Day 3: Independent and Dependent Events

Warm-up:

1. If you have a standard deck of cards in how many different hands exist of: 5 cards? 2 cards? (Show work by hand) $_{52}C_5$ 2,598,960 $_{52}C_2$ $_{52}C_2 = \frac{52\cdot51\cdot50\cdot49\cdot48}{2\cdot1} = \frac{52!}{(52-2)!\,2!}$ $\boxed{1326}$
2. Pick a team of 3 people from a group of 10. $_{10}C_3 = \boxed{120}$
3. Choose 3 desserts from a menu of 8 desserts. $_8C_3 = \boxed{56}$
4. Choose a winner and a runner up from the 40 Miss Pickle Princess contestants. $_{40}P_2 = \boxed{1560}$
5. Arrange the letters of the word FACTOR = $_6P_6 = \boxed{720}$
6. Choose two jelly beans from a bag of 15? $_{15}C_2 = \boxed{105}$
7. Assign the part of a play to the 4 lead characters from a group of 30 who tried out. $_{30}P_4$ $\boxed{657720}$

Day 3: Independent and Dependent Events

Remember, the probability that an event E will occur is abbreviated P(E).

Review:

You Try!

Ex 1/ If you are dealt one card from a standard 52-card deck, find the probability of getting a king. $P(\text{king}) = \frac{4}{52} = \boxed{\frac{1}{13}}$

Ex 2/ Find the probability of rolling a number greater than 2 when you roll a die once. 3, 4, 5, 6 $\frac{4}{6}$ $\boxed{\frac{2}{3}}$

There are 7 marbles in a bag. You draw 2 marbles from the bag using the following scenarios:

Experiment 1: Draw one marble. Put it back. Draw a marble again.

Draw 2 IS NOT affected by draw 1.

When the outcome of a second event **is not** affected by the outcome of the first event, then the two events are called independent events.

If A and B are independent events, then

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

Example 1: Suppose 5 marbles in the bag are yellow and 2 marbles are green. You draw 1 marble and put it back before drawing a second. Find the probability that the marble color in both draws is yellow.

P(yellow and yellow) = $P(Y) \cdot P(Y) = \frac{5}{7} \cdot \frac{5}{7} = \boxed{\frac{25}{49}}$

Experiment 2: Draw one marble. Then draw another without replacing the first.

Draw 2 IS affected by draw 1.

When the outcome of a second event **is** affected by the outcome of the first event, then the two events are called dependent events.

If A and B are dependent events, then

P(A, then B) = $P(A) \cdot P(B \text{ after } A)$

this means we assume the 1st draw was a success

Example 2: Suppose 5 marbles in the bag are yellow and 2 marbles are green. You draw 1 marble and then another without putting back the first marble. Find the probability that both marbles are yellow.

P(yellow, then yellow) =
P(Y) • P(Y after Y)
$= \frac{5}{7} \cdot \frac{4}{6} = \frac{20}{42} = \boxed{\frac{10}{21}}$

Classifying Events as Dependent or Independent

1) Pick a cookie from the party platter. Then pick another cookie from the same platter. **Dependent** 2nd pick is affected by the first

2) A number from 1 to 31 is selected at random. Then a month is selected at random. **Independent** 2nd pick is not affected by the 1st

3) A grade level from K-12 is selected at random. Then one of the remaining grade levels is selected at random. **Dependent** 2nd pick is affected by the first

4) Select a bag of chips at random from the pile. Change your mind and return it. Then pick another bag of chips at random. **Independent** 2nd pick is Not affected by the 1st

Calculating Probabilities of Independent and Dependent Events

A game board in your closet has 7 purple game pieces, 4 red game pieces, and 3 green game pieces. You randomly choose one game piece and then replace it. Then you choose a second game piece. Find each probability.

→ independent events   14 total

You try

1) P(red and green)

P(R) • P(G)

$\frac{4}{14} \cdot \frac{3}{14} = \frac{12}{196}$

$\boxed{\frac{3}{49}}$

2) P(green and purple)

P(G) • P(P)

$\frac{3}{14} \cdot \frac{7}{14} = \frac{21}{196}$

$\boxed{\frac{3}{28}}$

3) P(both red)

P(R) • P(R)

$\frac{4}{14} \cdot \frac{4}{14} = \frac{16}{196}$

$\boxed{\frac{4}{49}}$

You are folding the socks from the laundry basket, which contains 6 brown socks, 2 blue socks, and 5 black socks. You pick one sock at a time and don't replace it. Find each probability.   13 total

4) P(blue, then black)

P(Blue) • P(Black after Blue)

$\frac{2}{13} \cdot \frac{5}{12} = \frac{10}{156} = \boxed{\frac{5}{78}}$

5) P(brown, then blue)

P(Brown) • P(Blue after Brown)

$\frac{6}{13} \cdot \frac{2}{12} = \frac{12}{156} = \boxed{\frac{1}{13}}$

6) P(both black)

P(Black) • P(Black after black)

$\frac{5}{13} \cdot \frac{4}{12} = \frac{20}{156} = \boxed{\frac{5}{39}}$

Tree Diagrams

A compound event is an event that is the result of more than one outcome.

