

Can you pick three?

Estimated time: 2 – 45 minute classes or 1 – 90 minute class

Objectives:

- Students will discover the difference in the probability of winning versus the probability of losing in a random 3 digit number
- Students will create frequency distribution tables to determine difference in experimental probability and theoretical probability.
- Students will calculate experimental probability given data.

CSO

MA.7.2.13 represent and solve real world problems appropriate for 7th grade using multiple strategies

MA.7.5.1 determine experimental and theoretical probability of an event using appropriate technology

MA.7.5.2 construct sample spaces by listing, tree diagrams, and frequency distribution tables to determine permutations and combinations.

Standard: Data Analysis and Probability

Students will:

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them;
- Select and use appropriate statistical methods to analyze data; develop and evaluate inferences and predictions that are based on models; and
- Apply and demonstrate an understanding of basic concepts of probability through communication, representation, reasoning proof, problem solving, and making connections within and beyond the field of mathematics.

Materials

Paper, pen, tootsie rolls, work record sheet, random number generator or TI-83 or TI-84, “grand prize”. Student calculators are optional

Introduction

What is the quickest legal way to make a million dollars?...(lottery, gambling). Gambling is a quick way to make a lot of money, right? Where would you go if you wanted to do a lot of gambling?....(Las Vegas)

Right, Las Vegas is the biggest gambling city in the United States. Over 30 million travelers visited Las Vegas just in the last year. 87% of those visitors gambled for about 4 hours a day.

Here are some other gambling-related facts: 68% of people who gamble play the slot machines most often; Las Vegas has twice as many hotel rooms as NEW YORK CITY; all but two states have some kind of legalized gambling activity; and 60% of American adults gambled last year. In our research we found out that a LOT of people gamble, but we also found out that many do not think about their actual probability of winning because the grand prize is so large and attractive. What do you think about gambling?.....

You have been given a pretest while was talking. Please put your name on the pretest and follow the directions to complete the sheet. When you are finished raise your hand so we can collect your paper. You have 4 minutes to complete the pre-test.

A really common lottery game is Pick 3. We are going to experiment with a variation of this "game" today.

Put away all writing utensils except a pen, and then put your name on the "Pick 3" (P3) sheet you have been given.

You should also have been given 20 tootsie rolls in a baggie. We are going to play twenty (20) Pick 3 games.

You are required to play the first 5 games. After that you may decide whether or not to play. If you chose not to play you must put an "x" in the box (you get to keep your tootsie roll, but you also have no chance to win the Grand Prize!)

To play, you should put a check mark in the correct box and give up ONE tootsie roll for your gamble. Your tootsie roll will be collected and kept in the "house".

You must then record your "play numbers"--play numbers are three numbers 0 to 9 of your choice placed in the appropriate three boxes for each trial on your Pick 3 sheet.

The teacher will then use a calculator to generate three random numbers.

There are two ways you can win. If you have an EXACT MATCH (number and order) you win the GRAND PRIZE!! You can also win with a box match. A box match is when you have all the numbers that were randomly chosen, but you have them in a different order. If you have a box match, you win 25 more tootsie rolls. You must then finish filling out the Pick 3 sheet for that round--win or lose and how many tootsie rolls you now have.

Let's do one round to make sure everyone understands the procedure and then we will start playing for tootsie rolls.

When we have played 20 rounds, there will be some questions for you to answer related to this experiment.

Procedure

- Administer pre-test
- Pass out 20 tootsie rolls to each student

- Ask each student to write down a 3 digit number and put pens down
- Teacher will use TI-84 to produce 3 digit number
- Students will record results on record sheet
- Play one round to make sure all students understand procedure
- Teacher will collect house winnings or pay out winnings
- Repeat steps 2-5 – 19 more times
- Complete record sheet and answer conclusion questions

Second part

Introduction: Who really ended up winning in the experiment yesterday?... (the house).

Did you know that people LOSE more than 6 million dollars a year gambling in Las Vegas alone?

In 20 years the amount of money that Americans LEGALLY wagered went from 17 billion to over 500 billion? Gambling companies make more money than the movies, sports, amusement parks, cruise ships, and the recorded music industry COMBINED!

About 50% of people who gambled within the last 12 months admit to losing money. Suicide rates are 200 times higher than the national average for compulsive gamblers...yikes!

Yesterday we told you that many people gamble without knowing the exact probability of them winning. The Theoretical probability of YOU winning the game yesterday was 1:1000 for an exact match and 6:1000 for a box match. YET, many of you played every game and lost all of your tootsie rolls.

