R Textbook Companion for Managerial Statistics by Gerald Keller[1]

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Book Description

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R 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)

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

Contents

List of R Codes

Chapter 2

Graphical and Tabular Descriptive Techniques

R code Exa 2.1 Light Beer Preference Survey

```
###page_no_18####

rm(list=ls())
lbp<-c
   (1,1,5,1,3,3,3,7,2,6,1,6,3,4,5,2,5,5,2,1,1,5,1,2,3,3,6,1,5,5,4,1,
length(lbp)
table<-table(lbp);table
rf<-round(((table(lbp)/length(lbp))*100),digits=2);
   rf
brand<-c("Bud Light","Busch Light","Coors Light","
   Michelob Light","Miller Lite","Natural Light","
   Other brands")
barplot(table,names.arg=brand,main="bar chart",ylab=
   "frequency",ylim=c(0,90),cex.names=0.5)
lbls<-paste(brand,rf)
lbls<-paste(lbls,"%",sep="")
pie(table,labels = lbls,col=c("red","purple","blue",
   "brown","pink","orange","green"))
```

```
legend("topleft",legend=brand,fill=c("red","purple","blue","brown","pink","orange","green"),cex=0.5)
```

R code Exa 2.2 Energy Consumption in the United States

```
######page_no_24######
rm(list=ls())
ES<-c("Coal","Oil","Natural Gas","Nuclear","Hydroelectric","Biomass","Others")
hc<-c(545258,903440,517881,209890,18251,52473,20533)
sum(hc)
rf<-round((hc/sum(hc))*100);rf
lbls<-paste(ES,rf)
lbls<-paste(lbls,"%",sep="")
pie(hc,labels = lbls,col=c("red","purple","blue","brown","pink","orange","green"))
legend("topleft",legend=ES,fill=c("red","purple","blue","brown","pink","orange","green"),cex=0.5)
```

R code Exa 2.3 Per Capita Beer Consumption

```
#####page_26###
rm(list=ls())
country<-c("Australia","Belgium","Canada","Czech Republic","Germany","Ireland","New Zeland","Russia","United kingdom","United States")
consumption<-c(109.9,93,68.3,156.9,115.8,131.1,77,58.9,99,81.6)
barplot(consumption,names.arg=country,main="Bar Chart",xlab="Country",ylab="per capita beer consumption",cex.names=0.6)
```

R code Exa 2.4 Analysis of Long Distance Telephone Bills

```
######page_no_31####
rm(list=ls())
bill<-c
  (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15
table((cut(bill,breaks=seq(0,120,by=15),right=F)))
hist(bill,ylim=c(0,70),ylab="telephone calls",breaks
  =seq(0,120,by=15))
```

R code Exa 2.5 Comparing Returns on Two Investments

```
#####page_no_38###
rm(list=ls())
returnsA<-c
  (30,-2.13,4.3,25,12.89,-20.24,1.2,-2.59,33,14.26,-15.83,0.63,38,6
returnsB<-c
  (30.33,-30.37,-5.61,29,-26.01,0.46,2.07,29.44,11,-25.93,8.29,61,-
par(mfrow=c(1,2))
hist(returnsA,breaks=seq(-30,75,by=15))
hist(returnsB,breaks=seq(-45,75,by=15))
```

R code Exa 2.6 Bussiness Statistics Marks

```
#####page_no_40#####
rm(list=ls())
```

```
marks<-c
    (65,71,66,79,65,82,80,86,67,64,62,74,67,72,68,81,53,70,76,73,73,8
hist(marks,breaks=seq(50,100,10))
```

R code Exa 2.7 Mathematical Statistics Marks

```
####page_no_41###
rm(list=ls())
marks<-c
    (77,74,75,75,67,72,81,76,79,73,59,83,77,74,78,67,82,55,73,92,75,7
hist(marks,breaks=seq(40,100,10))
```

R code Exa 2.11 Energy Source in the United States and Canada

```
######page_no_62#####
rm(list=ls())
ES<-c("Coal","Oil","Natural Gas","Nuclear","
    Hydroelectric","Biomass","Others")
US<-c(545258,903440,517881,209890,18251,52473,20533)
Canada<-c(30775,88850,71477,20103,28541,10424,25)
sum(US)
sum(Canada)
par(mfrow=c(1,2))
rf_US<-round((US/sum(US))*100);rf_US
lbls1<-paste(ES,rf_US)
lbls1<-paste(lbls1,"%",sep="")
pie(US,labels = lbls1,main="US energy consumption",
    col=c("red","purple","blue","brown","pink","
    orange","green"))
legend("topright",legend=ES,fill=c("red","purple","
    blue","brown","pink","orange","green"),cex=0.4)
```

```
rf_C<-round((Canada/sum(Canada))*100);rf_C
lbls2<-paste(ES,rf_C)
lbls2<-paste(lbls2,"%",sep="")
pie(Canada,labels = lbls2,main="Canadian energy
   consumption",col=c("red","purple","blue","brown",
   "pink","orange","green"))
legend("topright",legend=ES,fill=c("red","purple","
   blue","brown","pink","orange","green"),cex=0.4)
```

R code Exa 2.12 Analyzing the Relationship between Price and Size of Houses

```
####page_no_66###
rm(list=ls())
size<-c(23,18,26,20,22,14,33,28,23,20,27,18)
price<-c
   (315,229,355,261,234,216,308,306,289,204,265,195)
plot(size,price,type="p")
```

Chapter 4

Numerical Descriptive Techniques

R code Exa 4.1 Mean Time Spent on the Internet

```
####page_no_98###
rm(list=ls())
x<-c(0,7,12,5,33,14,8,0,9,22)
n=10
mean<-sum(x)/n;mean
```

R code Exa 4.2 Mean Long Distance Telephone Bills

```
######page_no_98####
rm(list=ls())
bill<-c
   (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15

mean<-round((sum(bill)/200),2);mean
```

R code Exa 4.3 Median Time Spent on the Internet

```
####page_no_99###
rm(list=ls())
x<-c(0,0,5,7,8,9,12,14,22,33)
n=10
median(x)
```

R code Exa 4.4 Median Long Distance Telephone Bills

```
######page_no_100####
rm(list=ls())
bill<-c
    (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15
median(bill)
```

R code Exa 4.5 Mode Time Spent on the Internet

```
####page_no_101###
rm(list=ls())
getmode<-function(x){
  uniq<-unique(x)
uniq[which.max(tabulate(match(x,uniq)))]}
x<-c(0,7,12,5,33,14,8,0,9,22)
n=10
mode<-getmode(x);mode
```

R code Exa 4.6 Mode Long Distance Telephone Bills

```
####page_no_101###
rm(list=ls())
getmode<-function(bill){
  uniq<-unique(bill)
uniq[which.max(tabulate(match(bill,uniq)))]}

bill<-c
   (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15

n=200
mode<-getmode(bill);mode
```

R code Exa 4.7 Summer Jobs

```
####page_no_108###
rm(list=ls())
x<-c(17,15,23,7,9,13)
n=6
mean(x)
var(x)
```

R code Exa 4.9 Using the empirical rule to interpret Standard Deviation

```
###page_no_112###
rm(list=ls())
m=10
s=8
M<-paste(m,"%",sep="")
S<-paste(s,"%",sep="")

print("for 68% ")
lt1<-m-s
```

```
lt1<-paste(lt1,"%",sep="");lt1
rt1<-m+s
rt1<-paste(rt1,"%",sep="");rt1

print("for 95% ")
lt2<-m-(2*s)
lt2<-paste(lt2,"%",sep="");lt2
rt2<-m+(2*s)
rt2<-paste(rt2,"%",sep="");rt2

print("for 99.77% ")
lt3<-m-(3*s)
lt3<-paste(lt3,"%",sep="");lt3
rt3<-m+(3*s)
rt3<-paste(rt3,"%",sep="");rt3
```

R code Exa 4.10 Using Chebysheffs theorem to interpret Standard Deviation

```
###page_no_112###
rm(list=ls())
m=28000
s=3000

print("for 75% ")
lt1<-m-(2*s);lt1
rt1<-m+(2*s);rt1

print("for 88.9% ")
lt2<-m-(3*s);lt2
rt2<-m+(3*s);rt2
```

R code Exa 4.11 Percentiles of Time Spent on internet

```
####page_no_116###
rm(list=ls())
x<-c(0,7,12,5,33,14,8,0,9,22)
sort(x)
n=10
L_25<-(n+1)*(.25);L_25
L_50<-(n+1)*(.5);L_50
L_75<-(n+1)*(.75);L_75
```

R code Exa 4.12 Quartiles of Long Distance telephone bills

```
######page_no_117####
rm(list=ls())
bill<-c
   (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15

quantile(round((sort(bill)),2))
sum(bill)
mean(bill)
sd(bill)
var(bill)

#the answer may slightly vary due to rounding off
   values
```

R code Exa 4.13 Interquartiles Range of Long Distance Telephone Bills

```
######page_no_118####
rm(list=ls())
bill<-c
   (42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15
```

```

IQR(bill)
```

R code Exa 4.14 Box Plot of Long Distance Telephone Bills

```
######page_no_119####
rm(list=ls())
bill<-c(42.19,38.45,29.23,89.35,118.04,110.46,0,72.88,83.05,95.73,103.15

boxplot(bill,horizontal=T,main="Box Plot")
```

R code Exa 4.16 Calculating the coefficients of correlation

```
#####page_no_126###
x<-c(2,6,7)
n=3
mean(x)
sx<-sqrt(var(x));sx
y1<-c(13,20,27)
mean(y1)
sy1<-sqrt(var(y1));sy1
r1<-(sum((x-mean(x))*(y1-mean(y1)))/(n-1))/(sx*sy1);r1

y2<-c(27,20,13)
mean(y2)
sy2<-sqrt(var(y2));sy2
r2<-(sum((x-mean(x))*(y2-mean(y2)))/(n-1))/(sx*sy2);r2

y3<-c(20,27,13)
```

```
mean(y3)
sy3<-sqrt(var(y3));sy3
r3<-(sum((x-mean(x))*(y3-mean(y3)))/(n-1))/(sx*sy3);
   r3
```

