Maharaja Agrasen Institute of Technology

Maharaja Agrasen Chowk, Plot No.1, Sector-22, Rohini, Delhi-110086
Approved by AICTE, NBA Accredited (CSE, ECE, MAE),
ISO 9001-2015 certified institution, Affiliated to GGSIP University, Delhi

Department of Information Technology and Engineering

Lab Manual

Subject Name:	Probability and Statistics
Subject Code :	ETIE-254
Semester :	IV

Index

Chapter 1

University Syllabus

PROBABILITY AND STATISTICS LAB

Paper Code: ETIE 254	**L**	**T/P**	**C**
Paper: Probability And Statistics Lab	**0**	**2**	**1**

1. Fitting of binomial distributions for given n and p.
2. Fitting of binomial distributions after computing mean and variance.
3. Fitting of Poisson distributions for given value of lambda.
4. Fitting of Poisson distributions after computing mean.
5. Fitting of normal distribution when parameters are given.
6. Fitting of normal distribution when parameters are not given
7. Exact Sample Tests based on Chi-Square Distribution.
8. Testing of significance and confidence intervals for single proportion and difference of two proportions
9. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.
10. Testing of significance and confidence intervals for difference of two standard deviations.

NOTE:- At least 8 Experiments out of the list must be done in the semester.

Chapter 2

Departmental List of Practical

PROBABILITY AND STATISTICS LAB

1. Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.
2. Program for demonstration of theoretical probability limits.
3. Program to plot normal distributions and exponential distributions for various parametric values.
4. Fitting of binomial distributions for given n and p.
5. Fitting of binomial distributions after computing mean and variance.
6. Fitting of Poisson distributions for given value of lambda.
7. Fitting of Poisson distributions after computing mean.
8. Fitting of normal distribution when parameters are given.
9. Fitting of normal distribution when parameters are not given (Estimation of parameters).
10. Exact Sample Tests based on Chi-Square Distribution.
11. Testing of significance and confidence intervals for single proportion and difference of two proportions.
12. Testing of significance and confidence intervals for single mean and difference of two means and paired tests.
13. Testing of significance and confidence intervals for difference of two standard deviations.

NOTE:- At least 10 Experiments out of the list must be done in the semester of which at least 8 must be from university list.

Chapter 3

Rules and Evaluation Criteria

Students are expected to follow the following rules for every practical:

1. Students are required to get each practical evaluated in time. The evaluation rubrics are given below.
2. Practical for the day should be completed on the same day and the file checked on the next date.
3. If the practical cannot be completed on the date for some reason, the same should be taken as home work and finished in the same week. In no case will the practical be evaluated after one week.
4. A student must complete at least 10 practical. The total marks obtained will be out of 100, averaged over 10 and scaled to 40. E.g. if a student gets 30 marks in 3 practical, his marks out of 100 = 30. Marks out of 10 = 30/10 = 3. Scaled to 40, final marks = 3*4 = 12. On the other hand if a student performs 10 practical and gets 100, his marks will be 100/10 = 10. Scaled over 40 the final marks = 10*4 = 40.

Evaluation Metrics and index page format (to be made by students as is given here):

Expt. No.	Title	Marks					
		Program	Output	File	Viva	Submission	Total
		2	2	2	2	2	10
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
	Total marks obtained (out of 100) = K						
	Marks out of 10, L = K/10						
	Marks out of 40, M = L * 4						

Chapter 4

Experiments

Experiment # 1

1. **Objective:**
   Installation of Scilab and demonstration of simple programming concepts like marix multiplication (scalar and vector), loop, conditional statements and plotting.

2. **Formulation and Method:**
   a. Install scilab version 6 or onwards.
   b. Make directory by your name in the root folder and change the current directory to this directory.
   c. Do simple arithmetic on command prompt.
   d. Open editor and WAP for the following:
      i. Multiplication of a matrix with a scalar.
      ii. Multiplication of a matrix with a matrix (scalar product).
      iii. Multiplication of a matrix with a matrix (vector product).
      iv. Loop 100 times and print if the number is odd or even.
      v. Plot (2D) the square function (squares of 1 to 10).

3. **Results:**
   The following are required as output:
   a. The full code.
   b. The screen shot of the numerical output.
   c. The actual png figure of the graph for d(v).

Experiment # 2

1. **Objective:**
   Program for demonstration of theoretical probability limits.

