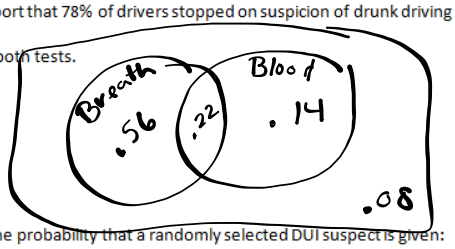
1. Police report that 78% of drivers stopped on suspicion of drunk driving are given a breath test, 36% a blood test, and 22% both tests.



What is the probability that a randomly selected DUI suspect is given:

a. A test? $P(Br \text{ or } Bl) = .78 + .36 - .22 = .92$

b. A test, but not both?
$P(Br \cup Bl) - P(Br \cap Bl) = .92 - .22 = .70$

c. Neither test?
$P(Br^c \text{ or } Bl^c) = 1 - .92 = .08$

d. How (mathematically) do we know that the tests are not mutually exclusive?
$P(Br \text{ or } Bl) \neq P(Br) + P(Bl)$
$.92 \neq .78 + .36$

e. Are giving the two tests independent? Provide mathematical evidence.

$P(Br) \qquad P(Br \mid Bl)$

$.78 \neq \frac{P(Br \cap Bl)}{P(Bl)} = \frac{.22}{.36}$

Not Independent

Two Way Tables

2. Two psychologists surveyed 478 children in grades 4, 5, 6 in elementary schools in Michigan. They stratified the sample, drawing 1/3 from rural, 1/3 from suburban and 1/3 urban schools. Among the questions, they ask students whether their primary goal was to get good grades, to be popular, or to be good at sports. Here is a contingency table giving the counts of the students by their goals and gender.

	Grades	Popular	Sports	Total
Boy	117	50	60	227
Girl	130	91	30	251
Total	247	141	90	478

What is the probability that a student from the study is a ...

a. Girl? $P(girl) = 251/478$

b. A girl and popular is her primary?
$P(girl \cap pop) = 91/478$

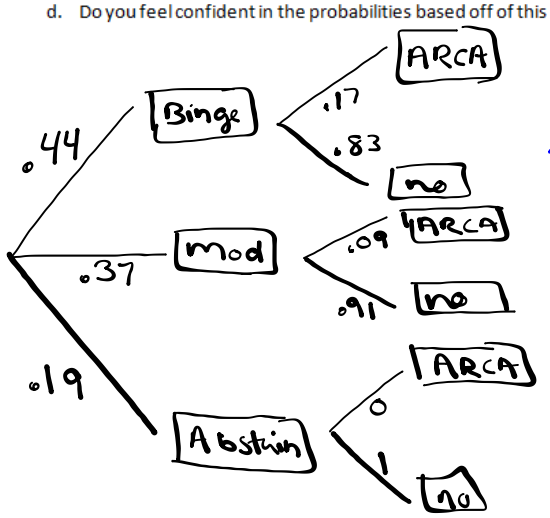
c. A boy or to be good at sports?
$P(boy \cup sports) = 257/478$

d. Primary goal sports?
$P(sports) = 90/478$

e. Have the goal of being good at sports if you know it is a girl?
$P(sports \mid girl) = 30/251$

Tree Diagrams: Tree diagrams work well when you have a sequence of events. They are also valuable because after the first event the rest of the branches offer conditional probabilities. They work well for both "and" and "or" questions.

3. According to a student by the Harvard School of Public Health, 44% of college students engage in binge drinking (four or more drinks in a row), 37% moderate drinking, 19% abstain completely. The same study found among binge drinkers, 17% have been involved in an alcohol related car accident, while moderate drinkers have only been in alcohol related car incidents 9% of the time.
   a. Create a tree diagram
   b. What is the probability that a random college student will be a binge drinker and get into an alcohol related car accident?
   c. What is the probability that a random college student will get into an alcohol related car accident?
   d. Do you feel confident in the probabilities based off of this study? Explain.



$P(\text{Binge} \cap \text{ARCA}) = .44(.17) = .075$

$P(\text{ARCA}) = .075 + .37(.09) = .108$