

R Textbook Companion for
Elementary Statistics: A Step by Step
Approach
by Allan G. Bluman¹

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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	4
2 Frequency Distribution and graphs	5
3 Data Description	12
4 Probability and counting rules	14
5 Discrete Probability Distrubution	22
6 The Normal Distribution	31
7 Confidence Intervals and Sample Size	35
8 Hypothesis Testing	41
9 Testing the Difference Between Two Means and Two Proportions and Two Variances	47
10 Correlation and Regression	54
11 Other Chi Square Tests	57
12 Analysis of Variance	59
13 Nonparametric Statistics	62

List of R Codes

Exa 2.1	Frequency table	5
Exa 2.2	Frequency table	5
Exa 2.3	MPG for SUV	6
Exa 2.4	histogram Record high temperatures	7
Exa 2.5	frequency polygon	7
Exa 2.6	ogive	8
Exa 2.7	Histogram frequency polygon and ogives	8
Exa 2.8	bar graphs	9
Exa 2.9	pareto chart	9
Exa 2.10	time series graph	10
Exa 2.11	pie graph	10
Exa 4.17	Find Probability	14
Exa 4.21	Probability	15
Exa 4.22	Probability	15
Exa 4.27	Probability	16
Exa 4.28	University Crime	16
Exa 4.29	Homeowners and Automobile Insurance	16
Exa 4.30	Drawing Cards	17
Exa 4.42	Permutation	17
Exa 4.43	Permutation	17
Exa 4.44	Permutation and Combination	18
Exa 4.45	Permutation and Combination	18
Exa 4.47	Combinations	18
Exa 4.48	Permutation and Combination	19
Exa 4.49	Permutation and Combination	19
Exa 4.50	Probability using combinations	19
Exa 4.51.a	Probability using combinations	19
Exa 4.51.b	Probability using combinations	20

Exa 4.51.c	Probability using combinations	20
Exa 4.51.d	Probability using combinations	20
Exa 4.52	Probability using combinations	21
Exa 5.2	Probability Distribution	22
Exa 5.5	Mean of Probability distribution	22
Exa 5.6	Mean of probability distribution	23
Exa 5.7	Tossing Coins	23
Exa 5.8	Mean of Probability Distribution	23
Exa 5.9	Variance and standard deviation of probability distribu- tion	23
Exa 5.10	Discrete Probability Distribution	24
Exa 5.11	Variance and standard deviation of probability distribu- tion	24
Exa 5.12	Expectation	25
Exa 5.13	Discrete Probability Distribution	25
Exa 5.14	Bond Investment	25
Exa 5.16	Survey on Doctor Visits	26
Exa 5.17	Survey on Employment	26
Exa 5.19.a	Find Probability	27
Exa 5.19.b	Find Probability	27
Exa 5.19.c	Find Probability	27
Exa 5.20	Find Probability	27
Exa 5.24	Leisure Activities	27
Exa 5.25	CD Purchases	28
Exa 5.26	Selecting Colored Balls	28
Exa 5.27	Typographical Errors	29
Exa 5.28.a	Find Probability	29
Exa 5.28.b	Find Probability	29
Exa 5.28.c	Find Probability	30
Exa 5.29	Left Handed People	30
Exa 6.7	Monthly Newspaper Recycling	31
Exa 6.11	Checking for normal distribution	32
Exa 6.12	Checking for normal distribution	33
Exa 6.15	Meat Consumption	33
Exa 7.1	Days it takes to sell an Aveo	35
Exa 7.2	Ages of Automobiles	35
Exa 7.3	Credit Union Assets	36
Exa 7.4	Depth of a River	36

Exa 7.5	Critical t value	37
Exa 7.6	Sleeping Time	37
Exa 7.7	Home Fires Started by Candles	37
Exa 7.9	Male Nurses	38
Exa 7.10	Religious Books	38
Exa 7.11	Home Computers	39
Exa 7.12	Car Phone Ownership	39
Exa 7.14	Nicotine Continent	40
Exa 7.15	Cost of Ski Lift Tickets	40
Exa 8.3	Professors Salaries	41
Exa 8.4	Costs of Mens Athletic Shoes	42
Exa 8.5	Cost of Rehabilitation	42
Exa 8.13	Substitute Teachers Salaries	43
Exa 8.17	people who are trying to avoid Trans Fats	43
Exa 8.18	Survey on Call Waiting Service	44
Exa 8.23	critical chisq value	44
Exa 8.25	Outpatient Surgery	45
Exa 8.30	Sugar Production	45
Exa 8.31	Hog Weight	46
Exa 9.1	Hotel Room Cost	47
Exa 9.3	Confidence Interval	48
Exa 9.4	Farm Sizes	48
Exa 9.5	Confidence Interval	49
Exa 9.6	Vitamin for Increased Strength	50
Exa 9.7	Cholesterol Levels	50
Exa 9.8	Confidence Interval	50
Exa 9.9	Vaccination Rates in Nursing Homes	50
Exa 9.10	Missing Work	51
Exa 9.11	Confidence Interval	52
Exa 10.12	Copy Machine Maintenance Costs	54
Exa 10.14	Standard error estimation	55
Exa 10.15	State board scores	55
Exa 10.16	State board scores	55
Exa 10.17	State board scores	56
Exa 11.1	Fruit Soda Flavor Preference	57
Exa 11.5	College Education and Place of Residence	57
Exa 11.6	Alcohol and Gender	58
Exa 11.7	Lost Luggage on Airline Flights	58

Exa 12.1	Lowering Blood Pressure	59
Exa 12.2	Employees at Toll Road Interchanges	59
Exa 12.3	Scheffe Test	60
Exa 12.4	Turkey Test	60
Exa 12.5	Gasoline Consumption	60
Exa 13.1	snow Cone Sales	62
Exa 13.3	Ear infections in Swimmers	62
Exa 13.6	Milliequivalents of Potassium in Breakfast Drinks . . .	63
Exa 13.10	Ages of Drug Program Participants	63

Chapter 2

Frequency Distribution and graphs

R code Exa 2.1 Frequency table

```
1 a<-c("A","B","B","AB","O","O","B","AB","B","B","B","O",  
      "A","O","A","O","O","O","AB","AB","A","O","B",  
      "A","O")  
2 results<-table(a)  
3 results  
4 results/length(a)*100
```

