KDE and BoxCox

Katie, Rita, and Chang

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```
if (!require("KernSmooth")) install.packages("KernSmooth", dep=TRUE)
```

```
## Loading required package: KernSmooth
```

```
## KernSmooth 2.23 loaded
## Copyright M. P. Wand 1997-2009
```

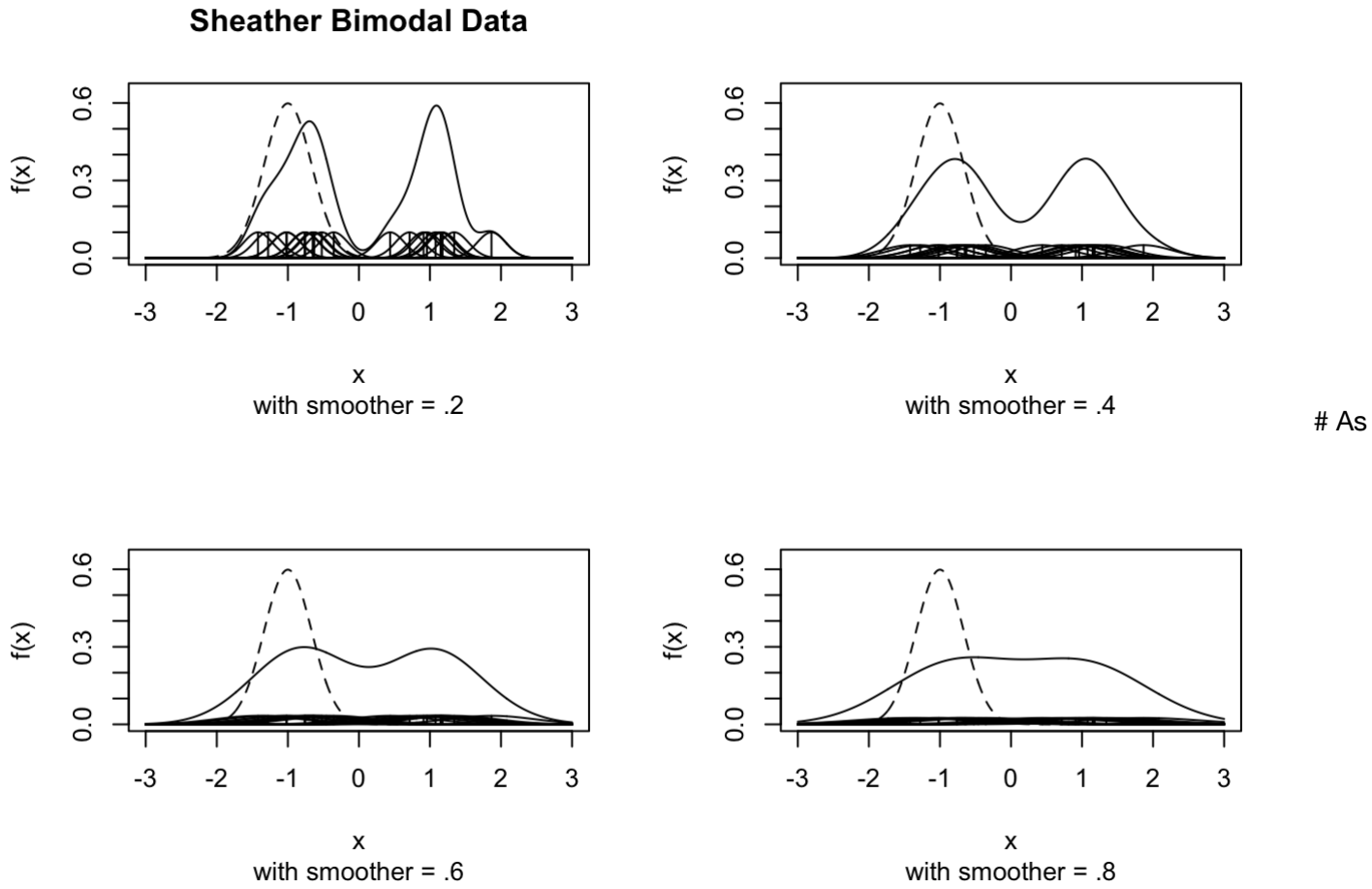
```
library("KernSmooth")
setwd("/Users/katieclewett/Desktop")
bimodal <-read.csv("Bimodal.csv")
attach(bimodal)
summary(bimodal)
```