R code Exa 4.17 Estimating Fixed and Variable Costs

```
#####page_no_130##
rm(list=ls())
day<-c(1,10,10)
x<-c(7,3,2,5,8,11,5,15,3,6)
y<-c
   (23.8,11.89,15.98,26.11,31.79,39.93,12.27,40.06,21.38,18.65)

sum(x*y)
sum(x^2)
sum(y^2)
cov(x,y)
var(x)
mean(x)
mean(y)
b1<-cov(x,y)/var(x);b1
b0<-mean(y)-b1*mean(x);b0
est_y<-b0+b1*x;est_y
plot(x,y,type="p",ylim=c(0,50),xlim=c(0,16),xlab="
   Number of tools",ylab="Electrical costs")
abline(lm(y~x))
```

R code Exa 4.18 Measuring the strength of the linear relationship

```
#####page_no_132##
rm(list=ls())
day<-c(1,10,10)
```

```
x<-c(7,3,2,5,8,11,5,15,3,6)
y<-c
   (23.8,11.89,15.98,26.11,31.79,39.93,12.27,40.06,21.38,18.65)
sum(x*y)
sum(x^2)
sum(y^2)
cov(x,y)
sx<-sqrt(var(x))
sy<-sqrt(var(y))
r<-cov(x,y)/(sx*sy);r
```

Chapter 6

Probability

R code Exa 6.1 Determining of Success among Mutual Fund Managers

```
###page_no_175###
rm(list=ls())
p_a1b1<-.11
p_a2b1<-.06
p_a1b2<-.29
p_a2b2<-.54

p_a1<-p_a1b1+p_a1b2;p_a1
p_a2<-p_a2b1+p_a2b2;p_a2
p_b1<-p_a1b1+p_a2b1;p_b1
p_b2<-p_a1b2+p_a2b2;p_b2
```

R code Exa 6.2 Determining of Success among Mutual Fund Managers

```
###page_no_178###
rm(list=ls())
p_a1b1<-.11
p_a2b1<-.06
```

```
p_a1b2<-.29
p_a2b2<-.54

p_b2<-p_a1b2+p_a2b2;p_b2

p_a1ib2<-round((p_a1b2/p_b2),4);p_a1ib2
```

R code Exa 6.3 Determining of Success among Mutual Fund Managers

```
###page_no_179###
rm(list=ls())
p_a1b1<-.11
p_a2b1<-.06
p_a1b2<-.29
p_a2b2<-.54

p_a1<-p_a1b1+p_a1b2;p_a1
p_a2<-p_a2b1+p_a2b2;p_a2
p_b1<-p_a1b1+p_a2b1;p_b1
p_b2<-p_a1b2+p_a2b2;p_b2

p_a1_b1<-p_a1b1/p_b1;p_a1_b1
p_a2_b1<-p_a2b1/p_b1;p_a2_b1
p_a1_b2<-p_a1b2/p_b2;p_a1_b2
p_a2_b2<-p_a2b2/p_b2;p_a2_b2

if(p_a1==p_a1_b1)print("independent")else("dependent")
if(p_a2==p_a2_b1)print("independent")else("dependent")
if(p_a1==p_a1_b2)print("independent")else("dependent")
if(p_a2==p_a2_b2)print("independent")else("dependent")
```

R code Exa 6.4 Determining of Success among Mutual Fund Managers

```
###page_no_179###
rm(list=ls())
p_a1b1<-.11
p_a2b1<-.06
p_a1b2<-.29
p_a2b2<-.54

p_a1ob1<-p_a1b1+p_a2b1+p_a1b2;p_a1ob1
p_a1ob1<-1-p_a2b2;p_a1ob1
```

R code Exa 6.5 Selecting two students without replacement

```
###page_no_186###
rm(list=ls())
m<-7
f<-3
n=2; N=10

p_a<-f/N;p_a
p_b_a=(f-1)/(N-1);p_b_a

p_ab<-round((p_a*p_b_a),3);p_ab
```

R code Exa 6.6 Selecting two students with replacement

```
###page_no_186###
rm(list=ls())
```

```
m<-7
f<-3
n=2; N=10

p_a<-f/N;p_a
p_b<-f/N;p_b

p_ab<-p_a*p_b;p_ab
```

R code Exa 6.7 Applying the Addition Rule

```
###page_no_188###
rm(list=ls())
p_a<-.22
p_b<-.35
p_ab<-.06

p_aob<-p_a+p_b-p_ab;p_aob
```

R code Exa 6.8 Probability of Passing the Bar exam

```
###page_no_189###
rm(list=ls())
p_p<-.72
p_f<-.28
p_p_f<-.88
p_f_f<-.12

p_fp<-p_f*p_p_f;p_fp
p_ff<-p_f*p_f_f;p_ff

p_pp<-p_p+p_fp;p_pp

```

```
print("lawyers are 96.64%")
```

R code Exa 6.9 Should an MBA Applicant Take a Preparatory course

```
###page_no_192###
rm(list=ls())
p_a<-.1
p_ac<-1-p_a;p_ac
p_b_a<-.52
p_b_ac<-.23

p_bc_a<-1-p_b_a;p_bc_a
p_bc_ac<-1-p_b_ac;p_bc_ac

p_ab<-p_a*p_b_a;p_ab
p_acb<-p_ac*p_b_ac;p_acb

p_b<-p_ab+p_acb;p_b

p_a_b<-round((p_ab/p_b),3);p_a_b
```

R code Exa 6.10 Probability of prostate cancer

```
###page_no_197###
rm(list=ls())
age<-c("40-50","50-60","60-70","over70")
p<-c(.01,.022,.046,.079)

p_c1<-.01
p_cc1<-1-.01;p_cc1

p_nt_c1<-.3
p_pt_c1<-1-p_nt_c1;p_pt_c1
```

```
p_pt_cc1<-.135
p_nt_cc1<-1-p_pt_cc1;p_nt_cc1

p_c1Upt<-p_c1*p_pt_c1;p_c1Upt
p_c1Unt<-p_c1*p_nt_c1;p_c1Unt
p_cc1Upt<-p_cc1*p_pt_cc1;p_cc1Upt
p_cc1Unt<-p_cc1*p_nt_cc1;round(p_cc1Unt,4)

p_pt1<-round((p_c1Upt+p_cc1Upt),4);p_pt1
p_c1_pt<-round((p_c1Upt/p_pt1),4);p_c1_pt
p_cc1_pt<-round((1-p_c1_pt),4);p_cc1_pt

p_c2<-.022
p_cc2<-1-.022;p_cc2

p_nt_c2<-.3
p_pt_c2<-1-p_nt_c2;p_pt_c2
p_pt_cc2<-.135
p_nt_cc2<-1-p_pt_cc2;p_nt_cc2

p_c2Upt<-p_c2*p_pt_c2;p_c2Upt
p_c2Unt<-p_c2*p_nt_c2;p_c2Unt
p_cc2Upt<-p_cc2*p_pt_cc2;p_cc2Upt
p_cc2Unt<-p_cc2*p_nt_cc2;round(p_cc2Unt,4)

p_pt2<-round((p_c2Upt+p_cc2Upt),4);p_pt2
p_c2_pt<-round((p_c2Upt/p_pt2),4);p_c2_pt
p_cc2_pt<-round((1-p_c2_pt),4);p_cc2_pt

p_c3<-.046
p_cc3<-1-.046;p_cc3

p_nt_c3<-.3
p_pt_c3<-1-p_nt_c3;p_pt_c3
p_pt_cc3<-.135
p_nt_cc3<-1-p_pt_cc3;p_nt_cc3

p_c3Upt<-p_c3*p_pt_c3;p_c3Upt
```

```
p_c3Unt<-p_c3*p_nt_c3;p_c3Unt
p_cc3Upt<-p_cc3*p_pt_cc3;round(p_cc3Upt,4)
p_cc3Unt<-p_cc3*p_nt_cc3;round(p_cc3Unt,4)

p_pt3<-round((p_c3Upt+p_cc3Upt),4);p_pt3
p_c3_pt<-round((p_c3Upt/p_pt3),4);p_c3_pt
p_cc3_pt<-round((1-p_c3_pt),4);p_cc3_pt

p_c4<-.079
p_cc4<-1-.079;p_cc4

p_nt_c4<-.3
p_pt_c4<-1-p_nt_c4;p_pt_c4
p_pt_cc4<-.135
p_nt_cc4<-1-p_pt_cc4;p_nt_cc4

p_c4Upt<-p_c4*p_pt_c4;p_c4Upt
p_c4Unt<-p_c4*p_nt_c4;p_c4Unt
p_cc4Upt<-p_cc4*p_pt_cc4;round(p_cc4Upt,4)
p_cc4Unt<-p_cc4*p_nt_cc4;round(p_cc4Unt,4)

p_pt4<-round((p_c4Upt+p_cc4Upt),4);p_pt4
p_c4_pt<-round((p_c4Upt/p_pt4),4);p_c4_pt
p_cc4_pt<-round((1-p_c4_pt),4);p_cc4_pt

cancer<-c(p_c1_pt,p_c2_pt,p_c3_pt,p_c4_pt)
no_cancer<-c(p_cc1_pt,p_cc2_pt,p_cc3_pt,p_cc4_pt)
positive_portion<-c(p_pt1,p_pt2,p_pt3,p_pt4)
biospies<-c(p_pt1*1000000,p_pt2*1000000,p_pt3*
   1000000,p_pt4*1000000)
cancer_detected<-c(round(p_c1_pt*p_pt1*1000000),
   round(p_c2_pt*p_pt2*1000000),round(p_c3_pt*p_pt3*
   1000000),round(p_c4_pt*p_pt4*1000000))
biospies_per_detected<-round((biospies/cancer_
   detected),2)
cost_per_biospy<-(biospies_per_detected*1000)

cbind(age,cancer,no_cancer)
```

```
cbind(age, positive_portion ,biospies ,cancer_
   detected ,biospies_per_detected ,cost_per_biospy)
```

