Name______________________________

AP Statistics CED 4.1 Daily Video 1 (Skill 1.A)

Introducing Statistics – Random and Non-Random Patterns

What Will We Learn?

What is a random process?

How can seemingly non-random patterns be a result of a random process?

Random Process

Randomness shows up in our ________________, in what we _____________, in what we __________ at, what we see on __________. What is a random process??

Random Process

In each of these cases, we are _____________ of the possible outcomes, but have _____________ what the outcome will be.

This is called a _________________________.

Even though _________________ outcomes are uncertain, there is a sense of ___________________ that occurs in the _____________________.

Give It a Chance!

Write down a sequence of 100 flips that you think could come from a fair coin. (Do not actually flip the coin.) (Record your sequence below.)

How many heads did your "coin" result in? ___________ How many tails? ___________

What is the longest streak of heads or tails recorded by your "coin"? ____________

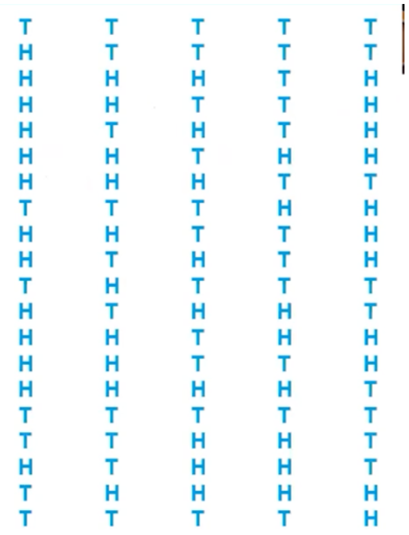
Give It a Chance!

I flipped an actual coin 100 times and got the following sequence of heads and tails.

Is there indication that the coin/flipping method is unfair?

Do you notice any patterns in the sequence flips?

Is it possible to determine the results of the next flip?



T	T	T	T	T
H	T	T	T	T
H	H	H	T	H
H	H	T	T	H
H	T	H	T	H
H	H	T	H	H
H	H	H	T	T
T	T	T	H	H
H	H	T	T	H
H	T	H	T	H
T	H	T	T	T
H	T	H	H	T
H	H	T	H	H
H	H	T	T	H
H	H	H	H	T
T	T	T	T	T
T	T	H	H	T
H	T	H	H	T
T	H	H	H	H
T	T	T	T	H

Name________________________________

Give It a Chance!

The first five flips were all tails. Is this indication of non-random activity? Is this indication that the next flip was DUE to be a heads?

T	T	T	T	T
H	T	T	T	T

Give It a Chance!

The longest streak that occurred was: ____________

How likely is it to get a string of 8 heads or 8 tails withing a set of 100 rolls?

How truly "random" was your set of random flips? What was your longest run?

Should we be surprised by the streak of 8?

T	T	T	T	T
H	T	T	T	T
H	H	H	T	H
H	H	T	T	H
H	T	H	T	H
H	H	T	H	H
H	H	H	T	T
T	T	T	H	H
H	H	T	T	H
H	T	H	T	H
T	H	T	T	T
H	T	H	H	T
H	H	T	H	H
H	H	T	T	H
H	H	H	H	T
T	T	T	T	T
T	T	H	H	T
H	T	H	H	T
T	H	H	H	H
T	T	T	T	H

What Should We Take Away?

A _________________________ is a situation where all possible outcomes that can occur are known, but _______________________ outcome are unknown.

Patterns of random occurrences may include ________________ or ___________ of outcomes that appear to be ___________________________.

Name______________________________

AP Statistics CED 4.2 Daily Video 1 (Skill 3.A)

Estimating Probabilities Using Simulation

What Will We Learn?

What is a random process?

Why is simulation effective in modeling real-life chance situations?

Random Events and Outcomes

-A _____________________ generates results that are determine by _________________.

Example: ____

-An ___________________ is the result of a ______________ of a _____________________________

Example: ____

-An ______________ is a collection of __________________________.

Example: ____

Give It a Chance

A coin was flipped 100 times and got the following sequence of heads and tails.

How likely is it to get a string of 8 (or more) heads or 8 (or more) tails within a set of 100 flips?

T	T	T	T	T	H	T	T	T	T
H	H	H	T	H	H	H	T	T	H
H	T	H	T	H	H	H	T	H	H
H	H	H	T	T	T	T	T	H	H
H	H	T	T	H	H	T	H	T	H
T	H	T	T	T	H	T	H	H	T
H	H	T	H	H	H	H	T	T	H
H	H	H	H	T	T	T	T	T	T
T	T	H	H	T	H	T	H	H	T
T	H	H	H	H	T	T	T	T	H

Random Process: Flipping a coin ________ times

Possible Outcomes: The sequence to the right is _______ such (possible) example.

Event: String of ____________ or _____________

According to our example, there is a ______________ of getting string of 8+ heads or tails.

-This is because we ____________ preformed one __________________.

Instead, we need to perform ______________ trials, due to ____________________ in the random process (each set of 100 flips is still random).

Give It (Another) Chance!

After flipping the coin another 100 times, we get the following:

Take minute to look for a string of 8 heads or 8 tails in this trial and circle if you find one.

T	T	H	H	H	H	H	H	H	T
T	T	T	T	T	H	H	H	T	T
H	T	T	H	H	H	T	T	H	H
H	T	H	H	T	T	T	H	T	T
H	T	T	H	T	H	T	T	H	T
T	T	T	T	T	T	T	H	H	H
T	H	T	T	H	T	T	T	T	T
H	T	T	T	T	H	H	H	T	H
T	T	T	T	T	H	T	T	T	H
T	T	H	T	T	T	H	H	H	H

So, 2 out of 2 successes = ______________________

Give it (Another) Chance!

After flipping the coin yet another 100 times, we get the following:

This time there is no string of 8+ heads or tails.

H	H	H	H	T	H	H	H	H	H
T	H	T	H	H	H	H	H	T	H
H	T	H	T	T	H	H	T	H	T
H	T	T	T	H	T	H	H	H	H
H	T	H	T	H	H	H	T	T	T
H	H	T	T	H	T	H	H	T	H
H	T	H	H	T	H	H	T	H	T
T	T	H	H	T	H	H	T	H	T
T	T	T	H	T	T	H	H	H	H
T	H	T	H	T	H	T	T	T	H

So, 2 out of 3 successes = _______________________

If we were to repeat this many, many times we would find the Empirical probability!

Name________________________________

Give It (Another) Chance!

This is a _______ of flipping coins! There must be an easier way! Is there something else that can work similarly to the flip of a coin that saves time and energy?

_____________________ - a way to model ______________________________, such that the simulated outcomes closely match the ________________________ outcomes.

Give It a Chance!

How likely is it to get a string of 8 (or more) heads or 8 (or more) tails within a set of 100 flips?

Here are the results from a computer simulation of 50 sets of 100 coin flips.

Circle the portion of the graph that shows a streak of 8 or more.

Of the 50 trails, 16 had a streak of 8 heads or tails. Based on this simulation, the estimated probability of getting a streak of 8 (or more) heads or 8 (or more) tails within a set of 100 flips of a fair coin is _________________________________

How can we design a simulation???? Stay tuned!

What Should We Take Away?

An _________________ is a collection of ___________________, which are the results of a ___________ of a random process.

________________________ is a way to _______________ a random process, so that the simulated outcomes closely match the _______________________ outcome.

Name______________________________

AP Statistics CED 4.2 Daily Video 2 (Skill 3.A)

Inference and Experiments

What Will We Learn?

What is the law or large numbers?
How can simulation be used to estimate probabilities?

Law of Large Numbers

___________________ probabilities seem to get closer to the __________ probability as the number of trials _________________.

Example: "Fair" coin?

H H T H H H T T H T (6/10)
T H T H T H H H T H (12/20)
T H H H H H H T H H (20/30)
H H H H H H H H T H (29/40)
H H H H H T H H H H (38/50)

Trial	1	2	3	4	5	6	7	8	9	10
Prop. Heads	1/1 = 100%	2/2 = 100%	2/3 = 66.7%	3/4 = 75%	4/5 = 80%	5/6 = 83.3%	5/7 = 71.4%	5/8 = 67.5%	6/9 = 66.7%	6/10 = 60%

Trial	20	30	40	50	100	500	1000
Prop. Heads	12/20 = 60%	20/30 = 66.7%	29/40 = 72.5%	38/50 = 76%	79/100 = 79%	391/500 = 78.2%	806/1000 = 80.6%

Do you think that this coin is a fair coin? Since _______________ probability gets closer to theoretical probability, for this coin, we can give a ______________________ probability close to a _______________ chance of heads. So, we would say this coin is ________ fair! Because, as the number of trials _____________, the variability from the __________ probability is _______________.

Conducting a Simulation

Use a __________ device to imitate the _____________ process: __________, ___________, _____________, ___________________________, ____,

Using a random number generator:

*Describe how the _____________ digits will imitate the _________ (what digits represent which outcomes). Also determine what will be __________________ from each trial.
*Perform ______________ trials of the simulation.
*Calculate the ______________________________ of successful trials to get a simulated probability.

Sharpshooter!

A member of the basketball team is known as a consistent free throw shooter, making 82% of the free throws she attempts. At the end of each practice, each player must shoot free throw shots until they miss. In an attempt to break the team record, she must make 16 consecutive shots. Design a simulation to determine the likelihood of the record being broken.