R code Exa 2.2 Frequency table

```
1 mpg<-c  
  (112,110,107,116,120,100,118,112,108,113,127,117,114,110,120,120,  
  
2 H = max(mpg)  
3 L = min(mpg)  
4 cat("Maximum value is: ", H)  
5 cat("Minimum value is: ", L)
```

```

6 Range = H - L
7 cat("Range is: ", Range)
8 cat("\n")
9 breaks= seq(99.5,134.5, by=5)
10 mpg.div=cut(mpg, breaks, right=TRUE)
11 mpg.freq=table(mpg.div)
12 table<-data.frame(mpg.freq)
13 table

```

R code Exa 2.3 MPG for SUV

```

1 mpg<-c(12, 17, 12, 14, 16, 18, 16, 18, 12, 16, 17,
        15, 15, 16, 12, 15, 16, 16, 12, 14, 15, 12, 15,
        15, 19, 13, 16, 18, 16, 14)
2 H = max(mpg)
3 L = min(mpg)
4 cat("Maximum value is: ", H)
5 cat("\n")
6 cat("Minimum value is: ", L)
7 cat("\n")
8 Range = H - L
9 cat("Range is: ", Range)
10 cat("\n")
11 breaks= seq(12, 20, by=1)
12 mpg.div=cut(mpg, breaks, right=FALSE)
13 mpg.freq=table(mpg.div)
14 table<-data.frame(mpg.freq)
15 table
16 #for cumulative frequency
17 mpg.cumfreq = cumsum(mpg.freq)
18 tbl<-data.frame(mpg.cumfreq)
19 tbl

```

R code Exa 2.4 histogram Record high temperatures

```
1 temp<-c(112, 100, 127, 120, 134, 118, 105, 110, 109,
          112, 110, 118, 117, 116, 118, 122, 114, 114,
          105, 109, 107, 112, 114, 115, 118, 117, 118, 122,
          106, 110, 116, 108, 110, 121, 113, 120, 119,
          111, 104, 111, 120, 113, 120, 117, 105, 110, 118,
          112, 114, 114)
2 H = max(temp)
3 L = min(temp)
4 Range = H - L
5 Width = ceiling(Range/7)
6 #though the question specifies lower limit as 99.5
   and upper limit as 134.5, the considered upper
   and lower limits are 100 and 135
7 hist(temp,main="Histogram of Recorded Temperatures",
      xlab="temperature",border="red",col="yellow",xlim
      =c(100,135),las=1,breaks=Width)
```

R code Exa 2.5 frequency polygon

```
1 temp<-c(112, 100, 127, 120, 134, 118, 105, 110, 109,
          112, 110, 118, 117, 116, 118, 122, 114, 114,
          105, 109, 107, 112, 114, 115, 118, 117, 118, 122,
          106, 110, 116, 108, 110, 121, 113, 120, 119,
          111, 104, 111, 120, 113, 120, 117, 105, 110, 118,
          112, 114, 114)
2 H = max(temp)
3 L = min(temp)
4 Range = H - L
5 Width = ceiling(Range/7)
6 #using package "mosaic"
7 library(mosaic)
8 freqpoly(temp)
```

R code Exa 2.6 ogive

```
1 temp<-c(112, 100, 127, 120, 134, 118, 105, 110, 109,
          112, 110, 118, 117, 116, 118, 122, 114, 114,
          105, 109, 107, 112, 114, 115, 118, 117, 118, 122,
          106, 110, 116, 108, 110, 121, 113, 120, 119,
          111, 104, 111, 120, 113, 120, 117, 105, 110, 118,
          112, 114, 114)
2 H = max(temp)
3 L = min(temp)
4 Range = H - L
5 Width = ceiling(Range/7)
6 #installed package agricolae
7 library(agricolae)
8 #since the histogram division is from 100 to 135,
   ther is a shift in the ogive curve, when compared
   with the original
9 temp.h=hist(temp,main="Histogram of Recorded
   Temperatures",xlab="temparature",border="red",col
   ="yellow",xlim=c(100,135),las=1,breaks=7)
10 ogive.freq(temp.h, xlab="temparature", ylab="
   relative cumulative frequency")
```

R code Exa 2.7 Histogram frequency polygon and ogives

```
1 fr<-c
   (6,11,11,17,17,17,22,22,22,22,22,27,27,27,27,32,32,32,37,37)

2 H=40.5
3 L=5.5
4 Range = H - L
5 Width = ceiling(Range/7)
```

```

6 #though the question specifies lower limit as 99.5
   and upper limit as 134.5, the considered upper
   and lower limits are 100 and 135
7 fr.h=hist(fr,main="Histogram of Recorded
   Temperatures",xlab="temperature",border="red",col
   ="yellow",xlim=c(5,41),las=1,breaks=Width)
8 fr.h
9 #using package "mosaic"
10 library(mosaic)
11 freqpoly(fr)
12 library(agricolae)
13 ogive.freq(fr.h, xlab="miles", ylab="relative
   cumulative frequency")
14 #install package "agricolae"

```

R code Exa 2.8 bar graphs

```

1 #bar plot construction
2 amount<-c(728, 344, 141, 72)
3 barplot(amount, main="Expenditure of a first year
   college student", xlab="expenditure", ylab="
   amount", names.arg =c("electronics", "dorm decor"
   , "clothing", "shoes"), border="green")
4 barplot(amount, main="Expenditure of a first year
   college student", xlab="expenditure", ylab="
   amount", names.arg =c("electronics", "dorm decor"
   , "clothing", "shoes"), border="green", horiz=
   TRUE)

```

R code Exa 2.9 pareto chart

```

1 tp<-c(2.9, 4.3, 6, 3.8, 5.8)

```

```

2 names(tp)<-c("Indiana","Oklahoma","Florida","Maine",
  "Pennsylvania")
3 #install package qcc that contains pareto chart
4 library(qcc)
5 pareto.chart(tp, xlab="States", ylab="Number of
  Turnpikes", main="Turnpike Distribution", col="
  blue")

```

R code Exa 2.10 time series graph

```

1 damage<-c(2.8, 3.3, 3.4, 5.0, 8.5)
2 ts(damage, start=2001, end= 2005)
3 names(damage)<-c("2001", "2002", "2003", "2004", "
  2005")
4 plot.ts(damage,xlab="Year",ylab="Damage(in millions)
  ")

```

R code Exa 2.11 pie graph

```

1 snacks<-c(11.200, 8.200, 4.300, 3.800, 2.500)
2 food<-c("Potato chips", "Tortilla chips", "Pretzels"
  , "Popcorn", "Snack Nuts")
3 pct <- round(snacks/sum(snacks)*100, digits = 1)#
  round off to one decimal place
4 pct
5 food <- paste(food,"(", pct, ")")
6 food <- paste(food,"%",sep="")
7 pie(snacks, labels=food, main="Amount of food eaten
  during super bowl")

