EXAM OF STATISTICS
(PROBABILITY AND RANDOM VARIABLES)

Pharmacy/Biotechnology 1st year — Version A — **June 15, 2018**

Duration: 1 hour.

(3 pts.) 1. A study about hypertension has found that 36% of people suffer hypertension, that 60% of smokers suffer hypertension and that 75% of people without hypertension are non smokers.

(a) Compute the probability that a person is a smoker.
(b) Compute the probability that a person is a smoker or suffers hypertension.
(c) Compute the probability that a non smoker person does not suffer hypertension.
(d) Does suffering hypertension depend on smoking?

Solution

(a) $P(S) = 0.4$.
(b) $P(H \cup S) = 0.52$.
(c) $P(\overline{H}|\overline{S}) = 0.8$.
(d) Yes, because $P(S) = 0.4 \neq 0.6667 = P(S|H)$.

(7 pts.) 2. It is known that eye pressure in patients with glaucoma follows a normal distributions with mean 26 mmHg and standard deviation 2.1 mmHg, while in people without glaucoma follows a normal distribution with mean 15 mmHg and standard deviation 2.8 mmHg. A test for detecting glaucoma gives a positive outcome when the eye pressure is above 22 mmHg and a negative outcome if not.

(a) Compute the sensitivity and the specificity of the test.
Remark: If you are not able to compute this values, assume a sensitivity of 0.95 and a specificity of 0.97 for the following parts.
(b) If there are 6% of persons with glaucoma in the population, what are the positive and negative predictive values of the test?
(c) If we consider 10 persons with a positive outcome in the test, what is the probability that more than 8 suffer glaucoma?
(d) If we apply the test to 70 persons, what is the probability of getting between 2 and 5 positive outcomes, both included?

Solution

(a) Let X_1 the eye pressure in patients with glaucoma and X_2 in people without glaucoma.
Sensitivity: $P(+|D) = P(X_1 > 22) = 0.9716$.
Specificity: $P(-|\overline{D}) = P(X_2 \leq 22) = 0.9938$.
(b) $PPV = P(D|+) = 0.909$ and $NPV = P(\overline{D}|-) = 0.9982$.
(c) Let Y be the number of persons with glaucoma in a sample of 10 persons with a positive outcome in the test. $Y \sim B(10, 0.909)$ and $P(Y > 8) = 0.7707$.
(d) Let U be the numer of persons with a positive outcome in the test in a sample of 70 persons. $U \sim B(70, 0.0641) \approx P(4.4893)$ and $P(2 \leq U \leq 5) = 0.6431$.
