

STAT 511A Homework 11

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Question 1

Review problem 11.22 from Ott & Longnecker regarding treadmill “time to exhaustion” (X) and 10km race times (Y).

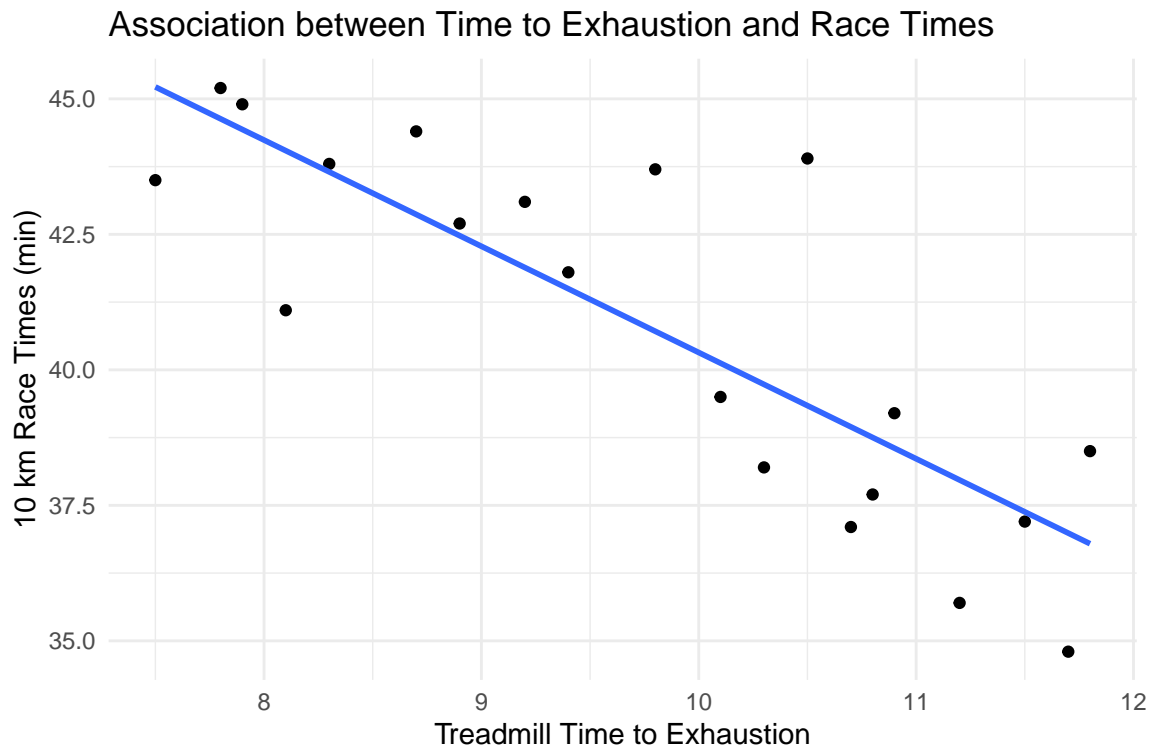
Part 1A: Data

Regress 10.K (Y) on Treadmill (X) and include the “summary” information in your assignment.

```
##
## Call:
## lm(formula = race_time ~ treadmill, data = run_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.9440 -1.5788  0.1860  0.7863  4.5603
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   59.9211     3.1166   19.226 1.90e-13 ***
## treadmill     -1.9601     0.3164   -6.194 7.59e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.921 on 18 degrees of freedom
## Multiple R-squared:  0.6807, Adjusted R-squared:  0.6629
## F-statistic: 38.37 on 1 and 18 DF,  p-value: 7.589e-06
```

Part 1B: Scatterplot

Create a scatterplot of 10-K vs Treadmill with fitted regression line overlaid.



Part 1C: Slope

Give the estimate, 95% confidence interval and interpretation of the slope. (4 pts)

Estimate

The estimate for the slope is -1.9601351.

95% Confidence Interval

The 95% confidence interval for the slope is (-2.6249573, -1.295313).

