Scilab Textbook Companion for Probability And Statistics For Engineers And Scientists by S. M. Ross[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

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Chapter 2

Descriptive Statistics

Scilab code Exa 2.2a Relative Frequency

```
1 starting_salary = [47 48 49 50 51 52 53 54 56 57
    60];
2 frequency = [4 1 3 5 8 10 0 5 2 3 1];
3 total = sum(frequency);
4 relative_frequency = frequency/total;
5 disp("The relative frequencies are ")
6 disp(relative_frequency)
```

Scilab code Exa 2.2b pie chart

```
1 values = [42 50 32 55 9 12];
2 percentages = values*100 / sum(values);
3 new_text = string(percentages);
4 text = ["Lung ", "Breast ", "Colon ", "Prostate ", "
    Melanoma ", "Bladder "];
5 percentage_sign = ["%", "%", "%", "%", "%", "%"];
6 final_text = text + new_text + percentage_sign;
```

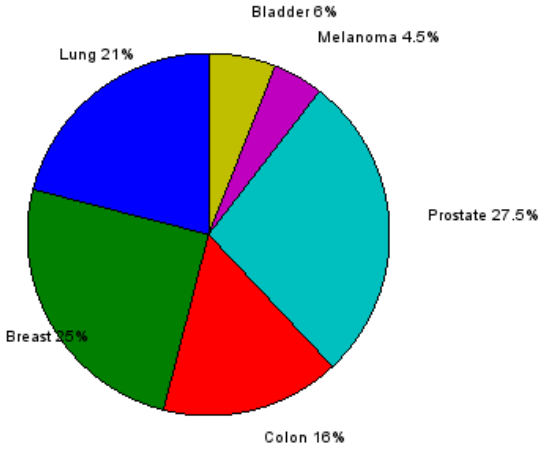

Figure 2.1: pie chart

```
7 //pie([42 50 32 55 9 12], ["Lung", "Breast", "Colon
    ", "Prostate", "Melanoma", "Bladder"]);
8 pie(values , final_text);
```

Scilab code Exa 2.3a Sample mean

```
1 scores=[284, 280, 277, 282, 279, 285, 281, 283, 278,
    277];
2 new_scores = scores - 280;
3 final_mean = mean(new_scores)+ 280;
4 disp(final_mean)
```

Scilab code Exa 2.3b Sample mean of age

```
1 age= [15 16 17 18 19 20];
2 frequencies = [2 5 11 9 14 13];
3 product  = age.*frequencies;
4 total_people = sum(frequencies);
5 mean_age = sum(product)/total_people ;
6 disp("The sample mean of the ages is")
7 disp(mean_age)
```

Scilab code Exa 2.3c Sample Median

```
1 age= [15 16 17 18 19 20];
2 frequencies = [2 5 11 9 14 13];
3 i=1;
4 for j=1:6
5     for k = 1:frequencies(j)
6         final_age(i) = age(j);
```

```
7           i = i +1 ;
8       end;
9   end
10
11
12  final_median = median(final_age);
13  disp(final_median);
```

Scilab code Exa 2.3d Mean and Median

```
1  germ_free_mice = [158 192 193 194 195 202 212 215
       229 230 237 240 244 247 259 301 301 321 337 415
       434 444 485 496 529 537 624 707 800];
2  conventional_mice = [159 189 191 198 235 245 250 256
        261 265 266 280 343 356 383 403 414 428 432];
3  disp (mean(germ_free_mice), "Sample mean for germ-
       free mice is ");
4  disp (median(germ_free_mice), "Sample median for
       germ-free mice is ");
5  disp (mean(conventional_mice), "Sample mean for
       conventional mice is ");
6  disp (median(conventional_mice), "Sample mean for
       conventional mice is ");
```

Scilab code Exa 2.3e Mean Median and Mode

```
1  value = [1 2 3 4 5 6];
2  frequencies= [9 8 5 5 6 7];
3  i=1;
4  for j=1:6
5      for k = 1:frequencies(j)
6          final_value(i) = value(j);
7          i = i +1 ;
```

```
8       end;
9   end
10  product  = value.*frequencies;
11  disp(product , sum(product))
12
13  total_value = sum(frequencies);
14  mean_value = sum(product)/total_value ; //the answer
        in the textbook is incorrect
15  [m1 m2]= max(frequencies);
16  n= m2;
17
18  disp("The sample mean is")
19  disp(mean_value)
20  disp(median(final_value), "The median is")
21  disp(value(n) , "The mode is")
```

Scilab code Exa 2.3f sample variance

```
1  A = [ 3 4 6 7 10];
2  B= [-20 5 15 24];
3  disp(variance(A), "The sample variance of A is")
4  disp(variance(B), "The sample variance of B is")
```

Scilab code Exa 2.3g sample variance of accidents

```
1  accidents = [22 22 26 28 27 25 30 29 24];
2  new_accidents = accidents - 22;
3  disp(variance(new_accidents), "The variance of the
       number of accidents is")
```

Scilab code Exa 2.3h Percentile

```
1 population = [7333253 3448613 2731743 1702086
    1524249 1151977 1048949 1022830 998905 992038
    816884 752279 734676 702979 665070 635913 617044
    614289 579307 567094 547727 520947 514013 504505
    493559];
2 disp(perctl(population, 10), "The sample 10
    percentile is")
3 disp(perctl(population, 80), "The sample 80
    percentile is")
4 disp(perctl(population, 50), "The sample 80
    percentile is")
5 disp(median(population), "The median is")
```

Scilab code Exa 2.3i Quartiles

```
1 noise = [ 82 89 94 110 74  122 112 95 100 78 65 60
    90 83 87 75 114 85 69 94 124 115 107 88  97 74 72
     68 83 91 90 102 77 125 108 65];
2 disp(quart(noise), "The quartiles are")
```

Scilab code Exa 2.4a Chebyshev Inequality

```
1 cars = [448162 404192 368327 318308 272122 260486
    249128 234936 218540 207977];
2 interval1 = mean(cars) - (1.5*st_deviation(cars));
3 interval2 = mean(cars) + (1.5*st_deviation(cars));
4 data = 100*5/9;
5 disp(interval2, , "to" , interval1, "Atleast 55.55%
    of the data lies in the interval" );
```

Scilab code Exa 2.5a Empirical Rule

```
data = [90 91 94 83 85 85 87 88 72 74 74 75 77 77 78
    60 62 63 64 66 66 52 55 55 56 58 43 46];
disp("According to the empirical rule")
disp("68% of the data lies between")
disp(mean(data)+st_deviation(data), "and", mean(data
   )-st_deviation(data))
disp("95% of the data lies between")
disp(mean(data)+(2*st_deviation(data)), "and", mean(
   data)-(2*st_deviation(data)) )
disp("99.7% of the data lies between")
disp(mean(data)+(3*st_deviation(data)), "and", mean(
   data)-(3*st_deviation(data)))
```

Scilab code Exa 2.6a Sample Correlation Coefficient

```
temp = [24.2 22.7 30.5 28.6 25.5 32.0 28.6 26.5 25.3
    26.0 24.4 24.8 20.6 25.1 21.4 23.7 23.9 25.2
   27.4 28.3 28.8 26.6];
defects = [25 31 36 33 19 24 27 25 16 14 22 23 20 25
    25 23 27 30 33 32 35 24];
temp_new = temp- mean(temp);
defects_new = defects - mean(defects);
num=0
s1 =0;
s2=0;
for i=1:22
    num = num + (temp_new(i)*defects_new(i));
    s1 = s1 + (temp_new(i)*temp_new(i));
    s2 = s2 + (defects_new(i)*defects_new(i));
end
```

```
13 coefficient = num/sqrt(s1*s2);
14 disp(coefficient)
```

Scilab code Exa 2.6b Sample Correlation Coefficient

```
1  year = [12 16 13 18 19 12 18 19 12 14];
2  pulserate = [73 67 74 63 73 84 60 62 76 71];
3  year_new = year- mean(year);
4  pulserate_new = pulserate - mean(pulserate);
5  num=0
6  s1 =0;
7  s2=0;
8  for i=1:10
9      num = num + (year_new(i)*pulserate_new(i));
10     s1 = s1 + (year_new(i)*year_new(i));
11     s2 = s2 + (pulserate_new(i)*pulserate_new(i));
12 end
13 coefficient = num/sqrt(s1*s2);
14 disp(coefficient)
```

Chapter 3

Elements Of Probability

Scilab code Exa 3.4a Union

```
1 cigarette = 0.28;
2 cigar = 0.07;
3 cigar_and_cigarette = 0.05 ;
4 cigar_or_cigarette = cigarette + cigar -
    cigar_and_cigarette;
5 disp( "% of the males smoke neither cigar nor
    cigarette", (1-cigar_or_cigarette)*100 )
```

Scilab code Exa 3.5a Basic Principle of Counting

```
1 white_balls= 6;
2 black_balls = 5;
3 total = white_balls + black_balls;
4 probability_whiteandblack = white_balls*black_balls
    /(total*(total-1));
5 probability_blackandwhite = white_balls*black_balls
    /(total*(total-1));
6 reqd_probability = probability_whiteandblack +
    probability_blackandwhite;
```

```
7 disp(reqd_probability, "Thus, the required
    probability is")
```

Scilab code Exa 3.5b Basic Principle of Counting

```
1 maths = 4;
2 chemistry = 3;
3 history = 2;
4 language = 1;
5 total_arrangements = factorial(4)*factorial(maths)*
    factorial(chemistry)*factorial(history)*factorial
    (language);
6 disp(total_arrangements, "The total number of
    possible arrangements is ")
```

Scilab code Exa 3.5c Basic Principle of Counting

```
1 men = 6;
2 women = 4;
3 disp(factorial(men+women), "No of different rankings
    possible is")
4 women_top4 = factorial(women)*factorial(men);
5 prob = women_top4/factorial(men+women);
6 disp(prob, "Probability that women receive the top 4
    scores is")
```

Scilab code Exa 3.5d Committee Probability

```
1 men = 6;
2 women = 9;
```

```
3 reqd_size =5;
4 total =factorial(men+women)/(factorial(reqd_size)*
     factorial(men+women-reqd_size));
5 given_committee = factorial(men)*factorial(women)/(
     factorial(3)*factorial(2)*factorial(men-3)*
     factorial(women-2));
6 prob = given_committee/total;
7 disp(prob, "Probability that the committee consists
     of 3 men and 2 women is")
```

Scilab code Exa 3.5f Pairing Probability

```
1 black_p = 6;
2 white_p = 6;
3 pair = 2;
4 total_p = black_p + white_p;
5
6
7
8
9 total_pairs  = 1;
10 while(total_p >0)
11     total_pairs = total_pairs*factorial(total_p)/(
          factorial(pair) * factorial(total_p - pair) )
          ;
12     total_p = total_p -2;
13     //disp(total_pairs)
14 end
15 //disp(total_pairs)
16 total_pairs= total_pairs/factorial(6);
17 black_pairs  = 1;
18 while(black_p >0)
19     black_pairs = black_pairs*factorial(black_p)/((
          factorial(pair) * factorial(black_p - pair) )
          );
```

```
20      black_p = black_p -2;
21      //disp(black_pairs)
22  end
23  black_pairs= black_pairs/factorial(3);
24  //disp(black_pairs)
25
26
27  white_pairs = black_pairs;
28  allowed_pairs = black_pairs * white_pairs;
29  probb = allowed_pairs/ total_pairs;
30  disp(probb, " Probability that a random pairing will
        not result in any of the white and black players
        rooming together is ")
```

Scilab code Exa 3.6a Acceptable Transistor

```
1  defective =5;
2  partially_defective = 10;
3  acceptable = 25;
4  disp(acceptable/(acceptable+partially_defective), "
      The required probability is")
```

Scilab code Exa 3.6b Both Boys

```
1  prob_bb = 0.25;
2  prob_bg = 0.25;
3  prob_gb = 0.25;
4  prob_gg = 0.25;
5  disp(prob_bb/(prob_bg+prob_gb+prob_bb), "Probability
       that both are boys is")
```

Scilab code Exa 3.6c Branch Manager

```
1 prob_phoenix = 0.3;
2 prob_manager = 0.6;
3 disp(prob_phoenix*prob_manager , "Probability that
    Perez will be a Phoenix branch office manager is"
    )
```

Scilab code Exa 3.7a Accident Probability

```
1 accident_prone= 0.4;
2 nonaccident_prone= 0.2;
3 pop_accident = 0.3;
4 prob = pop_accident*accident_prone + (1-pop_accident
    )*nonaccident_prone;
5 disp(prob, "The required probability is ");
```

Scilab code Exa 3.7b Accident within a year

```
1 accident_prone= 0.4;
2 nonaccident_prone= 0.2;
3 pop_accident = 0.3;
4 prob_of_accident = pop_accident*accident_prone + (1-
    pop_accident)*nonaccident_prone;
5 prob = pop_accident * accident_prone /
    prob_of_accident;
6 disp(prob, "The required probability is")
```

Scilab code Exa 3.7c Multiple Choice Test

```
m = 5;
p =1/2;
disp( (m*p)/(1+((m-1)*p)), "The required probability
    is")
```

Scilab code Exa 3.7d blood test

```
detect_present = 0.99;
detect_notpresent = 0.01;
pop_disease = 0.005;
prob = detect_present*pop_disease/((detect_present*
   pop_disease) +(detect_notpresent*(1-pop_disease))
    ) ;
disp(prob, "The required probability is")
```

Scilab code Exa 3.7e Criminal Investigation

```
criminal_char = 0.9
convinced= 0.6;
pop_char = 0.2;
prob = (convinced*criminal_char) /((convinced*
   criminal_char) + (pop_char*(1-convinced)));
disp(prob, "The required probability is")
```

Scilab code Exa 3.7f Missing Plane

```
alpha1 = 0.4;
plane_in_region1 = 1/3;
plane_in_region2 = 1/3;
plane_in_region3 = 1/3;
```

```
5 prob1 = (alpha1*plane_in_region1)/((alpha1*
    plane_in_region1)+ 1*plane_in_region2 + 1*
    plane_in_region3);
6 prob2 = (1*plane_in_region2)/((alpha1*
    plane_in_region1)+ 1*plane_in_region2 + 1*
    plane_in_region3);
7 disp(prob1 , "The probability that the planes is in
    region 1 given that the search of region 1 did
    not uncover it ");
8 disp(prob2 , "The probability that the planes is in
    region 2/3 given that the search of region 1 did
    not uncover it ");
```

Scilab code Exa 3.8a Independent Events

```
1 prob_A = 4/52;
2 prob_H = 13/52;
3 disp(prob_A*prob_H , "P(AH) is")
```

Chapter 4

Random Variables And Expectation

Scilab code Exa 4.1a sum of two fair dice

```
p11 = 1/36;
p12 = 1/36;
p13 = 1/36;
p14 = 1/36;
p15 = 1/36;
p16 = 1/36;
p21 = 1/36;
p22 = 1/36;
p23 = 1/36;
p24 = 1/36;
p25 = 1/36;
p26 = 1/36;
p31 = 1/36;
p32 = 1/36;
p33 = 1/36;
p34 = 1/36;
p35 = 1/36;
p36 = 1/36;
p41 = 1/36;
```

```
20 p42 = 1/36;
21 p43 = 1/36;
22 p44 = 1/36;
23 p45 = 1/36;
24 p46 = 1/36;
25 p51 = 1/36;
26 p52 = 1/36;
27 p53 = 1/36;
28 p54 = 1/36;
29 p55 = 1/36;
30 p56 = 1/36;
31 p61 = 1/36;
32 p62 = 1/36;
33 p63 = 1/36;
34 p64 = 1/36;
35 p65 = 1/36;
36 p66 = 1/36;
37 disp(p11, "Probability that the sum is 2")
38 disp(p12+p21, "Probability that the sum is 3")
39 disp(p13+p31+p22, "Probability that the sum is 4")
40 disp(p14+p41+p32+p23, "Probability that the sum is 5
   ")
41 disp(p15+p51+p24+p42+p33, "Probability that the sum
   is 6")
42 disp(p16+p61+p25+p52+p34+p43, "Probability that the
   sum is 7")
43 disp(p26+p62+p35+p53+p44, "Probability that the sum
   is 8")
44 disp(p36+p63+p45+p54, "Probability that the sum is 9
   ")
45 disp(p46+p64+p55, "Probability that the sum is 10")
46 disp(p65+p56, "Probability that the sum is 11")
47 disp(p66, "Probability that the sum is 12")
```

