Math 3070 § 1. **March Precipitation in Minneapolis:** Name: Example
Treibergs **Normal QQ Plots and Transformations.** June 9, 2011

R Session:

```
R version 2.11.1 (2010-05-31)
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  Natural language support but running in an English locale

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[R.app GUI 1.34 (5589) i386-apple-darwin9.8.0]

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

> ################### ENTER DATA USING scan() ############################
>
> # Is normality of the march Precipitation in Minneapolis plausible?
> # If not, will a transformation of the data make a mor normal variable?
> # Problem 4.94 of Devore lists rainfall for last thirty years.
> # It is easy to enter using scan()
>
> tt <- scan()
1: .77 1.20 3.00 1.62 2.81 2.84 1.74 .47 3.09 1.31 1.87 .96 .81
14: 1.43 1.51 .32 1.18 1.89 1.20 3.37 2.10 .59 1.35 .90 1.95
26: 2.20 .52 .81 4.75 2.05
31:
Read 30 items
> tt
 [1] 0.77 1.20 3.00 1.62 2.81 2.84
 [7] 1.74 0.47 3.09 1.31 1.87 0.96
[13] 0.81 1.43 1.51 0.32 1.18 1.89
[19] 1.20 3.37 2.10 0.59 1.35 0.90
[25] 1.95 2.20 0.52 0.81 4.75 2.05
>
> # Oops. Item tt[6] is not correct. Fix it. One way is to replace
