

Lecture 11: Selecting prior information

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The principle of insufficient reason

Example: Random variable with two possible values

- You have a random variable X with two possible values, say 0 and 1.
- If that's all you know, what probability do you assign to each value?

$$p(X=0) = p(X=1) = \frac{1}{2}$$

Example: Random variable with six possible values

- You have a random variable X with six possible values, say 1, 2, 3, 4, 5, 6.
- If that's all you know, what probability do you assign to each value?

$$p(X=1) = p(X=2) = \dots = p(X=6) = \frac{1}{6}$$

Laplace considered this obvious

“The theory of chance consists in reducing all the events of the same kind to a certain number of cases equally possible, that is to say, to such as we may be equally undecided about in regard to their existence, and in determining the number of cases favorable to the event whose probability is sought. The ratio of this number to that of all the cases possible is the measure of this probability, which is thus simply a fraction whose numerator is the number of favorable cases and whose denominator is the number of all the cases possible...”

— Pierre-Simon Laplace



https://en.wikipedia.org/wiki/Pierre-Simon_Laplace#/media/File:Laplace,_Pierre-Simon,_marquis_de.jpg

Principle of insufficient reason

- Let X be a discrete random variable taking N different values x_1, \dots, x_N .
- If that all we know, then the principle of insufficient reason states that we should assign:

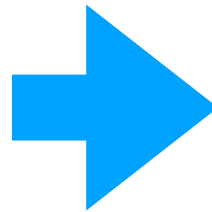
$$p(X = x_1) = \dots = p(X = x_N) = \frac{1}{N}$$

Generalizations of the principle of insufficient reason

*Equivalent states of knowledge
should be assigned equivalent
epistemic probabilities*
—E. T. Jaynes



https://en.wikipedia.org/wiki/Edwin_Thompson_Jaynes#/media/File:ETJaynes1.jpg



Principle of
transformation groups
(advanced)

Principle of maximum
entropy