R Textbook Companion for Introduction to Mathematical Statistics by Robert V. Hogg, Joseph W. Mckean, Allen T. Craig[1]

Created by
Ashwin Guptha
B.Tech
Computer Science and Engineering
Vellore Institute of Technology, Chennai
Cross-Checked by
R TBC Team

July 31, 2022

[1]Funded by a grant from the National Mission on Education through ICT - http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and R codes written in it can be downloaded from the "Textbook Companion Project" section at the website - https://r.fossee.in.

Book Description

Title: Introduction to Mathematical Statistics

Author: Robert V. Hogg, Joseph W. Mckean, Allen T. Craig

Publisher: Pearson, USA

Edition: 7

Year: 2012

ISBN: 9780321795434

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 1

Probability And Distributions

R code Exa 1.1.1 Coin Toss

```
#Page no. 1

library(prob)
tosscoin(2)
```

R code Exa 1.1.2 Dice Sample Space

```
#Page no 1

sample_space_two_die<-expand.grid(x=1:6, y=1:6)
sample_space_two_die
```

R code Exa 1.1.3 Dice Relative Frequency

```
#Page no 2

```

```
f<-60
N<-400
rf<-f/N
p<-rf
rf
p
```

R code Exa 1.2.3 Union

```
#Page no 4

c1<-c(8:11)
c2<-c(0:10)
c3<-union(c2,c1)
c3
```

R code Exa 1.2.4 Union

```
#Page no. 4

c1<-c(0:1)
c2<-c(-1:2)
c3<-union(c1,c2)
setequal(c2,c3)
```

R code Exa 1.2.5 Union

```
#Page no. 4

c1<-sample(1000,size=10)
```

```
c2<-c(NULL)
c3<-union(c1,c2)
setequal(c1,c3)
```

R code Exa 1.2.6 Union

```
#Page no. 4

c<-sample(1000,size=10)
c1<-union(c,c)
setequal(c1,c)
```

R code Exa 1.2.8 Intersection of Sets

```
#Page no. 4

c1<-c('0,0','0,1','1,1')
c2<-c('1,1','1,2','2,1')
ans<-intersect(c1,c2)
ans
```

R code Exa 1.2.10 Intersection of Sets

```
#Page no. 4

c<-sample(1000,size=10)
null<-c(NULL)
c1<-intersect(c,c)
c2<-intersect(c,null)
setequal(c1,c)
setequal(null,c2)
```

R code Exa 1.2.12 Venn Diagram

```
#Page no. 5

library(VennDiagram)
grid.newpage()
draw.pairwise.venn(5,5,2,fill="gray",category = c("
   C1","C2"))
grid.newpage()
draw.pairwise.venn(5,5,2,fill=c("red","blue"),
   category = c("C1","C2"))
```

R code Exa 1.2.13 Coin Sample Space

```
#Page no 5

library(prob)
toss<-tosscoin(4)
toss
set_c<-c()
for (i in c(1:16)) {
  count<-0
  if(toss[i,1]=='H')
  {
    count=count+1
  }
  if(toss[i,2]=='H')
  {
    count=count+1
  }
  if(toss[i,3]=='H')
```

```
  {
    count=count+1
  }
  if(toss[i,4]=='H')
  {
    count=count+1
  }
  set_c<-c(set_c,count)
}
set_c<-unique(set_c)
set_c
```

R code Exa 1.2.15 Set Complement

```
#Page no. 6

c<-c(0,1,2,3,4)
c1<-c(0,1)
complement<-setdiff(c,c1)
complement
```

R code Exa 1.2.16 Set Operations

```
#Page no. 6

c<-c(0,1,2,3,4)
c1<-c(0,1)
comp<-setdiff(c,c1)
comp2<-setdiff(c,comp)

set<-union(c1,comp)
setequal(set,c)

```

```
set<-intersect(c1,comp)
setequal(set,NULL)

set<-union(c1,c)
setequal(set,c)

set<-intersect(c1,c)
setequal(set,c1)

setequal(comp2,c1)
```

R code Exa 1.2.17 De Morgans Law

```
#Page no. 6

c1<-c(0,1,2)
c2<-c(2,3,4,5)
c<-union(c1,c2)
c1comp<-setdiff(c,c1)
c2comp<-setdiff(c,c2)

set<-intersect(c1,c2)
lhs<-setdiff(c,set)
rhs<-union(c1comp,c2comp)
setequal(lhs,rhs)

set<-union(c1,c2)
lhs<-setdiff(c,set)
rhs<-intersect(c1comp,c2comp)
setequal(lhs,rhs)
```

R code Exa 1.2.18 Set Functions

```
#Page no. 6

C<-c(0:4)
Qc<-0
for (i in C)
{
  if(i>0)
  {
    Qc<-Qc+1
  }
}
Qc

C<-c(-2,-1)
Qc<-0
for (i in C)
{
  if(i>0)
  {
    Qc<-Qc+1
  }
}
Qc

inf<-9999999
C<-c(-inf:5)
Qc<-0
for (i in C)
{
  if(i>0)
  {
    Qc<-Qc+1
  }
}
Qc
```

R code Exa 1.2.21 Functions

```
#Page no. 7

f<-function(x)
{
  ((1/2)^x)*(x>0)
}
C<-c(0:3)
Qc<-f(C)
sum(Qc)
```

R code Exa 1.2.23 1D Set Integration

```
#Page no 7

library(pracma)
f<-function(x)
{
  exp(-x)
}

qc1<-integral(f,0,Inf)
qc1

qc2<-integral(f,1,2)
qc2

qc3<-integral(f,0,3)
qc3
#The answer may vary due to difference in
   representation.
```

R code Exa 1.3.1 Set Probability

```
#Page no. 13

p<-1/36
c1<-c('1,1','2,1','3,1','4,1','5,1')
c2<-c('1,2','2,2','3,2')
P1<-length(c1)*p
P2<-length(c2)*p
P3<-length(union(c1,c2))*p
P4<-length(intersect(c1,c2))*p
P1
P2
P3
P4
#The answer may vary due to difference in
    representation
```

R code Exa 1.3.2 Set Probability

```
#Page no. 13

C<-c('H,H','H,T','T,H','T,T')
c1<-c('H,H','H,T')
c2<-c('H,H','T,H')
p1<-length(c1)/length(C)
p2<-length(c2)/length(C)
p3<-length(intersect(c1,c2))/length(C)
p4<-length(union(c1,c2))/length(C)
p1
p2
```

```
p3
p4
#The answer may vary due to difference in
    representation
```

