AP Statistics
Unit 04 – Probability
Homework #3

Name Key
Period _____

1. In a large Introductory Statistics lecture hall, the professor reports that 55% of the students enrolled have never taken a Calculus course, 32% have taken only one semester of Calculus, and the rest have taken two or more semesters of Calculus. The professor randomly assigns students to groups of three to work on a project for the course. What is the probability that the first groupmate you meet has studied...

13%.

A: no calc 55%.
B: 1 sem calc. 32%
C: 2+ sem calc. 13%

a) two or more semesters of Calculus? 13%.
P(C)

b) some Calculus? 32% + 13% = 45%.
P(B∪C) = P(B) + P(C)

c) no more than one semester of Calculus? 87%.
1 − P(C) = P(A) + P(B) = P(A∪B) = 55% + 32%

2. You are assigned to be part of a group of three students from Problem 1. What is the probability that, of your other two groupmates, ...

a) neither has studied Calculus? P(A) × P(A) = (0.55) × (0.55) = 30.25%.

b) both have studied at least one semester of Calculus?
P(B or C) × P(B or C) = (0.45)(0.45) = 20.25%.

c) at least one has had more than one semester of Calculus?
1 − P(neither had 2+ sem) = 1 − P(C^c ∩ C^c) = 1 − 0.87 · 0.87 = 24.31%.

3. You roll a fair die three times. What is the probability that...

a) you roll all 6's? P(6) × P(6) × P(6) = 1/6 · 1/6 · 1/6 = 1/216 = 0.463%.

b) you roll all odd numbers? 1/2 · 1/2 · 1/2 = 1/8 = 12.5%.

c) none of your rolls gets a number divisible by 3? 2/3 · 2/3 · 2/3 = 8/27 = 29.6%.

d) you roll at least one 5? 1 − P(no 5's) = 1 − 5/6 · 5/6 · 5/6 = 91/216 = 42.1%.

4. A Gallup poll in March 2001 asked 1005 U.S. adults how the United States should deal with the current energy situation: by more production, more conservation, or both? Here are the results:

Response	Number
More Production	332
More Conservation	563
Both	80
No Opinion	30
Total	**1005**

If we select a person at random from this sample of 1005 adults,

a) what is the probability that the person responded "More Production?"
P(more prod.) = 332/1005 = 33%.

b) what is the probability that the person responded "Both" or had no opinion?
P(Both ∪ no opinion) = P(both) + P(no opinion) = 80/1005 + 30/1005 = 10.9%.

5. Suppose we select three people at random from the sample in Problem 4.

   a) what is the probability that all three responded "More Conservation?"

   $0.56 \cdot 0.56 \cdot 0.56 = 17.56\%$

   b) what is the probability that none responded "Both"?

   $P(\text{both}^c \cap \text{both}^c \cap \text{both}^c) = 0.92 \cdot 0.92 \cdot 0.92 = 77.97\%$

6. A slot machine has a three wheels that spin independently. Each has 10 equally likely symbols: 4 bars, 3 lemons, 2 cherries, and a bell. If you play, what is the probability

   a) you get 3 lemons?

   $0.3 \cdot 0.3 \cdot 0.3 = 2.7\%$

   b) you get no fruit symbols?

   $0.5 \cdot 0.5 \cdot 0.5 = 12.5\%$

   c) you get 3 bells (the jackpot)?

   $0.1 \cdot 0.1 \cdot 0.1 = 0.1\%$

   d) you get no bells?

   $0.9 \cdot 0.9 \cdot 0.9 = 72.9\%$

   e) you get at least one bar (an automatic loser)?

   $1 - P(\text{no bars}) = 1 - 0.6 \cdot 0.6 \cdot 0.6 = 78.4\%$

7. A certain bowler can bowl a strike 70% of the time. What is the probability that she

   a) goes three consecutive frames without a strike?

   $0.3 \cdot 0.3 \cdot 0.3 = 2.7\%$

   b) makes her first strike in the third frame?