Interpretation

A difference of a one unit increase in treadmill time to exhaustion is, on average, associated with a -1.9601351 minute decrease in 10 km race time in this sample. There is a negative, linear association between treadmill time to exhaustion and 10 km race time.

Part 1D

Give the R^2 value and interpretation in terms of this scenario.

$$R^2 = 0.6807$$

Interpretation

68% of the variance in 10 km run times can be attributed to the model relating treadmill time to exhaustion and 10 km run times.

Part 1E

Give the predicted 10.K time for a runner with Treadmill = 11.

38.3596317 minutes

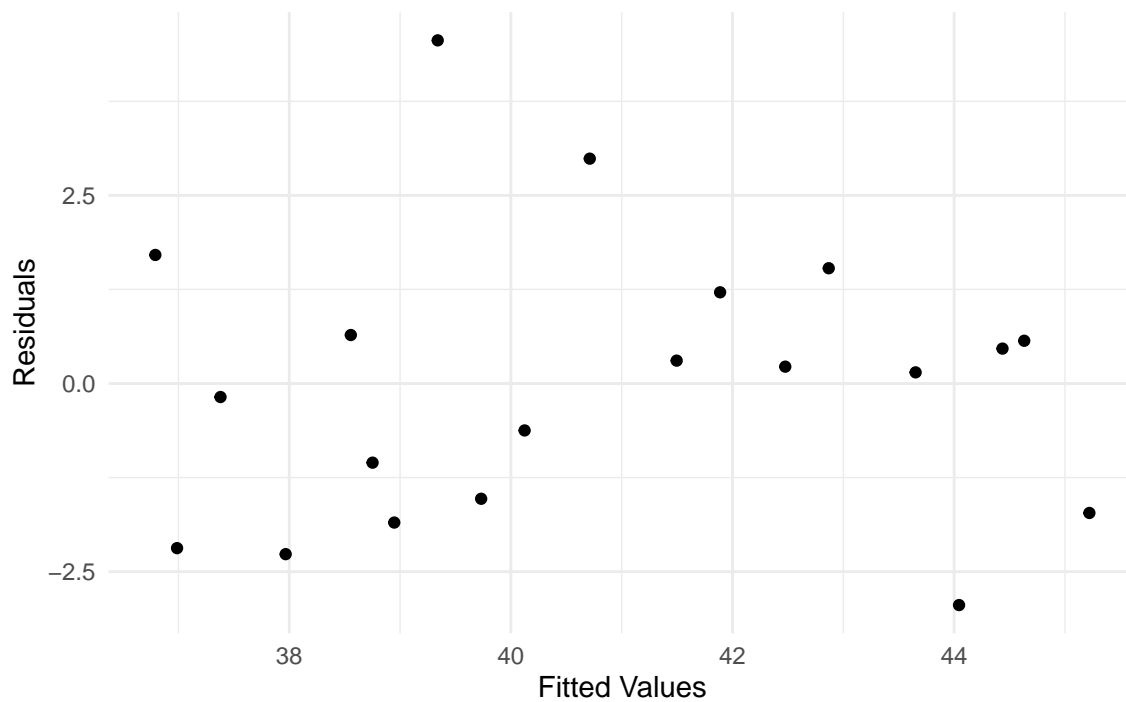
Also provide a corresponding prediction interval.