```

Chapter 3

Data Description

Chapter 4

Probability and counting rules

R code Exa 4.17 Find Probability

```
1 dough<-c(3,4,5) #glazed , jelly and chocolate  
   doughnuts respectively  
2 pr<-(dough[3]+dough[1])/sum(dough)
```

```
3 n<-paste("the answer is",round(pr,digits=2))
4 n
```

R code Exa 4.21 Probability

```
1 designation<-c(8,5)
2 gender<-c(10,3)
3 repnf<-7
4 reppf<-3
5 repnm<-designation[1]-reppf
6 pr<-(designation[1]+gender[2]-repnm)/sum(designation
    )
7 n<-paste("The probability that selected staff is",
    round(pr, digits=2))
8 n
```

R code Exa 4.22 Probability

```
1 p1<-0.32
2 p2<-0.09
3 p3<-0.06
4 pr<-p1+p2-p3
5 n<-paste("probability of having an accident while
    intoxicated or driving is",pr)
6 n
```

R code Exa 4.27 Probability

```
1 pr<-0.09
2 ne<-3
3 lbs<-paste("The probability is",(pr^ne))
4 lbs
```

R code Exa 4.28 University Crime

```
1 c1=5
2 c2=16
3 c3=32
4 t=c1+c2+c3
5 c21=c2-1
6 p=(c2/t)*(c21/(t-1))
7 l<-paste("the probability that both will have
  occurred in 2004 is",p)
8 l
```

R code Exa 4.29 Homeowners and Automobile Insurance

```

1 a=0.53
2 h=0.27
3 l<-paste("the probability that both will have
  occurred in 2004 is",a*h)
4 l

```

R code Exa 4.30 Drawing Cards

```

1 l<-paste("Probability of getting three jacks is",(4/
  52)*(3/51)*(2/50))
2 l
3 l<-paste("Probability of getting an ace, a king, and
  a queen in order is",(4/52)*(4/51)*(4/50))
4 l
5 l<-paste("Probability of getting a club, a spade,
  and a heart in order is",(13/52)*(13/51)*(13/50))
6 l
7 l<-paste("Probability of getting three clubs is",(13
  /52)*(12/51)*(11/50))
8 l

```

R code Exa 4.42 Permutation

```

1 l<-paste("There are",factorial(5),"different
  possible rankings")
2 l

```

R code Exa 4.43 Permutation

```

1 n=5

```

```
2 r=3
3 l<-paste("There are",factorial(n)/factorial(n-r),"
  different ways")
4 l
```

R code Exa 4.44 Permutation and Combination

```
1 n=8
2 r=3
3 l<-paste("There are",factorial(n)/factorial(n-r),"
  different ways")
4 l
```

R code Exa 4.45 Permutation and Combination

```
1 n=9
2 r=2
3 l<-paste("There are",factorial(n)/factorial(n-r),"
  different ways")
4 l
```

R code Exa 4.47 Combinations

```
1 n=4
2 r=2
3 l<-paste("There are",choose(n,r)," different ways")
4 l
```

R code Exa 4.48 Permutation and Combination

```
1 n=8
2 r=3
3 l<-paste("There are",choose(n,r),"different ways")
4 l
```

R code Exa 4.49 Permutation and Combination

```
1 n1=5
2 n2=7
3 r1=2
4 r2=3
5 l<-paste("There are",choose(n1,r1)*choose(n2,r2),"
different ways")
6 l
```

R code Exa 4.50 Probability using combinations

```
1 n1=4
2 n2=52
3 r1=4
4 r2=5
5 l<-paste("Probability is",48*choose(n1,r1)/choose(n2,
,r2))
6 l
```

R code Exa 4.51.a Probability using combinations

```
1 n1=4
```

```

2 n2=20
3 n3=24
4 r1=2
5 r2=2
6 r3=4
7 l<-paste("There are",choose(n1,r1)*choose(n2,r2)/
           choose(n3,r3),"different ways")
8 l

```

R code Exa 4.51.b Probability using combinations

```

1 n1=20
2 n2=24
3 r1=4
4 r2=4
5 l<-paste("There are",choose(n1,r1)/choose(n2,r2),"
           different ways")
6 l

```

R code Exa 4.51.c Probability using combinations

```

1 n1=24
2 r1=4
3 l<-paste("There are",1/choose(n1,r1),"different ways
           ")
4 l

```

R code Exa 4.51.d Probability using combinations

```

1 n1=20

```



```

2 n2=24
3 r1=4
4 r2=4
5 l<-paste("There are",1-(choose(n1,r1)/choose(n2,r2))
           ,"different ways")
6 l

```

R code Exa 4.52 Probability using combinations

```

1 n1=6
2 n2=8
3 n3=14
4 r1=1
5 r2=1
6 r3=2
7 l<-paste("There are",choose(n1,r1)*choose(n2,r2)/
           choose(n3,r3),"different ways")
8 l

```

Chapter 5

Discrete Probability Distribution

R code Exa 5.2 Probability Distribution

```
1 h<-c(0,1,2,3)
2 ss<-8
3 pr<-c(1/ss,3/ss,3/ss,1/ss)
4 tbl<-data.frame(h,pr)
5 tbl
```

R code Exa 5.5 Mean of Probability distribution

```
1 out<-c(1,2,3,4,5,6)
2 pr<-c(1/6,1/6,1/6,1/6,1/6,1/6)
3 mea<-weighted.mean(out,pr)
4 n<-paste("the mean of the probability distribution
           is",round(mea,digits=3))
5 n
```

R code Exa 5.6 Mean of probability distribution

```
1 out<-c(0,1,2)
2 pr<-c(1/4,1/2,1/4)
3 mea<-weighted.mean(out,pr)
4 n<-paste("the mean of the probability distribution
           is",round(mea,digits=3))
5 n
```

R code Exa 5.7 Tossing Coins

```
1 h<-c(0,1,2,3)
2 p<-c(1/8,3/8,3/8,1/8)
3 weighted.mean(h,p)
```

R code Exa 5.8 Mean of Probability Distribution

```
1 out<-c(0,1,2,3,4)
2 pr<-c(0.06, 0.70, 0.20, 0.03, 0.01)
3 mea<-weighted.mean(out,pr)
4 n<-paste("the mean of the probability distribution
           is",round(mea,digits=3))
5 n
```

