AP Statistics
Chapter 15 – Probability Rules!

Name: KEY
Date: ________________ Pd: ________

1. Consider a standard deck of playing cards.

   a. One card is drawn. What is the probability it is an ace or red?

   $P(\text{ace or red}) = P(\text{ace}) + P(\text{red}) - P(\text{ace and red})$

   $= \frac{4}{52} + \frac{26}{52} - \frac{2}{52}$

   $= \frac{28}{52}$

   b. Two cards are drawn without replacement. What is the probability they are both aces?

   $P(\text{two aces}) = \frac{4}{52} \cdot \frac{3}{51} = \frac{12}{2652}$

   c. What is the probability of getting 5 hearts in a row?

   $P(\text{5 hearts}) = \frac{13}{52} \cdot \frac{12}{51} \cdot \frac{11}{50} \cdot \frac{10}{49} \cdot \frac{9}{48} \approx 0.0005$

   d. I draw one card and look at it. I tell you it is red.

      i. What is the probability it is a heart?

      $P(\text{heart} \mid \text{red}) = \frac{P(\text{heart and red})}{P(\text{red})} = \frac{\frac{13}{52}}{\frac{26}{52}} = \frac{13}{26} = \frac{1}{2}$

      ii. And what is the probability it is red, given that it is a heart?

      $P(\text{red} \mid \text{heart}) = \frac{P(\text{red and heart})}{P(\text{heart})} = \frac{\frac{13}{52}}{\frac{13}{52}} = 1$

   e. Are "red card" and "spade" independent? Mutually exclusive (disjoint)?

   $P(\text{red} \mid \text{spade}) = 0$
   $P(\text{red}) = \frac{1}{2}$
   $\therefore$ not independent / they are disjoint since there are no red spades

   f. Are "red card" and "ace" independent? Mutually exclusive (disjoint)?

   $P(\text{red card} \mid \text{ace}) = \frac{1}{2}$
   $P(\text{red}) = \frac{1}{2}$
   $\therefore$ independent / not disjoint

   g. Are "face card" and "king" independent? Mutually exclusive (disjoint)?

   $P(\text{face} \mid \text{King}) = 1$
   $P(\text{face}) = \frac{12}{52}$
   $\therefore$ not independent / not disjoint

2. Use the following table to answer the questions below:

	Jeans	Other	Total
Male			
Female			
Total			

a. What is the probability that a male wears jeans?

b. What is the probability that someone wearing jeans is male?

c. Are being male and wearing jeans disjoint?

d. Are gender and attire independent?

3. In April 2003, *Science* magazine reported on a new computer-based test for ovarian cancer, "clinical proteomics," that examines a blood sample for the presence of certain patterns of proteins. Ovarian cancer, though dangerous, is very rare, afflicting only 1 of every 5000 women. The test is highly sensitive, able to correctly detect the presence of ovarian cancer in 99.97% of women who have the disease. However, it is unlikely to be used as a screening test in the general population because the test gave false positives 5% of the time. Why are false positives such a big problem? Draw a tree diagram and determine the probability that a woman who tests positive using this method actually has ovarian cancer.

Event O: ovarian cancer

Event A: test positive

ovarian cancer $P(O) = \frac{1}{5000}$

- test positive $P(A|O) = .9997$ — $P(O \cap A) = (.0002)(.9997)$
- test negative $P(A^c|O) = .0003$ — $P(O \cap A^c) = (.0002)(.0003)$

no ovarian cancer $P(O^c) = \frac{4999}{5000}$

- test positive $P(A|O^c) = .05$ — $P(O^c \cap A) = (.9998)(.05)$
- test negative $P(A^c|O^c) = .95$ — $P(O^c \cap A^c) = (.9998)(.95)$

$$P(O|A) = \frac{P(O \cap A)}{P(A)} = \frac{(.0002)(.9997)}{(.0002)(.9997) + (.9998)(.05)} \approx 0.00398$$