Intro to Algebra II

[Implement start year (2013-2014)]

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Unit #3 Probability

Stage 1 – Desired Results

Established Goals

2009 NJCCC Standard(s), Strand(s)/CPI #
(http://www.nj.gov/education/cccs/2009/final.htm)

Common Core Curriculum Standards for Math and English
(http://www.corestandards.org/)

Conditional Probability and the Rules of Probability S-CP: 1,2,3,6,7

- Understand independence and conditional probability and use them to interpret data.
- Use the rules of probability to compute probabilities of compound events in a uniform probability model.

Using Probability to Make Decisions S-MD: 6,7

- Use probability to evaluate outcomes of decisions.

21st Century Themes
(www.21stcenturyskills.org)

___ Global Awareness
_X__Financial, Economic, Business and Entrepreneurial Literacy
___Civic Literacy
___Health Literacy
___Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
_X__Creativity and Innovation
_X__Critical Thinking and Problem Solving
_X__Communication and Collaboration

Information, Media and Technology Skills:
___Information Literacy
___Media Literacy
_X__ICT (Information, Communications and Technology) Literacy

Life and Career Skills:
_X__Flexibility and Adaptability
_X__Initiative and Self-Direction
_X__Social and Cross-Cultural Skills
_X__Productivity and Accountability
_X__Leadership and Responsibility

Enduring Understandings: Students will understand that . . . EU 1 Counting objects and sets of objects is the precursor to probability. EU 2 Probability quantifies the random phenomena of life. EU 3 Mathematics is used to make appropriate decisions.	**Essential Questions:** EU 1 • What are the counting methods and how do you choose the appropriate one? EU 2 • How is probability used to quantify and compare situations, events, and real-world phenomena? EU 3 • How are the patterns in the information we collect useful? • What is the role of probability in decision-making? • How can mathematics be used to derive and interpret data to make predictions?
Knowledge: Students will know . . . EU 1 • the difference between permutations and combinations (including the Fundamental Counting Principle) and when each is applicable to the given problem. EU 2 • the difference between theoretical probabilities and experimental probabilities (from real-world data) are related to each other but often are not the same value. • how to recognize real-world events as simple, multiple, or conditional.	**Skills:** Students will be able to . . . EU 1 • apply the permutation and combination formulas appropriately. • use and apply factorial notation. EU 2 • differentiate between theoretical and experimental probability. • calculate probabilities of simple, multiple, and conditional events in real-world phenomena.

EU 3 • how probability is expressed and the relationship to an event as a value from 0 to 1, and how this is related to the likelihood of an event. • probability can be expressed in multiple ways.	EU 3 • justify decisions based upon the likelihood of an event. • express probabilities as a fraction, decimal, or percentage.

Stage 2 – Assessment Evidence

Recommended Performance Tasks: EU 3

http://thehothand.blogspot.com/
The hot hand effect is psychological effect whereby a string of success or failures affects the probability that one will continue to succeed or fail. This is most commonly associated with basketball where a player having made a series of shots is deemed to be 'hot' and perceived probability of him/her making the next shot is increased. Much research has been done to prove/disprove the statistical existence of the 'hot hand'. Share an article on the hot hand effect.

Your Task: Gather and analyze raw data and create a representative model in an attempt to either prove or disprove the existence of the 'hot hand' in free throw shooting in basketball.
Data Collection: Collect data on the results as a string of H-hits and M-misses for 30 minutes. Collect and record the results from at least 100 to 200 shots. At the end of the time, fill out the 'shooter information sheet'.

Analysis of the Raw Data: Use the experimental data to find the following probabilities:
- Probability of a hit
- Probability of a hit given a hit has already happened
- Probability of a miss given a miss has already happened
- Probability of a hit given three consecutive hits have already happened
- Probability of a miss given three consecutive misses have already happened

Analyze the streaks of success in the raw data. Count and tally the streaks (three or more consecutive outcomes) and create a visual representation of the data collected including the number of streaks and streak length. Write a paragraph detailing the amount of raw data collected and whether or not it is enough data to draw reasonable conclusions for all the different associated probabilities.

Deliverables:

The Report should be computer typed and have the following headings:

1. Introduction: Introduce the concept of 'hot hand'.

2. Methodology: Discuss the process used to collect data, analyze data, model and report.

3. Expected Results: What does the student expect to find? Does the student have any preconceived notions about what will be found?

4. Shooter's Results: A discussion on the shooter's results. The shooter's overall probabilities as well as the dependent probabilities and their implication with regards to evidence of the 'hot hand'. State how each was calculated and the number of occurrences that were used to calculate the probabilities. Include a bar graph showing the streaks of the shooter. Attach the raw collected data in an appendix at the back of the report.

