Scilab Manual for Probability Theory and Statistics Lab by Prof S N Chandra Shekhar Electronics Engineering Sreenidhi Institute Of Science & Technology[1]

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Contents

List of Experiments

Experiment: 1

Poisson Distribution

Scilab code Solution 1.1 1

```
1
2 //Poisson Distribution
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear;
7 clc;
8 close;
9
10 Frequency=[12,10,19,17,10,8,7,5,5,3,3,1]
11 n=sum(Frequency)
12 X=[0,1,2,3,4,5,6,7,8,9,10,11]
13
14 F=[]
15 P1=[]
16 P2=[]
17
18 mprintf("    ------------------------------------\n")
19 mprintf("    Arrivals                Frequency\n")
20 mprintf("    ------------------------------------")
21 for i=1:12
```

```
22      mprintf("\n        %d                              %d",i-1,
           Frequency(i))
23      F($+1)=Frequency(i)
24      product1=F(i)*X(i)
25      product2=F(i)*(X(i)**2)
26      P1($+1)=product1
27      P2($+1)=product2
28      sumP1 =sum(P1)
29      sumP2 =sum(P2)
30  end
31  mprintf("\n    ----------------------------------------")
32  Xbar = sumP1/n
33  S_sqr = (sumP2 - n*Xbar**2)/(n-1)
34  S = sqrt(S_sqr)
35
36  //Result
37  mprintf("\n\n Total number of arrivals = %d",n)
38  mprintf("\nalpha = Xbar = Sum(fj*Xj)/n = %f",Xbar)
39  mprintf("\nSample variance = (Sum(fj*Xj^2) - n*Xbar
       ^2) / n-1 = %f",S_sqr)
```

Experiment: 2

Lognormal Distribution

Scilab code Solution 2.2 2

```
1
2 //Lognormal Distribution
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear all;
7 clc;
8 close;
9
10 X = [18.8, 27.9, 21.0, 6.1, 37.4, 5.0, 22.9, 1.0,
     3.1, 8.3] // rate
11
12 X1=[]
13 X2=[]
14
15 n=length(X)
16
17 for i=1:n
18     X1($+1)=log(X(i))
19     X2($+1)=X1(i)**2
20 end
```

```
21 Xbar = sum(X1)/n
22 S2 = (sum(X2) - (n*(Xbar)**2))/(n-1)
23
24 //Result
25 mprintf("
   ------------------------------------------------------------\n")
26 mprintf("      Rates(X)                        lognormal(X1)
   ")
27 mprintf("\n
   ------------------------------------------------------------\n")
28 for i=1:10
29     mprintf("\n      %.1f\t\t\t%.1f",X(i),X1(i))
30 end
31 mprintf("\n
   ------------------------------------------------------------\n")
32 mprintf("\n N=%d",n)
33 mprintf("\n mu = Xbar = Sum(lognormal)/N = %f",Xbar)
34 mprintf("\nS^2 = (Sum(X1i^2) - (N*(Xbar)^2))/(N-1) =
    %f",S2)
```

Experiment: 3

Normal Distribution

Scilab code Solution 3.3 3

```
1
2 //Normal Distribution
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear all;
7 clc;
8 close;
9
10
11 mprintf("In Normal Distribution: \n mu = Xbar \n
     sigma^2 = S^2 \n")
12
13 value =
     [99.79,100.26,100.23,99.55,99.96,99.56,100.41,100.27,99.62,99.90,
14
15 V = gsort(value,'g','i')
16 V2 =[]
17 n =length(V)
18
```

```
for i=1:n
    V2($+1)=(V(i)**2)
end

Xbar = sum(V)/n
S2 = (sum(V2) - (n*(Xbar)**2))/(n-1)
S = sqrt(S2)

//Result
mprintf("\n
   ------------------------------------------------------------\n")
mprintf("      j\t\tvalue\tj\tvalue")
mprintf("\n
   ------------------------------------------------------------\n")
ul=n/2
for i=1:ul
    mprintf("\n      %d\t\t%.2f\t%d\t%.2f",i,V(i),(i
       +10),V(i+10))
end
mprintf("\n
   ------------------------------------------------------------\n")
mprintf("\n N=%d",n)
mprintf("\n mu = Xbar = Sum(V)/N = %f",Xbar)
mprintf("\nsigma^2 = (S^2) = (%f)^2 second^2",S)
```

