

Subject

probabilities

Please do not write on the exam paper and do not forget to give back the examination paper at the end of the test.

"In 1951, history major Jerome Cornfield used Bayes' Theorem to solve a puzzle about the chances of a person getting lung cancer. His paper helped epidemiologists to see how patients' histories could help measure the link between a disease and its possible cause. Moreover, he had begun to establish the link between smoking and lung cancer. Later efforts in England and the U.S. confirmed Cornfield's results."

source: http://lesswrong.com/lw/774/a_history_of_bayes_theorem/

Bayes' Formula:

If A and B are two events such that $p(A) \neq 0$ and $p(B) \neq 0$

$$\text{Then } p_B(A) = \frac{p_A(B) \times p(A)}{p(B)}$$

Here are some data concerning smoking and lung cancer in the United Kingdom in 2009:

0.588% of the population suffer from lung cancer

86% of those diagnosed with a lung cancer are smokers

22% of the people are smokers.

source: <http://www.cancerresearchuk.org/cancer-info/cancerstats/types/lung/smoking/lung-cancer-and-smoking-statistics>

Let us choose a person from the United Kingdom at random, and find out whether he or she smokes, and whether he or she suffers from lung cancer.

We shall denote by: L the event that the person suffers from lung cancer

S the event that the person is a smoker

1) Use the notations of the events to interpret the data given above as probabilities.

2) We know the person we've chosen is a smoker.

What is the probability that he or she suffers from lung cancer? (as a percentage, to the nearest tenth)

3) We know the person we've chosen is not a smoker.

What is the probability that he or she suffers from lung cancer? (as a percentage, to the nearest tenth)

4) The quotient $\frac{p_S(L)}{p_{\bar{S}}(L)}$ gives the rate of increased risk of getting a lung cancer when smoking.

By how much do you increase your risk of getting a lung cancer when you smoke?