

EXAM OF STATISTICS (PROBABILITY AND RANDOM VARIABLES)

Pharmacy/Biotechnology 1st year

Version A

November, 23 2020

Duration: 1 hour.

- (2.5 pts.) 1. A test to detect the COVID19 was applied to 850 persons infected by COVID19 with a positive outcome in 800 of them, and it was also applied to 9150 non-infected persons with a positive outcome in 10% of them.
- (a) Compute the sensitivity and the specificity of the test.
 - (b) Compute the positive and the negative predictive values and interpret them.
 - (c) Compute the probability of a correct diagnostic.

Solution

Sea E el suceso consistente en tener la enfermedad y $+$ y $-$ los sucesos correspondientes a obtener un resultado positivo y negativo respectivamente en el test.

- (a) $VPP = 0.9192$.
 - (b) $VPN = 0.9776$.
 - (c) Es más fiable para descartar la enfermedad ya que el valor predictivo negativo es mayor que el valor predictivo positivo.
 - (d) $P(E \cap +) + P(\bar{E} \cap -) = 0.966$.
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- (2.5 pts.) 2. A newborn baby affected by Moebius syndrome blinks, on average, twice a minute.
- (a) Compute the probability that a newborn blinks twice in half a minute.
 - (b) In a hospital five children have been born with Moebius syndrome. Compute the probability that at least 3 of them blink in their first minute of life.
 - (c) In which distribution is more representative the mean, in the number of times that a newborn blinks in a minute or in the number of times that a newborn blinks in half a minute?

Solution

- (a) Sea X el número de pacientes que llegan en 1 horas. $X \sim P(2)$ y $P(X > 4) = 0.0527$.
 - (b) Sea Y el número de horas en un día en las que algún paciente no puede ser atendido. $Y \sim B(6, 0.0527)$ y $P(Y > 0) = 0.2771$. Se necesitan 5 empleados para que esta probabilidad sea menor del 10%.
Se necesitan 5 empleados para que esta probabilidad sea menor del 10%, ya que $P(X > 5) = 0.0527$ y $P(Y > 0) = 0.0954$, siendo ahora $Y \sim B(6, 0.0166)$.
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- (3 pts.) 3. The prolactin level in pregnant and non-pregnant females follows a normal distribution with different means but with the same variance. When the prolactin levels exceed 15 ng/ml, females secrete milk through their mammary glands. It is known that 95% of pregnant females secrete milk but only 1% of non-pregnant females secrete milk.

- (a) If the median of the prolactin level in pregnant females is 16 ng/ml, what are the means and the standard deviation of the prolactin level in both populations?
Remark: If you are not able to compute the mean or the standard deviation for pregnant females, use $\mu = 17$ ng/ml and $\sigma = 2$ ng/ml for the next parts.
- (b) Compute the percentage of pregnant females with a prolactin level between 15.5 and 17 ng/ml.
- (c) Compute the prolactin level such that 20% of pregnant females are above that level.

Solution

- (2 pts.) 4. An organism has the same chance of being infected by a virus and a bacteria. At the same time, the probability of being infected by a virus doubles when the organism has been previously infected by a bacteria. On the other hand, the probability of being infected by no pathogen (neither virus nor bacteria) is 0.52.
- (a) What is the probability of being infected by a virus and a bacteria at the same time?
- (b) What is the probability of being infected by a bacteria if it has been infected by a virus?
- (c) What is the probability of being infected only by a virus?
- (d) Are the events of being infected by a virus and a bacteria independent?

Solution
