Finding LS estimates in R

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Read data from an URL

```
toluca <- read.table ("http://www.cnachtsheim-text.csom.umn.edu/Kutner/Chapter%20%201%20Data%20Sets/CH0
#toluca
```

```
toluca <- read.table("http://www.cnachtsheim-text.csom.umn.edu/Kutner/Chapter%20%201%20Data%20Sets/CH01


#Look at the first 6 entries
head(toluca)
```

```
  V1  V2
1 80 399
2 30 121
3 50 221
4 90 376
5 70 361
6 60 224
```

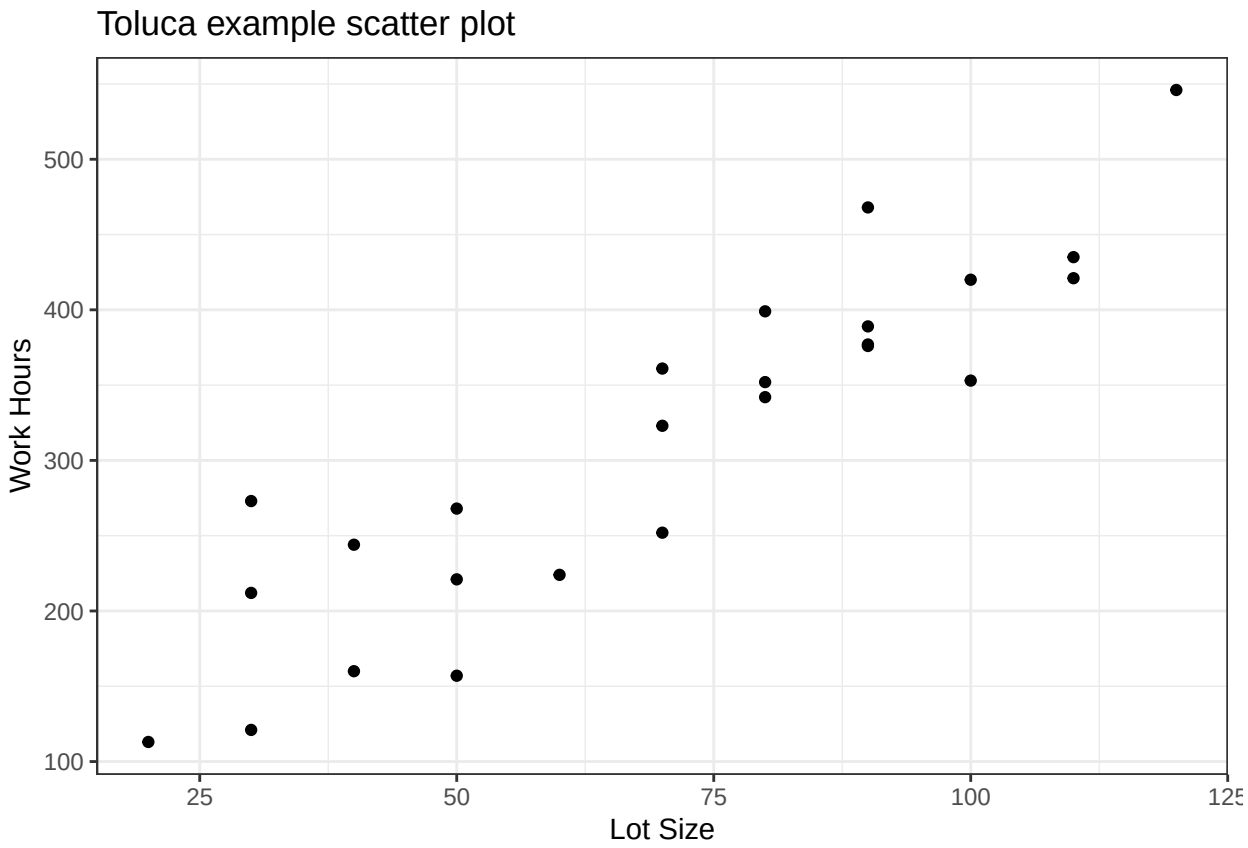
Rename columns

```
colnames(toluca) <- c("lotSize", "hours")

#Look at the first 6 entries
#head(toluca)
```

Creating a scatter plot

```
library(ggplot2)
ggplot(toluca, aes(x = lotSize, y = hours)) +
  geom_point() +
  labs(x = "Lot Size", y = "Work Hours", title = "Toluca example scatter plot") +
  theme_bw()
```