```
##        X                x               X.1
##  Min.   : 1.00   Min.   :-1.42099   Mode:logical
##  1st Qu.: 5.75   1st Qu.:-0.75715   NA's:20
##  Median :10.50   Median : 0.04272
##  Mean   :10.50   Mean   : 0.11878
##  3rd Qu.:15.25   3rd Qu.: 1.09593
##  Max.   :20.00   Max.   : 1.86610
```

```
x <- bimodal$x
n<-length(x)
xx <- c(-300:300)/100
```

```
sheather.curve = function(h,  main=" ", sub = " ") {
  truedensity = 0.5*(3/(sqrt(2*pi)))*exp(-0.5*((xx+1)/(1/3))^2)
      + 0.5*(3/(sqrt(2*pi)))*exp(-0.5*((xx-1)/(1/3))^2)
  plot( x=c(-3,3),y=c(0,0.65),type="n",xlab="x",ylab="f(x)")
  title(main=main, sub = sub)
  ysum = numeric(601)
for (i in 1:n)
  {points(x[i], 1/(n*h*sqrt(2*pi)),type="h")
     x1 = numeric(601)+x[i]
     y = (1/(h*sqrt(2*pi)))*exp(-0.5*((xx-x1)/h)^2)
     ysum = y/n + ysum
     lines(xx,y/n,lty=1)}
lines(xx,ysum,lty=1)
lines(xx,truedensity,lty=2)
}
```