> tt[6]<- 2.48
> summary(tt)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  0.320   0.915   1.470   1.675   2.088   4.750
```
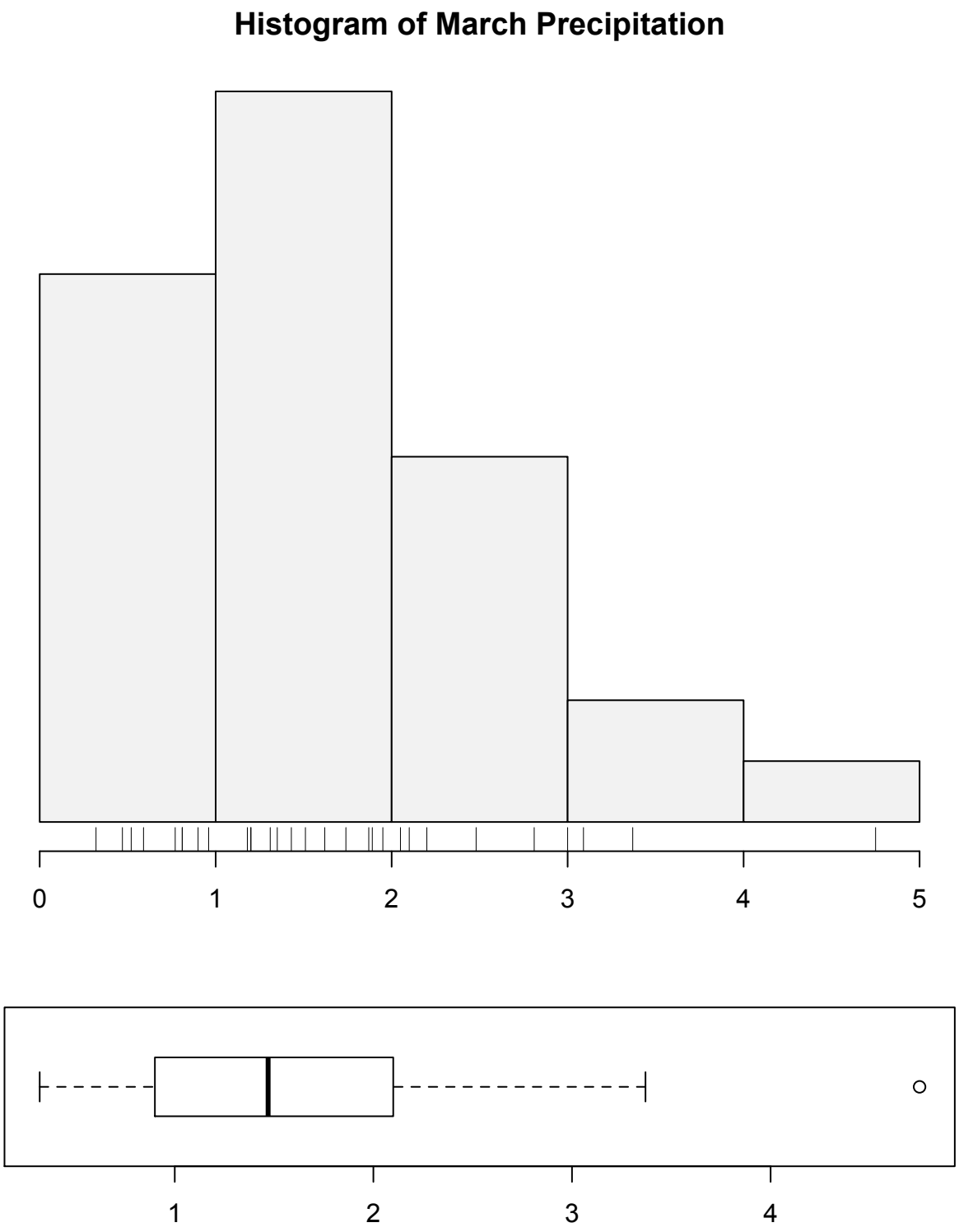
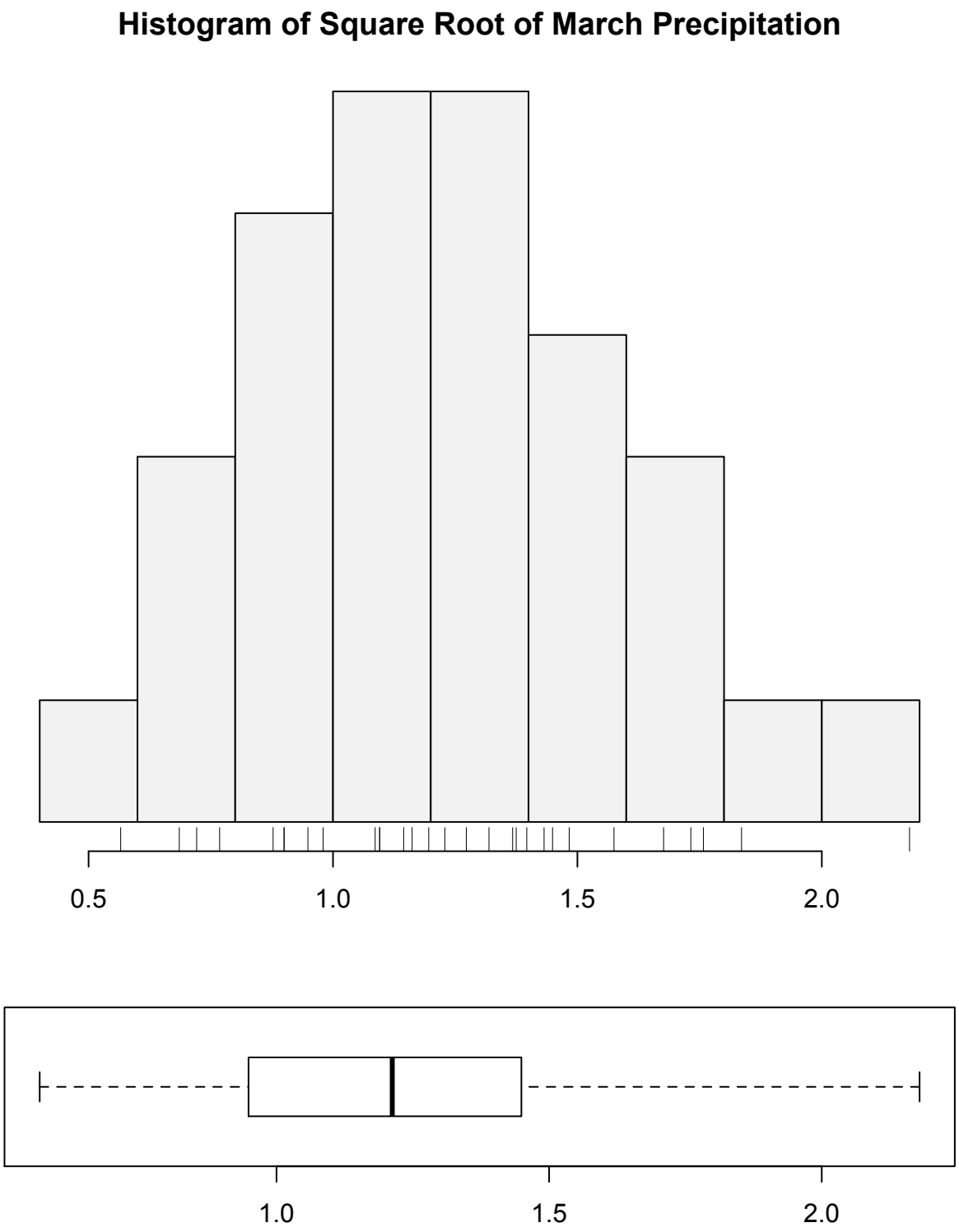
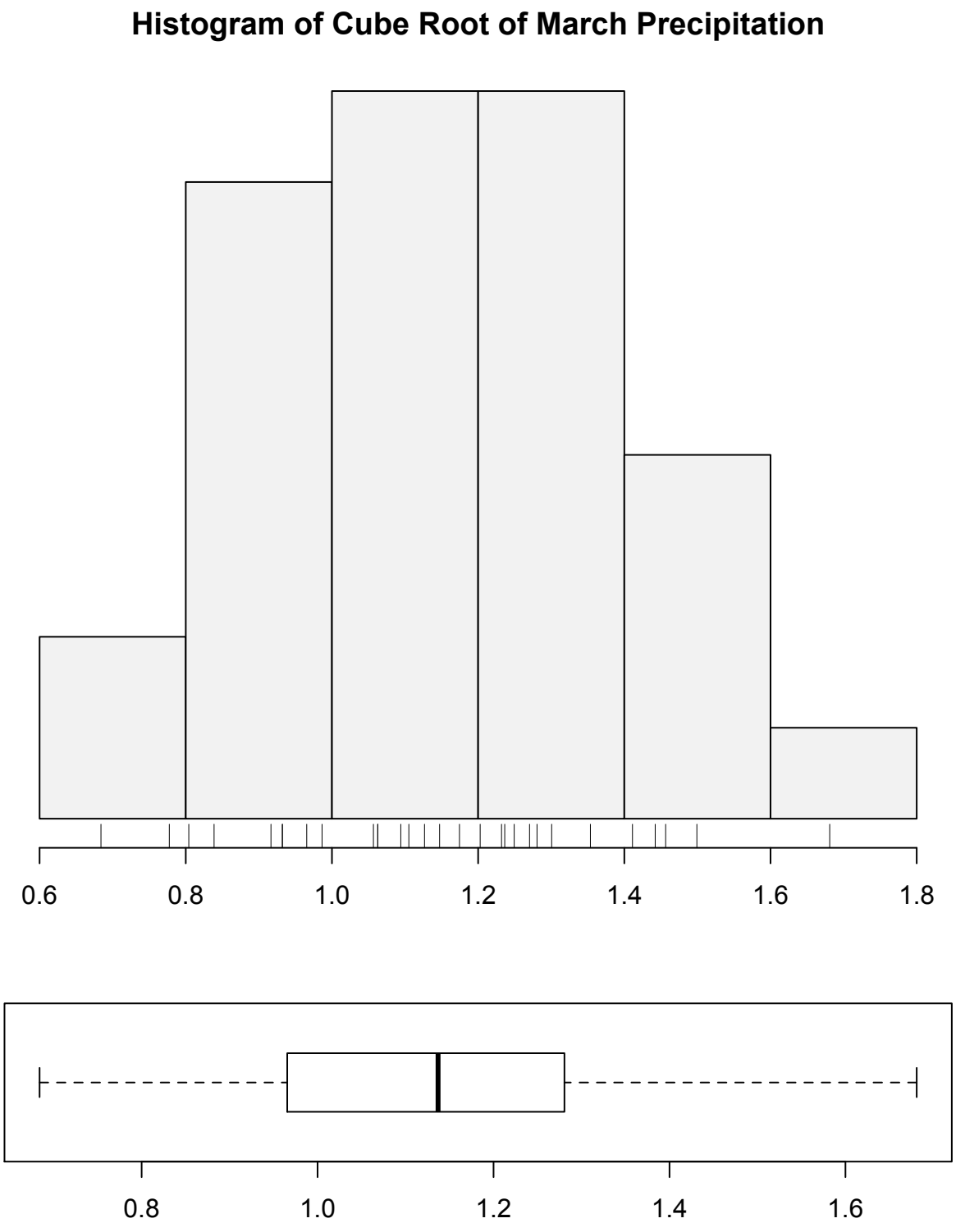
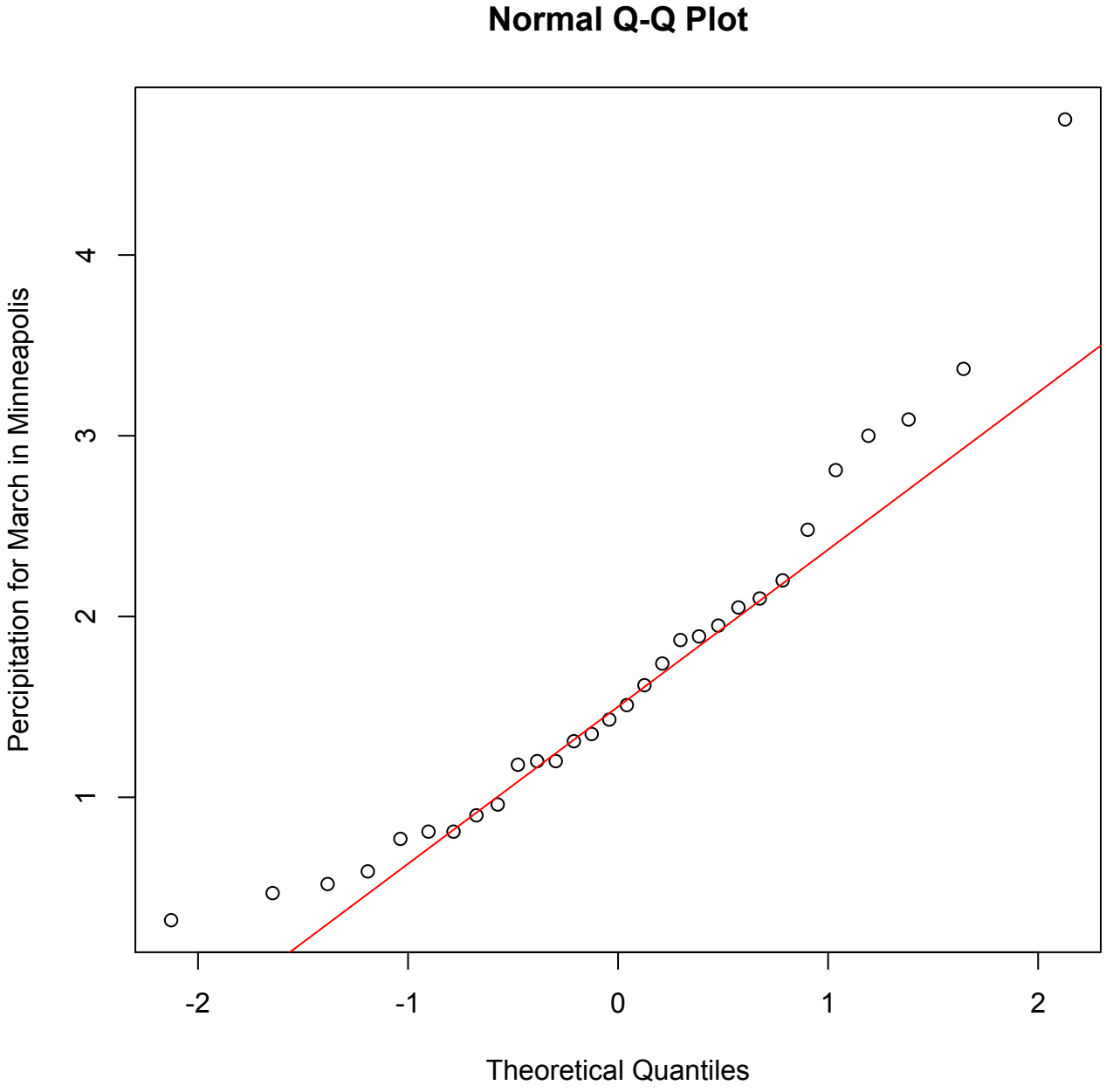

```
> ########################## LOAD FANCY GRAPHICS FROM "UsingR" ###################
> # Verzani's "Using R for Introductory Statistics" supplies fancy plots
> library(UsingR)
Loading required package: MASS
>
> ######################### PLOT HISTOGRAM AND BOXPLOT TOGETHER ####################