Today we are going to talk about the difference between experimental and theoretical probability. We are going to calculate the experimental probability of our experiment yesterday, and make some graphs. Then you will be asked to take a post-test to see what you learned.

Procedure Day 2

- Construct frequency chart
- Calculate probability for winning and probability for losing using the formula:

$$\frac{\text{Number of particular response}}{\text{Total number of rounds}}$$
- Teacher will use individual students' frequency charts to calculate class' probabilities
- Teacher will explain difference between experimental and theoretical probabilities
- Share theoretical probability of this particular situation Theoretical $1/10 * 1/10 * 1/10 = 1/1000$ and compare with class experimental results
- Administer post-test

Assess

- Students will be observed as they perform probability experiment aka Pick 3
- Student's final work will be assessed for completeness, correct calculations and accuracy of short answer responses.

- Student's pre-test and post-test will be evaluated for level of mastery.
- Student frequency table will be evaluated for correct construction and completeness.

Performance Descriptors

Distinguished – student can calculate experimental probability of losing and experimental probability of winning. Student can collect, organize, graphically represent, analyze and interpret data displays. He/she can extend understanding of probability to decision making to other games of chance and defend decisions using said understanding. Student can differentiate between theoretical and experimental probability.

Above Mastery - student can calculate experimental probability of losing and experimental probability of winning. Student can collect, organize, graphically represent, analyze and interpret data displays. He/she can see a correlation between probabilities of different games of chance but has difficulty determining exact ratios. Student can differentiate between theoretical and experimental probability.

Mastery – student can calculate experimental probability of losing and experimental probability of winning. Student can collect, organize, graphically represent, and interpret data displays. Student can differentiate between theoretical and experimental probability

Partial Mastery - student can predict outcome given enough information. Student can collect, organize, and graphically represent data displays. Student can identify theoretical and experimental probability when given.

Novice - student can predict outcome given enough information. Student can collect and organize data. He/she can recognize situations involving probability. Student can not clearly differentiate between theoretical and experimental probability even when given.

Related Websites

Facts about Las Vegas

<http://www.pbs.org/wgbh/pages/frontline/shows/gamble/etc/facts.html>

<http://www.sunsetcities.com/Las-Vegas.html>

Gambler's Anonymous

<http://sportsgambling.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=sportsgambling&cdn=sp>

[orts&tm=9&f=00&tt=2&bt=1&bts=1&zu=http%3A//www.gamblersanonymous.org/](http://www.gamblersanonymous.org/)

Math dictionary

<http://www.shodor.org/interactivate/dictionary/>

Extending concept to Powerball

<http://ipse.mnstate.edu/ExhibitProofs/powerball.pdf>

This lesson is adapted from Gambling Does Not Pay by David Rock from ON Math Vol. 3 No. 1 Fall 2004. National Council of Teachers of Mathematics.

Pick Three – Day 2

Frequency Chart for Tootsie Roll Game

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1. Calculate your experimental probability. $\frac{\text{Number of wins or losses}}{\text{number of rounds}}$

2. Your teacher is collecting the class' individual probability. When they are tallied calculate the class' experimental probability.

4. What is the probability of winning a lottery requiring 6 number matches? _____

5. When you turn 18 are you going to play lottery games? Why or why not? _____

6. Summarize the difference between experimental and theoretical probability. _____

Rubric for Pick Three

	3	2	1
Pretest	Completed	Finished but left some questions unanswered	Did not take or left most of the questions unanswered
Part one			
Records	Every round recorded correctly	Left out one or two rounds OR recorded incorrectly	Left out three or more rounds OR recorded three or more incorrectly
Questions	Answered every question completely	Left one answer unanswered	Left two or more questions unanswered
Calculations on candy tally	Complete and accurate	Complete with one mistake	Two or more mistakes
Part two			
Frequency chart	Complete and accurate	Complete with only one mistake	Not complete or with more than one mistake
Individual probability	Accurate	Miscalculation	Did not attempt
Class probability	Accurate	Miscalculation	Did not attempt
Probability for 6 numbers	Accurate	Miscalculation	Did not attempt
Gambling over 18	Answers and justification is logical	Answers but justification shows little logic	Shows no justification OR did not answer
Difference in probabilities	Indicates thorough understanding	Indicates some understanding but not completely thought through	Indicates no or little understanding OR did not answer question
Grammar on both parts	Used full sentences and only one or two mistakes	Used full sentences and made three or four mistakes	Did not use full sentences OR made more than four mistakes
Post test	Completed	Completed by left some questions unanswered	Did not take or left most questions unanswered
Learning	Shows significant difference in knowledge from pretest to post test	Shows some difference in knowledge from pretest to post test	Shows little difference in knowledge from pretest to post test