Scilab code Exa 4.1b Defective or Acceptable

```
pdd= 0.09;
pda = 0.21;
pad = 0.21;
paa = 0.49;

disp(pdd, "Probability that the number of acceptable
    components is 0 is")
disp(pda+pad, "Probability that the number of
   acceptable components is 1 is")
disp(paa, "Probability that the number of acceptable
    components is 2 is")
disp(pdd, "Probability that I is 0  is")

disp(paa+pad+pda, "Probability that I is 1 is")
```

Scilab code Exa 4.1c X exceeds 1

```
prob = 1-(1-(1/%e));
disp( prob, "Probability that X exceeds 1 is")
```

Scilab code Exa 4.2a sum of pmf

```
p1 = 1/2;
p2 = 1/3;
disp (1-(p1+p2), "Probability that X is 3 is ")
```

Scilab code Exa 4.2b pdf

```

integral = integrate('(4*x)-(2*x*x)' , 'x', 0, 2);
```

```
C = 1/integral;
disp(C, "The value of C is")
integral_new = integrate('C*((4*x)-(2*x*x))' , 'x', 0, 1);
disp(1-integral_new , "Probability that X is greater than 1 is")
```

Scilab code Exa 4.3a Joint distribution of batteries

```
new = 3;
working = 4;
defective =5;
total = factorial(12)/(factorial(3)*factorial(9));
disp(factorial(5)/(factorial(3)*factorial(2)*total), "Probability that X=0 and Y=0");
disp(factorial(5)*factorial(4)/(factorial(3)*factorial(2)*factorial(3)*total), "Probability that X=0 and Y=1");
disp(factorial(5)*factorial(4)/(factorial(2)*factorial(2)*factorial(4)*total), "Probability that X=0 and Y=2");
disp(factorial(4)/(factorial(3)*factorial(1)*total), "Probability that X=0 and Y=3");
disp(factorial(3)*factorial(5)/(factorial(2)*factorial(2)*factorial(3)*total), "Probability that X=1 and Y=0");
disp(factorial(5)*factorial(4)*factorial(3)/(factorial(2)*factorial(3)*factorial(4)*total), "Probability that X=1 and Y=1");
disp(factorial(3)*factorial(4)/(factorial(2)*factorial(2)*factorial(2)*total), "Probability that X=1 and Y=2");
disp(factorial(3)*factorial(5)/(factorial(2)*factorial(4)*factorial(1)*total), "Probability that X=2 and Y=0");
```

```
13 disp(factorial(3)*factorial(4)/(factorial(2)*
     factorial(1)*factorial(3)*total), "Probability
     that X=2 and Y=1");
14 disp(factorial(3)/(factorial(3)*total), "Probability
      that X=3 and Y=3");
```

Scilab code Exa 4.3b Joint distribution of boys and girls

```
1  child0 = 0.15;
2  child1 = 0.2;
3  child2 = 0.35;
4  child3 = 0.30;
5  pboy = 0.5;
6  pgirl = 0.5;
7
8  disp(child0 , "Probability that B=0 and G=0")
9  disp(child1*pgirl , "Probability that B=0 and G=1")
10 disp(child2*pgirl*pgirl , "Probability that B=0 and
     G=2")
11 disp(child3*pgirl*pgirl*pgirl , "Probability that B
     =0 and G=3")
12 disp(child1*pboy , "Probability that B=1 and G=0")
13 disp(child2*pgirl*pboy , "Probability that B=1 and G
     =1")
14 disp(child3*pgirl*pgirl*pboy , "Probability that B=1
      and G=2")
15 disp(child2*pboy*pboy , "Probability that B=2 and G
     =0")
16 disp(child3*pgirl*pboy*pboy , "Probability that B=2
     and G=1")
17 disp(child3*pboy*pboy*pboy , "Probability that B=3
     and G=0")
```

Scilab code Exa 4.3c Joint Density Function

```
intx= integrate('%e^(-x)', 'x',0, 1 );
inty=integrate('2*%e^(-2*y)', 'y', 0, 1);
answer = (1-intx)*inty;
disp(answer , "Probability that X>1 and Y<1 is")

//For other two parts, symbolic manipulations are
   required
```

Scilab code Exa 4.3e Density of Independent Random Variables

```
pdec3 = 0.05;
pdec2= 0.1;
pdec1 = 0.2;
p0= 0.3
pinc1= 0.2;
pinc2= 0.1;
pinc3 = 0.05;
disp(pinc1*pinc2*p0, "Probability that the stock
   price will increase successively by 1, 2 and 0
   points in the next 3 days is")
```

Scilab code Exa 4.3f Conditional Probability Mass Function

```
disp(0.1/0.3875, "probability that B =0 given G=1 ")
   ;
disp(0.175/0.3875, "probability that B =1 given G=1
   ");
disp(0.1125/0.3875, "probability that B =2 given G=1
    ");
disp(0/0.3875, "probability that B =3 given G=1 ");
//The values are taken from Table 4.2
```

Scilab code Exa 4.3g Conditional Probability Mass Function

```
p00=0.4;
p01 = 0.2;
p10 = 0.1;
p11= 0.3;

pY1= p01+p11;
disp(p01/pY1, "Probability that X=0 and Y=1")
disp(p11/pY1, "Probability that X=1 and Y=1")
```

Scilab code Exa 4.4a Expectation of a fair die

```
p1=1/6;
p2=1/6;
p3=1/6;
p4=1/6;
p5=1/6;
p6=1/6;
expec= p1 + (2*p2)+(3*p3)+(4*p4)+(5*p5)+ (6*p6);
disp(expec)
```

Scilab code Exa 4.4d Expectation of the message time

```
expec= integrate('(x)/1.5', 'x', 0,1.5);
disp("hours", expec, "On an average, you have to
   wait for ")
```

Scilab code Exa 4.5a Expectation

```
p0= 0.2;
p1= 0.5;
p2=0.3;
expec = 0*0*p0 + 1*1*p1 + 2*2*p2;
disp(expec, "Expectation of X^2 is")
```

Scilab code Exa 4.5b Expected cost of breakdown

```
expec = integrate('x^3', 'x', 0, 1);
disp(expec, "The expectation is")
```

Scilab code Exa 4.5c Expectation

```
p0= 0.2;
p1= 0.5;
p2=0.3;
expec = 0*0*p0 + 1*1*p1 + 2*2*p2;
disp(expec, "Expectation of X^2 is")
```

Scilab code Exa 4.5d Expectation

```
expec = integrate('x^3', 'x', 0, 1);
disp(expec, "The expectation is")
```

Scilab code Exa 4.5e Expected profit

```
profit1 = 10;
profit2= 20;
profit3 = 40;
prob1= 0.2;
prob2 = 0.8;
prob3 = 0.3;
expec = profit1*prob1 + profit2*prob2 + profit3*
   prob3;
disp(" thousand dollars", expec, "The expectd profit
    is")
```

Scilab code Exa 4.5f Letters in Correct Envelopes

```
//As scilab does not symbolic computations, this
   example is solved taking N=5
prob = 1/5 //probability that a letter is put into
   the right envelope
EX1 = 1*prob+0*(1-prob);
EX2 = 1*prob+0*(1-prob);
EX3 = 1*prob+0*(1-prob);
EX4 = 1*prob+0*(1-prob);
EX5 = 1*prob+0*(1-prob);
EX= EX1 + EX2+ EX3 +EX4 + EX5;
disp(EX, "Thus, the expectation is")
```

Scilab code Exa 4.5g Different types of coupons

```
ProbXiequals1 = 1 - ((19/20)^10);
EXi = ProbXiequals1 ;
EX = 20*EXi;
disp(EX, "The expectation is")
```

Scilab code Exa 4.6a Variance of a fair die

```
probXequalsi = 1/6;
expecXsquared = 0;
for n=1:6
    expecXsquared = expecXsquared + (n*n*
       probXequalsi)
end

expecX= 3.5 // from eg 4.4a
var = expecXsquared - (expecX^2);
disp(var, "The variance is")
```

Scilab code Exa 4.7a Variance of 10 rolls of a fair die

```
probXequalsi = 1/6;
expecXsquared = 0;
for n=1:6
    expecXsquared = expecXsquared + (n*n*
       probXequalsi)
end

expecX= 3.5 // from eg 4.4a
var = expecXsquared - (expecX^2);
var10 = var*10;
disp(var10, "The variance is")
```

Scilab code Exa 4.7b Variance of 10 tosses of a coin

```
1 probIj = 0.5;
2 varIj = probIj*(1-probIj);
3 var = 10*varIj;
4 disp(var, "Thus, the required variance is")
```

Scilab code Exa 4.9a Inequalities

```
1 avg  = 50;
2 probX75 = avg/75;
3 disp(probX75, "Probability that X>75 is")
4 var = 25;
5 upperlimit = var/100;
6 disp(1-upperlimit, "Probability that X lies between
     40 and 60 is")
```

Chapter 5

Special Random Variables

Scilab code Exa 5.1a Returning of disks

```
1 defects= 0.01;
2 disks = 10;
3 package = 3;
4 probdefect0 = ((1-defects)^10);
5 probdefect1 = factorial(disks)*defects*((1-defects)
    ^9)/factorial(disks-1);
6 prob = 1 - probdefect0 -probdefect1;
7 disp(prob, "Probability that a package will be
    returned is")
8 newprob = factorial(package)*prob*((1-prob)^2)/
    factorial(package-1);
9 disp(newprob, "Probability that exactly one of the
    packages will be returned among 3 is" )
10
11 //the solution in the textbook is approximate
```

Scilab code Exa 5.1b Colour of Eyes

```
function result= binomial(n, k, p)
    result = factorial(n)*(p^k)*((1-p)^(n-k))/(
       factorial(k)*factorial(n-k))
endfunction

children = 4;
reqdblueyes = 2;
probblueeyes = 0.5*0.5;
prob = binomial(children, reqdblueyes, probblueeyes)
   ;
disp(prob, "The reqd probability is")
```

Scilab code Exa 5.1e Binomial Random Variable

```
function result=bin(n,k, p)
    if(k==0)
        result = (1-p)^n;
     else
         result  = p*(n-k+1)*bin(n, k-1, p)/((1-p)*k
            );
     end
endfunction

disp(bin(6, 0, 0.4), "Probability that X=0 is")
disp(bin(6, 1, 0.4), "Probability that X=1 is")
disp(bin(6, 2, 0.4), "Probability that X=2 is")
disp(bin(6, 3, 0.4), "Probability that X=3 is")
disp(bin(6, 4, 0.4), "Probability that X=4 is")
disp(bin(6, 5, 0.4), "Probability that X=5 is")
disp(bin(6, 6, 0.4), "Probability that X=6 is")
```

Scilab code Exa 5.2a Probability of accident

```
[probX0, Q]= cdfpoi("PQ", 0, 3);
probX1 = 1- probX0;
disp(probX1, "Probability that there is at least one
    accident this week is ")
```

Scilab code Exa 5.2b Defective Items

```
function result= bino(n, k, p)
    result = factorial(n)*(p^k)*((1-p)^(n-k))/(
       factorial(k)*factorial(n-k))
endfunction

prob = bino(10,0, 0.1) + bino(10, 1,0.1 );
disp(prob, "The exact probability is ");

probp =  cdfpoi("PQ", 1, 1)
disp(probp, "The poisson approximation is ")
```

Scilab code Exa 5.2c Number of Alpha particles

```
Xlam  = 3.2;
i =2;
prob = cdfpoi("PQ", i, Xlam);
disp(prob)
```

Scilab code Exa 5.2d Claims handled by an insurance company

```
function result= bino(n, k, p)
    result = factorial(n)*(p^k)*((1-p)^(n-k))/(
       factorial(k)*factorial(n-k))
```

```
3 endfunction
4 avg = 5;
5 i=3;
6 prob = cdfpoi("PQ", 2, avg);
7 disp(prob, "Proportion of days that have less than 3
      claims is")
8 probX4 = cdfpoi("PQ",i+1, avg) - cdfpoi("PQ", i, avg
    );
9
10 reqdprob = bino(5,3 , probX4);
11 disp(reqdprob, "Probability that 3 of the next 5
    days will have exactly 4 claims is ")
```

Scilab code Exa 5.2f Defective stereos

```
1 avg = 4;
2 prob = cdfpoi("PQ", 3, 2*avg)
3 disp(prob)
```

Scilab code Exa 5.3a Functional system

```
1 function result= hyper(N, M, n, i)
2     result = factorial(N)*factorial(M)*factorial(n)*
        factorial(N+M-n)/(factorial(i)*factorial(N-i)
        *factorial(n-i)*factorial(M-n+i)*factorial(N+
        M));
3 endfunction
4
5 prob = hyper(15, 5,6, 4)+hyper(15, 5,6,5)+hyper
    (15,5,6,6);
6 disp(prob, "Probability that the system will be
    functional is")
```

Scilab code Exa 5.3b Determining Population Size

```
1 function result= hyper(N, M, n, i)
2     result = factorial(N)*factorial(M)*factorial(n)*
        factorial(N+M-n)/(factorial(i)*factorial(N-i)
        *factorial(n-i)*factorial(M-n+i)*factorial(N+
        M));
3 endfunction
4
5 r= 50;
6 n=100;
7 X=25;
8 disp(r*n/X , "Estimate of the number of animals in
    the region is")
```

Scilab code Exa 5.3c Conditional Probability

```
1 function result= bino(n, k, p)
2     result = factorial(n)*(p^k)*((1-p)^(n-k))/(
        factorial(k)*factorial(n-k))
3 endfunction
4
5 function answer= condprob(n,k,p,i)
6     answer = bino(n,i,p)*bino(m,k-i,p)/bino(n+m,k, p
        );
7 endfunction
8
9 //The function condprob will give P{X=i|X+Y=k}
```

Scilab code Exa 5.4b Bus Timings

```
pass_f = 1/30;
prob1 = (15-10)*pass_f + (30-25)*pass_f;
prob2 = (3-0)*pass_f + (18-15)*pass_f;
disp(prob1, "Probability that he waits less than 5
   minutes for a bus")
disp(prob2, "Probability that he waits at least 12
   minutes for a bus")
```

Scilab code Exa 5.4c Current in a diode

```
a=5;
I0=10^-6;
v_f = 1/(3-1);
vupperlim = 3;
vlowerlim = 1;
expecV = (vupperlim + vlowerlim)/2;
expec = integrate('(%e^(a*x))/2', 'x', 1,3);
expecI=I0*(expec -1);
disp(expecI)
```

Scilab code Exa 5.5a Normal Random Variable

```
u= 3;
var = 16;

prob1 = cdfnor("PQ", 11, u, sqrt(var));
disp(prob1, " P{X<11}");
prob2 = 1- cdfnor( "PQ", -1, u, sqrt(var));
disp(prob2, "P{X>-1}");
prob3= cdfnor("PQ", 7, u, sqrt(var)) - cdfnor("PQ",
   2, u, sqrt(var));
```

```
9 disp(prob3, "P{2<X<7}");
```

Scilab code Exa 5.5b Noise in Binary Message

```
1 disp(cdfnor("PQ", -1.5, 0, 1), "P{error|message is
    1}")
2 disp(1-cdfnor("PQ", 2.5, 0, 1), "P{error|message is
    0 }")
```

Scilab code Exa 5.5c Power dissipation

```
1 r =3;
2 avg = 6;
3 std= 1;
4 var = std^2;
5 expecV2 = var + (avg^2);
6 expecW = 3*expecV2;
7 disp(expecW, "Expectation of W is ")
8 limw=120;
9 limV = sqrt(limw/r);
10 disp(1-cdfnor("PQ", limV, avg, std), "P{W>120} is")
```

