

# Introduction to Biostatistics

## Exercises on Lecture 2

September 19, 2022

**(Q1):** Find the following probabilities?

- **Positive Predictive Value:** Probability that a person with a positive test truly has the disease
  - $\mathbb{P}[D = 1|Y^k \geq t] = ?$
- **Negative Predictive Value:** Probability that a person with a negative test truly don't have the disease
  - $\mathbb{P}[D = 0|Y^k < t] = ?$

Test Outcome	Disease Status (Gold Standard)		Total
	Positive ( $D = 1$ )	Negative ( $D = 0$ )	
Positive ( $Y \geq t$ )	<b>a</b> (TP)	b (FP)	a+b
Negative ( $Y < t$ )	c (FN)	<b>d</b> (TN)	c+d

**(Q2):** Use the "Biomarker" data generated below to assess the performances of IL-8 and IL-10 cytokines as biomarkers of HIV disease. Which cytokine is superior in distinguishing HIV patients from negative subjects? Plot the ROC curve and calculate the area under the ROC curve for each cytokine?

Biomarker<-

data.frame(IL10=c(rnorm(100,100,10),rnorm(100,80,10)),

IL8=c(rnorm(100,90,10),rnorm(100,80,10)),

HIV=c(rep("Positive",100),rep("Negative",100)),

D=c(rep(1,100),rep(0,100)))

- **(Q3)**. Suppose that 60% of HIV patients are co-infected with HSV-2. If 100 HIV patients are tested for HSV-2, what is the probability of
  - Zero HSV-2 infection
  - At least one HSV-2 infection
  - Exactly 50 HSV-2 infections

- (Q4). Based on data from the FRESH study, on average, there are eight HIV infections per year in Durban. Find the probability of
  - No infection in 2019
  - At least one infection in 2019
  - Ten infections in 2019

- (Q5). Let  $\mathbf{X}$  be a random variable that represents diastolic blood pressure of men in the US ( $\mathbf{X} \sim N(\mu=129, \sigma=19.8)$ )
  - 1 What is the probability that a randomly selected man has a diastolic blood pressure greater than 150 mm Hg?
  - 2 What is the probability that he has a diastolic blood pressure less 167.8 mm Hg?
  - 3 What is the probability that he has a diastolic blood pressure less 69.6 mm Hg?
  - 4 What is the probability that he has a diastolic blood pressure between 89 mm Hg and 169?