```
par(mfrow=c(2,2))
 sheather.curve(.2, "Sheather Bimodal Data", "with smoother = .2")
 sheather.curve(.4, " ", "with smoother = .4")
 sheather.curve(.6, " ", "with smoother = .6")
 sheather.curve(.8, " ", "with smoother = .8")
```

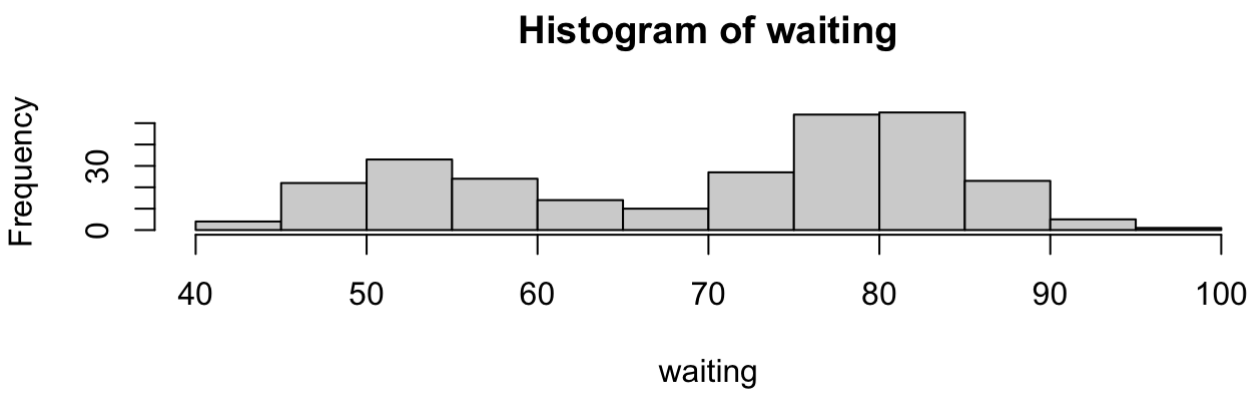


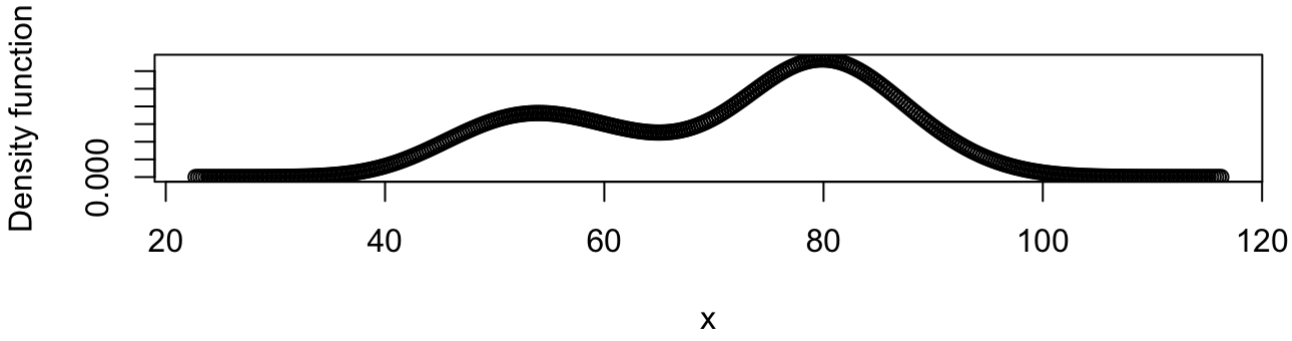
As the bandwidth increases, the line becomes smoother. # In other words, there are far fewer peaks. # The line