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Assignment: Exercises 2.16, 2.18, 2.20, and 2.26 in *OpenIntro Statistics* (pp. 108-114).

2.16: PB & J. Suppose 80% of people like peanut butter, 89% like jelly, and 78% like both. Given that a randomly sampled person likes peanut butter, what's the probability that he also likes jelly?

Answer:

P(PB) = .8

P(J) = .89

P(PB and J) = P(J and PB) = .78

$$\mathrm{P(J|PB)} = \frac{\mathrm{P(J\ and\ PB)}}{P(PB)} = \frac{.78}{.8} = 0.975 = 97.5\%$$

There is a 97.5 % chance that a randomly sampled person likes jelly given that he likes peanut butter.

2.18 Weight and health coverage, Part II. Exercise 2.14 introduced a contingency table summarizing the relationship between weight status, which is determined based on body mass index (BMI), and health coverage for a sample of 428,638 Americans. In the table below, the counts have been replaced by relative frequencies (probability estimates).

	Neither (BMI < 25)	Overweight (25 ≤ BMI < 30)	Obese (BMI ≥ 30)	Total
Coverage :Yes	0.3145	0.3306	0.2503	0.8954
Coverage : No	0.0352	0.0358	0.0336	0.1046
Total	0.3497	0.3664	0.2839	1.0000

(a) What is the probability that a randomly chosen individual is obese?

Answer: 28.39 %

$$\mathrm{P(Obese)} = 0.2839 = 28.39\ \%$$

(b) What is the probability that a randomly chosen individual is obese given that he has health coverage?

Answer: 88.16%

$$\mathrm{P(Obese|Coverage = Yes)} = \frac{\mathrm{P(Obese\ and\ coverage = yes)}}{P(\mathrm{coverage = yes})} = \frac{.2503}{.2839} = 0.8816 = 88.16\%$$

(c) What is the probability that a randomly chosen individual is obese given that he doesn't have health coverage?

Answer: 11.94%

$$\text{P(Obese|Coverage = No)} = \frac{\text{P(Obese and coverage = No)}}{P(\text{coverage = No})} = \frac{.0339}{.2839} = 0.1194 = 11.94\%$$

(d) Do being overweight and having health coverage appear to be independent?

Answer: The being of overweight and having health coverage is not independent. Since the probability of being obese is 28.39%, while the probability of being obese given that they have health coverage is 88.16%. The probability changes when we are given the information about the individual having health coverage.

$$\text{P(Obese)} = 28.39\ \%$$

$$\text{P(Obese|Coverage = Yes)} = 88.16\%$$

2.20 Assortative mating is a nonrandom mating pattern where individuals with similar genotypes and/or phenotypes mate with one another more frequently than what would be expected under a random mating pattern. Researchers studying this topic collected data on eye colors of 204 Scandinavian men and their female partners. The table below summarizes the results.

	Partner (female)				
Self (male)		Blue	Brown	Green	Total
	Blue	78	23	13	114
	Brown	19	23	12	54
	Green	11	9	16	36
	Total	108	55	41	204

(a) What is the probability that a randomly chosen male respondent or his partner has blue eyes?

Answer: 70.59 %

$$\text{P(m = blue or f = blue)} = \text{P(m = blue)} + \text{P(f = blue)} - \text{P(m = blue and f = blue)}$$

$$\frac{114}{204} + \frac{108}{204} - \frac{78}{204} \approx 0.7059 = 70.59\ \%$$

(b) What is the probability that a randomly chosen male respondent with blue eyes has a partner with blue eyes?

Answer: 68.42 %

$$\text{P(f = blue|m = blue)} = \frac{\text{P(f = blue and m = blue)}}{\text{P(m = blue)}} = \frac{78}{114} \approx 0.6842 = 68.42\ \%$$

(c) What is the probability that a randomly chosen male respondent with brown eyes has a partner with blue eyes? What about the probability of a randomly chosen male respondent with green eyes having a partner with blue eyes?