Experiment: 4

Gamma Distribution

Scilab code Solution 4.4 4

```
1
2 //Gamma Distribution
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear all;
7 clc;
8 close;
9
10 Order =
     [1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20]

11 Leadtime = [70.292, 10.107, 48.386, 20.480, 13.053,
     25.292, 14.713, 39.166, 17.421, 13.905, 30.215,
     17.137, 44.024, 10.552, 37.298, 16.314, 28.073,
     39.019,32.330,36.547]
12
13 X = []
14 logX =[]
15
16 n =length(Order)
```

```
17 Xbar = sum(Leadtime)/n
18 logXbar = log(Xbar)
19 for i=1:n
20     X($+1)=Leadtime(i)
21     logX($+1)=log(Leadtime(i))
22 end
23 sumlogX = sum(logX)
24 M = logXbar - (sumlogX/n)
25 Minv = 1/M
26 betav = 3.7411
27 thetav = 1/Xbar
28
29 //Result
30 mprintf("\n
    ------------------------------------------------------------\
    n")
31 mprintf("    Order\tLead time\tOrder\tLead time")
32 mprintf("\n
    ------------------------------------------------------------\
    n")
33 ul=(length(X))/2
34 for i=1:ul
35     mprintf("\n    %d\t\t%.3f\t\t%d\t%.3f",i,Leadtime
       (i),(i+10),Leadtime(i+10))
36 end
37 mprintf("\n
    ------------------------------------------------------------\
    n")
38 mprintf("\n Xbar = Sum(leadtime)/n = %f",Xbar)
39 mprintf("\n ln Xbar = %.2f",logXbar)
40 mprintf("\n Sum(ln(Xi)) = %.2f",sumlogX)
41 mprintf("\n M = ln(Xbar) - (Sum(ln(Xi))/n) = %.2f",M
    )
42 mprintf("\n 1/M = %.2f",Minv)
43 mprintf("\n beta value for 1/M = 7.11 is 3.7411")
44 mprintf("\n Beta = %.2f",betav)
45 mprintf("\n Theta = 1/Xbar = %.2f",thetav)
```

Experiment: 5

Calculate Mean and Standard Deviation

Scilab code Solution 5.5 5

```
1
2 //Calculate Mean and Standard Deviation
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear;
7 clc;
8 close;
9
10 disp('The first row denotes the size of item')
11 A(1,:)=[6 7 8 9 10 11 12];
12 disp('The second row denotes the corresponding
     frequency (f)')
13 A(2,:)=[3 6 9 13 8 5 4];
14 disp('The third row denotes the corresponding
     deviation (d)')
15 A(3,:)=[-3 -2 -1 0 1 2 3];
16 disp('The fourth row denotes the corresponding f*d '
     )
```

```
17 for i=1:7
18   A(4,i)=A(2,i)*A(3,i);
19 end
20 disp('The fifth row denotes the corresponding f*d^2'
     )
21 for i=1:7
22   A(5,i)=A(2,i)*(A(3,i)^2);
23 end
24 disp(A)
25 b=0;
26 for i=1:7
27   b=b+A(4,i);
28 end
29 disp(b,'Sum of fourth row elements')
30 c=0
31 for i=1:7
32   c=c+A(5,i);
33 end
34 disp(c,'Sum of fifth row elements')
35 d=0;
36 for i=1:7
37   d=d+A(2,i);
38 end
39 disp(d,'Sum of all frequencies')
40 mean_value=9+b/d
41 disp(mean_value,'Mean=9+b/d=')
42 standard_deviation=(c/d)^0.5
43 disp(standard_deviation,'Standard Deviation=(c/d)
     ^0.5')
```