R code Exa 1.3.4 Poker Question

```
#Page no. 15

k<-52
r1<-13
r2<-4
E1<-r1/k
E2<-r2/k
E1
E2
PE1<-choose(4,1)*choose(13,5)/choose(52,5)
round(PE1,5)
PE2<-choose(13,1)*choose(4,3)*choose(12,2)*choose
    (4,1)^2/choose(52,5)
round(PE2,4)
PE3<-choose(4,3)*choose(4,2)/choose(52,5)
round(PE3,7)
```

R code Exa 1.4.1 Conditional Probabilty

```
#Page no. 22

number_of_cards<-52
number_of_spades<-13

CP2=choose(number_of_spades,5)/choose(number_of_
    cards,5)
```

```
CP1=(choose(number_of_spades,4)*choose(39,1)+choose(
   number_of_spades,5))/choose(number_of_cards,5)
ans<-round(CP2/CP1,4)
ans
```

R code Exa 1.4.2 Conditional Probabilty Chip Problem

```
#Page no. 22

number_of_chips<-8
redchips<-3
bluechips<-5
pc1<-redchips/number_of_chips
pc2c1<-bluechips/(number_of_chips-1)
ans<-pc1*pc2c1
round(ans,4)
```

R code Exa 1.4.3 Conditional Probabilty Card Problem

```
#Page no. 22

number_of_cards<-52
number_of_spades<-13

CP1=choose(number_of_spades,2)*choose(number_of_
   cards-number_of_spades,3)/choose(number_of_cards
   ,5)
CP1=round(CP1,4)
PC2givenC1=11/47

ans=round(CP1*PC2givenC1,4)
ans
```

R code Exa 1.4.4 Cards In Order

```
#Page no. 23

n<-52
spade<-13
heart<-13
diamond<-13
club<-13
p<-(spade/n)*(heart/(n-1))*(diamond/(n-2))*(club/(n
   -3))
round(p,4)
```

R code Exa 1.4.5 Bayes Theorem

```
#Page no. 23

c1_red<-3
c1_blue<-7
c2_red<-8
c2_blue<-2
PC1<-2/6
PC2<-4/6
PCgivenC1<-c1_red/(c1_blue+c1_red)
PCgivenC2<-c2_red/(c2_blue+c2_red)
PC1givenC<-PC1*PCgivenC1/((PC1*PCgivenC1)+(PC2*
   PCgivenC2))
PC2givenC<-1-PC1givenC
PC1givenC
PC2givenC
#The answer may vary due to difference in
   representation
```

R code Exa 1.4.6 Plant Problem

```
#Page no. 24

PC1<-0.1
PC2<-0.5
PC3<-0.4
PCC1<-0.01
PCC2<-0.03
PCC3<-0.04
PC1C<-(PC1*PCC1)/(PC1*PCC1+PC2*PCC2+PC3*PCC3)
PC1C
#The answer may vary due to difference in
    representation
```

R code Exa 1.4.7 Bayes Theorem Child Abuse Problem

```
#Page no. 24

A<-0.01
N<-0.99
PNd_A<-0.04
PAd_N<-0.05
PAd_A<-0.96
PNd_N<-0.95
PAd<-PAd_A*A+PAd_N*N
PAd

PA_Ad<-PAd_A*A/PAd
round(PA_Ad,4)
```

R code Exa 1.4.8 Sum of 2 Die

```
#Page no. 26

n1<-c(rep(1,6),rep(2,6),rep(3,6),rep(4,6),rep(5,6),
   rep(6,6))
n2<-c(rep(1:6,6))
count<-n1+n2
sum<-as.data.frame(table(count))
prob<-sum$Freq/length(n1)
prob
#The answer may vary due to difference in
   representation
```

R code Exa 1.4.9 Mutual Independence

```
#Page no 27

sample<-c(1:4)
sample2<-expand.grid(x=1:4, y=1:4)
sample
sample2
c1<-4
c2<-1
c3<-1
pc1<-c1/(length(sample)*length(sample))
pc2<-c2/length(sample)
pc3<-c3/length(sample)
pc1
pc2
pc3
pc1c2c3<-1/(length(sample)*length(sample))
```

```
PC<-pc1*pc2*pc3

PC
pc1c2c3
#The answer may vary due to difference in
   representation.
```

R code Exa 1.4.10 Coin Probability

```
#Page no. 27

H<-1/2
T<-1-H
P1<-H*H*T*H
P2<-T*T*H
P3<-1-(T*T*T*T)
P1
P2
P3
#The answer may vary due to difference in
   representation
```

R code Exa 1.4.11 Mutually Independent Events

```
#Page no. 27

k1<-0.01
k2<-0.03
k3<-0.08
Pfailure<-k1*k2*k3
Pnotfailure<-1-Pfailure
Pfailure
Pnotfailure
```

R code Exa 1.5.1 Random Variable Pmf

```
#Page no. 32

n1<-c(rep(1,6),rep(2,6),rep(3,6),rep(4,6),rep(5,6),
   rep(6,6))
n2<-c(rep(1:6,6))
count<-n1+n2
sum<-as.data.frame(table(count))
prob<-sum$Freq/length(n1)
sum$count
prob
p1<-prob[6]+prob[10]
p1
p2<-prob[1]+prob[2]+prob[11]
p2
#The answer may vary due to difference in
   representation
```

R code Exa 1.5.2 Probability Density Function

```
#Page no. 33

f<-function(x) {(x>0 & x<1)*1}
fx1<-integrate(f,lower=0,upper=1/8)
fx2<-integrate(f,lower=7/8,upper=1)
ans<-fx1$value+fx2$value
ans
#The answer may vary due to difference in
   representation
```

R code Exa 1.5.3 Step Function Plot

```
#Page no. 34

f<-function(x){(x<1)*0+(x>=1 & x<2)*1/6+(x>=2 & x<3)
    *2/6+(x>=3 & x<4)*3/6+(x>=4 & x<5)*4/6+(x>=5 & x
    <6)*5/6+(x==6)*1}
plot(f,xlim=c(0,6),ylim=c(0,1))
```

R code Exa 1.5.4 Cumulative Distribution Function

```
#Page no. 34

f<- function(x) {(x<0)*0+(x>=0 & x<1)*x+(x>=1)*1}
plot(f,xlim=c(-1,2),ylim=c(0,1))
```