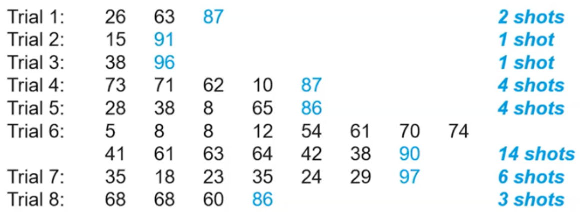
*Assign digits to represent outcomes: Numbers ______: Made shots; Numbers ______: missed shots
Use a random number generator to obtain a number between ___________. Continue to select numbers until a shot is ___________. Because each number represents the ________________ of a shot, ___________________________. Count the number of _____________ shots. Repeat this for several ___________ and calculate the ________________ of trials where at least ___________ consecutive shots were made.

Name________________________________

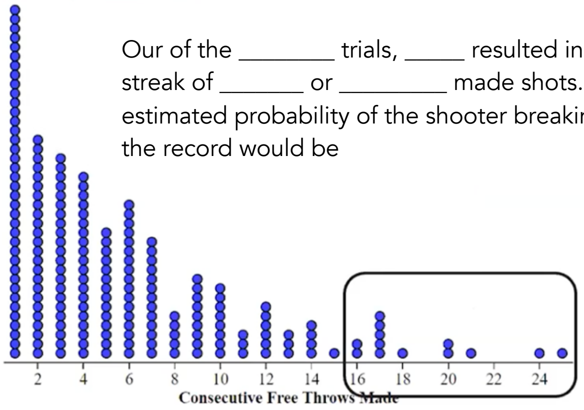
Table of Random Digits

To use a table of random digits, we must assign __________________ to represent the shots:
Numbers _______________: made shot and Numbers _______________________ missed shot
We then select _____________ at a time, moving ________________________ on a row in the table of random digits. Because each number represents an _________________ of a shot, ______________ are acceptable. We continue to select ____________________________ until a shot is _________________.
Count the number of _______________ shots. Repeat for several _______________, and calculate the ___________________ of trials with ___________________ consecutive shots made.

Sharpshooter!



Trial 1:	26	63	87						*2 shots*
Trial 2:	15	91							*1 shot*
Trial 3:	38	96							*1 shot*
Trial 4:	73	71	62	10	87				*4 shots*
Trial 5:	28	38	8	65	86				*4 shots*
Trial 6:	5	8	8	12	54	61	70	74	
	41	61	63	64	42	38	90		*14 shots*
Trial 7:	35	18	23	35	24	29	97		*6 shots*
Trial 8:	68	68	60	86					*3 shots*



Our of the ________ trials, _____ resulted in a streak of _______ or _________ made shots. The estimated probability of the shooter breaking the record would be

This is just our set of ____________ trials. If we were to do _______________ of 200 trials, then we should _______________ to get a different set of _________________________.

How can we determine the probability of an event without doing a simulation???? Stay tuned!!!!

What Should We Take Away?

As the _____________ of trials of a random process _______________, the probability tends to get closer to the ___________ probability. The is called the _______________________________________.

____________________ involves using a _____________ device to perform ___________ trials of a random process. The ________________________ of a particular outcome or event is an ______________________ of its probability.

Name________________________________

AP Statistics CED 4.3 Daily Video 1 (Skill 3.A)

Introduction to Probability

What Will We Learn?

How can we calculate the probability of events involving equally likely outcome?
How can we interpret the probability of an event?

Sample Spaces

For a random process the ____________________is the collections of ___________________ outcomes.
The letter ______ is often used to represent sample space.
<u>Example:</u> Flip a single coin. S = _________________
<u>Example:</u> Roll a die (number cube). S = ________________

Sample Spaces

<u>Example:</u> Flip two coins. Record the sequence of heads or tails. S = ____________________________
<u>Example:</u> Randomly select a vowel from the English alphabet. S = _____________________________
<u>Example:</u> Roll two dice. S = ____

Probability for Equally Likely Outcomes

Event - ________________ of outcomes for the ________________ process. Events are usually denoted with a ______________ capital letter, like A, B, etc.

Probability of an event: $P(A) = \frac{\text{total number of outcomes in event A}}{\text{total number of outcomes in sample space}}$

A probability will always be a number between ______________, inclusive.
*A probability of __________ means the event is _________________.
*A probability of __________ means it is a _________________ (it will always occur).

Listen Up!

The owner of a local record store is interested in what types of music people are buying. He has kept record of the genre of vinyl albums sold over the past year The following number of albums were sold according to genre.

- 327 rock & roll albums
- 431 jazz albums
- 192 classical albums
- 790 hip-hop albums
- 276 world music albums
- 89 pop albums

Listen Up!

Random process: Randomly select an ____.
Outcome: ____
Sample Space: the entire set of albums sold: S = ________________________________ = ___________
Event A = _______________________________

$$P(\text{Jazz}) = \frac{\text{total number of jazz albums sold}}{\text{total number of albums sold}} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

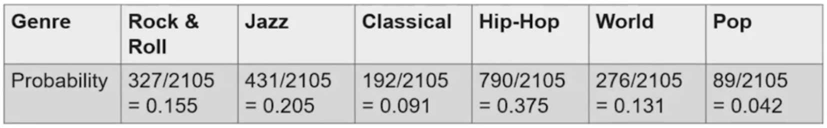
Interpreting Probability

Probability of events in repeatable situations can be interpreted as the __________________ frequency with which the event will occur in the _____________________. **P(Jazz) = _____________**
If we were to __________________ select many individual albums sold this year (with replacement), the ___________________ frequency of jazz albums selected would be approximately _____________.

Name_______________________________

Listen Up!

One way to organize the information is by using a table that lists event and corresponding probabilities.



Genre	Rock & Roll	Jazz	Classical	Hip-Hop	World	Pop
Probability	327/2105 = 0.155	431/2105 = 0.205	192/2105 = 0.091	790/2105 = 0.375	276/2105 = 0.131	89/2105 = 0.042

Add up all of the probabilities. What do they equal to? _________________ What should they equal to? _________________ Is this a valid probability distribution?

If we add the decimals, we get _________. This is because of _________________, but it ________ a valid probability distribution because the ___________ of all probabilities is ______ (_______________).

Complements

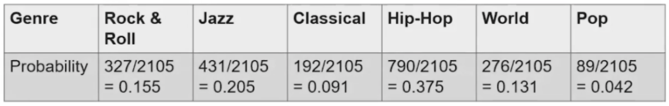
The complement of an event A is the event that A _______________________________.

The complement of A is denoted by ______________________________.

The probability of the complement of A is equal to _______________________.

P(A') = 1 – P(A)

Listen Up!



Genre	Rock & Roll	Jazz	Classical	Hip-Hop	World	Pop
Probability	327/2105 = 0.155	431/2105 = 0.205	192/2105 = 0.091	790/2105 = 0.375	276/2105 = 0.131	89/2105 = 0.042

P(not Jazz) = _______________

= _______________

= _______________

What Should We Take Away?

The probability of an event involving equally likely outcomes is the _____________of the number of ______________ for a certain event divided by the _________________ in the ___________________.

The probability of an event is a number between _________________, inclusive.

The probability of the ______________________ of an event E is equal to _____________________.

Name______________________________

AP Statistics CED 4.4 Daily Video 1 (Skill 4.B)

Mutually Exclusive Event

What Will We Learn?

Why are some events mutually exclusive, and other not?

Listen Up!

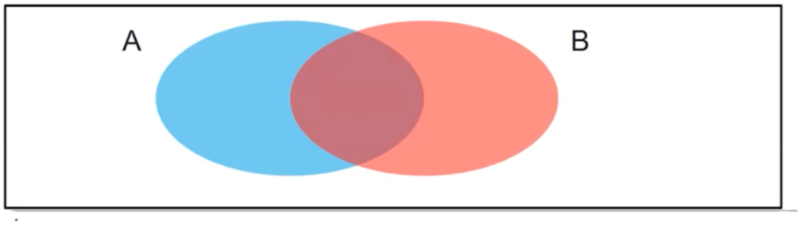
Genre	Rock & Roll	Jazz	Classical	Hip-Hop	World	Pop
Probability	327/2105 = 0.155	431/2105 = 0.205	192/2105 = 0.091	790/2105 = 0.375	276/2105 = 0.131	89/2105 = 0.042

In this example, each column represented the number of albums of different genre that were sold by a record store. Because an album can only be classified by a single genre, the genres are ________________________________. Mutually exclusive (_________________) events ________________ occur at the ________________________.

Venn Diagrams

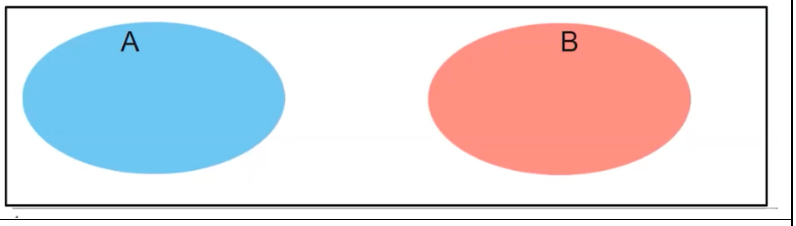
__________________ can be used to represent probabilities in a ______________ form. Venn diagrams often use circles/ovals to represent _______________. The portion where the graphs _______________ is the _______________ of the two events, and is represent by the notation A ∩ B.