becomes more like a normal distribution instead of a bimodal distribution. # The best bandwidth for this data set is 0.4 because it best reflects the bimodal distribution.

The Old Faithful geyser data

Waiting Time

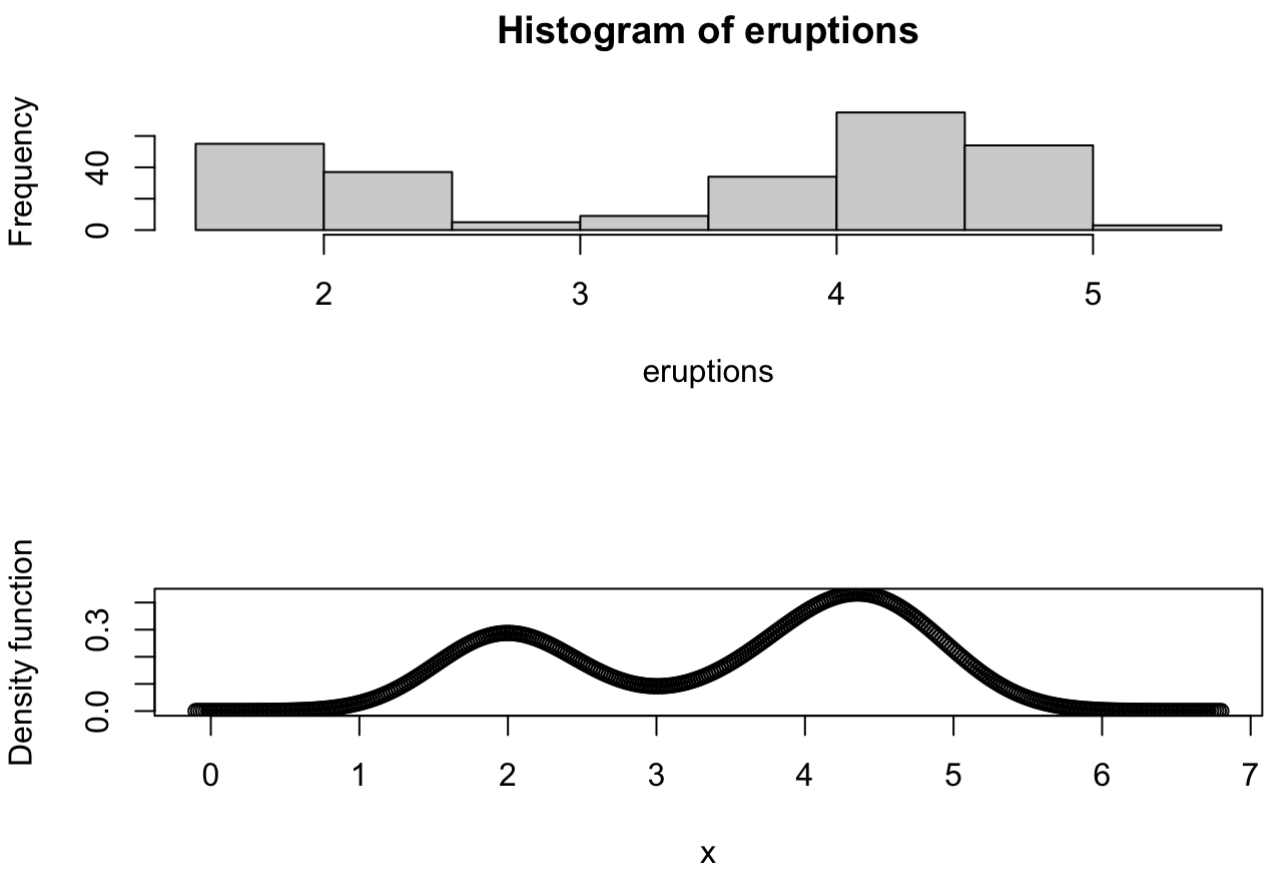
```
par(mfrow=c(2,1))
 library(KernSmooth)
 attach(faithful)
 hist(x=waiting)
 fhat <- bkde(x=waiting)
 plot (fhat, xlab="x", ylab="Density function")
```





Eruption Time