Scilab code Exa 5.5d Yearly precipitation

```
1 meanX1  = 12.08;
2 meanX2= 12.08;
3 stX1= 3.1;
4 meanX = meanX1 + meanX2;
5 varX = 2*(3.1^2);
6 lim= 25;
```

```
7 disp(1-cdfnor("PQ", lim, meanX, sqrt(varX)), "
    Probability that the total precipitation during
    the next 2 years will exceed 25 inches")
8
9 meanXnew= meanX1 - meanX2;
10 new_lim= 3;
11 disp(1- cdfnor("PQ", new_lim, meanXnew, sqrt(varX)),
    "Probability that precipitation in the next year
     will exceed that in the following year by more
    than 3 inches")
```

Scilab code Exa 5.6a Wearing of Battery

```
1 lamda = 1/10000;
2 x  = 5000;
3 prob = %e^(-1*lamda*x);
4 disp(prob, " Probability that she will be able to
    complete her trip without having to replace her
    car battery is");
```

Scilab code Exa 5.6b Working Machines

```
1 //When C is put to use, one other machine(either A
    or B ) will still be working . The probability of
     this machine or C failing is equal due to the
    memoryless propoerty of exponential random
    variables.
2
3 disp(1/2, "The probability that machine which is
    still operable is machine C is ")
```

Scilab code Exa 5.6c Series System

```
function result= new(lamda,n, t )
    newsum = 0;
    for i=1:n
        newsum= newsum + lamda(i)
        result=%e^(-1*newsum*t)
    end
endfunction
```

Scilab code Exa 5.8a Chi square random variable

```
disp(cdfchn("PQ", 30, 26, 0));
```

Scilab code Exa 5.8b Chi square random variable

```
disp(cdfchn("X", 15, 0,0.95, 0.05 ))
```

Scilab code Exa 5.8c Locating a Target

```
disp(1- cdfchn("PQ", 9/4, 3, 0))
```

Scilab code Exa 5.8d Locating a Target in 2D space

```
disp(1- cdfchn("PQ", 2.25,2,0))
```

Scilab code Exa 5.8e T distribution

```
disp(cdft("PQ", 1.4, 12), "P{T12 <=1.4}");
disp(cdft("T", 9,  0.975, 0.025), "t0.025, 9")
```

Scilab code Exa 5.8f F Distribution

```
disp(cdff("PQ", 1.5, 6, 14))
```

Chapter 6

Distribution of Sampling Statistics

Scilab code Exa 6.3a Claims handled by an insurance company

```
number = 25000;
meaneach = 320;
sdeach = 540;
claim = 8300000;
meantotal= meaneach*number;
sdtotal = sdeach*sqrt(number);
disp(1- cdfnor("PQ",claim, meantotal, sdtotal ))
```

Scilab code Exa 6.3c Class strength

```
ideal_num = 150;
actual_num = 450;
attend = 0.3;
tolerance = 0.5
disp(1-cdfnor("PQ",ideal_num+tolerance, actual_num*
   attend, sqrt(actual_num*attend*(1-attend)) ))
```

Scilab code Exa 6.3d Weights of workers

```
1 meaneach  = 167;
2 sdeach = 27;
3 num = 36;
4 sdtotal = sdeach/sqrt(num);
5 //sdtotal = sdtotal*sdtotal;
6 //disp(sdtotal)
7 disp(cdfnor("PQ", 170, meaneach, sdtotal)-cdfnor("PQ
    ", 163, meaneach,sdtotal ), "Probability that the
     sample mean of their weights lies between 163
    and 170(when sample size is 36)")
8
9 num=144;
10 sdtotal = sdeach/sqrt(num);
11 //disp(sdtotal)
12 disp(cdfnor("PQ", 170, meaneach, sdtotal)-cdfnor("PQ
    ", 163, meaneach,sdtotal ), "Probability that the
     sample mean of their weights lies between 163
    and 170(when sample size is 144)")
13
14 //The answer given in the textbook is incorrect as
    (170-167)/4.5 is not equal to 0.6259 .
```

Scilab code Exa 6.3e Distance of a start

```
1 prob = 0.95;
2 lim = 0.5;
3 X = cdfnor("X", 0,1, 0.975, 0.025 )
4 disp(ceil((4*X)^2), "Observations are necessary (
    atleast)")
```

Scilab code Exa 6.5a Processing time

```
n= 15;
sigmasquare= 9;
lim =12;
actual_lim = (n-1)*lim/sigmasquare;
prob =  1- cdfchi("PQ", actual_lim, (n-1))
disp(prob)
```

Scilab code Exa 6.6a Candidate winning an election

```
favour = 0.45;
samplesize = 200;
expec= favour*samplesize;
sd = sqrt(samplesize*favour*(1-favour));
disp(expec, "The expected value is ")
disp(sd, "The standard deviation is ")

function result= bino(n, k, p)
    result = factorial(n)*(p^k)*((1-p)^(n-k))/(
       factorial(k)*factorial(n-k))
endfunction

//newsum = 0;
//for i=1:10
 //    newsum = newsum + bino(200,i, favour)
//end
//prob = 1-newsum;*/

lim = 101;
tolerance = 0.5;
lim= lim - tolerance;
```

```
21 prob = 1- cdfnor("PQ", lim, expec, sd)
22
23 disp(prob, "Probability that more than half the
     members of the sample favour the candidate")
```

Scilab code Exa 6.6b Pork consumption

```
1 meaneach = 147;
2 sdeach  = 62;
3 samplesize = 25;
4 lim =150;
5 samplemean = meaneach;
6 samplesd= sdeach/sqrt(samplesize)
7 prob = 1- cdfnor("PQ", lim, samplemean, samplesd)
8 disp(prob)
```

Chapter 7

Parameter Estimation

Scilab code Exa 7.2a Maximum likelihood estimator of a bernoulli parameter

```
1 samplesize = 1000;
2 acceptable =921;
3 disp(acceptable/samplesize, "The maximum likelihood
    estimate of p is")
```

Scilab code Exa 7.2b Errors in a manuscript

```
1 function result= totalerror(n1, n2, n12)
2     result = n1*n2/n12;
3 endfunction
```

Scilab code Exa 7.2c Maximum likelihood estimator of a poisson parameter

```
1 total_people = 857;
```

```
2 days= 20;
3 disp(total_people/days, "The maximum likelihood
    estimate of lambda")
```

Scilab code Exa 7.2d Number of traffic accidents

```
1 accidents= [4 0 6 5 2 1 2 0 4 3 ];
2 lambda= mean(accidents)
3 disp(cdfpoi("PQ", 2, lambda))
```

Scilab code Exa 7.2e Maximum likelihood estimator in a normal population

```
1 function[u, sigmasquared]=normal(X, Xmean, n)
2     u= Xmean;
3     newsum = 0;
4     for i= 1:n
5         newsum= newsum + (X(i)-Xmean)^2
6     end
7     sigmasquared = sqrt((newsum/n));
8 endfunction
```

Scilab code Exa 7.2f Kolmogorovs law of fragmentation

```
1 X= [2.2 3.4 1.6 0.8 2.7 3.3 1.6 2.8 2.5 1.9]
2 upperlimX = 3
3 lowerlimX = 2;
4 upperlimlogX= log(upperlimX);
5 lowerlimlogX = log(lowerlimX);
6
```

```
7 logX = log(X)
8 samplemean= mean(logX)
9 samplesd= sqrt(variance(logX))
10 //disp(samplemean)
11 //disp(samplesd)
12 prob = cdfnor("PQ", upperlimlogX, samplemean,
      samplesd) - cdfnor("PQ", lowerlimlogX, samplemean
      , samplesd)
13 disp(prob)
```

Scilab code Exa 7.2g Estimating Mean of a Uniform Distribution

```
1 function result= unif(X, n)
2     result = max(X)/2;
3 endfunction
```

Scilab code Exa 7.3a Error in a signal

```
1 avg = 0;
2 var = 4;
3 num = 9;
4 X =[5 8.5 12 15 7 9 7.5 6.5 10.5];
5 samplemean= mean(X);
6 lowerlim = samplemean - (1.96*sqrt(var/num))
7 upperlim = samplemean + (1.96*sqrt(var/num))
8
9 disp(upperlim, "to ",lowerlim,"The 95% confidence
      interval is ",   )
```

Scilab code Exa 7.3b Confidence interval

```
avg = 0;
var = 4;
num = 9;
X =[5 8.5 12 15 7 9 7.5 6.5 10.5];
samplemean= mean(X);
lowerlim = samplemean - (1.645*sqrt(var/num))
upperlim = samplemean + (1.645*sqrt(var/num))

disp(" to infinity", lowerlim,"The 95% upper
   confidence interval is " )
disp(upperlim,"The 95% upper confidence interval is
   minus infinity to " )
```

Scilab code Exa 7.3c Confidence interval

```
var = 4;
num = 9;
X =[5 8.5 12 15 7 9 7.5 6.5 10.5];
samplemean= mean(X);
alpha= 0.005;
zalpha = cdfnor("X", 0, 1,1-alpha ,alpha);
//disp(zalpha)
lowerlim = samplemean - (zalpha*sqrt(var/num))
upperlim = samplemean + (zalpha*sqrt(var/num))
disp(upperlim, "to ",lowerlim,"The 95% confidence
   interval is ",  )

alpha= 0.01;
zalpha = cdfnor("X", 0, 1,1-alpha ,alpha);
lowerlim = samplemean - (zalpha*sqrt(var/num))
upperlim = samplemean + (zalpha*sqrt(var/num))
disp(" to infinity", lowerlim,"The 95% upper
   confidence interval is " )
disp(upperlim,"The 95% upper confidence interval is
   minus infinity to " )
```

Scilab code Exa 7.3d Weight of a salmon

```
sd= 0.3;
lim = 0.1;
num = (1.96*sd/lim)^2;
disp(num, "Sample size should be greater than");
```

Scilab code Exa 7.3e Error in a signal

```
X = [5 8.5 12 15 7 9 7.5 6.5 10.5];
num = 9;
meanX= mean(X);
X2 = X^2;
s2= (sum(X2)- (num*(meanX^2)))/(num-1);
s= sqrt(s2);
tval =  cdft("T", num-1,  0.975, 0.025);
//disp(tval)
upperlim = meanX + (tval*s)/sqrt(num);
lowerlim = meanX - (tval*s)/sqrt(num);
disp(upperlim, "to ",lowerlim,"The 95% confidence
   interval is ",  )
```

Scilab code Exa 7.3f Average resting pulse

```
X = [54 63 58 72 49 92 70 73 69 104 48 66 80 64 77];
num = 15;
meanX= mean(X);
X2 = X^2;
s2= (sum(X2)- (num*(meanX^2)))/(num-1);
```

```
6  s= sqrt(s2);
7  tval =  cdft("T", num-1,  0.975, 0.025);
8  //disp(tval)
9  upperlim = meanX + (tval*s)/sqrt(num);
10 lowerlim = meanX - (tval*s)/sqrt(num);
11 disp(upperlim, "to ",lowerlim,"The 95% confidence
      interval is ",   )
12 alpha = 0.05;
13 tval = cdft("T", num-1, 1-alpha, alpha);
14 lim = meanX + (tval*s)/sqrt(num);
15 disp(lim, "The 95% lower confidence interval is from
       minus infinity to ")
```

Scilab code Exa 7.3g Evaluating integrals

```
1  meanX = 0.786;
2  s= 0.03;
3  num = 100;
4  alpha = 0.05;
5  tval = cdft("T", num-1, 1-alpha, alpha);
6  upperlim = meanX + (tval*s)/sqrt(num);
7  lowerlim = meanX - (tval*s)/sqrt(num);
8  disp(upperlim, "to ",lowerlim,"The 95% confidence
      interval is ",   )
```

Scilab code Exa 7.3h Thickness of washers

```
1  num=10;
2  X= [0.123 0.133 0.124 0.126 0.120 0.130 0.125 0.128
      0.124 0.126];
3  //disp(variance(X))
4  s2 = variance(X);
5  chi1 = cdfchi("X",num-1,0.95, 0.05  );
```

```
chi2 = cdfchi("X",num-1,0.05, 0.95  );
//disp(chi1, chi2)
lowerlim = (num-1)*s2/chi2;
upperlim = (num-1)*s2/chi1;
disp(sqrt(upperlim), "to ",sqrt(lowerlim),"The 90%
   confidence interval is "  )
```

Scilab code Exa 7.4a Cable insulation

```
A=[36 44 41 53 38 36 34 54 52 37 51 44 35 44];
B=[52 64 38 68 66 52 60 44 48 46 70 62];
sigmaA= 40;
sigmaB= 100;
alpha = 1-0.95;
beta= alpha/2;
meanA = mean(A);
meanB= mean(B);
zbeta = cdfnor("X",0, 1, 1-beta, beta );

lowerlim= mean(A) - mean(B) - (zbeta*sqrt((sigmaA/
   length(A)) + (sigmaB/length(B))))  ;
upperlim= mean(A) - mean(B) + (zbeta*sqrt((sigmaA/
   length(A)) + (sigmaB/length(B))))  ;
disp(upperlim, "to ",lowerlim,"The 95% confidence
   interval is "   )

beta=alpha;
zbeta = cdfnor("X",0, 1, 1-beta, beta );

upperlim= mean(A) - mean(B) + (zbeta*sqrt((sigmaA/
   length(A)) + (sigmaB/length(B))))  ;
disp(upperlim, "A value that exceed the difference
   of the means with 95% confidence is"   )
```

Scilab code Exa 7.4b Battery production

```
tech1 = [140 136 138 150 152 144 132 142 150 154 136
    142];
tech2 = [144 132 136 140 128 150 130 134 130 146 128
    131 137 135];
num1= 12;
num2= 14;
mean1= mean(tech1);
mean2= mean(tech2);
//disp(mean1)
//disp(Sp)
alpha = 0.9;
S1 = variance(tech1) //*num1/(num1-1);
S2 = variance(tech2) // *num2/(num2-1);
Sp = (((num1-1)*S1) + ((num2-1)*S2))/(num1+ num2 -2)
   ;
Sp= sqrt(Sp);
num= (1/num1)+(1/num2);
betaa = (1-alpha)/2;
tval = cdft("T", num1+num2-2, 1-betaa, betaa);
upperlim = mean1-mean2 + (tval*Sp)*sqrt(num);
lowerlim = mean1-mean2 - (tval*Sp)*sqrt(num);
disp(upperlim, "to ",lowerlim,"The 90% confidence
   interval is "   )
alpha = 0.95
betaaa = 1-alpha;
tval = cdft("T", num1+num2-2, 1-betaaa, betaaa);
lowerlim = mean1-mean2 - (tval*Sp)*sqrt(num);
disp("the upper confidence interval is")
disp(" to infinity", lowerlim)
```

Scilab code Exa 7.5a Transistors

```
1 phat = 0.8;
2 zalpha = 1.96;
3
4 samplesize = 100;
5 lowerlim = phat - (zalpha*sqrt(phat*(1-phat)/
    samplesize));
6 upperlim = phat + (zalpha*sqrt(phat*(1-phat)/
    samplesize));
7 disp(upperlim, "to ",lowerlim,"The 95% confidence
    interval is "   )
```

Scilab code Exa 7.5b Survey

```
1 phat = 0.52;
2 error = 0.04;
3 zalpha = 1.96;
4 //lowerlim = phat - (zalpha*sqrt(phat*(1-phat)/
    samplesize));
5 //upperlim = phat + (zalpha*sqrt(phat*(1-phat)/
    samplesize));
6 samplesize = (error/zalpha)^2/(phat*(1-phat));
7 disp(1/samplesize)
```

Scilab code Exa 7.5c Acceptable chips

```
1 initialsample = 30;
2 acceptable= 26;
3 phat = acceptable/initialsample;
4 error = 0.05/2;
5 zalpha = 2.58;
6
```

```
samplesize = (error/zalpha)^2/(phat*(1-phat));
finalsize = ceil(1/samplesize);
acceptablenew= 1040 + acceptable;
phat = acceptablenew/finalsize;
lowerlim = phat - (zalpha*sqrt(phat*(1-phat)/
   finalsize));
upperlim = phat + (zalpha*sqrt(phat*(1-phat)/
   finalsize));
disp(upperlim, "to ",lowerlim,"The 99% confidence
   interval is "   )
```

