Tuesday, January 22, 2019

- Warm-up
  - **Suppose the average height of policemen is 71 inches with a standard deviation of 4 inches, while the average for policewomen is 66 inches with a standard deviation of 3 inches.**
    - **If a committee looks at all ways of pairing up one male with one female officer, what will be the mean and standard deviation for the difference in heights for the set of possible partners?**
    - **What is the probability that the female partner will be taller than the male?**
- Check Homework
- Review Activities

Objectives

Content: I will work to be prepared for the Chapter 16 & 17 test.

Social: I will contribute to the class activities.

Language: I will use correct vocabulary when explaining my reasoning on a problem.

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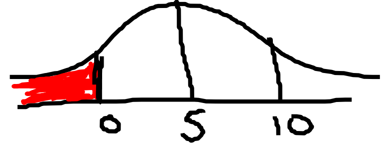
Warm-up



$z = \frac{0-5}{5} = -1$ $\quad P(z<-1) = \underline{\underline{15.87\%}}$

- **Suppose the average height of policemen is 71 inches with a standard deviation of 4 inches, while the average for policewomen is 66 inches with a standard deviation of 3 inches.**
  - **If a committee looks at all ways of pairing up one male with one female officer, what will be the mean and standard deviation for the difference in heights for the set of possible partners?**

$E(M - W) = E(M) - E(W) = 71 - 66 = 5 \text{ in}$

$SD(M - W) = \sqrt{SD(M)^2 + SD(W)^2} = \sqrt{4^2 + 3^2} = 5 \text{ in}$

$\sqrt{Var(M) + Var(W)}$

  - **What is the probability that the female partner will be taller than the male?**

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The Normal Model to the Rescue!

- When dealing with a large number of trials in a Binomial situation, making direct calculations of the probabilities becomes tedious (or outright impossible).
- Fortunately, the Normal model comes to the rescue…

Objectives

Content: I will use a Normal Model to approximate probabilities of Bernoulli trials.

Social: I will participate in the class discussion without distracting myself or others.

Language: I will use correct vocabulary in solving probabilities of Bernoulli trials.

The Normal Model to the Rescue (cont.)

$np \geq 10$

$nq \geq 10$

- As long as the $\boxed{\text{Success/Failure Condition}}$ holds, we can use the Normal model to approximate Binomial probabilities.

n= number of trials

  - Success/failure condition: A Binomial model is approximately Normal if we expect at least 10 successes and 10 failures:

$$np \geq 10 \text{ and } nq \geq 10$$

p= probability of success

q= probability of failure

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Continuous Random Variables

- When we use the Normal model to approximate the Binomial model, we are using a continuous random variable to approximate a discrete random variable.
- So, when we use the Normal model, we no longer calculate the probability that the random variable equals a *particular* value, but only that it lies *between* two values.

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Back to our M&M's

30% to be speckled

binomcdf(15000, 0.3, 4400, 15000)
n P lbound upbound

- If I go to a store and buy all of their packages of special M&M's, what is the probability that out of the 15,000 M&M's at least 4400 of them are speckled?

$E(X) = np = 15000 \times .3$
$= 4500$

$SD(X) = \sqrt{npq} = \sqrt{15000 \times .3 \times .7}$
$= 56.12$

$z = \dfrac{4400 - 4500}{56.12}$

$np \to 15000 \times .30 \geq 10$

$nq \to 15000 \times .70 \geq 10$

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What Can Go Wrong?

- Be sure you have Bernoulli trials.
  - You need two outcomes per trial, a constant probability of success, and independence. as long as not more than 10% are taken
  - Remember that the 10% Condition provides a reasonable substitute for independence.
- Don't confuse Geometric and Binomial models.
- Don't use the Normal approximation with small *n*.
  - You need at least 10 successes and 10 failures to use the Normal approximation.

30 people (sample)
population ≥ 300

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What have we learned?

- Bernoulli trials show up in lots of places.
- Depending on the random variable of interest, we might be dealing with a
  - Geometric model
  - Binomial model
  - Normal model

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What have we learned? (cont.)

- Geometric model
  - When we’re interested in the number of Bernoulli trials until the next success.
- Binomial model
  - When we’re interested in the number of successes in a certain number of Bernoulli trials.
- Normal model
  - To approximate a Binomial model when we expect at least 10 successes and 10 failures.

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Review → Discrete Random Variables

Our local florist determines the probabilities for the number of flower arrangements they deliver each day.

X	6	7	8	9	10
P(X)	0.2	0.2	0.3	0.2	0.1

Find the mean, variance and standard deviation

$\mu = 6 \cdot 0.2 + 7 \cdot 0.2 + 8 \cdot 0.3 + \cdots$

$\sigma^2 = Var = (6-\mu)^2 0.2 + (7-\mu)^2 0.2 + \cdots$

$\sigma = \sqrt{Var}$

Approximately how many arrangements should he expect to deliver each week?

What would be the standard deviation for a week?

Review → Combining Random Variables

Another local but smaller florist determines the probabilities for the number of flower arrangements they deliver each day.

X	2	3	4	5	6
P(X)	0.1	0.2	0.1	0.1	0.5

The mean, variance and standard deviation are

$\mu = 4.7$ $\sigma^2 = 2.21$ $\sigma = 1.487$

What is the expected difference between the two florists' daily sales?

What is the probability that the smaller florist sells more arrangements on given day than the larger one?

Review → Geometric vs. Binomial Distributions

In the college dorm, 24% of all fire alarms are false alarms.

- How many alarms do we expect until we have a false alarm?
- What is the probability that the 7^{th} alarm is the first false alarm?
- What is the probability that out of 10 alarms, 5 of them are false?
- If there are 10 alarms, how many false alarms do we expect?

More Practice - MC

Homework

- Gather all homework Wednesday!!