

# Activities For Finite Math and Probability and Statistics

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Copies of all handouts posted: <http://www.avon-schools.org/Domain/3488>

## 1. Finite Math: "I Have – You Have – Matrix Arithmetic"

*\*In my class, I do this at the beginning of class the meeting AFTER teaching matrix multiplication or as a review activity.\**

Academic Standard:

FM.MA.1 Add, subtract, and multiply matrices of appropriate dimensions (i.e. up to  $3 \times 3$ ). Multiply matrices by scalars. Calculate row and column sums for matrix equations.

Basic Idea:

Each student draws a card with a matrix. Student writes their matrix at the top of their handout and determines the size. Students then "pair up" one at a time with 5 different classmates. For each pair, they are required to complete several matrix arithmetic operations. I have students do their work on individual white boards that they erase after each pairing. The goal is for students to accurately perform matrix arithmetic and to recognize situations where matrix sums and products are undefined.

## 2. Finite Math: Payoff Matrix Penny Wars

*\*In my class I do this activity on the first day of our "Game Theory" chapter\**

Academic Standard:

Prerequisite Skill for FM.P.7 "Analyze decisions and strategies using probability concepts. Analyze probabilities to determine risk and odds of events."

Basic Idea: Students play on a variety of "game boards" that resemble payoff matrices. Students take turns being the row and column player, each trying to choose the best strategies to bankrupt their partner. The goal is for students to learn to easily read and interpret a payoff matrix in a two-player game based on a given combination of strategies and introduce the concept of pure strategies, mixed strategies, and dominating strategies.

## 3. Probability & Statistics/Finite Math: DIY Election – Winner Winner Winner

*\*In my class, I introduce this project on the first day of the chapter on election theory where we discuss elections, preference ballots, majority, and plurality.\**

Academic Standard:

PS.ED.2 Use election theory techniques to analyze election data. Use weighted voting techniques to decide the power in a group.

Basic Idea: Students create an election for four candidates with a very short presentation and preference ballots. Peers vote to rank the candidates. Students perform all the chapter techniques on their "real" election data and submit their analysis at the end of the chapter.

#### **4. Probability & Statistics/Finite Math: Weighted Voting in the News**

Goal: Recognize situations concerning weighted voting in the news (preferably print)

Academic Standard:

PS.ED.2 Use election theory techniques to analyze election data. Use weighted voting techniques to decide the power in a group.

Basic Idea: At the end of the chapter on weighted voting techniques, show the news article (published in the Mathematics Teacher) and discuss. Assign a student or group of students to read the local newspaper each week and look for examples of weighted voting (or any other voting related issue). Make a classroom bulletin board with clippings (physical or electronic). Use to prompt classroom discussion about how understanding the mathematics related to voting makes us better citizens.

#### **5. Finite Math: Steiner Point Construction Lab**

*\*I teach this lab at the end of trees and networking. Students have the prior knowledge that the shortest network for three points is the Steiner tree, if it exists, or the MST, if no Steiner tree exists.\**

Goal: Use compass-and-ruler geometric constructions to find the Steiner Point in a triangle. Find the length of the shortest network for the three vertices of the triangle.

Academic Standard:

FM.N.2 Optimize networks in different ways and in different contexts by finding minimal spanning trees, shortest paths, and Hamiltonian paths including real-world problem.

Extension Ideas: Steiner Trees can be constructed in Geometer's Sketchpad or Geogebra if your students are familiar with those activities. Also, there is a NUMB3RS episode that discusses Steiner Points and has a corresponding student activity.

#### **6. FINITE MATH: OBSCURE TOPICS – Graph Coloring & Bin Packing Techniques**

*\*Nothing fancy and hands-on here, but in my many years of teaching this I've discovered resources for these topics are difficult to find. The materials I use are posted on my website.\**

Academic Standards:

FM.N.5 Use graph-coloring techniques to solve problems.

FM.O.1 Use bin-packing techniques to solve problems of optimizing resource usage.

#### **7. FINITE MATH: Expected Value Lab**

*\*Usually conducted the day after the lesson on calculating expected value as the mean of a probability distribution. Can be split into two activities or done over a long class\**

Academic Standards:

FM.P.6 Calculate the expected value of a random variable; interpret it as the mean of a probability distribution.

