

Probability and Statistics for Gifted Middle School Students

**Yul Inn
Fun Math Club
www.FunMathClub.com**

My Background

From Math to Software and Back to Math

Current Activities

**Before/After-School Math Enrichment Programs for
3rd-8th Grade Students**

GATE and Other Gifted Programs, Math Nights

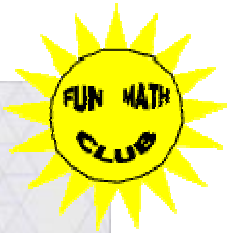
Johns Hopkins University Center for Talented Youth (CTY)

2nd- 10th Grade Students at 95th Percentile or Higher

Three-week Summer Programs

CTY Daily Schedule

9	Class
11:30	Lunch
1:00	Class
2:30	Break
3:00	Class
4:30	Activities



Data and Chance Class Description from CTY Web Site

Behind only one of three doors is a fabulous prize. After you choose door #1, the host, who knows where the prize is hidden, reveals door #2 has nothing behind it. She then offers you the opportunity to change your selection. Should you switch to door #3? This classic example of conditional probability, in which you determine the chance of something happening given that something else already has happened, is not as simple as it seems.

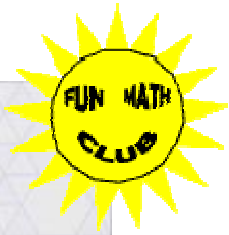
In this course, students develop a greater understanding of data and chance, two areas of mathematics that easily transfer from the classroom to the real world. Students conduct experiments and generate data which they display in graphs, charts, and tables in order to compare the effects of particular variables. For example, students might analyze data to examine how various design characteristics of a paper airplane, such as weight or length, affect the distance it will travel. In addition, students consider other data sources, including newspapers and journals, and identify examples of incorrectly gathered or misrepresented data that have been used to mislead consumers or influence voters.

Students also explore probability, the study of chance, to learn how numerical data are used to predict future events. Students examine permutations and combinations; develop strategies for calculating the number of possible outcomes for various events; calculate probabilities of independent, dependent, and compound events; and learn to distinguish between theoretical and experimental probability.

By the way, the answer to the question is that you should switch.

Sample text: Materials compiled by the instructor.

Students must have completed grades: 5 or 6



Challenges

Three Weeks, 5½ Hours per Day of Math

How to Fill Day

Keep Students Engaged

Students in an Unfamiliar Environment

Students Living in Dormitory

Foreign Students

Unknown Math Skills

Little or No Algebra

Differing Exposure to Probability and Statistics

Differing Abilities

Limited Facilities

No Access to Computers

Creating the Syllabus

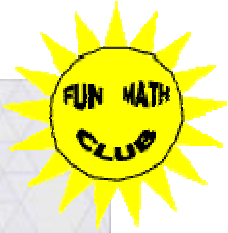
No Formal Course Guidelines

Where to Find Resources



Resources

Activities	Problems	Reading	Data	Resource
X				Clark, Phil, "Probability and Statistics for Teachers", http://www.clarkphil.com/prob/
	X			Gardner, Martin, <i>Martin Gardner's Mathematical Games</i> on CD ROM, MAA, 2005
	X			Grinstead, Charles, <i>Introduction to Probability</i> , http://www.Dartmouth.edu/~chance/teaching_aids/books_articles/probability_book/amsbook.mac.pdf
		X		Huff, Darrell, <i>How to Lie with Statistics</i> , WW Norton, 1993
	X			Moore, David, <i>Statistics Concepts and Controversies</i> , WH Freeman, 2001
		X		Paulos, John Allen, <i>Innumeracy</i> , Hill and Wang, 1988 Paulos, John Allen, <i>A Mathematician Reads the Newspaper</i> , Anchor Books 1995
X				Saari, Donald, <i>Chaotic Elections!</i> , American Mathematical Society, 2001
X				Schaeffer, Richard, et al., <i>Activity-based Statistics</i> , Key College Publishing, 2004
		X		Tufte, Edward, <i>The Visual Display of Quantitative Information</i> , Graphics Press, 2001
		X		Vos Savant, Marilyn, <i>The Power of Logical Thinking</i> , St. Martins Press, 1996
X	X			Watkins, Ann et al., <i>Statistics in Action</i> , Key Curriculum Press, 2004
	X			Chance News, http://chance.dartmouth.edu/chancewiki/index.php/Main_Page
	X			Harper's Index, http://www.harpers.org/HarpersIndex.html
			X	US Government, http://www.census.gov/statab/www/



