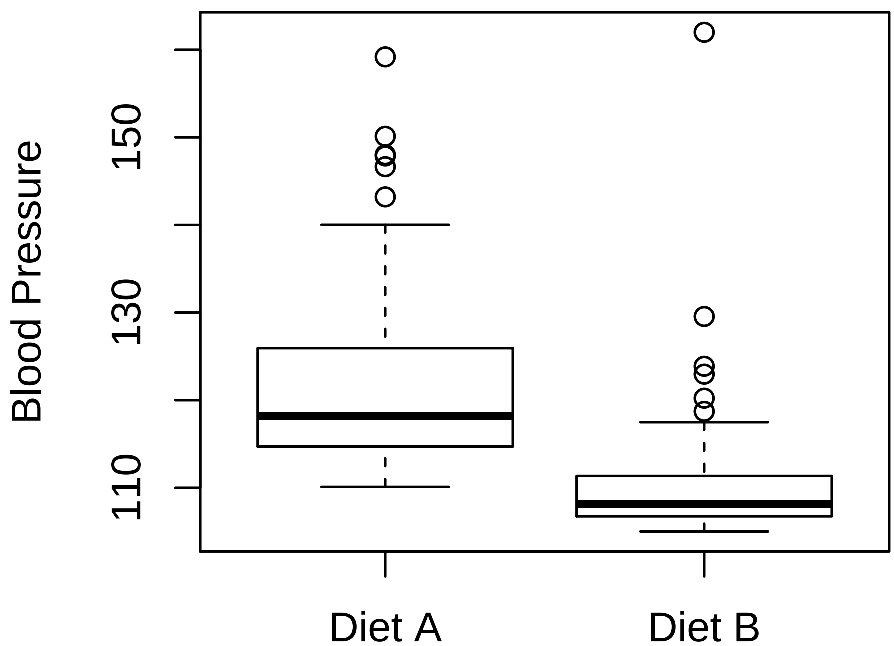
Introduction to Biostatistics (Stats 8)

Midterm Exam – A

Duration: 1:00 to 1:50 PM

Name: Student ID:



1. Consider the above figure.
   (a) Comment on the relationship between diet type and blood pressure.
   Diet type and blood pressure seem to be related: blood pressure tends to be lower for people on Diet B.
   (b) Which group has a larger IQR?
   Diet A
   (c) Which group has a larger range?
   Diet B

2. To investigate the relationship between car accidents and cellphone use, we conducted a study where 40 drivers were randomly assigned to one of two groups. One group used a cellphone while driving through a zigzag path set up by traffic cones, the other group did not use a cellphone while driving through the same path. For each driver, we recorded whether he/she hit any traffic cone. We obtained the following contingency table:

	Did not hit any traffic cone	Hit at least one traffic cone
Did not use cellphone	18	2
Used cellphone	12	8

(a) Comment on the type of the study we have conducted and identify the response and explanatory variables.

This is a randomized experiment; The response variable is a binary indicator showing whether the drivers had an accident, and the explanatory variable is also a binary indicator identifying drivers who used cellphone while driving.

(b) Use the above contingency table to comment on the relationship between car accidents and using a cellphone while driving.

For drivers who did not use cellphone, denote the proportion of them who hit at least one traffic cone as p_1. We use p_2 to denote the corresponding proportion for drivers who used cellphone. Based on the above contingency table, $p_1 = 2/20 = 0.1$ and $p_2 = 8/20 = 0.4$. The risk of having accident (in this case, hitting a traffic cone) is $p_2/p_2 = 0.4/0.1 = 4$ times higher among drivers who use cellphone while driving. The odds ratio is

$$\frac{p_2/(1-p_2)}{p_1/(1-p_1)} = \frac{0.4/0.6}{0.1/0.9} = 6$$

Therefore, the sample odds (using people participating in our experiment) of having an accident is 6 times higher among drivers who use cellphone while driving.

3. Suppose the probability of having a car accident is 0.05, and the probability of using a cellphone while driving is 0.1. Given a driver had a car accident, the probability that he/she was using a cellphone while driving is 0.3. If someone is using a cellphone while driving, what is the probability that he/she would have a car accident? Are these two events (car accident and using cellphone while driving) independent?

$$\begin{aligned} P(Accident|Cellphone) &= \frac{P(Cellphone|Accident)P(Accident)}{P(Cellphone)} \\ &= \frac{0.3 \times 0.05}{0.1} = 0.15 \end{aligned}$$

Therefore, the probability of having accident is 3 times higher among drivers using cellphone while driving. The two events are dependent since knowing that one event has happened changes the probability of the other event.

4. The sample mean and coefficient of variation (CV) for variable X are 5 and 1 respectively. We create a new variable, Y, by first subtracting 1 from X and then dividing the result by 2. What is CV for Y?

   Mean and standard deviation of X are both 5. Subtracting 1 from X, changes the mean to 4, but the standard deviation remains the same. Dividing the result by 2 changes the mean to $4/2 = 2$ and changes the standard deviation to $5/2 = 2.5$. Therefore, for Y, CV is $2.5/2 = 1.25$.

5. For two events E_1 and E_2, we have $P(E_1) = 0.3$ and $P(E_2) = 0.4$. Write down the following probabilities:

   (a) $P((E_1 \cap E_2)^c)$ if E_1 and E_2 are independent.
   $P(E_1 \cap E_2) = 0.3 \times 0.4 = 0.12$; therefore, $P((E_1 \cap E_2)^c) = 1 - 0.12 = 0.88$

   (b) $P(E_1|E_2)$ if the two events are disjoint.
   $P(E_1|E_2) = 0$ because when E_2 happens, E_1 does not happen.

   (c) $P(E_1|E_2)$ if the two events are independent.
   $P(E_1|E_2) = 0.3$ because knowing that E_2 has happened does not change the probability of E_1.