General

- Always draw and shade Normal curves when problems involve Normal distributions
- Always write probability statements for questions that involve probability… such as P(X < n)
- Normal curves are continuous, binomial and geometric distributions are discrete. For example, if you're finding P(X < 8) using a binomial distribution, you would use binomcdf(n, p, 7). But, if you use a Normal distribution to approximate this, you would use normalcdf(-∞, 8, mu, sigma).
- When drawing tree diagrams, label all branches and multiply the numbers along branches

6.3 Quick Summary

Binomial Probability

- BITS (or BINS with a fixed N)
- $P(X = k) = nCk \cdot p^k(1-p)^{n-k}$ **(using the formula is not required)**
- Use `binompdf` to find $P(X = K)$ **(all calc syntax MUST be labeled for full credit)**
- Use `binomcdf` to find $P(X \leq K)$ **(all calc syntax MUST be labeled for full credit)**
- For a binomial random variable: $\mu_x = np$ and $\sigma_x = \sqrt{np(1-p)}$
- Binomial distribution gives a good approximation to the count of successes in an SRS of size n, as long as $n \leq 0.10N$, where N is the population size.
- If sampling without replacement, be sure and check the 10% rule!!

Normal approximation for binomial distribution

- Suppose a count X successes has a binomial distribution with n trials and success p.
- When n is large the distribution of X is approximately normal with: $\mu_x = np$ and $\sigma_x = \sqrt{np(1-p)}$
- Check the large counts conditions $np \geq 10$ and $n(1-p) \geq 10$
- Use `normalcdf` to find $P(X \leq K)$
- Draw a normal curve, label +/- 3 standard deviations, shade the area
- No calculator syntax required

Geometric Probability

- BINS, but N is not fixed
- $P(Y = k) = (1-p)^{k-1}p$ **(formula not required but probably faster than calculator for most probability questions)**
- $E(x) = 1/p$
- Use `geometpdf` to find $P(X = K)$ **(all calc syntax MUST be labeled for full credit)**
- Use `geometcdf` to find $P(X \leq K)$ **(all calc syntax MUST be labeled for full credit)**

6.2 Quick Summary

Adding a constant to a random variable

- adds the constant to the measures of center
- does not change the measures of spread
- does not change the shape of the probability distribution

Multiplying a random variable by a constant

- multiplies the measures of center by the constant
- multiples the spread by the constant
- does not change the shape of the probability distribution (but it may stretch or shrink)

If X and Y are any two random variables

- $\mu_{X+Y} = \mu_X + \mu_Y$
- $\mu_{X-Y} = \mu_X - \mu_Y$

If X and Y are any two INDEPENDENT random variables

$$\sigma^2_{X+Y} = \sigma^2_X + \sigma^2_Y$$

$$\sigma^2_{X-Y} = \sigma^2_X + \sigma^2_Y:$$

6.1 Quick Summary

A random variable

- takes on numerical values determined by the outcome of a chance process
- the probability distribution tells us the possible values of X and how the probabilities are assigned
- can be discrete or continuous

Expected value (mean)

$$\mu_X = E(X) = \sum x_i p_i = x_1 p_1 + x_2 p_2 + x_3 p_3 + \ldots$$

Variance and Standard Deviation

$$\sigma^2_X = \sum (x_i - \mu_X)^2 p_i = (x_1 - \mu_X)^2 p_1 + (x_2 - \mu_X)^2 p_2 + (x_3 - \mu_X)^2 p_3 + \cdots$$

$$\sigma_X = \sqrt{\sum (x_i - \mu_X)^2 p_i}$$

5.3 Quick Summary

Conditional probability

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

General Multiplication Rule

$$P(A \text{ and } B) = P(A \cap B) = P(A) \cdot P(B \mid A)$$

Frequency Tables

- Make the entire table equal to 1 or 100%
- The rows and columns should all add up correctly

Tree Diagrams
- Draw a tree when a chance behavior involves a sequence of outcomes
- multiply along the branches to show the results of each branch pathway

Independent Events
- When known that one event has occurred does not change the probability that another event happens

$$P(A \mid B) = P(A) \text{ and } P(B \mid A) = P(B)$$

$$P(A \text{ and } B) = P(A \cap B) = P(A) \cdot P(B)$$

5.2 Quick Summary

Probability Events
- $0 \leq P(A) \leq 1$
- $P(A) \ = \ number\ of\ outcomes\ corresponding\ to\ A\ /\ total\ number\ of\ outcomes\ in\ sample\ space$

Complement Rule

$$P(A^C) = 1 - P(A)$$

Mutually Exclusive events
- have no outcomes in common
- P(A or B) = P(A) + P(B)
- By definition, mutually exclusive events are DEPENDENT

General Addition Rule for non-mutually exclusive events

$$P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

5.1 Quick Summary

Law of Large Numbers
- says that the proportion of times that a particular outcome occurs in many repetitions will approach a single number

Probability
- describes what happens in the long run
- short runs of random phenomena often don't look random to us because they do not show the regularity that emerges only in very many repetitions

Simulation
- an imitation of chance behavior.

- Follow the four-step process
  - **State -** ask a question about a chance process
  - **Plan -** describe how to use a chance device to imitate one repetition of the process. Tell what you will record at the end of each repetition
  - **Do -** perform many repetitions
  - **Conclude -** use the results to answer the question of interest