When we draw a Venn diagram, we want to start off with some sort of rectangle to represent the entire _____________________________.



Mutually Exclusive Events

_________________________ events are events that ________________ occur at the same time. There would be ____________________________ of the two events.



Number Cubes

Consider rolling a number cube with side 1 – 6.

Event A = ____

Event B = ____

Event C = ____

Calculate P(A ∩ B) and P(A ∩ C)

P(A ∩ B) = _____________________

A and C are _________________________

P(A ∩ C) = _____________________

Name______________________________

Super Status!

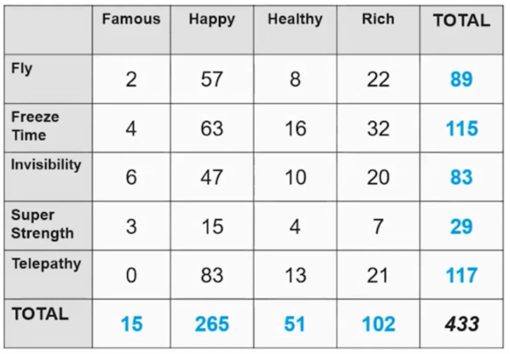
High school students from across the country answered the following two questions:

*If you had to choose a superpower, what would it be?

- fly, freeze time, invisibility, super strength, telepathy

*Which of the following statuses would you prefer to describe you?

- famous, happy, healthy, rich



	Famous	Happy	Healthy	Rich	TOTAL
Fly	2	57	8	22	89
Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	*433*

The results from a sample of 433 respondents are shown in the table.

Super Status! (See the table above)

The data are summarized in a _________________________. Probabilities can be found by calculating the ___________ of the desired frequencies.

Example: What is the probability that a randomly selected student chose to be happy?

- P(Happy) = ___________________________

Super Status!

Example: What is the probability that a randomly selected student chose to be happy and freeze time?

- P(Happy ∩ Freeze Time) = _____________________________

This probability is called the __________________________________. It is the probability of the intersection of the events _____________ and ________________________.

Super Status!

Example: What is the probability that a selected student chose to be famous and telepathic?

- P(Famous ∩ Telepathy) = _______________________

Because no students chose to be _______________ famous and telepathic, the two events are ________________________________ (____________________).

What Should We Take Away?

The ____________________________ is the probability if the _______________________ of two event.

Two events are _________________________ (_______________) if they __________________ occur at the same time. If two events are mutually exclusive, the probability of their intersection is ______.

Name________________________________

AP Statistics CED 4.5 Daily Video 1 (Skill 3.A)

Conditional Probability

What Will We Learn?

What is conditional probability?

How does conditional probability help us find the joint probability P(A and B)?

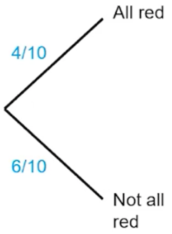
Marble-ous!

Suppose we select tow of these marbles at random (without replacement). What is the probability that both marbles are fully red?

<u>Assign two events</u>: A = ______________________________ B = ___________________________

P(A) = __________________. What about the second marble being red? I ____________ on what the first marble was. The probability of the second marble being red is _____________________ on the status of the _____________ marble.

Tree Diagram:
(Complete with Video)

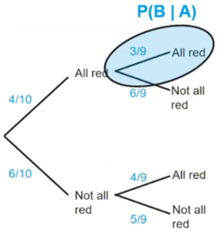


Conditional Probability

We can use the following notation to represent conditional probabilities:

P(B | A) is read, "_______________"

What is the probability that event B ________ occur given that event A __________________ occurred?

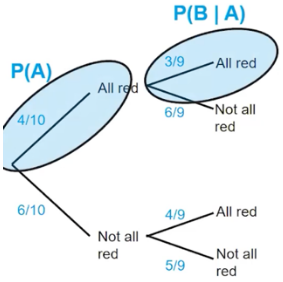


Marble-ous!

Suppose we select two of these marbles at random (without replacement). What is the probability that both marbles are fully red?

Multiplication Rule:

$$P(A) \cdot P(B \mid A) = P(A \cap B)$$



For our example: P(A ∩ B) = _________________________________

= _________________________________

= _________________________________

Divide both sides by P(A) to get formula for conditional probability.

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

*Note this formula can be "flip-flopped" for P(A I B) = $\frac{P(B \cap A)}{P(B)}$

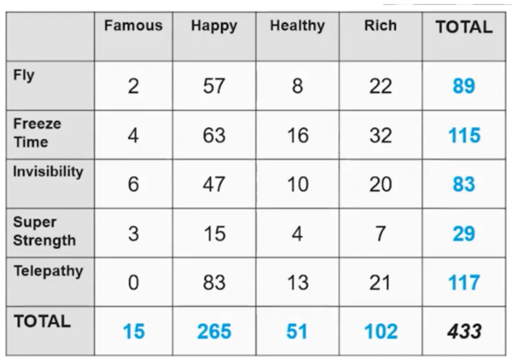
Name________________________________

Super Status!

High school students from across the country answered the following two questions:

*If you had to choose a superpower, what would it be?
  - fly, freeze time, invisibility, super strength, telepathy

*Which of the following statuses would you prefer to describe you?
  - famous, happy, healthy, rich



	Famous	Happy	Healthy	Rich	TOTAL
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Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

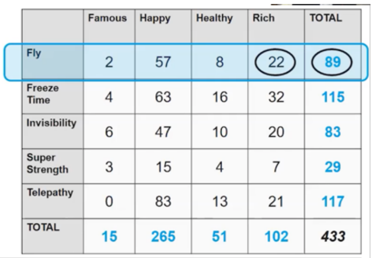
The results from a sample of 433 respondents are shown in the table.
What is the probability that a "randomly selected" student stated that they wanted to be rich, given they also wanted to fly?

$$P(Rich \mid Fly) = \frac{P(Rich \cap Fly)}{P(Fly)} = \underline{\hspace{6cm}} = \underline{\hspace{6cm}}$$

Super Status!

This same question can be answered by looking at a two-way table. For our problem, the Condition: ___________ so we look solely at this row of the table to the right.

$$P(Rich \mid Fly) = \underline{\hspace{6cm}}$$



	Famous	Happy	Healthy	Rich	TOTAL
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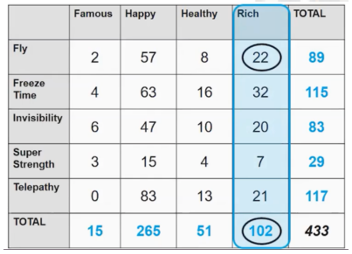
Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

Super Status!

The order of the conditional statement matters! For this problem, the Condition: __________. We are only interested in students who said they wanted to be _______ and also said they wanted to _____.

$$P(Fly \mid Rich) = \underline{\hspace{6cm}}$$



	Famous	Happy	Healthy	Rich	TOTAL
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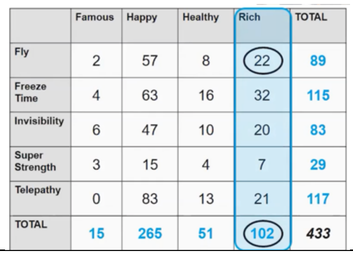
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

Super Status!

Sometimes we need to look at more than one column. In this case the condition is: _________________.

$$P(Fly \mid Rich') = \underline{\hspace{10cm}}$$



	Famous	Happy	Healthy	Rich	TOTAL
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Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

What Should We Take Away?

____________________________ is the probability that an event happens _________ that another event is known to have _________________ happened.

The _______________________________ rule for two events A and B is: $P(A \cap B) = P(A) \cdot P(B \mid A)$

Name______________________________

AP Statistics CED 4.6 Daily Video 1 (Skill 3.A)

Independent Events and Union of Events

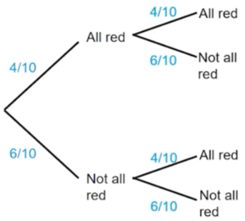
What Will We Learn?

How can conditional probabilities be used to determine independence?
How can we use the multiplication rule to determine independence?

Marble-ous! Part 2

Suppose we selected one marble at random, replace it, and then randomly select a second marble. What is the probability that both marbles are fully red?

First, we define our events. A = ___________________ and
B = ____________________



Independent Events

P(A | B) = ____________ **and** P(A | B′) = _________________
(same is true with know if B has occurred)
P(B | A) = ____________ **and** P(B | A′) = __________________

Independent Events

General Multiplication Rule: $\mathrm{P(A\ and\ B) = P(A)} \cdot$ ____________

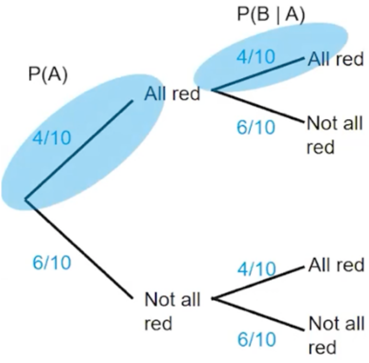
But because of _________________ (or in the case of two independent events) we can know that our conditional probability is equal to the unconditional probability, IF we check to make sure the two events are independent.