Outline of Syllabus

Week 1

Data

Graphing

Distributions

Center, Shape, Spread

Week 2

Surveys

Counting

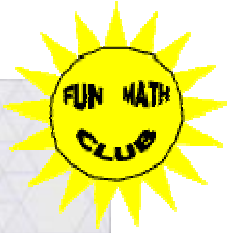
Probability

Week 3

Expected Value

Probability Distributions

Applications to Games and Experiments



Methods

Activity-based Learning

Short Lectures

Activities with Worksheets

Warm-up Problems

Exercise Concepts

Logic Problems

Informal Assessment

Debunking and Demystifying Data

Critical Thinking

Class Discussions

Vocabulary Cards

Common Words, Formal Terms, Principles and Theorems

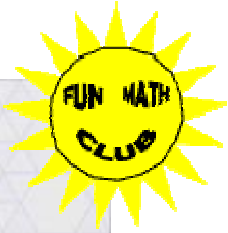
Vocabulary Bingo

Games and Group Projects

Social Activity

Applying Concepts

Using Probability to Make Decisions



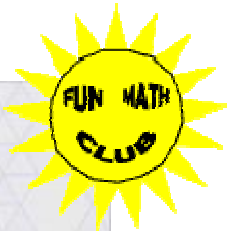
Problem Samples

Mean, Range, Median, and Mode

(from 1995 AHSME) A list of five positive integers has mean 12 and range 18. The mode and median are both 8. How many different values are possible for the second largest element in the list?

Socks

1. You own 25 socks, some of which are red; the rest are green. If you reach into the drawer and pick two socks, the chances are exactly even that you will have a matching pair. If you have more red socks than green socks, how many do you have of each color?
2. Continuing from problem 1, we now assume that someone gives you a certain number of blue socks to add to your collection of red and green. Amazingly enough, it is still true that if you reach into the drawer and pick two, you get a match with even odds. How many blue socks did you receive?



Debunking and Demystifying Data Samples

(from Moore's book *Statistics: Concepts and Controversies*)

Drunk driving.

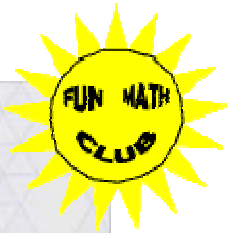
A newspaper article on drunk driving cited data on traffic deaths in Rhode Island: "Forty-two percent of all fatalities occurred on Friday, Saturday, and Sunday, apparently because of increased drinking on the weekends." What percent of the week do Friday, Saturday, and Sunday make up? Are you surprised that 42% of fatalities occur on those days?

Advertising painkillers.

An advertisement for the pain reliever Tylenol was headlined "Why Doctors Recommend Tylenol More Than All Leading Aspirin Brands Combined." The makers of Bayer Aspirin, in a reply headlined "Makers of Tylenol, Shame on You!" accused Tylenol of misleading by giving the truth but not the whole truth. You be the detective. How is Tylenol's claim misleading even if true?

(from Harper's Index, October 2006)

- **Estimated number of minutes of cocoa picking required to make a treat-sized Hershey chocolate bar: 1** [Harper's research]
- **Percentage of tea drunk in America that is served iced: 85** [Tea Association of the USA (N.Y.C.)]
- **Ratio of the estimated number of tigers living in the wild to the number living as U.S. pets: 1:1** [World Wildlife Fund (Washington)/The Humane Society of the United States (Washington)]



Prisoners Activity

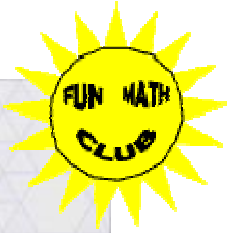
Alice and Bob, who are prisoners under the supervision of warden Wayne, are in separate cells and cannot communicate with each other.

Wayne meets with Alice, gives her an unbiased coin, and tells her that he will call her into his office at 10 a.m. the next day. She may choose to bring the coin or not. He also tells her that there is another prisoner who will be given the same information. When they arrive in his office, each prisoner who has brought a coin will flip the coin. If at least one coin is flipped and if all coins that are flipped come up heads, then warden Wayne will release both prisoners. Otherwise, both will be sent back to their cells.

The warden then meets Bob, gives him a coin, and gives him the same information he gave Alice.

What are Alice's and Bob's best strategy to obtain their releases the next day?





Prisoner Activity

Simulation

You will simulate this problem with a partner by playing the following cooperative game:

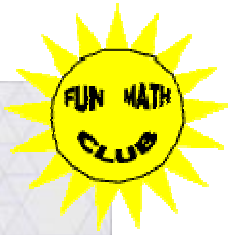
One of you will simulate being Alice, and the other Bob. Each of you will put both hands behind their back with the coin. Each will bring one hand forward in a closed fist, either holding the coin or not. When both fists are out, both of you will reveal whether you brought the coin out or not. If neither of the fists contains a coin, then the game is lost. Otherwise, the coin (or coins) brought forward are flipped. You win if all flipped coins are heads. Otherwise, you lose. You are not allowed to consult with each other on your strategy.

What strategy did you adopt?

Can you use probability and expected value to find the optimum strategy?

Bonus Question:

How could the prisoners in the original problem implement the optimum strategy?



Conclusions

Probability and Statistics

- An excellent area to offer for math enrichment**
- An abundance of applications to the real world**
- Many opportunities for engaging learning activities**
- Students started with good background in graphing**
- Students started with weak background in probability concepts**

Gifted Students

- A great ability to remain focused on a single subject over long periods of time**
- Generally very motivated, but also react negatively to the same things as other students**
- Students used calculators more than expected**