   $0.3 \cdot 0.3 \cdot 0.7 = 6.3\%$

   c) has at least one strike in the first three frames?

   $1 - P(\text{no strikes}) = 1 - 0.027 = 97.3\%$

   d) bowls a perfect game (12 consecutive strikes)?

   $0.7^{12} = 1.4\%$

8. According to data on drunk driving, 78% of suspect drivers get a breath test, 36% a blood test, and 22% both. Use this information to complete the contingency table below.

Blood Test \ Breath Test	Yes	No	**Total**
Yes	0.22	0.14	**0.36**
No	0.56	0.08	0.64
Total	**0.78**	0.22	**1.00**

9. Two psychologists surveyed 478 children in grades 4,5, and 6 in elementary schools in Michigan. They stratified their sample, drawing roughly 1/3 from rural, 1/3 from suburban, and 1/3 from urban schools. Among other questions, they asked students whether their primary goal was to get good grades, to be popular, or to be good at sports. One question of interest was whether boys and girls at this age had similar goals.

Below is a contingency table giving frequencies of the students by their goals and gender.

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

Assuming we select a student at random the 478 surveyed, calculate the following probabilities:

a) P(girl) = $251/478 = 52.5\%$

b) P(sports) = $90/478 = 18.8\%$

c) P(sports | girl) = $\frac{P(\text{sports} \cap \text{girl})}{P(\text{girl})} = \frac{30}{251} = 11.95\%$

d) P(grades | boy) = $\frac{P(\text{grades} \cap \text{boy})}{P(\text{boy})} = \frac{117}{227} = 51.5\%$

e) P(girl | popular) = $\frac{P(\text{girl} \cap \text{popular})}{P(\text{popular})} = \frac{91}{141} = 64.5\%$

f) Is getting good grades independent of being a girl?

$P(\text{grades}) \overset{?}{=} P(\text{grades} | \text{girl})$

$\frac{117}{247} \neq \frac{130}{251}$

$47.4\% \neq 51.8\%$

getting good grades is not independent of being a girl.

g) Is being popular independent of being a boy?

$P(\text{boy}) \neq P(\text{boy} | \text{popular})$

$227/478 \neq 50/141$

$47.5\% \neq 35.5\%$

being popular is not independent of being a boy.

h) Is being a girl independent of being good at sports?

$P(\text{girl}) \neq P(\text{girl} | \text{sports})$

$251/478 \neq \frac{30}{90}$

$52.5\% \neq 33.3\%$

being a girl is not independent of being good at sports.

9. According to a study by the Harvard School of Public Health, 44% of college students engage in binge drinking, 37% drink moderately, and 19% abstain entirely. Another study, published in the American Journal of Health Behavior, finds that among binge drinkers, aged 21 to 34, 17% have been involved in an alcohol-related car accident, while among non-binge drinkers of the same age, only 9% have been involved in such accidents.

a) What's the probability that a randomly selected college student will be a binge drinker who has had an alcohol-related accident?

$P(\text{binge} \cap \text{accident}) = (0.44)(0.17) = 0.0748$

There is a 7.48% chance that a randomly selected college student is a binge drinker who has had an alcohol-related accident.

b) What's the probability that a randomly selected student has had an alcohol-related accident?

$P(\text{accident}) = 0.0748 + 0.0333 + 0.0171 = 0.1252$

There is a 12.52% chance that a randomly selected student has had an alcohol-related accident.

c) If a student has had an alcohol-related car accident, what's the probability they are a binge drinker?

$$P(\text{binge} \mid \text{accident}) = \frac{P(\text{binge} \cap \text{accident})}{P(\text{accident})} = \frac{0.0748}{0.1252} = 0.5974$$

There is a 59.74% chance that a randomly chosen student is a binge drinker, given that they have had an alcohol-related car accident.

d) Construct and label a tree diagram showing the probabilities for the binge drinking and alcohol-related accidents outcomes.