

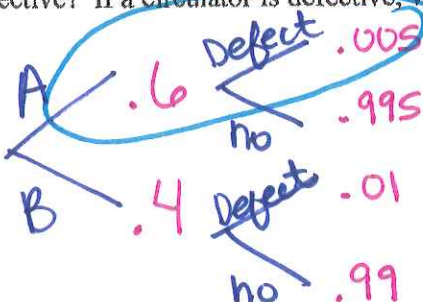
Name

Key

Hr

1. A plumbing contractor obtains 60% of her boiler circulators from a company whose defect rate is 0.005, and the rest from a company whose defect rate is 0.010. What proportion of the circulators can be expected to be defective? If a circulator is defective, what is the probability that it came from the first company?

- a. .0070, .429  
b. .0070, .600  
c. .0075, .500  
d. .0075, .600  
e. .0150, .571



$$P(A|\text{Defect}) = \frac{P(A \cap \text{Defect})}{P(\text{Defect})}$$

$$= \frac{.6(.005)}{.007}$$

2. Given the probabilities  $P(A) = .3$  and  $P(B) = .2$ , what is the probability of the union  $P(A \cup B)$  if A and B are mutually exclusive? If A and B are independent? If B is a subset of A?

- a. .44, .5, .2  
b. .44, .5, .3  
c. .5, .44, .2  
d. .5, .44, .3  
e. 0, .5, .3

(A) (B)  
.3 + .2  
= .5

$$\begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\ &= .3 + .2 - (.3)(.2) \\ &= .44 \end{aligned}$$



3. There are two games involving flipping a coin. In the first game you win if you can throw between 45% and 55% heads. In the second game you win if you can throw more than 80% heads. For each game would you rather flip the coin 30 times or 300 times?

- a. 30 times for each game  
b. 300 times for each game  
c. 30 times for the first game and 300 times for the second game  
d. 300 times for the first game and 30 times for the second game  
e. The outcomes of the games do not depend on the number of flips

*Law of large numbers*

4. Suppose that for a certain Caribbean island in any 3-year period the probability of a major hurricane is .25, the probability of water damage is .44, and the probability of both a hurricane and water damage is .22. What is the probability of water damage given that there is a hurricane?

- a. .47  
b. .50  
c. .69  
d. .88  
e. .91

$$P(H) = .25$$

$$P(W) = .44$$

$$P(H \cap W) = .22$$

$$P(W|H) = \frac{P(W \cap H)}{P(H)} = \frac{.22}{.25} = .88$$

5. Suppose that you toss a fair die three times and it comes up an even number each time. Which of the following is a true statement?
- By the law of large numbers, the next toss is more likely to be an odd number than another even number
  - Based on the properties of conditional probability the next toss is more likely to be an even number given that three in a row have been even.
  - Die actually do have memories, and thus the number that comes up on the next toss will be influenced by the previous tosses.
  - The law of large numbers tells how many tosses will be necessary before the percentages of evens and odds are again in balance.
  - The probability that the next toss will again be even is .5

6. According to one poll, 12% of the population favor legalizing all drugs. In a simple random sample of six people, what is the probability that at least one person favors legalization?

- .380
- .464
- .536
- .620
- .844

$$1 - P(\text{none})$$

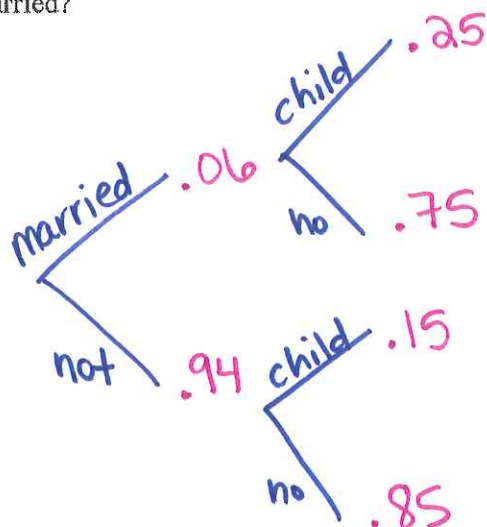
$$1 - .88^6 = .536$$

$$P(\text{favor}) = .12$$

$$P(\text{not favor}) = .88$$

7. In a certain city 6% of teenagers are married, 25% of married teenagers have children, and 15% of unmarried teenagers have children. If a teenager has a child, what is the probability that a teenager is not married?

- .156
- .200
- .500
- .904
- .940



$$P(\text{not married} | \text{child}) = \frac{.94(.15)}{.06(.25) + .94(.15)} = .904$$

8. A simple random sample of adults living in a suburb of a large city was selected. The age and annual income of each adult in the sample were recorded. The resulting data are summarized in the table below.

