Conditional Probability:

$$P(video\ games \mid girl)=\frac{12}{60}=.20$$

	girls	boys	
read a book	18	4	22
video games	12	20	32
watch Netflix	30	16	46
	60	40	100

event
The event is always contained within the conditional sample space.

condition
The condition is always just a portion of the sample space.
This is called the *conditional sample space*.

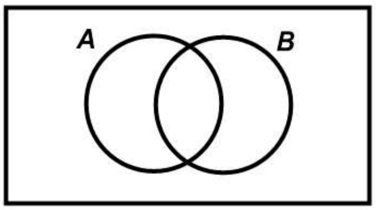
The conditional sample space is a portion of the sample space.
The event is a portion of the conditional sample space.

The event (what comes before the line) goes in the numerator of the fraction.
(but stay inside the conditional sample space)

$$P(video\ games \mid girl)=\frac{12}{60}=.20$$

The condition (what comes after the line) goes in the denominator of the fraction.

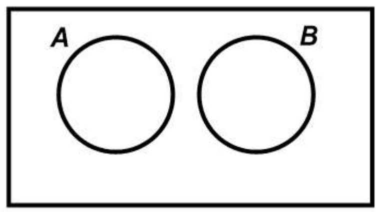
OR = add probabilities. Catch: must handle the overlap



A and B are non mutually-exclusive
A and B are not disjoint events
A and B are joint events

$$P(A\cap B)\neq 0$$

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



A and B are mutually-exclusive
A and B are disjoint events

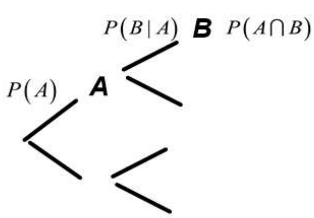
$$P(A\cap B)=0$$

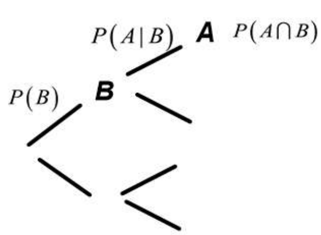
$$P(A\cup B)=P(A)+P(B)$$

AND = multiply probabilities.
Catch: 2nd probability must be conditional

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

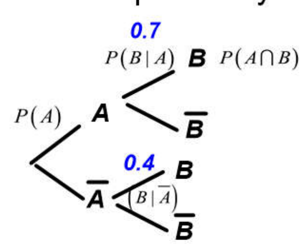
$$P(A\cap B)=P(B)\cdot P(A\mid B) \quad either\ event\ can\ be\ first$$





Independent Events

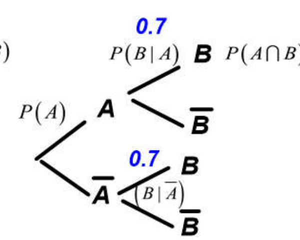
Whether one event happens does not affect the probability of the other event.



$$P(B\mid A)\neq P(B\mid \overline{A})$$

$$0.7\neq 0.4$$

events not independent



$$P(B\mid A)=P(B\mid \overline{A})$$

$$0.7=0.7$$

events are independent

For independent events, simpler AND formula:

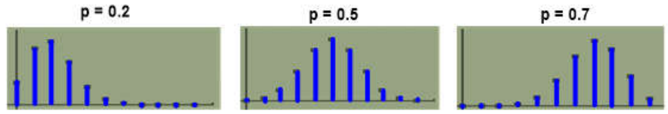
$$P(A\cap B)=P(A)\cdot P(\cancel{B\mid \overline{A}})$$

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

simpler formula can also test for independence

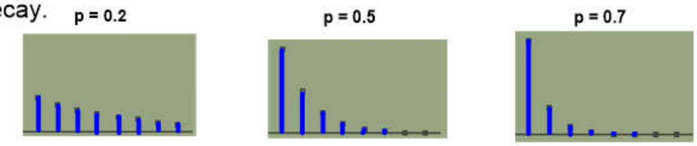
Binomial Shape depends upon p.

$$\mu = np \qquad \sigma = \sqrt{npq}$$



Geometric Shape is always exponential decay.

$$\mu = \frac{1}{p} \qquad \sigma = \frac{\sqrt{1-p}}{p}$$



General Discrete Model

$$\mu = \text{'expected value'} = \sum X \cdot P(X)$$

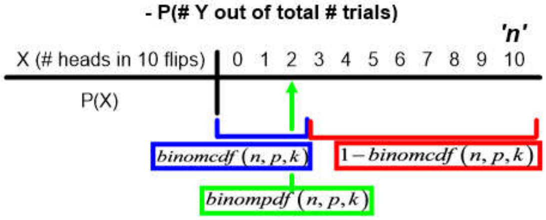
$$\sigma\ (\text{and } \mu)\ \text{found using } L1(\text{data}), L2(\text{freqList}), 1-\text{Var Stats}$$

X	
P	

Binomial model

- Only 2 outcomes
- Probabilities must be the same each trial.
- Probabilities of trials must be independent.

- P(# Y out of total # trials)

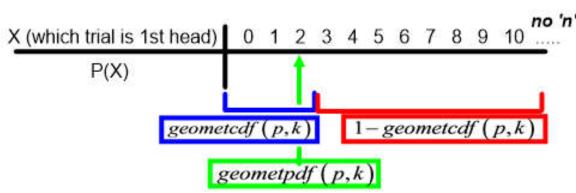


$$P(\text{exactly } k \text{ successes out of } n \text{ trials})$$
$$= {}_nC_k (p)^k (q)^{n-k}$$

Geometric model

- Only 2 outcomes
- Probabilities must be the same each trial.
- Probabilities of trials must be independent.

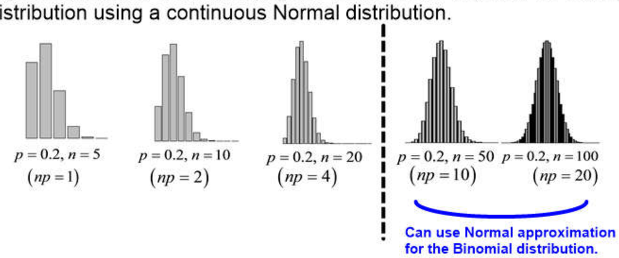
- P(1st Y occurs on a specific trial)



$$P(\text{success on the } k^{th} \text{ trial})$$
$$= (q)^{k-1}(p)$$

Using Normal models to approximate Binomial models

If the sample size is high enough so that the mean (expected number of successes, np) and the expected number of failures (nq) are both at least 10, then we can approximate the discrete Binomial distribution using a continuous Normal distribution.



Normal mean and SD given by the Binomial Model formulas:

$$\mu = np$$
$$\sigma = \sqrt{npq}$$

Combining Multiple Distributions

If we had 4 independently varying random variables, *A*, *B*, *C*, and *D*, and we define a new variable *E*:

$$E = A + B - C - D$$

The means are always follow the algebra:

$$\mu_E = \mu_A + \mu_B - \mu_C - \mu_D$$

For standard deviation, ***variances*** always add:

$$\sigma_E^{\ 2} = \sigma_A^{\ 2} + \sigma_B^{\ 2} + \sigma_C^{\ 2} + \sigma_D^{\ 2}$$

Transforming One Distribution

Algebra to transform will always include a multiply (which changes the units) and may include add or subtract.

Multiplying/dividing affects both center and spread...

Adding/Subtracting does not affect spread..