

Name: _____

January 28

QUIZ 2

Each question is worth 5 points.

Ground rules:

- DO NOT WRITE YOUR NAME ON THE QUIZ. If you're worried about losing the first page, write your student number on each page.
- You can use your notes or books, but you may not communicate with other people about this exam nor the material covered by it.
- In order to receive as much credit as possible, please show all of your work. Showing that you understand the question and know how to set up the solution correctly is more important than arriving at the exact answer.
- Read each question carefully and answer all parts of each question.
- Make sure to both write your answer in terms of probability and in English.
- Good luck!

Mothers Against Drunk Driving is a very visible organization whose main focus is to educate the public about the harm caused by drunk drivers. A study was recently done that emphasized the problem we all face with drinking and driving. Four hundred accidents that occurred on a Saturday night were analyzed. Two items noted were the number of vehicles involved and whether alcohol played a role in the accident. The numbers are shown below:

	Number of Vehicles Involved			
Did Alcohol Play a Role?	1	2	3	Totals
Yes	50	100	20	170
No	25	175	30	230
Totals	75	275	50	400

Let A=Alcohol plays a role; MV=Multiple Vehicles

1. What is the probability that alcohol played a role in an accident from among those on that Saturday night?

$P(A)=170/400=.43$ or 43% There is a 43% probability that alcohol played a role in an accident from this sample.

2. What is the probability that one accident involved more than 1 vehicle and alcohol?

Joint probability/intersection

$P(A \cap MV) = P(A \text{ and } MV) = (100+20)/400 = .30$ or 30% There is a 30% probability of an accident involving more than one vehicle and alcohol.

3. What is the probability that one accident involved multiple cars or alcohol? Make sure to state the probability rule you are using to arrive at your answer.

Union of Mutually Exclusive Events.

Use the additive rule:

$$P(A \cup MV) = P(A \text{ or } MV) = P(A) + P(MV) - P(A \text{ and } MV) = .43 + (275+50)/400 - .30$$

$$= .43 + .81 - .30 = .94$$

OR

$$P(A \text{ or } MV) = (50+100+20+175+30)/400 = 375/400 = .94$$

So there is a 94% chance that an accident involved multiple cars or alcohol.

4. Given that a multi-car accident occurred, what is the probability that it involved alcohol?

Conditional probability

$$P(A|MV) = P(A \text{ and } MV) / P(MV) = .30 / .81 = .37$$

$$\text{OR } P(A|MV) = (100+20) / (275+50) = .37$$

Given that there was a multi-car accident, there is a 37% chance that it involved alcohol.

5. Are the number of cars involved in an accident and the involvement of alcohol independent? Make sure to show how you arrived at your answer and state your result in nontechnical language.

For car accidents and the involvement of alcohol to be independent, the following must be true:

$$P(MV|A) = P(MV)$$

$$P(A|MV) = P(A)$$

$$P(A \text{ and } MV) = P(A) * P(MV)$$

We know from above that the $P(A|MV) = .37$ and that $P(MV) = .81$ so the second statement is not true.

The number of cars involved and the involvement of alcohol are dependent.

There is a relationship between the number of cars involved in an accident and the use of alcohol.

6. Recap last quiz: I estimate from U.S. Census data that the mean age of the U.S. population in 2000 was 35.9 years. Suppose the standard deviation of age in the U.S. population is 22 years. At least three-quarters of the people in the U.S. must be between what ages? How did you arrive at your answer?

According to Chebyshev's Rule, at least three-quarters of the measurements of any data set will fall within 2 standard deviations of the mean ($\mu - 2\sigma, \mu + 2\sigma$). For the census data, $35.9 - 2(22) = -8.1$ and $35.9 + 2(22) = 79.9$. So, at least three quarters of the U.S. population has ages between 0 and 79.9 years.