Marble-ous! Part 2

Events A and B are independent if, and only if, knowing whether or not event A has occurred (or will occur) does not change the probability that event B will occur. First, determine the events.
A = ______________________ and B = _______________________

So in our example: P(A | B) ____________ and P(B) _____________

Therefore, P(A and B) = P(A) · P(B). In our example then:
P(A and B) = _________________________ = _________



Independent Events

Suppose you selected four marbles, one at a time, with replacement. What is the probability of selecting two red marbles followed by two non-red marbles?

P(Red and Red and Non-Red and Non-Red) = _________________________________ = __________

Independent Events

Suppose you select 10 marbles, one at a time, with replacement. What is the probability that at least one marble is red? For this type of problem we will use the ___________________________ Rule

P(at least one red) = ______________________ = _________________________ = _______________

Name______________________________

Determining Independence

Consider two events, E and F.

P(E) = __________; P(F) = ___________ and P(E and F) = __________. Are the events E and F independent?

If two events are ________________________, then P(E | F) = P(E). We need to calculate the ____________________ probability P(E | F).

P(E | F) = ______________________ = _______________________ ≈ ______

Now, compare P(E | F) _________ to P(B) = __________, are they equal? __________

Because P(E | F) ________ P(B), the events E and F are ______________________________________.

Determining Independence

Consider two events, E and F. P(E) = .40; P(F) = 0.60 and P(E and F) = 0.25. Are the events E and F independent? If two events are independent, then P(E and F) = ______________.

So, we need to calculate _________________ = ___________________ = _______________

Because P(E and F) ______ P(E) · P(F), the events _____________ are ______________________________.

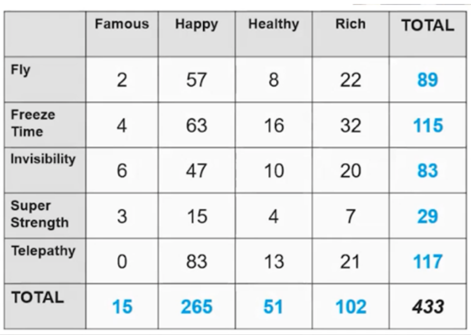
Super Status!

High school students from across the country answered the following two questions:

*If you had to choose a superpower, what would it be?

- fly, freeze time, invisibility, super strength, telepathy. The results from a sample of 433 respondents are shown in the table.

Are the events "choose invisibility" and "choose to be famous" independent? Justify your answer.



	Famous	Happy	Healthy	Rich	TOTAL
Fly	2	57	8	22	89
Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

If the two events are _______________ then P(___________ | ___________) = P(_________________)

P(_______________ | _______________) = ____________________ = ____________

P(______________) = ___________________ = _________________

Because the ______________________ probability is ________ equal to the __________________ probability, the events are _____________________________________.

We can also calculate this from the two-way table. If the two events are _______________________ then P(____________ ∩ ___________) = P(___________) · P (_____________) So to check this...

P(____________ ∩ ___________) = ____________________ = ________________

P(___________) · P (_____________) = _____________________ = ________________

Because the probability of the ___________________ is _________ equal to the ___________ of the individual probabilities, the events are ____.

What Should We Take Away?

Two events A and B are independent if, and only if, P(A|B) = P(A) and P(B|A) = P(B)

Two events A and B are independent if, and only if, P(A and B) = P(A) · P(B)

Name______________________________

AP Statistics CED 4.6 Daily Video 2 (Skill 3.A)

Independent Events and Unions of Events

What Will We Learn?

How do we calculate the probability for the union of two events?

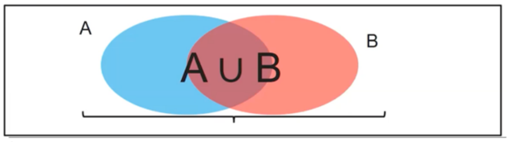
Union of Events

The probability that event A or event B (or both) will occur is the probability of the ______________ of A and B, denoted P(A ∪ B).

The ___________________ states that the probability that event A and event B or _________ will occur is _____________ to the probability that event A will occur, _________ the probability that event B will occur, ___________ the probability that ____________ events A and B will occur. This is denoted: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

Venn Diagrams

Venn diagrams can be used to represent probabilities in a ______________ form. Venn Diagrams often use circles/ovals to represent ______________. The portion contained within either oval is the ____________ of the two events, and is represented by the notation ______________.



Number Cubes

Consider rolling a number cube with side 1 -6. Define our events.

Event A = __________________ = ____________. Event B = __________________ = _____________.

Calculate the P(A ∪ B) (Use the addition rule above and make sure to not double count outcomes!)

P(A ∪ B) = ____________________________ = _______________ ≈ _________

Calculating the Union

Consider two events, E and F. P(E) = _________; P(F) = _________ and P(E | F) = 0.25. Find the probability of event E or event F (or both) happens. (Again, us the formula above.)

We need to find: P(E ∩ F) = P(F) · P(E | F) = __________________ = _______.

Once we have this, we can use the formula:

P(E ∪ F) = ___________________________________ = ______________

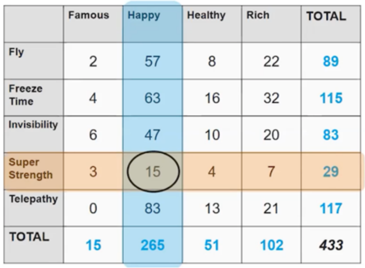
Super Status!

High school students from across the country answered the following two questions:

*If you had to choose a superpower, what would it be?

- fly, freeze time, invisibility, super strength, telepathy

The results from a sample of 433 respondents are shown in the table. What is the probability of selecting a student who chose to be happy or wants super strength? First we define the events:



	Famous	Happy	Healthy	Rich	TOTAL
Fly	2	57	8	22	89
Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

A = ______________________ B = _______________________ now find:

P(A ∪ B) = P(A or B) = _______________________________________ (copy formula)

= _____________________________ = ______________ = _________

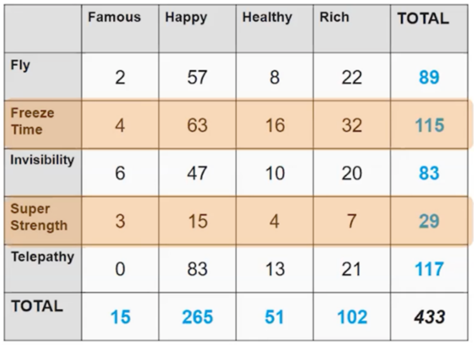
Name________________________________

Super Status!

What is the probability of selecting a student who chose to freeze time or want super strength? Be sure to start by defining the events:

A = ______________________________

B = ______________________________



	Famous	Happy	Healthy	Rich	TOTAL
Fly	2	57	8	22	89
Freeze Time	4	63	16	32	115
Invisibility	6	47	10	20	83
Super Strength	3	15	4	7	29
Telepathy	0	83	13	21	117
TOTAL	15	265	51	102	433

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

Looking at the table to the right, we see that events A and B are _______________________, so the P(A or B) = _______________; So using the formula we get:

P(A or B) = P(A) + P(B) = __________________________________ = ______________________

What Should We Take Away?

The probability of the union of two events can be found by the formula:

____

Name______________________________

AP Statistics CED 4.6 Daily Video 3 (Skill 3.A)

Independent Events and Unions of Events

What Will We Learn?

How can we distinguish questions involving conditional and unconditional probabilities?

How do we determine which probability formula to use when?

Probability Recap

If all outcomes in a sample space are equally likely, then the probability of an event E occurring can be defined as: _________________________

The probability of an event is a number between _________________________.

The probability of the complement of an event E, denoted by _______, _______, or ________ is equal to __________________.

Probability Recap

*Probabilities can be interpreted as the _____________________ relative frequency the event will occur if the random process is _____________ many times.

*Two events are _______________________ (______________) if they _________________ occur at the same time. If two events A and B are mutually exclusive, them ______________________________.

* ____________________ probability is the probability that an event will occur, given that another event has __________________ occurred. Which is denoted by the formula:

P(A | B) = _________________________

Probability Recap

The probability of the ___________________of two events can be found by the formula:

*P(A ∩ B) = _________________________________

If two events are _____________________________, then:

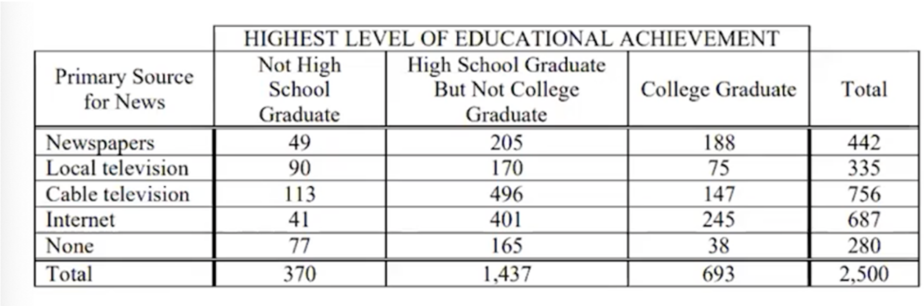
*P(A | B) = _________________________

*P(B | A) = _________________________

*P(A ∩ B) = ________________________

What's the News?

An advertising agency in a large city is conducting a survey of adults to investigate whether there is an association between highest level of educational achievement and primary source for news. The company take a random sample of 2500 adults in the city. The results are shown in the table below.



	HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT			
Primary Source for News	Not High School Graduate	High School Graduate But Not College Graduate	College Graduate	Total
Newspapers	49	205	188	442
Local television	90	170	75	335
Cable television	113	496	147	756
Internet	41	401	245	687
None	77	165	38	280
Total	370	1,437	693	2,500

(a) If an adult is to be selected at random from this ample, what is the probability that the selected adult is a college graduate or obtains news primarily from the internet?

Name_______________________________

What's the News?

Define the events: A: ______________________________ and B: _______________________________

Use the formula: P(A or B) = ____ (copy formula)

= ______________________________________ = _____________

What's the News?

(b) If an adult who is a college graduate is to be selected at random from this sample, what is the probability that the selected adult obtains news primarily from the internet?

Define the events: A =_____________________________ and B = _______________________________

Use the formula: P(B l A) = ----------------------------- = ------------------------------ = ------------- = _________

What's the News?

To distinguish between part A and part B we have to look at the two questions: (Highlight with video)

(a) If an adult is to be selected at random from this ample, what is the probability that the selected adult is a college graduate or obtains news primarily from the internet?

Adult selected ______________________________

(b) If an adult who is a college graduate is to be selected at random from this sample, what is the probability that the selected adult obtains news primarily from the internet?

Adult selected ____

What's the News?

(c) When selecting an adult at random from the sample of 2,500 adults, are the events "is a college graduate" and "obtains new primarily from the internet" independent? Justify your answer.

Define the events: A = ___________________________ and B = ______________________________

Use the formula: P(B l A) = ____________________

*P(B l A) = _________________________ and the P(B) = ___________________________

Because the _____________________________ probability P(internet l college grad) is _________ equal to the __________________________ probability P(internet), the events "_________________________" and "____________________________________" are ____.

OR

Use the formula: P(A ∩ B) = P(A) · P(B);

*P(A ∩ B) = _______________ = _______________

*P(A) · P(B) = ________________________ = ________________

What Should We Take Away?

Conditional Probabilities can be calculated from _________________________ by selecting the appropriate ________________ or __________________.

If the conditional probability ___________________ is _________ to the unconditional probability _____________, then the events A and B are _____________________________.

The probability for the _____________ of two events can be found by using

P(A or B) = ____

Name______________________________

AP Statistics CED 4.7 Daily Video 1 (Skill 2.B)

Introduction to Random Variables and Probability Distributions

What Will We Learn?

How should we define a random variable?
What is the difference between a discrete and continuous random variable?
How can we display a probability distribution for a discrete random variable?

Random Variables:

Random variables are ___________________ outcomes of _______________________________.

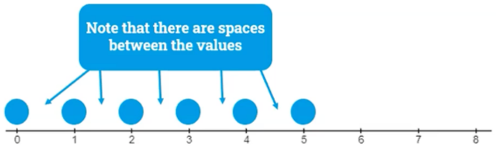
For example:

- X = _________________________ in a _________________ selected household.
- W = __________________ it takes a ________________ selected person to run a mile.
- Y = the number of _____________________________ out of _____ randomly selected dogs.
- L = ___________________ of a _________________ selected person's index finger.

Discrete Versus Continuous Random Variables

A _______________ random variable can only take a _________________ number of values.

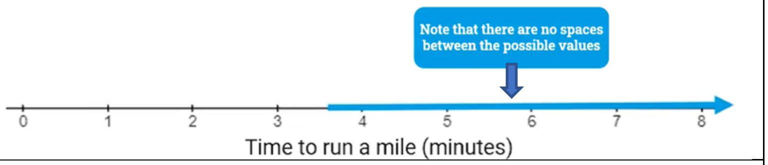
X = number of children in a randomly selected household.



*Note: countable could mean ______________________.

A __________________ random variable can take on an _________________ number of values in an ________________ on a number line.

W = time (in minutes) it takes a randomly selected person to run a mile. The current world record for the mile is 3:43 minutes.



Classifying Random Variables

- X = number of children in a randomly selected household _______________
- W = time (min) it takes a randomly selected person to run a mile _______________
- L = length (cm) of a randomly selected person's index finger _______________

Thermostat Settings:

Proper disposal and reduction of refrigerant chemicals used to cool our homes in heat of summer are a high priority in reducing CO_2 and CO_2 equivalents into the atmosphere. Toward that end, the City of Austin recommends setting thermostats to 78 degrees for air conditioning.

X = the ______________________ a thermostat is set below the recommended 78 degrees.

The thermostat is set at _______ degrees. The difference between the recommended setting and the actual setting is ______ degrees. So ________ would be the value of our random variable X.
The thermostat is set at _______ degrees. The difference between the recommended setting and the actual setting is ______ degrees. So ________ would be the value of our random variable X.

Probability of a Random Variable.

The city of Austin recommends setting thermostats to 78 degrees for air conditioning. A study determined that:

- The probability that a randomly selected thermostat is set at 78 degrees is ____________.
- The probability that a randomly selected thermostat is set at 75 degrees is ____________.

A display of the entire set of values with associated probability is called a _______________________ _____________________________.

Name______________________________

Probability Distributions

There are two properties of a probability distributions:

temp.	78	77	76	75	74	73	72
x	0	1	2	3	4	5	6
P(x)	0.03	0.03	0.05	0.18	0.31	0.28	0.12

X = the number of degrees a thermostat is set below the recommended 78 degrees

1. Each value is associated with a ______________________________________.
2. The sum of all probabilities must be ______________.

Calculating Probability with the Distribution

Now that we have the complete distribution, we can determine probabilities for defined events. What is the probability that a randomly selected thermostat is set at 74 degrees or lower?

temp.	78	77	76	75	74	73	72
x	0	1	2	3	4	5	6
P(x)	0.03	0.03	0.05	0.18	0.31	0.28	0.12

X = the number of degrees a thermostat is set below the recommended 78 degrees

$P(X \geq 4)$ = ____ = __________

Calculating Probabilities

temp.	78	77	76	75	74	73	72
x	0	1	2	3	4	5	6
P(x)	0.03	0.03	0.05	0.18	0.31	0.28	0.12

X = the number of degrees a thermostat is set below the recommended 78 degrees

1. What is the probability that a randomly selected thermostat is set at 77 degrees?

____

2. What is the probability that a randomly selected thermostat is set less than 74 degrees?

____

3. What is the probability that a randomly selected thermostat is set for at least 75 degrees?

____

4. What is the probability that a randomly selected thermostat is set at 70 degrees.

____

What Should We Take Away?

A random variable must be defined _________________________.

A __________________ probability distribution gives ________ possible outcomes paired with each outcome's probability.

The ___________ of probabilities for ________ possible values of a _______________ random variable is ______________.

Name______________________________

AP Statistics CED 4.7 Daily Video 2 (Skill 4.B)

Introduction to Random Variables and Probability Distributions

What Will We Learn?

How can we describe a probability distribution?
What conclusions can be made from a probability distribution?

Prairie Dogs

Prairie dogs are keystone species. That means they are disproportionately important to their ecosystem. Many other species of plants and animals would suffer without them. Prairie dogs only mate once a year. The number of pups in a randomly selected litter varies and can be modeled by using a probability distribution.

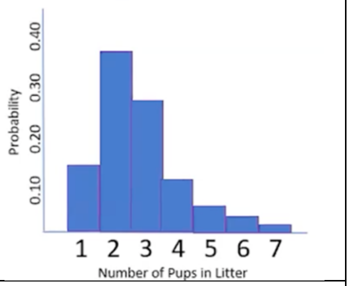
Prairie Dog Pups: Probability Distribution

X = the number of pups in a randomly selected prairie dog litter

x	1	2	3	4	5	6	7
P(x)	0.15	0.38	0.27	0.11	0.05	0.03	0.01

Describing the Distribution

A histogram could be constructed for easier viewing.



- Shape ____
- Center ____
- Spread ____
  ____

Interpret the Distribution in Context

Should a zoologist be surprised if a randomly selected female prairie dog produced a litter with 6 or 7 pups? ______________. The probability of a litter having ________________ pups is only __________, which is relatively __________________. This event would be big news in the prairie dog world.

Thermostat Settings

temp.	78	77	76	75	74	73	72
x	0	1	2	3	4	5	6
P(x)	0.03	0.03	0.05	0.18	0.31	0.28	0.12

X = the number of degrees a thermostat is set below the recommended 78 degrees

Proper disposal and reduction of refrigerant chemicals used to cool our homes in heat of summer are a high priority in reducing CO_2 and CO_2 equivalents into the atmosphere. Toward that end, the City of Austin recommends setting thermostats to 78 degrees for air conditioning. Describe the distribution:

- Shape: ____
- Center: ____
- Spread: ____

Would you recommend an advertising campaign to encourage citizens to set their thermostats to a higher temperature? Justify your answer using the probability distribution. _________. The majority of citizens have their thermostats set a least __________ below the recommended ________ degrees. This can be supported by the ________________ of _____ being clearly in the __________ degree setting. Also, the probability that a ____________________ selected household has their thermostat set at __________________________ is ___________________________________.

Name______________________________

What Should We Take Away?

A complete description of a probability distribution requires ______________, _______________, and __________________.

Conclusions may be drawn about the ____ using a probability ___________________________.