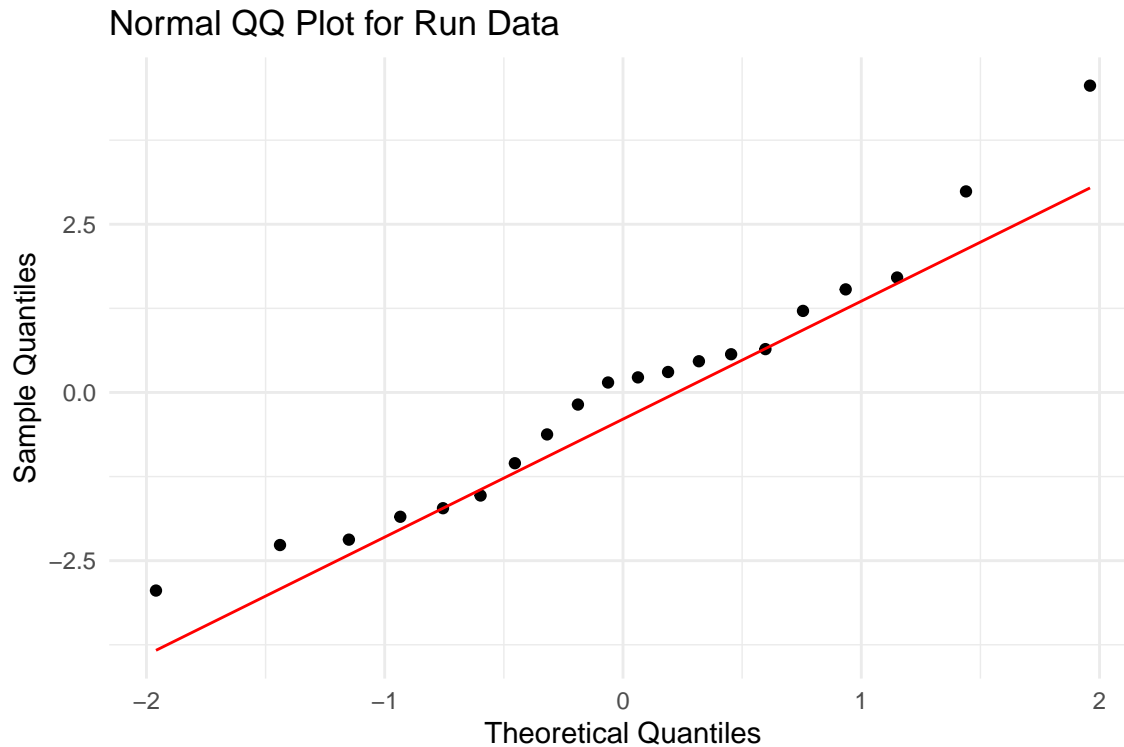
(37.1351131, 39.5841504)

Part 1F

Create the plots of (1) residuals vs fitted values and (2) qqplot of residuals.

Residual Plot for Run Data





Part 1G

Based on the plots above, subject 13 appears to be a bit of an outlier. Run a formal outlier test for this observation. Provide the p-value and make a conclusion. Note that since we identified this observation after looking at the data, a Bonferonni adjustment is appropriate.

Using `car::outlierTest` to identify the observation with the most extreme residual, the Bonferonni p-value for observation 13 is $0.18867 > \alpha = 0.05$. Based on this, we fail to reject the null hypothesis that observation 13 is NOT an outlier.

Question 2

Data on age in coating Thickness (X) and Strength (Y) from an experiment involving steel are available from Canvas as Steel.csv.

Part 1A

Regress Strength (Y) against Thick (X) and look at (1) the plot of Strength versus Thick (2) residuals versus predicted values and (3) qqplot of residuals. Include these plots in your assignment. Do the regression assumptions appear to be met? Discuss. (4 pts)

Part 1B

Perform an F-test for “lack of fit”. Give your p-value and make a conclusion. (4 pts)

Part 1C

Now perform a quadratic regression and create a scatterplot with the fitted curve overlaid. Include the “summary” table and plot in your assignment. This can be done with code like the following. (4 pts)

Note that b_0, b_1, b_2 need to be *replaced* with estimates from the quadratic regression.

Question 3

Review problem 11.50 from Ott & Longnecker regarding SAT Scores.

Part 1A

Create pairwise scatterplots for all 4 variables (Male.Verbal, Female.Verbal, Male.Math, Female.Math)

Part 1B

Calculate pairwise (Pearson) correlations for all 4 variables. Which pair of variables has the strongest correlation? (4 pts)

Part 1C

Provide a test of the correlation for Female.Verbal vs Female.Math. Give the p-value and conclusion in your assignment.