Experiment: 6

Calculate Coefficient Of Correlation

Scilab code Solution 6.6 6

```
1
2 //Calculate Coefficient of Correlation
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear;
7 clc;
8
9 disp('The first row of A denotes the corresponding I
     .R. of students ')
10 A(1,:)=[105 104 102 101 100 99 98 96 93 92];
11 disp('The second row denotes the corresponding
     deviation of I.R.')
12 for i=1:10
13   A(2,i)=A(1,i)-99;
14 end
15 disp('The third row denotes the square of
     corresponding deviation of I.R. ')
16 for i=1:10
```

```
17    A(3,i)=A(2,i)^2;
18  end
19  disp('The fourth row denotes the corresponding  E.R.
       of students ')
20    A(4,:)=[101 103 100 98 95 96 104 92 97 94];
21  disp('The fifth row denotes the corresponding
      deviation of E.R. ')
22  for i=1:10
23    A(5,i)=A(4,i)-98;
24  end
25  disp('The sixth row denotes the square of
      corresponding deviation of E.R. ')
26  for i=1:10
27    A(6,i)=A(5,i)^2;
28  end
29  disp('The seventh row denotes the product of the two
       corresponding deviations ')
30  for i=1:10
31    A(7,i)=A(2,i)*A(5,i);
32  end
33  disp(A)
34  a=0;
35  for i=1:10
36    a=a+A(1,i);
37  end
38  disp(a,'The sum of elements of first row')
39  b=0;
40  for i=1:10
41    b=b+A(2,i);
42  end
43  disp(b,'The sum of elements of second row')
44  c=0;
45  for i=1:10
46    c=c+A(3,i);
47  end
48  disp(c,'The sum of elements of third row')
49  d=0;
50  for i=1:10
```

```
51    d=d+A(4,i);
52  end
53  disp(d,'The sum of elements of fourth row')
54  e=0;
55  for i=1:10
56    e=e+A(5,i);
57  end
58  disp(e,'The sum of elements of fifth row')
59  f=0;
60  for i=1:10
61    f=f+A(6,i);
62  end
63  disp(f,'The sum of elements of sixth row')
64  g=0;
65  for i=1:10
66    g=g+A(7,i);
67  end
68  disp(g,'The sum of elements of seventh row')
69  coefficient_correlation=g/(c*f)^0.5
70  disp(coefficient_correlation,'Coefficient of
       correlation=')
```

Experiment: 7

Determine Frequency Distribution

check Appendix AP 1 for dependency:

```
freqdist.sci
```

Scilab code Solution 7.7 7

```
1 //Determine Frequency Distribution
2 //OS:Windows 10
3 //Scilab 5.5.2
4 //The dependency file is freqdist.sci
5
6 x=int(100*rand(1,100));
7 xclass=[0:10:100];
8 freqdist(x,xclass)
```

Experiment: 8

Discrete Probability Distributions

Scilab code Solution 8.8 8

```
1
2 //Discrete Probability Distributions
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear;
7 clc;
8 close;
9
10 //(i)Binomial
11 deff('[CC]=C(n,r)','CC=gamma(n+1)./(gamma(r+1).*
     gamma(n-r+1))')      //Binomial coefficient
12 deff('[bb]=b(x,n,p)','bb=C(n,x).*p.^x.*(1-p).^(n-x)'
     )                    //Binomial pmf
13 deff('[BB]=B(x,n,p)','BB=sum(b([0:1:x],n,p))')
                          //Binomial CDF
14 n=10;
15 p=0.25;
16
```

```
17 //P(X=2)
18 p=b(2,10,0.25)
19 disp(p)
20
21 //pmf
22 b10=[];
23 for j=0:10,b10=[b10 b(j,10,0.25)]; end;
24 disp(b10)
25
26 //CDF
27 x=2
28 p=B(2,10,0.25)
29 disp(p)
30
31 //P(X>2)=1-P(X<=2)
32 p=1-B(2,10,0.25)
33 disp(p)
34
35 //List of values of CDF
36 B10=[];
37 for j=0:10,B10=[B10 B(j,10,0.25)]; end;
38 disp(B10)
39
40 //(ii)Geometric
41 deff('[gg]=g(x,p)','gg=p.*(1-p).^(x-1)')
                                    //Geometric pmf
42 deff('[GG]=G(x,p)','GG=sum(g([1:x],p))')
                                    //Geometric CDF
43
44 //P(X=3) and P(X=5),p=0.50
45 p=g(3,0.50)
46 disp(p)
47 p=g(5,0.50)
48 disp(p)
49
50 //Calculate vector of values of pmf
51 disp(g([1:10],0.5))
52
```

```
53 //P(X6) ,P(X3) ,P(X1)
54 p1=G(6,0.5)
55 disp(p1)
56 p2=G(3,0.5)
57 disp(p2)
58 p3=G(1,0.5)
59 disp(p3)
60
61 //Vector of values of CDF
62 G10=[];
63 for j=1:10, G10=[G10 G(j,0.5)]; end;
64 disp(G10)
65
66 //(iii)Hypergeometric
67 deff('[hh]=h(x,N,n,a)','hh=C(a,x).*C(N-a,n-x)./C(N,n
      )')            //Hypergeometric pmf
68 deff('[HH]=H(x,N,n,a)','HH=sum(h([0:1:x],N,n,a))')
                     //Hypergeometric CDF
69 N=100;
70 n=20;
71 a=35;
72
73 //P(X=12)
74 p=h(12,N,n,a)
75 disp(p)
76
77 //Cumulative distribution ,x=12
78 cd_x=H(12,N,n,a)
79 disp(cd_x)
80
81 //Generate vector of values of pdf
82 disp(h([0:20],N,n,a))
83
84 //Generate vector of values of CDF
85 H10=[];
86 for j=1:10,H10=[H10 h(j,N,n,a)]; end;
87 disp(H10)
```

