**11.5 Probability Models**  
Objective: To use probabilities to make fair decisions and analyze decisions

In order for a decision to be considered fair the probability of each outcome must be the same.

**Are the following situations considered fair? Explain your reasoning?**

Example:  
A teacher wants to pick 2 students at random from the class. The teacher lines them up in order from tallest to shortest and has the first student flip a coin, if they get heads they will be picked, if they get tails they will not. The first two students to flip heads are the two the teacher picks.

Not fair. The shorter students probably won’t even get a chance to flip the coin because the chances that a taller student flips heads first is greater.

Example:

A teacher wants to pick 2 students at random from the class. The teacher has each student write their name on a piece of paper then puts them in a hat. Assuming the pieces of paper are all the same size, the teacher shuffles the pieces of paper and picks 2 names.

Yes fair. Each student has an equal chance of being selected.

**Probability model:** A mathematical representation of a situation in which probabilities are assigned to outcomes.

Example:

McDonalds is giving away toys in happy meals. There are six different toys that will be randomly placed with the meal. Create a simulation that could model the chances of getting each toy.

You could assign a number from 1-6 to each toy then roll a die and record the results until you have rolled each number at least once.

The results of this trial indicate that you would have to buy 3+4+2+1+2+3=15 happy meals in order to get all six different toys.

Repeat this exact same simulation 24 more times (25 times is usually enough to get the idea) and find the average.

15, 17, 10, 8, 18, 22, 10, 12, 14, 13, 11, 18, 19, 18, 10, 11, 11, 18, 19, 20, 11, 12, 10, 9, 15

**On average you’ll have to buy 14 happy meals in order to get all six toys.**

**Using Probability to Analyze Decisions**

Example:

A company is testing the effectiveness of a new drug. 160 volunteers are split into two groups without their knowledge. 80 are given the drug and 80 given a placebo. They are then asked if they noticed an improvement in their symptoms.

What is the probability that a volunteer reported improvement in symptoms given that they received the test drug?

What is the probability that a volunteer received the placebo given that they did not report a noticeable improvement?

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Should they make/distribute the drug?  
**Yes, 83% of the people who took it improved and 81% of people who had the placebo didn’t improve.**

**HMWK: page 707 #1-9, 11**