

Introduction: Some Examples on Statistics

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A study of lung cancer

Doll and Hill (1952) interviewed 1465 patients with lung cancer in hospitals near London, England, between 1948 and 1952 on their histories of smoking. Of 1465 patients, there were 1357 men and 108 women. At the same time, Doll and Hill looked for different 1465 patients without lung cancer (this is called “control group”) but with other diseases including other types of cancer that is not likely to be related to smoking and interviewed their smoking histories.

Table 1 summarizes their findings (from Table V of Doll and Hill (1952)).

Question: Do you think Table 1 provides evidence that smoking is related to lung cancer? Is the evidence strong even for women?

We may test the following hypothesis: “The likelihood of being a smoker is the same between lung-cancer patients and patients with other diseases.” Doll and Hill showed that this hypothesis is rejected using statistical procedure even for women.

Now, suppose that Professor Kasahara did similar interview but he only interviewed 146 patients, among which 136 patients were men and 10 patients are women. Table 2 summarizes Professor Kasahara’s findings.

Question: Do you think Table 2 provides evidence that smoking is related to lung cancer? Is the evidence strong even for women?

Test of Mammograms: False Positives and False Negatives

Table 4 presents an example of the results of mammograms taken on 10,000 women with tumors (either benign or malignant) taken from page 509 of Bennett, Briggs, and Triola (2000).

Question: Suppose you did mammogram screening and it turned out that test is positive. How likely do you have, in fact, cancer?

Answer: Probability of having cancer if the test is positive is $\frac{85}{1570} \approx 0.054$.

Probability that Vancouver Canucks wins 2011 Stanley Cup Finals

In the 2011 Stanley Cup Final, Vancouver Canucks won the first two games. The Canucks would have won the 2011 Stanley Cup if the Canucks could have won at least 2 games out of 5 games left.

Question: If the probability that the Canucks wins against the Boston Bruins for each game is 0.5 (i.e., 50 : 50 chance of winning), what is the probability that the Canucks wins at least 2 games out of 5 games, and therefore wins the 2011 Stanley Cup Final?

Answer: Probability of winning at least 2 games out of 5 games = $\frac{13}{16} \approx 0.81$.

References

- [1] Doll, Richard, and A. Bradford Hill (1952) “A Study of the Aetiology of Carcinoma of the Lung,” *The British Medical Journal*, 4797(2): 1271-1286.

Table 1: Average Amount of Tobacco Smoked Daily Over the 10 years

Disease Group	No. of Non-Smokers	No. of Smokers with the the Daily Average of		
		1-14 Cigs.	15-24 Cigs.	25+ Cigs.
Men:				
1357 lung-cancer patients	7 (1%)	55 (4%)	964 (71%)	331 (24%)
1357 patients with other diseases	61 (5%)	129 (10%)	1001 (74%)	166 (12%)
Women:				
108 lung-cancer patients	40 (37%)	16 (15%)	38 (35%)	14 (13%)
108 patients with other diseases	59 (55%)	25 (23%)	24 (22%)	0 (0%)

Notes: Computed from Table V of Doll and Hill (1952).

Table 2: Average Amount of Tobacco Smoked Daily Over the 10 years (Hypothetical example)

Disease Group	No. of Non-Smokers	No. of Smokers with the the Daily Average of		
		1-14 Cigs.	15-24 Cigs.	25+ Cigs.
Men:				
136 lung-cancer patients	1 (1%)	6 (4%)	96 (71%)	33 (24%)
136 patients with other diseases	6 (4%)	13 (10%)	100 (74%)	17 (13%)
Women:				
10 lung-cancer patients	4 (40%)	1 (10%)	4 (40%)	1 (10%)
10 patients with other diseases	6 (60%)	2 (20%)	2 (20%)	0 (0%)

Table 3: Two-way table of results of tests on 10,000 patients with Tumors

	Malignant (cancer)	Benign (no cancer)	Total
Test Positive	85	1485	1570
Test Negative	15	8415	8430
Total	100	9900	10000

Notes: From Table 10.19 of Bennett, Briggs, and Triola (2000).

Table 4: The probability distribution of how many games will be won out of 5 games by the Canucks if the probability of winning each game is 0.5

	Probability
Winning 0 games	1/32
Winning 1 games	5/32
Winning 2 games	10/32
Winning 3 games	10/32
Winning 4 games	5/32
Winning 5 games	1/32