## Formulas you will be given - know what they mean and how to use them

- $\mathrm{P}(\mathrm{A})=\frac{n(A)}{n(S)}$
- $P\left(\mathbf{A}^{C}\right)=1-P(A)$
- $P(A$ or $B)=P(A)+P(B)-P(A$ and $B)$
$P(A$ and $B)$
- $P(A \mid B)=P(B)$
- $\quad P(A$ and $B)=P(A \mid B)^{*} P(B)=P(B) * P(A \mid B)$
- Disjoint Events: $P(A$ and $B)=0$
- Independent events: $P(A \mid B)=P(A)$

$$
\begin{gathered}
P(B \mid A)=P(B) \\
P(A \text { and } B)=P(A) * P(B)
\end{gathered}
$$

1) Find a coin.
a. Flip the coin five times, what was the proportion of seeing a head?
b. Flip the coin ten times, what was the proportion of seeing a head?
c. Flip the coin twenty times, what was the proportion of seeing a head?
d. Over time, say we flip a fair coin thousands of times, what do we expect the proportion of a heads to be IN THE LONG RUN?

Draw the Venn Diagrams for the following probabilities - shade the region we're interested in. a. $\mathrm{P}(\mathrm{A}$ and B$)$
b. $P\left(A^{\wedge} c\right)$
c. $\mathrm{P}(\mathrm{A}$ or B$)$
d. $P(A)$

Fill out the following diagrams for the events:
A = pulling an ace out of a deck randomly
$B=$ pulling out a red card out of a deck randomly

a. What is the probability of pulling an ace out of a deck randomly, $P(A)$ ?
b. What is the probability of pulling a red card out of a deck randomly, $\mathrm{P}(\mathrm{B})$ ?
c. What is the probability of pulling a red ace out of a deck randomly, $P(A$ and $B)$ ?
d. What is the probability of pulling a red card or an ace out of a deck, $\mathrm{P}(\mathrm{A}$ or B$)$ ?
e. What is the probability of pulling an ace out of the deck given that you pulled a red card, $P(A \mid B)$ ?
f. Are $A$ and $B$ independent events?
g. Are $A$ and $B$ mutually exclusive? If not, name a mutually exclusive event for each.

A woman, Sally Clark, was found guilty of the murder of her two sons. The chance of a family suffering sudden infant death syndrome was 1 in 8,500 . Pediatrician Professor Roy Meadow, testified that the chance of two children from an affluent family suffering from sudden infant death syndrome was 1 in 73 million by calculating $\left(\frac{1}{8500}\right) *\left(\frac{1}{8500}\right)$. The judgment was that it was far too unlikely that the deaths were caused by the disease and must have been inflicted otherwise. Do you agree with the verdict, why or why not? If you don't agree explain why and state what additional information you would need.

Fill out the following tree diagram for flipping an unfair coin, a coin that lands on heads three quarters of the time, and use to answer the following questions.

e. Find the probability of the coin landing on heads for the first toss.
f. Find the probability of the coin landing on heads for the second toss.
g. Find the probability that two heads are flipped in a row.
h. Find the probability that a head and a tail are flipped in the two tosses, regardless of order.
i. Is flipping a heads on the first toss and flipping a head on the second toss independent?
j. What is a mutually exclusive, or disjoint, event for the event flipping a heads on the first trial and why is it so?
6) There's a bag of ten Jolly Ranchers somewhere that only has watermelon and blue raspberry jollies in it. There are 6 blue raspberry jollies in the bag, draw a tree diagram for making two selections without replacement.
a. Draw a tree diagram for making two selections without replacement.
b. Find the probability of choosing a blue raspberry jolly rancher on the first try.
c. Find the probability of choosing a blue raspberry jolly rancher on the second try, given that the first choice was watermelon.
d. Find the probability that two watermelon jollies were chosen in a row.
e. Find the probability that a watermelon and a blue raspberry jolly were chose, regardless of order.
f. Is choosing jolly ranchers from the bag without replacement an example of independent trials? Why or why not?
g. What is a mutually exclusive, or disjoint, event for choosing a blue raspberry jolly rancher on the first try?
7) Consider the following contingency table, based on demographics and drink preference, and answer the following questions.

|  | Coffee Preference | Other Breakfast Drink | Total |
| :--- | :--- | :--- | :--- |
| Southern US | 910 | 90 | 1000 |
| Northern US | 780 | 220 | 1000 |
| Total | 1690 | 310 | 2000 |

a. What's the probability that a randomly selected person prefers coffee to other beverages?
b. What's the probability that a randomly selected person prefers something other than coffee? How many ways can you think to calculate this?
c. What's the probability that a randomly selected person prefers coffee, given that they are from the south?
d. What's the probability that a randomly selected person from the north, given that they like coffee?
8) Consider the following contingency table, based on gender and drink preference, and answer the following questions.

|  | Beer Preference | Other Preference (Not Beer) | Total |
| :--- | :--- | :--- | :--- |
| Male | 82 | 18 | 100 |
| Female | 56 | 44 | 100 |
| Total | 138 | 62 | 200 |

a. What's the probability that a randomly selected person prefers beer to other beverages?
b. What's the probability that a randomly selected person prefers something other than beer? What are two ways to go about calculating this?
c. What's the probability that a randomly selected person prefers beer, given that they are male?
d. What's the probability that a randomly selected person doesn't prefer beer, given that they are female?

