7A,B: Fundamentals of Probability and Combining Probabilities

Coin Toss. In the video we looked at the theoretical probabilities for flipping a quarter, dime and nickel. Now we will do a class experiment to find empirical probabilities.

1a. Empirical Probability. Get a quarter, nickel and dime for your group. Take turns tossing them for a total of 10 trials. Record H or T for each coin in each trial.

Trial	1	2	3	4	5	6	7	8	9	10
Quarter										
Nickel										
Dime										

b. From your 10 trials, count the number of times you got 0 heads, 1 head, 2 heads and 3 heads. Write the number in each column. They should add up to 10 trials.

Number of Heads	0	1	2	3
Group Count				

c. Combining the Class Data. Record your totals on the class sheet on the document camera. Once all the data is added, write the totals in the next table. Number of trials____

Number of Heads	0	1	2	3
Total Class Count				

d. Empirical **Probability Model**. Using the class totals, calculate the empirical probability of each outcome.

Number of Heads	0	1	2	3
Empirical Probability				

e. Compare these numbers to the theoretical outcomes on your notes. How do they compare?

f. What would you expect if we repeated this experiment for 1000 trials?

Theoretical Probability

2. Using the prize wheel below, make a theoretical probability model and then use it to find the probabilities below.

	Sub	Drink	Cookies	Chips	BOGO	Mystery Prize
Probability						

3. If you spin the wheel once, what's the probability that you get

a. chips or a drink?

b. not the mystery prize?

c. a drink or not BOGO?

4. Find the following **odds**:

a. The odds of winning the mystery prize.

b. The odds against winning the mystery prize.

c. The odds on winning a sandwich.

5. If you get to spin the wheel repeatedly, would that be like drawing with or without replacement?

a. If you get to spin 3 times, what is the chance you would get 3 bags of chips?

b. If you get to spin twice, what is the chance you will get two BOGO's?

Subjective Probability

6. Make up an example of a subjective probability.

7. Dinner combinations:

Starter—Caesar salad, mozzarella sticks, steamer clams, chicken skewers, calamari

Protein—Alaskan king crab, prime rib, grilled chicken, pork ribs, rainbow trout

Side—baked potato, french fries, garlic mashed potatoes, steamed broccoli, garlic toast

Dessert—apple pie, carrot cake, marionberry cobbler, caramel sundae

a. If a meal is made from one choice in each category, find the total number of different meals.

b. How many meals include a Caesar salad?

c. What is the probability that a meal includes a Caesar salad?

8. If you can use capital letters, lowercase letters, the numbers 0-9 and 8 special characters (!,@,#, etc.), how many 8-character passwords could you make?

9. The t-shirts for your school group just arrived: 5 red small, 5 orange small, 10 red medium, 10 orange medium, 15 red large, 15 orange large, 10 red extra-large, 10 orange extra-large.

If you grab one t-shirt at random, what is the probability that

a. it is a small or an extra-large?

b. it is extra-large or orange?

c. it is not small or medium?

d. it is not small or red?

10. If five people come up and you draw 5 shirts at random, what is the probability that

a. they are all red larges?

b. there is at least one orange extra-large?

7C: Expected Value and the Law of Large Numbers

Beginning in October, 2015, **Powerball**® became an even larger combined large jackpot game and cash game. Every Wednesday and Saturday night at 10:59 p.m. Eastern Time, we draw five white balls out of a drum with 69 balls and one red ball out of a drum with 26 red balls.
Source: http://www.powerball.com/powerball/pb_prizes.asp

Powerball - Prizes and Odds

Match	Prize	Odds
5 + Powerball	Grand Prize	1 in 292,201,338.00
5	$1,000,000	1 in 11,688,053.52
4 + Powerball	$50,000	1 in 913,129.18
4	$100	1 in 36,525.17
3 + Powerball	$100	1 in 14,494.11
3	$7	1 in 579.76
2 + Powerball	$7	1 in 701.33
1 + Powerball	$4	1 in 91.98
Powerball	$4	1 in 38.32

The overall odds of winning a prize are 1 in 24.87.
The odds presented here are based on a $2 play (rounded to two decimal places).

11.a. If the current Powerball grand prize amount is $90 million, calculate the expected winnings per ticket:

b. Calculate the expected profit or loss for the ticket-holder per Powerball ticket:

12. a. Calculate the expected value of the Subway prize wheel from activity 7A,B. Let's say the mystery prize is a $20 gift card.

	Sub	Drink	Cookies	Chips	BOGO	Mystery Prize
Prize Value	$4.25	$1.60	$1.30	$0.99	$4.25	
Probability	$\frac{2}{13}$	$\frac{2}{13}$	$\frac{2}{13}$	$\frac{4}{13}$	$\frac{2}{13}$	$\frac{1}{13}$

b. What does the expected value mean in this example? Explain it in a complete sentence.

13. Based on historical data, an auto insurance company estimates that a particular customer has a 1.5% likelihood of having an accident in the next year, with the average insurance payout being $10,000.

If the company charges this customer an annual premium of $500, what is the company's expected value of this insurance policy?

a. Make a probability table.

Possibilities	Accident	No Accident
Payout		
Probability		

b. Calculate the expected value for the company.

14. A company estimates that 7% of their products will fail after the original warranty period but within 2 years of the purchase, with a replacement cost of $250.

If they want to offer a 2-year extended warranty, what price should they charge so that they'll break even (in other words, so the expected value will be 0)

a. Make a probability table.

b. Calculate the expected value and answer the question.