Probability and Statistics

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Unit #3 Probability and Probability Distributions

Students will be able to independently use their learning to make appropriate decisions in life based on 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 #1-9

- 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 #1-7

- Calculate expected values and use them to solve problems.
- Use probability to evaluate outcomes of decisions.

Making Inferences and Justifying Conclusions S-IC #2,6

- Understand and evaluate random processes underlying statistical experiments.
- Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

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: ___Flexibility and Adaptability _x_Initiative and Self-Direction ___Social and Cross-Cultural Skills _x_Productivity and Accountability _x_Leadership and Responsibility
Enduring Understandings: *Students will understand that . . .* *EU 1* the probability of an event's occurrence can be predicted with varying degrees of confidence. *EU 2* experimental results tend to approach theoretical probabilities after a large number of trials. *EU 3* real life decisions are made by assigning probabilities to all possible outcomes pertaining to a situation.	**Essential Questions:** *EU 1* • What is probability? • How do you determine if an event is independent or dependent? • How do you determine if an event is mutually exclusive or not? *EU 2* • How can experimental and theoretical probabilities be used to make predictions or draw conclusions? • Why might you get different results when repeating an experiment multiple times? • What are the drawbacks of using probability in regards to what will occur in the short term? *EU 3* • When is it appropriate to use a probability distribution? • How are the forms of measurement of a probability distribution used to summarize the situation? • How have you encountered probability distributions in your life?

Knowledge: *Students will know . . .*	**Skills:** *Students will be able to . . .*
EU 1 • probability is used in decision making • compound events are either independent or dependent • compound events can be mutually exclusive	*EU 1* • compute probability for simple and compound events. • determine whether events are independent or dependent. • determine whether events are mutually exclusive or not.
EU 2 • probability does not aid in the prediction of an occurrence in the short term. • the probability of an event can be useful in decision making . • the probability of an event can be used to support or dispute a claim . • theoretical probability is what happens over the long run, whereas experimental probability is what is obtained from a given experiment .	*EU 2* • compute probability for simple and compound events . • use the probability obtained to make predictions about an event. • compare and contrast experimental and theoretical probabilities.
EU 3 • the risk and reward of various situations. • the key characteristics differentiating the various distributions. • the key characteristics present in all probability distributions.	*EU 3* • use expectation and probability to evaluate the risk/reward of the situation. • recognize which situations fit the appropriate probability distributions. • compute mean, expected value, standard deviation, and variance for a binomial distribution.

Stage 2 – Assessment Evidence

Recommended Performance Tasks: EU 1,2,3

Other Recommended Evidence: *Tests, Quizzes, Prompts, Self-assessment, Observations, Dialogues, etc.*.

Test and quizzes to include: Calculating the theoretical probability of simple and compound events, determine if events are independent or dependent, determine if events are mutually exclusive or not, obtain the experimental probability of events, supporting or disputing claims using probability, determining mathematical expectation, interpret the results from a simulation, solving problems using probability distributions.

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.*

Ti-Nspire Activity #1: Statistics: Tossing Dice (M,T)

- Students will estimate the probability of an outcome from a dot plot.
- Students will compare a simulated sampling distribution to the theoretical distribution for the underlying relationship. (Take note: Simulated distribution will more closely approximate the theoretical distribution after a large number of samples.
- Students will model with using mathematics
  http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5026&t=5078&id=17177

TI-Nspire Activity #2: Statistics: Conditional Probability (M,T)

- Students will identify the differences between the probability of an outcome and the conditional probability of an outcome.
- Students will answer probability questions using information presented in a table and in a graph.
- Students will reason abstractly and quantitatively.
  http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5026&t=5078&id=17175

Ti-Nspire Activity #3: Statistics: Probability Distributions (M,T)

- Students will compare the distribution of a discrete sample space to distributions of randomly selected outcomes from the sample space.
- Students will identify the structure that emerges as more and more data are added to the distribution (that is, the features of the distribution of random processes stabilize as the sample gets larger).
- Students will recognize the relative frequency of particular outcomes. (After a few observations are more likely to deviate substantially from expected values than are relative frequency based on more observations.)
- Students will use appropriate tools strategically.
- Students will look for and make use of structure.
  http://education.ti.com/calculators/timathnspired/US/Activities/Detail?sa=5026&t=5078&id=13335

Consider this problem: _(A,M,T)

- A con man has 3 coins. One coin has been specially made and has a head on each side. A second coin has been specially made and has a tail on each side. Finally, the third coin has a head and a tail on it. All coins are the same denomination. The con man places the 3 coins in his pocket, selects one, and shows you one side. It is heads. He is willing to bet money, that it is the two-headed coin. His reasoning is, it can't be the two tailed coin since a head is showing; therefore there is a 50-50 chance of it being the two-headed coin. Would you take the bet? Explain your reasoning using probability and expectation.
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Key Vocabulary Includes:

- Theoretical probability
- Sample space
- Independent events
- Mutually exclusive events
- The complement of an event
- Compound events
- Permutation
- Combination
- Conditional probability
- Binomial distribution
- Poisson Distribution
- Hypergeometric distribution, multinomial distribution

The following are the suggested sequence of learning activities in a logical sequence.

Approximate time of completion of unit: ___33___ days

Students will be

- determine the sample space of an event (A)
- find the probability of the occurrence of events using the rules for classical probability and complementary events. (M)
- compare theoretical and experimental probability using the law of large numbers. (T)
- develop and interpret simulations to represent real-life scenarios. (T)
- TI-Nspire Activity #2: Tossing Dice (T)
- utilize the rules of probability to evaluate risk taking. (T)
- apply the addition rules of probability (mutually exclusive) (M)
- apply the multiplication rules for probability (independence) (M)
- apply the conditional rules for probability. (M)
- TI-Nspire Activity #3: Conditional Probability (T)
- find the number of outcomes available in a specific situation using the Fundamental Counting Principle. (T)
- apply the combination and permutation rules to find the number of ways that a number of objects can be selected from a sample size. (M)

- develop probability distributions and use them to determine mathematical expectation. (M)
- identify mean, expected value, standard deviation, and variance of a probability distribution. (M)
- use binomial distribution to determine probability of an events occurrence. (M)
- find probabilities of outcomes of variables using the poisson, hypergeometric, and multinomial distributions. (M)
- TI-Nspire Activity #1: Probability Distributions (T)