5.3 What are the Chances

**What is Conditional Probability?**

When we are trying to find the probability that one event will happen under the *condition* that some other event is already known to have occurred, we are trying to determine a **conditional probability.**

Suppose we know that event *A* has happened. Then the probability that event *B* happens *given* that event *A* has happened is denoted by *P(B | A).*

Example 1:



Define events

*E*: the grade comes from an Engineering and Physical Science course, and

*L*: the grade is lower than a B.

1. Find P(L)
2. Find P(E|L)
3. Find P(L|E)

Example 2:



1. Find the probability a student takes a car to school
2. Find the probability that a student is an 11th or 12th grader given that they take a car to school
3. Find the probability a student takes a bus given they are a 9th or 10th grader

**Conditional Probability and Independence**

When knowledge that one event has happened does not change the likelihood that another event will happen, we say the two events are **independent.**

Two events *A* and *B* are **independent** if the occurrence of one event has no effect on the chance that the other event will happen. In other words, events *A* and *B* are independent if

*P(A | B) = P(A)* and *P(B | A) = P(B).*

Example 3:



Are the events “male” and “left-handed” independent? Justify your answer.

Example 4:



**Tree Diagrams**

A way to model chance behavior that involves a sequence of outcomes is to construct a **tree diagram**.

Consider flipping a coin twice. Draw a tree diagram to illustrate these events

What is the probability of getting two heads?

**General Multiplication Rule**

The idea of multiplying along the branches in a tree diagram leads to a general method for finding the probability *P*(*A* **∩** *B*) that two events happen together.

The probability that events *A* and *B* both occur can be found using the **general multiplication rule**

*P*(*A* **∩** *B*) = *P*(*A*) • *P*(*B* | *A*)

where *P*(*B* | *A*) is the conditional probability that event *B* occurs given that event *A* has already occurred.

If A and B are independent, then *P*(*B* | *A*) = P(B)

Example 1:

The Pew Internet and American Life Project finds that 93% of teenagers (ages 12 to 17) use the Internet, and that 55% of online teens have posted a profile on a social-networking site.

What percent of teens are online *and* have posted a profile? Use a tree diagram to help find the answer.

Example 2:

A study found that 27% of adult Internet users are 18-29, 45% are 30-49 and 28% are over 50. Another study found that 70% of Internet users in the 18-29 range have visited Youtube, 51% of Internet users 30-49 have visited Youtube and 26% of Internet users over 50 have visited Youtube.

What percent of all adult Internet users visit YouTube?

Example 3:



