Data File Used in this Analysis:

```
# Math 3080 - 1       Chrysanthemum Data       March 15, 2010
# Treibergs
#
# From Walpole, Myers, Myers, Ye " Probability and Statistics for Engineers
# and Scientists, 7th ed"
# From a study "Effect of Magnesium Ammonium Sulphate on the Height of
# Chrysathemums." Different amounts of fertilizer applied to 10 plants
# each. Y = change in heights (cm) in four weeks
# Treatments are conc MgNH4Po4 in (g/bu)
#
"Treatment" "Height-Change"
50 1.320000000E+01
50 1.240000000E+01
50 1.280000000E+01
50 1.720000000E+01
50 1.300000000E+01
50 1.400000000E+01
50 1.420000000E+01
50 2.160000000E+01
50 1.500000000E+01
50 2.000000000E+01
100 1.600000000E+01
100 1.260000000E+01
100 1.480000000E+01
100 1.300000000E+01
100 1.400000000E+01
100 2.360000000E+01
100 1.400000000E+01
100 1.700000000E+01
100 2.220000000E+01
100 2.440000000E+01
200 7.800000000E+00
200 1.440000000E+01
200 2.000000000E+01
200 1.580000000E+01
200 1.700000000E+01
200 2.700000000E+01
200 1.960000000E+01
200 1.800000000E+01
200 2.020000000E+01
200 2.320000000E+01
400 2.100000000E+01
400 1.480000000E+01
400 1.910000000E+01
400 1.580000000E+01
400 1.800000000E+01
400 2.600000000E+01
```

```
400 2.110000000E+01
400 2.200000000E+01
400 2.500000000E+01
400 1.820000000E+01
```

R Session:

```
R version 2.14.0 (2011-10-31)
Copyright (C) 2011 The R Foundation for Statistical Computing
ISBN 3-900051-07-0
Platform: i386-apple-darwin9.8.0/i386 (32-bit)

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[R.app GUI 1.42 (5933) i386-apple-darwin9.8.0]

[Workspace restored from /home/1004/ma/treibergs/.RData]
[History restored from /home/1004/ma/treibergs/.Rhistory]

> tt <- read.table("M3082DataChr.txt",header=T)
> tt
   Treatment Height.Change
1         50          13.2
2         50          12.4
3         50          12.8
4         50          17.2
5         50          13.0
6         50          14.0
7         50          14.2
8         50          21.6
9         50          15.0
10        50          20.0
11       100          16.0
12       100          12.6
13       100          14.8
14       100          13.0
15       100          14.0
16       100          23.6
17       100          14.0
```
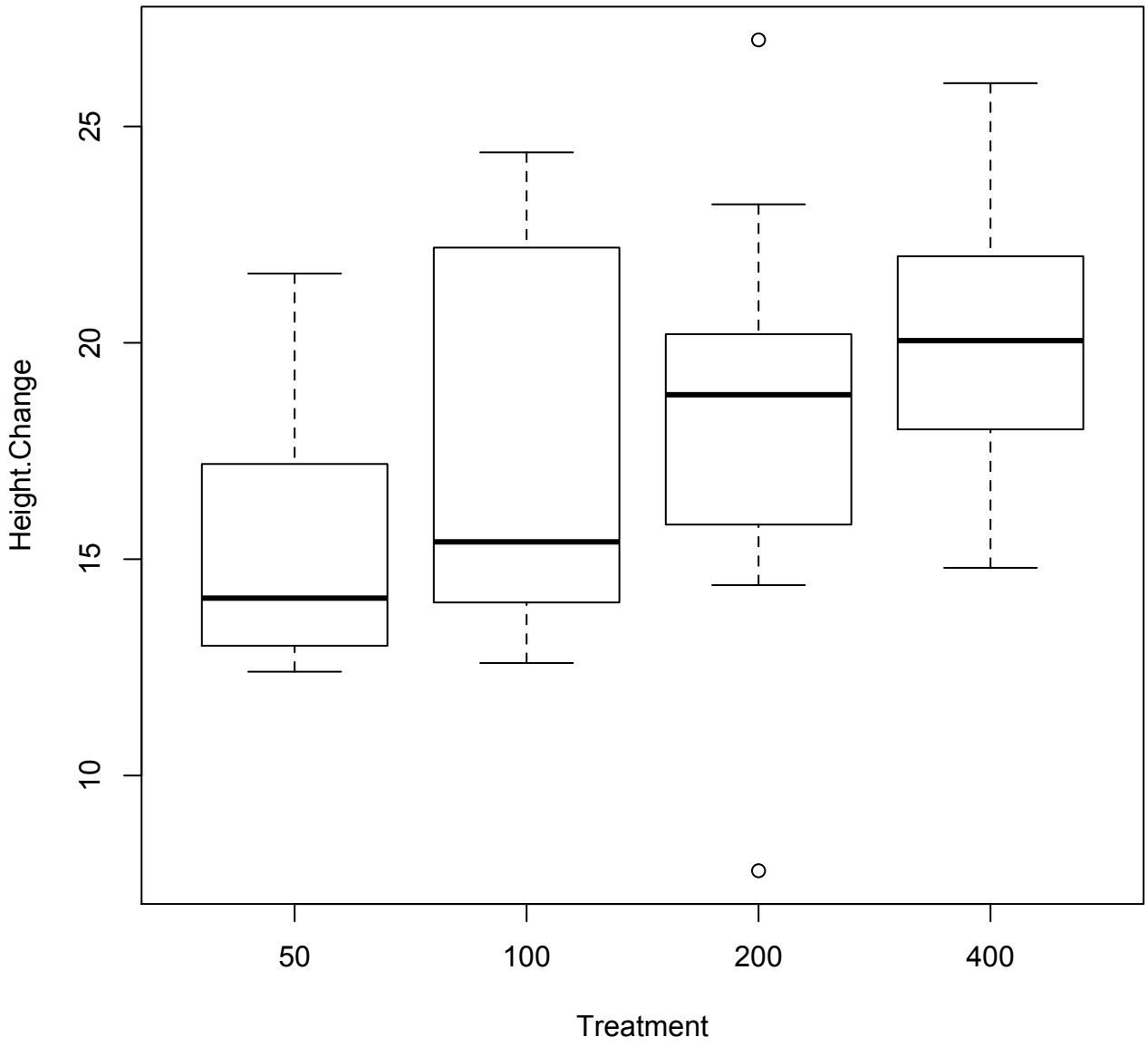
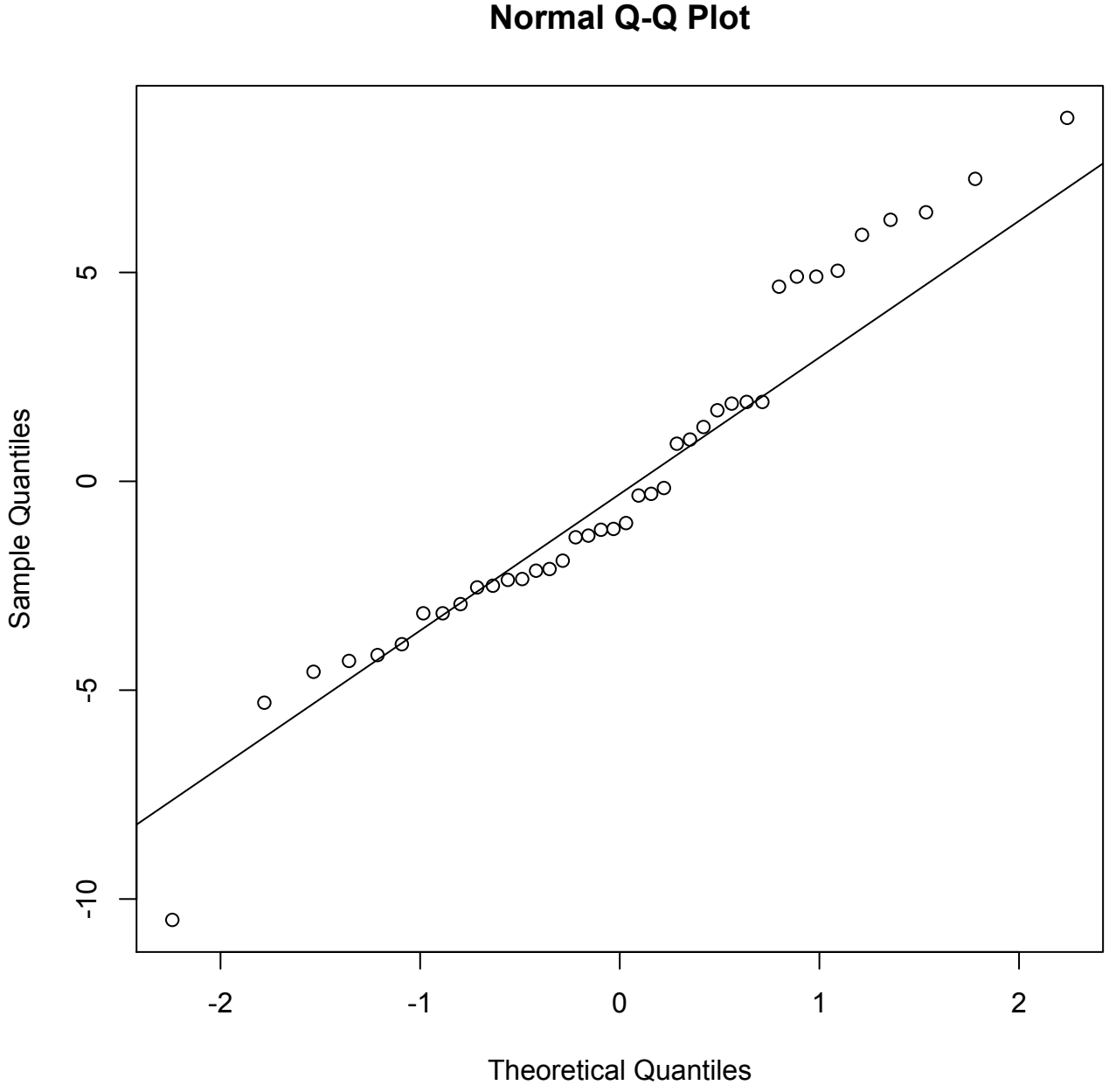

```
18       100          17.0
19       100          22.2
20       100          24.4
21       200           7.8
22       200          14.4
23       200          20.0
24       200          15.8
25       200          17.0
26       200          27.0
27       200          19.6
28       200          18.0
29       200          20.2
30       200          23.2
31       400          21.0
32       400          14.8
33       400          19.1
34       400          15.8
35       400          18.0
36       400          26.0
37       400          21.1
38       400          22.0
39       400          25.0
40       400          18.2
> attach(tt)

>#==============SUMMARIZE EACH TREATMENT POPULATION=======
> tapply(Height.Change,Treatment,summary)
$`50`
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  12.40   13.05   14.10   15.34   16.65   21.60

$`100`
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  12.60   14.00   15.40   17.16   20.90   24.40

$`200`
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   7.80   16.10   18.80   18.30   20.15   27.00

$`400`
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  14.80   18.05   20.05   20.10   21.78   26.00

>#==============MAKE trt AN ORDERED FACTOR=================
> trt <- ordered(Treatment)

>#==============MAKE SIDE-BY-SIDE BOXPLOTS=================
> plot(Height.Change~trt,xlab="Treatment")
```

```
>#==============COMPUTE MSE==================================
> tapply(Height.Change,trt,var)
      50      100      200      400
10.30267 20.47822 26.82000 13.31556


> MSE = mean(tapply(Height.Change,trt,var)); MSE
[1] 17.72911

>#==============COMPUTE MSTr=================================
> tapply(Height.Change,trt,mean)
