PRIOR: A FORTRAN IV program for calculating posterior probabilities on the basis of prior probabilities and likelihood ratios

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In a typical experiment on Bayesian probability revision (Till, 1977), the normative Bayesian model is calculated in the following way:

$$\frac{P(H|D)}{P(\bar{H}|D)} = \frac{P(D|H)P(H)}{P(D|\bar{H})P(\bar{H})}. \quad (1)$$

In Equation 1 $P(H)/P(\bar{H})$ are the prior odds (Ω_0) with respect to Hypothesis H, $P(D|H)/P(D|\bar{H})$ is the likelihood ratio (LR), and $P(H|D)/P(\bar{H}|D)$ are the posterior odds ($\Omega\dot{\Lambda}$).

Equation 1 can be written as

$$\Omega\dot{\Lambda} = LR\Omega_0. \quad (2)$$

If we take the log base 10 of the two sides of Equation 2, then

$$\text{Log}_{10}\Omega\dot{\Lambda} = \text{Log}_{10}LR + \text{Log}_{10}\Omega_0 \quad (3)$$

and

$$\text{Log}_{10}LR = \text{Log}_{10}\Omega\dot{\Lambda} - \text{Log}_{10}\Omega_0. \quad (4)$$

When the composition of Bag H and $\bar{H}$ is not symmetrical, then the likelihood ratio (LR) is calculated in the following way:

$$LR = \frac{p^r q^b}{p'^r q'^b} \quad (5)$$

(see Edwards, Lindman, & Phillips, 1965), where p is the probability of red chips in Bag H, r and b are equal to the corresponding numbers of red and blue chips in sample, and p' is the probability of red chips in Bag $\bar{H}$. The probabilities q and q' are equal to the corresponding probabilities (1 - p) and (1 - p').

The Program. PRIOR is a program designed to facilitate the calculation of various parameters in the

"book bag and poker chips" task, when the prior odds (Ω_0) are not equal to 1, and when the bag composition is not symmetrical. It can be used both for teaching and as a subroutine in a bigger program that provides subjects with feedback on various normative solutions to this problem. It can also be used as a tool for generating research hypotheses.

Input. The program varies: (1) the probability of red chips in Bags H and $\bar{H}$ (or alternatively the value of p and p'), (2) the number of red and blue chips in the sample (or the values of r and b), and (3) the prior odds [$P(H)/P(\bar{H})$].

Output. The program calculates, for each combination of bag composition, prior odds and sample composition values: (1) the log base 10 of the prior odds, (2) the likelihood of Bag H and Bag $\bar{H}$ and their likelihood ratio, (3) the log base 10 of the likelihood ratio, (4) the posterior odds ($\Omega\dot{\Lambda}$), (5) the log base 10 of the posterior odds, and (6) the posterior probability [$P(H|D)$].

Equation 4 holds for the output of this program. When the prior odds are equal to 1 and the bag composition is symmetrical, the output of this program is the same as the output of the program BOOKBAG (Till, 1977).

Restrictions. The program is written in FORTRAN IV, so any computer system which supports FORTRAN IV will run it. The time to run this program depends, of course, on the number of different calculations one wants to perform. However, it took 6 sec to run the program on the Burroughs B6700 for nine different computations.

Availability. A copy of the listing, documentation, and sample of output can be obtained, free of charge, by writing to Amnon Till, Department of Psychology, Victoria University of Wellington, Private Bag, Wellington, New Zealand.

REFERENCES

- EDWARDS, W., LINDMAN, H., & PHILLIPS, L. D. Emerging technologies for decision making. In *New directions in psychology* (Vol. 2). New York: Holt, 1965.
TILL, A. BOOKBAG: A FORTRAN IV program for calculating various parameters of the "book bag and poker chips" Bayesian task. *Behavior Research Methods & Instrumentation*, 1977, 9, 30.

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