R code Exa 1.5.5 Mechanical Part CDF Problem

```
#Page no. 36

cdf<-expression(1-exp(-x))
pdf<-D(cdf,'x')
x<-1
ans1<-eval(pdf)
x<-3
ans2<-eval(pdf)
ans<-ans1-ans2
round(ans,3)
```

R code Exa 1.5.6 Cumulative Distribution Function

```
#Page no. 37

f<-function(x)
{
  x/2*(x>=0 & x<1)+1*(x>=1)
}
p1<-f(1/2)-f(-1)
p1
p2<-f(1)-f(0.99999999)
p2
#The answer may vary due to difference in
    representation
```

R code Exa 1.5.7 Probability Mass Function

```
#Page no 38

library(rSymPy)
sympyStart()

x<-c(1:10)
c<-Var('c')
sumpx<-sum(x)*c
sumpx
sympy("solve([Eq(55*c,1)],c)")
```

R code Exa 1.5.8 Probability Density Function

```
#Page no. 38

f<-function(x)
{
  ((x^3)/4)*(x>0 & x<2)
}
ans<-integrate(f,lower=1/4,upper=1)
round(ans$value,5)
```

R code Exa 1.6.2 Fuse Problem

```
#Page no. 41

fuses<-100
defective<-20
ans<-choose(fuses-defective,5)/choose(fuses,5)
round(ans,5)
```

R code Exa 1.7.1 Circle Probability Problem

```
#Page no. 45

pdf<-function(x) (2*x)
px<-integrate(pdf,lower = 1/4,upper=1/2)
px$value
#The answer may vary due to difference in
   representation
```

R code Exa 1.7.2 Telephone Probability Problem And Graph

```
#Page no. 45

f=function(x) (1/4*exp(-x/4))
px=integrate(f,lower=4,upper=Inf)

plot(f,type='l',ylab='f(x)',ylim=c(0,0.3),xlim=c(0,6))
cord.x<-c(4,4,6,6)
cord.y<-c(0,f(4),f(6),0)
polygon(cord.x,cord.y,col='blue')
round(px$value,4)
```

R code Exa 1.7.6 Cumulative Distribution Function

```
#Page no. 48

f1=function(x) {(x<0)*(0)+(x>=0 & x<1)*((x+1)/2)+(x>=1)*1}
p1=f1(1/2)-0
p2=f1(0)-0
plot(f1,type="l",ylab="f(x)",xlim=c(0,3),ylim=c(0,2))
p1
p2
#The answer may vary due to difference in representation
```

R code Exa 1.7.7 Company Loss Problem

```
#Page no 49

f<-function(y)
{
```

```
  1-(10/(10+y))^3
}
jump=1-f(10)
jump

#The answer may vary due to difference in
   representation.
```

R code Exa 1.8.2 Random Variable

```
#Page no. 53

x<-c(1,2,3,4)
px<-c(0.4,0.1,0.3,0.2)
ex=sum(x*px)
ex
```

R code Exa 1.8.3 Probability Density Function

```
#Page no. 53

f<-function(x){(x>0 & x<1)*(x*4*x^3)}
ex<-integrate(f,lower=0,upper=1)
ex$value
#The answer may vary due to difference in
   representation
```

R code Exa 1.8.4 Expectation Problem

```
#Page no. 55
```

```
f1<-function(x){(x>0 & x<1)*x*2*(1-x)}
f2<-function(x){(x>0 & x<1)*x^2*2*(1-x)}
ex<-integrate(f1,lower=-Inf,upper=Inf)
ex2<-integrate(f2,lower=-Inf,upper=Inf)
ex$value
ex2$value
ans<-6*ex$value+3*ex2$value
ans
#The answer may vary due to difference in
    representation
```

R code Exa 1.8.5 Expectation Problem

```
#Page no. 55

px<-function(x1) {x1/6}
f<-function(x) {x^3*px(x)}
ans<-f(1)+f(2)+f(3)
ans
#The answer may vary due to difference in
    representation
```

R code Exa 1.8.6 Expectation Problem

```
#Page no. 55

f<-function(x)
{
  1/5*(x>0 & x<5)
}
f1<-function(x)
{
```

```
  f(x)*x
}
f2<-function(x)
{
  f(x)*(5-x)
}
f3<-function(x)
{
  f(x)*(5-x)*x
}
ex<-integrate(f1,lower = 0,upper = 5)
ex$value
ex<-integrate(f2,lower = 0,upper = 5)
ex$value
ex<-integrate(f3,lower = 0,upper = 5)
ex$value
#The answer may vary due to difference in
   representation
```

R code Exa 1.8.7 Expectation Chip Problem

```
#Page no. 56

px<-function(x1) {choose(3,x1)*choose(2,2-x1)/choose
   (5,2)}
f<-function(x) {(8-3*x)*px(x)}
ans<-f(0)+f(1)+f(2)
ans
#The answer may vary due to difference in
   representation
```

R code Exa 1.9.1 Mean And Variance

```
#Page no. 59

pdf<-function(x) {(x>-1 & x<1)*(x+1)/2}
mean<-function(x){x*pdf(x)}
variance<-function(x){((x^2)*pdf(x))}
ans1<-integrate(mean,lower=-Inf,upper=Inf)$value
ans2<-integrate(variance,lower=-Inf,upper=Inf)$value
    -(ans1)^2
ans1
ans2
#The answer may vary due to difference in
    representation
```

R code Exa 1.10.1 Chebyshev Inequality

```
#Page no 69

f<-function(x)
{
  (1/(2*sqrt(3)))*(x>-sqrt(3) & x<sqrt(3))
}
k<-3/2
i<-integrate(f,lower = -k,upper = k)
p<-1-i$value
p
#The answer may vary due to difference in
    representation
```

Chapter 2

Multivariate Distributions

R code Exa 2.1.2 Multivariate Random Variable

```
#Page no. 75

library(cubature)
pdf<-function(x){(x[1]>0 & x[1]<1 & x[2]>0 & x[2]<1)*6*x[1]^2*x[2]}
f1<-adaptIntegrate(pdf,lowerLimit = c(0,1/3), upperLimit = c(3/4,2))
round(f1$integral,3)
#The answer may vary due to difference in representation
```

R code Exa 2.1.3 Chips From Bowl Problem

```
#Page no 77

p11<-1/10
p12<-1/10
p21<-1/10
```

```
p22<-2/10
p31<-2/10
p32<-3/10

jointp<-matrix(c(p11,p21,p31,p12,p22,p32),ncol=2)
jointp

px1<-apply(jointp,1,sum)
px1

px2<-apply(jointp,2,sum)
px2
```

