Probability

$P_{Total} = 1$

$0 \le P(A) \le 1$

Simple Events

$$P(A) = \frac{n(A)}{n(S)}$$

Conditional Probability

$$P(B|A) = \frac{P(A\ and\ B)}{P(A)}$$

given

Complex Events

compound

OR

(Addition rule)

(disjoint)

Mutually Exclusive

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

Venn diagrams

NOT Mutually Exclusive

$$P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$$

same time

AND

(Multiplication rule)

Independent

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

in sequence

tree diagrams

Dependent

$$* \ P(A\ and\ B) = P(A) \bullet P(B|A)$$

$$* \ P(A\ and\ B) = P(B)\ P(A|B)$$

$$P(not\ A) = P(A') = 1 - P(A)$$

Sometimes it is easier to use the complement, P(A) + P(A') = 1.

~~Counting Principles, Permutations, and Combinations can be used to calculate the n(A) and/or n(S)~~

$P(B) = .44$ $\quad P(AR \mid B) = .17$

$P(M) = .37$ $\quad P(AR \mid M) = .09$

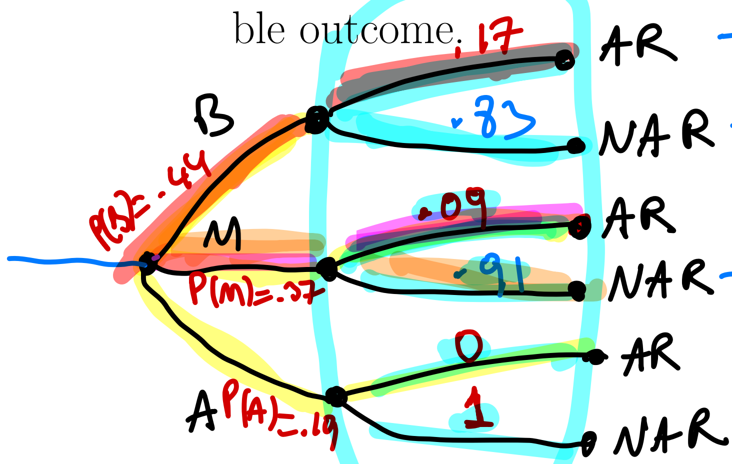
$P(A) = .19$

Using Tree Diagrams

The kind of picture that helps us look at conditional probabilities and multiplication rule for dependent events is called a **tree diagram**.

Example 2. According to a study 44% of college students engage in binge drinking (B), 37% drink moderately (M), and 19% abstain entirely (A). Another study finds that among binge drinkers, 17% have been involved in an alcohol-related automobile accident (AR), while among non-bingers of the same age, only 9% have been involved in such accidents.

1. Build a tree diagram with corresponding probabilities on each possible outcome.



$.17 = P(AR \mid B)$

$.83 = P(NAR \mid B)$

$1 - .09 = .91$

these are conditional probabilities

$(.37)(.09)$ and probability

2. What's the probability that a randomly selected college student will be a binge drinker **and** has had an alcohol-related car accident?

$P(B \text{ and } AR) = (.44)(.17)$

3. What's the probability that a randomly selected college student will have an alcohol-related car accident **given** they are a moderate drinker?

$P(AR \mid M) = .09$

4. What's the probability that a randomly selected college student will be a moderate drinker **and** has had no alcohol-related car accident?

$P(M \text{ and } NAR) = (.37)(.91)$