Scilab code Exa 7.6a Life of a product

```
sum_lives = 1740;
num = 10;
alpha = (1-0.95)/2;
chi1= cdfchi("X", (2*num), alpha, 1-alpha);
chi2 = cdfchi("X", (2*num), 1-alpha, alpha);
//disp(chi2)
lowerlim = 2*sum_lives/chi2;
upperlim = 2*sum_lives/chi1;
disp(upperlim, "to ",lowerlim,"The 95% confidence
   interval is "   )

//The confidence interval is from 101.847 to 360.211
    whereas my solution in Scilab is 101.84489 to
362.8485 because of the difference in the value of
   chi-square(0.975, 20). The textbook says the
   value is
9.661 whereas scilab calculates its value as 9.59
```

Scilab code Exa 7.7a Point estimator

```
function result1= estimator1(X)
    result1= X(1);
    //result2= mean(X);

endfunction
function result2= estimator2(X)
    //result1= X(1);
    result2= mean(X);

endfunction
```

Scilab code Exa 7.7b Point estimator

```
function result1 = estimate(d, sigma)
    sigmainv = 1/sigma;
    new = d./sigma;
    result1 = sum(new)/sum(sigmainv);
endfunction

function result2 = mserror( sigma)
    sigmainv = 1/sigma;

    result1 = 1/sum(sigmainv);
endfunction
```

Scilab code Exa 7.7c Point estimator of a uniform distribution

```
function result = unbiasedestimator(X, n)
    c=(n+2)/(n+1);
    result = c*max(X);
endfunction
```

Scilab code Exa 7.8a Bayes estimator

```
1 function result= estimator(X, n)
2     result= (sum(X) +1)/(n+2);
3 endfunction
```

Scilab code Exa 7.8b Bayes estimator of a normal population

```
1 function result= meanestimator(sigma0 , u, sigma, n,
      X)
2     meanX= mean(X);
3     result = (n*meanX/sigma0)/((n/sigma0)+(1/sigma))
          + (u/sigma)/((n/sigma0)+(1/sigma));
4 endfunction
5
6 function result= varestimator(sigma0 , sigma, n)
7     result = (sigma0*sigma)/((n*sigma)+sigma0);
8 endfunction
```

Scilab code Exa 7.8d estimator of the signal value

```
1 function result= meanestimator(sigma0 , u, sigma, n,
      X)
2     meanX= mean(X);
3     result = (n*meanX/sigma0)/((n/sigma0)+(1/sigma))
          + (u/sigma)/((n/sigma0)+(1/sigma));
4 endfunction
5
6 function result= varestimator(sigma0 , sigma, n)
```

```
7       result = (sigma0*sigma)/((n*sigma)+sigma0);
8   endfunction
9
10  u = 50;
11  sigma= 100;
12  sigma0 = 60;
13  n =1;
14  X =40;
15  expec = meanestimator(sigma0 , u, sigma, n, X);
16  var  = varestimator (sigma0, sigma,n);
17  //disp(expec);
18  //disp(var);
19
20  zalpha = 1.645
21  lowerlim = -1*sqrt(var)*zalpha+expec;
22  upperlim = sqrt(var)*zalpha+expec;
23  disp(upperlim, "to ",lowerlim,"With probability 0.9,
        the sent signal lies between ",   )
```

Chapter 8

Hypothesis Testing

Scilab code Exa 8.3a Noise in a Signal

```
noise_var = 4;
noise_mean= 0;
num = 5;
Xbar = 9.5;
u = 8;
statistic = sqrt(num/noise_var)*(Xbar - u);
compare = cdfnor("X", 0, 1, 0.975, 0.025);
if(statistic<compare)
    disp("Hypothesis is accepted");
else
    disp("Hypothesis is not accepted")
end
```

Scilab code Exa 8.3b Error in a signal

```
noise_var = 4;
noise_mean= 0;
num = 5;
```

```
4 Xbar = 8.5;
5 u = 8;
6 statistic = sqrt(num/noise_var)*(Xbar - u);
7
8 prob = 2*cdfnor("PQ", -1*statistic , 0,1 );
9 disp(prob, "P-value is")
```

Scilab code Exa 8.3c Error in a signal

```
1 noise_var = 4;
2 num = 5;
3 Xbar = 10;
4 u = 8;
5 statistic = sqrt(num/noise_var)*(Xbar - u);
6 compare = cdfnor("X", 0, 1, 0.975, 0.025);
7 lim1 = statistic + compare;
8 lim2 = statistic - compare;
9 prob = cdfnor("PQ", lim1 , 0,1 ) - cdfnor("PQ", lim2
      , 0,1 );
10 disp(prob)
```

Scilab code Exa 8.3d Number of signals to be sent

```
1 alpha = 0.025;
2 betaa = 0.25;
3
4 u1 = 9.2;
5 uo = 8;
6 var =4;
7 zalpha = cdfnor("X", 0, 1, 1-alpha, alpha);
8 zbeta = cdfnor("X", 0, 1, 1-betaa, betaa);
9 //disp(zalpha);
10 n = ((zalpha + zbeta)/(u1-uo))^2 *var;
```

```
11 disp(ceil(n), "Required number of samples is")
12 statistic = sqrt(ceil(n)/var)*(u1 - uo);
13 //disp(statistic);
14 lim1 = -1*statistic + zalpha;
15 lim2 = -1*statistic - zalpha;
16 //disp(lim1)
17 //disp(lim2)
18 prob = cdfnor("PQ", lim1 , 0,1 ) - cdfnor("PQ", lim2
       , 0,1 );
19 disp(1-prob, "Thus, if the message is sent the reqd
     number of times is , then the probability that
     the null hypothesis will be rejected is")
```

Scilab code Exa 8.3e Number of signals to be sent

```
1 n =5;
2 Xbar = 9.5;
3 uo = 8;
4 var = 4;
5 statistic = sqrt(n/var)*(Xbar - u);
6 p = 1 - cdfnor("PQ", statistic, 0, 1);
7 disp("The test would call for rejection at all
     significance levels greater than or equal to ")
8 disp(p);
```

Scilab code Exa 8.3f Nicotine content in a cigarette

```
1 n =20;
2 Xbar = 1.54;
3 uo = 1.6;
4 sd = 0.8;
5 statistic = sqrt(n)*(Xbar - uo)/sd;
6 disp(statistic, "Test statistic is")
```

```
7 p =  cdfnor("PQ", statistic, 0, 1);
8 disp(p, "P-value is")
```

Scilab code Exa 8.3g Blood cholestrol level

```
1 n = 50;
2 Xbar = 14.8;
3 S = 6.4;
4 T = sqrt(n)*Xbar/S;
5 disp(T,"The T value is")
```

Scilab code Exa 8.3h Water usage

```
1 X= [340 356 332 362 318 344 386 402 322 360 362 354
     340 372 338 375 364 355 324 370];
2 uo = 350;
3 Xbar = mean(X);
4 var =  variance(X);
5 S = sqrt(var)
6 //disp(Xbar, sqrt(var));
7 n = length(X)
8 T = sqrt(n)*(Xbar - uo)/S;
9 Tvalue = cdft("T", n-1, 0.95, 0.05 );
10 //disp(Tvalue)
11 disp(T, "The T value is ")
12 if(T<Tvalue)
13     disp("Null hypothesis is accepted at 10% level
          of significance")
14  else
15       disp("Null hypothesis is not accepted at 10%
            level of significance")
16 end
```

Scilab code Exa 8.3i Life of a tire

```
X= [36.1 40.2 33.8 38.5 42 35.8 37 41 36.8 37.2 33
   36];
n = length(X);
uo = 40;
Xbar=mean(X);
sd = sqrt(variance(X));
T = sqrt(n)*(Xbar - uo)/sd;
Tvalue = cdft("T", n-1, 0.05, 0.95 );
//disp(Tvalue)
disp(T, "The T value is ")
if(T<Tvalue)
    disp("Null hypothesis is rejected at 5% level of
        significance")
 else
      disp("Null hypothesis is  accepted at 5% level
         of significance")
end
```

Scilab code Exa 8.3j Service Time

```
X = [8.6 9.4 5.0 4.4 3.7 11.4 10.0 7.6 14.4 12.2
   11.0 14.4 9.3 10.5 10.3 7.7 8.3 6.4 9.2 5.7 7.9
   9.4 9.0 13.3 11.6 10.0 9.5 6.6];
n = length(X);
uo = 8;
Xbar=mean(X);
sd = sqrt(variance(X));
T = sqrt(n)*(Xbar - uo)/sd;
disp(T, "The test statistic is ")
p = 1- cdft("PQ", T, n-1);
```

```
9 disp(p, "P-value is")
10 disp("A small p value indicates that the mean
    service time exceeds 8 minutes")
```

Scilab code Exa 8.4a Tire lives

```
1 A = [61.1 58.2 62.3 64 59.7 66.2 57.8 61.4 62.2
    63.6];
2 B= [62.2 56.6 66.4 56.2 57.4 58.4 57.6 65.4];
3 uA = mean(A);
4 uB = mean(B);
5 varA = 40^2;
6 varB =60^2;
7 n= length(A);
8 m =length(B);
9 den = sqrt((varA/n)+ (varB/m));
10 statistic = (uA -uB)/den;
11 disp(statistic, "The test statistic is");
12 disp("A small value of the test statistic indicates
    that the null hypothesis is accepted")
```

Scilab code Exa 8.4b Medicine for cold

```
1 X = [5.5 6.0 7.0 6.0 7.5 6.0 7.5 5.5 7.0 6.5];
2 Y = [6.5 6.0 8.5 7.0 6.5 8.0 7.5 6.5 7.5 6.0 8.5 7.0
     ];
3 n = length(X);
4 m= length(Y);
5 Xbar= mean(X);
6 Ybar = mean(Y);
7 Sx = variance(X);
8 Sy = variance(Y);
9 Sp = ((n-1)*Sx/(n+m-2)) + ((m-1)*Sy/(n+m-2));
```

```
10 den = sqrt(Sp*((1/n)+(1/m)));
11 TS = (Xbar -Ybar)/den;
12 disp(TS, "The test statistic is");
13 tvalue = cdft("T", m+n-2, 0.95, 0.05)
14 //disp(tvalue)
15 if(TS<tvalue)
16     disp("Null hypothesis is rejected at 5% level of
       significance")
17  else
18       disp("Null hypothesis is  accepted at 5% level
         of significance")
19 end
```

Scilab code Exa 8.4c Unknown population variance

```
1 A = [61.1 58.2 62.3 64 59.7 66.2 57.8 61.4 62.2
   63.6];
2 B= [62.2 56.6 66.4 56.2 57.4 58.4 57.6 65.4];
3 uA = mean(A);
4 uB = mean(B);
5 n= length(A);
6 m =length(B);
7 Sx = variance(A);
8 Sy = variance(B);
9 Sp = ((n-1)*Sx/(n+m-2)) + ((m-1)*Sy/(n+m-2));
10 den = sqrt(Sp*((1/n)+(1/m)));
11 TS = (uA-uB)/den;
12 disp(TS, "The test statistic is");
13 pvalue = 2*(1- cdft("PQ", TS, m+n-2));
14 //disp(tvalue)
15 disp(pvalue, "Null hypothesis is accepted at any
   significance level less than")
```

Scilab code Exa 8.4d effectiveness of safety program

```
A = [30.5 18.5 24.5 32 16 15 23.5 25.5 28 18];
B = [23 21 22 28.5 14.5 15.5 24.5 21 23.5 16.5];
n= length(A);
W = B-A;
Wbar = mean(W);
S = sqrt(variance(W));
T = sqrt(n)*Wbar/S;

disp(T, "The test statistic is");
pvalue =  cdft("PQ", T, n-1);
//disp(tvalue)
disp(pvalue, "The p value is")
```

Scilab code Exa 8.5a effectiveness of machine

```
n =20;
S2= 0.025;
chk = 0.15;
compare = (n-1)*S2/(chk^2);
pvalue = 1- cdfchi("PQ", compare, n-1);
disp(pvalue, "The p-value is")
disp("Thus , the null hypothesis is accepted")
```

Scilab code Exa 8.5b Catalyst

```
S1 = 0.14;
S2 = 0.28;
n= 10;
m= 12;
ratio  = S1/S2;
prob1 = cdff("PQ", ratio, n-1, m-1);
```

```
prob2 = 1-prob1;
prob = min([prob1 prob2]);
pvalue = 2*prob;
disp(pvalue, "The p value is")
disp("So the hypothesis of equal variance cannot be
   rejected")
```

Scilab code Exa 8.6a Computer chip manufacturing

```
samplesize = 300;
p =0.02;
defective=9;
val = 1- cdfbin("PQ", defective, samplesize, p, 1-p)
   ;
disp(val, "P0.02{X>10} = ");
disp("Manufacturers claim cannot be rejected at the
   5% level of significance")
```

Scilab code Exa 8.6b Finding p value

```
samplesize = 300;
p =0.02;
defective=9;
compare = 10;
npo = samplesize*p;
sd = sqrt(npo*(1-p));
tol = 0.5;
pvalue = 1- cdfnor("PQ", compare-tol, npo,sd );
disp(pvalue, "The pvalue is")
```

Scilab code Exa 8.6c Change in manufacturing pattern

```
samplesize = 500;
p =0.04;
defective=16;
prob1 =  cdfbin("PQ", defective, samplesize, p, 1-p)
prob2 = 1- cdfbin("PQ", defective-1, samplesize, p,
   1-p);
pvalue = 2*min([prob1 prob2]);
disp(pvalue, "The pvalue is")
```

Scilab code Exa 8.7a Mean number of defective chips

```
x = [28 34 32 38 22];
claim = 25;
total = sum(x);
pval = 1 - cdfpoi("PQ", total-1, (claim*length(x)));
disp(pval, "The pvalue is")
```

Scilab code Exa 8.7b Safety Conditions in a plant

```
plant1 = [16 18 9 22 17 19 24 8];
plant2 = [22 18 26 30 25 28];
X1= sum(plant1);
X2 = sum(plant2);
n =length(X1);
m= length(X2);
//disp(X1, X2, X1+X2)
prob1 = 1 - cdfbin("PQ",X1 -1,X1+X2, (4/7), (3/7) );
prob2 = cdfbin("PQ",X1 ,X1+X2, 4/7, 3/7 );
disp(prob1, prob2)
pvalue = 2*min([prob1 prob2]);
disp(pvalue, "The pvalue is")
```

Scilab code Exa 8.7c Better proof reader

```
1 Aerror =28;
2 Berror = 18;
3 common =10;
4 N2 = Aerror - common;
5 N3 =Berror- common;
6 pval = 1- cdfbin("PQ", N2-1, N2 + N3, 0.5, 0.5);
7 disp(pval, "P-value is")
```

Chapter 9

Regression

Scilab code Exa 9.1a Scatter Diagram

```
1 X= [100 110 120 130 140 150 160 170 180 190];
2 Y= [45 52 54 63 62 68 75 76 92 88];
3 plot2d(X, Y, -1);
4 disp("A linear regression model seems appropriate")
```

Scilab code Exa 9.2a Relative humidity and moisture content

```
1 A = [46 53 29 61 36 39 47 49 52 38 55 32 57 54 44];
2 B = [12 15 7 17 10 11 11 12 14 9 16 8 18 14 12];
3 plot2d(A, B, -1);
4 [X, Y] = reglin(A, B);
5 //disp(X);
6 //disp(Y);
7 p = 0 : 0.1: 65;
8 q = p.*X + Y
```