   50   100   200   400
15.34 17.16 18.30 20.10

> MSTr=10*var(tapply(Height.Change,trt,mean));MSTr
[1] 39.929

>#==============COMPUTE f, CRITICAL f, P-VALUE===============
> f=MSTr/MSE;f
[1] 2.252172

> qf(.95,3,36)
[1] 2.866266

> pf(f,3,36,lower.tail=F)
[1] 0.09893277

>#==============RUN ANOVA AND PRINT ANOVA TABLE===============
> f1=aov(Height.Change~trt); summary(f1)

          Df Sum Sq Mean Sq F value Pr(>F)
trt          3  119.8   39.93   2.252 0.0989 .
Residuals   36  638.2   17.73
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1
```

```
>#==============DISPLAY DATA AS TABLE=========================
> MM=matrix(Height.Change,nrow=10);MM
      [,1] [,2] [,3] [,4]
 [1,] 13.2 16.0  7.8 21.0
 [2,] 12.4 12.6 14.4 14.8
 [3,] 12.8 14.8 20.0 19.1
 [4,] 17.2 13.0 15.8 15.8
 [5,] 13.0 14.0 17.0 18.0
 [6,] 14.0 23.6 27.0 26.0
 [7,] 14.2 14.0 19.6 21.1
 [8,] 21.6 17.0 18.0 22.0
 [9,] 15.0 22.2 20.2 25.0
[10,] 20.0 24.4 23.2 18.2

> rownames(MM)=1:10
> colnames(MM)=c("   50","  100","  200","  400")
> MM
      50   100   200   400
1   13.2  16.0   7.8  21.0
2   12.4  12.6  14.4  14.8
3   12.8  14.8  20.0  19.1
4   17.2  13.0  15.8  15.8
5   13.0  14.0  17.0  18.0
6   14.0  23.6  27.0  26.0
7   14.2  14.0  19.6  21.1
8   21.6  17.0  18.0  22.0
9   15.0  22.2  20.2  25.0
10  20.0  24.4  23.2  18.2

>#==============TABLE OF PREDICTED VALUES=================

> > MI=matrix(rep(tapply(Height.Change,trt,mean),10),ncol=4,byrow=T);MI
       [,1]  [,2] [,3] [,4]
 [1,] 15.34 17.16 18.3 20.1
 [2,] 15.34 17.16 18.3 20.1
 [3,] 15.34 17.16 18.3 20.1
 [4,] 15.34 17.16 18.3 20.1
 [5,] 15.34 17.16 18.3 20.1
 [6,] 15.34 17.16 18.3 20.1
 [7,] 15.34 17.16 18.3 20.1
 [8,] 15.34 17.16 18.3 20.1
 [9,] 15.34 17.16 18.3 20.1
[10,] 15.34 17.16 18.3 20.1

>#==============QQ-PLOT OF RESIRUALS=========================
> qqnorm(MM-MI); qqline(MM-MI)
```


Height.Change
10
15
20
25
50
100
200
400
Treatment


Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles
5
0
-5
-10
-2
-1
0
1
2