PROBABILITY AND LIFE

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- 1) Before entering a new job, David has to undergo a routine medical check-up including the HIV test. Test producer claims that in the case of an ill person, the test detects the virus with the probability 99.99 %, and in the case of a healty person, it gives the negative result with the probability 99.90 %. In the Czech Republic, approximately 1 person in 10 000 is infected by HIV. After the evaluation of the test, the physician calls David and says he is positive and it is thus necessary to repeat the test. The result of the second test will be known in one week. In the meanwhile, David has to wait, fearing the worst.
- a) As far as the danger of HIV infection is concerned, David considers himself to be an average Czech. What is the probability after the result of the first test that he is indeed infected by HIV?
 - i) greater than 99 %
 - ii) between 90 % and 99 %
 - iii) between 60 % and 90 %
 - iv) between 40 % and 60 %

- v) between 10 % and 40 %
- vi) between 1 % and 10 %
- vii) smaller than 1 %





P(infected | positive) = 1/2



P(infected | positive) = 1/2

P(positive | infected) = P(infected | positive)

	infected	healthy	Σ
positive	1	1	2
negative	0	9998	9998
Σ	1	9999	10 000

P(infected | positive) = 1/2 = 50 %

P(healthy | positive) = 1/2 = 50 % ... false positivity

	infected	healthy	Σ
positive	1	10	11
negative	0	99989	99 989
Σ	1	99 999	100 000

P(infected | positive) = 1/11 = 9,09 %

P(healthy | positive) = 10/11 = 90,91 %

	infected	healthy	Σ
positive	9990	99	10089
negative	10	989 901	989 91 1
Σ	10000	990 000	1 000 000

P(infected | positive) = 9990 / 10 089 = 99,02 %

P(healthy | positive) = 99/10089 = 0,98 %

Probability that a woman has a breast cancer is 0,8%. Probability that the mammogram of a woman with the breast cancer is positive, is 90%. For a healthy woman, probability that the mammogram is positive is 7%. Imagine a woman, whose mammogram is positive. What is the probability that she indeed has a breast cancer?

Eight women in 1000 has a breast cancer. On average, seven of these women have positive mammograms. Of remaining 992 women that do not have a breast cancer, approximately 70 also have a positive mammogram. Consider a group of women with the positive mammogram. How many of them have indeed the breast cancer? Eight women in 1000 has a breast cancer. On average, seven of these women have positive mammograms. Of remaining 992 women that do not have a breast cancer, approximately 70 also have positive mammograms.



P(breast cancer | positive) = 7/77 = 9,09 %

	conditional probabilities	absolute frequencies
incorrectly	22	13
correctly	2	11



-		test result		total
		negative	positive	lolai
breast	no	922	70	992
cancer	yes	1	7	8
total		923	77	1 000

(1) How many women in 1000 will test positive?(2) How many of women with a positive test have the breast cancer?

8 in 1 000 women have the breast cancer. 7 of them test positive, 1 negative. Of remaining 992 women (those without breast cancer), 70 test positive.
(1) How many women in 1000 test positive?
(2) How many women of them have the breast cancer?

	text	table
incorrectly	29	27
correctly	15	17





	physicians	elementary school children
incorrectly	13	56
correctly	11	32