Chapter 7

Random Variables And Discrete Probability Distributions

R code Exa 7.1 Probability Distribution of the Number of Color Television

```
####page_no_212###
rm(list=ls())
tv<-c(0,1,2,3,4,5)
h<-c(1218,32379,37961,19387,7714,2842)
px<-round((h/sum(h)),3);px
sum(px)
```

R code Exa 7.2 Probability Distribution of the Number of Sales

```
###page_no_213###
rm(list=ls())
p_s<-.2
p_sc<-1-p_s;p_sc
```

```
event<-c("sss","sssc","sscs","sscsc","scss","scssc",
    "scscs","scscsc")
x<-c(3,2,2,1,2,1,1,0)
p<-c(p_s^3,(p_s^2)*p_sc,(p_s^2)*p_sc,p_s*p_sc^2,p_sc
    *p_s^2,p_s*p_sc^2,p_s*p_sc^2,p_sc^3);p

p_0<-.512
p_1<-3*(p_s*p_sc^2);p_1
p_2<-3*.032;p_2
p_3<-.008

X<-c(0,1,2,3)
P<-c(p_0,p_1,p_2,p_3)
cbind(X,P)
```

R code Exa 7.3 Describing the Population of the Number of Color Television

```
####page_no_215###
rm(list=ls())
x<-c(0,1,2,3,4,5)
h<-c(1218,32379,37961,19387,7714,2842)
px<-h/sum(h);px
E<-sum(x*px);E
v<-sum(((x-E)^2)*px);v
var<-(sum((x^2)*px)-E^2);var
sd<-sqrt(var);sd
```

R code Exa 7.4 Describing the Population of Monthly Profits

```
###page_no_217###
rm(list=ls())
```

```
m<-25000
s<-4000

E_p<-.3*m-6000;E_p
V_p<-(.3^2)*s^2;V_p
s_p<-sqrt(V_p);s_p
```

R code Exa 7.5 Bivariate Distribution of the Number of House Sales

```
###page_no_222###
rm(list=ls())
x<-c(0,1,2)
y0<-c(.12,.42,.06)
y1<-c(.21,.06,.03)
y2<-c(.07,.02,.01)
y<-c(0,1,2)
p<-rbind(y0,y1,y2);p

p_x_0<-sum(p[,1]);p_x_0
p_x_1<-sum(p[,2]);p_x_1
p_x_2<-sum(p[,3]);p_x_2
p_x<-c(p_x_0,p_x_1,p_x_2)

p_y_0<-sum(y0);p_y_0
p_y_1<-sum(y1);p_y_1
p_y_2<-sum(y2);p_y_2
p_y<-c(p_y_0,p_y_1,p_y_2)

E_x<-sum(x*p_x);E_x
V_x<-sum(((x-E_x)^2)*p_x);V_x
s_x<-sqrt(V_x);s_x

E_y<-sum(y*p_y);E_y
V_y<-sum(((y-E_y)^2)*p_y);V_y
s_y<-sqrt(V_y);s_y
```

R code Exa 7.6 Describing the Bivariate Distribution

```
###page_no_224###
rm(list=ls())
x<-c(0,1,2)
y0<-c(.12,.42,.06)
y1<-c(.21,.06,.03)
y2<-c(.07,.02,.01)
y<-c(0,1,2)
p_xy<-c(y0,y1,y2)
p<-rbind(y0,y1,y2);p

p_x_0<-sum(p[,1]);p_x_0
p_x_1<-sum(p[,2]);p_x_1
p_x_2<-sum(p[,3]);p_x_2
p_x<-c(p_x_0,p_x_1,p_x_2)

p_y_0<-sum(y0);p_y_0
p_y_1<-sum(y1);p_y_1
p_y_2<-sum(y2);p_y_2
p_y<-c(p_y_0,p_y_1,p_y_2)

E_x<-sum(x*p_x);E_x
V_x<-sum(((x-E_x)^2)*p_x);V_x
s_x<-sqrt(V_x);s_x

E_y<-sum(y*p_y);E_y
V_y<-sum(((y-E_y)^2)*p_y);V_y
s_y<-sqrt(V_y);s_y

E_xy<-sum(x*y[1]*p_xy[seq(1,3,1)],x*y[2]*p_xy[seq(4,6,1)],x*y[3]*p_xy[seq(7,9,1)]);E_xy
s_xy<-E_xy-E_x*E_y;s_xy

```

```
cor<-round((s_xy/(s_x*s_y)),2);cor
```

R code Exa 7.7 Describing the Population of the Total Number of House Sales

```
###page_no_225###
rm(list=ls())
x<-c(0,1,2)
y0<-c(.12,.42,.06)
y1<-c(.21,.06,.03)
y2<-c(.07,.02,.01)
y<-c(0,1,2)
p_xy<-c(y0,y1,y2)
p<-rbind(y0,y1,y2);p

p_x_0<-sum(p[,1]);p_x_0
p_x_1<-sum(p[,2]);p_x_1
p_x_2<-sum(p[,3]);p_x_2
p_x<-c(p_x_0,p_x_1,p_x_2)

p_y_0<-sum(y0);p_y_0
p_y_1<-sum(y1);p_y_1
p_y_2<-sum(y2);p_y_2
p_y<-c(p_y_0,p_y_1,p_y_2)

E_x<-sum(x*p_x);E_x
V_x<-sum(((x-E_x)^2)*p_x);V_x
s_x<-sqrt(V_x);s_x

E_y<-sum(y*p_y);E_y
V_y<-sum(((y-E_y)^2)*p_y);V_y
s_y<-sqrt(V_y);s_y

E_xy<-sum(x*y[1]*p_xy[seq(1,3,1)],x*y[2]*p_xy[seq
    (4,6,1)],x*y[3]*p_xy[seq(7,9,1)]);E_xy
```

```
s_xy<-E_xy-E_x*E_y;s_xy

E_xay<-E_x+E_y;E_xay
V_xay<-V_x+V_y+(2*s_xy);V_xay
```

R code Exa 7.8 Describing the Population of the Returns on a Portfolio

```
###page_no_229###
rm(list=ls())
E_r1<-.08
E_r2<-.15
w1<-.25; w2<-.75
s_r1<-.12; s_r2<-.22
ro1=1; ro2=.5; ro3=0

E_r<-(w1*E_r1)+(w2*E_r2);E_r
V_ro1<-round((((w1^2)*(s_r1^2))+((w2^2)*(s_r2^2))+2*
    w1*w2*ro1*s_r1*s_r2),4);V_ro1
sd_ro1<-round((sqrt(V_ro1)),4);sd_ro1
V_ro2<-round((((w1^2)*(s_r1^2))+((w2^2)*(s_r2^2))+2*
    w1*w2*ro2*s_r1*s_r2),4);V_ro2
sd_ro2<-round((sqrt(V_ro2)),4);sd_ro2
V_ro3<-round((((w1^2)*(s_r1^2))+((w2^2)*(s_r2^2))+2*
    w1*w2*ro3*s_r1*s_r2),4);V_ro3
sd_ro3<-round((sqrt(V_ro3)),4);sd_ro3
```

R code Exa 7.9 Pat Statsdud and the Statistics Quiz

```
###page_no_236##
rm(list=ls())
n=10; p=0.2
dbinom(0,n,p)
dbinom(2,n,p)
```

R code Exa 7.10 Will Pat Fail the Quiz

```
####page_no_237###
rm(list=ls())
n=10 ; p=0.2
pbinom(4,n,p)
```

R code Exa 7.11 Pat Statsdud has been cloned

```
###page_no_240###
rm(list=ls())
n=10
p=.2

m<-n*p;m
sd<-round((sqrt(n*p*(1-p))),2);sd
```

R code Exa 7.12 Probability of the Number of Typographical Errors in Textbooks

```
####page_no_243###
rm(list=ls())
m=1.5; n=100
dpois(0,m)
```

R code Exa 7.13 Probability of the Number of Typographical Errors in 400 pages

```
###page_243####
rm(list=ls())
m=6 ; n=400

round((dpois(0,m)),6)

round((ppois(5,m)),4)
```

Chapter 8

Continuous Probability Distribution

R code Exa 8.1 Uniformly distributed Gasoline Sales

```r
###page_no_256###
rm(list=ls())

p_a<-punif(3000,2000,5000)-punif(2500,2000,5000);p_a
p_b<-1-punif(4000,2000,5000);p_b
p_c<-round(dunif(2500,2000,5000));p_c
```

R code Exa 8.2 Normally distributed Gasoline Sales

```r
###page_no_261###
rm(list=ls())
m=1000; s=100; n=1100
pnorm(1100,m,s)
```

R code Exa 8.3 Probability of a Negative Return on investment

```
###page_no_266###
rm(list=ls())
m=10; s=5
pnorm(0,m,s)

new_s=10
pnorm(0,m,new_s)
```

R code Exa 8.6 Determining the Reorder point

```
###page_no_273####
rm(list=ls())
m=200; s=50; z=1.645
ROP<-s*z+m;ROP
```

R code Exa 8.7 Lifetimes of Alkaline Batteries

```
###page_no_278###
rm(list=ls())
l=0.05
m=1/l;m
s=1/l;s
pexp(15,l)-pexp(10,l)
1-pexp(20,l)
```

R code Exa 8.8 Supermarket Checkout Counter

```
###page_no_280###
```

```
rm(list=ls())
l=0.1
pexp(5,l)
1-pexp(10,l)
pexp(8,l)-pexp(5,l)
```

