probability density function:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}, \quad -\infty < x < \infty, -\infty < \mu < \infty, \sigma^2 > 0$$

Notation : X~N(μ,σ^2), sketch of p.d.f for various values of parameters, properties of normal curve, mean, median, mode, variance, quartiles, point of inflexion, moments, recurrence relation for central moments, m.g.f., β_1, β_2 γ_1, γ_2 coefficients, standard normal distribution, additive property, distribution of X^2 if X~N(0,1), distribution of aX+bY+c when X and Y are independent normal r.v.s, normal as a limiting case of i) Binomial ii) Poisson (without proof), illustrations of use of normal distribution in various fields.

5. Exact sampling distribution **(15)**

5.1 Chi-square Distribution

Definition of chi-square variate as a sum of square of n i.i.d standard normal varaites, derivation of p.d.f of χ^2 with n degrees of freedom (d.f.) using m.g.f. Sketch of p.d.f for various values of parameters(d.f), mean, mode, variance, moments, skewness, kurtosis, m.g.f., additive property, relation with gamma distribution, Normal approximation to χ^2.

5.2 Students t- Distribution:

Definition of t- variate with n d.f. in the form t = $\frac{U}{\sqrt{\frac{\chi^2}{n}}}$ where U ~ N (0,1) and

χ^2 is chi-square variate with n d.f. and U and χ^2 are independent r.v.s, derivation of p.d.f., sketch of p.d.f for various values of parameters, mean, mode, variance, moments, β_1, β_2 γ_1, γ_2 coefficients.

5.3 Snedecor's F- distribution:

Definition of F- variate with n_1 and n_2 d.f. as F = $\frac{\chi_1^2 / n_1}{\chi_2^2 / n_2}$ where $\chi_1^2 and \chi_2^2$ are independent chi-square variates with n_1 and n_2 d.f. respectively, mean, mode, variance. Inter-relation between t, F and χ^2.

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STATISTICS PAPER VIII: Applied Statistics

1. Sampling Theory: (10)

1.1 Definitions of population, sample, statistic, parameter, sample survey, census survey. Advantages of sample survey over census survey.

1.2 Methods of sampling: i) Deliberate (purposive) sampling ii) Probability sampling and iii) Mixed sampling.

1.3 Simple random sampling (SRS): SRS with and without replacement.

Proof of i) Expected value of sample mean is population mean

ii) Expected value of product of population size and sample mean is population total.

iii) Expected value of sample mean square is population mean square.

iv) Variance of sample mean = S^2

v) Variance of sample mean = S^2

vi) Estimated variance of sample mean = s^2 .

Standard error of sample mean, comparison of SRSWR and SRSWOR.

2. Tests of Hypothesis-I (Large Sample Tests) (8)

2.1 Notion of hypothesis, null and alternative hypothesis, simple and composite hypothesis, test statistic, critical region, idea of one and two tailed test, type I and type II errors, level of significance, p-value. Statement of Central Limit Theorem (CLT) for independently identically distributed (i.i.d) r.v.s

2.2 Large sample tests: Construction of test statistic and identification of its probability distribution.

a) Tests for means i) $H_0 : \mu = \mu_0$ ii) $H_0 : \mu_1 = \mu_2$.

b) Tests for proportion: i) $H_0 : P_0 = P_1$ ii) $H_0 : P_1 = P_2$.

c) Tests for population correlation coefficient: i) $H_0 : \rho = \rho_0$ ii) $H_0 : \rho_1 = \rho_2$, using Fisher's Z transformation.

3. Tests of Hypothesis-II (Small Sample Tests) (7)

If $X_1, X_2,$ ------- X_n is a r.s from N(μ, σ^2) then $\bar{X}$ and S^2 are independently distributed (without proof), construction of test statistic and identification of distribution of test statistic.

a) t tests for means: i) $H_0 : \mu = \mu_0$ (σ is unknown), ii) $H_0 : \mu_1 = \mu_2$ ($\sigma_1 = \sigma_2$ is unknown) unpaired t test. iii) $H_0 : \mu_1 = \mu_2$ (paired t test).

b) χ^2 tests :

i) Test for population variance (when mean is given and not given).

ii) Test for goodness of fit

iii) Tests for independence of attributes: $m \times n$ contingency table, 2×2 contingency table, Yate's correction for continuity (concept only).

c) F tests : Test for equality of population variance.