R code Exa 5.9 Variance and standard deviation of probability distribution

```

1 out<-c(1,2,3,4,5,6)
2 pr<-c(1/6,1/6,1/6,1/6,1/6,1/6)
3 mea<-weighted.mean(out,pr)
4 v<-round(sum(out*out*pr),digits=1)-(round(mea,digits
    =1)*round(mea,digits=1))
5 sd<-round(sqrt(v),digits=1)
6 n<-paste("the variance and standard deviation of the
    probability distribution is",v,"and",sd,"
    respectively")
7 n

```

R code Exa 5.10 Discrete Probability Distribution

```

1 out<-c(3,4,5)
2 pr<-c(2/5,1/5,2/5)
3 mea<-weighted.mean(out,pr)
4 v<-round(sum(out*out*pr),digits=1)-(round(mea,digits
    =1)*round(mea,digits=1))
5 sd<-round(sqrt(v),digits=1)
6 n<-paste("the variance and standard deviation of the
    probability distribution is",round(v,digits=1),"
    and",sd,"respectively")
7 n

```

R code Exa 5.11 Variance and standard deviation of probability distribution

```

1 out<-c(0,1,2,3,4)
2 pr<-c(0.18, 0.34, 0.23, 0.21, 0.04)
3 mea<-weighted.mean(out,pr)
4 v<-round(sum(out*out*pr),digits=1)-(round(mea,digits
    =1)*round(mea,digits=1))
5 sd<-round(sqrt(v),digits=1)

```

```

6 round(v,digits=1)
7 n<-paste("the variance and standard deviation of the
    probability distribution is",round(v,digits=1),"
    and",sd," respectively")
8 n
9 k=2
10 ct<-round(mea,digits=1)+(k*round(sd,digits=1))
11 f<-paste("Most calls will be accomodated by",round(
    ct)," phone lines")
12 f

```

R code Exa 5.12 Expectation

```

1 gain<-c(350,-1)#win and lose
2 pr<-c(0.001,0.999)
3 e<-weighted.mean(gain,pr)
4 n<-paste("the expectation of the event is",e)
5 n

```

R code Exa 5.13 Discrete Probability Distribution

```

1 gain<-c(98,48,23,8,-2)#win and lose
2 pr<-c(0.002,0.002,0.002,0.002,0.992)
3 e<-weighted.mean(gain,pr)
4 n<-paste("the expectation of the event is",e)
5 n

```

R code Exa 5.14 Bond Investment

```

1 principle<-c(5000)

```

```

2 r1<-c(0.04)
3 r2<-c(0.025)
4 dr1<-c(0.02)
5 dr2<-c(0.01)
6 a<-((principle*r1)*(1-dr1))-(principle*dr1)
7 b<-((principle*r2)*(1-dr2))-(principle*dr2)
8 a
9 b
10 if (a>b)
11   s<-paste("Bond X brings more returns")
12 if(a<b)
13   s<-paste("Bond Y brings more returns")
14 s

```

R code Exa 5.16 Survey on Doctor Visits

```

1 n<-10
2 x<-n-3
3 q<-4/5
4 n<-paste("Probability is",round(dbinom(x,n,q),3))
5 n

```

R code Exa 5.17 Survey on Employment

```

1 n=5
2 x=n-3
3 q=0.7
4 n<-paste("Probability is",round(pbinom(x,n,q),2))
5 n

```

R code Exa 5.19.a Find Probability

```
1 dbinom(5,20,0.05)
```

R code Exa 5.19.b Find Probability

```
1 pbinom(3,20,0.05)
```

R code Exa 5.19.c Find Probability

```
1 1-pbinom(2,20,0.05)
```

R code Exa 5.20 Find Probability

```
1 dbinom(12,15,0.7)
```

R code Exa 5.24 Leisure Activities

```

1 n=5
2 x1=3
3 x2=1
4 x3=1
5 p1=0.5
6 p2=0.3
7 p3=0.2
8 P=dmultinom(c(x1,x2,x3),size = 5,prob = c(p1,p2,p3))
9 n<-paste("Probability is",P)
10 n

```

R code Exa 5.25 CD Purchases

```

1 n=6
2 x1=1
3 x2=3
4 x3=2
5 p1=0.3
6 p2=0.6
7 p3=0.1
8 P=dmultinom(c(x1,x2,x3),size = 6,prob = c(p1,p2,p3))
9 n<-paste("Probability is",P)
10 n

```

R code Exa 5.26 Selecting Colored Balls

```

1 n=5
2 x1=2
3 x2=2
4 x3=1
5 p1=0.4
6 p2=0.3
7 p3=0.3

```



```

8 P=dmultinom(c(x1,x2,x3),size = 5,prob = c(p1,p2,p3))
9 n<-paste("Probability is",P)
10 n
11 #answer is in decimals

```

R code Exa 5.27 Typographical Errors

```

1 np=500
2 ne=200
3 x=3
4 l=ne/np
5 P=dpois(x,l)
6 n<-paste("Probability that there are three errors in
          a page is less than a percentage of",round(P*
          100))
7 n

```

R code Exa 5.28.a Find Probability

```

1 x<-c(0,1,2,3)
2 l<-3
3 f<-dpois(x,l)
4 sum(f)

```

R code Exa 5.28.b Find Probability

```

1 x<-c(0,1,2)
2 l<-3
3 f<-dpois(x,l)
4 round(1-sum(f),4)

```

R code Exa 5.28.c Find Probability

```
1 x<-c(0,1,2,3,4)
2 l<-3
3 f<-dpois(x,l)
4 1-sum(f)
```

R code Exa 5.29 Left Handed People

```
1 np=0.02
2 ne=200
3 x=5
4 l=ne*np
5 P=dpois(x,l)
6 n<-paste("Probability is",round(P,4))
7 n
```

Chapter 6

The Normal Distribution

R code Exa 6.7 Monthly Newspaper Recycling

```
1 X1=27
2 X2=31
3 X3=30.2
4 m=28
5 sd=2
6 z3=round((X3-m)/sd,2)
7 z1=round((X1-m)/sd,2)
```

```

8 g<-paste(round((1-pnorm(z3))*100,2),"% is the
    probability that a randomly selected household
    generates More than 30.2 pounds per month")
9 g
10 z2=round((X2-m)/sd,2)
11 g<-paste(round((pnorm(z2)-pnorm(z1))*100,2),"% is
    the probability that a randomly selected
    household generates between 27 and 31 pounds of
    newspapers per month")
12 g