Chapter 9

Sampling Distribution

R code Exa 9.1 Content of a 32 ounce bottle

```
####page_no_304###
rm(list=ls())
m=32.2; s=0.3; n=4
1-pnorm(32,m,s)
sx<-s/sqrt(n);sx
1-pnorm(32,m,sx)
```

R code Exa 9.2 Political Survey

```
###page_no_314###
rm(list=ls())
n=300; p=0.52; m=0.52
sd<-sqrt((p*(1-p))/n);sd
1-pnorm(0.5,m,sd)
```

R code Exa 9.3 Starting Salaries of MBAs

```
###page_no_316###
rm(list=ls())
n1=50; n2=60
m1=62000; m2=60000
m<-m1-m2;m
s1<-14500^2
s2<-18300^2
s<-round(sqrt((s1/n1)+(s2/n2)));s
1-pnorm(0,m,s)
```

Chapter 10

Introduction to Estimation

R code Exa 10.1 Doll Computer Company

```
####page_328####
rm(list=ls())
ddlt<-c
   (235,421,394,261,386,374,361,439,374,316,309,514,348,302,296,499,

sum(ddlt)
m<-mean(ddlt);m
z=1.96
sd=75
n=25
LCL<-m-z*(sd/sqrt(n));LCL
UCL<-m+z*(sd/sqrt(n));UCL
```

Chapter 12

Inference about a Population

R code Exa 12.1 Newspaper Recycling Plant

```
####page_no_383###
rm(list=ls())
x<-c
  (2.5,0.7,3.4,1.8,1.9,2,1.3,1.2,2.2,.9,2.7,2.9,1.5,1.5,2.2,3.2,0.7
T=2.351; m=2; n=148
sum(x)
sum(x^2)
mean(x)
var(x)
s<-sqrt(var(x));s
t<-(mean(x)-m)/(s/sqrt(n));t
```

R code Exa 12.2 Tax Collected from Audited Returns

```
###page_no_386###
rm(list=ls())
x<-c
```

```
    (6039,5147,4384,3790,5713,4818,7798,6687,6511,1600,6766,4817,3189
t=1.972; n=209

x_bar<-round(mean(x));x_bar
s_2<-var(x);s_2
s<-round(sqrt(s_2));s

LCL<-round(x_bar-(t*s/sqrt(n)));LCL
UCL<-round(x_bar+(t*s/sqrt(n)));UCL
```

R code Exa 12.3 Consistency of a Container filling machine

```
###page_no_398####
rm(list=ls())
x<-c
    (999.6,1000.7,1000.5,1001.3,999.5,1000.4,999.7,1000.7,1000.1,1000
s=1 ; n=25 ;C=13.85
sum(x)
sum(x^2)
var(x)
c<-((n-1)*var(x))/s;c
```

R code Exa 12.4 Consistency of a Container filling machine

```
###page_no_400####
rm(list=ls())
x<-c
    (999.6,1000.7,1000.5,1001.3,999.5,1000.4,999.7,1000.7,1000.1,1000
s=1 ; n=25 ;C005=45.56; C995=9.89
sum(x)
```

```
sum(x^2)
var(x)
LCL<-((n-1)*var(x))/C005;LCL
UCL<-((n-1)*var(x))/C995;UCL
```

R code Exa 12.5 Election Day Exit Poll

```
####page_no_406###
rm(list=ls())
p=0.5; n=765; x=407
Z=1.645
est_p<-(x/n);est_p
z<-(est_p-p)/(sqrt((p*(1-p))/n));z
p_value<-1-pnorm(1.77,0,1);p_value
```

R code Exa 12.6 Segmenting the Breakfast Cereal market

```
####page_no_419###
rm(list=ls())
x=269 ; n=1250
est_p<-x/n;est_p
z=1.96

LCL<-est_p-(z*(sqrt(est_p*(1-est_p)/n)));round(LCL
    ,4)
UCL<-est_p+(z*(sqrt(est_p*(1-est_p)/n)));round(UCL
    ,4)
```

R code Exa 12.7 GAO Audit of the US Forest Services

```
###page_no_424###
rm(list=ls())
x<-c
  (689,1027,804,718,817,434,1451,1485,331,536,794,381,644,1456,1120
t=1.98; n=125

x_bar<-mean(x);x_bar
s_2<-var(x);s_2
s<-sqrt(s_2);s

lcl<-round((x_bar-(t*s/sqrt(n))),2);lcl
ucl<-x_bar+(t*s/sqrt(n));ucl

LCL<-8659*857.42;LCL
UCL<-(8659*1001.92);UCL
```

R code Exa 12.8 Audit of Purchase orders at a car dealership

```
###page_no_426####
rm(list=ls())
x<-c
  (0,43.86,0,26.24,18.71,0,31.59,0,0,20.72,0,0,17.68,0,0,0,-25.1,-31
n<-96 ;N<-866

x_bar<-round((mean(x)),2);x_bar
var(x)
s<-round((sd(x)),2);s
t<-1.984

LCL<-N*(x_bar-round((t*(s/sqrt(n))*(sqrt((N-n)/(N-1)
  ))),2));LCL
UCL<-N*(x_bar+round((t*(s/sqrt(n))*(sqrt((N-n)/(N-1)
  ))),2));UCL
```

R code Exa 12.9 Audit of Work orders at a car dealership

```
###page_no_428####
rm(list=ls())
x=87; n=750; N=11054
z=1.96
p<-x/n;p

LCL<-round(N*(p-z*(sqrt((p*(1-p))/n))*sqrt(((N-n)/(N
   -1)))));LCL
UCL<-round(N*(p+z*(sqrt((p*(1-p))/n))*sqrt(((N-n)/(N
   -1)))));UCL
```

Chapter 13

Inference about comparing two Populations

R code Exa 13.1 Direct and Broker purchased mutual funds

```
####page_no_443##
rm(list=ls())
d<-c
   (9.33,6.94,16.17,16.97,5.94,12.61,3.33,16.13,11.2,1.14,4.68,3.09,7
b<-c
   (3.24,-6.76,12.8,11.1,2.73,-.13,18.22,-.8,-5.75,2.59,3.71,13.15,1
F=var(d)/var(b);F
if(F<1.75)print("H0 may be accepted")

md<-round(mean(d),2);md
mb<-round(mean(b),2);mb
sd<-round(var(d),2);sd
sb<-round(var(b),2);sb
n1=50;n2=50
p_v<-round(((n1-1)*sd+(n2-1)*sb)/(n1+n2-2),2);p_v
df<-n1+n2-2;df
t<-round(((md-mb)-0)/sqrt(p_v*((1/n1)+(1/n2))),2);t
```

```
sprintf("H0 is rejected")

t_95=1.984
LCL<-(md-mb)-t_95*sqrt(p_v*((1/n1)+(1/n2)));LCL
UCL<-(md-mb)+t_95*sqrt(p_v*((1/n1)+(1/n2)));UCL
```

R code Exa 13.2 Effect of New CEO in Family Run Business

```
###page_no_448###
rm(list=ls())
os<-c
   (-1.95,0,.56,1.44,1.5,1.41,-.32,-1.7,-1.66,-1.87,-1.38,.57,3.05,2

o<-c
   (.69,-.95,-2.2,2.65,5.39,4.15,4.28,2.97,4.11,2.66,6.31,-3.04,-.42

n1=42; n2=98
s1<-var(os);s1
s2<-var(o);s2
F<-s1/s2;F
v1<-n1-1;v1
v2<-n2-1;v2
if(F<0.57)print("H0 rejected")

m1<-mean(os);m1
m2<-mean(o);m2
v<-(((s1/n1)^2)+((s2/n2)^2))/((((s1/n1)^2)/(n1-1))
   +(((s2/n2)^2)/(n2-1)));v
v<-(v*2);v
t_cal<-((m1-m2)-0)/sqrt((s1/n1)+(s2/n2));t_cal
if(t_cal< -1.982 || t_cal>1.982)print("H0 rejected")

t<-1.982
LCL<-(m1-m2)-(t*sqrt((s1/n1)+(s2/n2)));LCL
UCL<-(m1-m2)+(t*sqrt((s1/n1)+(s2/n2)));UCL
```

R code Exa 13.3 Dietary Effects of High Fiber Breakfast cereals

```r
###page_no_461##
rm(list=ls())
C<-c
  (568,498,589,681,540,646,636,739,539,596,607,529,637,617,633,555,
NC<-c
  (705,819,706,509,613,582,601,608,787,573,428,754,741,628,537,748,
var(C)
var(NC)
t.test(C,NC,var.equal = F)
```

R code Exa 13.4 Comparing salary offers for finance and marketing MBA Majors

```r
##page_no_464###
rm(list=ls())
fm<-c
  (61228,62531,65948,51836,77073,29392,20620,86705,96382,73356,7028
mm<-c
  (73361,79816,58925,36956,51943,78704,63627,35272,62553,71069,6063
m1<-round(mean(fm));m1
m2<-round(mean(mm));m2
s1<-var(fm);s1
s2<-var(mm);s2
n1=n2=25
s_p<-((n1-1)*s1+(n2-1)*s2)/(n1+n2-2);s_p
```

```
t<-((m1-m2)-0)/sqrt(s_p*((1/n1)+(1/n2)));t
v<-n1+n2-2;v
if(t<1.676)print("H0 may be accepted")
t.test(fm,mm,var.equal = T)
```

R code Exa 13.5 Comparing salary offers for finance and marketing MBA Majors

```
##page_no_466###
rm(list=ls())
group<-seq(1,25,1)
f<-c
   (95171,88009,98089,106322,74566,87089,88664,71200,69367,82618,691
ma<-c
   (89329,92705,99205,99003,74825,77038,78272,59462,51555,81591,6811
d<-f-ma;d
n=25
m<-round(mean(d));m
s<-round(sqrt(var(d)));s
t<-(m-0)/(s/sqrt(n));t
if(t<1.711)print("H0 may be accepted")else("H0 is
   rejected")
t.test(f,ma,paired=T,var.equal = T)
```

