Agenda

- 2 Presentations
- Start Section 6.3 Day 1 (we'll finish on Monday which means the Ch. 6 Test will get pushed back to next Friday.
- LCQ

You need to take your own notes for a bit.

OMG

How many ways can you arrange a deck of cards?

title

Answer: 52!

$52 \cdot 51 \cdot 50 \cdot 49 \cdots 1$

$n! = n \cdot (n-1) \cdot (n-2) \cdots 1$

Next question:

5 friends are hanging out.

How many ways can you choose 2 people to go get food?

Translation: How many "combinations" ~~of 2~~ of two people can be chosen from 5?

Binomial Coefficient

The number of ways to arrange k successes among n trials

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

$$\binom{5}{2} = \frac{5!}{2!(5-2)!} = \frac{5 \cdot 4 \cdot \cancel{3} \cdot \cancel{2} \cdot 1}{2 \cdot 1 \cdot \cancel{3} \cdot \cancel{2} \cdot 1} = 10$$

$\binom{5}{2} =$

$\binom{7}{3} =$

Other notation: $\binom{7}{3}$ or ${}_7C_3$

Calculator

Pop Quiz

good news: I's multiple choice

bad news: 10 questions

good news: There's only 5 possible answers A B C D E

bad news: You don't get to see the questions

Answer all 10 in $1\frac{1}{2}$ minutes

you have the same prob. of success on each question.

it's simple you're either right or wrong

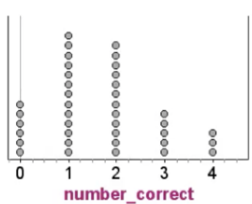
Now Correct

1 B 2 D 3 A 4 B 5 A

6 C 7 E 8 A 9 E 10 B

Record No. of Successes, P.

What is the center?



This is an example of a binomial Setting
(base on the information provided)

- *Each question had two outcomes (correct or not correct).*
- *The probability of getting an answer correct is 1/5.*
- *The probability remained 1/5 for each questions (questions are independent).*
- *There were ten questions. (n was fixed.)*

Binomial Settings and
Binomial Random Variables
(pages 403-406)

✓ DETERMINE whether the conditions for a binomial setting are met.

A binomial setting arises when we perform *n* independent trials of the same chance process and count the number of times that a particular outcome (called a "success") occurs.

The four conditions for a binomial setting are

- ***B**inary?* The possible outcomes of each trial can be classified as "success" or "failure." (p) (q)
- ***I**ndependent?* Trials must be independent. That is, knowing the outcome of one trial must not tell us anything about the outcome of any other trial.
- ***N**umber?* The number of trials *n* of the chance process must be fixed in advance.
- ***S**ame probability?* There is the same probability of success *p* on each trial.

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- ***S**ame probability?* There is the same probability of success *p* on each trial.

We'll try to avoid: "one trial doesn't affect another"

why: we don't want to think that the independence condition is violated only when there is a cause and effect condition.

Instead: Knowing the outcome of one trial tells us nothing about the outcome of another.

"Success" does not always mean something awesome happened

For example: Success could be defined as a faulty part
a person being diabetic

Note:

The term trials can be used interchangeably with the term observations.

Example to Watch

Problem: Determine whether the given scenario describes a binomial setting. Justify your answer.

(a) Genetics says that the genes children receive from their parents are independent from one child to another. Each child of a particular set of parents has probability 0.25 of having type O blood. Suppose these parents have 5 children. Count the number of children with type O blood.

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(a) Genetics says that the genes children receive from their parents are independent from one child to another. Each child of a particular set of parents has probability 0.25 of having type O blood. Suppose these parents have 5 children. Count the number of children with type O blood.

(a)
- *Binary? "Success" = has type O blood. "Failure" = doesn't have type O blood.*
- *Independent? Knowing one child's blood type tells you nothing about another child's because they inherit genes independently from their parents.*
- *Number? $n = 5$*
- *Same probability? $p = 0.25$*

This is a binomial setting.

Problem: Determine whether the given scenario describes a binomial setting. Justify your answer.

(b) Shuffle a standard deck of 52 playing cards. Turn over the first 10 cards, one at a time. Record the number of aces you observe.

Problem: Determine whether the given scenario describes a binomial setting. Justify your answer.

(b) Shuffle a standard deck of 52 playing cards. Turn over the first 10 cards, one at a time. Record the number of aces you observe.

(b)
- *Binary? "Success" = get an ace. "Failure" = don't get an ace.*
- *Independent? No. If the first card you turn over is an ace, then the next card is less likely to be an ace because you're not replacing the top card in the deck. If the first card isn't an ace, the second card is more likely to be an ace.*

This is not a binomial setting because the independent condition is not met.

Problem: Determine whether the given scenario describes a binomial setting. Justify your answer.
(c) Shuffle a deck of cards. Turn over the top card. Put the card back in the deck, and shuffle again. Repeat this process until you get an ace. Count the number of cards you had to turn over.

Problem: Determine whether the given scenario describes a binomial setting. Justify your answer.
(c) Shuffle a deck of cards. Turn over the top card. Put the card back in the deck, and shuffle again. Repeat this process until you get an ace. Count the number of cards you had to turn over.

(c)
- *Binary? "Success" = get an ace. "Failure" = don't get an ace.*
- *Independent? Yes. Because you are replacing the card in the deck and shuffling each time, the result of one trial doesn't tell you anything about the outcome of any other trial.*
- *Number? No. The number of trials is not fixed in advance.*

Because there is no fixed number of trials, this is not a binomial setting.

Dice, cars, hoops
example

Dice, cars, and hoops

Determine whether the random variables below have a binomial distribution. Justify your answer.

(a) Roll a fair die 10 times and let X = the number of 6s.

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(a)

Binary? success = 6, failure = not a 6.

Independent? Yes; knowing the outcomes of past rolls tells you nothing about the outcomes of future rolls.

Number? Yes; there are n = 10 trials.

Same probability? Yes; the probability of success is always p = 1/6.

This is a binomial setting. The number of 6s, X, is a binomial random variable with n = 10 and p = 1/6.

$B\left(10, \frac{1}{6}\right)$

(b) Shoot a basketball 20 times from various distances on the court. Let Y = number of shots made.

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(b)

Binary? Yes; success = make the shot, failure = miss the shot.

Independent? Yes; evidence suggests that it is reasonable to assume that knowing the outcome of one shot does not change the probability of making the next shot.

Number? Yes; there are $n = 20$ trials.

Same probability? No; the probability of success changes because the shots are taken from various distances.

Because the probability of success is not constant, *Y* is not a binomial random variable.

(c) Observe the next 100 cars that go by and let C = color of each car.

B

I

N

S

(c)

Binary? No; there are more than two possible colors.

Independent? Yes; knowing the color of one car tells you nothing about the color of other cars.

Number? Yes; there are $n = 100$ trials.

Same probability? A success hasn't been defined, so we cannot determine if the probability of success is always the same.

Because there are more than two possible outcomes, *C* is not a binomial random variable.

AP Tip

Free response questions about the binomial distribution are one of lowest scoring questions on average.

Why ?

Test takers do not recognize that a binomial setting is present.

LCQ

Open Notes

Assignment

1. Take Home LCQ (5.2)
2. 6.3 .... 77 and 79 →

Assignment: