

Maths makes the link!



Mathematics and applied mathematics are used in everyday life. Stock markets, mobile phones, car manufacturing, Google, Hollywood special effects, digital TV and satellites all use cutting-edge mathematics tools in their basic functions. The Mathematical Modelling Series presents a number of applications of mathematics in domains as varied as the human body, volcanology, telecommunications or finance.

Does smoking increase the risk of getting cancer?

If not, is there a relationship between cancer and smoking and, if so, what is the nature of the relationship? Observational studies establish associations between variables. By observing data collected in a 1950 medical journal the association between smoking and lung cancer was recognised. Prior to this smoking was not considered to be dangerous. Repeated studies are used to determine causation showing the same, strong association.

How it works

The role of observational studies is important in connecting outcomes that previously may not have been considered associated. An observational study is solely concerned with observing what is happening; there is no attempt to intervene or alter the outcome. The probability (P) of an outcome occurring can be determined based on data collected in an observational study. The study undertaken by Doll and Hill (1950) considered 709 smokers with 709 non-smokers as the control. The data suggested that smoking and lung cancer are not

Disease Group	No of cigarettes smoked daily				
	0 Cigs	1 Cigs	5 Cigs	15 Cigs	25 Cigs +
Lung-Carcinoma Patients (98)	2	12	36	27	21
Control patients with diseases other than cancer (98)	9	9	50	19	11

$\chi^2=11.68; n=4; 0.01 < P < 0.02$

independent events as $P(\text{smoker}) \times P(\text{lung cancer}) \neq P(\text{smoker and lung cancer})$. This illustrates an association between lung cancer and smoking that was not recognised prior to this 1950 study. Independent and conditional probability assist in determining the relationship between two events and the level of their association. Mutually exclusive events can also be calculated and this gives a clear indication of a lack of association. By repeatedly considering the associative features of two particular outcomes over a period of time, causation can be determined. Reference: Doll, R., Hill, A. Smoking and carcinoma of the lung. *British Medical Journal*, 1950.

Conclusion

The value of observational studies is evident in the case of lung cancer and smoking. Prior to 1950 smoking was not thought to be dangerous. Statistical tests carried out by Doll and Hill showed that the trends observed were significant (with a very low possibility [<0.05] of finding these results by chance), and that the risk of developing lung cancer increased with the amount smoked. Through recognising the association between a smoking habit and lung cancer, public awareness of the effects of smoking has been raised and the dangers of smoking highlighted.

Parts of the curriculum used in this project:

- Statistics
- Observational data
- Probability
- Conditional probability
- Mutually exclusive events
- Independent events

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If you want more information about MACSI and this project:

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