R code Exa 2.1.4 Joint PDF Problem

```
#Page no. 78

library(pracma)
f<-function(x1,x2)
{
  (x1>0 & x1<1 & x2>0 & x2<1)*(x1+x2)
}
P1<-integral2(f,0,0.5,0,1)
P1$Q

ymax<-function(x1){1-x1}
P2<-integral2(f,0,1,0,ymax)
P2$Q
#The answer may vary due to difference in
   representation
```

R code Exa 2.1.5 Multivariate Expectation Problem

```
#Page no. 80

library(pracma)
f<-function(x2,x1){8*x1*x2}
ymax<-function(x2){x2}
e1<-function(x2,x1){x1*(x2^2)*f(x2,x1)}
E1<-integral2(e1,0,1,0,ymax)
E1$Q

e2<-function(x2,x1){x2*f(x2,x1)}
E2<-integral2(e2,0,1,0,ymax)
E2$Q

pdf<-function(x2){4*(x2)^3}
ex2<-function(x2){x2*pdf(x2)}
integral(ex2,0,1)

E3<-(7*E1$Q)+(5*E2$Q)
E3
#The answer may vary due to difference in
    representation
```

R code Exa 2.1.6 Multivariate Expectation Problem

```
#Page no. 81

library(pracma)
pdf<-function(y){2*y}
e1<-function(y){y*pdf(y)}
E1<-integrate(e1,lower=0,upper=1)
E1$value

f<-function(x2,x1){8*x1*x2}
e2<-function(x2,x1){(x1/x2)*f(x2,x1)}
ymax<-function(x2){x2}
```

```
E2<-integral2(e2,0,1,0,ymax)
E2$Q
#The answer may vary due to difference in
    representation
```

R code Exa 2.3.1 Mean Variance And Probability

```
#Page no. 96

library(pracma)
f1<-function(x1){2*(1-x1)}
f2<-function(x2){1/x2}
f3<-function(x1){f2(3/4)}
p1<-integral(f3,0,1/2)
p1

p2<-integral(f1,0,1/2)
p2
#The answer may vary due to difference in
    representation
```

R code Exa 2.3.2 Mean And Variance

```
#Page no. 97

g<-function(y){81/8*(y^2)}
ey<-function(y){y*g(y)}
Ey<-integral(ey,0,2/3)
Ey
ey2<-function(y){y^2*g(y)}
Ey2<-integral(ey2,0,2/3)
var<-Ey2-(Ey)^2
var
```

```
#The answer may vary due to difference in
    representation
```

R code Exa 2.4.1 Correlation Coefficient

```
#Page no. 102

library(pracma)
f<-function(x,y){x+y}
ex<-function(x,y){x*f(x,y)}
Ex1<-integral2(ex,0,1,0,1)
Ex1$Q
ex2<-function(x,y){x^2*f(x,y)}
Ex2<-integral2(ex2,0,1,0,1)
Ex2$Q
varx<-Ex2$Q-(Ex1$Q^2)
varx
Ey1<-Ex1
vary<-varx
exy<-function(x,y){x*y*f(x,y)}
Exy<-integral2(exy,0,1,0,1)
num<-Exy$Q-(Ex1$Q*Ex1$Q)
num
den<-sqrt(vary*varx)
corr<-num/den
corr
#The answer may vary due to difference in
    representation
```

R code Exa 2.5.3 Independent Random Variables

```
#Page no. 113

```

```
library(pracma)
f1<-function(x1,x2){x1+x2}
f2<-function(x1){x1+1/2}
f3<-function(x2){1/2+x2}
p1<-integral2(f1,0,1/2,0,1/2)$Q
p2<-integral(f2,0,1/2)
p3<-integral(f2,0,1/2)
p1
p2
p3
p2*p3
#The answer may vary due to difference in
    representation
```

R code Exa 2.6.2 Several Random Variable Problem

```
#Page no. 121

library(pracma)
pdf<-function(x){2*x}
f<-function(x1,x2,x3){pdf(x1)*pdf(x2)*pdf(x3)}
f1<-function(x1,x2,x3){(5*x1*(x2^3)+3*x2*(x3)^4)*f(
    x1,x2,x3)}
E<-integral3(f1,0,1,0,1,0,1)
E

p<-integral3(f,0,1/2,0,1/2,0,1/2)
p
#The answer may vary due to difference in
    representation
```

Chapter 3

Some Special Distributions

R code Exa 3.1.1 Binomial Distribution

```
#Page no. 141

n<-7
p1<-pbinom(1,n,1/2,lower.tail = T)
p2<-dbinom(5,n,1/2)
p1
p2
#The answer may vary due to difference in representation
```

R code Exa 3.1.2 Binomial Distribution

```
#Page no. 141

n<-5
p<-1/3
q<-1-p
mean<-n*p
```

```
var<-n*p*q
mean
var
#The answer may vary due to difference in
   representation
```

R code Exa 3.2.1 Poisson Distribution

```
#Page no. 152

lambda<-2
p<-1-dpois(0,2)
round(p,3)
```

R code Exa 3.2.2 Poisson Distribution

```
#Page no. 153

lambda<-4
p<-dpois(3,lambda)
round(p,3)
```

R code Exa 3.2.3 Poisson Distribution

```
#Page no. 153

lambda<-1/1000
mean<-3000*lambda
p<-1-ppois(4,mean)
round(p,3)
```

R code Exa 3.2.4 Poisson Distribution

```
#Page no. 154

lambda<-1/1000
mean<-3000*lambda
newmean<-3*mean
p<-1-ppois(14,newmean)
round(p,3)
```

R code Exa 3.3.5 Chi Square Distribution

```
#Page no. 160

p1<-round(pchisq(20.5,df=10),3)
p2<-round(pchisq(3.5,df=10),3)
p<-p1-p2
round(p,2)
#The answer may slightly vary due to rounding off values
```

R code Exa 3.4.3 Normal Distribution

```
#Page no. 172

mean=2
v=25
sd=sqrt(v)
p1<-pnorm(10,mean,sd)-pnorm(0,mean,sd)
```

```
p1

p2<-pnorm(1,mean,sd)-pnorm(-8,mean,sd)
round(p2,3)
```

R code Exa 3.4.4 Normal Distribution

```
#Page no 172

p<-pnorm(2)-pnorm(-2)
round(p,3)
```