4. Statistical Quality Control (12)

4.1 Meaning and purpose of SQC, quality of product, process control, product control, assignable causes, chance causes, Shewhart's control chart: construction, working, theoretical basis (3σ limits), lack of control situation.

4.2 Control charts for Variables : Control chart for process average ($\overline{X}$), control chart for process variation (R), Construction and working of $\overline{X}$ and R chart for unknown standards, revised control limits, estimate of process standard deviation.

4.3 Control charts for Attributes: Defects, defectives, fraction defective, control chart for fraction defectives (p chart) for fixed sample size and unknown standards, construction, working of p chart, revised control limits.

4.4 Control chart for number of defects (c chart) for standards not given, construction and working of the c chart, revised control limits.

5. Elements of Demography (08)

5.1 Introduction and need of vital statistics.

5.2 Mortality rates: Crude Death Rate (CDR), Specific Death Rate, Standard Death Rate

5.3 Fertility rates: Crude Birth Rate (CBR), General Fertility Rate (GFR), Age Specific Fertility Rate (ASFR), Total Fertility Rate (TFR).

5.4 Reproduction rates: Gross Reproduction Rate (GRR), Net Reproduction Rate(NRR).

5.5 Illustrative examples.

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Reference Books for Paper-V to Paper –VIII

Sr.No.	Name of the Authors	Title of Book
1.	Hogg R.V. and Craig A.T.	Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.
2.	Gupta S.C. & Kapoor V.K	Fundamentals of Mathematical Statistics Sultan Chand & Sons, New Delhi
3.	Gupta S.C. & Kapoor V.K	Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi
4.	Mood A.M.,Graybill F.A and Boes D.C.	Introduction to Theory of Statistics, Tata McGraw Hill, New Delhi
5.	Walpole R.E & Mayer R.H.	Probability and Statistics , MacMillan Publishing Co. Inc, New York
6	Duncan A.J	Quality Control and Industrial Statistics, D.B.Tataporewala & Sons Co. Mumbai.
7.	Mayer P.L	Introductory probability & Statistical Applications. Oxford & IBH Publication Co. 66 Janpath New Delhi.
8.	Kapoor J.N & Saxana H.C	Mathematical Statistics, Sultan Chand & Sons, New Delhi
9.	Goon A.M., Gupta A.K. and Dasgupta	Fundamentals of Statistics (vol. I & II), The world Calcutta Press Pvt. Ltd., Calcutta.
10.	Rohatgi V.K	Introduction to Probability Theory & Mathematical Statistics, Wiley Eastern Limited.
11.	Kangji G.	100 Statistical Tests
12.	Kulkarni M.B., Gore A.P. & Ghatpande S.B.	Common Statistical Tests. Satyajeet Prakashan, Pune
13.	Gupta S.D.	Statistical Methods. Sultan Chand & Sons, New Delhi
14.	Gupta S.C.	Fundamentals of Statistics. Himalaya Publishing House, Mumbai.
15.	Grant E.L.	Statistical Quality Control.
16.	Gupta S.P.	Statistical Method.
17.	Montgomery	Introduction to Statistical Quality Control
18.	Srivastav D.S.	A Text Book of Demography

Statistics Practical Course at B.Sc. Part- II

Objectives:

By the end of course students are expected to:

i. Compute probabilities of standard probability distributions.

ii. Compute the expected frequency and test the goodness of fit.

iii. Drawing random samples from standard probability distributions.

iv. Compute the multiple and partial correlation coefficients.

v . Selection of samples by SRS.

vi. Computation and interpretation of vital statistics.

v. Construction of control chart.

vi. Interpretation of results obtained by using MS-Excel.