2. **Formulation and Method:**
   The demonstration is done by simulating the flipping of a coin. The objective is to show that as the number of flips increase the theoretical probability of 0.5 is approached. The practical probability is simulated by generating random number for each flip as follows:
   a. Generate a random number, r.
   b. If $r < 0.5$ then count a head else count a tail.
   c. Repeat for 10, 20, 50, 100, 1000, 10000 iterations. Calculate probability of head, p_h by counting the number of heads in each case.

3. **Results:**
   The following are required as output:
   a. The full code.
   b. Plot a graph of p_h against number of iterations. Also plot a horizontal line at $y = 0.5$.
   c. Show that the graph asymptotically touches the 0.5 line as the number of iterations increase.

Experiment # 3

1. **Objective:**
   Program to plot normal distributions and exponential distributions for various parametric values.

2. **Formulation and Method:**
   Normal Distribution:

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

   where, μ is the mean and σ is the standard deviation.

   Exponential Distribution:

$$f(x) = \alpha e^{-\alpha x} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

   where, $1/\alpha$ is the mean of the distribution.

   Method

   a. Take $\mu = 0, \sigma = 1;\ \mu = 2, \sigma = 1;\ \mu = 2, \sigma = 2$ for normal distribution and $\alpha = 1,2,3$ for exponential distribution.
   b. Use the *grand* function with argument "nor" and "exp" for normal and exponential distributions respectively with given parameters. This function gives random numbers from variety of distributions.
   c. Take appropriate bin sizes.

3. **Results:**
   The following are required as output:
   a. The full code.
   b. Plot graphs for both the distributions. All the graphs for normal distributions on one panel and for exponential distribution on second panel.
   c. The graphs should be properly labelled and legends shown.

Experiment # 4

1. **Objective:**
   Fitting of binomial distributions for given n and p

2. **Formulation and Method:**
   Binomial Distribution:

$$P(X = k) = (n, k)p^k(1 - p)^{n-k} \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

   where, k = number of success, p = probability of success, n = total number of Bernoulli trials.

   Problem statement:
   6 fair dice are tossed 1458 times. Getting a 2 or a 3 is counted as success. Calculate expected frequencies. Fit the appropriate Binomial Distribution. Fit a binomial distribution and calculate expected frequencies

   Method:
   a. $N = 1458$
   b. Here $n = 6, p = \frac{2}{6} = \frac{1}{3}$
   c. $P(X = x) = (n, x)p^x(1 - p)^{n-x}$
   d. Find $P(0), P(1), P(2), P(3), P(4), P(5), P(6)$
   e. Tabulate (Table 3)

x	P(X=x)	P(X=x)*N (BD) for n and p
0		
1		
2		
3		
4		
5		
6		

3. **Results:**
   The following are required as output:
   a. The full code.
   b. The table shown above (with completed entries). The plot of the table.

Experiment # 5

1. **Objective:**
   Fitting of binomial distributions after computing mean and variance.

2. **Formulation and Method:**
   Binomial Distribution:

$$P(X = k) = (n, k)p^k(1-p)^{n-k} \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where, k = number of success, p = probability of success, n = total number of Bernoulli trials.

Problem statement:
A set of three similar coins are tossed 100 (N) times with the following results (Table 1). Note the difference with experiment number 4 where "observed frequencies" were not given.

No of heads (x)	**0**	**1**	**2**	**3**
Frequency (f)	36	40	22	2

Fit a binomial distribution and calculate expected frequencies

Method

f. (Table 2)

x	**F**	**x*f**
0	36	
1	40	
2	22	
3	2	
Total (N)	100	

g. Mean $\mu = \frac{\sum x*f}{\sum f}$

h. For binomial distribution$\mu = np \Longrightarrow p = \mu/n \Longrightarrow p = {}^{\mu}/_{3}$. This is the "$p$" of the distribution to be fitted.

i. $P(X = x) = (n, x)p^x(1-p)^{n-x}$

j. Find $P(0), P(1), P(2), P(3)$

k. Tabulate (Table 3)

X	**0**	**1**	**2**	**3**	**Total**
Observed Freq	36	40	22	2	100
Expected Freq, P(X=x)*100					100

3. **Results:** The following are required as output:
   a. The full code.
   b. The tables shown above (with completed entries). The plot of table 3.