```

R code Exa 6.11 Checking for normal distribution

```

1 g<-c
    (5,29,34,44,45,63,68,74,74,81,88,91,97,98,113,118,151,158)

2 #since the formula for skewness in the inbuilt is
    not the same as in textbook, using manual methods
3 sk=3*(mean(g)-median(g))/sd(g)
4 l<-paste("Skewness is",round(sk,3))
5 l
6 iqr<-IQR(g,type = 2)
7 q1<-quantile(g,0.25,type = 2)
8 q3<-quantile(g,0.75, type = 2)
9 r1=q1-(1.5*iqr)
10 r2=q3+(1.5*iqr)
11 if(max(g)>r2){lb<-paste(max(g)," is a outlier");
12 lb}else{print("no outlier")}}

```

R code Exa 6.12 Checking for normal distribution

```
1 g<-c
  (81,148,152,135,151,152,159,142,34,162,130,162,163,143,67,112,70)

2 #since the formula for skewness in the inbuilt is
  not the same as in textbook, using manual methods
3 sk=3*(mean(g)-median(g))/sd(g)
4 l<-paste("Skewness is",round(sk,3))
5 l
6 iqr<-IQR(g,type = 2)
7 q1<-quantile(g,0.25,type = 2)
8 q3<-quantile(g,0.75, type = 2)
9 r1=q1-(1.5*iqr)
10 r2=q3+(1.5*iqr)
11 if(max(g)>r2){lb<-paste(max(g),"is a outlier");
12 lb}else{print("no outlier")}
```

R code Exa 6.15 Meat Consumption

```
1 x=224
2 m=218.4
3 s=25
4 n=40
5 z1=(x-m)/s
6 l<-paste("the probability that a person selected at
  random consumes less than 224 pounds per year is"
  ,round(pnorm(z1)*100,1),"%")
7 l
8 z2=(x-m)/(s/sqrt(n))
9 l<-paste("the probability that the mean of a sample
```

```
of 40 individuals is less than 224 pounds per  
year is",round(pnorm(z2)*100,1),"%")
```

10 1

Chapter 7

Confidence Intervals and Sample Size

R code Exa 7.1 Days it takes to sell an Aveo

```
1 m=54
2 z=round(qnorm(0.975),2)
3 z
4 s=6
5 n=50
6 x=round((z*s)/sqrt(n),2)
7 l<-paste("Hence one can say with 95% confidence that
  the interval between",m-x,"and",m+x,"days does
  contain the population mean, based on a sample of
  50 automobiles.")
8 1
```

R code Exa 7.2 Ages of Automobiles

```
1 m=5.6
2 z=round(qnorm(0.995),2)
```

```

3 s=0.8
4 n=30
5 x=round((z*s)/sqrt(n),1)
6 l<-paste(" one can be 99% confident that the mean
    age of all primary vehicles is between",m-x,"and"
    ,m+x,"years , based on 30 vehicles.")
7 l

```

R code Exa 7.3 Credit Union Assets

```

1 da<-c(12.23, 16.56, 4.39, 2.89, 1.24, 2.17, 13.19,
    9.16, 1.42, 73.25, 1.91, 14.64, 11.59, 6.69,
    1.06, 8.74, 3.17, 18.13, 7.92, 4.78, 16.85,
    40.22, 2.42, 21.58, 5.01, 1.47, 12.24, 2.27,
    12.77, 2.76)
2 m=round(mean(da),2)
3 s=round(sd(da),2)
4 c=0.9
5 a=1-c
6 z=round(qnorm(0.951),2)
7 n=30
8 x=round((z*s)/sqrt(n),3)
9 l<-paste("Hence, one can be 90% confident that the
    population mean of the assets of all credit
    unions is between",m-x,"and",m+x,"based on a
    sample of 30 credit unions")
10 l

```

R code Exa 7.4 Depth of a River

```

1 c=0.99
2 a=1-c
3 s=4.38

```



```

4 z=round(qnorm(0.995),2)
5 z
6 E=2
7 ss=(z*s/E)^2
8 l<-paste("to be 99% confident that the estimate is
          within 2 feet of the true mean depth, the
          scientist needs at least a sample of",round(ss),"
          measurements.")
9 l

```

R code Exa 7.5 Critical t value

```

1 round(qt(0.975,21),2)

```

R code Exa 7.6 Sleeping Time

```

1 t=round(qt(0.975,9),3)
2 c=0.95
3 s=0.78
4 n=10
5 m=7.1
6 lo=round(m-(t*(s/sqrt(n))),2)
7 hi=round(m+(t*(s/sqrt(n))),2)
8 l<-paste("Therefore, one can be 95% confident that
          the population mean is between",lo,"and",hi,"
          inches")
9 l

```

R code Exa 7.7 Home Fires Started by Candles

```

1 t=qt(0.995,6)
2 s=1610.3
3 n=7
4 m=7041.4
5 lo=round(m-(t*(s/sqrt(n))))
6 hi=round(m+(t*(s/sqrt(n))))
7 l<-paste("Therefore, one can be",c*100," confident
           that the population mean is between",lo,"and",hi)
8 l

```

R code Exa 7.9 Male Nurses

```

1 x=60
2 n=500
3 p=round((x/n),2)
4 q=1-p
5 z=round(qnorm(0.951),2)
6 lo=round((p-(z*sqrt(p*q/n)))*100,1)
7 hi=round((p+(z*sqrt(p*q/n)))*100,1)
8 l<-paste("Hence, you can be 90% confident that the
           percentage of applicants who are men is between",
           lo,"and",hi,"%")
9 l

```

R code Exa 7.10 Religious Books

```

1 n=1721
2 p=0.159
3 q=1-p
4 z=round(qnorm(0.975),2)
5 lo=round((p-(z*sqrt(p*q/n)))*100,1)

```

```

6 hi=round((p+(z*sqrt(p*q/n)))*100,1)
7 l<-paste("Hence, you can be 95% confident that the
  true percentage is between",lo,"and",hi,"%")
8 l

```

R code Exa 7.11 Home Computers

```

1 z=round(qnorm(0.975),2)
2 E=0.02
3 p=0.40
4 q=1-p
5 n=p*q*((z/E)^2)
6 l<-paste("Minimum sample space required is",round(n)
  )
7 l

```

R code Exa 7.12 Car Phone Ownership

```

1 z=round(qnorm(0.951),2)
2 E=0.05
3 p=0.50
4 q=1-p
5 n=p*q*((z/E)^2)
6 if(n>round(n))
7   n=n+1
8 l<-paste("Minimum sample space required is",round(n)
  )
9 l