STATISTICS PRACTICAL –II

1. Fitting of Discrete Uniform distribution and test for goodness of fit.
2. Fitting of Binomial distribution and test for goodness of fit.
3. Fitting of Hyper-geometric distribution and test for goodness of fit.
4. Fitting of Poisson distribution and test for goodness of fit.
5. Fitting of Geometric distribution and test for goodness of fit.
6. Fitting of Negative Binomial distribution and test for goodness of fit.

   (r should be taken to the next integer.)
7. Model sampling from Discrete Uniform and Binomial distribution.
8. Model sampling from of Hyper-geometric distribution
9. Model sampling from of Poisson and Geometric distribution
10. Model sampling from of Negative Binomial distribution
11. Fitting of Continuous Uniform distribution and test for goodness of fit.
12. Fitting of Exponential distribution and test for goodness of fit.

13. Fitting of Normal distribution and test for goodness of fit.

14. Model sampling from Continuous Uniform and Exponential distribution.

15. Model sampling from Normal distribution.

16. Application of Exponential and Normal distributions.

17. Fitting of Binomial, Poison & Negative Binomial distribution using MS-Excel.

18. Fitting of Exponential & Normal distribution using MS-Excel.

19. Model sampling from continuous Uniform and Exponential distributions by using MS-Excel.

20. Model sampling from Normal distribution by using MS-Excel.

STATISTICS PRACTICAL –III

1. Fitting of straight lines and second degree curves.

2. Fitting of curves of type $Y = a.b^X$, $Y= a.X^b$ and $Y= a.e^{bX}$

3. Multiple regressions.

4. Multiple and partial correlation.

5. Application of Poisson, Geometric & Negative Binomial distributions.

6. Application of multinomial distribution.

7. Large sample tests for means.

8. Large sample tests for proportions.

9. Tests for population correlation coefficients (Using Fisher's Z transformation)

10. Tests based on Chi-square distribution.

    (Test for population variance, Test for goodness of fit)

11. Tests for independence.

12. Tests based on t distribution ($\mu=\mu_0$, $\mu_1=\mu_2$, paired and unpaired)

13. Tests based on F distribution ($\sigma_1^2 = \sigma_2^2$)

14. Construction of $\overline{X}$ and R charts.

15. Construction of p and c chart.

16. Simple random sampling (with and without replacement).

17. Demography-I (Mortality Rates)

18. Demography-II (Fertility Rates, Population Growth)

19. Fitting of Straight line, parabola, and exponential curves using MS-EXCEL.

20. Multiple, partial correlation and partial regression coefficients using MS-EXCEL.

Note:

i) Computer printouts for the practicals based on MS-EXCEL are to be attached to the journal.

ii) Student must complete the entire practical to the satisfaction of the teacher concerned.

iii) Student must produce the laboratory journal along with the completion certificate duly signed by Head of Department at the time of practical examination.

Laboratory requirements:

Laboratory should be well equipped with sufficient number of electronic calculators and Computers along with necessary software, printers and UPS.

Nature of Practical Question Paper of B.Sc. Part-II

a) Each practical paper is of 50 marks, containing four questions each of 20 marks and students has solve two questions. In only one of four questions there shall be a sub question of about 10 marks based on MS-EXCEL.

b) Evaluation of MS-EXCEL based question will be on-line and should be demonstrated to the examiner.

c) Five marks are reserved for journal and five marks for oral examination.

d) Practical examination is of FOUR hour duration which includes oral examination and online demonstration.

Solapur University, Solapur

Nature of Question Paper For Semester Pattern

Faculty of Science B.Sc.Part-II STATISTICS

(w.e.f. June 2014)

Time :- 2 hrs. **Total Marks-50**

Q. No.1) Multiple choice questions. **(10)**

1) ----------

a) b) c) d)

2)
3)
4)
5)
6)
7)
8)
9)
10)

Q.No.2) Answer any Five of the following **(10)**

i)
ii)
iii)
iv)
v)
vi)

Q.No.3) A) Answer any Two of the following **(06)**

i)
ii)
iii)

B) Write the Answer/Solve/Problem/Note **(04)**

Q.No.4) Answer any Two of the following **(10)**

i)
ii)
iii)

Q.No.5) Answer any One of the following **(10)**

i)
ii)