Name: Date:

**Assignment 1: Theoretical Probabilities vs. Simulated Probabilities**

Expectations

Through this assignment, you will have the opportunity to…

…show, using a simulation, that the larger the number of trials conducted, the closer the experimental probability approaches the theoretical probability

…determine theoretical probability of all outcomes of a discrete sample space (i.e., outcomes that come as a result of counting rather than measuring)

Problem

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| --- |
| Mr. Stewart’s students want to know the probabilities of getting heads or tails when they flip a coin. * They already know that for one coin, getting either a head or a tail is 50/50.
* Being ambitious students of Data Management, they pursue an experiment in which they flip a coin three times to see if the predictions of a theoretical calculation resemble the predictions of their experiment (i.e., simulation).
* Fortunately, they have Microsoft Excel to complete their experiment and digital responses for

Date:  * *Special Note:* This assignment is to be done individually. If you have questions, please consult with me. Answer the questions below and submit your work and excel file to me. If using Class Notebook (Onenote), all work can be done and submitted digitally. I will provide you with feedback (if necessary) for deepening your understanding of the specific expectations of this assignment (above). The attached rubric will give you an idea of those elements that are important to producing well-communicated mathematical solutions.
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1a) List all possible outcomes of flipping a standard coin three times. Show and/or describe your process for determining the total number of possible outcomes.

[KU, COMM]

b) Show how you would diagram and/or calculate the theoretical probability of getting three tails in a row. Determine this probability.

[KU, COMM]

c) Determine the theoretical probability of getting one tail and two heads in any order. Show your work.

[KU, COMM]

2. Using Excel, design a simulation that explores the probabilities of the above scenario by running 200 trials.

*Hint: Consider using the numbers, 0 and 1, when setting up your simulation—heads could be zero; tails, one.*

a) What is the *mean* of the simulated probability after taking into account ten updates (“update” means new randomizations of data) *and* how close is it to the theoretical probability of 1.b)? To measure how close it is, use the percentage error formula, below. For additional assistance with percent error, you can consult the [video](https://youtu.be/ezsD3yeHceg) I’ve created.

 **% error = (|Your Result - Accepted Value| / Accepted Value) x 100**

The following table outlines some success criteria for the successful completion and communication of your solution(s).

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| --- | --- | --- |
|  | Excel: Communicating/labeling which region of data pertains to trials | COMM |
|  | Excel: Communicating/labeling which cell keeps track of the number of occurrences of the desired outcome | COMM |
|  | Excel: Communicating/labeling the total number of trials | COMM |
|  | Excel: Communicating/labeling which cell determines the probability of the desired outcome | COMM |
|  | Excel: Communicating/labeling your collection of randomized trials | COMM |
|  | Excel: Determining the number of times the desired outcome occurs | KU |
|  | Excel: Calculating the probability | KU |
|  | Remaining elements of your solution: Writing out the probabilities, calculating the mean probability, and % error | KU, COMM |

b) What is the mean of the simulated probability after taking into account ten updates *and* how close is it to the theoretical probability of 1.c)? Use the error formula. Recall: In 1.c), you were finding the probability of getting one tail and two heads in any order.

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| --- | --- | --- |
|  | Excel: Determining the number of times the desired outcome occurs | KU |
|  | Excel: Calculating the probability | KU |
|  | Remaining elements of your solution: Writing out the probabilities, calculating the mean probability, and % error | KU, COMM |

Communication Rubric Name:

|  |  |  |  |
| --- | --- | --- | --- |
| **Level 1** | **Level 2** | **Level 3** | **Level 4** |
| Misinterprets a major part of the information, but carries on to make some otherwise reasonable statements  | Misinterprets part of the information, but carries on to make some otherwise reasonable statements | Correctly interprets the information, and makes reasonable statements | Correctly interprets the information, and makes subtle or insightful statements |
| Sometimes uses mathematical symbols, labels and conventions correctly | Usually uses mathematical symbols, labels and conventions correctly | Consistently uses mathematical symbols, labels and conventions correctly | Consistently and meticulously uses mathematical symbols, labels and conventions, recognizing novel opportunities for their use  |
| Sometimes uses mathematical vocabulary correctly when expected | Usually uses mathematical vocabulary correctly when expected | Consistently uses mathematical vocabulary correctly when expected | Consistently uses mathematical vocabulary correctly, recognizing novel opportunities for its use |
| Either mathematical or narrative form is present, but not both | Both mathematical and narrative forms are present, but the forms are not integrated | Both mathematical and narrative forms are present and integrated | A variety of mathematical forms and narrative are present, integrated and well chosen |
| Explanations and justifications are partially understandable | Explanations and justifications are understandable by me, but would likely be unclear to others | Explanations and justifications are clear for a range of audiences | Explanations and justifications are particularly clear and detailed |