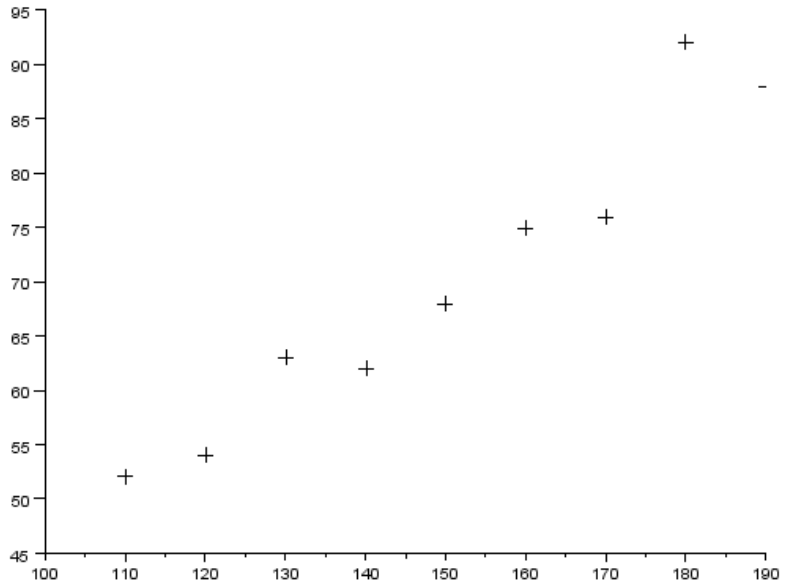

Figure 9.1: Scatter Diagram

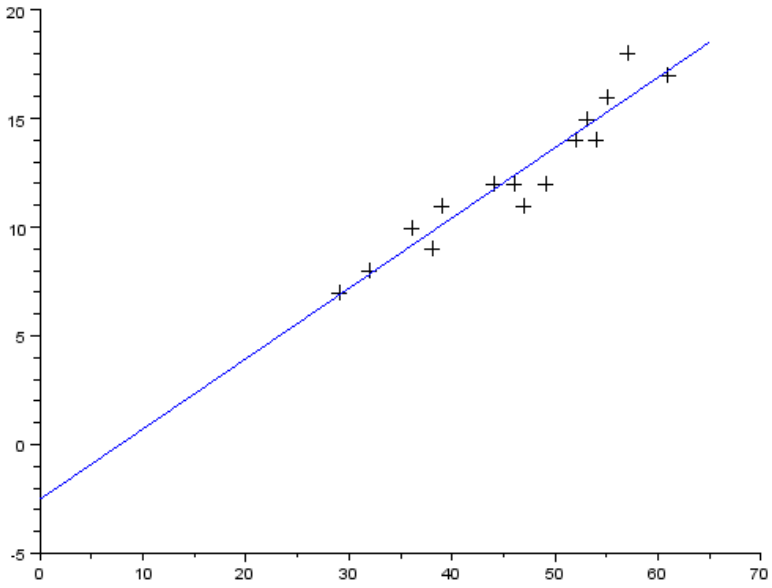

Figure 9.2: Relative humidity and moisture content

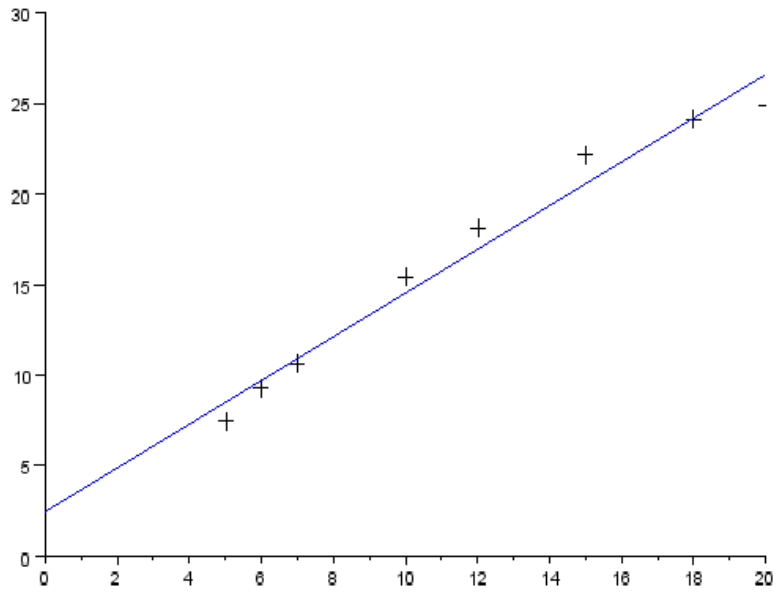

Figure 9.3: Moisture against Density

```
9 plot2d(p, q, 2);
```

Scilab code Exa 9.3a Moisture against Density

```
1 x= [5 6 7 10 12 15 18 20];
2 y= [7.4 9.3 10.6 15.4 18.1 22.2 24.1 24.8];
3 plot2d(x,y,-1);
4
5 xbar = mean(x);
6 ybar= mean(y);
7 n= 8;
```

```
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);
disp(A, "A is");
disp(B, "B is");
p= 0:0.1: 20;
q= A + B*p;
plot2d(p,q,2);

SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
disp(SSR, "The SSR is")
```

Scilab code Exa 9.4a Effect of speed on mileage

```
x= [45 50 55 60 65 70 75];
y= [24.2 25.0 23.3 22.0 21.5 20.6 19.8];
xbar = mean(x);
ybar= mean(y);
n= 7;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end
```

```
10
11 Sxx = 0;
12 for i=1:n
13     Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
14 end
15 SYY = 0;
16 for i=1:n
17     SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
18 end
19 B = SxY/Sxx;
20 A = ybar - (B*xbar);
21 //disp(A, "A is");
22 //disp(B, "B is");
23
24 SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
25 //disp(SSR, "The SSR is")
26 ts = sqrt(((n-2)*Sxx)/SSR)*abs(B);
27 disp(ts, "the test statistic is");
28 tvalue= cdft("T",5, 0.995, 0.005 );
29 //disp(tvalue, "tvalue is");
30 if(tvalue < ts)
31     disp("Hypothesis beta= 0 is rejected at 1% level
       of significance")
32 else
33     disp("Hypothesis beta= 0 is accepted at 1% level
       of significance")
34  end
```

Scilab code Exa 9.4b Confidence interval estimate

```
1 x= [45 50 55 60 65 70 75];
2 y= [24.2 25.0 23.3 22.0 21.5 20.6 19.8];
3 xbar = mean(x);
4 ybar= mean(y);
5 n= 7;
```

```
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);
//disp(A, "A is");
//disp(B, "B is");

SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
//disp(SSR, "The SSR is")

tvalue= cdft("T",5, 0.975, 0.025 );
k = sqrt(SSR/((n-2)*Sxx))*tvalue;
int1 = B + k;
int2= B-k;
disp(int2, "to ", int1 ,"The 95% confidence interval
    is " );
```

Scilab code Exa 9.4c Regression to the mean

```
x= [60 62 64 65 66 67 68 70 72 74];
y= [63.6 65.2 66 65.5 66.9 67.1 67.4 68.3 70.1 70];
plot2d(x,y,-1);
```

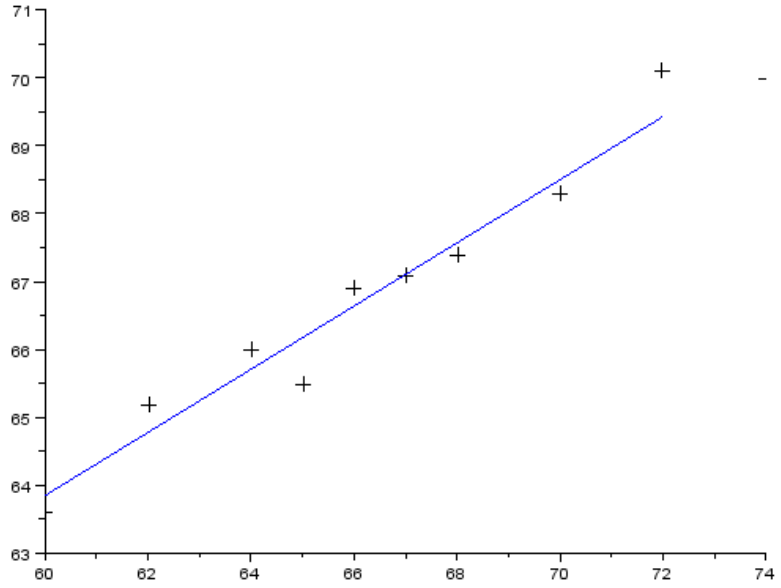

Figure 9.4: Regression to the mean

```
xbar = mean(x);
ybar= mean(y);
n= 10;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);
//disp(A, "A is");
//disp(B, "B is");
p= 60:0.1: 72;
q= A + B*p;
plot2d(p,q,2);
SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
ts = sqrt(((n-2)*Sxx)/SSR)*(B-1)
//disp(ts);
tvalue= cdft("T",n-2, 0.99, 0.01 );
//disp(tvalue);
if(ts<(-1*tvalue))
    disp("Null hypotheis is rejected at 1% level of
       significance")
else
    disp("Null hypotheis is accepted at 1% level of
       significance")
end
```

Scilab code Exa 9.4d Motor vehicle deaths

```
x= [121 96 85 113 102 118 90 84 107 112 95 101];
y= [104 91 101 110 117 108 96 102 114 96 88 106];

plot2d(x,y,-1);
xlabel("Deaths in 1988");
ylabel("Deaths in 1989");

xbar = mean(x);
ybar= mean(y);
n= 12;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);
disp(A, "A is");
disp(B, "B is");
```

Scilab code Exa 9.4e Confidence interval for height

```
x= [60 62 64 65 66 67 68 70 72 74];
y= [63.6 65.2 66 65.5 66.9 67.1 67.4 68.3 70.1 70];
x0 = 68;
xbar = mean(x);
ybar= mean(y);
n= 10;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end
//disp(SxY, "SxY is");
Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
//disp(Sxx, "Sxx is");
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
//disp(SYY, "SYY is");
B = SxY/Sxx;
A = ybar - (B*xbar);
tvalue= cdft("T",n-2, 0.975, 0.025 );
SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
//disp(tvalue, "tvalue is");
intvl = A + (B*x0);
//disp(intvl);
change = sqrt((1/n)+(((x0-xbar)^2)/Sxx))* sqrt(SSR/(
   n-2))*tvalue;
intvl1 = intvl - change;
intvl2= intvl + change;
disp(intvl2, "to ", intvl1 ,"The 95% confidence
   interval is "  );
```

Scilab code Exa 9.4f Confidence interval for height

```
x= [60 62 64 65 66 67 68 70 72 74];
y= [63.6 65.2 66 65.5 66.9 67.1 67.4 68.3 70.1 70];
x0 = 68;
xbar = mean(x);
ybar= mean(y);
n= 10;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end
//disp(SxY, "SxY is");
Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
//disp(Sxx, "Sxx is");
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
//disp(SYY, "SYY is");
B = SxY/Sxx;
A = ybar - (B*xbar);
tvalue= cdft("T",n-2, 0.975, 0.025 );
SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
//disp(tvalue, "tvalue is");
intvl = A + (B*x0);
//disp(intvl);
change = sqrt(((n+1)/n)+(((x0-xbar)^2)/Sxx))* sqrt(
   SSR/(n-2))*tvalue;
intvl1 = intvl - change;
intvl2= intvl + change;
disp(intvl2, "to ", intvl1 ,"The 95% confidence
   interval is " );
```

Scilab code Exa 9.5a Height of son and father

```
x= [60 62 64 65 66 67 68 70 72 74];
y= [63.6 65.2 66 65.5 66.9 67.1 67.4 68.3 70.1 70];

xbar = mean(x);
ybar= mean(y);
n= 10;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);

SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
R2 = 1 - (SSR/SYY);
disp(R2, "The coefficient of determination is")
```

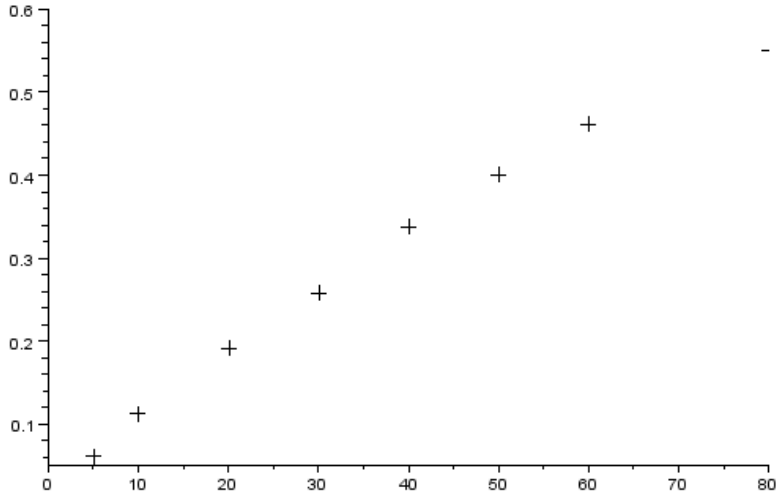

Figure 9.5: Percentage of chemical used

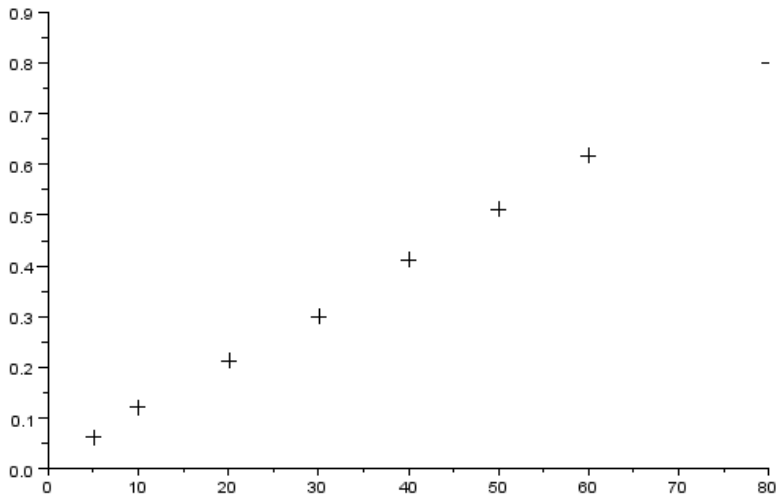

Figure 9.6: Percentage of chemical used

Scilab code Exa 9.7a Percentage of chemical used

```
x= [5 10 20 30 40 50 60 80];
yold= [0.061 0.113 0.192 0.259 0.339 0.401 0.461
   0.551];
plot2d(x, yold, -1);
y = -1*log(1-yold);
scf(2);
plot2d(x, y, -1);


xbar = mean(x);
ybar= mean(y);
n= 8;
SxY = 0;
for i= 1:n
    SxY = SxY + (x(i)*y(i)) - (xbar*ybar);
end

Sxx = 0;
for i=1:n
    Sxx= Sxx + (x(i)*x(i)) - (xbar*xbar);
end
SYY = 0;
for i=1:n
    SYY = SYY + (y(i)*y(i)) - (ybar*ybar);
end
B = SxY/Sxx;
A = ybar - (B*xbar);
//disp(A, "A is");
//disp(B, "B is");
SSR = ((Sxx*SYY)- (SxY*SxY))/Sxx ;
chat = exp(-1*A);
dhat = 1 - exp(-1*B);
disp(chat, "chat is");
disp(dhat, "dhat is");
```

Scilab code Exa 9.8b Distance vs Travel Time

```
x = [0.5 1 1.5 2 3 4 5 6 8 10];
y= [15 15.1 16.5 19.9 27.7 29.7 26.7 35.9 42 49.4];
for i=1:10
    w(i) = 1/x(i);
end
//disp(w)
n = 10;
p = zeros(2,2);
q = zeros(2, 1);
p(1, 1) = sum(w);
p(1,2) = n;
p(2,1) = n;
p(2,2) = sum(x);
for i=1:10
    new(i) = w(i)*y(i)
end

q(1,1)= -1*sum(new);
q(2,1) = -1*sum(y);
//disp(p);
//disp(q);
sol = linsolve(p,q);
A = sol(1,1 );
B = sol(2,1);
disp(A, "A is");
disp(B, "B is");
```