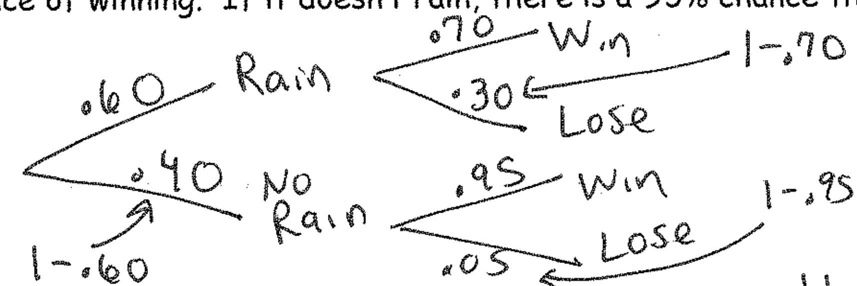
Ex 1: What is prob that you forgot to do HW & there is a pop quiz?

Ex 2! If you flip a coin & roll a die what is prob of getting tails & an even #?

To determine probabilities of compound events, we can use tree diagrams.

Ex 2: Create a Tree Diagram for the following scenario:

There is a 60% chance of rain on Wednesday. If it rains, the track team has a 70% chance of winning. If it doesn't rain, there is a 95% chance that the track team will win.



To calculate probabilities using tree diagrams, we use the multiplication rule **for Compound Events.** To use this rule, all of the separate outcomes that make up the compound event must be independent events, which means that the probabilities of the outcomes do not affect one another.

To calculate probability of compound events:

1st) Make a Tree Diagram

2nd) Multiply along the branches on the tree

Ex 3: Fill in the remaining outcomes for Example 2 above. Then, calculate the probabilities for each outcome.

Outcome	Calculations	Probability
Rain and Track Team Wins	(.60)(.70) = .42	42%
Rain and Track Team Loses	(.60)(.30) = .18	18%
No Rain and Track Team Wins	(.40)(.95) = .38	38%
No Rain and Track Team Loses	(.40)(.05) = .02	2%

sum 60%

sum 40%

Ex 4: What is the probability that the track team wins?

P(team win) = P(rain & win) + P(No rain & win)

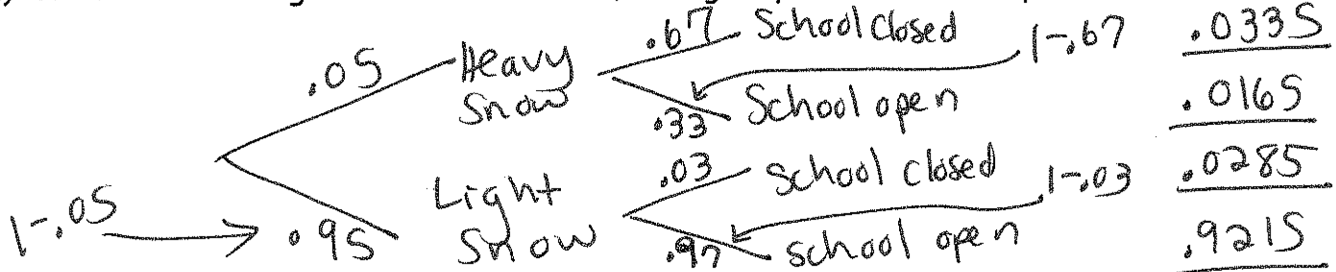
= 42% + 38% = $\boxed{80\%}$

Ex 5: A student in Buffalo, New York, made the following observations:

- Of all snowfalls, 5% are heavy (at least 6 inches).
- After a heavy snowfall, schools are closed 67% of the time.
- After a light (less than 6 inches) snowfall, schools are closed 3% of the time.

You Try

a) Create a tree diagram for the scenario, listing all possibilities and probabilities.



b) Find the probability that snowfall is light and schools are open.

$(.95)(.97) = .9215$ $\boxed{92.15\%}$

c) Find the probability that there is snowfall and schools are open.

P(heavy + open) + P(light + open) = $(.05)(.33) + (.95)(.97)$

$.0165 + .9215 = \boxed{93.8\%}$

check... totals to 1 (for 100%)

d) Find P(schools open, given heavy snow).

$\boxed{33\%}$ "Zoom in" to heavy snow branch + find probability of school open off that