EXAM OF STATISTICS
(PROBABILITY AND RANDOM VARIABLES)

Pharmacy/Biotechnology 1st year — Version A — **January 18, 2021**

Duration: 1 hour.

(3.5 pts.) 1. A test to detect prostate cancer produces 1% of false positives and 0.2% false negatives. It is known that 1 in 400 males suffer this type of cancer.

(a) Compute the sensitivity and the specificity of the test.

(b) If a male got a positive outcome in the test, what is the chance of developing cancer?

(c) Compute and interpret the negative predictive value.

(d) Is this test better to predict or to rule out the cancer?

(e) To study wether there is an association between the practice of sports and this type of cancer, a sample of 1000 males was drawn, of which 700 practiced sports, and it was observed that there were 2 males with cancer in the group of males who practiced sports, and there were 3 males with cancer in the group of males who did not practice sports. Compute the relative risk and the odds ratio and interpret them.

Solution

Let D the event corresponding to suffering COVID19 and $+$ and $-$ the events corresponding to get a positive and a negative outcome respectively.

(a) The sensitivity is $P(+|D) = 0.58$ and specificity $P(-|\overline{D}) = 0.01$.

(b) Positive predictive value $P(D|+) = 0.0205$ and negative predictive value $P(\overline{D}|-) = 0.4$. As de positive predictive value is less than 0.5 we can not use this test to confirm COVID19, but we can use it to rule it out with a strong confidence since the negative predictive value is pretty close to 1.

(c) $P(D \cap +) + P(\overline{D} \cap -) = 0.0297$.

(3 pts.) 2. The probability that a child of a mother with the color-blind gene and a father without the color-blind gene is a color-blind male is 0.25. It is also known that in a population there is one color-blind male for every 5000 males.

(a) If this couple has 5 children, what is the probability that at most 2 of them are color-blind males?

(b) If this couple has 5 children, and the gender of the children is equiprobable, what is the probability that 3 or more are females?

(c) In a random samble of 10000 males of this population, what is the probability that more than 3 are color-blind males?

Solution

(3.5 pts.) 3. The primate cranial capacity follows a normal distribution with mean 1200 cm^3 and standard deviation 140 cm^3.

(a) Compute the probability that the cranial capacity of a primate is greater than 1400 cm^3.

(b) Compute the probability that the cranial capacity of a primate is exactly than 1400 cm^3.

(c) Above what cranial capacity will 20% of primates be?

(d) Compute the interquartile range of the cranial capacity of primates and interpret it.

Solution

Let X and Y be the prolactin levels in pregnant and non-pregnan females respectively.
