Kyle Klamka
Group P

Question: Does the direction of a surface change the amount of friction produced?

Hypothesis: The direction of a surface should have little to no bearing on the amount of friction, since the normal force should be the same, and the coefficient of friction should remain constant as a result.

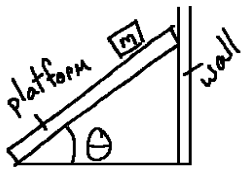

Fig 1: Inclined-Plane Setup

Strategy:

- A rectangular object was placed on a wooden board with its length down the board being the long edge.
- One end of the board was lifted until the object started to slide, and the height of the end was measured. This was repeated for the object after turned 90 degrees horizontally, and for another surface as well.
- Using the length of the board, the critical angle and the coefficient of friction was calculated. The results were then compared using a t-test for the difference in means.

Data:

The length of the board used was 0.7185 meters

Type of surface	Avg Raised Height (m)
Fuzzy Surface (Long)	0.3187
Fuzzy Surface (Wide)	0.3292
Wooden Surface (Long)	0.3152
Wooden Surface (Wide)	0.2875

The raised heights are the averages of 3 trials

Analysis:

We know that

$$\mu_s = \tan\theta$$

In other words, the coefficient of static friction is equal to the tangent of the angle of the inclined plane. It is only a matter of finding the angle of the inclined plane. We can imagine that the plane, the ground, and the wall formed a triangle. Since we have two lengths of the triangle, and we know that the ground forms a right angle with the wall, we can solve for the missing angle (about 26.3, 27.3, 26.0, and 23.6 degrees, respectively).

$$\theta = \sin\frac{Opposite}{Hypotenuse}$$

If we treat the inclined board as the "hypotenuse", and the raised height of the board as the "opposite" side to the angle our board creates with the ground, then we can find said angle that our board makes with the ground, and therefore the coefficients of static friction (.495, .516, .488, .437, in respect to the chart).

My next step was to perform a two-tailed 2-sample t-test for the differences in means due to possible human error. I did this at an alpha level of 5%, with a null hypothesis of the means being from the same distribution. This resulted in a p-value of about 0.39 for the fuzzy surface and a p-value of about 0.10 for the wooden surface, which means that there is not enough evidence to suggest that the differences were statistically significant. By failing to reject the null hypothesis, this data supports my original hypothesis, that the heights of the raised boards—and therefore the coefficients of static friction in extension—are constant no matter the orientation of a surface.

Although a hypothesis test was conducted, human error is still greatly possible due to the low sample size of 3. We also didn't consider gravity causing the object to lean. Our percent errors aren't calculatable since we do not know the actual coefficient of friction.

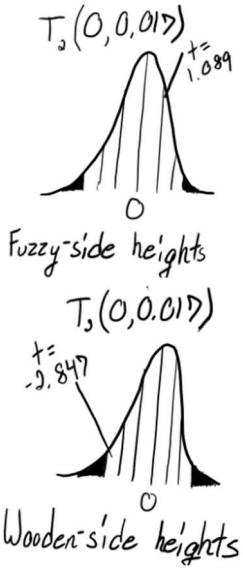

Figure 2: T-Distributions