FM.P.9 Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.

Basic Idea: Lab in two parts - Part 1, Theoretical Values of finding the sum of a pair of dice vs.  
Experimental Values of finding the sum of a pair of dice.  
Part 2, Expected Value of the "number of candies" in a bag.

## **8. PROBABILITY & STATISTICS: Bead Count Lab – Confidence Intervals**

*\*Usually done the day after the lesson on how to construct a confidence interval for a proportion.*

Academic Standards:

PS.DA.4 Understand hypothesis tests of means and differences between means and use them to reach conclusions. Compute and use confidence intervals to make estimates. Construct and interpret margin of error and confidence intervals for population proportions.

Basic Idea: A large bag of hundreds of colored beads represents a population. By taking samples of the population (handfuls of beads) and constructing confidence intervals, we can estimate the proportion of beads that are a specific color.

## **9. PROBABILITY & STATISTICS: Hypothesis Test of M&Ms**

*\*Usually done the day after the lesson on how to do a hypothesis test of a proportion.*

Academic Standards:

PS.DA.4 Understand hypothesis tests of means and differences between means and use them to reach conclusions. Compute and use confidence intervals to make estimates. Construct and interpret margin of error and confidence intervals for population proportions.

Basic Idea: Use the “Color Distribution Statement” from the M&Ms company and a classroom sample of M&Ms to do a hypothesis test.

## **10. ANY TOPIC ANY COURSE – Example: Prob/Stats Standard Normal Distribution**

Basic Idea: Perfect “get your students up and moving” activity for review, in place of “homework,” or as an “exit ticket” or “bell ringer.” Questions best suited for Around the World are multiple choice that don’t take a lot of multi-step computation.

*\*SEE SAMPLE\** Around the World with Standard Normal Distributions

PS.DA.2 ... Use tables and technology to estimate areas under the normal curve....

Students start at different locations around the room. Each question’s answer will lead them to the next question. They will continue to answer questions, making a circuit around the room. If they get through all the questions and back to where they started, they know that all their answers are correct. If they are partially through the questions and get back to a question they’ve already been to, then they know that have a mistake and need to go back and check their answers. Grading is easy – just start on their answer sheet with the first number on your key and follow the circuit.

## **11. PROBABILITY & STATISTICS – Rock-Paper-Scissors Binomial Probability Distributions**

Academic Standards:

PS.P.8 Develop a probability distribution for a random variable defined for a sample space in which theoretical probability can be calculated. Compute and interpret the expected value of random variables.

Basic Idea: Students construct a probability distribution from experimental data and compare that data to the theoretical probabilities of binomial distribution. Situation 1: Drawing cards from a special deck that contains 60% black cards. Situation 2: Rock-Paper-Scissors tournament.

## **12. PROBABILITY & STATISTICS – Sampling Techniques Lab**

*\*Fun way to introduce sampling techniques prior to experimental design*

Academic Standard:

PS.ED.7 Understand and apply basic ideas related to the design, analysis, and interpretation of surveys and sampling, such as background information, random sampling, causality, and bias.

Basic Idea:

Have kids use a random number generator (or a random number table) to generate random samples from the students in their classroom. Students then “interview” their classmates pulled from the samples they generate using the following techniques: Simple Random Sample, Systematic Sampling, Cluster Sampling, Stratified Sampling, and Convenience Sampling.

This activity is a great conversation/discussion starter about types of data (qualitative/quantitative), possible bias, and sample results vs. population results. I usually ask at the end if anyone didn't get selected at all for any sample.

## **Other things I have done to help students relate to challenging concepts or fun activities with Finite/Stats connections:**

- Drawing Cards (with replacement from a rigged deck of all black cards) and offering a prize (candy) to the first person who draws a red card. Generally students call “shenanigans” after about 5 cards. The  $P(5 \text{ red in a row})$  with replacement is about 3%. This is a great way to start a discussion about the level of significance  $\alpha$  for hypothesis testing.
- The Price is Right “Range Game” (check out youtube) is a great way to introduce Confidence Intervals.
- “The Knights Tour” – relates to Hamilton Circuits – have students move a check knight around a checkerboard and try to hit each square exactly one time.
- Pathuku – free app in Google Play store that simulates finding an Euler circuit or path under a time crunch