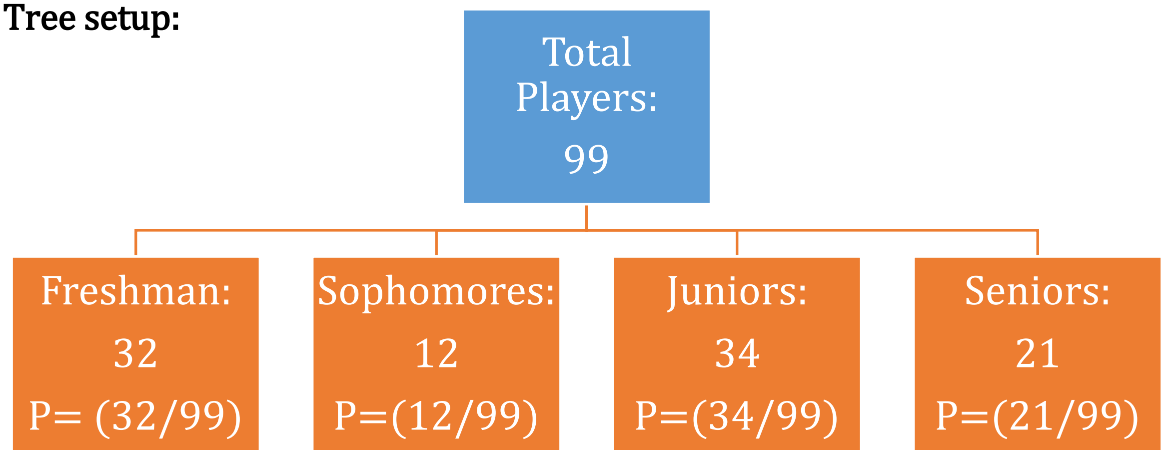
Lab 6 Solutions

1. On the Iowa Football Team there are exactly 99 players on the team. Of them 32 are freshman, 12 are sophomores, 34 are juniors, and 21 are seniors.

a.

Tree setup:



b. $P(\text{Senior}^C) = 1 - P(\text{Senior})$

$1 - (21/99) = 0.79$

c. $P(\text{Soph}|\text{Senior}^c) = \dfrac{P(\text{Soph} \cap \text{Senior}^C)}{P(\text{Senior}^C)} = \dfrac{P(\text{Soph})}{P(\text{Senior}^C)}$

The union of sophomore and not a senior is simply the probability of being a sophomore. If you are a sophomore, you are not a senior or anything else for that matter. Mutually exclusive.

$0.12/0.79 = 0.153$

Another approach is simply subtracting the number of senior from the total (99-21= 78) and then dividing the number of sophomores over the denominator with seniors removed.

$12/78 = 0.153$

d. *Independent* P(Two juniors with replacement)= P(Junior) x P(Junior)

$$\frac{34}{99}^2 = 0.118$$

Not independent P(Two juniors without replacement)=

P(Junior) x P(Junior|Junior first draw)

$$\frac{34}{99} \text{ x } \frac{33}{98} = 0.116$$

2.

Count

		periodontal status			
		healthy	gingivitis	perio	Total
GENDER	male	1143	929	937	3009
	female	2607	1490	921	5018
Total		3750	2419	1858	8027

a. P(Male OR Healthy)= P(Male) + P(Healthy) – P(Male and Healthy)

$$\frac{3009}{8027} + \frac{3750}{8027} - \frac{1143}{8027} = 0.6997 \text{ or about } 70\%$$

b. P(Female AND Ging-Perio)= P(Female) x P(Ging-Perio | Female)

$$\frac{5018}{8027} \text{ x } \frac{(1490+921)}{5018} = 0.3003 \text{ or about } 30\%$$

Alternatively (but you might not always have this information)

$$\frac{(1490+921)}{8027} = 0.3003$$

3.

a. Prevalence: P(H)= 0.001; Sensitivity: P(T|H)= 0.95

b. P(H and T)= P(H) x P(T|H)

0.001 x 0.95 = 0.00095

9.5 out of every 10,000 people in this population will have HIV and test positive

c. P(not T|H) = 1- P(T|H)

1-0.95 = 0.05

Otherwise known as the false negative rate

4.

a.

Prevalence: P(cancer)= 0.01

No cancer: P(no cancer)= 0.99

Sensitivity: P(+|cancer)= 0.90

False Negative (1- sensitivity): P(- | cancer)= 0.10

False Positive: P(+|no cancer)= 0.09

Specificity (1-FP): P(-|no cancer)= 0.91

b.

$$P(\text{cancer}|+) = \frac{\text{P(cancer)P(+|cancer)}}{\text{P(cancer)P(+|cancer)} + \text{P(no cancer)P(+|no cancer)}}$$

c.

$$\frac{0.01 \text{ x } 0.90}{0.01 \text{ x } 0.90 + (0.99) \text{ x } (0.09)} = 0.0917$$

Alternatively, from the tree diagram:

$$\text{P(D}|+) = \frac{90}{90 + 891} = \frac{90}{981} = 0.0917$$

Out of 10 women who test positive as you did, only about 1 has breast cancer.