R code Exa 3.4.5 Finding mu and sigma

```
#Page no 173

library(rSymPy)
sympyStart()

m<-Var("m")
s<-Var("s")
sympy("solve([Eq(-1.28*s+m,60),Eq(1.64*s+m,90)],(s,m))")

#The answer may slightly vary due to rounding off values.
```

R code Exa 3.5.3 Population Normal Distribution Example

```
#Page no. 184
```

```
p<-pnorm(2)-pnorm(-2)
round(p,3)*100
```

Chapter 4

Some Elementary Statistical Inferences

R code Exa 4.1.5 Hair Colour Problem

```
#Page no. 208

head<-c("Medium","Fair","Dark","Red","Black")
count<-c(9418,5789,5678,1319,157)
p<-c(0.421,0.259,0.254,0.059,0.007)
data<-data.frame(head,count,p)
barplot(data$p,names.arg = data$head)
```

R code Exa 4.1.6 Simulated Poisson Variates

```
#Page no 209

variates<-c(2,1,1,1,1,5,1,1,3,0,2,1,1,3,4,
            2,1,2,2,6,5,2,3,2,4,1,3,1,3,0)
j<-c(0,1,2,3,4,5,6)
total<-length(variates)
```

```
count<-c(2,11,7,5,2,2,1)
p<-round(count/total,3)
j
p
barplot(count,names.arg = j)
```

R code Exa 4.1.7 Histogram For Normally Generated Data

```
#Page no. 211

x<-c('10-20','20-30','30-40','40-50','50-60','60-70')
count<-c(1,0,3,8,5,3)
data<-data.frame(x,count)
barplot(count,names.arg=x)
```

R code Exa 4.2.4 Two Sample Confidence Interval Problem

```
#Page no 218

nx<-10
ny<-7
meanx<-4.2
meany<-3.4
sx<-49
sy<-32

diff<-meanx-meany
sp<-sqrt((((nx-1)*sx)+((ny-1)*sy))/(nx+ny-2))
me<-sqrt((1/nx)+(1/ny))*sp*qt(0.95,df=nx+ny-2)
interval_lower<-diff-me
interval_upper<-diff+me
interval_lower
```

```
interval_upper
```

R code Exa 4.2.5 Confidence Intervals

```
#Page no 219

n1<-100
n2<-400
y1<-30
y2<-80
p1<-y1/n1
p2<-y2/n2
se<-sqrt((p1*(1-p1)/n1)+(p2*(1-p2)/n2))
alpha<-(100-95.4)/100
ov<-p1-p2
m<-qnorm(alpha/2)*se
me<-round(m,1)
lowerinterval<-round(ov+me,1)
upperinterval<-ov-me
lowerinterval
upperinterval
```

R code Exa 4.4.3 Order Statistics of Random Sample

```
#Page no 230

y1<-expression(z2-z1)
y3<-expression(z2)
D(y1,'z1')
D(y1,'z2')
D(y3,'z1')
D(y3,'z2')

```

```
J<-matrix(c(-1,1,0,1),ncol=2)
d<-det(J)
d

library(rSymPy)
sympyStart()

z1<-Var('z1')
h<-abs(d)*6*z1
h

sympy("z1=Symbol('z1')")
sympy("z2=Symbol('z2')")
sympy("integrate(6*z1, (z2, z1, 1))")
```

R code Exa 4.4.4 Five Number Summary

```
#Page no 232

x<-c
  (56,70,89,94,96,101,102,102,102,105,106,108,110,113,116)

fivenum(x)
middle_data<-median(x)
middle_data
```

R code Exa 4.4.5 Box And Quantile Plots

```
#Page no. 232

library(L1pack)

```

```
x <- c
   (56,70,89,94,96,101,102,102,102,105,106,108,110,113,116)

q1 <- x[floor(length(x)/4)+1]
q2 <- x[floor(length(x)/2)+1]
q3 <- x[floor(length(x)/4)+1+floor(length(x)/2)+1]
h <- 1.5*(q3-q1)
h
lf <- q1-h
lf
uf <- q3+h
uf
n <- length(x)
p <- (1:n)/(n + 1)
normalqs <- qnorm(p)
y <- sort(x)
par(mfrow = c(2, 2))
boxplot(y, ylab = "x")
plot(normalqs, y)
plot(qlaplace(p), y)
plot(qexp(p), y)
```

R code Exa 4.5.2 Test for Binomial Proportion of Success

```
#Page no 242

pbinom(11,20,0.7)
pbinom(12,20,0.7)
```

R code Exa 4.5.5 Box And Quantile Plots

```
#Page no 245

```

```
cross<-c
   (23.5,12,21,22,19.125,21.5,22.125,20.375,18.250,21.625,23.250,21,
self<-c
   (17.375,20.375,20,20,18.375,18.625,18.625,15.25,16.5,18,16.25,18,
data<-cross-self
n <- length(data)
xbar<-round(mean(data),2)
xbar
std<-round(sqrt(var(data)),2)
std
t_crit<-qt(0.05,n-1,lower.tail = FALSE)
t_crit
t_stat<-round(xbar/(std/sqrt(n)),2)
t_stat

if(t_crit<t_stat)
{
  cat("Rejected H0")
}

p <- (1:n)/(n + 1)
normalqs <- qnorm(p)
y <- sort(data)
boxplot(y, ylab = "x")
plot(normalqs, y)
```

R code Exa 4.6.4 Randomized Test

```
#Page no 251

p1<-round(ppois(2,1,lower.tail = F),3)
p2<-round(ppois(3,1,lower.tail = F),3)
```

```
p1
p2

alpha<-0.05
p3<-(alpha-p2)/(p1-p2)
p3

p4<-p2+dpois(3,1)*p3
round(p4,2)

#The answer may vary due to difference in
   representation.
```

R code Exa 4.6.5 P value of Normal Distribution

```
#Page no 252

n<-25
sd2<-4
mu<-77
mean<-76.1
var<-sd2/n
z<-(mean-mu)/sqrt(var)
a<-0.05
pnorm(z)
a
```

R code Exa 4.7.1 Goodness Of Fit

```
#Page no. 256

x<-c(1,2,3,4,5,6)
p<-1/6
```

```
n<-60
a<-0.05
exp<-c(n*p,n*p,n*p,n*p,n*p,n*p)
obs<-c(13,19,11,8,5,4)
df<-length(x)-1
chisq<-sum((obs-exp)^2/exp)
chisq
tv<-qchisq(1-a,df)
tv
if (chisq>tv){
  cat("Rejected")
} else{
  ("Accepted")
}
```