Age Category	Annual Income			Total
	\$25,000-\$35,000	\$35,001-\$50,000	Over \$50,000	
21-30	8	15	27	50
31-45	22	32	35	89
46-60	12	14	27	53
Over 60	5	3	7	15
Total	47	64	96	207

- (a) What is the probability that a person chosen at random from those in this sample will be in the 31-45 age category?
- (b) What is the probability that a person chosen at random from those in this sample whose incomes are over \$50,000 will be in the 31-45 age category? Show your work.
- (c) Based on your answers to parts (a) and (b), is annual income independent of age category for those in this sample? Explain.

$$a.) \frac{89}{207} = .43$$

$$b.) \frac{35}{96} = .365$$

c) No, not independent b/c  $.43 \neq .365$



9. Every Monday a local radio station gives coupons away to 50 people who correctly answer a question about a news fact from the previous day's newspaper. The coupons given away are numbered from 1 to 50, with the first person receiving coupon 1, the second person receiving coupon 2, and so on, until all 50 coupons are given away. On the following Saturday, the radio station randomly draws numbers from 1 to 50 and awards cash prizes to the holders of the coupons with these numbers. Numbers continue to be drawn without replacement until the total amount awarded first equals or exceeds \$300. If selected, coupons 1 through 5 each have a cash value of \$200, coupons 6 through 20 each have a cash value of \$100, and coupons 21 through 50 each have a cash value of \$50.

- (a) Explain how you would conduct a simulation using the random number table provided below to estimate the distribution of the number of prize winners each week.
- (b) Perform your simulation 3 times. (That is, run 3 trials of your simulation.) Start at the leftmost digit in the first row of the table and move across. Make your procedure clear so that someone can follow what you did. You must do this by marking directly on or above the table. Report the number of winners in each of your 3 trials.

<del>72749</del>	<del>13347</del>	<del>65030</del>	<del>26128</del>	<del>49067</del>	<del>02904</del>	49953	74674	94617	13317
81638	36566	42709	33717	59943	12027	46547	61303	46699	76423
38449	46438	91579	01907	72146	05764	22400	94490	49833	09258

01-05 → \$200

06-20 → \$100

21-50 → \$50

Select two digit #'s, note prize money awarded and stop when money equals or exceeds \$300. (Skip 51-00). Note the number of prizes awarded.

Trial 1: 3 winners

Trial 2: 3 winners

Trial 3: 3 winners

10. An advertising agency in a large city is conducting a survey of adults to investigate whether there is an association between highest level of educational achievement and primary source for news. The company takes a random sample of 2,500 adults in the city. The results are shown in the table below.

Primary Source for News	HIGHEST LEVEL OF EDUCATIONAL ACHIEVEMENT			Total
	Not High School Graduate	High School Graduate But Not College Graduate	College Graduate	
Newspapers	49	205	188	442
Local television	90	170	75	335
Cable television	113	496	147	756
Internet	41	401	245	687
None	77	165	38	280
Total	370	1,437	693	2,500

- (a) If an adult is to be selected at random from this sample, what is the probability that the selected adult is a college graduate or obtains news primarily from the internet?
- (b) If an adult who is a college graduate is to be selected at random from this sample, what is the probability that the selected adult obtains news primarily from the internet?
- (c) When selecting an adult at random from the sample of 2,500 adults, are the events "is a college graduate" and "obtains news primarily from the internet" independent? Justify your answer.

$$\begin{aligned}
 \text{a.) } P(\text{College grad} \cup \text{Internet}) &= P(\text{college grad}) + P(\text{Internet}) - P(\text{college grad} \cap \text{inter}) \\
 &= \frac{693}{2500} + \frac{687}{2500} - \frac{245}{2500} \\
 &= \frac{1135}{2500} = \boxed{.454}
 \end{aligned}$$

$$\begin{aligned}
 \text{b.) } P(\text{Internet} | \text{College grad}) &= \frac{P(\text{Internet} \cap \text{College grad})}{P(\text{college grad})} \\
 &= \frac{\frac{245}{2500}}{\frac{693}{2500}} = \boxed{.354} \quad \left( \text{or } \frac{245}{693} \right)
 \end{aligned}$$

$$\begin{aligned}
 \text{c.) } P(\text{Internet} | \text{College grad}) &\neq P(\text{Internet}) \\
 .354 &\neq .275
 \end{aligned}$$



