



Chapters 14 and 15 – Introduction to Probability

Introduction to Probability...

1. A firm discovered that 39.9% of all sick days are taken on a Monday or a Friday. Should they clamp down on sick leave?
 - a) Yes
 - b) No
2. In 6 tosses of a coin, which sequence listed below is least likely to occur? H = heads, T = Tails.
 - a) HTHTHT
 - b) HHHHHT
 - c) THTTTH
 - d) HHHHHH
 - e) They are all equally likely to occur
3. Let's Make a Deal. What's the chance you win if you change your door selection?
4. A certain AIDS test reports 99% accuracy. If you test positive for AIDS, approximately what is the chance you have the disease?
 - a) 99%
 - b) 75%
 - c) 50%
 - d) 25%
 - e) 1%

Dealing with Random

- On any given day, do you know if we will turn in hw?
- If we toss a coin, do we know exactly how it will land?
- A trial is **random** if we know what outcomes could happen, but not which particular values.
 - A combination of outcomes is an **event**
 - The collection of all possible outcomes is the **sample space**
- What is the sample space for
 - Homework submission?
 - Tossing a coin?
- Are events we listed in those sample spaces equally likely?

Coin Toss

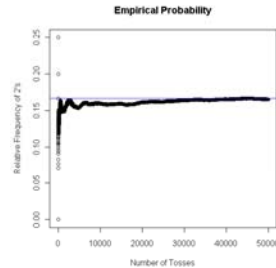


- Experiment Time! Take out a coin and flip it
- No coin?
 - Simulate a toss with Minitab
 - Put H, T in a column
 - Then go to Calc > Random Data > Sample from columns
 - Sampling 1 Row is the same as one coin toss!
- We are going to record the number of Heads. Be ready with "1" for Heads or "0" for Tails.
- We (Amy) will use R to recalculate the percent of Heads after each new toss. We will examine a plot of the results.
- You can use the table to record the first few tosses.

Toss #	1	2	3	4	5	6	7	8	9	...
# H this toss										
# H so far (from toss 1)										
% of H so far										

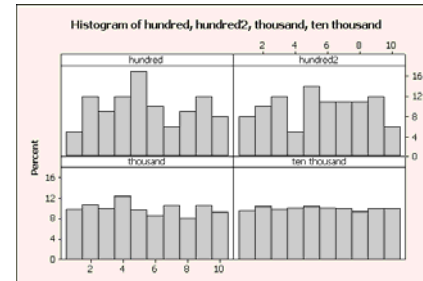
Law of Large Numbers (LLN)

- When we computed the percent of Heads, we were calculating the relative frequency of heads
- Simulation of Rolling a Die
 - Diagram looks at getting 2's
- For independent trials, the **law of large numbers** (LLN) says that as the number of trials increases, the long-run relative frequency of repeated events gets closer and closer to a single value



Only a Few Classes Ago...

- ...we simulated draws from the uniform distribution (and normal distribution in class work). We were seeing the Law of Large Numbers!



What the LLN Does Not Say

- As far as turning in HW, one class has been on a "noHW" streak. They have only submitted homework once.
 - Does this mean we should start putting money on the next one being "HW"?
- How about the lottery?
 - Should we keep track of numbers picked and bet on those that haven't shown up for awhile?
- This misconception is referred to as the 'law of averages'
 - The random events that we've been discussing have no memory.
 - You could make simulation for tossing a coin. Examine what happens every time there are 4 heads in a row...

What the LLN Does Say

- What if we sit at the roulette wheel and notice that the table has slight tilt, causing the numbers 28, 12, 35, 3, 26, 0 to come up more often...
- In this case, should we adjust our betting strategy from our 'favorites'?



Theoretical Probability

- If outcomes are equally likely, we can calculate the theoretical probability:

$$P(A) = \frac{\text{\# outcomes in } A}{\text{\# possible outcomes}}$$

• Examples

- | | |
|---------------------------|----------------------------|
| 1. Rolling a 20-sided die | 2. Tossing two coins |
| a) P(2) | a) P(no Heads) |
| b) P(even) | b) P(at least one H) |
| c) P(1 or 2) | c) P(one H, one T) |
| d) P(21) | d) P(1 st is H) |
| e) P(odd) | e) P(TT) |

Example Using Percents

- Suppose that 40% of cars in Santa Clarita are manufactured in the US, 30% in Japan, 10% in Germany, and 20% in other countries.
- If cars are randomly selected, find the probability that
 - A car is not US-made
 - A car is made in Japan or Germany

AIDS Testing

- The *combined accuracy* of the ELISA plus either the WB or IFA (tests for AIDS) is greater than 99% (http://www.sfaf.org/aids101/hiv_testing.html). An estimated 1.1 million people in the U.S. have AIDS (<http://www.cdc.gov/hiv/topics/testing/index.htm>). There are an estimated 303.8 million people living in the U.S. (<https://www.cia.gov/library/publications/the-world-factbook/print/us.html>).

	Tested Positive	Tested Negative	Totals
Have AIDS	(.99)(1.1)		1.1
Do Not Have AIDS		(.99)(_____)	
Totals			303.8

- So what does a 'positive' or 'negative' test result really mean?
 - Find the chance of having AIDS given that you test positive
 - Find the chance of not having AIDS given that you tested negative

Take Your Survey...

- <http://classes.thegradekeeper.com/exam1.php>
- Finished?
 - Show Amy the "Success" screen (class work credit)
 - Start the Chapter 14 class work

Class Work

- To get credit, it is your responsibility to get checked off.
 1. Exam 1 Survey
 2. Chapter 14 Handout
 - Checking solutions? No pens in the front!

Homework

- Textbook/Routine Homework
 - Due Next Week (25% chance of collection)
 1. Read Chapter 14
 2. Pg 379-383: #1, 3, 5, 9, 11, 19, 25, 31(a)

- Project/Exploration Homework
 - Project #2 Survey (next time)
 - Project #2 Analysis