

## Section 4.2: Conditional Probability & Independence

$$P(E | F) = \frac{P(E \cap F)}{P(F)} \quad \& \quad P(F | E) = \frac{P(E \cap F)}{P(E)}$$

$P(E | F)$ : probability of  $E$  given  $F$ , or probability of  $E$  knowing  $F$ .

$P(F | E)$ : probability of  $F$  given  $E$ , or probability of  $F$  knowing  $E$ .

The two events  $E$  &  $F$  are **independent** if:  $P(E \cap F) = P(E) \cdot P(F)$

**Example 1:** If  $P(E) = 2/3$ ,  $P(F) = 5/8$  and  $P(E \cap F) = 5/12$ , are  $E$  &  $F$  independent?

**Example 2:** If  $P(E) = 0.5$ ,  $P(F) = 0.02$  and  $P(E \cap F) = 0.2$ , are  $E$  &  $F$  independent?

**Example 3:** In a survey of 100 people, it was found that:

	Married ( $R$ )	Divorced ( $D$ )	Singles ( $S$ )	
Male ( $M$ )	25	7	15	
Female ( $F$ )	30	10	13	

If one person is selected, find the probability that this person is:

- a) male, female, married, divorced
  
- b) male and married, male and divorced, female and married
  
- c) male, given he is married
  
- d) married given the person is female
  
- e) divorced given the person is male

**Example 4:** A pair of dice are rolled and the numbers are noted. What is the probability that:

a) both are even given that the sum is 8

b) the sum is 8 given that both are even.

**Example 5:** A box with 7 red balls, 5 white balls and 4 blue balls. 3 are selected at random, find the probability that:

a) they are red given that they are of the same color.

b) one is white given that at least one is white.

**Example 6:** There are 7 women and 5 men in a room in which 3 will be selected at random. Find the probability that:

a) all are women given that they are of the same gender.

b) at least 1 is a man and at least 1 is a woman given that the team contain at least 1 man.

**Example 7:** A committee consists of 6 Democrats and 5 Republicans. Three of the Democrats are men and three of the Republicans are men. If 2 people are selected, find the probability that they are:

a) Republican, given they are men.

b) opposite gender, given they are Republican.

**Example 8:** The probability that Mike will go to college is 0.4 and that he will join the army is 0.5. Find the probability that he will go to either one if:

a) the two events are independent

b) the two events are mutually exclusive.