Answer: 35.19 %; 30.56%

$$\mathrm{P(f = blue|m = brown)} = \frac{\mathrm{P(f = blue\ and\ m = brown\ )}}{\mathrm{P(m = brown)}} = \frac{19}{54} \approx 0.3519 = 35.19\ \%$$

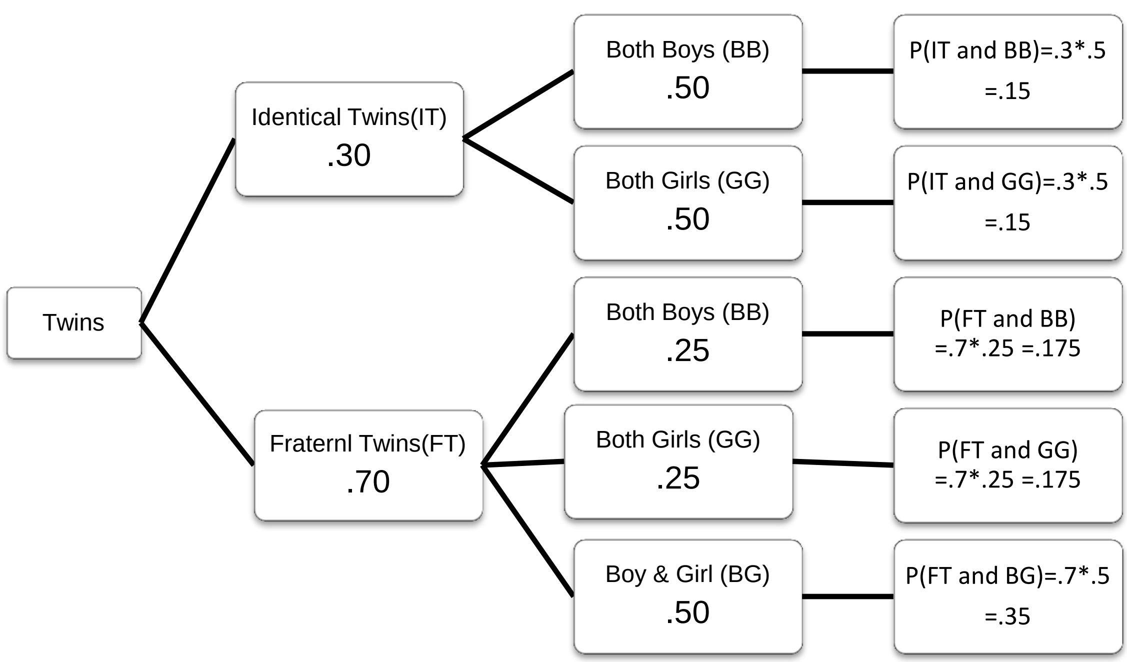
$$\mathrm{P(f = blue|m = green)} = \frac{\mathrm{P(f = blue\ and\ m = green\ )}}{\mathrm{P(m = green)}} = \frac{11}{36} \approx 0.3056 = 30.56\ \%$$

(d) Does it appear that the eye colors of male respondents and their partners are independent? Explain your reasoning.

Answer: The probability of eye colors of male and their partners are dependent. For example the probability of female partner having blue eyes is $P(f = blue) = \frac{108}{204} \approx 52.94\ \%$, while the probability female partner having blue eyes given that her male respondents have blue eyes is $\mathrm{P(f = blue|m = blue)} \approx 68.42\ \%$.

2.26 Twins. About 30% of human twins are identical, and the rest are fraternal. Identical twins are necessarily the same sex – half are males and the other half are females. One-quarter of fraternal twins are both male, one-quarter both female, and one-half are mixes: one male, one female. You have just become a parent of twins and are told they are both girls. Given this information, what is the probability that they are identical?

Answer: There is a 46.15% chance that they are identical.



$$P(IT|GG) = \frac{P(IT\ and\ GG)}{P(GG)} = \frac{P(IT\ and\ GG)}{P(IT\ and\ GG) + P(FT\ and\ GG)} = \frac{.15}{.15 + .175} \approx .4615$$