

## EXAM OF STATISTICS (PROBABILITY AND RANDOM VARIABLES)

Pharmacy/Biotechnology 1st year

Version A

December, 16 2019

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**Duration:** 1 hour.

- (3 pts.) 1. To study the association between the osteoporosis and the gender a random sample of people between 65 and 70 years old was taken. The following table summarize the results

	Osteoporosis	Not osteoporosis
Women	480	2320
Men	255	1505

- (a) Compute the prevalence of the osteoporosis in the population.
- (b) Compute the relative risk of osteoporosis in females with respect to males and interpret it.
- (c) Compute the odds ratio of osteoporosis in females with respect to males and interpret it.
- (d) Which of the two measures is most suitable to study the association between the osteoporosis and the gender?

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**Solution**

Let  $D$  be the event of suffering osteoporosis.

- (a) Prevalence:  $P(D) = 0.1612$ .
- (b)  $RR(D) = 1.1832$ . Thus, the risk of suffering osteoporosis in women is higher than in men but not to much. There is no strong association between the osteoporosis and the gender.
- (c)  $OR(D) = 1.2211$ . Thus, the odds of suffering osteoporosis in women is higher than in men but not to much.
- (d) Since we can compute the prevalence of  $D$ , both statistics are suitable, but relative risk is easier to interpret.

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- (3.5 pts.) 2. The risks of getting the flu in two cities  $A$  and  $B$  with the same population size are 14% and 8% respectively.

- (a) Compute the probability of having more than 2 persons getting the flu in a random sample of 10 persons of the city  $A$ .
- (b) Compute the probability of having more than 2 and less than 5 persons getting the flu in a random sample of 50 persons of the city  $B$ .
- (c) Compute the probability of having 2 persons getting the flu in a random sample of 8 persons of the two cities.
- (d) Compute the probability of having some person getting the flu in a random sample of 5 persons that have been living in both cities.

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**Solution**

- (a) Let  $X$  be the number of persons with flu in a sample of 10 persons from  $A$ , then  $X \sim B(10, 0.14)$  and  $P(X > 2) = 0.1545$ .

- (b) Let  $Y$  be the number of persons with flu in a sample of 50 persons from  $B$ , then  $Y \sim B(50, 0.08) \approx P(4)$  and  $P(2 < Y < 5) = 0.3907$ .
- (c) Let  $Z$  be the number of persons with flu in a sample of 8 persons from  $A$  and  $B$ , then  $Z \sim B(8, 0.11)$  and  $P(Z = 2) = 0.1684$ .
- (d) Let  $U$  be the number of persons with flu in a sample of 5 persons living in both cities, then  $U \sim B(5, 0.2088)$  and  $P(U > 0) = 0.69$ .
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(3.5 pts.) 3. In a study about the cholesterol two samples of 10000 males and 10000 females was taken. It was observed that 3420 males and 1234 females had a cholesterol level above 230 mg/dl, and that 4936 males had a cholesterol level between 210 and 230 mg/dl. Assuming that the cholesterol level in males and females follows a normal distribution with the same standard deviation, compute:

- (a) The means and the standard deviation of the distributions of cholesterol level in males and females.
- (b) The percentage of males with cholesterol level between 200 and 240 mg/dl.
- (c) The interquartile range of the cholesterol level of females.
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**Solution**

- (a) Let  $X$  be cholesterol level in males and  $Y$  the cholesterol level in females, then  $X \sim N(224.1164, 14.4556)$  and  $Y \sim N(213.2581, 14.4556)$
- (b)  $P(200 \leq X \leq 240) = 0.8164$ .
- (c)  $IQR = 19.5003$  mg/dl.
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