

Class #9 - Wednesday September 25
Probability: Basic Concepts & Properties

Exam #1 – Wednesday, Oct 2:

- the exam will cover the material up to and including linear regression
 - review the outlines/notes/spreadsheets for Classes #1-8 and the WebWork sets (HW2-Graphs, HW3, HW4-PairedData)
 - Additional review exercises TBA on OpenLab
 - Note: the college is closed on Mon Sept 30 (& Tues Oct 1)
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Basic Concepts/Definitions:

- **probability experiment:** any process where the outcome is uncertain
- **sample space** (of an experiment): the set of all possible outcomes S of an experiment
- an **event**: any particular set of outcomes, i.e., a subset of the sample space $A \subseteq S$
- basic set theory: complement of A , union $A \cup B$, intersection $A \cap B$, disjoint sets

Example 1: Many probability examples involves rolling dice or tossing coins.

- (i) Suppose an experiment of rolling a 6-sided die. What is the sample space, i.e., the set of possible outcomes? What are some examples of events?
- (ii) Next consider the experiment of flipping a coin. What is the sample space in this case?

Example 2: Now suppose a probability experiment consists of first flipping a coin and then rolling a 6-sided die.

- (i) What is the sample space? How many outcomes are there in the sample space?
- (ii) An example of an event A is $A = \text{“Rolling a 4”} = \{ H4, T4 \}$. Another example of an event is $B = \text{“Tossing heads and rolling an even number.”}$ List the outcomes that make up the latter event.
- (iii) What is the complement of A , i.e., A^C ? What is $A \cup B$? What is $A \cap B$? Are A and B disjoint?

Basic Properties of Probability: For an experiment with sample space S , we assume that for each event $A \subseteq S$ there is a number $P(A)$, called the probability of A , with the following properties:

- The probability of any event A is between 0 and 1: $0 \leq P(A) \leq 1$
- The probability of the entire sample space S is 1: $P(S) = 1$
- For any two disjoint events A and B : $P(A \cup B) = P(A) + P(B)$

What about two events that are not disjoint, i.e., that do have outcomes in common?

Addition Rule: For any events A and B ,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Examples...