AP Stats Chapter 6 Notes

6.1 Simulation

Simulation is the imitation of chance behavior, based on a model that accurately reflects the phenomenon under consideration.

Simulation Steps:

1. State the problem or describe the random phenomenon.

Toss a coin 10 times. What is the likelihood of a run of at least 3 consecutive tails?

2. State the assumptions.

A head or tail is equally likely to occur on each toss of the coin. Tosses are independent of each other (that is, what happens on one toss will not influence what happens on the next toss.)

3. Assign digits to represent outcomes. In a random number table, odds and evens have an equal chance of occurring.

One digit simulates one toss of the coin. Odd digits represent heads. Even digits represent tails.

4. Simulate many repetitions. Looking at 10 consecutive digits in Table B simulates one repetition. Read many groups of 10 digits from the table to simulate many repetitions. Be sure to keep track of whether or not the event we want occurs (run of 3 head s or 3 tails).

Enter the table wherever you want and perform this simulation 25 times. Record your results below.

5. State your conclusions. What is the estimated probability of a run of size 3? Use a proportion.

Another Simulation:

a. Choose a person at random from a group of which 70% are employed. One digit simulates one person.

It doesn't matter which three digits are assigned to "not employed" as long as they are distinct. The following is also an acceptable choice:

00, 01,, 69 = employed 70, 71,, 99 = not employed

This is not the best choice though because it requires twice as many digits and ten times as many numbers.

b. Choose one person at random from a group of which 73% are employed. How could we set up this simulation?

c. Choose one person at random from a group of which 50% are employed, 20% are unemployed, and 30% are not in the labor force. How could we set up this simulation?

Another Simulation:

A couple plans to have children until they have a girl or until they have four children, whichever comes first.

This model is the same as for coin tossing. We will assume that each child has a probability of 0.5 of being a girl and 0.5 of being a boy, and the sexes of successive children are independent. How can we now carry out this simulation?

Carry out your simulation 15 times using the random number table. Record your results below.

What were your results? Express as a proportion and percent.

Assignment: p. 397-398 6.1, 6.3, 6.4 p. 402 6.7, 6.10, 6.12

Activity 6B Directions:

A gentleman sent the following letter to the ombudsman at his local newspaper. "The company I worked for recently laid off 10 of its sales staff, including me, due to budget cuts. But after talking with one of my former fellow workers, we both realized that 6 of the 10 people they fired were older than 55, while a large proportion of the younger sales staff—who are paid less—kept their jobs. How can I find out if I have an age-discrimination case, and where can I turn for help?" What the gentleman is asking is whether this can reasonably be attributed to chance. We learn from the Bureau of Labor Statistics that 24% of all sales people in the last census were 55 or older.

You are going to use your calculator and its random number generator to conduct 20 repetitions of a simulation. Place the results in a frequency table. Then estimate the relative frequency that 6 or more sales people in a randomly selected group of 10 are 55 years old or older.

1. Let digits 1 to 100 represent the salespeople. Which digits will represent the 55 and older crowd? 54 and younger?

2. Now use your calculator to generate a group of 10 sales people: randInt(1, 100, 10) and store that in L1, then sort L1 ascending.

3. Look at your sample of 10 salespeople. How many of them are 55 and older? Record a tally mark in the appropriate column of your frequency table (next page). Repeat this 20 times.

Number of salespeople 55 or older	Frequency
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

4. Where should the center of the distribution be? Where is the center of your sample?

5. Calculate the relative frequency that 6 or more of the 10 salespeople laid off are 55 or older.

6. Combine your results with the rest of the class to obtain a more accurate relative frequency. Theory tells us that, in the long run, only about 1.6 times in 100 would you see 6 or more people 55 or older out of 10 if only chance were involved. This is unlikely to happen by chance alone. Does the gentleman have a case? Compare our relative frequency with the theoretical frequency of 0.016. How do they compare?

6.2 Probability Models

Random:

Probability:

Rules of Randomness:

1.

2.

3.

Sample Space:

Event:

Probability Model:

Tree Diagram:

Example: List all of the possibilities when one first flips a coin and then rolls a 6-sided die.

Multiplication Principle:

Example1: How many ways can you flip a coin 4 times?

Example 2: How many ways can you roll a pair of 6 sided dice?

