STAT 3010: Assignment 4

Spring 2024: Due Mar. 17, 2024

Please answer each question as completely as possible. Solutions must be typed and submitted to Canvas by 11:59pm CST on the due date.

1. In 1609 Galileo proved mathematically that the trajectory of a body falling with a horizontal velocity component is a parabola. His search for an experimental setting in which horizontal motion was not affected appreciably (to study inertia) let him to construct a certain apparatus. The data come from one of his experiments.

```
Location <- c("A", "A", "A", "B", "B", "B", "C")
Height <- c(100,200,300,450,600,800,1000)
Distance <- c(253,337,395,451,495,534,573)
```

   (a) Create a data frame called Galileo with the three variables and display the contents of the dataframe.

   (b) Compute the mean, median, variance, and IQR of the variable Distance in the dataframe Galileo.

(c) Create a variable for estimated distance D.Hat = 200 + .708 Height − .000344 Height^2 and add it to the data frame Galileo. Create a new variable LO that takes a value of TRUE when the estimated distance is lower than the measured distance (D.Hat < Distance) and a value of FALSE otherwise and add it to the data frame Galileo. Use the variable LO to extract a subset of the Galileo dataframe *removing* the observations for which the estimated distance is lower than the measured distance. Show the contents of this dataframe.

(d) Plot Distance (*y*-axis) versus Height (*x*-axis) and overlay this plot with the curve of D.Hat = 200 + .708 Height − .000344 Height^2 .

2. The indoor thermal climate is an important characteristic affecting the health and productivity of workers in buildings. The paper "Adaptive Comfort Temperature Model of Air-Conditioned Buildings in Hong Kong" (Building and Environment, 2003: 837–852) reported data on a number of building characteristics measured during the summer and also during the winter. The data which contain two columns on relative humidity and season are given in the file hw4q2.csv.

(a) Read in the data and give a comparison boxplot of summer and winter relative humidity. Comment on your observations.

(b) Draw two normal quantile plots - one for summer humidity and another for winter humidity. Comment on your observations.

(c) Calculate the variances and IQRs for summer humidity and for winter humidity. Comment on your observations.