Homework 7 MATH531

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Getting started

Loading the AudiA4 data and creating the X matrix for "broken" line regression.

```
library( fields) # load fields package
```

```
## Loading required package: spam
```

```
## Spam version 2.9-1 (2022-08-07) is loaded.
## Type 'help( Spam)' or 'demo( spam)' for a short introduction
## and overview of this package.
## Help for individual functions is also obtained by adding the
## suffix '.spam' to the function name, e.g. 'help( chol.spam)'.
```

```
##
## Attaching package: 'spam'
```

```
## The following objects are masked from 'package:base':
##
##     backsolve, forwardsolve
```

```
## Loading required package: viridisLite
```

```
##
## Try help(fields) to get started.
```

```
load("AudiA4.rda" )
head( AudiA4)
```

```
##     year price mileage distance
## 58  2020 39649    3848       29
## 145 2020 43175    3962        7
## 10  2020 43675    5316        7
## 52  2020 40649    5417       29
## 143 2020 42175    5846        7
## 9   2020 45675    6539        7
```

```
mileage<- AudiA4$mileage/1000
price<- AudiA4$price/1000

cut<- 30
  X<- cbind( ifelse( mileage<= cut, 1, 0),
             ifelse( mileage<= cut, mileage, 0),
             ifelse( mileage > cut, 1, 0),
             ifelse( mileage > cut, mileage, 0)
             )

fit<-   lm( price ~ X - 1)
```

For those students rusty with linear algebra in R here are OLS estimates found "by hand".

```
betaHat<- solve(t(X)%*%X)%*%t(X)%*%price
# check
bothBetas<- cbind(betaHat,fit$coefficients  )
print( bothBetas)
```

```
##          [,1]       [,2]
## X1 44.8365290 44.8365290
## X2 -0.7620508 -0.7620508
## X3 29.5786213 29.5786213
## X4 -0.1678757 -0.1678757
```

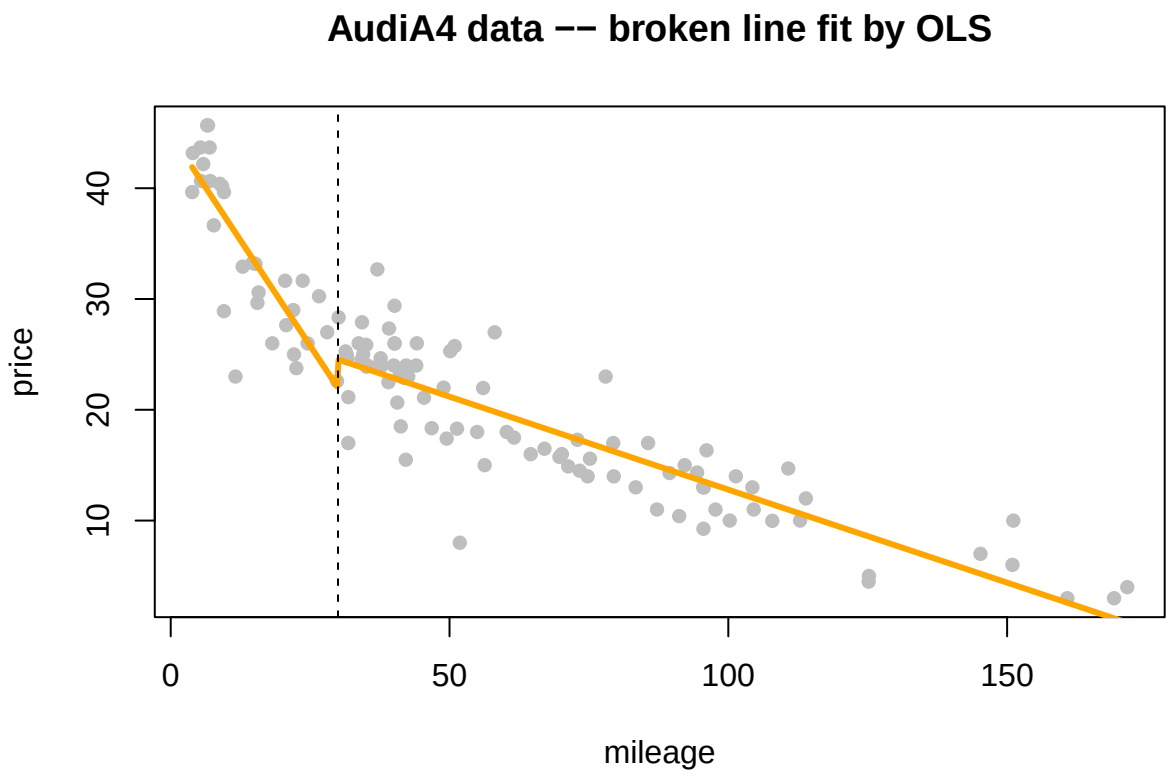
```
XbetaHat<- X%*%betaHat
test.for.zero(XbetaHat, fit$fitted.values )
```

```
## PASSED test at tolerance  1e-08
```

Agreement with R function!

A simple plot of the results. Note that using the fitted.values avoids have to code directly the broken line function that was fit.

```
plot( mileage, price, pch=16, col="grey")
lines( mileage, fit$fitted.values, col="orange", lwd=3)
abline( v= 30, col="black", lty=2)
title("AudiA4 data -- broken line fit by OLS")
```



Highlight discontinuity in unconstrained fit.

```
plot( mileage, price, pch=16, col="grey",
xlim=c( 20,40), ylim=c(15,35))
lines( mileage, fit$fitted.values, col="orange", lwd=3)
abline( v= 30, col="black", lty=2)
```