Name________________________________

AP Statistics CED 4.8 Daily Video 1 (Skill 3.B)

Mean and Standard Deviation of Random Variables

What Will We Learn?

How can we calculate the parameters of a discrete random variables?
How should we interpret the parameters?

Prairie Dogs

x	1	2	3	4	5	6	7
P(x)	0.15	0.38	0.27	0.11	0.05	0.03	0.01

Prairie dogs are keystone species. That means they are disproportionately important to their ecosystem. Many other species of plants and animals would suffer without them. Prairie dogs only mate once a year. The number of pups in a randomly selected litter varies and can be modeled by using a probability distribution.

Prairie Dogs

First, always define the ____.

X = the ______________ of pups in a ___________________ selected prairie dog litter.

Mean of a Probability Distribution

$$\mu_X = \sum x_i \cdot P(x_i)$$

Expected Value

The sum of each product

Each individual *x* value

The probability with each *x* value

X = the number of pups in a randomly selected prairie dog litter

x	1	2	3	4	5	6	7
P(x)	0.15	0.38	0.27	0.11	0.05	0.03	0.01

The formula takes into account the ________________ weights of each ________________.

Copy the work for finding the mean of a probability distribution:

____ = ___________

Interpret the Mean (Expected Value)

X = The number of pups in a randomly selected prairie dog litter

μ_x = _____________; How could we ____________ 2.66 pups per litter? That is not possible.

In the _________________________, if ____________ prairie dog litters are randomly selected, the ____________ number of pups per litter will be about ___________ pups.

Standard Deviation

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

X = the number of pups in a randomly selected prairie dog litter

x	1	2	3	4	5	6	7
P(x)	0.15	0.38	0.27	0.11	0.05	0.03	0.01

$\mu_X = 2.66$ pups

σ_X = ____ = ______________

Interpreting the Standard Deviation

What does the standard deviation mean?

The ________________ of prairie dog pups is _______________ selected litters will ______________ vary from the _____________ of _______________ by about __________________.

Name________________________________

Variance

Remember: The standard deviation is the ___________________ of the ___________________.

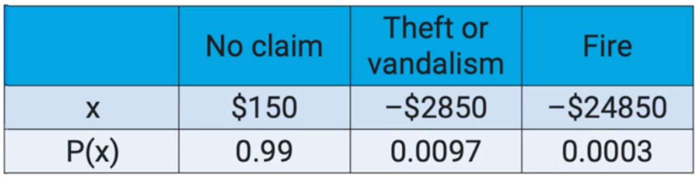
Then the _______________________ is $\sigma_x^2 = \sum(x_i - \mu_{x)}{}^2 \cdot \mathrm{P}(x_i)$

Renter's Insurance

An insurance company offers renter's insurance for apartment dwellers. A typical $25,000 policy costs $150 per year and pays for loss due to fire and theft/vandalism. The average payout for theft/vandalism is $3,000 and has a probability of 0.0097 of happening. A first usually pays out the entire $25,000 due to a complete loss of property. But for the most part, 99% of the time, there is no claim filed. Construct a probability distribution to represent the insurance company's profit for this type of policy.

Let the random variable X represent the insurance company's profit on a randomly selected policy.

X = the insurance company profit on a randomly selected policy



	No claim	Theft or vandalism	Fire
x	$150	−$2850	−$24850
P(x)	0.99	0.0097	0.0003

Calculate and interpret the expected profit of the insurance company.

μ_x = $E(X)$ = ____ = __________________

The insurance company can _____________ to make, __________________, about ____________ per renter's policy from a _____________________________ of randomly selected policies.

What Should We Take Away?

The _____________ and ________________________ of a _______________ random variable can be calculated using the formulas:

$$\mu_X = E(X) = \sum x_i \cdot P(x_i) \qquad \sigma_X = \sqrt{\sum (x_i - \mu_X)^2 \cdot P(x_i)}$$

Interpretations of parameters of random variables should use _____________________________ and include ___________________ of a specified population.

Name________________________________

AP Statistics CED 4.9 Daily Video 1 (Skill 3.C)

Combining Random Variables

What Will We Learn?

How does a linear transformation affect the mean of a random variable?
How does a linear transformation affect the standard deviation of a random variable?

Parking Lot Trees

The city of Austin requires businesses with parking lots to plant trees in and around the lot. Among other requirements, the code states that no parking space can be more than 50 feet from a tree. In a large retail parking lot, this means developers must create tree islands throughout the parking area.

Unhealthy Trees

One of the tasks of the Urban Forester is to randomly check the health of parking lot trees and report how many trees have died or have a disease. Most trees are well taken care of due to the fines associated with losing trees.

Let X represent the number ________________________ in a randomly selected parking lot. The distribution of X can be modeled with a ____.

Probability Distribution

Calculate the mean and standard deviation of X.

x	0	1	2	3
P(x)	0.93	0.04	0.02	0.01

X = the number of unhealthy trees in a randomly selected parking lot

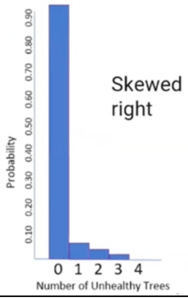
$\mu_x = \sum x_i \cdot \mathrm{P}(x_i) =$ __________________________________ = ______

$\sigma_x = \sqrt{\sum (x_i - \mu_x)^2 \cdot P(x_i)}$

= ____ = ____________

Probability Distribution

$\mu_x =$ ___________ and $\sigma_x =$ ______________; We have the center and the spread, let's make a histogram to see the shape.



From the histogram, we can see that the distribution is ________________________.

Transforming Data

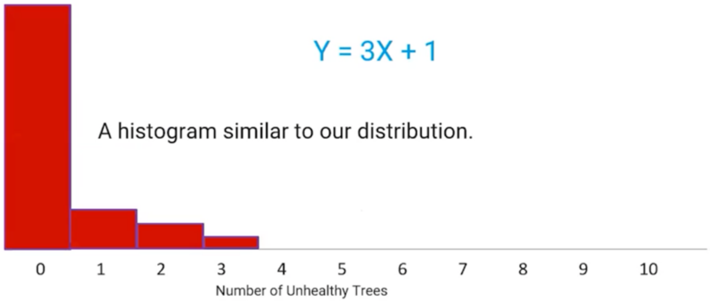
Suppose a disease-spreading insect has infested many trees throughout the city. The effect on the number of unhealthy trees can be modeled by the random variable Y = 3X + 1, where:

X = the number of ____________________ in a __________________ selected parking lot ____________ the insect infestation.
Y = the number of ____________________ in a __________________ selected parking lot ____________ the insect infestation.

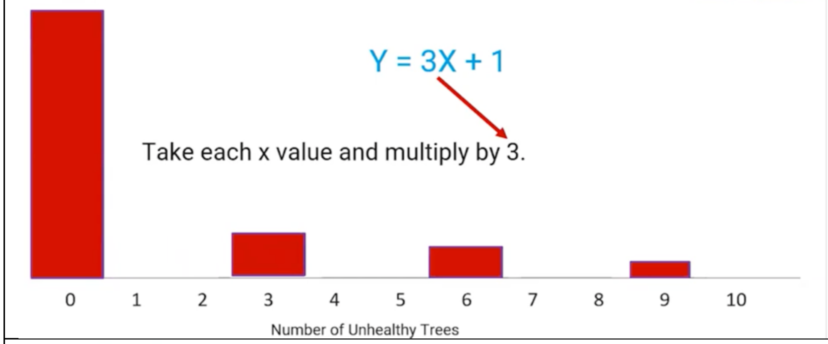
What are the shape, center (mean), and spread (standard deviation) of the probability distribution of Y?

Name______________________________

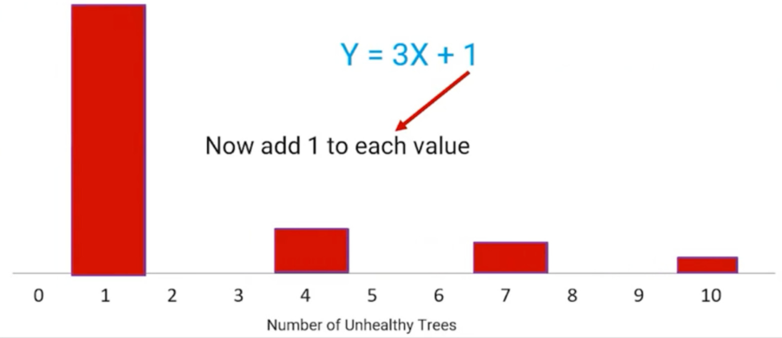
A Linear Transformation



Here the original histogram prior to any transformation.



Multiplying the values by ______ increases the ____________ (mean) and _________ (standard deviation) by a factor of 3.

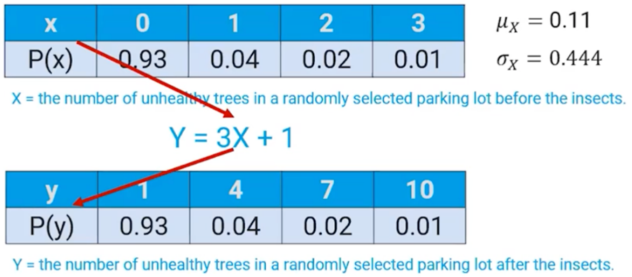


The _____________ did not change. The ____________ (mean) increased by ______.