Scilab code Exa 9.9a Polynomial Fitting

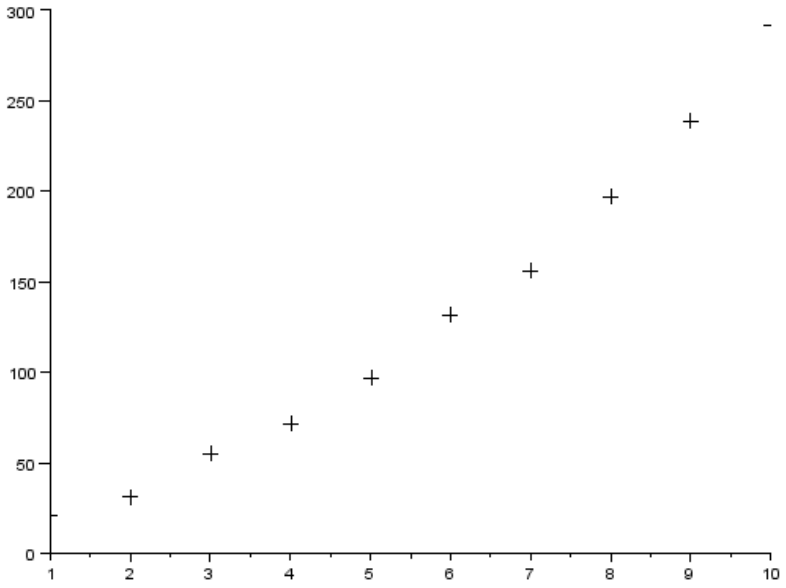

Figure 9.7: Polynomial Fitting

```
x = 1:1:10;
y= [20.6 30.8 55 71.4 97.3 131.8 156.3 197.3 238.7
   291.7];
plot2d(x, y, -1);
xlabel('X');
ylabel('Y');
n = length(x)
xsquared = x.^2;
xcube = x.^3;
xfour = x.^4;
xy = x.*y;
x2y = xy.*x;
p= zeros(3,3);
q = zeros(3,1);
p(1,1) = n;
p(1,2) = sum(x);
p(1,3)=sum(xsquared);
p(2,1) = sum(x);
p(2,2) = sum(xsquared);
p(2,3)=sum(xcube);
p(3,1) = sum(xsquared);
p(3,2) = sum(xcube);
p(3,3)=sum(xfour);
q(1,1)= -1*sum(y);
q(2,1) = -1*sum(xy);
q(3,1) = -1*sum(x2y);
B= linsolve(p, q);
disp(B(1,1), "B0 is");
disp(B(2,1), "B1 is");
disp(B(3,1), "B2 is");
```

Scilab code Exa 9.10a Multiple Linear Regression

```
x1= [679 1420 1349 296 6975 323 4200 633];
x2 = [30.4 34.1 17.2 26.8 29.1 18.7 32.6 32.5];
```

```
y = ones(8,1);
y= [11.6 ;16.1; 9.3; 9.1; 8.4; 7.7; 11.3; 8.4];
x = ones(8,3);
for i=1:8
    x(i,2)= x1(i);
    x(i,3)= x2(i);
end

pro1 = x';
//disp(pro1);

pro2= pro1*x;
//disp(pro2);
pro3 = inv(pro2);
//disp(pro3);
pro4 = pro3*pro1;
pro5 = pro4*y;
//disp(pro4);
//disp(y);
B= ones(3,1);
for i=1:3
    B(i,1)= 0;
    for k=1:8
        B(i,1)=B(i,1)+(pro4(i, k)*y(k, 1));
    end
end
disp(B);
//SSR = y'*y - B'*x'y;
SSR = y';
SSR= SSR*y;
sub = B';
sub = sub*x';
sub= sub*y;
SSR =SSR - sub;
disp(SSR, "SSr is");
```

Scilab code Exa 9.10b Estimate of variance

```
x1= [679 1420 1349 296 6975 323 4200 633];
x2 = [30.4 34.1 17.2 26.8 29.1 18.7 32.6 32.5];
y = ones(8,1);
n= 8;
k =2;
y= [11.6 ;16.1; 9.3; 9.1; 8.4; 7.7; 11.3; 8.4];
x = ones(8,3);
for i=1:8
    x(i,2)= x1(i);
    x(i,3)= x2(i);
end

pro1 = x';
//disp(pro1);

pro2= pro1*x;
//disp(pro2);
pro3 = inv(pro2);
//disp(pro3);
pro4 = pro3*pro1;
pro5 = pro4*y;
//disp(pro4);
//disp(y);
B= ones(3,1);
for i=1:3
    B(i,1)= 0;
    for k=1:8
        B(i,1)=B(i,1)+(pro4(i, k)*y(k, 1));
    end
end
//disp(B);
//SSR = y'*y - B'*x'y;
```

```
33 SSR = y';
34 SSR= SSR*y;
35 sub = B';
36 sub = sub*x';
37 sub= sub*y;
38 SSR =SSR - sub;
39 //disp(SSR, "SSr is");
40 k=2;
41 den = n-k-1;
42 disp(den)
43 sigma = SSR/den;
44 disp(sigma, "The variance is")
```

Scilab code Exa 9.10c Diameter of a tree

```
1 x1 = [44 33 33 32 34 31 33 30 34 34 33 36 33 34 37];
2 x2= [1.3 2.2 2.2 2.6 2.0 1.8 2.2 3.6 1.6 1.5 2.2 1.7
      2.2 1.3 2.6];
3 x3 = [250 115 75 85 100 75 85 75 225 250 255 175 75
     85 90];
4 x4= [0.63 0.59 0.56 0.55 0.54 0.59 0.56 0.46 0.63
     0.60 0.63 0.58 0.55 0.57 0.62 ];
5 y = [18.1; 19.6; 16.6; 16.4; 16.9 ;17.0; 20.0; 16.6;
      16.2; 18.5 ; 18.7; 19.4; 17.6; 18.3; 18.8];
6 n =length(x1);
7 x= ones(15, 5);
8 for i=1:15
9     x(i,2)= x1(i);
10    x(i,3)= x2(i);
11    x(i,4)= x3(i);
12    x(i,5)= x4(i);
13 end
14 pro1 = x';
15 //disp(pro1);
16 pro2= pro1*x;
```

```
17 //disp(pro2);
18 pro3 = inv(pro2);
19 //disp(pro3);
20 pro4 = pro3*pro1;
21 pro5 = pro4*y;
22
23 for i=1:5
24     B(i,1)= 0;
25     for k=1:15
26         B(i,1)=B(i,1)+(pro4(i, k)*y(k, 1));
27     end
28 end
29 SSR = y';
30 SSR= SSR*y;
31 sub = B';
32 sub = sub*x';
33 sub= sub*y;
34 SSR =SSR - sub;
35 //disp(SSR);
36 //disp(B(2))
37 xxinv = 0.379;
38 k= 4;
39 ts = sqrt((n-k-2)/SSR)*B(2)/0.616;
40 pvalue = 2*(1- cdft("PQ",ts, n-k-2 ));
41 disp(pvalue, "The p-value is")
42
43 The SSR calculated by scilab is 19.34 whereas the
     textbook gives the value as 19.26 , thus the
44
45 difference in the final answer.
```

Scilab code Exa 9.10d Estimating hardness

```
1 y=[79.2 ;64.0; 55.7; 56.3; 58.6; 84.3; 70.4; 61.3;
     51.3; 49.8];
```

```
x1 = [0.02 0.03 0.03 0.04 0.10 0.15 0.15 0.09 0.13
   0.09];
x2 = [1.05 1.20 1.25 1.30 1.30 1.00 1.10 1.20 1.40
   1.40];
tvalue= 2.365;
x = ones(10,3);
for i=1:10
    x(i,2)= x1(i);
    x(i,3)= x2(i);
end

pro1 = x';
//disp(pro1);

pro2= pro1*x;
//disp(pro2);
pro3 = inv(pro2);
//disp(pro3);
pro4 = pro3*pro1;
pro5 = pro4*y;
//disp(pro4);
//disp(y);
B= ones(3,1);
for i=1:3
    B(i,1)= 0;
    for k=1:10
        B(i,1)=B(i,1)+(pro4(i, k)*y(k, 1));
    end
end
//disp(B);
//SSR = y'*y - B'*x'y;
SSR = y';
SSR= SSR*y;
sub = B';
sub = sub*x';
sub= sub*y;
SSR =SSR - sub;
disp(SSR, "SSr is");
```

```
38 smallx = [1, 0.15, 1.15];
39 product = smallx * B;
40 //disp(product);
41 n = 10;
42 k=2;
43 val= sqrt(SSR/(n-k-1));
44 //disp(val);
45
46 pro5 = smallx * pro3;
47 pro6 = pro5* smallx';
48 pro7 = val*sqrt(pro6)*tvalue;
49 //disp(pro7)
50 up = product + pro7;
51 low = product - pro7;
52 disp(" 95% confidence interval is from ");
53 disp(up, "to", low);
```

Scilab code Exa 9.11a Animal fsickalling

```
1 cancer = 84;
2 total = 111;
3 level = 250;
4 alpha= -1*log((total-cancer)/total)/level;
5 disp(alpha , "Alpha is ")
```

Chapter 10

Analysis of Variance

Scilab code Exa 10.3a Dependence of mileage on gas used

```
1  Xij = [220 251 226 246 260; 244 235 232 242 225; 252
       272 250 238 256];
2  Xi = zeros(3,1);
3  n= 5;
4  m=3;
5  for i=1:3
6      for j=1:5
7          Xi(i)= Xi(i) + Xij(i,j);
8      end
9  end
10 Xi = Xi/n;
11 SSW= 0;
12 for i=1:3
13     for j= 1:5
14         SSW = SSW + ((Xij(i,j)-Xi(i))^2)
15     end
16 end
17 sigma1 = SSW/((n*m)-m);
18 Xdotdot = sum(Xi)/m;
19 new = (Xi - Xdotdot)^2;
20 SSb= n*sum(new);
```

```
21 sigma2 = SSb/(m-1);
22 TS = sigma2/sigma1;
23 //disp(sigma1);
24 //disp(sigma2);
25 disp(TS, "Value of the test statistic is");
26 pvalue = 1 - cdff("PQ", TS,m-1, ((n*m)-m) );
27 disp(pvalue, "The p-value is")
28 if(pvalue>0.05)
29 disp( "Since the p-value is greater than .05, the
      null hypothesis that the mean mileage is the same
       for all 3 brands of gasoline cannot be rejected.
      ")
30 end
```

Scilab code Exa 10.3b Dependence of mileage on gas used

```
1 Xijold = [220 251 226 246 260; 244 235 232 242 225;
     252 272 250 238 256];
2 Xij = Xijold - 220;
3 m=3;
4 n=5;
5 Xidot = zeros(3,1);
6 for i=1:m
7     for j=1:n
8         Xidot(i)=Xidot(i) + Xij(i,j);
9     end
10 end
11 Xidot = Xidot/n;
12 Xdotdot = sum(Xidot)/m;
13 SSb=0;
14 for i=1:m
15     SSb = SSb + (Xidot(i)-Xdotdot)^2;
16 end
17 SSb = SSb*n;
18 Xijsquared = Xij.^2;
```

```
SSW = sum(Xijsquared) - (m*n*(Xdotdot^2)) - SSb;
sigma1 = SSW/((n*m)-m);
sigma2 = SSb/(m-1);
TS = sigma2/sigma1;
disp(TS, "Value of the test statistic is");
```

Scilab code Exa 10.3c Difference in GPA

```
Xij = [3.2 3.4 3.3 3.5; 3.4 3.0 3.7 3.3; 2.8 2.6 3.0
    2.7];
Xi = zeros(3,1);
n= 4;
m=3;
for i=1:3
    for j=1:4
        Xi(i)= Xi(i) + Xij(i,j);
    end
end
Xi = Xi/n;
SSW= 0;
for i=1:3
    for j= 1:4
        SSW = SSW + ((Xij(i,j)-Xi(i))^2)
    end
end
sigma1 = SSW/((n*m)-m);
Xdotdot = sum(Xi)/m;
new = (Xi - Xdotdot)^2;
SSb= n*sum(new);
sigma2 = SSb/(m-1);
TS = sigma2/sigma1;
//disp(sigma1);
//disp(sigma2);
disp(TS, "Value of the test statistic is");
pvalue = 1 - cdff("PQ", TS,m-1, ((n*m)-m) );
```

```
27 disp(pvalue, "The p-value is")
28 C = 3.95; //from table A5
29 W = C*sqrt(SSW/(9*4));
30 disp(W);
31 disp(Xi(1)-Xi(2)+W ,"and ", Xi(1)-Xi(2)-W, "Mean1 -
      Mean2 lies between " );
32 disp(Xi(1)-Xi(3)+W ,"and ", Xi(1)-Xi(3)-W, "Mean1 -
      Mean3 lies between " );
33 disp(Xi(2)-Xi(3)+W ,"and ", Xi(2)-Xi(3)-W, "Mean2 -
      Mean3 lies between " );
```

Scilab code Exa 10.4b Estimating Parameters

```
1  X=[75 73 60 70 86; 78 71 64 72 90; 80 69 62 70 85;
      73 67 63 80 92 ];
2  Xidot = zeros(4,1);
3  for i=1:4
4      for j=1:5
5          Xidot(i)=Xidot(i) + X(i,j);
6      end
7  end
8  Xidot = Xidot/5;
9  Xjdot = zeros(5,1);
10 for j=1:5
11     for i=1:4
12         Xjdot(j)=Xjdot(j) + X(i,j);
13     end
14 end
15 Xjdot = Xjdot/4;
16 Xdotdot = sum(Xidot)/4;
17 //disp(Xdotdot)
18 meanhat = Xdotdot;
19 alphahat = Xidot - meanhat;
20 betahat = Xjdot - meanhat;
21 disp(meanhat, "The estimator of the mean is");
```

```
22 disp("The alphas are-")
23 disp(alphahat)
24 disp("The betas are-")
25 disp(betahat)
```

Scilab code Exa 10.5a Species collected

```
1  X = [53 35 31 37 40 43; 36 34 17 21 30 18; 47 37 17
      31 45 26; 55 31 17 23 43 37; 40 32 19 26 45 37;
      52 42 20 27 26 32; 39 28 21 21 36 28; 40 32 21 21
       36 35];
2  m= 8;
3  n = 6;
4  Xidot = zeros(8,1);
5  for i=1:8
6      for j=1:6
7          Xidot(i)=Xidot(i) + X(i,j);
8      end
9  end
10 Xidot = Xidot/6;
11 Xjdot = zeros(6,1);
12 for j=1:6
13     for i=1:8
14         Xjdot(j)=Xjdot(j) + X(i,j);
15     end
16 end
17 Xjdot = Xjdot/8;
18 Xdotdot = sum(Xidot)/8;
19 new = (Xidot - Xdotdot)^2;
20 SSr = n*sum(new);
21 new1 = (Xjdot - Xdotdot)^2;
22 SSc = m*sum(new1);
23 SSe = 0;
24 for i=1:m
25     for j=1:n
```

```
26          SSe = SSe + (X(i,j)-Xidot(i)-Xjdot(j)+
               Xdotdot)^2;
27      end
28  end
29  N =(m-1)*(n-1);
30  TS1 = SSr*N/((m-1)*SSe);
31  TS2 = SSc*N/((n-1)*SSe);
32  pvaluec = 1- cdff("PQ", TS1, m-1, N);
33  pvaluer = 1- cdff("PQ", TS2, n-1, N);
34  //disp(pvaluer, pvaluec);
35  //disp(TS1, TS2);
36  disp(TS1, "The value of the F-statistic for testing
       that there is no row effect is");
37  disp(pvaluec, "The p-value for testing that there is
        no row effect is");
38
39  disp(TS2, "The value of the F-statistic for testing
       that there is no column effect is");
40  disp(pvaluer, "The p-value for testing that there is
        no column effect is");
```

Chapter 11

Goodness of Fit Tests and Categorical Data Analysis

Scilab code Exa 11.2a Relation between death date and birth date

```
X = [90 100 87 96 101 86 119 118 121 114 113 106];
pi= ones(12,1);
pi= pi/12;
new = X.^2;
npi= sum(X)*pi;
T = sum(new);
T = T/npi;
T = T - sum(X);
disp("When there are 12 regions")
disp(T(1), "The test statistic is")
pvalue = 1- cdfchi("PQ",T(1), 11);
disp(pvalue, "The pvalue is ")

X = [277 283 358 333];
pi= ones(4,1);
pi= pi/4;
new = X.^2;
npi= sum(X)*pi;
T = sum(new);
```

```
20 T = T/npi;
21 T = T - sum(X);
22 disp("When there are 4 regions")
23 disp(T(1), "The test statistic is")
24 pvalue = 1- cdfchi("PQ",T(1), 3);
25 disp(pvalue, "The pvalue is ")
```

Scilab code Exa 11.2b Quality of bulbs

```
1 X = [3 6 9 7 5];
2 p= [0.15 0.25 0.35 0.20 0.05];
3 T= 0;
4 n3=sum(X);
5 np = p*n3;
6 Xsqu = (X-np).^2;
7 disp(Xsqu);
8 XT = Xsqu./np;
9 T = sum(XT);
10
11 //T = T - sum(X);
12 //disp("When there are 12 regions")
13 disp(T, "The test statistic is")
14 pvalue = 1- cdfchi("PQ",T(1), 4);
15 //a= cdfchi("PQ",T(1), 4);
16
17 disp(pvalue, "The pvalue is ")
18 disp("Thus, the hypothesis would not be rejected at
   5% level of significance")
```

Scilab code Exa 11.2d Six outcomes

```
1 X = [3 3 5 18 4 7];
2 p= [0.1 0.1 0.05 0.4 0.2 0.15];
```

```
psimu = 0.1843; //p-value obtained by simulation
num= 10000;
T= 0;
n=sum(X);
np = n*p;
Xsqu = X.^2;
for i= 1:6
    T = T + (Xsqu(i)/np(i));
end
T = T - sum(X);

disp(T(1), "The test statistic is")
pvalue = 1- cdfchi("PQ",T(1), 5);
//disp(pvalue, "The pvalue is ")
int1 = psimu - (1.645*sqrt(psimu*(1-psimu)/num));
int2 = psimu + (1.645*sqrt(psimu*(1-psimu)/num));
disp("With 90% confidence p-value lies between ")
disp(int1)
disp("and")
disp(int2);
```

Scilab code Exa 11.3a Weekly accidents

```
Y = [8 0 0 1 3 4 0 2 12 5 1 8 0 2 0 1 9 3 4 5 3 3 4
   7 4 0 1 2 1 2];
weeks = 30;
lamda = sum(Y)/weeks;
p = zeros(5,1);
p(1) = cdfpoi("PQ", 0, lamda);
p(2) = cdfpoi("PQ", 1, lamda) - p(1);
p(3) = cdfpoi("PQ", 3, lamda) - cdfpoi("PQ", 1,
   lamda);
p(4) = cdfpoi("PQ", 5, lamda) - cdfpoi("PQ", 3,
   lamda);
p(5) = 1 - cdfpoi("PQ", 5, lamda);
```

```
10 //disp(p);
11 X = zeros(5,1);
12 for i=1:30
13     if(Y(i)==0)
14         X(1) = X(1) +1;
15     end
16     if(Y(i)==1)
17         X(2) = X(2) +1;
18     end
19     if(Y(i)==2)
20         X(3) = X(3) +1;
21     end
22     if(Y(i)==3)
23         X(3) = X(3) +1;
24     end
25     if(Y(i)==4)
26         X(4) = X(4) +1;
27     end
28     if(Y(i)==5)
29         X(4) = X(4) +1;
30     end
31     if(Y(i)>5)
32          X(5) = X(5) +1;
33      end
34 end
35 //disp(X);
36 T= 0;
37 npi = weeks * p;
38 for i=1:5
39     T = T + ((X(i)-npi(i))^2)/npi(i);
40 end
41 disp(T, "T is");
42 pvalue = 1- cdfchi("PQ", T, 3);
43 disp(pvalue, "The p-value is")
44 disp("Hypothesis of an underlying poisson
   distribution is rejected")
```

Scilab code Exa 11.4a Ploitical affiliation and Gender

```
Nij = [68 56 32; 52 72 20];
n= sum(Nij);
Ni = zeros(2,1);
Mj = zeros(3,1);
for i= 1:2
    for j= 1:3
        Ni(i) = Ni(i) + Nij(i,j);
    end
end
for j= 1:3
    for i= 1:2
        Mj(j) = Mj(j) + Nij(i,j);
    end
end
NM = ones(2,3);
for i=1:2
    for j=1:3
        NM(i,j)= Ni(i)*Mj(j);
    end
end
NM= NM/n;
//disp(NM);
TS = 0
for i=1:2
    for j= 1:3
        TS = TS + ((Nij(i,j)-NM(i,j))^2)/NM(i,j);
    end
end
disp(TS, "The test statistic is")
compare = cdfchi("X", 2, 0.95, 0.05);
//disp(compare)
if(TS>compare)
```

```
33      disp("The null hypothesis is rejected at the 5%
          level of significance");
34  else
35      disp("The null hypothesis is accepted at the 5%
          level of significance");
36  end
```

Scilab code Exa 11.4b Machine Breakdown and shift

```
1  Nij = [68 56 32; 52 72 20];
2  n3= sum(Nij);
3  Ni = zeros(2,1);
4  Mj = zeros(3,1);
5  for i= 1:2
6      for j= 1:3
7          Ni(i) = Ni(i) + Nij(i,j);
8      end
9  end
10 for j= 1:3
11     for i= 1:2
12         Mj(j) = Mj(j) + Nij(i,j);
13     end
14 end
15 NM = ones(2,3);
16 for i=1:2
17     for j=1:3
18         NM(i,j)= Ni(i)*Mj(j);
19     end
20 end
21 NM= NM/n3;
22 //disp(NM);
23 TS = 0
24 for i=1:2
25     for j= 1:3
26         TS = TS + ((Nij(i,j)-NM(i,j))^2)/NM(i,j);
```

```
27      end
28  end
29  disp(TS, "The test statistic is")
30  compare = cdfchi("X", 2, 0.95, 0.05);
31  //disp(compare)
32  if(TS>compare)
33      disp("The null hypothesis is rejected at the 5%
           level of significance");
34  else
35      disp("The null hypothesis is accepted at the 5%
           level of significance");
36  end
```

Scilab code Exa 11.5a Lung cancer and smoking

```
1  Nij = [62 14; 9938 19986];
2  n= sum(Nij);
3  Ni = zeros(2,1);
4  Mj = zeros(2,1);
5  for i= 1:2
6      for j= 1:2
7          Ni(i) = Ni(i) + Nij(i,j);
8      end
9  end
10 for j= 1:2
11     for i= 1:2
12         Mj(j) = Mj(j) + Nij(i,j);
13     end
14 end
15 NM = ones(2,2);
16 for i=1:2
17     for j=1:2
18         NM(i,j)= Ni(i)*Mj(j);
19     end
20 end
```

```
21 NM= NM/n;
22 disp(NM);
23 TS = 0
24 for i=1:2
25     for j= 1:2
26         TS = TS + ((Nij(i,j)-NM(i,j))^2)/NM(i,j);
27     end
28 end
29 disp(TS, "The test statistic is")
30 compare = cdfchi("X", 1, 0.99, 0.01);
31 //disp(compare)
32 if(TS>compare)
33     disp("The null hypothesis is rejected at the 5%
       level of significance");
34 else
35     disp("The null hypothesis is accepted at the 5%
       level of significance");
36 end
```

Scilab code Exa 11.5b Females reporting abuse

```
1 Nij = [28 30 58 55; 472 470 442 445];
2 n= sum(Nij);
3 Ni = zeros(2,1);
4 Mj = zeros(4,1);
5 for i= 1:2
6     for j= 1:4
7         Ni(i) = Ni(i) + Nij(i,j);
8     end
9 end
10 for j= 1:4
11     for i= 1:2
12         Mj(j) = Mj(j) + Nij(i,j);
13     end
14 end
```

```
15 NM = ones(2,4);
16 for i=1:2
17     for j=1:4
18         NM(i,j)= Ni(i)*Mj(j);
19     end
20 end
21 NM= NM/n;
22 //disp(NM);
23 TS = 0
24 for i=1:2
25     for j= 1:4
26         TS = TS + ((Nij(i,j)-NM(i,j))^2)/NM(i,j);
27     end
28 end
29 disp(TS, "The test statistic is")
30 compare = cdfchi("X", 3, 0.99, 0.01);
31 pvalue = 1- cdfchi("PQ", TS, 3);
32 disp(pvalue, "The p-value is")
33 //disp(compare)
34 if(TS>compare)
35     disp("The null hypothesis is rejected at the 1%
       level of significance");
36 else
37     disp("The null hypothesis is accepted at the 5%
       level of significance");
38 end
```

Scilab code Exa 11.6a Testing distribution of a population

```
1 X= [66 72 81 94 112 116 124 140 145 155];
2 D= 0.4831487;
3 n= 10;
4 Dgiven = 1.480;
5 Dstar = (sqrt(n) + 0.12 + (0.11/sqrt(n)))*D;
6 disp(Dstar, "Dstar is ");
```

```
7  if(Dstar>Dgiven)
8      disp("Null hypothesis is rejected at 2.5% level
          of significance")
9  else
10     disp("Null hypothesis is accepted at 2.5% level
          of significance")
11 end
```

Chapter 12

Non parametric Hypothesis Tests

Scilab code Exa 12.2a testing the median

```
n= 200;
v = 120;
p =0.5;
if(v < (n/2))
    pvalue = 2*cdfbin("PQ", v, n, p,1-p);
else
    pvalue = 2*cdfbin("PQ", n-v, n, p,1-p);

end
disp(pvalue, "Pvalue is ");
```

Scilab code Exa 12.2b testing the median

```
n= 80;
v = 28;
p =0.5;
```

```
4
5      pvalue = cdfbin("PQ", v, n, p,1-p);
6  disp(pvalue, "Pvalue is ");
7  disp("Thus, the null hypothesis that the median
      income is less than or equal to $90,000 is
      rejected")
```

Scilab code Exa 12.3b Signed Rank Test

```
1  n =4;
2  mo = 2;
3  X = [4.2 1.8 5.3 1.7];
4  t =3;
5  tstar= min(t, (n*(n+1)/2) - t);
6  P = zeros(4,4);
7  P(1,1)= 0.5;
8  P(1,2) = 1;
9  P(1,3) = 1;
10 P(1,4) = 1;
11 for i=2:4
12     for j = 1:4
13         if (j-i <1)
14            P(i,j) = 0.5*P(i-1, j);
15            //disp(j,i);
16            //disp(P(i,j))
17
18         else
19             P(i,j) = 0.5*(P(i-1,j-i)+P(i-1,j));
20         end
21     end
22 end
23 disp(P)
```

Scilab code Exa 12.3c Determining Population Distribution

```
n =20;
t =142;
tstar= min(t, (n*(n+1)/2) - t);
P = ones(20,tstar+1);
P(1,1)= 0.5;
P(1,2) = 1;
for i=2:20
    for j = 1:tstar+1          if (j-i <1)
            P(i,j) = 0.5*P(i-1, j);
            //disp(j,i);
            //disp(P(i,j))

        else
            P(i,j) = 0.5*(P(i-1,j-i)+P(i-1,j));
        end
    end
end
//disp(P)
pvalue= 2*P(20,tstar+1);
disp(pvalue, "Pvalue is")
```

Scilab code Exa 12.4a Treatments against corrosion

```
X= [65.2 67.1 69.4 78.2 74 80.3];
Y = [59.4 72.1 68 66.2 58.5];
Z = [X Y];
Z = gsort(Z,'g','i');
[m n]=  size(X);
[p q] = size(Z)
T = 0;
for i=1:n
    test = X(i);
    for j =1 : q
```

```
11          if(test== Z(j))
12              T = T+ j;
13          end
14      end
15  end
16  disp(T, "The test statistic is ")
```

Scilab code Exa 12.4b Determining P

```
1  function result= prob(N, M, K)
2        if(N==1 & M==0)
3               if(K >0)
4                  result = 1;
5               else
6                   result =0;
7               end
8
9        elseif (N==0 & M==1)
10              if(K <0)
11                 result = 0;
12              else
13                  result =1;
14              end
15       elseif (N==0 & M==0 &K==0)
16             result =1;
17       else
18         result = (prob(N-1, M, K-N-M)*N/(N+M)) + (
              prob(N, M-1, K)*M/(N+M));
19         //result = prob(N-1, M, K-N-M)*N/(N+M) +
              prob(N, M-1, K);
20         //result = result +  prob(N, M-1, K);
21        end
22 endfunction
23
24 function result =pval(n,m,t)
```

```
25      result = 2*min(prob(n,m,t), 1-prob(n,m,t-1));
26  endfunction
```

Scilab code Exa 12.4c Finding p value

```
1  ans = pval(5,6,21);
2  disp(ans)
```

Scilab code Exa 12.4d Comparing production methods

```
1  ans = pval(9,13,72);
2  disp(ans)
```

Scilab code Exa 12.4e Determining p value

```
1  n1 =5;
2  m1= 6;
3
4  t1 =21;
5  num1 = n1*(n1+m1+1)/2;
6  d1=abs(t1 - num1);
7  val = d1/sqrt(n1*m1*(n1+m1+1)/12);
8  //disp(d1, "d is")
9  //disp(val, "val is")
10 pval = 2*(1-cdfnor("PQ", val, 0,1));
11 disp(pval, "The p-value for eg 12.4a is")
12 n2 =9;
13 m2= 13;
14 t2 =72;
15 d2=abs(t2 - n2*(n2+m2+1)/2);
```

```
16
17 val = d2/sqrt(n2*m2*(n2+m2+1)/12);
18 pval = 2*(1-cdfnor("PQ", val, 0,1));
19 disp(pval, "The p-value for eg 12.4d is")
```

Scilab code Exa 12.5a Testing randomness

```
1  function result= fact(num)
2      if(num<=0)
3          result= 1
4      else
5          result = factorial(num)
6      end
7  endfunction
8  function result = proba(n,m,k)
9      if(pmodulo(k,2)==0)
10         k=k/2;
11         result = 2*fact(m-1)*fact(n-1)*fact(n)*fact(
               m)/(fact(k-1)^2*fact(m-k)*fact(n-k)*fact(
               n+m));
12     else
13         k = (k-1)/2;
14         result = fact(m-1)*fact(n-1)*fact(n)*fact(m
               )/(fact(k-1)*fact(k)*fact(m-k)*fact(n-k
               -1)*fact(n+m)) + fact(m-1)*fact(n-1)*
               fact(n)*fact(m)/(fact(k-1)*fact(k)*fact(
               m-k-1)*fact(n-k)*fact(n+m));
15     end
16 endfunction
17
18 r1 = 20;
19 n1 = 20;
20 m1=10;
21 ans1 =0;
22 for i=1:19
```

```
23      ans1 =ans1 + proba(n1,m1,i);
24      //disp(proba(n,m,i));
25      //disp(ans1)
26  end
27  if(ans1<0.5)
28      pvalue1 = 2*ans1;
29  else
30      pvalue1 = 2*(1-ans1);
31  end
32  disp(pvalue1, "P-value is")
```

Scilab code Exa 12.5c Determining p value

```
1  u = 61;
2  sigma = 5.454;
3  r =75;
4  val = cdfnor("PQ", (r-u)/sigma, 0,1);
5  if(val>0.5)
6      pvalue = 2*(1-val);
7  else
8      pvalue = 2*val;
9  end
10 disp(pvalue, "P-value is");
```

Chapter 13

Quality Control

Scilab code Exa 13.2a Steel shaft diameter

```
1  X = [3.01 2.97 3.12 2.99 3.03 3.02 3.10 3.14 3.09
       3.20];
2  Y = 1:1:10;
3  u = 3;
4  sigma = 0.1;
5  n=4;
6  ucl = u + (3*sigma/sqrt(n));
7  lcl = u - (3*sigma/sqrt(n));
8  Z= 0.1:0.1:10;
9  P= ones(1,100);
10 Q= ones(1,100);
11 P =P*ucl;
12 Q =Q*lcl;
13 plot2d(Y, X, -2);
14 plot2d(Z, P, 1);
15 plot2d(Z, Q, 1);
16 //disp(size(Z));
17 //disp(size(P));
18 disp(ucl, 'ucl is');
19 disp(lcl, 'lcl is')
```

