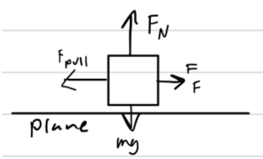
Question: Can we prove the relationship between normal and frictional force defined by the equation $F_F = \mu(F_N)$ is actually linear?
Hypothesis: The relationship between frictional force and normal force is linear. The residuals of the plotted data points and the linear regression line will be minimal.

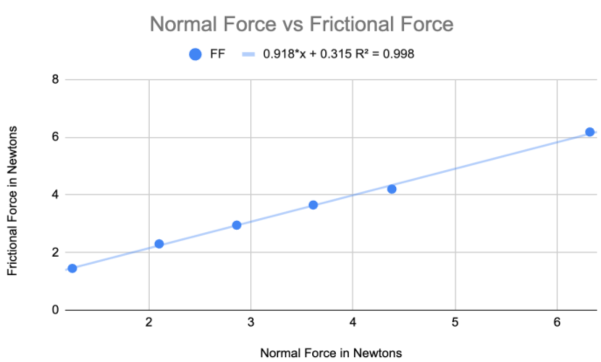


Procedure:

- The normal force of the block would first be measured using a Vernier force sensor. For each trial weight would be added to the block which would increase mass and therefore increase normal force.
- This block would then be laid on a plank of wood with the weights sitting on top. The block would be connected to the force sensor by a string.
- A pull force would be applied to the block while it was at rest, which would be measured by the force sensor. This pull force would gradually increase until the block moved.
- The peak force logged by the Vernier software would be considered the frictional force. Frictional force is equal to applied force until the object is no longer at rest meaning the peak measured force is the frictional force while the block is at rest.

Data:

Block	F_N (N)	F_F (N)	Weight (g)	Weight Increments
1	1.25	1.45	128	0
2	2.1	2.3	218	+90
3	2.86	2.95	298	+90+80
4	3.61	3.65	378	+90+80+80
5	4.38	4.2	458	+90+80+80+80
6	6.32	6.18	668	+90+80+80+80+210



As mentioned before the equation $F_F = \mu(F_N)$ models the relationship between normal force and frictional force. This equation takes on the the form of a linear equation with the independent variable being F_N and the dependent variable being F_F. Here the slope would be μ or in our case μ_S because our model measures frictional force while the object is still at rest. When plotting our data on a scatter plot and constructing a linear regression line we can see the following graph. Even without the regression line we can see the plotted points very clearly follow a linear trend. When the regression line is plotted you can see the residuals of the plotted points are very minimal. Further proof of this is our R^2 value of 0.998. This means 99.8% of the variance in the frictional force can be explained by the linear regression line. Our model very well fits the data. Furthermore, if we calculate μ for each trial by dividing F_F by F_N and average the values, we get the average observed value of μ for our experiment, 1.04. Using this value we can calculate percent error by subtracting then dividing by the slope of the regression line. If we calculate this we get a value of 0.1319 meaning we have an error of around 13.2%. This value is not bad by any means and shows our model is accurate. This proves that the relationship between frictional force and normal force is linear.