R code Exa 13.6 Comparing salary offers for finance and marketing MBA Majors

```
##page_no_470###
rm(list=ls())
group<-seq(1,25,1)
```

```
f<-c
   (95171,88009,98089,106322,74566,87089,88664,71200,69367,82618,6913
ma<-c
   (89329,92705,99205,99003,74825,77038,78272,59462,51555,81591,6811
d<-f-ma;d
n=25
m<-round(mean(d));m
s<-round(sqrt(var(d)));s
t<-(m-0)/(s/sqrt(n));t
if(t<1.711)print("H0 may be accepted")else("H0 is
   rejected")

t<-2.064
LCL<-m-round(t*(s/sqrt(n)));LCL
UCL<-m+round(t*(s/sqrt(n)));UCL
```

R code Exa 13.9 Test marketing of packages designs

```
##page_no_486###
rm(list=ls())
x1=180 ; n1=904 ; x2=155 ; n2=1038
est_p1<-x1/n1;est_p1
est_p2<-x2/n2;est_p2
est_p<-((x1+x2)/(n1+n2));est_p
z<-round(((est_p1-est_p2)/sqrt(est_p*(1-est_p)*((1/
   n1)+(1/n2)))),2);z
z_a=1.645
ifelse(z<z_a,"H0 accepted","H0 rejected")
```

R code Exa 13.10 Test marketing of packages designs

```
##page_no_488###
rm(list=ls())
x1=180 ; n1=904 ; x2=155 ; n2=1038

p<-.03

est_p1<-round((x1/n1),4);est_p1
est_p2<-round((x2/n2),4);est_p2

z<-round((((est_p1-est_p2)-p)/sqrt((est_p1*(1-est_p1
    )/n1)+(est_p2*(1-est_p2)/n2))),2);z
```

R code Exa 13.11 Test marketing of packages designs

```
##page_no_490###
rm(list=ls())
x1=180 ; n1=904 ; x2=155 ; n2=1038

p<-.03
z=1.96

est_p1<-round((x1/n1),4);est_p1
est_p2<-round((x2/n2),4);est_p2

LCL<-(est_p1-est_p2)-round((z*sqrt((est_p1*(1-est_p1
    )/n1)+est_p2*(1-est_p2)/n2)),4);LCL
UCL<-(est_p1-est_p2)+round((z*sqrt((est_p1*(1-est_p1
    )/n1)+est_p2*(1-est_p2)/n2)),4);UCL
```

Chapter 14

Analysis of Variance

R code Exa 14.1 Proportion of Total Assets Invested in stocks

```
###page_no_514###
rm(list=ls())
m_x1=44.4; m_x2=52.47; m_x3=51.14; m_x4=51.84
s1_2=386.55; s2_2=469.44; s3_2=471.82; s4_2=444.79
m_m_x=50.18
n1=84; n2=131; n3=93; n4=58
k=4; n=366


SST<-round(sum((n1*(m_x1-m_m_x)^2),(n2*(m_x2-m_m_x)^2),(n3*(m_x3-m_m_x)^2),(n4*(m_x4-m_m_x)^2)),1);SST
SSE<-round(sum((n1-1)*s1_2,(n2-1)*s2_2,(n3-1)*s3_2,(n4-1)*s4_2),1);SSE
TSS<-SST+SSE;TSS
MST<-round((SST/(k-1)),2);MST
MSE<-round((SSE/(n-k)),2);MSE
F<-round((MST/MSE),2);F

source<-c("treatment","error","total")
dof<-c(k-1,n-k,n-1)
```

```
ss<-c(SST,SSE,TSS);ss
mss<-c(MST,MSE,"")
F_statistics<-c(F,"","")
cbind(source,dof,ss,mss,F_statistics)

ifelse(F<.0405,"H0 may be accepted","H0 is rejected"
    )
```

R code Exa 14.2 Comparing the costs of repairing car bumpers

```
###page_no_530###
rm(list=ls())

Bumper<-c("b1","b2","b3","b4")
b1<-c(610,354,234,399,278,358,379,548,196,444)
b2<-c(404,663,521,518,499,374,562,505,375,438)
b3<-c(599,426,429,621,426,414,332,460,494,637)
b4<-c(272,405,197,363,297,538,181,318,412,499)


m1<-mean(b1); s1<-sd(b1)
m2<-mean(b2); s2<-sd(b2)
m3<-mean(b3); s3<-sd(b3)
m4<-mean(b4); s4<-sd(b4)

Mean<-(c(m1,m2,m3,m4))
StDev<-(c(s1,s2,s3,s4))
bumper<-factor(c(rep("b1",10),rep("b2",10),rep("b3"
    ,10),rep("b4",10)))
values<-c
    (610,354,234,399,278,358,379,548,196,444,404,663,521,518,499,374,

df<-data.frame(bumper,values)
fit<-aov(lm(values~bumper,data=df))
```

```
summary(fit)
F_tab<-qf(.95,3,36);F_tab
ifelse(summary(fit)[[1]][[4]][[1]]<F_tab,"Ho may Accepted ","Ho is Rejected")

n=40; k=4; n1=n2=n3=n4=ng=10
v<-n-k;v
MSE<-round(summary(fit)[[1]][[3]][[2]]);MSE
F_t<-3.79
w<-F_t*sqrt(MSE/(ng));w
DF<-data.frame(Bumper,10,Mean,StDev)

library(ggplot2)
ggplot(DF,aes(x=Mean,y=Bumper))+geom_errorbar(aes(xmin=Mean-StDev,xmax=Mean+StDev),width=.2)+geom_line()+geom_point()
```

R code Exa 14.3 Comparing cholesterol lowering drugs

```
###page_no_542###
rm(list=ls())
group<-seq(1,25,1)
d1<-c
   (6.6,7.1,7.5,9.9,13.8,13.9,15.9,14.3,16,16.3,14.6,18.7,17.3,19.6,
d2<-c
   (12.6,3.5,4.4,7.5,6.4,13.5,16.9,11.4,16.9,14.8,18.6,21.2,10,17,21
d3<-c
   (2.7,2.4,6.5,16.2,8.3,5.4,15.4,17.1,7.7,16.1,9,24.3,9.3,19.2,18.7
d4<-c
   (8.7,9.3,10,12.6,10.6,15.4,16.3,18.9,13.7,19.4,18.5,21.1,19.3,21.

```

```
Drug<-c(rep("d1",25),rep("d2",25),rep("d3",25),rep("
   d4",25))
Group<-rep(c("1","2","3","4","5","6","7","8","9","10
   ","11","12","13","14","15","16","17","18","19","
   20","21","22","23","24","25"),4)
y<-c
   (6.6,7.1,7.5,9.9,13.8,13.9,15.9,14.3,16,16.3,14.6,18.7,17.3,19.6,

df<-data.frame(Group,Drug,y)
fit<-aov(y~Group+Drug,data=df)
summary(fit)
```

R code Exa 14.4 Comparing the lifetime number of jobs by educational level

```
###page_no_549###
rm(list=ls())
Me1<-c(10,9,12,16,14,17,13,9,11,15)
Me2<-c(12,11,9,14,12,16,10,10,5,11)
Me3<-c(15,8,7,7,7,9,14,15,11,13)
Me4<-c(8,9,5,11,13,8,7,11,10,8)
Fe1<-c(7,13,14,6,11,14,13,11,14,12)
Fe2<-c(7,12,6,15,10,13,9,15,12,13)
Fe3<-c(5,13,12,3,13,11,15,5,9,8)
Fe4<-c(7,9,3,7,9,6,10,15,4,11)
factor<-c(rep("Me1",10),rep("Me2",10),rep("Me3",10),
   rep("Me4",10),rep("Fe1",10),rep("Fe2",10),rep("
   Fe3",10),rep("Fe4",10))
x<-c
   (10,9,12,16,14,17,13,9,11,15,12,11,9,14,12,16,10,10,5,11,15,8,7,7


df<-data.frame(factor,x)
fit<-aov(lm(x~factor,data=df))
summary(fit)
```

```
F_tab<-qf(.95,7,72);F_tab
ifelse(summary(fit)[[1]][[4]][[1]]<F_tab,"H0 may
    Accepted","H0 is Rejected")
```

Chapter 15

Chi squared tests

R code Exa 15.1 Testing market shares

```
##page_no_582###
rm(list=ls())
p1=0.45; p2=0.4; p3=0.15
pr<-c(p1,p2,p3)
f<-c(102,82,16)
n=200
e1<-n*p1;e1
e2<-n*p2;e2
e3<-n*p3;e3
e<-c(e1,e2,e3);e
d<-f-e;d
c<-round(((d^2)/e),2);c
c_sq<-sum(c);c_sq
v=2
if(c_sq<5.99)print("H0 may be accepted")else("H0 is
    rejected")
x<-rbind(f,e);x

names<-c("actual","expected")
name<-c("A","B","C")
barplot(x,names.arg=name,beside=T,space=c(0,1),main=
```

```
    "Bar chart",xlab="brands of fabric softner",ylab=
    "frequency",col = c("red","blue"))
legend("topright",legend=names,fill=c("red","blue"),
    cex=0.5)
```