Scilab code Exa 13.2b unknown mean and variance

```
1 Xbar = [3.01 2.97 3.12 2.99 3.03 3.02 3.10 3.14 3.09
      3.20];
2 S = [0.12 0.14 0.08 0.11 0.09 0.08 0.15 0.16 0.13
     0.16];
3 c = [0.7978849 0.8862266 0.9213181 0.9399851
     0.9515332 0.9593684 0.9650309 0.9693103
     0.9726596];
4 n=4;
5 Xbarbar= mean(Xbar);
6 Sbar =mean(S);
7 lcl = Xbarbar - (3*Sbar/(sqrt(n)*c(n-1)));
8 ucl = Xbarbar + (3*Sbar/(sqrt(n)*c(n-1)));
9 //disp(lcl, "LCL is")
10 //disp(ucl, "UCL is")
11 u = Xbarbar;
12 sigma= Sbar/c(n-1);
13 //disp(u);
14 //disp(sigma);
15 //disp(Sbar, c(4));
16 prob = cdfnor("PQ", 3.1, u, sigma) - cdfnor("PQ",
     2.9, u, sigma);
17 disp(prob*100, "Percentage of the items that will
     meet the specifications is")
```

Scilab code Exa 13.3a determining control limits

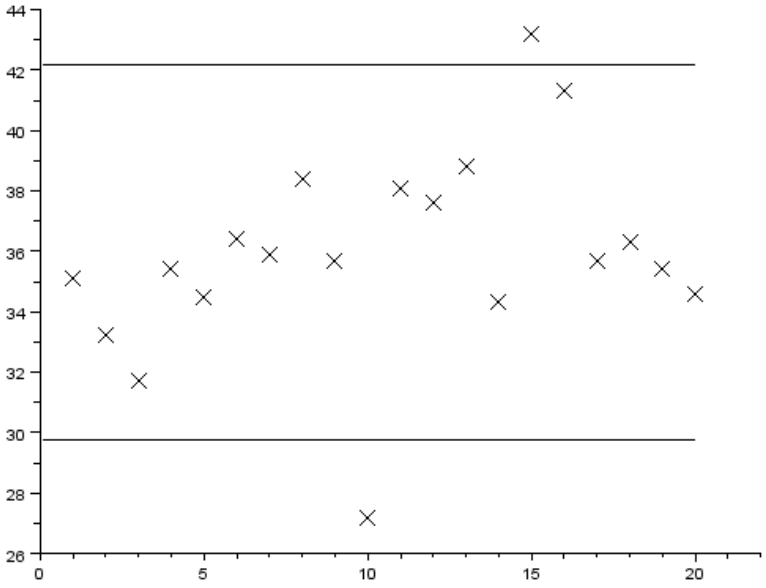

Figure 13.1: determining control limits

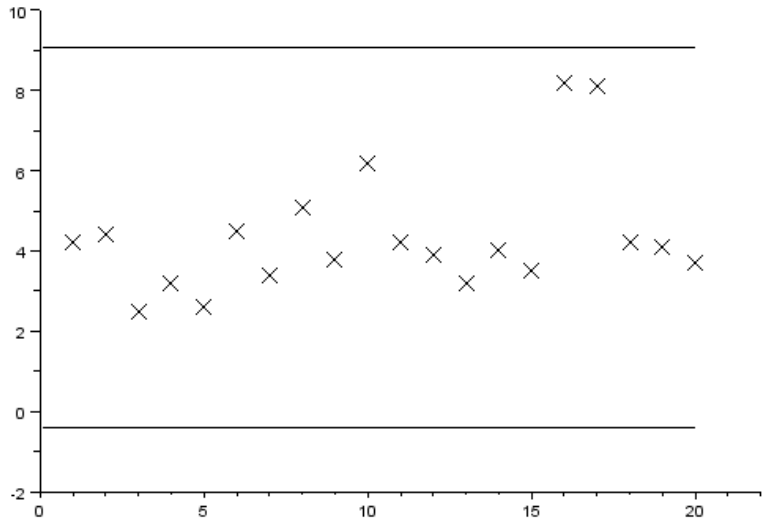

Figure 13.2: determining control limits

```
1  Xbar = [35.1 33.2 31.7 35.4  34.5 36.4 35.9 38.4
      35.7 27.2 38.1 37.6 38.8 34.3 43.2 41.3 35.7 36.3
       35.4 34.6];
2  S = [4.2 4.4 2.5 3.2 2.6 4.5 3.4 5.1 3.8 6.2 4.2 3.9
       3.2 4 3.5 8.2 8.1 4.2 4.1 3.7];
3  c = [0.7978849 0.8862266 0.9213181 0.9399851
      0.9515332 0.9593684 0.9650309 0.9693103
      0.9726596];
4  Y = 1:1:20;
5  n =5;
6  Z= 0.1:0.1:20;
7  Xbarbar = mean(Xbar);
8  Sbar = mean(S);
9  lclX = Xbarbar - (3*Sbar/(sqrt(n)*c(n-1)));
10 uclX = Xbarbar + (3*Sbar/(sqrt(n)*c(n-1)));
11 val1 = 1/c(n-1);
12 val1 = val1^2;
13 val1 = val1 - 1;
```

```
14 val = sqrt(val1);
15 //val = sqrt((1/c(n-1)^2)) - 1;
16 ucls = Sbar*(1+(3*val));
17 lcls = Sbar*(1-(3*val));
18 //disp(ucls, lcls)
19 plot2d(Y, Xbar, -2);
20 P= ones(1, 200);
21 Q = ones(1, 200);
22 P= P*lclX;
23 Q=Q*uclX;
24 disp(uclX, 'UCL(X)=');
25 disp(lclX, 'LCL(X)=');
26 plot2d(Z, P, 1);
27 plot2d(Z, Q, 1);
28 title('Control Chart for X')
29 scf(2);
30 disp(uclX, 'UCL(S)=');
31 disp(lclX, 'LCL(S)=');
32 //disp(ucls, lcls)
33 plot2d(Y, S, -2);
34 P= P*lcls/lclX;
35 Q=Q*ucls/uclX;
36 plot2d(Z, P, 1);
37 plot2d(Z, Q, 1);
38 title('Control Chart for S')
```

Scilab code Exa 13.4a Defectives Screws

```
1 defect = [6 5 3 0 1 2 1 0 2 1 1 3 2 0 1 1 0 2 1 2];
2 F = [0.12 0.10 0.06 0.00 0.02 0.04 0.02 0.00 0.04
     0.02 0.02 0.06 0.04 0.00 .02 0.02 0.00 0.04 0.02
     0.04];
3 total = 1000;
4 Fbar = sum(defect)/total;
5 n=50;
```

```
val = sqrt(Fbar*(1-Fbar)/n);
lcl = Fbar - (3*val);
ucl = Fbar + (3*val);
disp(lcl,"LCL is" );
disp(ucl, "UCL is");
for i= 1:20
    if( F(i)>ucl | F(i)<lcl)
        totald=sum(defect)-defect(i);
        //total = total -50;
     end
end
//disp(totald);
total =  total - 50;
Fbar = totald/total;
val = sqrt(Fbar*(1-Fbar)/n);
//disp(Fbar);
disp("After recomputation");
lcl = Fbar - (3*val);
ucl = Fbar + (3*val);
disp(lcl,"LCL is" );
disp(ucl, "UCL is");
```

Scilab code Exa 13.5a Control during production of cars

```
X = [141 162 150 111 92 74 85 95 76 68 63 74 103 81
   94 68 95 81 102 73];
total = sum(X);
num = 20;
Xbar = mean(X);
lcl = Xbar - 3*sqrt(Xbar);
ucl = Xbar + 3*sqrt(Xbar);
disp(ucl, "UCL is");
disp(lcl, "LCL is");
for i =1:20
    if(X(i)> ucl )
```

```
11          total = total - X(i);
12          num= num -1;
13      end
14  end
15  Xbar = total/num;
16
17  lcl = Xbar - 3*sqrt(Xbar);
18  ucl = Xbar + 3*sqrt(Xbar);
19  disp("After recomputation")
20  disp(ucl, "UCL is");
21  disp(lcl, "LCL is");
22  total = total - X(4);
23  num = num-1;
24  disp(Xbar, "Xbar is");
25  disp(X(4), " is");
26  Xbar = total/num;
27  lcl = Xbar - 3*sqrt(Xbar);
28  ucl = Xbar + 3*sqrt(Xbar);
29  disp("After second recomputation")
30  disp(ucl, "UCL is");
31  disp(lcl, "LCL is");
32  disp(Xbar, "It appears that the process is in
       control with mean");
33
34  //The mean after the second recomputation is
       incoreectly calculated in the textbook. It should
        be
35  ((17*84.41)-111 )/16 = 82.748 whereas the value
       given in the book is 82.56. The values of UCL and
        LCL
36  change accordingly.
```

Scilab code Exa 13.6b Service Time

```
1  X = [48 52 70 62 57 81 56 59 77 82 78 80 74 82 68
```

```
    84];
u = 62;
n = 4;
sigma = 24;
alpha = 0.25;
W = zeros(17);
W(1) = 60;
for i =2:17
    W(i) = (0.25*X(i-1)) + (0.75*W(i-1));
end
disp(W , "The values of W are")
val = 3*sigma*sqrt(alpha/(n*(2-alpha)));
lcl = u- val;
ucl = u+ val;
disp(lcl, "LCL is");
disp(ucl, "UCL is");
```

Scilab code Exa 13.6c Exponentially weighted moving average control

```
X = [9.617728 10.25437 9.867195 10.79338 10.60699
   10.48396 13.33961 9.462969 10.14556 11.66342
   11.55484 11.26203 12.31473 9.220009 11.25206
   10.48662 9.025091 9.693386 11.45989 12.44213
   11.18981 11.56674 9.869849 12.11311 11.48656];
t = 1:1:26;
alpha = 2/9;
val = 9.915051 - (alpha*9.617728);
val = val/(1-alpha);
disp(val, "val is");
u = 10;
n = 5;
sigma = 2;

```

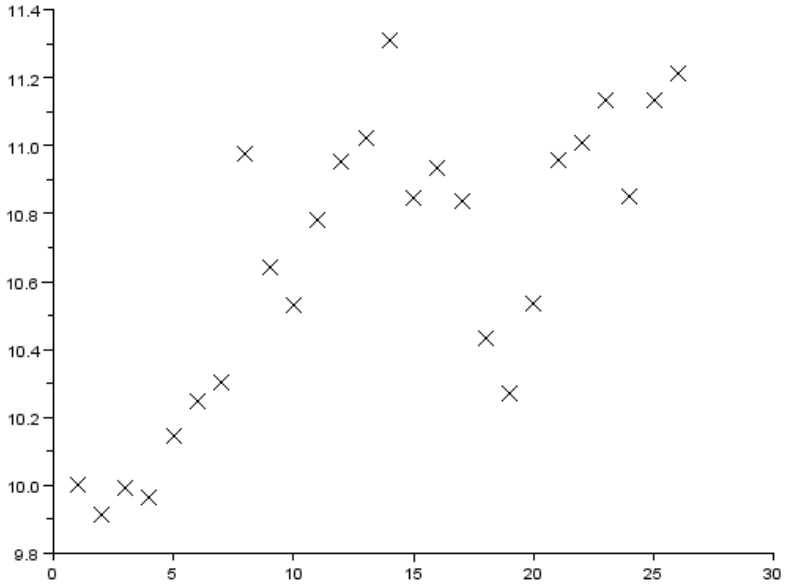

Figure 13.3: Exponentially weighted moving average control

```
11 W = zeros(26);
12 W(1) = 10.;
13 for i =2:26
14     W(i) = (alpha*X(i-1)) + ((1-alpha)*W(i-1));
15 end
16 disp(W , "The values of W are");
17 val = 3*sigma*sqrt(alpha/(n*(2-alpha)));
18 lcl = u- val;
19 ucl = u+ val;
20 disp(lcl, "LCL is");
21 disp(ucl, "UCL is");
22 plot2d(t,W, -2);
23 xlabel("t");
24 ylabel("W");
25 nlcl = ones(1, 26);
26 nlcl= nlcl.* lcl;
27 plot2d(t,nlcl);
28 nucl = ones(1, 26);
29 nucl= nucl.* ucl;
30 plot2d(t,nucl);
31
32 //The asymptpotic lines for UCL and LCL have been
     plotted
```

Scilab code Exa 13.6d Finding control limit

```
1 X = [29 33 35 42 36 44 43 45];
2 u =30;
3 sig = 8;
4 d =0.5;
5 B =5;
6 Y = X - u - (d*sig);
7 S = zeros(9);
8 S(1) =0;
9 for i=2:9
```

```
10      S(i)= max(S(i-1) + Y(i-1), 0);
11  end
12  disp(S, "S is")
13  cl = B*sig;
14  disp(cl)
15  answer =100;
16  for i=1:9
17      if(S(i)>cl)
18          answer = i;
19      end
20  end
21  disp("The mean has increased after observing the ")
22  disp(answer-1);
23  disp(" subgroup average");
```

Chapter 14

Life Testing

Scilab code Exa 14.3a Lifetime of a transistor

```
1 total =50;
2 failure = 15;
3 alpha = 0.05;
4 t =525;
5 val1 = cdfchi("X", 2*failure, alpha/2 , 1-(alpha/2))
     ;
6 val2 = cdfchi("X", 2*failure, 1-alpha/2 , (alpha/2))
     ;
7
8 int1 = 2*t/val1;
9 int2 = 2*t/val2;
10 disp("The 95% confidence interval is");
11 disp(int2);
12 disp(int1, "to");
13
14 //The confidence interval is from 22.35 to 62.17
     whereas my solution in Scilab is 22.35 to 62.53
15 because of the difference in the value of chi-square
     (0.975, 30). The textbook says the value is 16.89
16 whereas scilab calculates its value as 16.79
```

Scilab code Exa 14.3b Lifetime of Battery

```
t = 1800;
theta = 150;
r =20;
pvalue =  cdfchi("PQ",2*t/theta, 2*r );
disp(pvalue, "P-value is ")
```

Scilab code Exa 14.3c One at a time sequential test

```
T = 500;
alpha = 0.05;
r = 10;
val1 = cdfchi("X", 2*r, 1-alpha/2, alpha/2);
val2 = cdfchi("X", 2*r, alpha/2, 1- alpha/2);
int1= 2*T/val1;
int2= 2*T/val2;
disp("The 95% confidence interval is");
disp(int1);
disp(int2, "to");

 //The confidence interval is from 29.27 to 103.52
    whereas my solution in Scilab is 29.265774 to
104.26683 because of the difference in the value of
   chi-square(0.975, 30). The textbook says the
   value is
9.66 whereas scilab calculates its value as
   9.5907774 .
```

Scilab code Exa 14.3d Lifetime of semiconductors

```
r = 30;
T = 600;
theta = 25;
val1 = cdfchi("PQ", 2*T/theta, 2*r);
val2 = 1- cdfchi("PQ", 2*T/theta, 2*(r+1));
pvalue = min(val1, val2);
disp(pvalue, "The pvalue is");
disp("H0 would be accepted when the significance
   level is 0.10");
```

Scilab code Exa 14.3e Bayes estimator

```
X = [5 7 6.2 8.1 7.9 15 18 3.9 4.6 5.8];
Y= [3 3.2 4.1 1.8 1.6 2.7 1.2 5.4 10.3 1.5];
t = sum(X)+sum(Y);
R =10;
a = 20;
b = 2;
estimate = (R+b)/(a+t);
disp(estimate, "Bayes estimate of lambda is");
```

Scilab code Exa 14.4a Lifetime of items produced by two plants

```
Xlife = 420;
Ylife = 510;
Xnum=  10;
Ynum =15;
ts = Xlife*Ynum/(Ylife*Xnum);
disp(ts, "The value of the test statistic is");
val = cdff("PQ", ts, Xnum, Ynum);
pvalue = 2*(1-val);
```

```
 9 disp(pvalue, "The p-value is");
10 disp("We cannot reject H0");
```