> simple.hist.and.boxplot(tt,main="Histogram of March Precipitation")
> # M3074Minneapolis4.pdf
>
> # Looks Skewed. Try transforming the data.
>
> stt <- sqrt(tt)
> ctt <- tt^(1/3)
> simple.hist.and.boxplot(stt,main="Histogram of Square Root of March Precipitation")
> # M3074Minneapolis5.pdf
>
> # Better.
>
> simple.hist.and.boxplot(ctt,main="Histogram of Cube Root of March Precipitation">
> # Even better!
>
> # M3074Minneapolis6.pdf
```

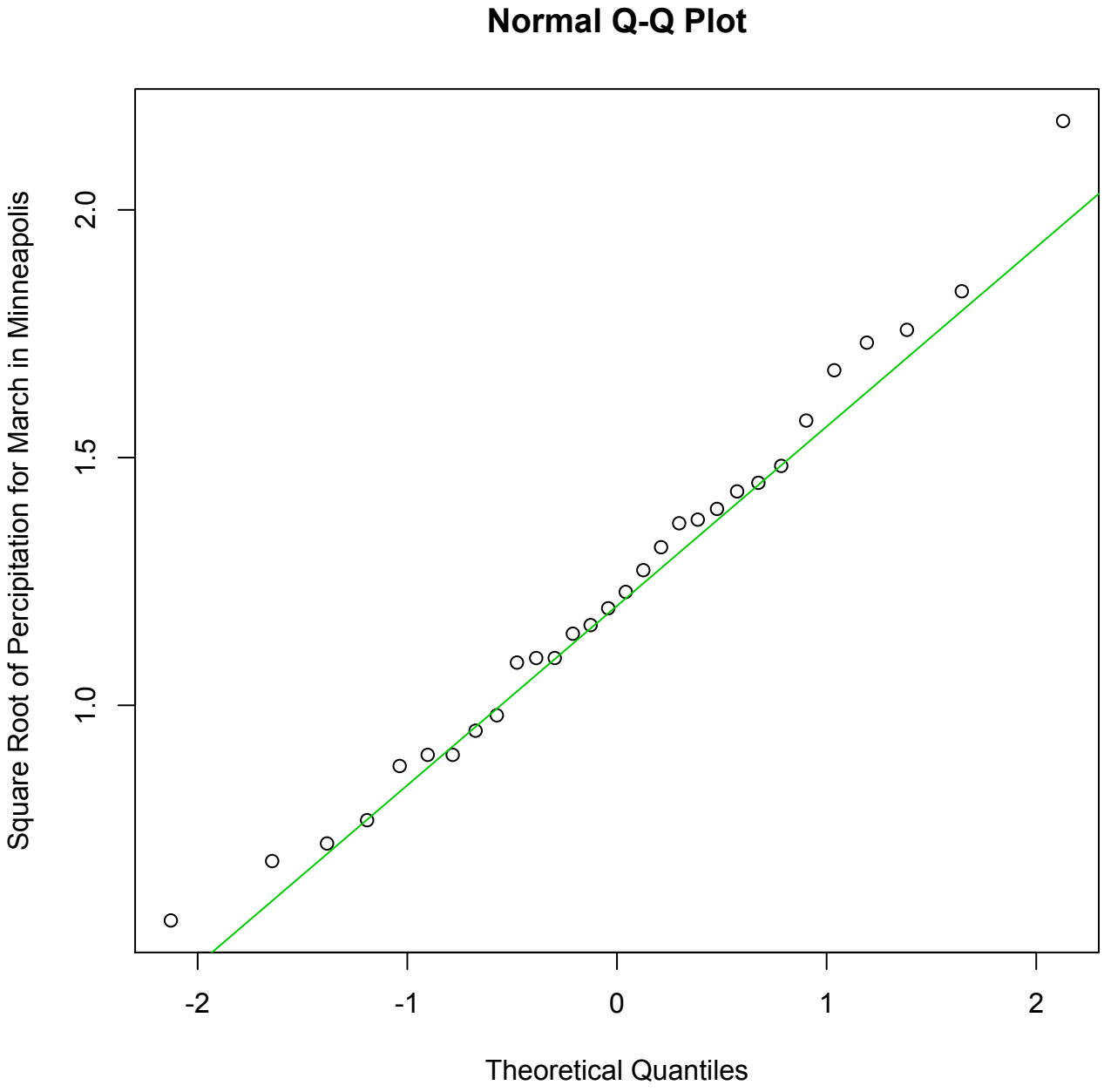

Histogram of March Precipitation
0
1
2
3
4
5
1
2
3
4