The _________ of the distribution remains the same -

____

Transformed Distribution – Finding the Mean



x	0	1	2	3
P(x)	0.93	0.04	0.02	0.01

X = the number of unhealthy trees in a randomly selected parking lot before the insects.

Y = 3X + 1

y	1	4	7	10
P(y)	0.93	0.04	0.02	0.01

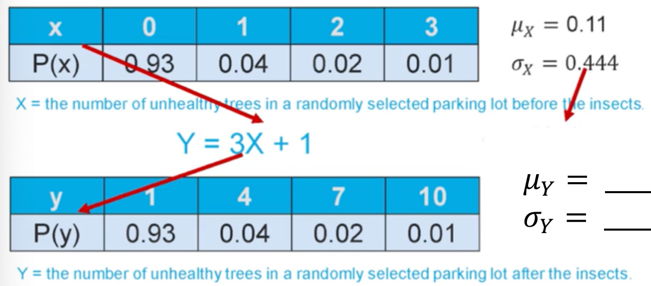
Y = the number of unhealthy trees in a randomly selected parking lot after the insects.

$\mu_X = 0.11$

$\sigma_X = 0.444$

$\boldsymbol{\mu_Y} =$ ____________________ = _________

Transformed Distribution – Finding the Standard Deviation



x	0	1	2	3
P(x)	0.93	0.04	0.02	0.01

X = the number of unhealthy trees in a randomly selected parking lot before the insects.

Y = 3X + 1

y	1	4	7	10
P(y)	0.93	0.04	0.02	0.01

Y = the number of unhealthy trees in a randomly selected parking lot after the insects.

$\mu_X = 0.11$

$\sigma_X = 0.444$

$\mu_Y =$ _______

$\sigma_Y =$ _______

Name_______________________________

Bowling

Bowling is a sport that requires players to roll a ball down an alley to knock down pins. To make the game of bowling more competitive for league players, each player is given a handicap score to add to the final score of each game they play. This ensures that players of all abilities have an opportunity to win.

Let X = the _________________ randomly selected players in a league where:

μ_x = 138 points and σ_x = 15.1 points

If the league uses the following formula to calculate the handicap, what are the mean and standard deviation of the handicap scores? Handicap = (200 – X) · 0.85

Handicap Scores

Identify the random variable: X = ____

Let Y = the handicap score

μ_Y = ___________________ σ_Y = ____________________

μ_Y = ___________________ σ_Y = ____________________

What Should We Take Away?

For any random variable X, the linear transformation Y = a + bX has a probability distribution with:

Mean: _____________________________ **and Standard Deviation:** _____________________________

Name________________________________

AP Statistics CED 4.9 Daily Video 2 (Skill 3.B)

Combining Random Variables

What Will We Learn?

How do we find the mean of a linear combination of two random variables?

How do we find the standard deviation of a linear combination of two random variables?

How do we determine independence of two random variables.

Gas and Hybrids

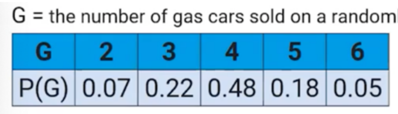
A new company that sells vehicles online in a rural area records the number of cars sold each day. The data for gas cars and hybrid cars are recorded separately.

Let G = ____

Let H = ____

Random variable G and H can each be represented by a ___________________________________.

Car Sales



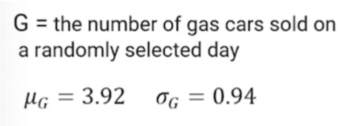
G = the number of gas cars sold on a randomly selected day

G	2	3	4	5	6
P(G)	0.07	0.22	0.48	0.18	0.05

H = the number of hybrid cars sold on a randomly selected day

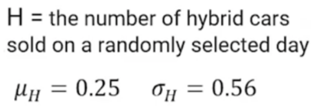
H	0	1	2
P(H)	0.81	0.13	0.06

Finding the Mean of a Sum



G = the number of gas cars sold on a randomly selected day

$\mu_G = 3.92 \quad \sigma_G = 0.94$



H = the number of hybrid cars sold on a randomly selected day

$\mu_H = 0.25 \quad \sigma_H = 0.56$

Let T = G + H. What is the mean of T? ___________________________________

So, the formula is as simple as ___________ the two means. $\mu_T = \mu_{G+H} = \mu_G + \mu_H$

Let D = G – H. What is the mean of D? ____________________________________

So, the formula is as simple as _____________ the two means. $\mu_D = \mu_{G-H} = \mu_G - \mu_H$

The company keep track of the ________________ in the number of gas cars sold and the number of hybrid cars sold on a randomly selected day.

Independent Random Variable

Suppose we are told the number of gas cars sold on a randomly selected day by the online company in this rural area. Does that change the probability distribution of H? ________ seems like a reasonable answer. So, G and H are ___________________ random variables.

Two random variables are __________________ if knowing information about one of them does _______ change the probability distribution of the other.

Finding the Standard Deviation

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

If two random variables X and Y are independent, then to find the standard deviation we must first find the __________________.

For a sum or difference of independent random variables, ___________________________.

Note that standard deviations ______________________________!

Name______________________________

Standard Deviation of a Sum

G = the number of gas cars sold on a randomly selected day

$\mu_G = 3.92 \quad \sigma_G = 0.94$

H = the number of hybrid cars sold on a randomly selected day

$\mu_H = 0.25 \quad \sigma_H = 0.56$

Let T = G + H. What is the standard deviation of T? Because G and T are independent random variables:

$\sigma_T^2 = \sigma_G^2 + \sigma_H^2$ = ____ = __________

σ_T = ______________________ = _______________

Standard Deviation for a Difference

G = the number of gas cars sold on a randomly selected day

$\mu_G = 3.92 \quad \sigma_G = 0.94$

H = the number of hybrid cars sold on a randomly selected day

$\mu_H = 0.25 \quad \sigma_H = 0.56$

Let D = G – H. What is the standard deviation of D? Because G and T are independent random variables:

$\sigma_D^2 = \sigma_G^2 + \sigma_H^2$ = ____________________________________ = _________

σ_T = ____________________ = ___________

Linear Combinations

For any two random variables X and Y, and real numbers *a* and *b*, the expression aX +bY is called a linear combination of X and Y. Mean = $a\mu_x + b\mu_x$;

If X and Y are independent: Standard deviation: ____________________

Holiday Sale

G = the number of gas cars sold on a randomly selected day

$\mu_G = 3.92 \quad \sigma_G = 0.94$

H = the number of hybrid cars sold on a randomly selected day

$\mu_H = 0.25 \quad \sigma_H = 0.56$

The online company awards 2 points for each gas car sold and 3 points for each hybrid car sold to its manager. Calculate the mean and standard deviation of the total points awarded to the regional manager on a randomly selected day.

2G + 3H = ____

μ_{2G+3H} = _______________________ = ______________________ = _______________

σ_T = ____ = ______________

What Should We Take Away?

For independent random variables X and Y and real number *a* and *b*:

the mean of ________________________ = ___________________

the standard deviation of _________________ = _____________________

Two random variables are _________________ if knowing information about _________ of them does ______ change the probability distribution of the other.

Name______________________________

AP Statistics CED 4.10 Daily Video 1 (Skill 3.A)

Introduction to the Binomial Distribution

What Will We Learn?

How can we recognize a binomial random variable?
How do we calculate a probability for a binomial distribution?

Weather

The weather has many examples of binomial settings. (Watch video!)

Binomial Setting

A binomial setting involves ______________ trials of a random process, where the following conditions are met:

- Two possible outcomes: ______________________________
- ______________________ of the same random process.
- A _____________________ of trials, *n*
- Each ___________ has the __________________________ of success, *p*

Checking Binomial Conditions

The probability a tropical storm becomes a hurricane is 0.53. If the weather service predicts 6 more tropical storms, what is the probability that exactly 5 of them become hurricanes?
Check the conditions:

- Two outcomes: ____
- Independent trials: ____
  ____
- A fixed number of trials: ____
- Each trial has the ___________ probability of success: ______________________________

We have met the conditions and we have a ___________________ distribution.
X = ____

Binomial Distributions

In a ________________________, the random variable X = the number of successes is called the ____. The probability distribution of X is a ____.

How can we find probabilities involving a binomial random variable?

- Use __________________ to estimate probabilities (See Topic 4.2, Video 2)
- Use the __________________________ formula to calculate probabilities.

The probability of getting exactly
_______________________ in ______ trials is:

$$P(X = x) = \binom{n}{x} p^x (1-p)^x$$

Calculating Binomial Probabilities

The probability a tropical storm becomes a hurricane is 0.53. If the weather service predicts 6 more tropical storms, what is the probability that exactly 5 of them become hurricanes?

Define the random variable: X = ____

Identify the distribution and values of interest: X has a __________________________________ with n = ________ and p = ________. We want to find P(X =5)

P (X = 5) = ____________________________ = ___________

Answer the question in context: The probability that ______________ 5 of the 6 tropical storms will become hurricanes is __________________.

Name______________________________

Cumulative Binomial Probabilities

The probability a tropical storm becomes a hurricane is 0.53. If the weather service predicts 22 tropical storms, what is the probability that at least 15 of them become hurricanes?

Define the random variable: X = ____

Identify the distribution and vale of interest: X has a binomial distribution with ________ and ___________. We want to find P(X = _____)

Find the probability: P(X ≥ 16) = ______________________________________ = ____________

Answer the question in context: The probability that _________________________ tropical storms will become hurricanes is ___________________.

