

EXAM OF STATISTICS (PROBABILITY AND RANDOM VARIABLES)

2nd Physiotherapy

Version A

May, 06 2022

Duration: 1 hour.

- (3 pts.) 1. A basketball player scores 12 points per game on average.
- What is the probability that the player scores more than 4 points in a quarter?
 - If the player plays 10 games in a league, what is the probability of scoring less than 6 points in some game?

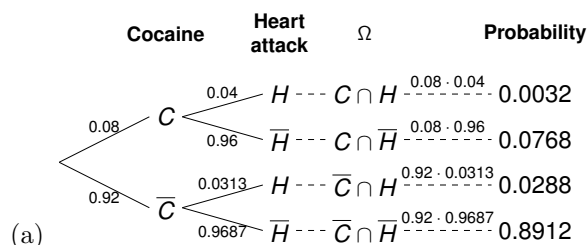
Solution

- Let X be the points scored in a quarter by the player. Then $X \sim P(3)$, and $P(X > 4) = 0.1847$.
- Let Y be the number of points scored in a game by the player. Then $Y \sim P(12)$ and $P(Y < 6) = 0.0203$.
Let Z be the number of games with less than 6 points scored by the player. Then $Z \sim B(10, 0.0203)$, and $P(Z > 0) = 0.1858$.

- (3 pts.) 2. 8% of people in a population consume cocaine. It is also known that 4% of people who consume cocaine have a heart attack and 10% of people who have a heart attack consume cocaine.
- Construct the probability tree for the random experiment of drawing a random person from the population and measuring if he or she consumes cocaine and if he or she has a heart attack.
 - Compute the probability that a random person of the population does not consume cocaine and does not have a heart attack.
 - Are the events of consuming cocaine and having a heart attack dependent?
 - Compute the relative risk and the odds ratio of suffering a heart attack consuming cocaine. Which association measure is more suitable for this study? Interpret it.

Solution

Let C the event of consuming cocaine and H the event of having a heart attack.



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- $P(\bar{C} \cap \bar{H}) = 0.8912$.
- The events are dependent as $P(C) = 0.08 \neq P(C|H) = 0.1$.
- $RR(H) = 1.2778$ and $OR(H) = 1.2894$. The odds ratio is more suitable as the study is retrospective. That means that the odds of having a heart attack is 1.2894 times greater if a person consumes cocaine.

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- (4 pts.) 3. The creatine phosphokinase (CPK3) is an enzyme in the body that causes the phosphorylation of creatine. This enzyme is found in the skeletal muscle and can be measured in a blood analysis. The concentration of CPK3 in blood is normally distributed, and the interval centered at the mean with the reference values, that accumulates 99% of the population, ranges from 40 to 308 IU/L in healthy adult males.
- (a) Compute the mean and the standard deviation of the concentration of CPK3 in healthy males.
Note: If you are not able to compute the standard deviation, use $\sigma = 50$ UI/L for the next parts.
 - (b) A diagnostic test to detect muscular dystrophy gives a negative outcome when the concentration of CPK3 is below 300 UI/L. Compute the specificity of the test.
 - (c) If the concentration of CPK3 in people with muscular dystrophy also follows a normal distribution with mean 350 IU/L and the same standard deviation, what is the sensitivity of the test?
 - (d) Compute the predictive values of the test and interpret them assuming that the muscular dystrophy prevalence is 8%.
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Solution

- (a) $\mu = 174$ IU/L and $\sigma = 51.938$ IU/L.
 - (b) Specificity = 0.9924.
 - (c) Sensitivity = 0.8321.
The test is better to confirm the disease as the specificity is greater than the sensitivity.
 - (d) PPV = 0.9046. Thus, we can diagnose the disease with a positive outcome.
NPV = 0.9855. Thus, we can rule out the disease with a negative outcome.
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