

Magical Misjudgements

Topic: Experimental & Theoretical Probabilities

Course: MDM4U

Time: 75 min

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
- ***This lesson is designed for students who are already familiar with the basic of Python coding***

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
- analyze media content from a critical point of view
- produce their own *text* with a specific goal for a specific audience

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
Minds On	10 min	<u>Card Magic Video:</u> <ul style="list-style-type: none">● Play the following video by David Blaine: David Blaine: Mentalism Tricks● You can then have a brief discussion with the students about

		<p>how the tricks are done and list 3 possibilities:</p> <ul style="list-style-type: none"> ○ (Option 1) The person is magical or psychic! ○ (Option 2) The person is just lucky! ○ (Option 3) The person is cheating! <ul style="list-style-type: none"> ● 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"> ● Load the following website on the projector http://random-cards.com/random-cards/ ● Instruct students to think of a card in their head, then click the card on the site to generate a random card. If the card they have in their head appears on the screen they should raise their hand and the class should record this as a HIT and record the other students as misses. ● After a few rounds, have the class add up all of the trials and hits 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 card 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/drive/1igxXxTouv244nc609aSE-AymKosy8uwN?usp=sharing ● Let students work in pairs to read through the Python code that can simulate the card guessing experiment. Students should think about what the code is doing in terms of the experiment done in class above. Have a class discussion and allow the students to explain the code. ● 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 actual theoretical probability. <ul style="list-style-type: none"> ○ Ex) What's the probability of choosing a diamond face card out of a full deck? What is the probability of getting a 3 if all face cards are removed from the deck? Etc.

Consolidation & Connecting	20 min	<p><u>Consolidation:</u></p> <ul style="list-style-type: none"> ● 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! <hr/> <p>***Read the “Going Beyond the Curriculum” section below before revealing how the trick is done if you wish to expose students to topics outside of the standard curriculum.***</p> <hr/> <ul style="list-style-type: none"> ● Now explain how the basic trick is done. The David Blaine video just involves repeating the guessing of cards with many, many people until you have some hits, then only putting the videos with successful guesses in your magic special! <ul style="list-style-type: none"> ○ The teacher may also demonstrate the method of the final trick in the video by preparing a deck of cards with one card facing the opposite direction, then go around the class having students guess cards until someone guesses the card you’ve turned the opposite way then have them open the deck to reveal the card. ● Have a brief discussion about how doing this is misleading to the audience and have students offer suggestions of other types of media that do this. An example is provided below: <ul style="list-style-type: none"> ○  Students Vs. Mexicans: Cultural Appropriation <p><u>Connecting:</u></p> <ul style="list-style-type: none"> ● Review some examples from the textbook, which will be similar to HW and test questions. ● Challenge students to make some of their own videos that rely on this type of editing.
----------------------------	--------	--

Going Beyond the Curriculum	
<ul style="list-style-type: none"> ● Given that the students have ruled out option 2 - The person is just lucky! - as an option, ask them to think about what probabilities they would assign to the other two possibilities: <ul style="list-style-type: none"> ○ (Option 1) The person is magical or psychic! ○ (Option 3) The person is cheating! ● The students will assign probabilities, or likelihoods, concerning options (1) and (3) based on their prior knowledge and experiences, which allows you to introduce the idea of <i>Bayes’ Theorem</i>. 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. The David Blaine video just involves repeating the guessing of cards with many, many people until you have some hits, then only putting the videos with successful guesses in your 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.
- Have a brief discussion about how doing this is misleading to the audience and have students offer suggestions of other types of media that do this.
- Suggest that students watch the following video on Bayes' theorem for further exploration: [▶ How To Update Your Beliefs Systematically - Bayes' Theorem](#)

Assessment Tools

- Observation/Conversation - Having class participate in initial experiment where they have to guess cards and tally results to calculate the experimental probability
- Observation - take anecdotal notes when students attempt to alter the code
- Homework

Suggested Homework

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