```
par(mfrow=c(2,1))
hist(x=eruptions)
 fhat <- bkde(x=eruptions)
 plot (fhat, xlab="x", ylab="Density function")
```



Regression model for Old Faithful data

```
mod1 = lm(waiting ~ eruptions, data=faithful)
summary(mod1)
```

```
##
## Call:
## lm(formula = waiting ~ eruptions, data = faithful)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.0796  -4.4831   0.2122   3.9246  15.9719
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  33.4744     1.1549   28.98   <2e-16 ***
## eruptions    10.7296     0.3148   34.09   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.914 on 270 degrees of freedom
## Multiple R-squared:  0.8115, Adjusted R-squared:  0.8108
## F-statistic:  1162 on 1 and 270 DF,  p-value: < 2.2e-16
```

```
covb = vcov(mod1)
coeff.mod1 = coef(mod1)

covb = vcov(mod1)
covb
```

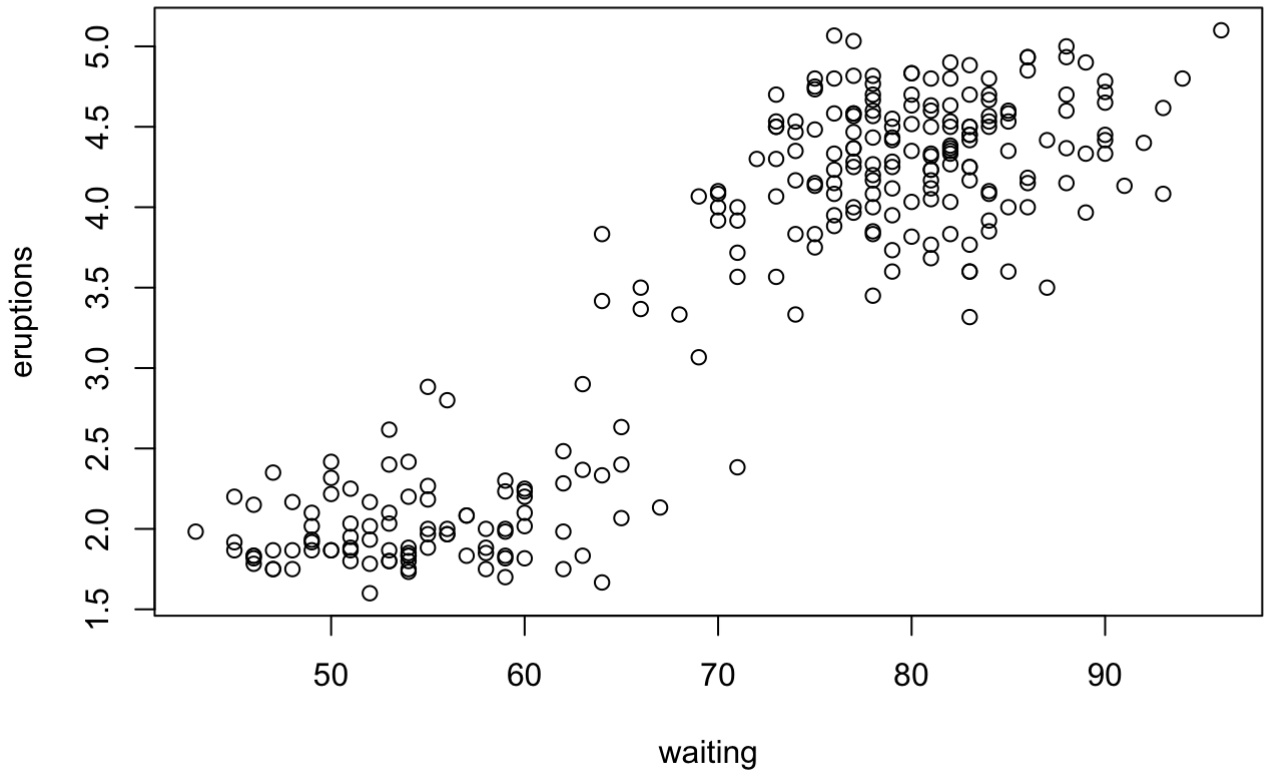
```
##             (Intercept)   eruptions
## (Intercept)   1.3337328 -0.34553365
## eruptions    -0.3455336  0.09906971
```

```
pred.per_fat = predict(mod1)
res.per_fat = residuals(mod1)
summary(res.per_fat)
```

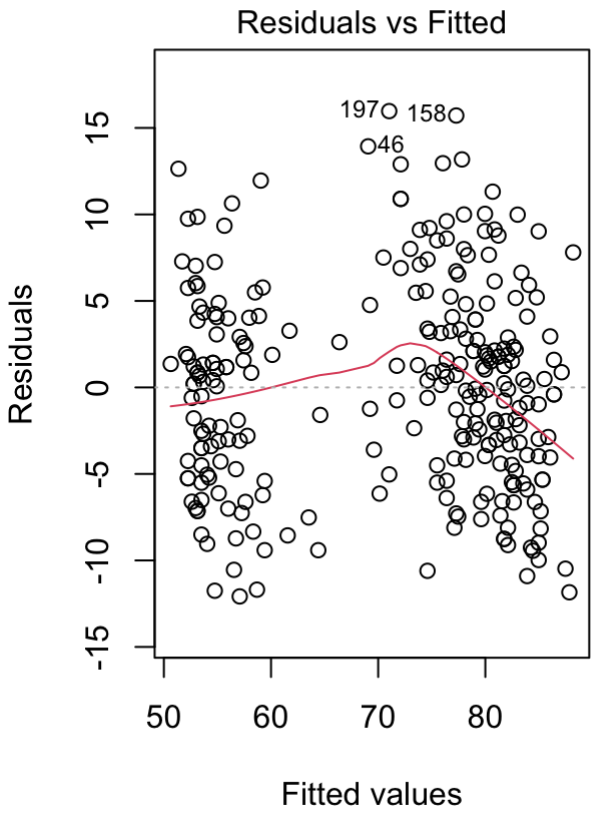
```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -12.0796  -4.4831   0.2122   0.0000   3.9246  15.9719
```

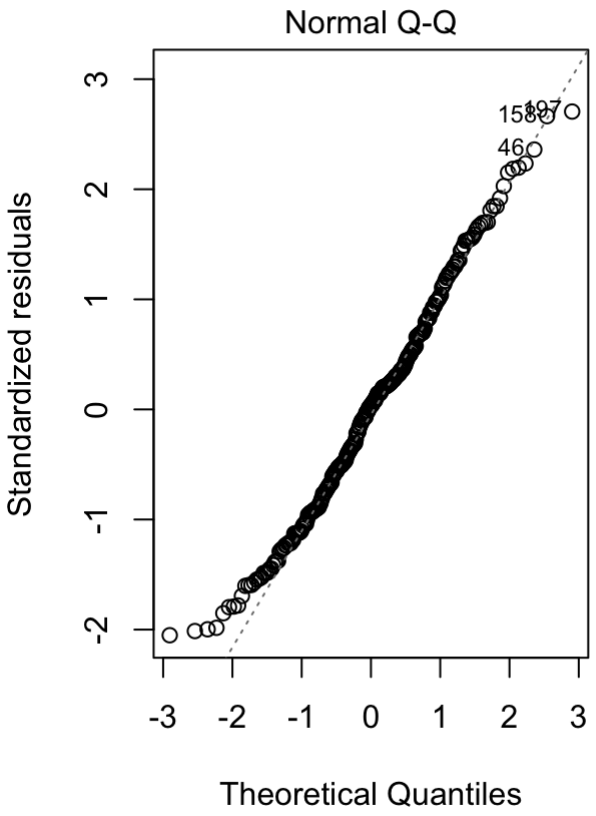
Plots of regression