R code Exa 4.7.2 Goodness Of Fit

```
#Page no 256

df<-4
a<-0.025
n<-80
exp<-c(5,15,25,35)
obs<-c(6,18,20,36)
chisq<-round(sum((obs-exp)^2/exp),2)
chisq
tv<-round(qchisq(1-a,df-1),2)
tv
if (chisq>tv){
  cat("Rejected")
} else{
  ("Accepted")
}
```

R code Exa 4.8.1 Pi Estimation

```
#Page no 262

findpi<-function(n)
{
  u1<-runif(n)
  u2<-runif(n)
  count<-rep(0,n)
  check<-u1^2+u2^2-1
  count[check<0]<-1

  pi<-4*mean(count)
  se<-1.96*4*sqrt(mean(count)*(1-mean(count))/n)
  list(pi_estimate=pi,standard_error=se)
}

findpi(100)
findpi(500)
findpi(1000)
findpi(10000)
findpi(100000)

#The answer may slightly vary due to rounding off
   values.
```

R code Exa 4.8.4 Pi Estimation By Monte Carlo Integration

```
#Page no 265

findpi<-function(n){
  samp<-4*sqrt(1-runif(n)^2)
```

```
  pi<-mean(samp)
  se<-1.96*sqrt(var(samp)/n)
  list(pi_estimate=pi,lowerCI=pi-se,upperCI=pi+se)
}

findpi(100)
findpi(1000)
findpi(10000)
findpi(100000)

#The answer may slightly vary due to rounding off
    values.
```

R code Exa 4.8.7 Probability Of Acceptance

```
#Page no 269

f1<-function(x)
{
  (1+x^2)*exp(-x^2/2)
}
f2<-function(x)
{
  (pi/sqrt(2*pi))*2*exp(-x^2/2)
}
M1<-f1(1)
M1
M2<-f2(1)
M2
1/M2
#The answer may slightly vary due to rounding off
    values.
```

R code Exa 4.9.1 Bootstrap

```
#Page no 275

boot<-function(x,b,alpha){
  theta<-mean(x)
  tstar<-rep(0,b)
  n<-length(x)
  for(i in 1:b){xstar<-sample(x,n,replace=T)
  tstar[i]<-mean(xstar)
  }
  tstar<-sort(tstar)
  pick<-round((alpha/2)*(b+1))
  lower<-tstar[pick]
  upper<-tstar[b-pick+1]
  list(mean=theta,lower_conf=lower,upper_conf=upper)
}
x<-c(131.7,182.7,73.3,10.7,150.4,42.3,22.2,17.9,264.0,154.4,4.3,265.6
boot(x,3000,0.1)
x1<-c(4.3,4.3,4.3,10.8,10.8,10.8,10.8,17.9,22.5,42.3,48.8,48.8,85.9,13
boot(x1,3000,0.1)

#The answer may slightly vary due to rounding off values.
```

R code Exa 4.9.2 Bootstrap

```
#Page no 278

x<-c(94.2,111.3,90.0,99.7,116.8,92.2,166.0,95.7,109.3,106.0,111.7,111
```

```
y<-c
   (125.5,107.1,67.9,98.2,128.6,123.5,116.5,143.2,120.3,118.6,105.0,

boxplot(y,x,border = "black",horizontal = TRUE,names
   =c("Sample 2","Sample 1"))
test_statistic<-mean(y)-mean(x)
round(test_statistic,2)
```

R code Exa 4.9.3 Bootstrap

```

#Page no 280

bootstrap<-function(x,t,b){
  n<-length(x)
  v<-mean(x)
  z<-x-mean(x)+t
  counter<-0
  final<-rep(0,b)
  for(i in 1:b){xstar<-sample(z,n,replace=T)
  vstar<-mean(xstar)
  if(vstar >= v){counter<-counter+1}
  final[i]<-vstar}
  pvalue<-counter/b
  list(origtest=v,pvalue=pvalue,final=final)
}

x<-c
   (119.7,104.1,92.8,85.4,108.6,93.4,67.1,88.4,101,97.2,95.4,77.2,10

ans<-bootstrap(x,90,3000)
hist(ans$final)
```

R code Exa 4.10.1 Tolerance Interval

```
#Page no 287

f<-function(v)
{
  (30*(v^4))*(1-v)
}
i<-integrate(f,lower=0,upper=0.8)
ans<-1-i$value
round(ans,2)
```

Chapter 5

Consistency and Limiting Distributions

R code Exa 5.2.6 Distribution Comparison

```
#Page no. 303

n<-50
p<-1/25
round(pbinom(1,n,p),3)
mhu<-n*p
poiss<-round(ppois(1,mhu),3)
poiss
```

R code Exa 5.3.2 Sample Probability

```
#Page no 309

n<-75
mhu<-1/2
var<-1/12
```

```
sd<-sqrt(var)
l1<-sqrt(n)*(0.45-mhu)/sd
l2<-sqrt(n)*(0.55-mhu)/sd
ans<-round(pnorm(l2)-pnorm(l1),3)
ans
```

R code Exa 5.3.3 Normal Approximation To Binomial Distribution

```
#Page no. 310

n<-10
p<-1/2
mean<-n*p
i<-c(0:10)
binomial<-dbinom(i,n,p)
normal<-dnorm(i,5,2.5)
barplot(binomial,names.arg=i)
par(new="T")
plot(normal,type='l',xlab="",ylab="",xaxt="n",yaxt="
    n")
```

R code Exa 5.3.4 Sample Probability

```
#Page no. 310

y<-c(48:52)
n<-100
p<-1/2
q<-1-p
mean<-n*p
var<-n*p*q
sd<-sqrt(var)
l1<-(47.5-mean)/sd
```

```
l2<-(52.5-mean)/sd
ans<-round(pnorm(l2)-pnorm(l1),3)
ans

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

Chapter 6

Maximum Likelihood Methods

R code Exa 6.2.5 ARE

```
#Page no 336

f1<-function(z)
{
  z^2*exp(-z)
}
i<-integrate(f1,lower=0,upper=Inf)
i$value
```

Chapter 8

Optimal Tests of Hypotheses

R code Exa 8.1.1 Multivariate Random Variable Hypotheses

