

Mathematical exercise: Probability & Linear Regression

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1 Probability: Bayes

A disease that is randomly found in one-half of one percent (.005) of the general population. A certain clinical blood test is 99 percent effective in detecting the presence of this disease; that means, it will yield an accurate positive result in 99 percent of the cases where the disease is actually present. But it also yields false-positive results in 5 percent (.05) of the cases where the disease is not present. What is the probability that the disease is present if a test comes back positive?

- 2 Let an experiment consist of tossing a fair coin three times. Let X denote the number of heads which appear. Then the possible values of X are 0, 1, 2, and 3. The corresponding probabilities are $1/8$, $3/8$, $3/8$, and $1/8$. Compute the expectation E of X .

- 3 Compute the maximum likelihood estimator of the linear regression coefficients and the variance under a Gaussian noise model. And compute the log likelihood. (Hint: The ordinary least squares estimator is equal to the maximum likelihood estimator in this model.)

The data regarding the production of wheat in tons (X) and the price of the kilo of flour in pesetas (Y) in the decade of the 80's in Spain were

Wheat production	30	28	32	25	25	25	22	24	35	40
Flour price	25	30	27	40	42	40	50	45	30	25