QUIZ 6 - SOLUTION

High levels of prostate–specific antigen (PSA) are associated with prostate cancer and may be observed at a very early stage in the disease's progression. A proposed technique for identifying individuals at high risk of developing prostate cancer within ten years is to declare an individual to be at high risk if his PSA level is above 4.0 (ng/ml). A study of this 'test' found that 46% of individuals that developed prostate cancer within 10 years had a PSA level above 4.0 while 91% of individuals who did not develop prostate cancer within 10 years had a level at or below 4.0. Assume that in the population 2% of individuals will develop prostate cancer within ten years. (The lifetime risk is actually much higher.)

1 point What is the probability of a false positive?

1 - 0.91 = 0.09

1 point What is the probability of a false negative?

1 - 0.46 = 0.54

4 points Calculate the probability that an individual will develop prostate cancer within ten years *given* that he has a measured PSA level above 4.0. Assume that this individual is randomly selected from a population among which 2% of individuals will develop prostate cancer within ten years.

Use Bayes theorem, make up a contingency table or use a tree diagram to work out the probability.

The solution is 0.0945 = 0.02*0.46/(.02*.46 + .98*.09).

Of the 2% that have cancer, only 46% test positive – this represents the number that have the disease and test positive. But of the 98% that do not have cancer, 9% will also test positive. The probability of a positive test is (.02*.46 + .98*.09). So out of all those that test positive, 0.02*0.46 out of (.02*.46 + .98*.09) actually have cancer.

2 points In this population, what percentage of "tests" indicate in a PSA level above 4.0, regardless of cancer status?

This is the denominator above (.02*.46 + .98*.09) which reflects all of those with the disease and a positive test + those without the disease and a positive test.