Experiment: 9

Statistical Inference -Continuous Probability Distribution

Scilab code Solution 9.9 9

```
1
2 //Statistical Inference-Continuous Probability
     Distributions
3 //OS:Windows 10
4 //Scilab 5.5.2
5
6 clear;
7 clc;
8 close;
9
10 //(i)Student t distribution
11 deff('[f]=fT(t,nu)','f=gamma((nu+1)./2).*(1+t.^2./nu
     ).^(-(nu+1)/2)/(sqrt(%pi*nu)*gamma(nu/2))')
12 tt=[-4:0.1:4];
13 ff=fT(tt,6);
14 figure
15 xlabel('t');
```

```
16 ylabel('fT(t)');
17 title('Student t - nu = 6');
18 plot(tt,ff,'x')
19
20 //Probability Calculation
21 [P,Q] = cdft("PQ",0.4,6)
22 disp(Q,'Q')
23 disp(P,'P')
24
25 //Inverse CDF Calculation
26 t = cdft("T",8,0.45,1-0.45)
27 disp(t,'t')
28
29 //Obtaining degrees of freedom
30 nu = cdft("Df",0.7,0.3,0.8)
31 disp(nu,'nu')
32
33 //Plotting CDF
34 xx=[-4:0.1:4];
35 yy=[];
36 for x=-4:0.1:4, yy=[yy cdft('PQ',x,6)]; end;
37 figure
38 xlabel('t');
39 ylabel('fX(t)');
40 title('Student t - nu = 6');
41 plot(xx,yy,'x')
42
43
44 //(ii)Chi-square distribution
45 xx = [0:0.1:10];
46 yy = [];
47 for x=0:0.1:10, yy=[yy cdfchi('PQ',x,4)]; end;
48 figure
49 xlabel('t');
50 ylabel('fX(t)');
51 title('Chi-square - nu = 4');
52 plot(xx,yy,'x')
53
```

```
54 //Probability calculation
55 [P,Q] = cdfchi("PQ",1,10)
56 disp(Q,'Q')
57 disp(P,'P')
58
59 [P,Q] = cdfchi("PQ",0.2,10)
60 disp(Q,'Q')
61 disp(P,'P')
62
63 //Inverse CDF calculation
64 chi2 = cdfchi("X",4,0.4,0.6)
65 disp(chi2,'chi2')
66
67 //Calculating degrees of freedom
68 nu = cdfchi("Df",0.4,0.6,2.7)
69 disp(nu,'nu')
70
71 //Plotting CDF
72 deff('[f]=fC(x,nu)','f=x.^(nu/2-1).*exp(-x./2)/(2.^(
      nu/2).*gamma(nu./2))')
73 cc = [0:0.1:30];
74 ff = fC(cc,10);
75 figure
76 xlabel('chi^2');
77 ylabel('fC(chi^2)');
78 title('Chi-square - nu = 10');
79 plot(cc,ff,'x')
80
81
82 //(iii)F distribution
83 deff('[f]=fF(F,nuN,nuD)','f=gamma((nuN+nuD)./2).*(
      nuN./nuD).^(nuN./2).*F.^(nuN./2-1)./(gamma(nuN
      ./2).*gamma(nuD./2).*(1+nuN.*F./nuD).^((nuN+nuD)
      ./2))')
84 xx = [0:0.1:10];
85 ff = fF(xx,4,6);
86 figure
87 xlabel('F');
```

```
88  ylabel('fF(F)');
89  title('F distribution- nuNum = 4 - nuDen =6');
90  plot(xx,ff,'x')
91
92  //Probability Calculation
93  [P,Q] = cdff("PQ",1.2,6,12)
94  disp(Q,'Q')
95  disp(P,'P')
96
97  //Inverse CDF calculation
98  F = cdff("F",10,2,0.4,0.6)
99  disp(F,'F')
100
101 //Calculating degrees of freedom
102 nuNum = cdff('Dfn',5,0.4,0.6,0.8)
103 disp(nuNum,'nuNum')
104
105 //Plotting CDF
106 xx = [0:0.1:10];
107 yy = [];
108 for x=0:0.1:10, yy=[yy cdff('PQ',x,4,6)]; end;
109 figure
110 xlabel('t');
111 ylabel('fX(t)');
112 title('F - nuNum = 4 - nuDen =6');
113 plot(xx,yy,'x')
```

