Physics: Analysis of Scientific Data

Paper citation: *Hu A, Peachey B (2016). Redesigning an Experiment to Determine the Coefficient of Friction. J Emerging Investigators 76: 1-5*

As part of scientific publication, scientists must analyze the data they collect. Often, there are multiple ways to analyze a dataset, and scientists must choose the most appropriate means to conduct an analysis given their experimental design and circumstances of data collection.

In the paper **"Redesigning an Experiment to Determine the Coefficient of Friction",** the authors calculate coefficients of kinetic friction from a new experimental setup. By looking at their set-up and using their raw, collected numbers, we can independently verify their results.

1. Start by first deriving a formula which relates μ (the coefficient of kinetic friction) to any variable which can be measured (D, H_1, H_2, and L).

   The derivation can be found in the derivation and theory section of the paper on pages 4 & 5.

2. Using your new equation, calculate μ for all cases below. You may use a computer or calculator to make these calculations faster.

Trial	Distance Smooth (cm)	μ Smooth	Distance Rough (cm)	μ Rough	Distance Sanded (cm)	μ Sanded
1	50.5	**0.34**	34.3	**0.48**	26.7	**0.52**
2	47.6	**0.38**	32.4	**0.50**	18.1	**0.55**
3	46.7	**0.39**	34.5	**0.48**	24.5	**0.53**
4	51	**0.34**	32.7	**0.49**	33.7	**0.49**
5	47	**0.38**	34.6	**0.48**	17.78	**0.55**
6	45.6	**0.40**	36.8	**0.47**	28.4	**0.52**
7	48.9	**0.36**	32.9	**0.49**	35.6	**0.48**
8	45.7	**0.40**	35.9	**0.47**	36.8	**0.47**
9	46.5	**0.39**	35.7	**0.48**	20.5	**0.54**
10	46.8	**0.39**	31.4	**0.50**	31.1	**0.50**
11	46.2	**0.39**	33.7	**0.49**	33	**0.49**
12	47.3	**0.38**	34.3	**0.48**	37	**0.47**
13	45.6	**0.40**	34.6	**0.48**	40	**0.45**
14	49.8	**0.35**	30.5	**0.51**	36.6	**0.47**
15	49.5	**0.36**	34.9	**0.48**	34.6	**0.48**
16	46.7	**0.39**	37.8	**0.46**	28.9	**0.51**
17	52.5	**0.32**	24.1	**0.53**	34.9	**0.48**
18	51.9	**0.33**	27.3	**0.52**	29.5	**0.51**
19	47.3	**0.38**	34.3	**0.48**	29.5	**0.51**
20	48.9	**0.36**	29.8	**0.51**	29.8	**0.51**

3. Calculate three averages and standards of deviation for the μ values you found above. If the numbers don't match those reported by the authors, think of some reasons why this might be.
   Using standard average and stdev functions in excel, one gets μ = 0.37± 0.024 (smooth), μ = 0.49± 0.017 (rough), and μ = 0.50± 0.030 (sanded). The slight difference in standards of deviation for the sanded sample may be due to slightly different formulas used by excel and the authors.