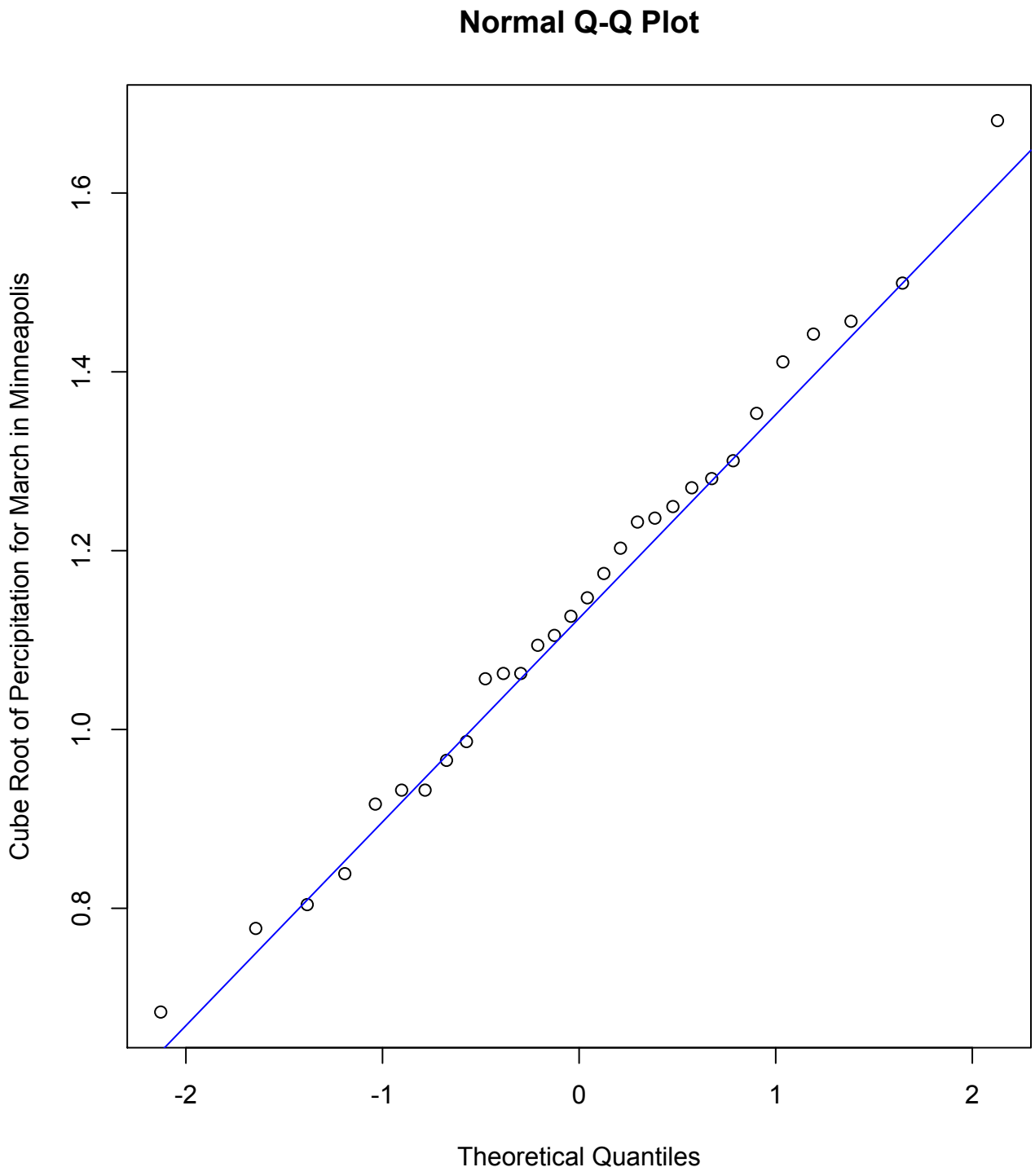

Histogram of Square Root of March Precipitation
0.5
1.0
1.5
2.0
1.0
1.5
2.0


Histogram of Cube Root of March Precipitation
0.6
0.8
1.0
1.2
1.4
1.6
1.8
0.8
1.0
1.2
1.4
1.6

```
> ############################## QQ PLOTS OF DATA AND TRANSFORMED DATA ##################
> # Do Normal QQ-Plot.
> qqnorm(stt,ylab="Square Root of Percipitation for March in Minneapolis")
> qqline(stt,col=3)
> # M3074Minneapolis1.pdf
>
> # Quite bowed up. Skewed: All positive so left tail lighter than right.
>
> qqnorm(stt,ylab="Square Root of Percipitation for March in Minneapolis")
