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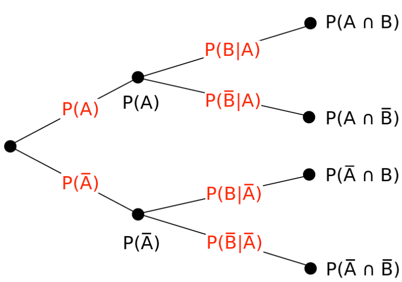
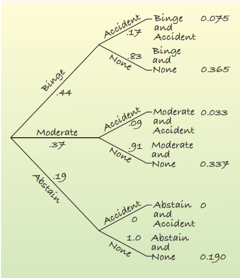
Lesson 28: How do tree diagrams help us solve probability problems?

What do you think are the uses of probability?

A Tree Diagram

A display of conditional events or probabilities that is helpful in thinking through conditioning





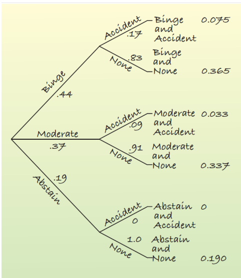
We can find the probabilities of compound events by multiplying the probabilities along the branch of the tree that leads to the event, just the way the General Multiplication Rule specifies.

$$P(\mathbf{A} \cap \mathbf{B}) = P(\mathbf{B}) \times P(\mathbf{A} \mid \mathbf{B})$$

$P(\text{binge} \cap \text{accident})$

According to a study by the Harvard School of Public Health (H. Wechsler, G. W. Dowdall, A. Davenport, and W. DeJong, "Binge Drinking on Campus: Results of a National Study"), 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 automobile accident, while among non-bingers of the same age, only 9% have been involved in such accidents.

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



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.

35. **Luggage.** Leah is flying from Boston to Denver with a connection in Chicago. The probability her first flight leaves on time is 0.15. If the flight is on time, the probability that her luggage will make the connecting flight in Chicago is 0.95, but if the first flight is delayed, the probability that the luggage will make it is only 0.65.

a) Are the first flight leaving on time and the luggage making the connection independent events? Explain.

b) What is the probability that her luggage arrives in Denver with her?

38. **Lungs and smoke.** Suppose that 23% of adults smoke cigarettes. It's known that 57% of smokers and 13% of nonsmokers develop a certain lung condition by age 60.

a) Explain how these statistics indicate that lung condition and smoking are not independent.
b) What's the probability that a randomly selected 60-year-old has this lung condition?

41. **Drunks.** Police often set up sobriety checkpoints—roadblocks where drivers are asked a few brief questions to allow the officer to judge whether or not the person may have been drinking. If the officer does not suspect a problem, drivers are released to go on their way. Otherwise, drivers are detained for a Breathalyzer test that will determine whether or not they will be arrested. The police say that based on the brief initial stop, trained officers can make the right decision 80% of the time. Suppose the police operate a sobriety checkpoint after 9 p.m. on a Saturday night, a time when national traffic safety experts suspect that about 12% of drivers have been drinking.

a) You are stopped at the checkpoint and, of course, have not been drinking. What's the probability that you are detained for further testing?
b) What's the probability that any given driver will be detained?
c) What's the probability that a driver who is detained has actually been drinking?
d) What's the probability that a driver who was released had actually been drinking?