R code Exa 15.2 Relationship between undergraduate degree and MBA major

```
###page_no_588###
rm(list=ls())
UG<-c("BA","BEng","BBA","Other")
Acc<-c(31,8,12,10)
Fin<-c(13,16,10,5)
Mkt<-c(16,7,17,7)
r=4; c=3

x<-rbind(Acc,Fin,Mkt);x
colSums(x)
major<-c("Accounting","Finance","Marketing")
barplot(x,names.arg=UG,besid=T, space=c(0,0.5),main=
    "Bar Chart",xlab="Undergraduate degre",ylab="
    Frequency",col=c("blue","red","yellow"))
legend("topright",legend=major,fill=c("blue","red","
    yellow"),cex=0.5)

total<-(sum(Acc,Fin,Mkt));total
p_Acc<-round((sum(Acc)/total),3);p_Acc
p_Fin<-round((sum(Fin)/total),3);p_Fin
p_Mkt<-round((sum(Mkt)/total),3);p_Mkt
p<-round((colSums(x)/total),3);p

e_Acc<-total*p_Acc*p;e_Acc
e_Fin<-total*p_Fin*p;e_Fin
e_Mkt<-total*p_Mkt*p;e_Mkt

```

```
c_Acc<-sum((Acc-e_Acc)^2/e_Acc);c_Acc
c_Fin<-sum((Fin-e_Fin)^2/e_Fin);c_Fin
c_Mkt<-sum((Mkt-e_Mkt)^2/e_Mkt);c_Mkt
c_sq<-sum(c_Acc,c_Fin,c_Mkt);c_sq

v<-(r-1)*(c-1);v
if(c_sq<12.6)print("HO may be accepted")else("H0 is
   rejected")


chisq.test(x)
```

Chapter 16

Simple Linear Regression and Correlation

R code Exa 16.1 Annual Bonus and Years of Experience

```
###page_no_620###
rm(list=ls())
x<-c(1,2,3,4,5,6)
y<-c(6,1,9,5,17,12)
n=6
sum(x)
sum(y)
sum(x*y)
sum(x^2)
s_xy<-(sum(x*y)-((sum(x)*sum(y))/n))/(n-1);s_xy
var(x)
b1<-s_xy/var(x);b1
mean(x)
mean(y)
b0<-mean(y)-b1*mean(x);b0
est_y<-b0+b1*x;est_y
e<-y-est_y;e
sum(e^2)
plot(x,y,type="p")
```

```
abline(lm(y~x))
```

R code Exa 16.2 Odometer reading and prices of used Toyota Camrys

```
###page_no_623###
rm(list=ls())
n=100
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-(1/(n-1))*(sum_x_2-((sum_x)^2)/n);s_x_2

b1<-s_xy/s_x_2;b1
mean_x<-sum_x/n;mean_x
mean_y<-sum_y/n;mean_y
b0<-mean_y-(b1*mean_x);b0
```

R code Exa 16.3 Odometer reading and prices of used Toyota Camrys

```
###page_no_633###
rm(list=ls())
n=100
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
sum_y_2<-22055.23
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-(1/(n-1))*(sum_x_2-((sum_x)^2)/n);s_x_2

s_y_2<-(1/(n-1))*(sum_y_2-((sum_y)^2)/n);s_y_2
```

```

SSE<-(n-1)*(s_y_2-((s_xy)^2/s_x_2));SSE
s_e<-round((sqrt(SSE/(n-2))),4);s_e
```

R code Exa 16.4 Are Odometer reading and prices of used Toyota Camrys related

```
###page_no_636###
rm(list=ls())
n=100
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
sum_y_2<-22055.23
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-(1/(n-1))*(sum_x_2-((sum_x)^2)/n);s_x_2
s_y_2<-(1/(n-1))*(sum_y_2-((sum_y)^2)/n);s_y_2
b1<-round((s_xy/s_x_2),4);b1
SSE<-(n-1)*(s_y_2-((s_xy)^2/s_x_2));SSE
s_e<-round((sqrt(SSE/(n-2))),4);s_e
beta1=0

s_b1<-round((s_e/sqrt((n-1)*s_x_2)),5);s_b1
t<-round(((b1-beta1)/s_b1),2);t

ifelse(t<-1.984 ,"H0 may be accepted","H0 is
   rejected")
```

R code Exa 16.5 Measuring the strength of the Linear relationship between Odometer reading and prices of used Toyota Camrys

```
###page_no_640###
```

```
rm(list=ls())
n=100
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
sum_y_2<-22055.23
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-(1/(n-1))*(sum_x_2-((sum_x)^2)/n);s_x_2
s_y_2<-(1/(n-1))*(sum_y_2-((sum_y)^2)/n);s_y_2

R_2<-(((s_xy)^2)/(s_x_2*s_y_2));R_2
```

R code Exa 16.6 Are Odometer reading and prices of used Toyota Camrys Linearly related

```
###page_no_643###
rm(list=ls())
n=100
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
sum_y_2<-22055.23
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-(1/(n-1))*(sum_x_2-((sum_x)^2)/n);s_x_2
s_y_2<-(1/(n-1))*(sum_y_2-((sum_y)^2)/n);s_y_2
s_x<-sqrt(s_x_2);s_x
s_y<-sqrt(s_y_2);s_y

r<-round((s_xy/(s_x*s_y)),4);r
t<-round((r*sqrt((n-2)/(1-r^2))),2);t
```

R code Exa 16.7 Predicting the Price and estimating the mean price of used Toyota Camrys

```
###page_no_649###
rm(list=ls())
n=100
x=40
sum_x<-3601.1
sum_y<-1484.1
sum_xy<-53155.93
sum_x_2<-133986.59
sum_y_2<-22055.23
s_xy<-(1/(n-1))*(sum_xy-(sum_x*sum_y/n));s_xy
s_x_2<-round(((1/(n-1))*(sum_x_2-((sum_x)^2)/n)),3);
    s_x_2
s_y_2<-(1/(n-1))*(sum_y_2-((sum_y)^2)/n);s_y_2
b1<-s_xy/s_x_2;b1
mean_x<-sum_x/n;mean_x
mean_y<-sum_y/n;mean_y
b0<-mean_y-(b1*mean_x);b0
SSE<-(n-1)*(s_y_2-((s_xy)^2/s_x_2));SSE
s_e<-round((sqrt(SSE/(n-2))),4);s_e

est_y<-17.25-0.0669*x;est_y
t<-1.984

LL_a<-round((est_y-(t*s_e*(sqrt(1+(1/n)+((x-mean_x)
    ^2/((n-1)*s_x_2)))))),3);LL_a
UL_a<-round((est_y+(t*s_e*(sqrt(1+(1/n)+((x-mean_x)
    ^2/((n-1)*s_x_2)))))),3);UL_a


LL_b<-round((est_y-(t*s_e*(sqrt((1/n)+((x-mean_x)^2/
    ((n-1)*s_x_2)))))),3);LL_b
UL_b<-round((est_y+(t*s_e*(sqrt((1/n)+((x-mean_x)^2/
    ((n-1)*s_x_2)))))),3);UL_b
```

Chapter 18

Model Building

R code Exa 18.4 Testing for pay equity equal pay for work of equal value

```
###page_no_735##
rm(list=ls())
job<-c("maintenance","security","gardener","
    technician","cleaner","secretatry","bookstore","
    cafeteria")
pay_rate<-c
    (13.55,15.65,13.8,19.9,11.85,14.75,18.9,13.3)
score<-c(3.25,3.52,3.3,6.37,2.95,5.03,4.6,3.05)
gender<-c(1,1,1,1,0,0,0,0)
regression<-cbind(score,gender)
df<-data.frame(score,gender)

model<-lm(pay_rate~score+gender)
summary(model)
fit<-aov(pay_rate~regression,data=df)
summary(fit)
```

R code Exa 18.5 Estimating the Probability of a Heart Attack among Diabetics

```
###page_no_740##
rm(list=ls())
b0=-2.15; b1=0.00847; b2=0.00214; b3=0.00539; b4
   =0.00989; b5=-0.288
e=0
ind<-seq(1,5,1)
x1<-c(0,40,15,0,60)
x2<-c(200,230,210,165,320)
x3<-c(20,80,35,0,150)
x4<-c(48,41,62,54,66)
x5<-c(1,0,0,1,0)
ln_y<-b0+(b1*x1)+(b2*x2)+(b3*x3)+(b4*x4)+(b5*x5)+e;
   ln_y
est_y<-exp(ln_y);est_y
prob<-round(est_y/(est_y+1),4);prob

cbind(ind,x1,x2,x3,x4,x5,prob)
```

R code Exa 18.6 Estimating the Probability of Loan Repayment

```
##page_no_743###
rm(list=ls())
b0=.1524; b1=.0281; b2=.0223; b3=.0152; b4=.0114
e=0
applicant<-c(1, 2,3)
x1<-c(27,48,37)
x2<-c(55,78,39)
x3<-c(6,3,12)
x4<-c(5,12,10)
ln_y<-b0+(b1*x1)+(b2*x2)+(b3*x3)+(b4*x4)+e;ln_y
est_y<-exp(ln_y);est_y
prob<-round(est_y/(est_y+1),4);prob

cbind(applicant,x1,x2,x3,x4,prob)
```

Chapter 19

Nonparametric Statistics

R code Exa 19.1 Wilcoxon rank sum test

```
####page_no_756###
rm(list=ls())
s1<-c(22,23,20)
s2<-c(18,27,26)

r<-rank(cbind(s1,s2));r
t1<-sum(r[seq(1,3,1)]);t1
t2<-sum(r[seq(4,6,1)]);t2
t<-t1

r_s1<-combn(6,3);r_s1
r_s<-colSums(r_s1);r_s

r_s2<-combn(6,3)
r_s2<-(r_s2[,seq(20,1,-1)]);r_s2
r_s<-colSums(r_s2);r_s

p_t<-table(r_s)/20;p_t

print(" we cannot reject the hypothesis")
```

R code Exa 19.2 Comparing pharmaceutical painkillers

```
###page_no_760###
rm(list=ls())
np<-c(3,5,4,3,2,5,1,4,5,3,3,5,5,5,4)
a<-c(4,1,3,2,4,1,3,4,2,2,2,4,3,4,5)
n1=n2=15
r<-rank(cbind(np,a));r
t1<-sum(r[seq(1,15,1)]);t1
t2<-sum(r[seq(16,30,1)]);t2
t<-t1
E_t<-n1*(n1+n2+1)/2;E_t
s_t<-round(sqrt(n1*n2*(n1+n2+1)/12),1);s_t
z<-round(((t-E_t)/s_t),2);z
p<-1-pnorm(1.83,0,1);p
```