```

R code Exa 7.14 Nicotine Continent

```
1 n=20
2 s=1.6
3 Xr=round(qchisq(0.975,19),2)
4 Xl=round(qchisq(0.025,19),2)
5 lo=(n-1)*(s^2)/Xr
6 lo=sqrt(lo)
7 hi=(n-1)*(s^2)/Xl
8 hi=sqrt(hi)
9 l<-paste("Hence, you can be 95% confident that the
  true standard deviation for the nicotine content
  of all cigarettes manufactured is between",round(
    lo,1),"and",round(hi,1),"milligrams based on a
  sample of 20 cigarettes.")
10 1
```

R code Exa 7.15 Cost of Ski Lift Tickets

```
1 n=10
2 m<-c(59, 54, 53, 52, 51, 39, 49, 46, 49, 48)
3 s=sd(m)
4 Xr=round(qchisq(0.95,9),3)
5 Xl=round(qchisq(0.05,9),3)
6 lo=(n-1)*(s^2)/Xr
7 lo=sqrt(lo)
8 hi=(n-1)*(s^2)/Xl
9 hi=sqrt(hi)
10 l<-paste("Hence, you can be 90% confident that the
  true standard deviation price of all single-day
  ski lift tickets of the population is between",
  round(lo,2),"and",round(hi,2),"dollars on a
  sample of 10 nationwide ski resorts.")
11 1
```

Chapter 8

Hypothesis Testing

R code Exa 8.3 Professors Salaries

```
1 x1=43260
2 m=42000
3 s=5230
4 n=30
5 c=round(qnorm(0.951),2)
6 z=round((x1-m)/(s/sqrt(n)),2)
7 f=z
8 x=seq(-4,4,length=200)
9 y=dnorm(x)
10 plot(x,y,type="l", lwd=2, col="green")
11 if(z<c)
12 { f=c
13   x=seq(z,z,length=100)
14   y=dnorm(x)
15   polygon(c(z,x,z),c(0,y,0),col="black")}
```

```

16 x=seq(f,4,length=100)
17 y=dnorm(x)
18 polygon(c(f,x,4),c(0,y,0),col="gray")
19 #values are compared on the plot

```

R code Exa 8.4 Costs of Mens Athletic Shoes

```

1 g<-c(60, 70, 75, 55, 80, 55, 50, 40, 80, 70, 50, 95,
      120, 90, 75, 85, 80, 60, 110, 65, 80, 85, 85,
      45, 75, 60, 90, 90, 60, 95, 110, 85, 45, 90, 70,
      70)
2 t.test(g, mu=80, conf.level = 0.9)

```

R code Exa 8.5 Cost of Rehabilitation

```

1 m=25226
2 mu=24672
3 s=3251
4 n=35
5 c=round(qnorm(0.995),2)
6 z=round((m-mu)/(s/sqrt(n)),2)
7 x=seq(-4,4,length=200)
8 y=dnorm(x)
9 plot(x,y,type="l",lwd=2,col="green")
10 x=seq(z,z,length=100)
11 y=dnorm(x)
12 polygon(c(z,x,z),c(0,y,0),col="black")
13 x=seq(-c,-4,length=100)
14 y=dnorm(x)
15 polygon(c(-c,x,-4),c(0,y,0),col="yellow")
16 x=seq(c,4,length=100)
17 y=dnorm(x)
18 polygon(c(c,x,4),c(0,y,0),col="yellow")

```

19 #values are compared on the plot

R code Exa 8.13 Substitute Teachers Salaries

```
1 g<-c(60, 56, 60, 55, 70, 55, 60, 55)
2 t.test(g, mu=60, conf.level = 0.9)
```

R code Exa 8.17 people who are trying to avoid Trans Fats

```
1 mu=0.60
2 n=200
3 x=128
4 p=x/n
```

```

5  q=1-mu
6  c=1.96
7  z=(p-mu)/sqrt(mu*q/n)
8  if((z>-c)&&(z<c))
9    l<-paste("Hypothesis rejected") else
10    l<-paste("Hypothesis accepted")
11  l

```

R code Exa 8.18 Survey on Call Waiting Service

```

1  mu=0.40
2  n=100
3  p=0.37
4  q=1-mu
5  c=qnorm(0.995)
6  z=(p-mu)/sqrt(mu*q/n)
7  if((z>-c)&&(z<c))
8    l<-paste("Hypothesis rejected") else
9    l<-paste("Hypothesis accepted")
10  l

```

R code Exa 8.23 critical chisq value

```

1  l<-paste(round(qchisq(0.975,22),3),"and",round(
    qchisq(0.025,22),3),"is the critical value")

```


R code Exa 8.25 Outpatient Surgery

```
1 g<-c(25, 30, 5, 15, 18, 42, 16, 9, 10, 12, 12, 38,
      8, 14, 27)
2 library(EnvStats)
3 varTest(g,alternative = "greater",conf.level = 0.9,
      sigma.squared = 64)
4 #chisq.test didn't give the correct output for me.
   Hence i have opted for varTest which essentially
   performs the same on variance as given in the
   question.
5 #please install package "EnvStats" before proceeding
```

R code Exa 8.30 Sugar Production

```
1 mu1=5
2 n=50
3 x=4.6
4 s=0.7
5 sq=round(sqrt(n),3)
6 z=(x-mu1)*sq/s
```

```

7 c1=-round(qnorm(0.975),2)
8 c2=round(qnorm(0.975),2)
9 if(z<c1 || z>c2)
10   l<-paste("Null hypothesis rejected")
11 l
12 m1=x-(c2*s/sq)
13 m2=x+(c2*s/sq)
14 p<-paste("confidence interval is between",round(m1
    ,1),"and",round(m2,1))
15 p

```

R code Exa 8.31 Hog Weight

```

1 mu1=200
2 n=10
3 x=198.2
4 s=3.3
5 sq=round(sqrt(n),4)
6 z=(x-mu1)*sq/s
7 c2=round(-qt(0.025,9),3)
8 c1=-round(-qt(0.025,9),3)
9 if(z>c1 || z<c2)
10   l<-paste("Null hypothesis accepted")else
11   l<-paste("Null hypothesis rejected")
12 l
13 m1=x-round((c2*s/sq),3)
14 m2=x+round((c2*s/sq),3)
15 p<-paste("confidence interval is between",round(m1
    ,1),"and",round(m2,1))
16 p

```

Chapter 9

Testing the Difference Between Two Means and Two Proportions and Two Variances

R code Exa 9.1 Hotel Room Cost

```
1  c1=-round(qnorm(0.975),2)
2  c2=round(qnorm(0.975),2)
3  s1=5.62*5.62
4  s2=4.83*4.83
5  n1=n2=50
6  x1=88.42
7  x2=80.61
8  z=(x1-x2)/sqrt(s1/n1 + s2/n2)
9  if(z>c2 || z<c1)
10    l<-paste("Null hypothesis rejected. There is
              enough evidence to support the claim that the
              means are not equal. Hence, there is a
              significant difference in the rates. ")
11  l
```