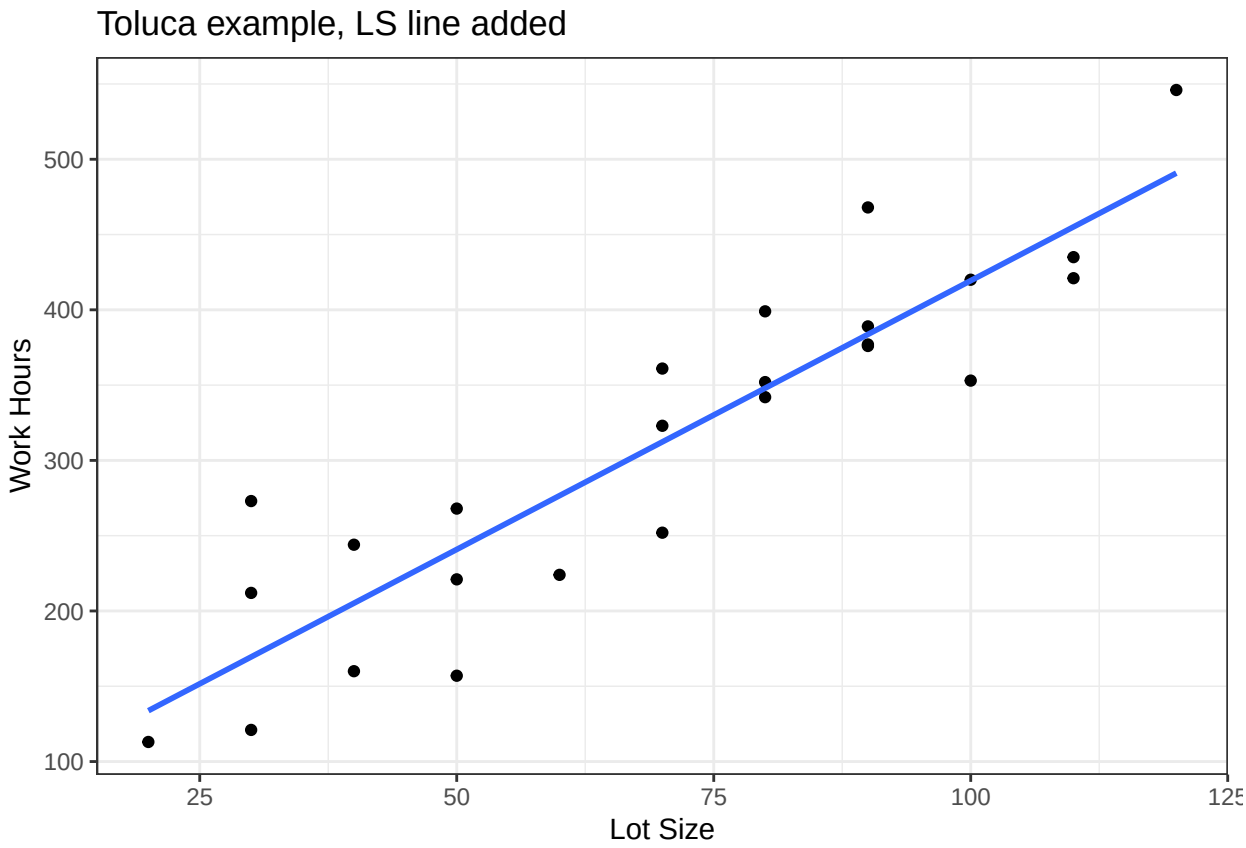



```
# within the ggplot function, first give the name of the data set then... since we need a scatterplot u
```

Note: Lot Size and Work hours has a strong, linear, positive association

Creating a scatter plot, LS line added

```
ggplot(toluca, aes(x = lotSize, y = hours)) +
  geom_point() +
  labs(x = "Lot Size", y = "Work Hours", title = "Toluca example, LS line added") +
  geom_smooth(method = "lm", se = FALSE) +
  theme_bw()
```



Finding the LS estimates

```
toluca_LS_model <- lm(hours ~ lotSize, data = toluca)
summary(toluca_LS_model)
```

```
Call:
lm(formula = hours ~ lotSize, data = toluca)

Residuals:
    Min      1Q  Median      3Q     Max
-83.876 -34.088  -5.982  38.826 103.528

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   62.366     26.177   2.382   0.0259 *
lotSize        3.570      0.347  10.290 4.45e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 48.82 on 23 degrees of freedom
Multiple R-squared:  0.8215,    Adjusted R-squared:  0.8138
F-statistic: 105.9 on 1 and 23 DF,  p-value: 4.449e-10
```

Finding fitted values $\hat{y}_i$, and residuals $e_i = (y_i - \hat{y}_i)$

```
library(moderndive)
Fittedandresiduals <-get_regression_points(toluca_LS_model)
Fittedandresiduals
```

```
# A tibble: 25 x 5
      ID hours lotSize hours_hat residual
   <int> <int>   <int>     <dbl>    <dbl>
 1     1   399      80      348.    51.0
 2     2   121      30      169.   -48.5
 3     3   221      50      241.   -19.9
 4     4   376      90      384.    -7.68
 5     5   361      70      312.    48.7
 6     6   224      60      277.   -52.6
 7     7   546     120      491.    55.2
 8     8   352      80      348.     4.02
 9     9   353     100      419.   -66.4
10    10   157      50      241.   -83.9
# ... with 15 more rows
```

Calculating $SSE = \sum(y_i - \hat{y}_i)^2$

```
sum_of_square_of_residuals <- sum(Fittedandresiduals$residual^2)
sum_of_square_of_residuals
```

```
[1] 54825.46
```

Calculating $MSE = SSE/(n-2)$

```
Mean_Square_Error <- sum_of_square_of_residuals/(nrow(toluca) -2)
Mean_Square_Error
```

```
[1] 2383.716
```

Calculating Residual Standard Error (estimator of standard deviation σ) $s = \sqrt{(MSE)}$

```
s <- sqrt(Mean_Square_Error)
s
```

```
## [1] 48.82331
```