6. Accuracy: State any limitations on the accuracy of the results. How might this alter the results? Were there enough trials/occurrences to accurately state the empirical dependent probabilities?

7. Conclusion: State the overall findings.

8. Applications: How might the findings affect views of sports and human psychology in general?

9. Appendix:
   - raw data
   - full-page sized versions of experimental and modeled streak graphs
   - Any necessary summary charts of the modeled data.

Raw Data Collection Sheet:

Date: _____

Shooters Name: _____

Shooters Results

For best results:

The shooter must take the process seriously and not rush. Take up to 10 practice shots to warm up.

The shooter's best effort is required to get the most accurate data. All data should be taken from a single shooter. If the shooter needs to take a two minute break, that is ok. If the shooter has shot a sufficient number of free throws (100-200) you may cease the experiment.

Shooters Thoughts:

Has the shooter ever experienced being 'hot'? Perhaps it wasn't in basketball but in another endeavor where repetitive attempts were required.

Did the shooter feel like he/she was getting tired during this process? _____

Did the shooter feel this had any effect on his/her performance? _____

Imagine playing for an NBA team and a scout from a rival team has scouted this performance. Information regarding the particular player's shooting streak tendency was being sought so an effective game plan could be devised for defense. Divide the total number of shots taken into four parts.

What was the probability the shooter got hot during the first part of the data? _____

What was the probability the shooter got hot during the second part of the data? _____

What was the probability the shooter got hot during the third part of the data? _____

What was the probability the shooter got hot during the fourth part of the data? _____

A scout would need to get this information because it could show when the shooter is most comfortable shooting the ball in a game. The more comfortable a person is shooting the ball, the better for that person's team and worse for the scout's team. Knowing when that shooter is likely to settle the nerves down and get hot is vital to developing a game plan to stop that shooter.

Based on the data that was collected, what do you think the scout would say about the shooter?

Other Recommended Evidence:

- Tests/quizzes on computing probabilities, permutations, and combinations
- "Ticket to leave" at the end of permutations and combinations lessons
- Student explanations of homework, do-nows, and class work
- Class discussions on the differences between a permutation and combination, and independent and dependent probabilities
- Observation on making inferences and justifying conclusions using probability

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Consider the WHERETO elements. Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

- Activity #1
  The below activity is an investigation into random playlists on your MP3 player and probability. (A/M/T)
  https://docs.google.com/viewer?a=v&pid=sites&srcid=Z3Vham9tZS5uZXR8YW5kZXJzb25ibHxneDozYjgxY2FhYWEyNzEzMTc3&pli=1

- Activity #2
  Why is a simulation better the more times you perform it? (M/T)

  - Using your graphing calculator, enter randInt(1, 2, 5). This will generate a list of 5 outcomes of 1 or 2. Let 1 represent a tossed coin landing heads-up and let 2 represent a tossed coin landing tails-up. Record your results in the table.
  - Repeat this experiment with 20 outcomes instead of 5.
  - Find the probability of landing on heads for each experiment and explain why a simulation is better the more times you perform it.

- Activity #3
  Calculate various probabilities for scenarios encountered in a game of cards. (A/M)
  Example Questions:
  - What's the probability of choosing a heart?
  - What is the probability of choosing a spade or club?
  - What's the probability of choosing the king of diamonds?

- Activity# 4
  In the form of a "ticket to leave" students will explain the reasoning to support their choice of permutation or combination in solving a problem. (M)

- Activity #5
  Students will use the formula for permutations to show that 0! = 1. (M)

- Activity #6
  Have students find experimental probabilities with dice or coins from their recorded results, and make predictions on future scenarios. (A/M/T)

- Activity# 7
  Have students illustrate the Fundamental Counting Principle by using tree diagrams. (M)

The following is the suggested sequence of learning activities for the Intro to Algebra II (Level 3) class and should comprise 22 school days:

- YWBAT use the Fundamental Counting Principal. (AM/T)
- Activity #7: Fundamental Counting Principal using Tree Diagrams. (M)
- Activity #1: Random Playlists (M)
- YWBAT identify and use combinations and permutations. (A)
- Activity #4: Permutation or Combination? (M)
- Activity #5: Understanding 0! (M)
- YWBAT calculate simple probability (Theoretical and Experimental). (A)
- Activity #2: Performing Multiple Simulations. (M/T)
- YWBAT calculate the probability of multiple events. (A)
- YWBAT calculate simple conditional probability (with and without replacement). (A)
- Activity #3: Applicatins of Games of Cards (A/M)
- YWBAT calculate the probability using combinatorics. (A)
- Activity #6: Predictions on Future Probabilities. (A/M/T)