University of California, Santa Cruz

Department of Statistics

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Statistical Methods for the Biological,

Environmental, and Health Sciences

STAT 007

Answers to Quiz 3

1. A group of students took a test and their scores were recorded. The following are summary statistics from that test: sample mean: $\bar{x}$=8.9, sample standard deviation: s=3.9, first quartile: Q_1=7.5, second quartile: Q_2=10, third quartile: Q_3=12.

   (a) A student is randomly chosen from the group. It is observed that he/she received 10 points in the test. Is the score of this student an outlier? Answer yes or no. Justify your answer. Explain, in your own words, what an outlier is.

   Because the score 10 is not greater that $Q_3 + 1.5(Q_3 - Q_1) = 12 + 1.5(12 - 7.5) = 18.75$ and is not less that $Q_1 - 1.5(Q_3 - Q_1) = 7.5 - 1.5(12 - 7.5) = 0.75$, it is not an outlier [2 pts.].
   An outlier is a value that is far from the vast majority of the data. [1 pts.]

2. The following table summarizes information from a study involving 1008 patients. Some patients had cancer and some did not have cancer. Each patient took a cancer test. The test's outcomes are positive (test shows cancer) or negative (test shows no cancer).

	Positive Test	Negative Test
Cancer	10	4
No Cancer	101	893

   Assume that one patient is randomly chosen. Use the frequentist approach to compute

   (a) The probability that the patient has cancer. Justify your answer.

   Using the frequentist approach,
   $$P(cancer) = \frac{number\ of\ patients\ with\ cancer}{number\ of\ patients} = \frac{10 + 4}{1008}\textit{[3 pts.]} = 0.0138.$$

   (b) The probability that the patient has cancer or his/her test is positive. Justify your answer.

   $$P(cancer\ or\ positive) = P(cancer) + P(positive) - P(cancer\ and\ positive)\textit{[2 pts.]}$$
   $$= \frac{10 + 4}{1008} + \frac{10 + 101}{1008} - \frac{10}{1008}\textit{[1 pts.]} = \frac{115}{1008} = 0.1140$$

   (c) The probability that the patient has cancer given that his/her test is positive. Justify your answer.

   $$P(cancer \mid positive) = \frac{P(cancer\ and\ positive)}{P(positive)}\textit{[2 pts.]}$$
   $$= \frac{10/1008}{(10 + 101)/1008}\textit{[1 pts.]} = \frac{10}{111} = 0.090$$

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