Data609HW3

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2. The following table gives the elongation e in inches per inch (in./in.) for a given stress S on a steel wire measured in pounds per square inch (lb/in.^{2}). Test the model $e = c_1 S$ by plotting the data. Estimate c_1 graphically.

$S\ (\times 10^{-3})$	5	10	20	30	40	50	60	70	80	90	100
$e\ (\times 10^{5})$	0	19	57	94	134	173	216	256	297	343	390

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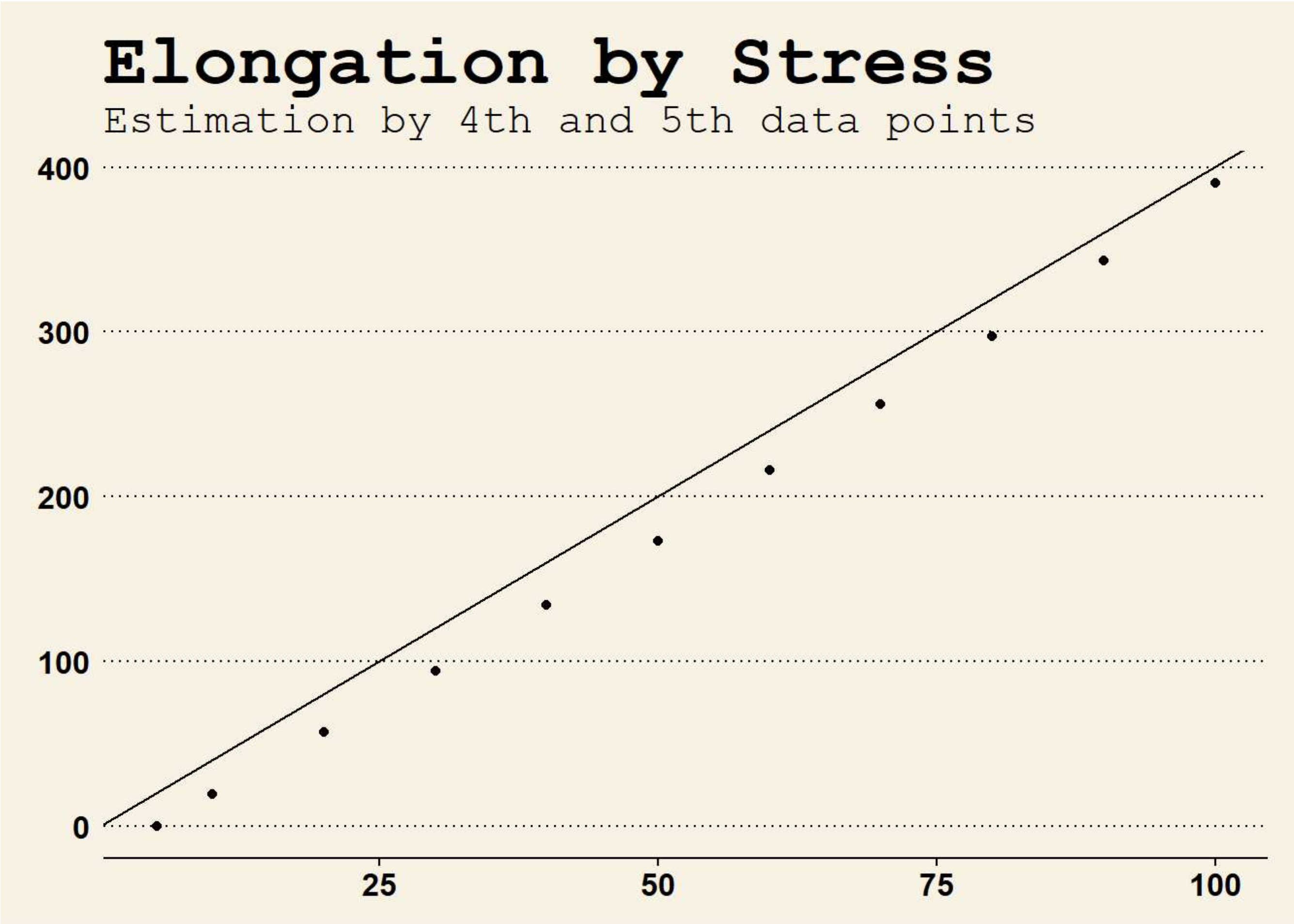
```
library(ggplot2)
library(ggthemes)
library(ggThemeAssist)
library(latex2exp)
library(knitr)
```

```
#Setting up the data table
S <- c(5, seq(10, 100, 10))
e <- c(0, 19, 57, 94, 134, 173, 216, 256, 297, 343, 390)
mydf <- data.frame(S = S, e = e)
```

```
#caculate the slope
c1 <- (mydf[5, 2] - mydf[4, 2])/(mydf[5, 1] - mydf[4, 1])
c1
```

```
## [1] 4
```

```
#plotting with slope from above
g <- ggplot(mydf, aes(x = S, y = e)) + geom_point() + theme_wsj()
g <- g + labs(title = "Elongation by Stress ")
g <- g + labs(subtitle = "Estimation by 4th and 5th data points",
    x = TeX("Stress ($lb./in.^2$)"), y = "Elongation  (in./in.)")
g <- g + theme (plot.subtitle = element_text(size = 16))
g <- g + geom_abline(slope = c1)
g
```