```
par(mfrow=c(1,1))
plot(waiting,eruptions)
```



```
par(mfrow=c(1,2))
plot(mod1, which=c(1,2))
```

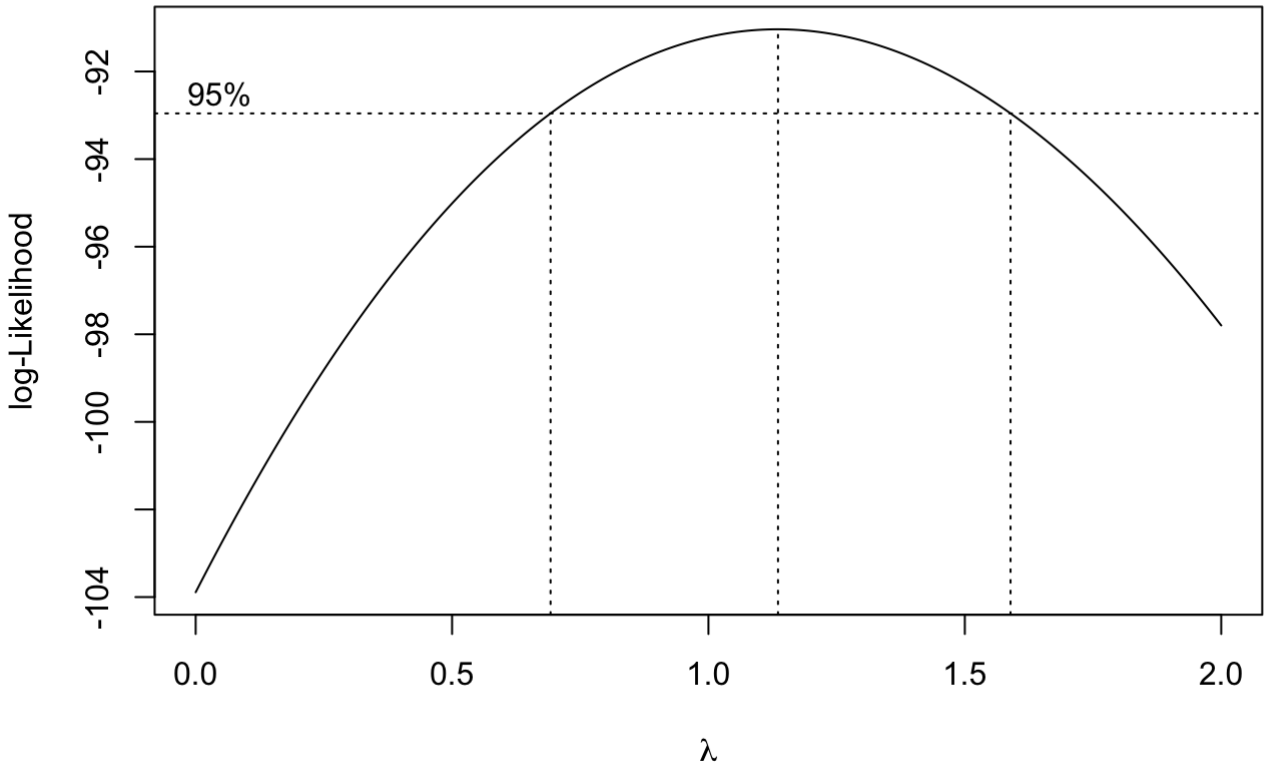




Box

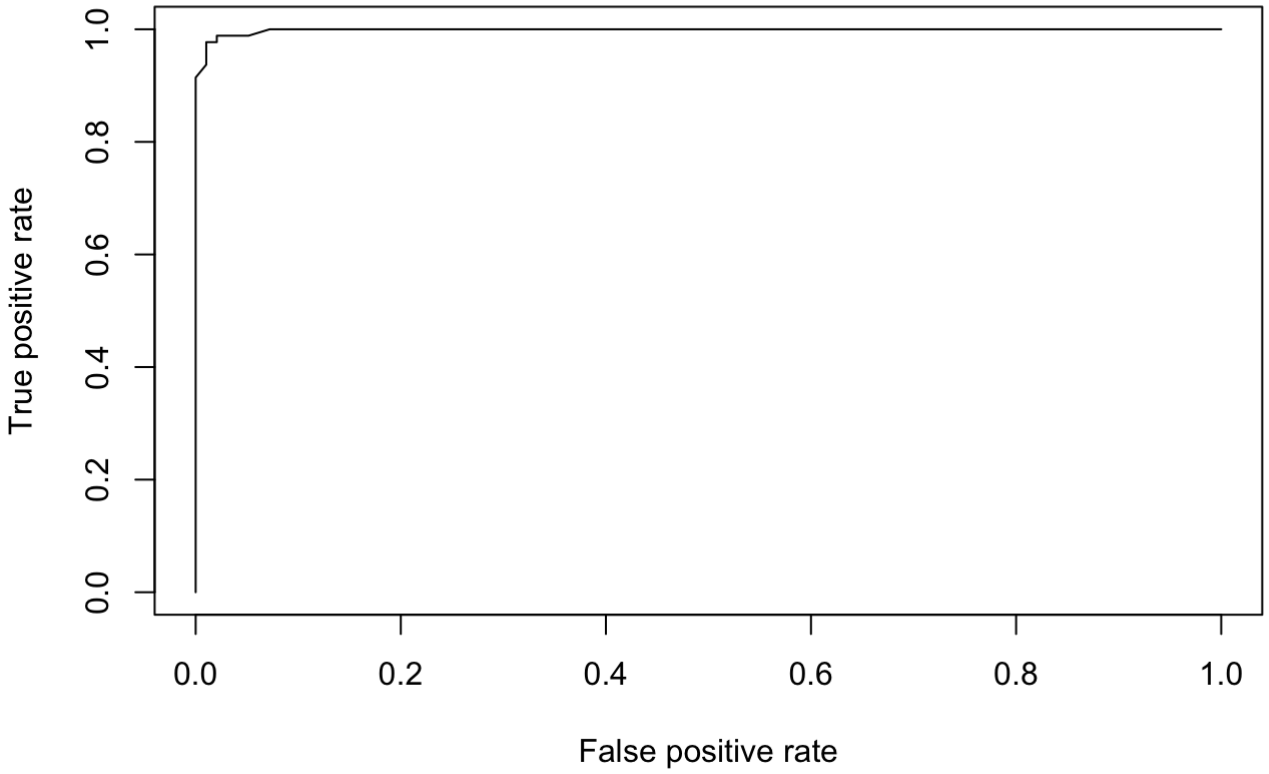
Cox transformation