Using Technology

Most calculators used in AP Statistics have built-in commands for calculating binomial probabilities. However, we don't recommend writing "calculator speak" in free-response solutions.

X has a binomial distribution with __________ and __________. We want to find P(X = 5).

$$P(X = 5) = \binom{6}{5} 0.53^5 (1 - 0.53)^1 = 0.118$$

P(X = 5) = _______________________________ = __________

X has a binomial distribution with ___________ and __________. We want to find P(X ≥ 16).

$$P(X \geq 16) = \binom{22}{16} 0.53^{16} (1 - 0.53)^6 + \cdots + \binom{22}{22} 0.53^{22} (1 - 0.53)^0 = 0.0486$$

P(X ≥ 16) = ____ = ______________ = _________

What Should We Take Away?

A ____________________ involves repeated ___________ of the same ____________ process, where these conditions are met:

- **Two possible outcomes: ______________________________________**
- **________________________ trials**
- **A ________________ of trials**
- **Each trial has the ____**

The binomial probability formula: ____

When calculating ________________________, be sure to _____________ the random variable, _____________ the distribution and values of interest, _________________ the correct probability, and answer the question ________________________,

Name______________________________

AP Statistics CED 4.11 Daily Video 1 (Skill 3.B)

Parameters for a Binomial Distribution

What Will We Learn?

How do we calculate the mean of a binomial distribution?

How do we calculate the standard deviation of a binomial distribution?

Cell Phone Disaster

Awwww. You dropped your phone and cracked the screen. Will you get it fixed? The Miami Herald estimates that over 5,700 cell phone screens are cracked every hour in the United States.

Quick Fix

An enterprising group of high school students calling themselves Better than a Bandage (BTB), is researching methods and materials to provide a quick on-the-spot fix to repair cracked cell phone screens.

Mean of a Binomial Distribution

According to Digital Trends, 21% of cell phone owners have a cracked screen. If the BTB team randomly selects 40 people who own cell phones, what is the expected number of cracked screens?

Define the random variable: C = ____

Always check the conditions: Two Outcomes? Independent Trials? Fixed # Trials? Same Probability?

So, C has a ______________________ with n = _______ and p = _______

The _________ (Expected Value) of a _________________ random variable X is __________________

So, _______ = _______ = ____

In ___________ random samples of _________ cell phones owners, the BTB team can ______________ an average of _______________ to have a cracked cell phone screen.

Standard Deviation of Binomial Distribution

The _____________________________ of a binomial random variable X is _______________________

So, _______ = ________________________ = ________________

In ___________ random samples of _________ cell phone owners, the _______________ with cracked phones will _____________________________ from the mean of _______ by about _______________.

Calculate the Parameters

The BTB team has set up a booth at a large outdoor shopping area with enough supplies to fix 25 phone screens. Recent experience has shown that 15% of people have a cracked cell phone screen and will buy a repair. The team plans to approach a random sample of 150 people about screen repair. Would you be surprised if the BTB team ran out of supplies? Justify your answer.

Define the random variable: ____

Check the conditions: Two Outcomes? _____; Independent Trials? ______; Fixed Number of Trials? ______; Same Probability? ________

State n and p: ____

Calculate mean: ____

Calculate standard deviation: ____

Name________________________________

Interpret Your Results

Would you be surprised if the BTB team ran out of supplies early?

_______, I would __________ be surprised if the __________________ ran out of supplies early. Just ________________________________ above the mean is _____________________________ customers with cracked screens who would pay for a repair. That would require _____________ supplies than BTB brought with them since they only brought supplies for _____________________.

Another Approach

Would you be surprised if the BTB team ran out of supplies early?

You could use the ________________________________ to actually calculate the binomial probability that C > 25. (You could do this by hand or using technology.)

P(C > 25) = ____

_______, I would __________ be surprised if the ________________ ran out of supplies early. The probability that ___________________ of a randomly selected group of _______________ would purchase screen repair is _____________. That is a high enough probability to warrant bringing more supplies.

What Should We Take Away?

The ___________ of a random variable X with a ________________ distribution is _________________.

The ___________________________ of a random variable X with a ____________________ distribution is _____________________________.

Probabilities and parameters for a binomial distribution should be interpreted use the ___________________________ within the _________________ of a specific situation.

Name________________________________

AP Statistics CED 4.12 Daily Video 1 (Skill 3.A)

The Geometric Distribution

What Will We Learn?

How do we calculate probabilities for a geometric random variable?
How do we calculate the parameters for a geometric distribution?

Developing Hurricanes

In 2020, NOAA updated their prediction to 41% of tropical storms will become hurricanes. A hurricane is defined as a storm with sustained wind speed of at least 74 mph. What is the probability that the fourth tropical storm of the season will be the first hurricane?

Define the random variable: ____

Check the conditions:

*Two possible outcomes: _________________________________

*________________________ trials

* Each trial has the ____

* Perform trials until we have ______________________________

State: H has a _____________________________________ with p = _________

Finding Geometric Probabilities

P(H = 4) = (______________)(______________)(______________)(__________) = ____________

Failure Success

For a geometric random variable X, ____

Cumulative Geometric Probabilities

In 2020, NOAA updated their prediction to 41% of tropical storms will become hurricanes. A hurricane is defined as a storm with sustained wind speed of at least 74 mph. What is the probability that the first hurricane will develop by the third tropical storm of the season?

Define the random variable: ____

Check the conditions:

*Two possible outcomes: _________________________________

*________________________ trials

* Each trial has the ____

* Perform trials until we have ______________________________

State: H has a _____________________________________ with p = _________

Calculate P ($H \leq 3$) = ____ = __________

Remember that this can be calculated by hand or using technology!

Using Technology

Most calculators used in AP Statistics have built-in commands for calculating geometric probabilities. However, we don't recommend writing "calculator speak" in free response solutions.

X has a binomial distribution of __________________. We want to find P(X = 4).

P(X = 4) = ____

NOTE: geompdf(0.53, 4) = 0.055 would NOT receive credit!

Name______________________________

Finding the Mean

In 2020, NOAA updated their prediction to 41% of tropical storms will become hurricanes. A hurricane is defined as a storm with sustained wind speed of at least 74 mph. What is the mean number of tropical storms in a season it will take to get the first hurricane?

Define the random variable: Let H = ____

State: H has a _________________________ with __________________.

The ______________ (expected value) of a geometric random variable X is __________________.

Calculate: μ_H = ______________________ = __________

Over ___________ seasons, we expect that it will take _______ tropical storms, ________________, to get the first hurricane.

Finding the Standard Deviation

In 2020, NOAA updated their prediction to 41% of tropical storms will become hurricanes. A hurricane is defined as a storm with sustained wind speed of at least 74 mph. What is the standard deviation of the number of tropical storms in a season it will take to get the first hurricane?

Define the random variable: Let H = ____

State: H has a _________________________ with __________________.

The _______________________ of a geometric random variables X is _________________________.

Calculate: σ_H = ______________________ = __________

Over __________ seasons, the number of tropical storms it will take to get the ___________ hurricane will _______________________ by about ________ storms from the ____________________ storms.

Prairie Dogs

Twenty percent of prairie dog litters have 4 or more pups. A zoologist is interested in studying the behavior of prairie dog siblings in these large prairie dog families.

a) What is the probability the zoologist will need to wait until a fifth litter is born in order to have a large family to study?

b) How many litters should the zoologist expect to be born until there is a large family to study?

What Should We Take Away?

A __________________ random variable counts the number of trials it take to get the ____________ success in a setting where ___________________, ________________________ trials of the same chance process are performed with probability p of success on each trial.

The geometric probability formula: $P(X = x) = (1 - p)^{x-1}p$

The parameters of a geometric distribution are:

Mean: ______________ **Standard deviation:** ______________________

Name______________________________

AP Statistics CED 4.12 Daily Video 2 (Skill 4.B)

The Geometric Distribution

What Will We Learn?

How can we distinguish between binomial and geometric distributions?
How can we interpret probabilities and parameters in context?

Get Your Supplies Ready

- We are going to practice a free-response question.
- Have paper, a calculator, and a formula sheet close by.
- You may wish to set a timer for 12 minutes.
- When the next slide come up, hit **Pause** and work through the problem.
- When you are finished, hit **Play** to see the solution.

Major Hurricanes

Major hurricanes (Category 4, 5, or 6) have sustained windspeeds of at least 111 mph. 22% of tropical storms turn into a major hurricane.

Geometric Probability

(a) Would it be unusual not to have a major hurricane until the seventh tropical storm?

Finding Means (Expected Values)

(b) Suppose NOAA predicts 18 tropical storms this year.

(i) How many major hurricanes should we expect this year?

(ii) How many tropical storms would we expect to happen to get the first major hurricane?

Cumulative Binomial Probability

(c) Suppose NOAA predicts 18 tropical storms this year. A team of pilots who fly into hurricanes to collect data is preparing for four major hurricanes. Will their preparations be sufficient? Justify your answer.

Name_______________________________

What Should We Take Away?

Carefully check _________________ to distinguish _____________________ situations from _____________________ situations.

_________________ any random variables.

Probabilities and parameters for a _____________________ should be interpreted within the _____________________ of a special population or situation.