R code Exa 19.3 Comparing the comfort of two midsize cars

```
## page_no_770###
rm(list=ls())
respondent<-seq(1,25,1)
e<-c
   (3,2,5,3,2,5,2,4,4,2,2,3,2,3,2,4,5,2,5,3,4,3,3,5,5)

na<-c
   (4,1,4,2,1,3,3,2,2,2,1,4,1,4,1,3,4,3,4,1,2,3,4,2,3)


d<-e-na;d
x<-length(d[d>0]);x
n=23

```

```
z<-round((x-(.5*n))/(.5*sqrt(n)),2);z
if(z<1.645)print("may accept the hypothesis")else("
    reject the hypothesis")
p<-1-pnorm(2.29,0,1);p
```

R code Exa 19.4 Comparing Flextime and Fixed time Schedules

```
###page_no_775###
rm(list=ls())
worker<-seq(1,32,1)
a<-c
    (34,35,43,46,16,26,68,38,61,52,68,13,69,18,53,18,41,25,17,26,44,3

f<-c
    (31,31,44,44,15,28,63,39,63,54,65,12,71,13,55,19,38,23,14,21,40,3

n=32

d<-a-f;d
m_d<-abs(d);m_d
r<-rank(m_d);r
t1<-sum(r[d>0]);t1
t2<-sum(r[d<0]);t2

t<-t1
E_t<-(n*(n+1)/4);E_t
s_t<-round(sqrt(n*(n+1)*(2*n+1)/24),2);s_t
z<-round(((t-E_t)/s_t),2);z
if(z<1.96)print("we fail to reject the H0")else("we
    reject the H0")
p<-2*(1-pnorm(1.94,0,1));p
```

R code Exa 19.5 Comparing quality in three shifts

```
###page_no_784###
rm(list=ls())
s1<-c(4,4,3,4,3,3,3,3,2,3)
s2<-c(3,4,2,2,3,4,3,3,2,3)
s3<-c(3,1,3,2,1,3,4,2,4,1)
n=30;n1=n2=n3=10

r<-rank(cbind(s1,s2,s3));r
t1<-sum(r[seq(1,10,1)]);t1
t2<-sum(r[seq(11,20,1)]);t2
t3<-sum(r[seq(21,30,1)]);t3


H<-round(((12/(n*(n+1)))*(((t1^2)/n1)+((t2^2)/n2)+((
    t3^2)/n3)))-(3*(n+1)),2);H
if(H<5.99)print("fail to reject H0")else("we reject
    H0")

print("adjusted")
kruskal.test(list(s1,s2,s3))
```

R code Exa 19.6 Comparing managers evaluation of job applicants

```
###page_no_790###
rm(list=ls())
manager<-seq(1,4,1)
a1<-c(2,1,2,2)
a2<-c(4,2,3,2)
a3<-c(2,2,2,3)
a4<-c(3,1,3,2)
a5<-c(3,2,3,5)
a6<-c(2,2,3,4)
a7<-c(4,1,5,5)
a8<-c(3,2,5,3)
b=8;k=4
```

```r

r1<-rank(a1);r1
r2<-rank(a2);r2
r3<-rank(a3);r3
r4<-rank(a4);r4
r5<-rank(a5);r5
r6<-rank(a6);r6
r7<-rank(a7);r7
r8<-rank(a8);r8

r<-rbind(r1,r2,r3,r4,r5,r6,r7,r8);r
t<-colSums(r);t

F<-round((((12/(b*k*(k+1)))*(sum(t^2)))-(3*b*(k+1))),2);F
if(F<7.81)print("may accept the H0")else("reject H0")

x<-rbind(a1,a2,a3,a4,a5,a6,a7,a8)
print("adjusted for ties")
friedman.test(x)
```

R code Exa 19.7 Testing the Relationship between Aptitude Tests and Performance

```r
###page_no_796###
rm(list=ls())
employee<-seq(1,40,1)
a<-c(59,47,58,66,77,57,62,68,69,36,48,65,51,61,40,67,60,56,76,71,52,6
p<-c(3,2,4,3,2,4,3,3,5,1,3,3,2,3,3,4,2,3,3,2,3,5,2,3,1,5,4,5,2,1,4,3,
n=40
```

```
r_a<-rank(a);r_a
r_p<-rank(p);r_p

s_ap<-((sum(r_a*r_p))-((sum(r_a)*sum(r_p))/n))/(n-1);s_ap
s_a<-sqrt((sum(r_a^2)-(sum(r_a)^2)/n)/(n-1));s_a
s_p<-sqrt((sum(r_p^2)-(sum(r_p)^2)/n)/(n-1));s_p

r<-s_ap/(s_a*s_p);r
z<-r*sqrt(n-1);z
p_value<-2*(1-pnorm(1.83,0,1));p_value
```

Chapter 20

Time Series Analysis And Forecasting

R code Exa 20.1 Gasoline Sales

```
#####page823####
rm(list=ls())
year<-seq(1,4,1)
quarter<-seq(1,4,1)
time<-seq(1,16,1)
sale<-c
    (39,37,61,58,18,56,82,27,41,69,49,66,54,42,90,66)
library(forecast)
ma3<-ma(sale,order=3);ma3
ma5<-ma(sale,order=5);ma5
plot(time,sale,type="l")
lines(time,ma3,type="l",col="red")
lines(time,ma5,type="l",col="blue")
legend("topleft",fill=c("black","red","blue"),legend
    =c("sale","3-Q MA","5-Q MA"),cex=0.6,pt.lwd=0.4)
```

R code Exa 20.2 Gasoline Sales

```
###page_no_829###
rm(list=ls())
t<-seq(1,16,1)
gs<-c
    (39,37,61,58,18,56,82,27,41,69,49,66,54,42,90,66)
ds<-data.frame(t,gs)

a=0.2
ds$a[1]<-ds$gs[1]
for(i in 2:16){
  ds$a[i]<-(1-a)*ds$a[i-1]+(a*ds$gs[i])

}
df1<-round(ds$a,1);df1

a2=0.7
ds$a2[1]<-ds$gs[1]
for(i in 2:16){
  ds$a2[i]<-(1-a2)*ds$a2[i-1]+(a2*ds$gs[i])

}
df2<-round(ds$a2,1);df2

plot(gs,type="l",ylab="gasoline sales",xlab="Quarter
    ",col="green")
lines(df1,col="red")
lines(df2,col="grey")
legend("topleft",legend=c("gs","df1","df2"),fill=c("
    green","red","grey"),cex=0.5)
```

R code Exa 20.3 Hotel Quarterly Occupancy Rates

```
###page_no_834###
```

```r
rm(list=ls())
year<-seq(2003,2007,1)
quarter<-seq(1,4,1)
t<-seq(1,20,1)
y<-c
   (.561,.702,.8,.568,.575,.738,.868,.605,.594,.738,.729,.6,.622,.70

b0=.639368; b1=.005246

est_y<-round((b0+b1*t),3);est_y
r<-round((y/est_y),3);r

y2003<-r[seq(1,4,1)];y2003
y2004<-r[seq(5,8,1)];y2004
y2005<-r[seq(9,12,1)];y2005
y2006<-r[seq(13,16,1)];y2006
y2007<-r[seq(17,20,1)];y2007

table<-rbind(y2003,y2004,y2005,y2006,y2007);table
q1<-mean(table[,1]);q1
q2<-mean(table[,2]);q2
q3<-mean(table[,3]);q3
q4<-mean(table[,4]);q4

i1<-round(q1,3);i1
i2<-round(q2,3);i2
i3<-round(q3,3);i3
i4<-round(q4,3);i4

plot(y,ylim=c(0,1),ylab="rate",xlab="quater",type="l
   ")
lines(est_y,col="red")
```

R code Exa 20.4 Comparing Forecasting Models

```
###page_no_840###
rm(list=ls())
year<-seq(2004,2007,1)
a_ts<-c(129,142,156,183)
m1<-c(136,148,150,175)
m2<-c(118,141,158,163)
m3<-c(130,146,170,180)
n=4

MAD1<-sum(abs(a_ts-m1))/n;MAD1
SSE1<-sum((a_ts-m1)^2);SSE1

MAD2<-sum(abs(a_ts-m2))/n;MAD2
SSE2<-sum((a_ts-m2)^2);SSE2

MAD3<-sum(abs(a_ts-m3))/n;MAD3
SSE3<-sum((a_ts-m3)^2);SSE3
```

R code Exa 20.5 Forecasting Hotel Occupancy Rares

```
###page_no_842##
rm(list=ls())
q<-seq(1,4,1)
t<-seq(21,24,1)
i<-c(.878,1.075,1.171,.876)
est_y<-round((.639+.00525*t),3);est_y
forecast<-round((est_y*i),3);forecast

cbind(q,t,est_y,i,forecast)
```

R code Exa 20.6 Forecasting changes to the consumer price index

```
###page_no_843##
```

```
rm(list=ls())
year<-seq(1978,2006,1)
CPI<-c
   (65.2,72.6,82.4,90.9,96.5,99.6,103.9,107.6,109.7,113.6,118.3,123.
change<-c(NA
   ,11.3,13.5,10.4,6.2,3.2,4.4,3.5,1.9,3.6,4.1,4.8,5.4,4.2,3,3,2.6,2

Y<-c
   (11.3,13.5,10.4,6.2,3.2,4.4,3.5,1.9,3.6,4.1,4.8,5.4,4.2,3,3,2.6,2
X<-c
   (13.5,10.4,6.2,3.2,4.4,3.5,1.9,3.6,4.1,4.8,5.4,4.2,3,3,2.6,2.8,2.
y<-Y/100
x<-X/100
df<-data.frame(y,x)
t<-lm(x~y,data=df)
summary(t)

est_y2007<-.006954+(.762155*X[27]);est_y2007
```

Chapter 21

Statistical process control

R code Exa 21.1 Statistical process control at Lear seating

```
#######page_859####
rm(list=ls())
sample<-c
   (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,2
a<-c(501.02,501.65,504.34,501.1)
a1<-mean(a)
a2<-sd(a)
b<-c(499.8, 498.89, 499.47, 497.9)
b1<-mean(b)
b2<-sd(b)
c<-c(497.12, 498.35,500.34, 499.33)
c1<-mean(c)
c2<-sd(c)
d<-c(500.68, 501.39, 499.74,500.41)
d1<-mean(d)
d2<-sd(d)
e<-c(495.87, 500.92,498,499.44)
e1<-mean(e)
e2<-sd(e)
f<-c(497.89,499.22,502.1,500.03)
```

```
f1<-mean(f)
f2<-sd(f)
g<-c(497.24,501.04,498.74,503.51)
g1<-mean(g)
g2<-sd(g)
h<-c(501.22,504.53,499.06,505.37)
h1<-mean(h)
h2<-sd(h)
i<-c(499.15,501.11,497.96,502.39)
i1<-mean(i)
i2<-sd(i)
j<-c(498.9,505.99,500.05,499.33)
j1<-mean(j)
j2<-sd(j)
k<-c(497.38,497.8,497.57,500.72)
k1<-mean(k)
k2<-sd(k)
l<-c(499.7,500.99,501.35,496.48)
l1<-mean(l)
l2<-sd(l)
m<-c(501.44,500.46,502.07,500.5)
m1<-mean(m)
m2<-sd(m)
n<-c(498.26,495.54,495.21,501.27)
n1<-mean(n)
n2<-sd(n)
o<-c(497.57,497,500.32,501.22)
o1<-mean(o)
o2<-sd(o)
p<-c(500.95,502.07,500.6,500.44)
p1<-mean(p)
p2<-sd(p)
q<-c(499.7,500.56,501.18,502.36)
q1<-mean(q)
q2<-sd(q)
r<-c(501.57,502.09,501.18,504.98)
r1<-mean(r)
r2<-sd(r)
```

```
s<-c(504.2,500.92,500.02,501.71)
s1<-mean(s)
s2<-sd(s)
t<-c(498.61,499.63,498.68,501.84)
t1<-mean(t)
t2<-sd(t)
u<-c(499.05,501.82,500.67,497.36)
u1<-mean(u)
u2<-sd(u)
v<-c(497.85,494.08,501.79,501.95)
v1<-mean(v)
v2<-sd(v)
w<-c(501.08,503.12,503.06,503.56)
w1<-mean(w)
w2<-sd(w)
x<-c(500.75,501.18,501.09,502.88)
x1<-mean(x)
x2<-sd(x)
y<-c(502.03,501.44,498.76,499.39)
y1<-mean(y)
y2<-sd(y)

x_bar_j<-c(a1,b1,c1,d1,e1,f1,g1,h1,i1,j1,k1,l1,m1,n1
   ,o1,p1,q1,r1,s1,t1,u1,v1,w1,x1,y1)
x_bar<-mean(x_bar_j)

s_j<-c(a2,b2,c2,d2,e2,f2,g2,h2,i2,j2,k2,l2,m2,n2,o2,
   p2,q2,r2,s2,t2,u2,v2,w2,x2,y2)
S<-sqrt((sum((s_j)^2))/25);S

C<-mean(x_bar)
LCL<-mean(x_bar)-3*(S/sqrt(4));LCL
UCL<-mean(x_bar)+3*(S/sqrt(4));UCL
library(qcc)
qcc(x_bar_j,type="xbar",sizes=4,std.dev=S,title="
   xbar chart",xlab="samples",ylab="sample mean")
```

R code Exa 21.2 Statistical process control at Lear seating

```
#######page_865####
rm(list=ls())
sample<-c
   (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,2

a<-c(501.02,501.65,504.34,501.1)
a1<-mean(a)
a2<-sd(a)
b<-c(499.8, 498.89, 499.47, 497.9)
b1<-mean(b)
b2<-sd(b)
c<-c(497.12, 498.35,500.34, 499.33)
c1<-mean(c)
c2<-sd(c)
d<-c(500.68, 501.39, 499.74,500.41)
d1<-mean(d)
d2<-sd(d)
e<-c(495.87, 500.92,498,499.44)
e1<-mean(e)
e2<-sd(e)
f<-c(497.89,499.22,502.1,500.03)
f1<-mean(f)
f2<-sd(f)
g<-c(497.24,501.04,498.74,503.51)
g1<-mean(g)
g2<-sd(g)
h<-c(501.22,504.53,499.06,505.37)
h1<-mean(h)
h2<-sd(h)
i<-c(499.15,501.11,497.96,502.39)
i1<-mean(i)
i2<-sd(i)
```

```
j<-c(498.9,505.99,500.05,499.33)
j1<-mean(j)
j2<-sd(j)
k<-c(497.38,497.8,497.57,500.72)
k1<-mean(k)
k2<-sd(k)
l<-c(499.7,500.99,501.35,496.48)
l1<-mean(l)
l2<-sd(l)
m<-c(501.44,500.46,502.07,500.5)
m1<-mean(m)
m2<-sd(m)
n<-c(498.26,495.54,495.21,501.27)
n1<-mean(n)
n2<-sd(n)
o<-c(497.57,497,500.32,501.22)
o1<-mean(o)
o2<-sd(o)
p<-c(500.95,502.07,500.6,500.44)
p1<-mean(p)
p2<-sd(p)
q<-c(499.7,500.56,501.18,502.36)
q1<-mean(q)
q2<-sd(q)
r<-c(501.57,502.09,501.18,504.98)
r1<-mean(r)
r2<-sd(r)
s<-c(504.2,500.92,500.02,501.71)
s1<-mean(s)
s2<-sd(s)
t<-c(498.61,499.63,498.68,501.84)
t1<-mean(t)
t2<-sd(t)
u<-c(499.05,501.82,500.67,497.36)
u1<-mean(u)
u2<-sd(u)
v<-c(497.85,494.08,501.79,501.95)
v1<-mean(v)
```

```
v2<-sd(v)
w<-c(501.08,503.12,503.06,503.56)
w1<-mean(w)
w2<-sd(w)
x<-c(500.75,501.18,501.09,502.88)
x1<-mean(x)
x2<-sd(x)
y<-c(502.03,501.44,498.76,499.39)
y1<-mean(y)
y2<-sd(y)

x_bar_j<-c(a1,b1,c1,d1,e1,f1,g1,h1,i1,j1,k1,l1,m1,n1
   ,o1,p1,q1,r1,s1,t1,u1,v1,w1,x1,y1)
x_bar<-mean(x_bar_j)

s_j<-c(a2,b2,c2,d2,e2,f2,g2,h2,i2,j2,k2,l2,m2,n2,o2,
   p2,q2,r2,s2,t2,u2,v2,w2,x2,y2)
S<-sqrt((sum((s_j)^2))/25);S

x<-rbind(a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,q,r,s,t,u,v
   ,w,x,y)
library(qcc)
qcc(x,type="S",center = 1.822,std.dev=S,xlab="
   Samples",ylab="Sample stDev")
```

R code Exa 21.3 Statistical process control at Lear seating

```
###page_no_867###
rm(list=ls())
s1<-c(502.653,498.354,502.209,500.08)
s2<-c(501.212,494.454,500.918,501.855)
s3<-c(500.086,500.826,496.426,503.113)
s4<-c(502.994,500.481,502.996,503.113)
s5<-c(500.549,498.78,502.48,499.836)
s6<-c(500.441,502.666,502.569,503.248)
```

```
x<-rbind(s1,s2,s3,s4,s5,s6);x
s_j<-c(var(s1),var(s2),var(s3),var(s4),var(s5),var(
    s6));s_j
S<-sqrt(sum((s_j)^2))/6;S
library(qcc)
qcc(x,type="S",sizes=4,std.dev=S,center = 1.822,ylab
    ="stdev",xlab="sample")
qcc(x,type="xbar",std.dev=S,center= 500.296,xlab="
    sample",ylab="sample mean")
```

Chapter 22

Decision analysis

R code Exa 22.1 An investment decision

```
###page_no_878###
rm(list=ls())
library(rpart)
library(rpart.plot)
son<-c("s1","s2","s3")
a1<-c(100000,100000,100000)
a2<-c(-50000,80000,180000)
a3<-c(150000,90000,40000)

p<-factor(c(rep("a1",3),rep("a2",3),rep("a3",3)))
values<-c(a1,a2,a3)
df<-data.frame(p,son,values);df
library(collapsibleTree)
collapsibleTree(df,hierarchy=c("p","son","values"),
   collapsed=F)

p_son<-c(0.2,0.5,0.3)

EMV_a1<-sum(p_son*a1);EMV_a1
EMV_a2<-sum(p_son*a2);EMV_a2
EMV_a3<-sum(p_son*a3);EMV_a3
```

```
SON<-c("s1 0.2","s2 0.5","s3 0.3")
P<-factor(c(rep("a1 100000",3),rep("a2 84000",3),rep
   ("a3 87000",3)))


a1_ld<-c(50000,0,80000)
a2_ld<-c(200000,20000,0)
a3_ld<-c(0,10000,140000)

EOL_a1<-sum(p_son*a1_ld);EOL_a1
EOL_a2<-sum(p_son*a2_ld);EOL_a2
EOL_a3<-sum(p_son*a3_ld);EOL_a3


Df<-data.frame(P,SON,values);Df
library(collapsibleTree)
collapsibleTree(Df,hierarchy=c("P","SON","values"),
   collapsed=F)
```