```
library(MASS)
boxcox(waiting ~. ,data=faithful, lambda=seq(0, 2.0, length=200))
```



ROC Curves for eruption > 3 minutes

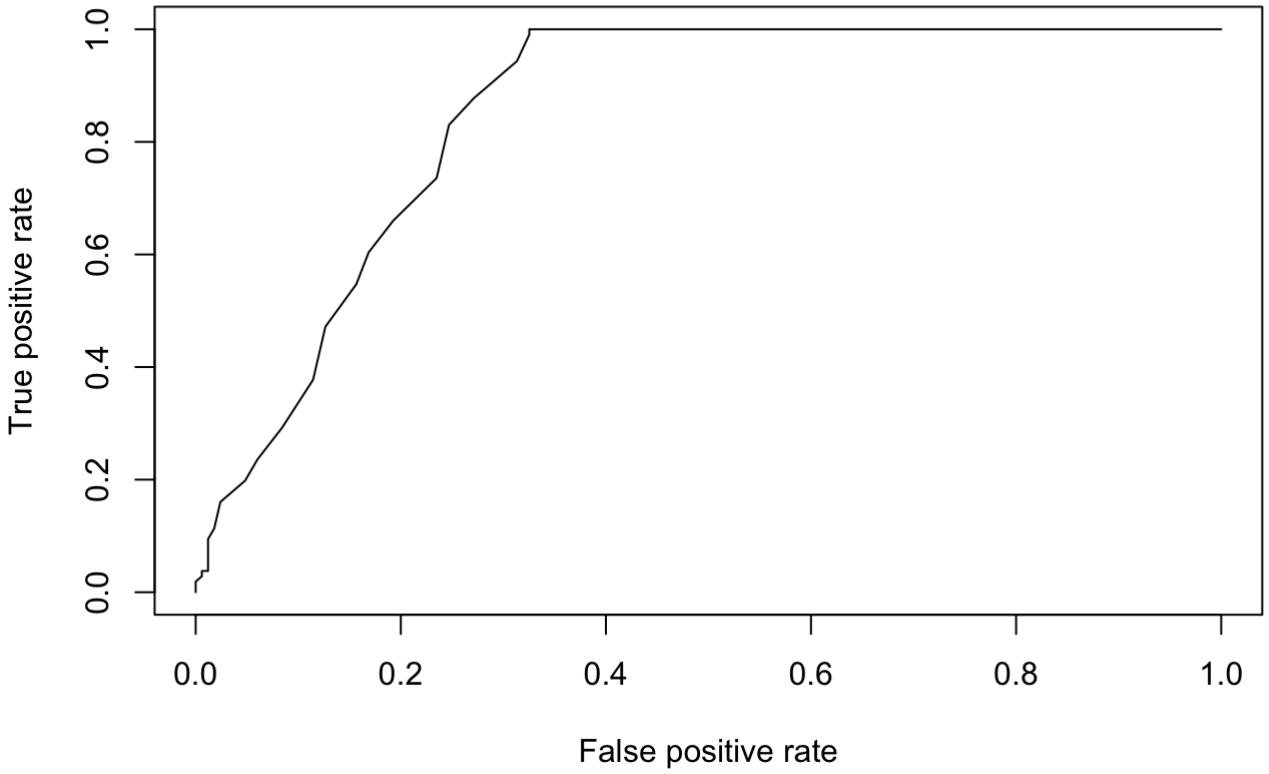
```
library(ROCR)
cut_point=(eruptions > 3)
pred = prediction(waiting,cut_point)
perf=performance(pred, "tpr", "fpr")
plot(perf)
```



ROC

Curves for eruption > 4.2 minutes

```
library(ROCR)
cut_point=(eruptions > 4.2)
pred = prediction(waiting,cut_point)
perf=performance(pred, "tpr", "fpr")
plot(perf)
```


True positive rate
0.0
0.2
0.4
0.6
0.8
1.0
False positive rate
0.0
0.2
0.4
0.6
0.8
1.0