Example 3: How many ways can you answer 5 multiple choice questions when each question has 4 possibilities?

With replacement versus Without Replacement: With replacement the possible outcomes stay the same while without replacement outcomes are eliminated once chosen.

Examples: Find the probability of drawing two hearts from a deck of cards if

a. The card is placed back into the deck before the second draw

b. The card is not placed back into the deck before the second draw

Assignment: p. 410-411 6.21, 6.23, 6.24, 6.28, p. 416-417 6.29, 6.32, 6.35, 6.36

Rules of Probability

1.

2.

3.

4. If 2 events are disjoint/mutually exclusive (have no outcomes in common) the probability of one or the other equals the sum of their individual outcomes.

5. Two events A and B are **independent** if knowing that one occurs does not change the probability that the other occurs. If A and B are independent,

Venn Diagrams: Visually shows the sample space of joint and disjoint events.

Examples: A and B are disjoint events.

A and its Complement

A and B and their overlap

Union:

Intersection:

General Addition Rule for Unions of two events:

Assignment: p. 423-424 6.38, 6.40, 6.41 p. 430 6.45, 6.46, 6.48, 6.51 p. 440-441 6.65, 6.66, 6.67, 6.70

Conditional Probability:

The probability of one event occurring under the condition that we know another event.

What is the probability of having an ace dealt to you out of a standard deck of cards?

This probability assumes we know nothing about the previous cards dealt. Suppose you have 4 cards in your hand already and 1 of them is an ace. You know nothing about the other 48 cards left except that exactly 3 aces remain. Now the probability of you being dealt an ace, given what you know is:

General Multiplication Rule for Any Two Events:

Conditional Probability:

What is the conditional probability that a grade at the University of New Harmony is an A, given that it comes from a liberal arts course?

P (liberal arts course) =

P (A grade and liberal arts course) =

Conditional Probability:

Online chat rooms:

Online chat rooms are dominated by the young. Teens are the biggest users. If we look only at adult Internet users (aged 18 and over), 47% of the 18 to 29 group chat, as do 21% of those aged 30 to 49 and just 7% of those aged 50 and over. To learn what percent of all internet users participate in chat rooms, we also need the age breakdown of users. Here it is: 29% of adult internet users are aged 18 to 29 (event A1), another 47% are 30 to 49 (Event A2) and the remaining 24% are 50 and over (event A3).

What is the probability that a randomly chosen user of the internet participates in chat rooms (Event C)?

What percent of adult chat room users are between the ages of 18 to 29?

Binge Drinking

For men, binge drinking is defined as having five or more drinks in a row, and for women as having four or more drinks in a row. According to a study by the Harvard School of Public Health, 44% of college students engage in binge drinking, 37% drink moderately and 19% abstain entirely. Another study, published in the American Journal of Health Behavior, finds that among binge drinkers aged 21 to 34, 17% have been involved in an alcohol related automobile accident, while among non-binge drinkers of the same age, only 9% have been involved in such accidents.

What's the probability that a randomly selected college student will be a binge drinker who has had an alcohol related car accident? Make a tree diagram to solve this problem.

P(binge and accident) =

Double check your tree diagram, the right hand column should have a sum of 1.

Reversing the Conditioning—

If we know a student has had an alcohol related accident, what's the probability that the student is a binge drinker? The tree gives us $P(accident \mid binge)$ but we want $P(binge \mid accident)$. We have reversed the conditioning.

To find the conditional probability, we need to know the probability that both events happen divided by the probability that the given event occurs. What's the probability of an alcohol related accident?

The probability that a student is both a binge drinker and had an alcohol related accident is given by the top branch: 0.075.

So, P (binge | accident) =

Example 2: Seatbelts

A recent Maryland highway safety study found that in 77% of all accidents the driver was wearing a seatbelt. Accident reports indicated that 92% of those drivers escaped serious injury (defined as hospitalization or death), but only 63% of the non-belted drivers were so fortunate.

What's the probability that a driver who was seriously injured wasn't wearing a seatbelt?

Let B = wearing a seatbelt and NB = no belt Let I = serious injury or death and OK = not seriously injured

Assignment: p. 446-447 6.71, 6.72, 6.73, 6.76 p. 451 6.80 p. 453-454 6.85, 6.88, 6.90