Math 3070 § 1. **Kevlar Data: Confidence, Prediction** Name: Example
Treibergs **& Tolerance Intervals based on t-Dist.** November 24, 2010

Data File Used in this Analysis:

```
# Math 3070-1     Kevlar data    Treibergs
# Nov. 6, 2010
#
# Breaking strength of hockey stick shaft made of graphite-Kevlar
# composite (in newtons)
Break
488.5
501.2
475.3
467.2
462.5
499.7
470.0
469.5
481.5
485.2
509.3
479.3
478.3
491.5
```

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

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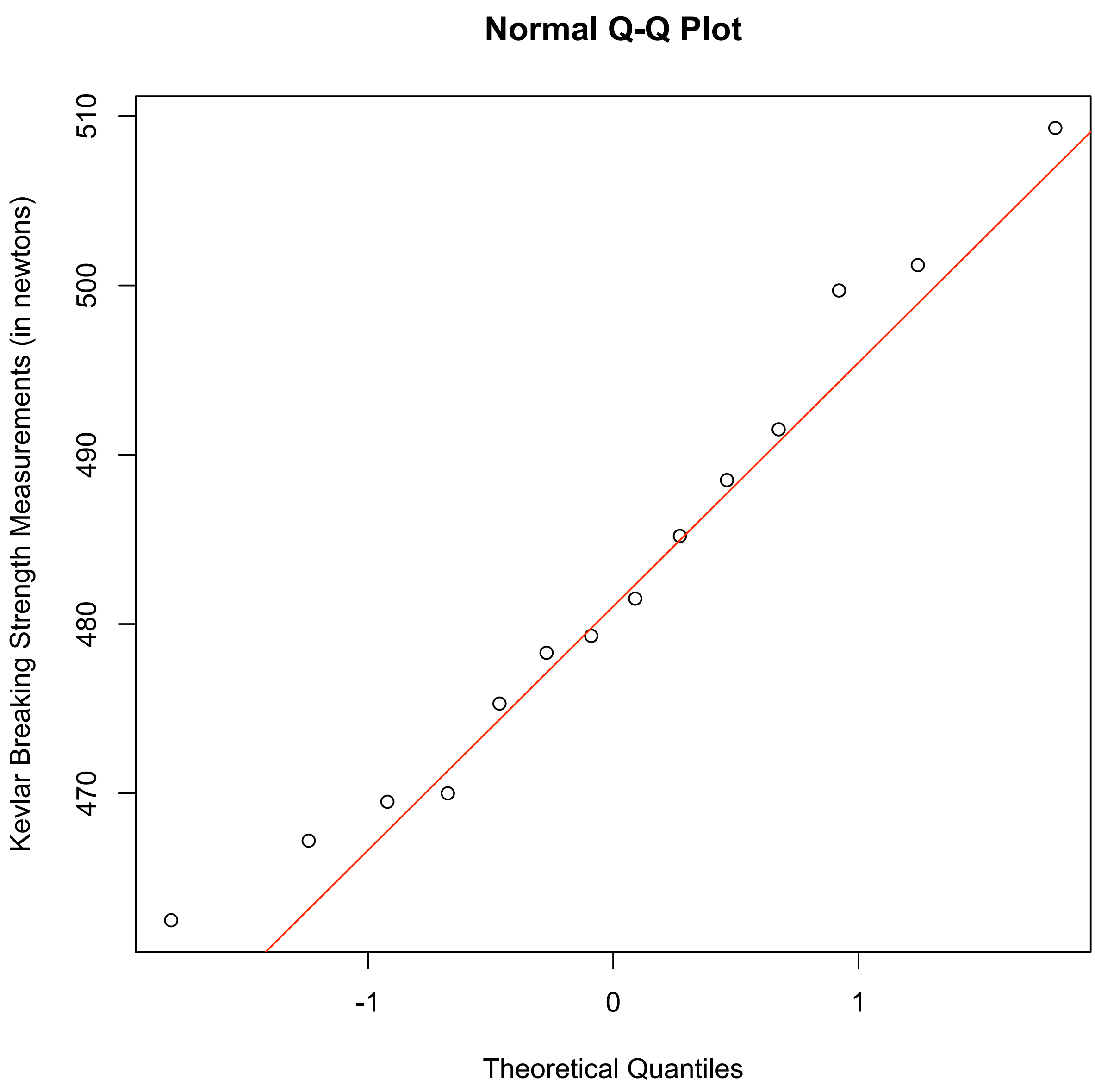
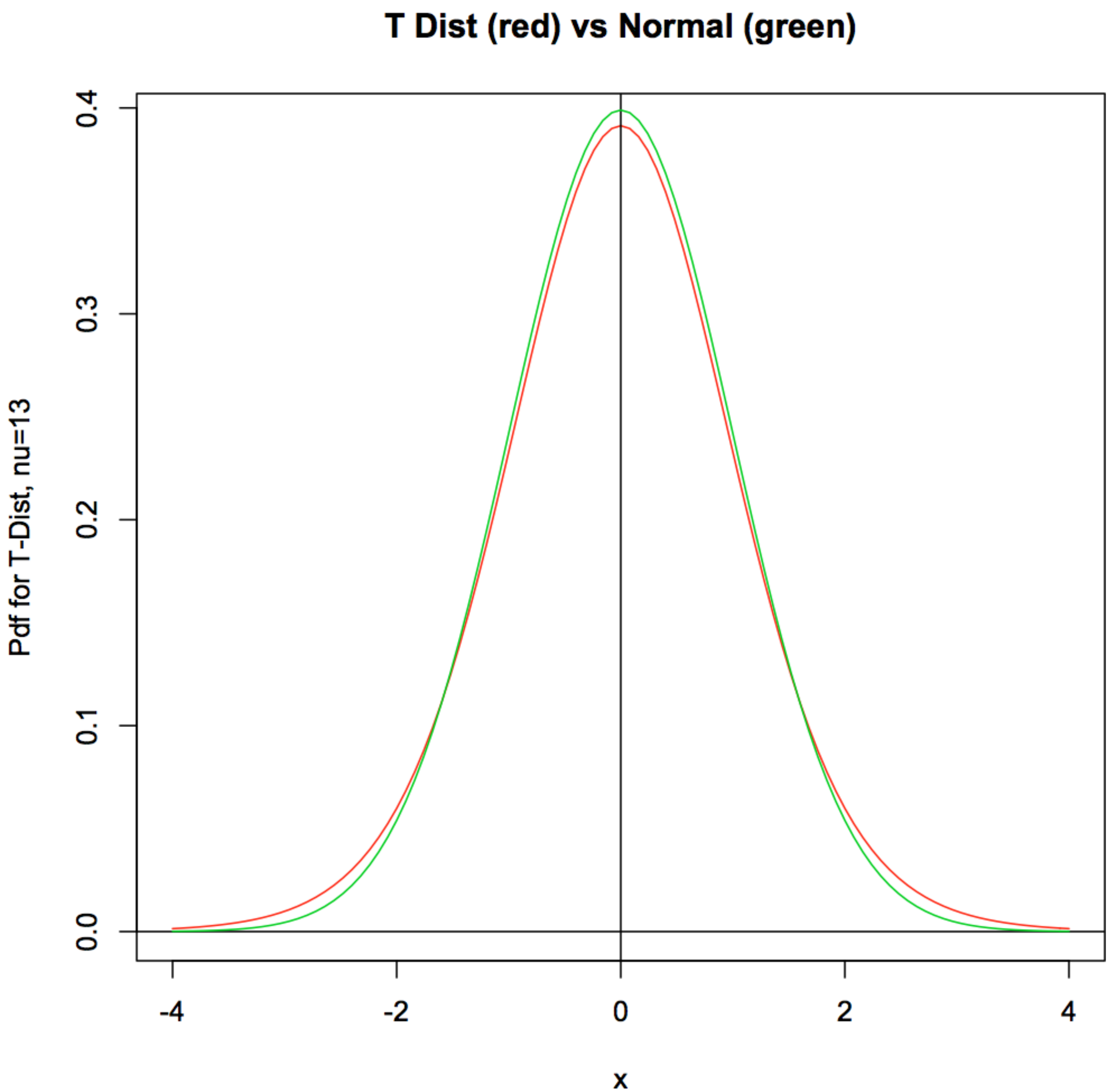

```
> read.table("M3073KevlarData.txt",header=TRUE)
   Break
1  488.5
2  501.2
3  475.3
4  467.2
5  462.5
6  499.7
7  470.0
8  469.5
9  481.5
10 485.2
11 509.3
12 479.3
13 478.3
14 491.5
> tt<-read.table("M3073KevlarData.txt",header=TRUE)
> attach(tt)
> Break
 [1] 488.5 501.2 475.3 467.2 462.5 499.7 470.0 469.5 481.5 485.2 509.3 479.3
[13] 478.3 491.5
```

```
> ######################### Q - Q PLOT OF BREAK  ##################################

> qqnorm(Break); qqline(Break, col=2)
> qqnorm(Break,ylab="Kevlar Breaking Strength Measurements (in newtons)")
> qqline(Break, col=2)
>
```




```
> # Break looks normal.
