Math 3070 § 1. **Colorado Stream Example:** Name: Example
Treibergs **Estimating Lognormal Parameters.** June 20, 2011

Data File Used in this Analysis:

```
# Math 3070 - 1     Colorado Stream data            June 19, 2011
# Treibergs
#
# Data taken from Devore, "Probability and statistics for Engineering and the
# Sciences, 5th ed.," Duxbury, 2000, problem 6.6.
#
# An article in Water Resources Research, 1974, studied stream flow at a
# station in Colorado. They recorded flow
# (in 1000's of acre ft) during Apr 1 - Ag 31 over a period of 31 yrs.
#
# The data is assumed log-normal. Estimate the paramneters. use these to
# estimate expected flow.
#
Flow
127.96
210.07
203.24
108.91
178.21
285.37
100.85
 89.59
185.36
126.94
200.19
 66.24
247.11
299.87
109.64
125.86
114.79
109.11
330.33
 85.54
117.64
302.74
280.55
145.11
 95.36
204.91
311.13
150.58
262.09
477.08
 94.33
```

R Session:

```
R version 2.10.1 (2009-12-14)
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  Natural language support but running in an English locale

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Type 'q()' to quit R.

[R.app GUI 1.31 (5538) powerpc-apple-darwin8.11.1]

[Workspace restored from /Users/andrejstreibergs/.RData]

> tt <- read.table("M3074ColoradoStreamData.txt",header=T)
> tt
     Flow
1  127.96
2  210.07
3  203.24
4  108.91
5  178.21
6  285.37
7  100.85
8   89.59
9  185.36
10 126.94
11 200.19
12  66.24
13 247.11
14 299.87
15 109.64
16 125.86
17 114.79
18 109.11
19 330.33
20  85.54
21 117.64
22 302.74
23 280.55
```
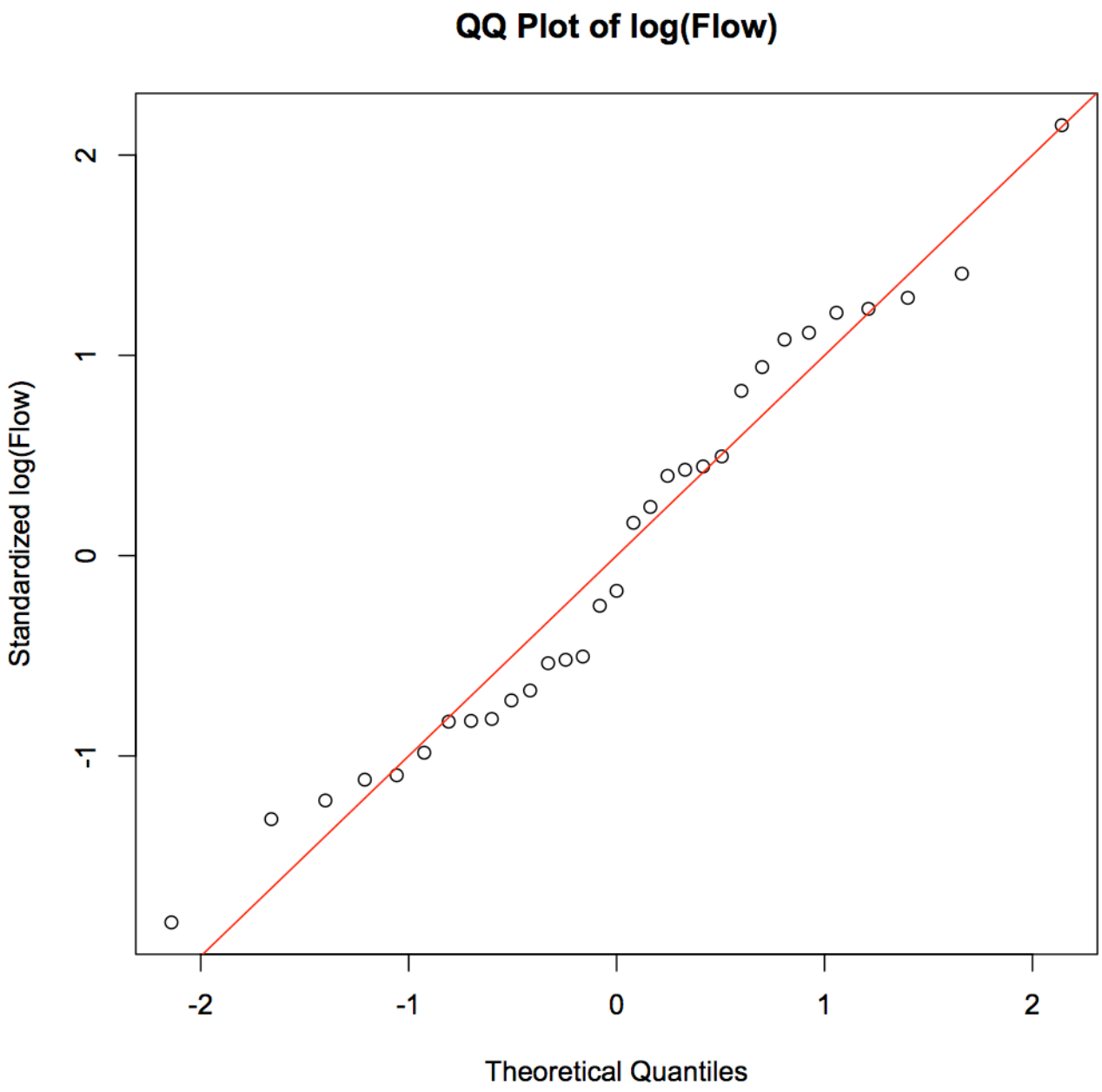
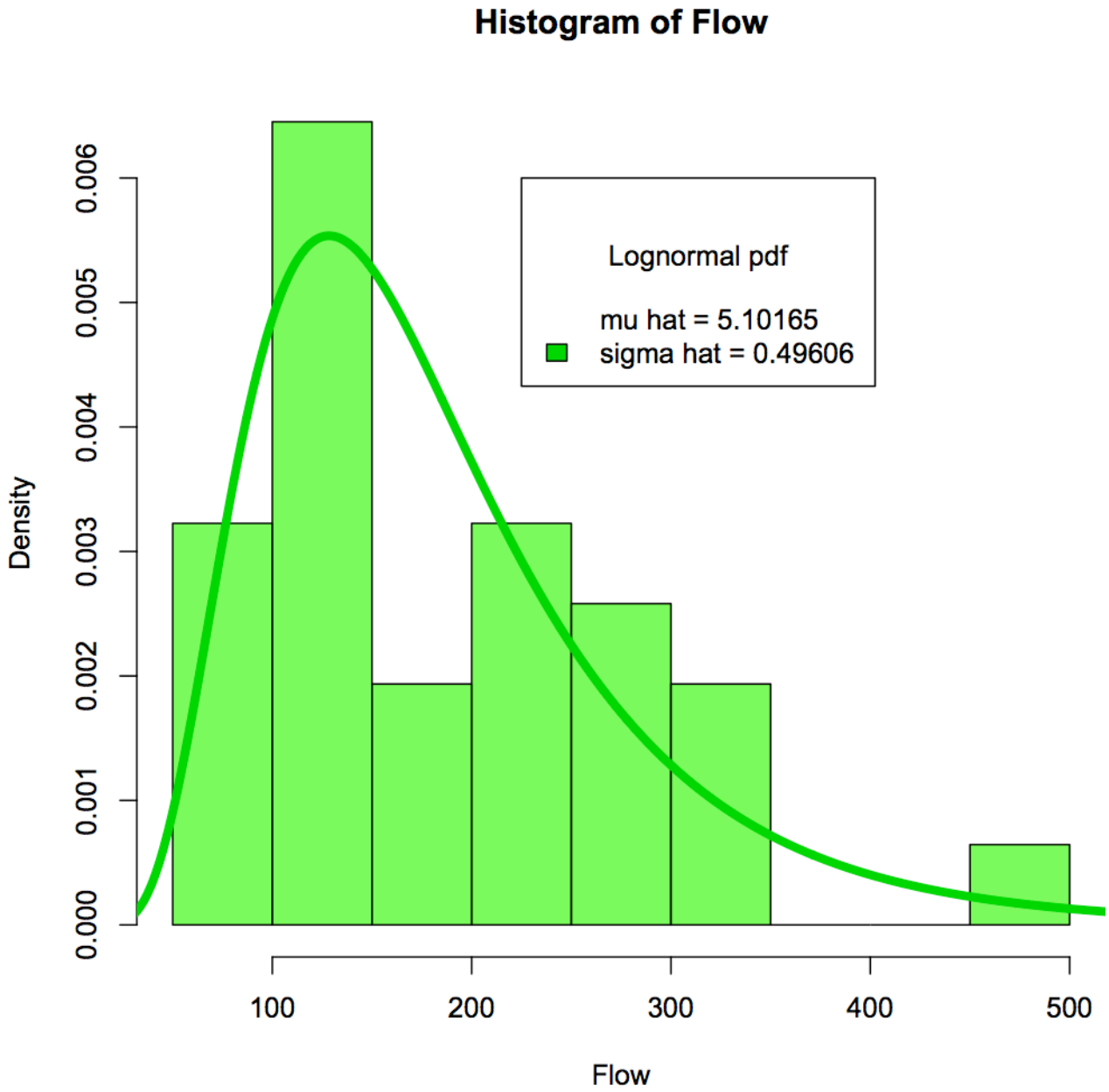
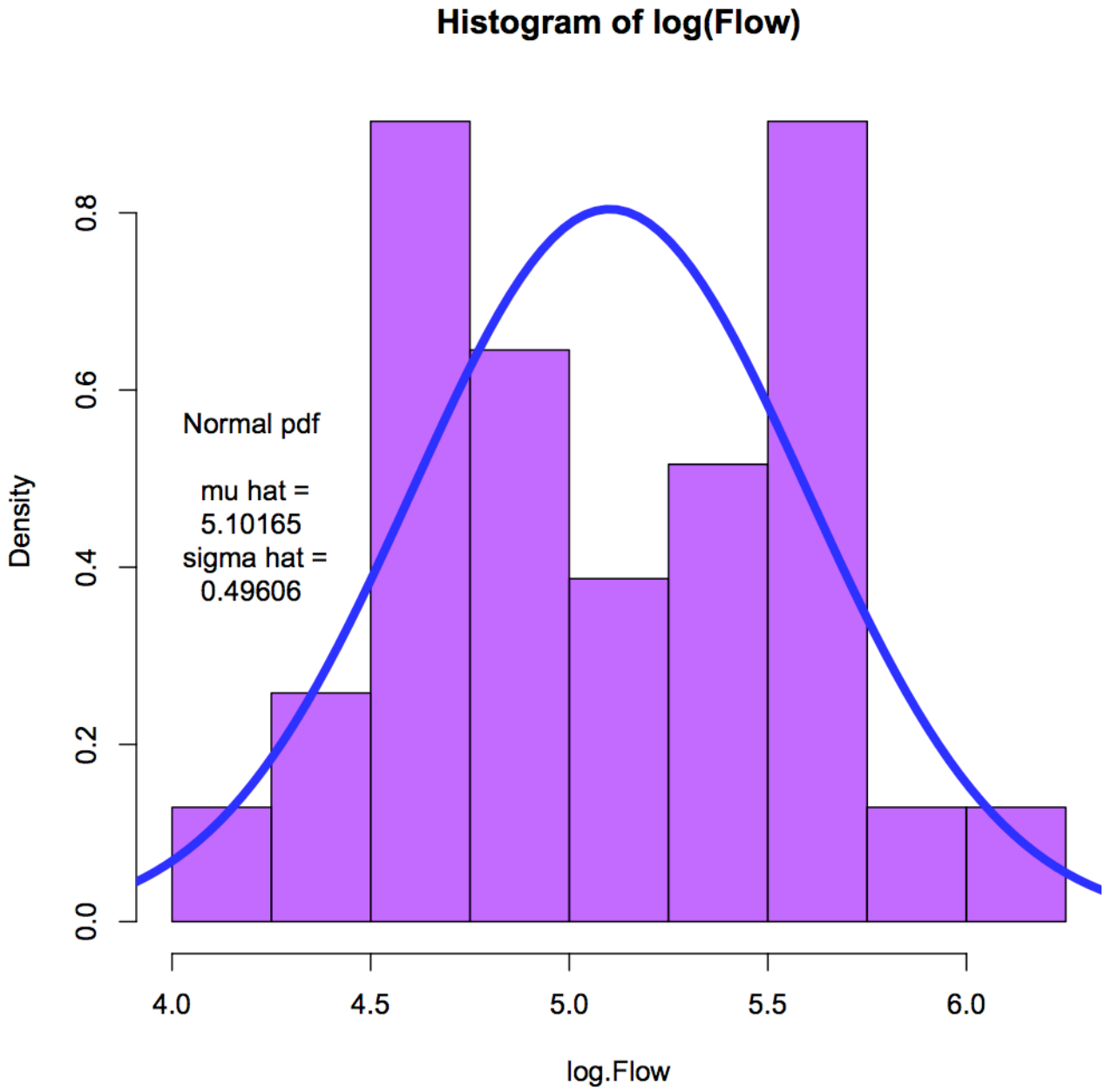

```
24 145.11
25  95.36
26 204.91
27 311.13
28 150.58
29 262.09
30 477.08
31  94.33

> attach(tt)

> ######################## CHECK LOGNORMALITY OF FLOW ########################
> # Sme as checking normality of  log(Flow)
> # Standardize log(Flow)
> log.Flow <-log(Flow)
> log.Flow.bar <- mean(log.Flow)
> log.Flow.v <- var(log.Flow)
