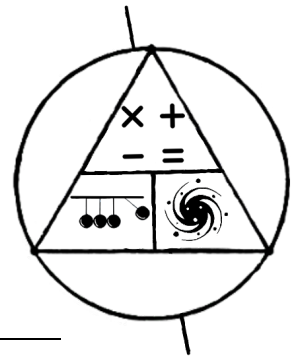


3 Part Lesson Plan: 5136

Lesson: Experimental & Theoretical Probability
Time: 75 minutes

Course: MDM4U
Teacher: Roger Wilkinson



Before class prep:

- Make sure the video and website links are still working
- Make sure the Colaboratory site and code is working

Materials Needed:

- Students need electronic devices or book computer lab time
- playing cards
- computer and projector

Learning Outcomes:

Students can;

- explain the difference between experimental and theoretical probabilities
- explain the connection and relationship between experimental and theoretical probabilities
- use technology (Python coding) to show that the experimental probability tends to the theoretical probability for any experiment as the number of trials increases

Specific Curriculum Expectations:

- A1.4 - determine, through investigation using class generated data and technology-based simulation models, the tendency of experimental probability to approach theoretical probability as the number of trials in an experiment increases

Activity	Time	Description
Getting Started	10 min	<u>Card Magic or Video:</u> <ul style="list-style-type: none">• I would have at least 3 students pick cards that I would subsequently guess by “reading their minds.” If you can’t do card magic you could also just play the following video by David Blaine: https://www.youtube.com/watch?v=oqNhqaBfBx4• You can then have a brief discussion with the students about how the tricks are done and list 3 possibilities:<ol style="list-style-type: none">1. The person is magical or psychic!2. The person is lucky!3. The person is cheating!• Tell students that we are going to use an experiment to determine how hard it is or isn’t to randomly guess chosen cards.

Working On It	40 min	<p><u>Class Experiment:</u></p> <ul style="list-style-type: none"> • Have students use an electronic device to load the following site: http://random-cards.com/random-cards/ • Instruct students to go to this website and think of a card in their head, then click the card on the site to generate a random card, if they don't guess the card, then they try again with a new card, but they MUST keep a tally of the number of tries they take. • Once someone guesses the card, have the class add up all of the trials and use this information to calculate the experimental probability. • Have the students then work in pairs to determine the theoretical probability and compare this to the experimental probability from the class experiment. • Then lock the classroom doors and tell the students that we are going to repeat the same guessing cards experiment 1,000,000 times! But to speed things up we'll use Python code. <p><u>Coding Time:</u></p> <ul style="list-style-type: none"> • Have students go to the Colaboratory site: https://colab.research.google.com/?utm_source=scs-index • Let students work in pairs to try to write a Python code that can simulate the card guessing experiment. Give hints about what information is essential and what is not. • After some time share your own code and walk through how it works and what it demonstrates about experimental and theoretical probabilities: https://colab.research.google.com/drive/1igxXxTouv244nc609aSE-AymKosy8uwN?usp=sharing • Give students various situations and have them alter the Python code to see if they can use their code as a type of "calculator" to determine the approximate value of the theoretical probability of a given situation without first determining the actually theoretical probability.
Consolidating & Connecting	20 min	<p><u>Consolidation:</u></p> <ul style="list-style-type: none"> • Review some examples from the textbook, which will be similar to HW and test questions.

Going Beyond the Curriculum

- Revisit the 3 possible explanations about how the tricks are done. The results of the lesson should allow you to eliminate possibility 2; there is no way someone is THAT lucky!
- Now the students will ‘determine’ probabilities, or likelihoods, concerning options 1. and 3. based on their prior knowledge and experiences, which allows you to introduce the idea of Bayes’ Theorem. Given diverse experiences some students will think that option 1. being psychic, is just as likely as option 3. cheating.
- Now explain how the basic trick is done, which for the David Blaine video just involves repeating the guessing of cards with many, many people until you have some hits, then only put the videos with successful guesses in you magic special!
- Now ask students to reevaluate the likelihood of options 1. and 3. given the new information that they have. They will now be updating their probabilities given new data and knowledge just like Bayes’ theorem suggests.
- Suggest that students watch the following video on Bayes’ theorem for further exploration:
<https://www.youtube.com/watch?v=R13BD8qKeTg>

Assessment Tools

- Having class participate in initial experiment where they have to guess cards (formative)
- Observation (diagnostic)
- Homework (formative)

Homework

- McGraw-Hill Ryerson, Data Management 12 Textbook:
 - Section 1.4, pgs 32-33, Questions 1-10