R code Exa 9.3 Confidence Interval

```
1 c1=-round(qnorm(0.975),2)
2 c2=round(qnorm(0.975),2)
3 s1=5.62*5.62
4 s2=4.83*4.83
5 n1=n2=50
6 x1=88.42
7 x2=80.61
8 z=1.96
9 lo=(x1-x2)-(z*sqrt(s1/n1 + s2/n2))
10 hi=(x1-x2)+(z*sqrt(s1/n1 + s2/n2))
11 p<-paste("Confidence interval is between",round(lo
,2),"and",round(hi,2))
12 if(lo>0)
13   l<-paste("Since the confidence interval does not
contain zero, the decision is to reject the
null hypothesis, which agrees with the previous
result.")else
14   l<-paste("Hypothesis accepted")
15 p
16 l
```

R code Exa 9.4 Farm Sizes

```
1 c1=-round(qt(0.975,7),3)
2 c1
3 c2=round(qt(0.975,7),3)
4 s1=38*38
5 s2=12*12
```

```

6  n1=8
7  n2=10
8  x1=191
9  x2=199
10 z=(x1-x2)/sqrt(s1/n1 + s2/n2)
11 z
12 if(z>c2 || z<c1)
13   l<-paste("Null hypothesis rejected.") else
14   l<-paste("Null hypothesis accepted. There is not
           enough evidence to support the claim that the
           average size of the farms is different. ")
15 l
16 #qf function with alpha=0.05 and df=7 doesnt give
   2.365

```

R code Exa 9.5 Confidence Interval

```

1  c2=round(qt(0.975,7),3)
2  c2
3  s1=38*38
4  s2=12*12
5  n1=8
6  n2=10
7  x1=191
8  x2=199
9  lo=(x1-x2)-(c2*sqrt(s1/n1 + s2/n2))
10 hi=(x1-x2)+(c2*sqrt(s1/n1 + s2/n2))
11 p<-paste("Confidence interval is between",round(lo
           ,2),"and",round(hi,2))
12 if(lo<0 && hi>0)
13   l<-paste("Since 0 is contained in the interval ,
           the decision is to not reject the null
           hypothesis") else
14   l<-paste("Hypothesis rejected")
15 p

```

```
16 1
17 #qf doesn't give the exact answer as in the tb
```

R code Exa 9.6 Vitamin for Increased Strength

```
1 X1<-c(210,230,182,205,262,253,219,216)
2 X2<-c(219,236,179,204,270,250,222,216)
3 t.test(X1,X2,paired = TRUE,alternative = "less")
```

R code Exa 9.7 Cholesterol Levels

```
1 X1<-c(210,235,208,190,172,244)
2 X2<-c(190,170,210,188,173,228)
3 t.test(X1,X2, paired = TRUE)
```

R code Exa 9.8 Confidence Interval

```
1 n=6
2 mu=0
3 c=2.015
4 X1<-c(210,235,208,190,172,244)
5 X2<-c(190,170,210,188,173,228)
6 t.test(X1,X2, paired = TRUE, conf.level = 0.90)
```

R code Exa 9.9 Vaccination Rates in Nursing Homes

```

1  x1=12
2  n1=34
3  x2=17
4  n2=24
5  p1=x1/n1
6  p2=x2/n2
7  p=(x1+x2)/(n1+n2)
8  q=1-p
9  c1=round(qnorm(0.975),2)
10 c2=-round(qnorm(0.975),2)
11 z=round((p1-p2)/sqrt(p*q*(1/n1+1/n2)),1)
12 if(z>c1 || z<c2)
13   l<-paste("There is enough evidence to reject the
              claim that there is no difference in the
              proportions of small and large nursing homes
              with a resident vaccination rate of less than
              80%.") else
14   l<-paste("Null hypothesis accepted")
15 l

```

R code Exa 9.10 Missing Work

```

1  p1=0.45
2  n1=200
3  p2=0.35
4  n2=200
5  x1=p1*n1
6  x2=p2*n2
7  p=(x1+x2)/(n1+n2)
8  q=1-p
9  c1=round(qnorm(0.995),2)
10 c2=-round(qnorm(0.995),2)
11 z=round((p1-p2)/sqrt(p*q*(1/n1+1/n2)),1)
12 if(z>c1 || z<c2)
13   l<-paste("Null hypothesis rejected") else

```

```

14     l<-paste("Null hypothesis accepted. There is not
              enough evidence to support the claim that
              there is a difference in proportions.")
15 1

```

R code Exa 9.11 Confidence Interval

```

1  x1=12
2  n1=34
3  x2=17
4  n2=24
5  p1=round(x1/n1,2)
6  q1=1-p1
7  p2=round(x2/n2,2)
8  q2=1-p2
9  p=(x1+x2)/(n1+n2)
10 q=1-p
11 c1=round(qnorm(0.975),2)
12 lo=(p1-p2)-(c1*sqrt((p1*q1)/n1 + (p2*q2)/n2))
13 hi=(p1-p2)+(c1*sqrt((p1*q1)/n1 + (p2*q2)/n2))
14 p<-paste("Confidence intervals are in between",round
           (hi,3),"and",round(lo,3))
15 p
16 if(lo<0 && hi<0)
17   l<-paste("Since 0 is not contained in the interval
             , the decision is to reject the null hypothesis
             ") else
18   l<-paste("Null hypothesis accepted")
19 1

```

Chapter 10

Correlation and Regression

R code Exa 10.12 Copy Machine Maintenance Costs

```
1 c<-c(1,2,3,4,4,6)
```

```

2 r<-c(62,78,70,90,93,103)
3 mo<-lm(r ~ c)
4 mo
5 summary(mo)

```

R code Exa 10.14 Standard error estimation

```

1 c<-c(1,2,3,4,4,6)
2 r<-c(62,78,70,90,93,103)
3 mo<-lm(r~c)
4 mo
5 predict(mo,interval = "prediction", level = 0.95)

```

R code Exa 10.15 State board scores

```

1 gpa<-c(3.2,2.7,2.5,3.4,2.2)
2 x<-c(22,27,24,28,23)
3 sbs<-c(550,570,525,670,490)
4 dt<-data.frame("Student"=c("a","b","c","d","e"), "GPA"
  " =gpa," Age"=x," State board scores"=sbs)
5 mo<-lm(dt$State.board.scores ~ dt$GPA +dt$Age)
6 mo
7 summary(mo)