```
#Page no. 430

n<-5
i<-c(0:5)
r1<-c(dbinom(i,n,1/2))
r2<-c(dbinom(i,n,3/4))
r3<-r1/r2
df<-data.frame(r1,r2,r3)
df
P<-df$r2[5]+df$r2[6]
P
#The answer may vary due to difference in
   representation
```

R code Exa 8.1.2 Hypothesis

```
#Page no 435

```

```
f1<-function(w)
{
  (1/sqrt(2*pi))*exp(-w^2/2)
}
i<-integrate(f1,lower=-3.355,upper=Inf)
i$value
```

R code Exa 8.1.3 Simple Hypotheses

```
#Page no. 436

f1<-function(x)
{
  exp(-1)/factorial(x)
}
f2<-function(x)
{
  (1/2)^(x+1)
}
p1<-1-(f1(1)+f1(2))
p2<-1-(f2(1)+f2(2))
round(p1,3)
round(p2,3)
```

R code Exa 8.2.1 PDF Hypothesis

```
#Page no 439

f<-function(t)
{
  ((t+9.5)/t)*exp(-9.5/t)
}
f(2)
```

```
f(4)
f(9.5)
#The answer may slightly vary due to rounding off
   values.
```

Chapter 10

Nonparametric and Robust Statistics

R code Exa 10.2.2 ARE Normal Distribution

```
#Page no 536

library(rSymPy)
sympyStart()

phi<-Var('p')
num<-phi*phi
num
dem<-(pi/2)*phi*phi
dem
expn=num/dem
expn
#The answer may slightly vary due to rounding off
    values.
```

R code Exa 10.2.3 ARE Laplace Distribution

```
#Page no 537

library(rSymPy)
sympyStart()

b<-Var('b')
num<-2*b*b
num
dem<-b*b
dem
expn=num/dem
expn
```

R code Exa 10.2.5 Golden Rectangle

```
#Page no 540

library(BSDA)
data<-c
   (0.553,0.570,0.576,0.601,0.606,0.606,0.609,0.611,0.615,0.628,0.654

md<-median(data)
md
SIGN.test(data,md=md)
```

R code Exa 10.3.1 Data of Darwin

```
#Page no. 544

p1<-1-psignrank(95,15)
round(p1,3)

mean<-60
```

```
den<-sqrt(15*16*31/24)
num<-95.5-mean
p2<-round(1-pnorm(num/den),3)
p2
```

R code Exa 10.3.2 ARE at Normal Distribution

```
#Page no. 548

f<-function(x)
{
  ((1/sqrt(2*pi))*exp(-(x^2)/2))^2
}
tw_1<-integrate(f,lower=-Inf,upper=Inf)
tw_1<-sqrt(12)*tw_1$value
tw2<-(1/tw_1)^2
sigma<-1
are<-sigma^2/tw2
round(are,3)
```

R code Exa 10.3.4 Zea Mays Problem

```
#Page no 550

library(Rfit)
library(DescTools)
data<-c
   (6.125,-8.375,1.000,2.000,0.750,2.925,3.500,5.125,1.750,3.625,7.00

ans<-median(walsh(data))
round(ans,2)

conf_level=0.95
```

```r
alpha=1-conf_level
crit_z<-qnorm(1-alpha/2)
n<-length(data)
c<-(n*(n+1)/4)-(crit_z*sqrt(n*(n+1)*(2*n+1)/24))-1/2
c

conf<-sort(walsh(data))
lower_conf<-conf[round(c)+1]
lower_conf
upper_conf<-conf[length(conf)-round(c)+1]
upper_conf
```

R code Exa 10.4.1 Water Wheel Problem

```r
#Page no 553

x<-c(2.3,0.3,5.2,3.1,1.1,0.9,2.0,0.7,1.4,0.3)
y<-c(0.8,2.8,4.0,2.4,1.2,0.0,6.2,1.5,28.8,0.7)
combine<-sort(c(x,y))
ranks<-rank(combine)
ranky<-c()
for (i in y){
  j<-match(i,combine)
  ranky<-c(ranky,ranks[j])
}
w<-sum(ranky)
w
m<-105
v<-175
z<-(w-m)/sqrt(v)
z
p<-2*(1-pnorm(z))
p
print("Ho accepted")
```

R code Exa 10.4.2 MWW Estimate

```
#Page no 558

x<-c(2.3,0.3,5.2,3.1,1.1,0.9,2.0,0.7,1.4,0.3)
y<-c(0.8,2.8,4.0,2.4,1.2,0.0,6.2,1.5,28.8,0.7)
combine<-sort(c(x,y))
ranks<-rank(combine)
ranky<-c()
for (i in y){
  j<-match(i,combine)
  ranky<-c(ranky,ranks[j])
}
w<-sum(ranky)
m<-105
v<-175
z<-(w-m)/sqrt(v)
mww<-1/z
mww

conf_level=0.95
alpha=1-conf_level
crit_z<-qnorm(1-alpha/2)
n1<-length(x)
n2<-length(y)
c<-(n1*n2/2)-(crit_z*sqrt(n1*n2*((n1+n2)-1)/12))-1/2
c

dif<-c()
for(i in y){
  dif<-c(dif,i-x)
}
dif<-sort(dif)

```

```
lower_conf<-dif[round(c)+1]
lower_conf
upper_conf<-dif[length(dif)-round(c)+1]
upper_conf
```

R code Exa 10.5.3 General Rank Scores

```
#Page no 566

library(rcompanion)
library(exactRankTests)
library(ggplot2)

x<-c
   (51.9,56.9,45.2,52.3,59.5,41.4,46.4,45.1,53.9,42.9,41.5,55.2,32.9

y<-c
   (59.2,49.1,54.4,47,55.9,34.9,62.2,41.6,59.3,32.7,72.1,43.8,56.8,7

ggplot(data.frame(x=x), aes(x = x)) + geom_dotplot(
   binwidth = 0.15, dotsize = 1.5) + theme_bw() +
   labs(title = "Sample 1", x = "", y ="")
ggplot(data.frame(y=y), aes(x = y)) + geom_dotplot(
   binwidth = 0.15, dotsize = 2.5) + theme_bw() +
   labs(title = "Sample 2", x = "", y = "")


w<-wilcox.test(y,x,mu=0,alt="two.sided",conf.int=T,
   conf.level=0.95,paired=F,exact=T,correct=T)
n_score<-cscores(c(y,x),type="NormalQuantile")
X<-sum(n_score[seq(along=x)])
normal_p_value<-pperm(X, n_score, length(x),
   alternative="two.sided",simulate = TRUE)


```

