

# Machine-Learning-with-Python

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## 1 Probability

**Exercise 1** To evaluate a new test for detecting Hansen's disease, a group of people 5% of which are known to have Hansen's disease are tested. The test finds Hansen's disease among 98% of those with the disease and 3% of those who don't. What is the probability that someone testing positive for Hansen's disease under this new test actually has it?

Solution 1 :

$$P(\text{disease}) = 0.05$$

$$P(\text{positive} \mid \text{disease}) = 0.98$$

$$P(\text{positive} \mid \text{notdisease}) = 0.03$$

$$P(\text{disease} \mid \text{positive}) = ??$$

$$P(\text{disease} \mid \text{positive}) = \frac{P(\text{positive} \mid \text{disease}) \times P(\text{disease})}{P(\text{positive})}$$

$$P(\text{positive}) = P(\text{positive} \mid \text{disease}) \times P(\text{disease}) + P(\text{positive} \mid \text{notdisease}) \times P(\text{notdisease})$$

$$= 0.98 \times 0.05 + 0.03 \times 0.95$$

$$= 0.0775$$

$$\Rightarrow P(\text{disease} \mid \text{positive}) = \frac{0.98 \times 0.05}{0.0775} = 0.632$$

**Exercise 2** Proof the following distributions are normalized then calculate the mean and standard deviation of these distribution:

1. Univariate normal distribution.
2. (Optional) Multivariate normal distribution.