Not independent b/c

b.)  $P(Y|\text{male}) \neq P(Y) \rightarrow .24 \neq .336$

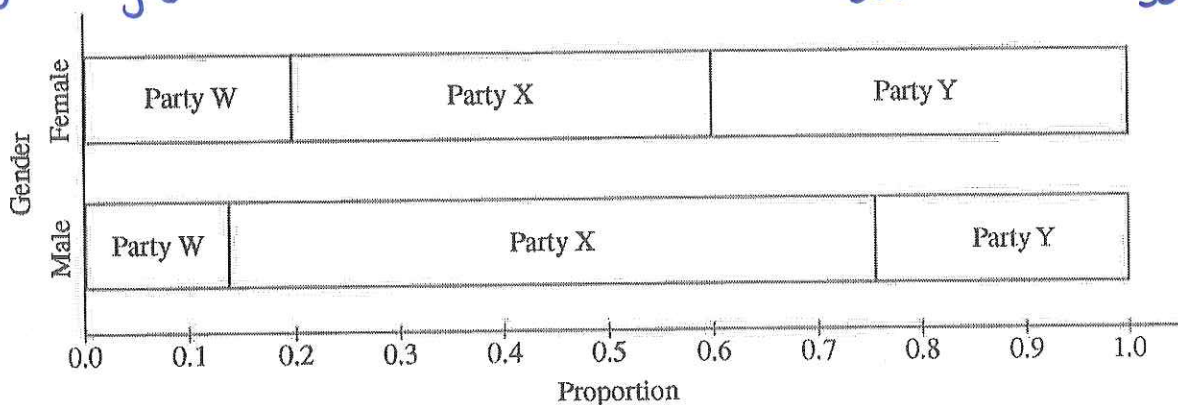
11. The table below shows the political party registration by gender of all 500 registered voters in Franklin Township.

PARTY REGISTRATION-FRANKLIN TOWNSHIP

	Party W	Party X	Party Y	Total
Female	60	120	120	300
Male	28	124	48	200
Total	88	244	168	500

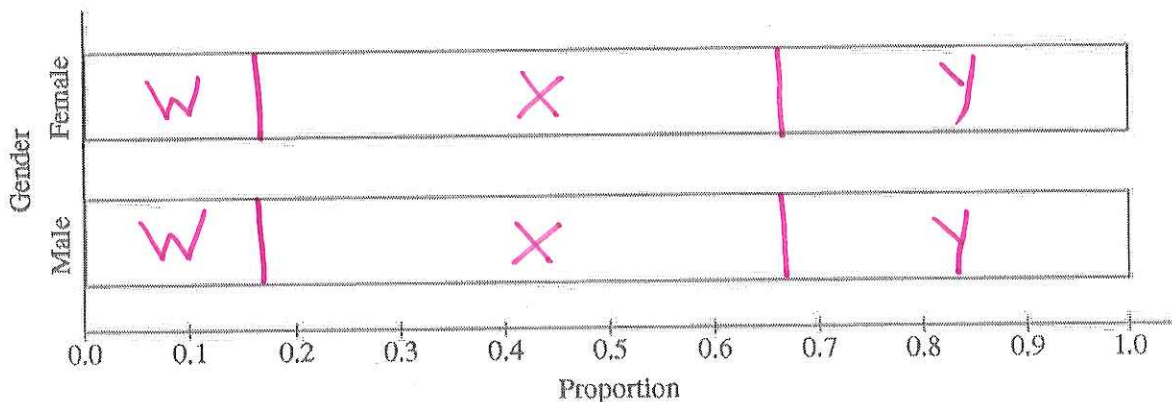
- (a) Given that a randomly selected registered voter is a male, what is the probability that he is registered for Party Y?  $\frac{48}{200} = .24$
- (b) Among the registered voters of Franklin Township, are the events "is a male" and "is registered for Party Y" independent? Justify your answer based on probabilities calculated from the table above.
- (c) One way to display the data in the table is to use a segmented bar graph. The following segmented bar graph, constructed from the data in the party registration-Franklin Township table, shows party-registration distributions for males and females in Franklin Township.

Ignoring gender:  $W \rightarrow \frac{88}{500} = .176$   $X \rightarrow \frac{244}{500} = .488$   $Y \rightarrow \frac{168}{500} = .336$



In Lawrence Township, the proportions of all registered voters for Parties W, X, and Y are the same as for Franklin Township, and party registration is independent of gender. Complete the graph below to show the distributions of party registration by gender in Lawrence Township.

LAWRENCE TOWNSHIP



12. Nine sales representatives, 6 men and 3 women, at a small company wanted to attend a national convention. There were only enough travel funds to send 3 people. The manager selected 3 people to attend and stated that the people were selected at random. The 3 people selected were women. There were concerns that no men were selected to attend the convention.

- (a) Calculate the probability that randomly selecting 3 people from a group of 6 men and 3 women will result in selecting 3 women.

$$\frac{3}{9} \cdot \frac{2}{8} \cdot \frac{1}{7} = .012$$

- (b) Based on your answer to part (a), is there reason to doubt the manager's claim that the 3 people were selected at random? Explain. *Yes, b/c there is only a 1.2% chance of that happening if the selection was truly random.*
- (c) An alternative to calculating the exact probability is to conduct a simulation to estimate the probability. A proposed simulation process is described below.

Each trial in the simulation consists of rolling three fair, six-sided dice, one die for each of the convention attendees. For each die, rolling a 1, 2, 3, or 4 represents selecting a man; rolling a 5 or 6 represents selecting a woman. After 1,000 trials, the number of times the dice indicate selecting 3 women is recorded.

Does the proposed process correctly simulate the random selection of 3 women from a group of 9 people consisting of 6 men and 3 women? Explain why or why not.

*No, b/c the random selection should be done without replacement. However, the simulation model indicates a process that is done with replacement.*