```

```
> ################################################################################
> ################ COMPUTE X BAR, S, N, NU AND PLOT T-DIST VS NORMAL DIST ########
> xbar <- mean(Break); xbar
[1] 482.7857
> s <- sd(Break); s
[1] 13.94213
> alpha <- .05; alpha
[1] 0.05
> n <- length(Break); n
[1] 14
> nu <- n-1; nu
[1] 13
> plot(function(x)dt(x,nu),-4,4,ylab="Pdf for T-Dist, nu=13",col=2,
  main="T Dist (red) vs Normal (green)")
> abline(h=0);abline(v=0)
> plot(function(x)dnorm(x,0,1),-4,4,col=3,add=TRUE)
>
```


T Dist (red) vs Normal (green)
Pdf for T-Dist, nu=13
0.0
0.1
0.2
0.3
0.4
-4
-2
0
2
4
x

```
> ################################################################################
> ################ CRITICAL t nu,alpha's  FOR CI , PI AND TOL I  #################

> ###  lower.tail = FALSE MEANS THAT THE PROBABILITY TO THE RIGHT IS COMPUTED  ###

> talpha <-qt(alpha,nu,lower.tail=FALSE);talpha
[1] 1.770933
> talphaover2 <-qt(alpha/2,nu,lower.tail=FALSE);talphaover2
[1] 2.160369
> zalpha <-qnorm(alpha,0,1,lower.tail=FALSE);zalpha
[1] 1.644854
> zalphaover2 <-qnorm(alpha/2,0,1,lower.tail=FALSE);zalphaover2
[1] 1.959964


> # Lower CI for mean. With 1-alpha = .95 conficdence, Mu exceeds
> xbar - talpha * s / sqrt(n)
[1] 476.1869


> # Upper CI for mean. With 1-alpha = .95 conficdence, Mu is at most
> xbar + talpha * s / sqrt(n)
[1] 489.3845


> # Two-Sided CI for mean. With 1-alpha = .95 conficdence, Mu is between
> xbar - talphaover2 * s / sqrt(n); xbar + talphaover2 * s / sqrt(n)
[1] 474.7358
[1] 490.8357

> ################################################################################
> ############  PREDICTION INTERVALS FOR THE NEXT OBSERVATION  ###################

> # Lower PI for mean. With 1-alpha = .95 conficdence, Next observation exceeds
> xbar - talpha * s * sqrt(1+1/n)
[1] 457.2285


> # Upper PI for mean. With 1-alpha = .95 conficdence, Next observation is at most
> xbar + talpha * s * sqrt(1+1/n)
[1] 508.3429


> # Two-sided PI for mean. With 1-alpha = .95 conficdence, Next observation is between
> c(xbar - talphaover2 * s * sqrt(1+1/n),xbar + talphaover2 * s * sqrt(1+1/n))
[1] 451.6084 513.9630
```

```
> ##################################################################################
> ############  PREDICTION INTERVALS FOR THE NEXT OBSERVATION  ###################


> #from table for  k = 90% tolerance for n=14
> tol1<- 2.109; tol2 <-2.529;c(tol1,tol2)
[1] 2.109 2.529


> # Two-sided TI. With 1-alpha = .95 conficdence, 90% obs are between
> c(xbar - tol2 * s ,xbar + tol2*s)
[1] 447.5261 518.0453


> # lower TI. With 1-alpha = .95 conficdence, 90% obs are above
> xbar - tol1 * s
[1] 453.3818


> # upper TI. With 1-alpha = .95 conficdence, 90% obs are below
> xbar + tol1 * s
[1] 512.1897
>
```