```

R code Exa 10.16 State board scores

```

1 gpa<-c(3.2,2.7,2.5,3.4,2.2)
2 x<-c(22,27,24,28,23)

```

```

3 sbs<-c(550,570,525,670,490)
4 dt<-data.frame("Student"=c("a","b","c","d","e"), "GPA"
  " =gpa", "Age"=x, "State board scores"=sbs)
5 mo<-lm(dt$State.board.scores ~ dt$GPA +dt$Age)
6 mo
7 summary(mo)

```

R code Exa 10.17 State board scores

```

1 gpa<-c(3.2,2.7,2.5,3.4,2.2)
2 x<-c(22,27,24,28,23)
3 sbs<-c(550,570,525,670,490)
4 dt<-data.frame("Student"=c("a","b","c","d","e"), "GPA"
  " =gpa", "Age"=x, "State board scores"=sbs)
5 mo<-lm(dt$State.board.scores ~ dt$GPA +dt$Age)
6 mo
7 summary(mo)

```

Chapter 11

Other Chi Square Tests

R code Exa 11.1 Fruit Soda Flavor Preference

```
1 o<-c(32,28,16,14,10)
2 chisq.test(o)
```

R code Exa 11.5 College Education and Place of Residence

```
1 u<-c(15,12,8,8,15,9,6,8,7)
2 m<-matrix(u,ncol=3,byrow = TRUE)
3 colnames(m)<-c("no college", "four year degree", "
  advanced college")
4 rownames(m)<-c("Urban", "Suburban", "Rural")
5 m<-as.table(m)
6 m
7 chisq.test(m)
```

R code Exa 11.6 Alcohol and Gender

```
1 u<-c(10,9,8,13,16,12)
2 m<-matrix(u,ncol=3,byrow = TRUE)
3 colnames(m)<-c("low", "moderate", "high")
4 rownames(m)<-c("Male", "Female")
5 m<-as.table(m)
6 m
7 chisq.test(m)
```

R code Exa 11.7 Lost Luggage on Airline Flights

```
1 u<-c(10,7,4,90,93,96)
2 m<-matrix(u,ncol=3,byrow = TRUE)
3 colnames(m)<-c("Airline 1", "Airline 2", "Airline 3"
4   )
5 rownames(m)<-c("Yes", "No")
6 m<-as.table(m)
7 m
8 chisq.test(m)
```

Chapter 12

Analysis of Variance

R code Exa 12.1 Lowering Blood Pressure

```
1 x<-data.frame("meal"=c(10,12,9,15,13),"exercise"=c
  (6,8,3,0,2),"diet"=c(5,9,12,8,4))
2 mo<-c(x$meal,x$exercise,x$diet)
3 gr<-factor(rep(letters[1:3],each = 5))
4 fit=aov(formula = mo ~ gr)
5 anova(fit)
```

R code Exa 12.2 Employees at Toll Road Interchanges

```
1 x<-data.frame("tp"=c(7,14,32,19,10,11),"mf"=c
  (10,1,1,0,11,1),"bv"=c(1,12,1,9,1,11))
2 mo<-c(x$tp,x$mf,x$bv)
3 gr<-factor(rep(letters[1:3],each = 6))
4 fit=aov(formula = mo ~ gr)
5 anova(fit)
```

R code Exa 12.3 Scheffe Test

```
1 me<-c(10,12,9,15,13)
2 ex<-c(6,8,3,0,2)
3 di<-c(5,9,12,8,4)
4 l<-c(me,ex,di)
5 fa<-factor(rep(c("meat","exercise","diet"),15))
6 pr=factor(rep(1:15, rep(3, 15)))
7 d<-data.frame(l,fa,pr)
8 fml<- aov(d$l ~ d$fa + d$pr, data = d)
9 library(DescTools)
10 ScheffeTest(x=fml)
```

R code Exa 12.4 Turkey Test

```
1 me<-c(10,12,9,15,13)
2 ex<-c(6,8,3,0,2)
3 di<-c(5,9,12,8,4)
4 l<-c(me,ex,di)
5 fa<-factor(rep(c("meat","exercise","diet"),15))
6 pr=factor(rep(1:15, rep(3, 15)))
7 d<-data.frame(l,fa,pr)
8 a1<- aov(d$l ~ d$fa + d$pr)
9 TukeyHSD(x=a1,"d$fa", conf.level=0.95)
```

R code Exa 12.5 Gasoline Consumption

```
1 ss<-c(26.7,25.2,32.3,32.8,28.6,29.3,26.1,24.2)
2 gas<-factor(c("reg","reg","ho","ho","reg","reg","ho",
  ,"ho"))
3 auto<-factor(c("tw","tw","tw","tw","fw","fw","fw","
  fw"))
```



```
4 dat<-data.frame("value"=ss,"Gas"=gas,"Automobile"=
  auto)
5 dat
6 results<-lm(dat$value ~ dat$Gas + dat$Automobile +
  dat$Gas*dat$Automobile, data=dat)
7 anova(results)
```

Chapter 13

Nonparametric Statistics

R code Exa 13.1 snow Cone Sales

```
1 x<-c
   (18,43,40,16,22,30,29,32,37,36,39,34,39,45,28,36,40,34,39,52)

2 a=0.05
3 SIGN.test(x)
4 #package BSDA to be downloaded for SIGN.test
```

R code Exa 13.3 Ear infections in Swimmers

```
1 x<-c(3,0,5,4,2,4,3,5,2,1)
2 y<-c(2,1,4,0,1,3,1,3,2,3)
3 SIGN.test(x,y)
4 #package BSDA to be downloaded for SIGN.test
```

R code Exa 13.6 Milliequivalents of Potassium in Breakfast Drinks

```
1 a<-c(4.7,3.2,5.1,5.2,5.0)
2 b<-c(5.3,6.4,7.3,6.8,7.2)
3 c<-c(6.3,8.2,6.2,7.1,6.6)
4 kruskal.test(list(a,b,c))
```

R code Exa 13.10 Ages of Drug Program Participants

```
1 d<-c(18, 36, 19, 22, 25, 44, 23, 27, 27, 35, 19, 43,
      37, 32, 28, 43, 46, 19, 20, 22)
2 runs.test(d)
3 l<-paste("Since there are 9 runs between 5 and 15,
      the null hypothesis is not rejected.")
4 l
5 #snpar package to be downloaded for runs.test
```