Experiment: 10

Weibull distribution

Scilab code Solution 10.10 10

```
1
2  //Weibull Distribution
3  //OS:Windows 10
4  //Scilab 5.5.2
5
6  clear;
7  clc;
8  close;
9
10 deff('[ww]=w(x,a,b)','ww=a.*b.*x^(b-1).*exp(-a.*x.^b
       )')                    //pdf
11 deff('[WW]=W(x,a,b)','WW=1-exp(-a.*x.^b)')
                                    //cdf
12 //alpha=2,beta=3
13 xx=(0:0.01:2);
14 yy=w(xx,2,3);
15 figure
16 xlabel('x');
17 ylabel('fX(x)');
18 title('Weibull distribution');
19 plot(xx,yy,'x')
```

```
20 yyy=[];
21 for x=0:0.01:2, yyy=[yyy W(x,2,3)]; end;
22 figure
23 xlabel('x');
24 ylabel('FX(x)');
25 title('Weibull distribution');
26 plot(xx,yyy,'x')
27
28 //Probability calculations
29 //P(X<1.5)
30 p1=W(1.5,2,3)
31 disp(p1,'P(X<1.5)')
32
33 //P(X>0.6)
34 p2=1-W(0.6,2,3)
35 disp(p2,'P(X>0.6)')
36
37 //P(0.5<X<1.2)
38 p3=W(1.2,2,3)-W(0.5,2,3)
39 disp(p3,'P(0.5<X<1.2)')
```

Appendix

Scilab code AP 1

```
1 clear;
2 clc;
3 close;
4
5 function freqdist(x,xclass)
6     [m n]=size(x);              //sample size
7     [m nB]=size(xclass);        //no.of class
        boundaries
8     k=nB - 1;
9
10    cmark = zeros(1,k);
11    for ii = 1:k
12        cmark(ii) = 0.5*(xclass(ii)+xclass(ii+1));
13    end
14
15    fcount=zeros(2,k);
16    fbelow=0;
17    fabove=0;
18
19    for ii=1:n
20        if x(ii) < xclass(1)
21            fbelow = fbelow + 1;
22        elseif x(ii) > xclass(nB)
23            fabove = fabove + 1;
24        else
25            for jj = 1:k
```

```
26                  if x(ii)>= xclass(jj) & x(ii)<
                       xclass(jj+1)
27                      fcount(jj) = fcount(jj) +1;
28                  end
29              end
30          end
31      end
32
33      frel=fcount/n
34
35      fcumul = zeros(1,k);
36      fcumul(1) = fcount(1);
37      for ii = 2:k
38          fcumul(ii) = fcumul(ii-1) + fcount(ii);
39      end;
40
41      fcumulrel = fcumul/n;
42
43      mprintf('\n
           ----------------------------------------------------------------------
           ');
44      mprintf('\nFrequency distribution');
45      mprintf('\n
           ----------------------------------------------------------------------
           ');
46      mprintf('\n  Class\tLowBound\tUpBound\t\tClass
           Mark\tFreq.\t\tRelFreq.\tCumFreq.\tRelCumFreq
           .');
47      mprintf('\n
           ----------------------------------------------------------------------
           ');
48      for ii = 1:k
49          mprintf('\n%5.0f\t%10.6g\t%10.6g\t%10.6g\
               t%10.6g\t%10.6g\t%10.6g\t%10.6g\t\n',ii,
               xclass(ii),xclass(ii+1),cmark(ii),fcount(
               ii),frel(ii),fcumul(ii),fcumulrel(ii))
50      end
```

```
51      disp('\n
          ');
52      disp(' ')
53
54      if fbelow ~= 0
55          mprintf('Outliers below minimum class
              boundary = %10.6g \n',fbelow)
56      end
57      if fabove ~= 0
58          mprintf('Outliers above maximum class
              boundary = %10.6g \n',fabove)
59      end
60      mprintf('Total no of data points = %10.6g \n',n)
          ;
61      mprintf('Total no of classes = %10.6g \n',k);
62
63      disp(' ');
64
65      xset('window',1);
66      histplot(k,x);
67      xtitle('histogram','x','rel.f');
68      xset('window',2);
69      xset('mark',-9,2);
70      plot2d(cmark,fcumulrel,-9);
71      plot2d(cmark,fcumulrel,1);
72      xtitle('ogive','x','cum.rel.f');
73  endfunction
```

freqdist