> qqline(stt,col=3)
> # M3074Minneapolis2.pdf
>
> # Looks better.
>
> ctt <- tt^(1/3)
> qqnorm(stt,ylab="Cube Root of Percipitation for March in Minneapolis")
> qqline(stt,col=4)
> # M3074Minneapolis3.pdf
>
> # Looks even better.
>
> ###################### SHAPIRO-WILK TEST OF NORMALITY ###################################
> # Low value means that reject H0: data is normal, in favor of Ha: Data is not normal.
> shapiro.test(tt)

Shapiro-Wilk normality test

data:  tt
W = 0.923, p-value = 0.03211

> # Contrast to transformed data.
> shapiro.test(stt)

Shapiro-Wilk normality test

data:  stt
W = 0.9843, p-value = 0.9238

> # High p-value: Can't reject H0: transformed data is consistent with normal data.
> shapiro.test(ctt)

Shapiro-Wilk normality test

data:  ctt
W = 0.9919, p-value = 0.9975

> # Even less evidence against normality.
```


Normal Q-Q Plot
Percipitation for March in Minneapolis
Theoretical Quantiles
1
2
3
4
-2
-1
0
1
2


Normal Q-Q Plot
Square Root of Percipitation for March in Minneapolis
1.0
1.5
2.0
-2
-1
0
1
2
Theoretical Quantiles


Normal Q-Q Plot
Cube Root of Percipitation for March in Minneapolis
0.8
1.0
1.2
1.4
1.6
-2
-1
0
1
2
Theoretical Quantiles