```
results1 <- data.frame(mean(y) - mean(x),
                       round(unname(t.test(y,x)$statistic),2),
                       round(t.test(y,x)$p.value,2),
                       mean(y) - mean(x))
colnames(results1) <- c("Test Statistic","Standardized","p-Value","Estimate of  ")
rownames(results1) <- "Student t"
results2 <- data.frame(sum(rank(c(x,y))[16:30]),
                       round(qnorm(w$p.value/2)*-1,2),
                       round(w$p.value,3),
                       w$estimate)
colnames(results2) <- c("Test Statistic","Standardized","p-Value","Estimate of  ")
rownames(results2) <- "Wilcoxon"
results3 <- data.frame(round(X,2),
                       qnorm(normal_p_value/2)*-1,
                       normal_p_value,
                       median(outer(y,x,'-')))
colnames(results3) <- c("Test Statistic","Standardized","p-Value","Estimate of  ")
rownames(results3) <- "Normal scores"
results1
results2
results3

x2<-x
x2[5]<-95.5
round(unname(t.test(y,x2)$statistic),2)
round(t.test(y,x2)$p.value,2)

w2<-wilcox.test(y,x2,mu=0,alt="two.sided",conf.int=T,conf.level=0.95,paired=F,exact=T,correct=T)
w2$p.value<-round(w2$p.value,2)
round(qnorm(w2$p.value/2)*-1,2)
w2$p.value

```

```
n_score2<-cscores(c(y,x2),type="NormalQuantile")
X2<-sum(n_score2[seq(along=x2)])
normal_p_value2<-pperm(X2, n_score2, length(x2),
   alternative="two.sided",simulate = TRUE)
normal_p_value2
round(qnorm(normal_p_value2/2)*-1,2)

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

R code Exa 10.7.2 Telephone Data Scores

```
#Page no. 578

year<-c(50:73)
call<-c
   (0.44,0.47,0.47,0.59,0.66,0.73,0.81,0.88,1.06,1.2,1.35,1.49,
         1.61,2.12,11.9,12.4,14.2,15.9,18.2,21.2,4.3,2.4,2.7,2.9)
plot(year,call,xlab="Year",ylab="Number of Calls")
ls<-lsfit(year,call)
coeff<-ls$coefficients
coeff

y<-function(x)
{
  -26+0.504*x
}
y1<-y(year)
y1
par(new=T)
lines(y=y1,x=year,type='l',xlab="",ylab="",xaxt="n",
   yaxt="n")
wilcox.test(year,call)
```

```
y<-function(x)
{
  -7.15+0.145*x
}
y2<-y(year)
y2
par(new=T)
lines(y=y2,x=year,type='l',xlab="",ylab="",xaxt="n",
   yaxt="n",lty=2)
```

R code Exa 10.8.1 Olympic Race Problem

```
#Page no 584

library(asympTest)
x<-c
   (373.2,246,245.4,252,243.4,236.8,241.8,233.6,233.2,231.2,227.8,229

      221.2,215.6,218.1,214.9,216.3,219.2,218.4)
y<-c
   (3530,3585,5333,3084,3318,2215,1956,2483,1977,1896,1759,2092,1383

      731,1226,740,595,663)
n<-length(x)+length(y)
ans<-cor.test(x,y,method=c("kendall"))
k<-ans$estimate
k
asym<-asymp.test(x,y)
round(asym$p.value,4)
varhk<-2*((2*n)+5)/(9*n*(n-1))
zk<-k/sqrt(varhk)
zk

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

R code Exa 10.8.2 Olympic Race Problem

```
#Page no 586

library(asympTest)
x<-c
   (373.3,246,245.4,252,243.4,236.8,241.8,233.6,233.2,231.2,227.8,229
      221.2,215.6,218.1,214.9,216.3,219.2,218.4)
y<-c
   (3530,3585,5333,3084,3318,2215,1956,2483,1977,1896,1759,2092,1383
      731,1226,740,595,663)
ans<-cor.test(x,y,method=c("spearman"),alternative =
    "two.sided")
r<-ans$estimate
r
n<-length(x)-1
asym<-r*sqrt(n)
asym
ans$p.value
print("Rejected Ho")

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

Chapter 11

Bayesian Statistics

R code Exa 11.2.6 Bayesian Testing Procedures

```
#Page no 616


alpha<-10
beta<-1.2
avg<-alpha*beta
avg
variance<-alpha*beta^2
variance
std<-sqrt(variance)
range<-seq(0,avg+5*std,0.01)
prior<-dgamma(range,alpha,rate=1/beta)
plot(range,prior,type='l',xlim=c(0,25))

data<-c
   (11,7,11,6,5,9,14,10,9,5,8,10,8,10,12,9,3,12,14,4)
mean(data)
suff_stat<-sum(data)
suff_stat
n<-length(data)
```

```
n

new_alpha<-suff_stat+alpha
new_beta<-beta/(n*beta+1)
new_alpha
new_beta
new_avg<-new_alpha*new_beta
new_avg
new_variance<-new_alpha*new_beta^2
new_variance
new_std<-sqrt(new_variance)
range<-seq(0,avg+5*std,0.01)
posterior<-dgamma(range,new_alpha,rate=1/new_beta)
plot(range,posterior,type='l',xlim=c(0,25))

p1<-round(pgamma(10,new_alpha,1/new_beta),4)
p2<-1-p1
p1
p2
if(p1>p2)
{
  print("Accept H0")
}else
{
  print("Reject H0")
}
conf_int<-round(qgamma(c(0.025, 0.975),shape=new_
    alpha,rate=1/new_beta),2)
conf_int
#The answer may slightly vary due to rounding off
    values.
```

R code Exa 11.4.2 Gibbs Sampler

```
#Page no 629
```

```
gibbser2 = function(alpha,m,n){
  x0 = 1
  yc = rep(0,m+n)
  xc = c(x0,rep(0,m-1+n))
  for(i in 2:(m+n)){yc[i] = rgamma(1,alpha+xc[i-1],2)
  xc[i] = rpois(1,yc[i])}
  y1=yc[1:m]
  y2=yc[(m+1):(m+n)]
  x1=xc[1:m]
  x2=xc[(m+1):(m+n)]
  list(y1=y1,y2=y2,x1=x1,x2=x2)
}

g<-gibbser2(10,3000,6000)
mean(g$x1)
mean(g$y1)
var(g$x1)
var(g$y1)
```