> log.Flow.s <- sd(log.Flow)
> slF <- (log.Flow-log.Flow.bar)/log.Flow.s
> qqnorm(slF, ylab = "Standardized log(Flow)", main = "QQ Plot of log(Flow)")
> abline(0,1,col=2)
>
> # QQ plot of log(Flow) lines up pretty well with 45 line. So normality OK.
>
> # Run Shapiro-Wilk test for normality.
> shapiro.test(log.Flow)

Shapiro-Wilk normality test

data:  log.Flow
W = 0.9602, p-value = 0.2946

> # Yup. Can't reject H0: log(Flow) is normal.
>
```


QQ Plot of log(Flow)
Standardized log(Flow)
Theoretical Quantiles
-2
-1
0
1
2
-1
0
1
2

```
> ################### PLOT HISTOGRAM AND PDF OF FLOW ##########################
> # Load up some nice colors.
> clr <- rainbow(12,alpha=.7)
> xx <- seq(0,600,.93)
> hist(Flow,freq=FALSE,main="Histogram of Flow",col=clr[4])
> lines(xx,dlnorm(xx,log.Flow.bar,log.Flow.s),col=3,lwd=5)
> legend(225,.006, legend = paste(" mu hat =", round(log.Flow.bar,5),
+ "\n sigma hat =", round(log.Flow.s,5), "\n "), fill = 3,
+ title = "Lognormal pdf", bg = "white")