10. Data for planets

Body	Period (sec)	Distance from sun (m)
Mercury	7.60×10^6	5.79×10^{10}
Venus	1.94×10^7	1.08×10^{11}
Earth	3.16×10^7	1.5×10^{11}
Mars	5.94×10^7	2.28×10^{11}
Jupiter	3.74×10^8	7.79×10^{11}
Saturn	9.35×10^8	1.43×10^{12}
Uranus	2.64×10^9	2.87×10^{12}
Neptune	5.22×10^9	4.5×10^{12}

Fit the model $y = ax^{3/2}$.

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```
#setting data frame
body <- c("Mercury", "Venus", "Earth", "Mars", "Jupiter", "Saturn", "Uranus",
    "Jupiter")

period   <- c(7.6 * 10^6, 1.94 * 10^7, 3.16 * 10^7, 5.94 * 10^7, 3.74 * 10^8, 9.35 * 10^8, 2.64
 * 10^9, 5.22 * 10^9)

distance <- c(5.79 * 10^10, 1.08 * 10^11, 1.5 * 10^11, 2.28 * 10^11, 7.79 * 10^11, 1.43 * 10^12,
 2.87 * 10^12, 4.5 * 10^12)

mydf2 <- data.frame(body = body, period = period, distance = distance)

# print as table
kable(mydf2)
```

body	period	distance
Mercury	7.60e+06	5.79e+10
Venus	1.94e+07	1.08e+11

body	period	distance
Earth	3.16e+07	1.50e+11
Mars	5.94e+07	2.28e+11
Jupiter	3.74e+08	7.79e+11
Saturn	9.35e+08	1.43e+12
Uranus	2.64e+09	2.87e+12
Jupiter	5.22e+09	4.50e+12

```
lsmodel <- nls(distance~a*period^(3/2), data = mydf2, start = list(a=0.5))
lsmodel
```

```
## Nonlinear regression model
##   model: distance ~ a * period^(3/2)
##    data: mydf2
##       a
## 0.01321
##  residual sum-of-squares: 3.055e+24
##
## Number of iterations to convergence: 1
## Achieved convergence tolerance: 2.825e-07
```

```
#plotting model using the results form nls model

nlsfun <- function(x) 0.01320756 * x^(3/2)
g2 <- ggplot(mydf2, aes(x = period, y = distance)) + geom_point() + theme_wsj()
g2 <- g2 + labs(title = "Distance from sun vs. Planet Period")
g2 <- g2 + labs(subtitle = TeX("Model: $y=0.01321x^{3/2}$"))
g2 <- g2 + theme (plot.title = element_text(size = 18))
g2 <- g2 + theme (plot.subtitle = element_text(size = 14))
g2 <- g2 + stat_function(fun = nlsfun)
g2
```