HOMEWORK 3

SETUP
The program was run and compiled in Ubuntu 18.04 but should work in most other versions. The following commands were done in order to get the program working:
```
> sudo apt-get update
> sudo apt-get install freeglut3
> sudo apt-get install freeglut3-dev
> sudo apt-get install binutils-gold
> sudo apt-get install g++ cmake
> sudo apt-get install libglew-dev
> sudo apt-get install g++
> sudo apt-get install mesa-common-dev
> sudo apt-get install build-essential
> sudo apt-get install libglew1.5-dev libglm-dev
> sudo apt-get install mesa-utils
> sudo apt-get -f install
```

PROGRAM COMPILATION AND RUNNING
The following command should be executed to compile the program:
```
> g++ least_squares.cc -lm -lglut -lGL -lGLU -o least_squares
```

This should create a "histogram" program which is ran doing the following command:
```
> ./least_squares
```

SOLUTIONS/SCREENSHOTS
For the least squares we have a very similar display shown as on problem 2 but this time an additional red line and equation is shown in each scatter plot which is the least-square regression line and equation respectively. This line conveys some of the information like in problem 2 about how the data is trending but also allows for some (very limited) amounts of interpolation.

We can see that the least-square regression for wine colour intensity vs wine alcohol travels with a slope of about 1.56 and starts at y = -15 for x = 0. This does not mean that if we have no alcohol we will have a negative wine colour intensity. We should only use the interpolation between roughly wine alcohol values from 9 to 15 and wine colour intensity from 2.5 to 13 since that is where our data is focused. What this line can tell us is that for an alcohol value of about 15 we should expect around 8 for the wine colour intensity. The least-square regression for wine hue vs wine alcohol is almost a straight line across because the data is clustered around a certain area. This is expected since changing the alcohol level seems to have little impact on the hue. Wine colour hue vs

wine intensity least-squares regression shows a downward trend just like
we saw with the covariance and correlation coefficient from question 2.

Unlike in question two, the 3 bottom left scatterplots and 3 top right
scatterplots have different least-square regression lines and equations.
This is due to the data being transposed thus allowing the least-square
regression line to behave differently. As we can see the data for wine
alcohol vs wine colour intensity and wine alcohol vs wine hue is better
represented by the two scatterplots on the top right and they would
provide more statistically relevant and accurate answers compared to their
transposed counterparts. However, the wine colour intensity vs wine hue
(and vice versa) scatterplots seem to both visually travel well between
the data points and both could be argued as better lines/equations if
needed to be used. This example shows us the importance for least-square
regression that it is important in what x and y axis' are chosen as they
may provide better information for a user.