> # M3074ColoradoFlow2.pdf
```



```
> ################## PLOT HISTOGRAM AND PDF OF LOG(FLOW) ####################
> lines(xx,dnorm(xx,log.Flow.bar,log.Flow.s),col=4,lwd=5)
> xxx <- seq(3.5,7,.027)
> hist(log.Flow, freq = FALSE, main = "Histogram of log(Flow)",
+ col = clr[10], breaks = seq(4,6.25,.25))
> lines(xxx, dnorm(xxx, log.Flow.bar, log.Flow.s), col=4, lwd=5)
> text(4.2,.45, label = paste("Normal pdf\n\n mu hat =\n",
+ round(log.Flow.bar,5), "\n sigma hat =\n", round(log.Flow.s,5), "\n "),
+ bg="white")
> # M3074ColoradoFlow3.pdf
```



```
> ############ COMPUTE EXPECTED FLOW FROM PARAMETER ESTIMATES ################
> eF <- exp(log.Flow.bar + .5*log.Flow.v)
> vF <- eF^2 * ( exp(log.Flow.v)-1)
> cat("\n Lognormal Parameters for Flow\n\n mu hat =", log.Flow.bar,
+ "\n sigma hat =", log.Flow.s,
+ "\n Expected Flow =", eF,
+ "\n Variance of Flow =", vF, "\n\n")

 Lognormal Parameters for Flow

 mu hat = 5.101652
 sigma hat = 0.4960617
 Expected Flow = 185.8036
 Variance of Flow = 9631.856
```