PROGRAM ABSTRACTS/ALGORITHMS

CONVERSION: A series of FORTRAN IV programs for converting probabilities, odds, evidence, and information measures into one another

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Probabilities (P), odds (O), evidence (E), and information (I) measures are all related to each other in the following way: If we define a specific probability as $p\hat{\Lambda}$, then the odds associated with that probability can be defined as

$$O\hat{\Lambda} = \frac{p\hat{\Lambda}}{1-p\hat{\Lambda}}. \quad (1)$$

The evidence measure associated with those odds is

$$E\hat{\Lambda} = 10 \log_{10} O\hat{\Lambda}. \quad (2)$$

Finally, the information measure associated with that probability is

$$I\hat{\Lambda} = -p\hat{\Lambda} \log_2 p\hat{\Lambda}. \quad (3)$$

On the basis of these relationships, McGee (1971) has developed two tables (see McGee's Appendices I and J). The first table transforms probabilities into odds and evidence, varying the probability measure from .01 to .99 in steps of .01. The second table transforms probabilities into information measures, again varying probabilities in the same way as in the first table.

If we cannot find the exact value of the measure that we wish to transform in the table, we cannot use the method of linear interpolation in order to find out its transformation. The reason for this is that the relationships between probabilities, odds, evidence, and information measures are nonlinear. Therefore, the value obtained by using the method of linear interpolation will be only a rough approximation of the true value of the transformed score.

In order to deal with the above problem we can: (1) develop computer programs that transform any specific value of one of these measures into the corresponding transformed values of the other measures, and/or, (2) develop more detailed tables than McGee's (1971).

While McGee transformed only probabilities to odds, evidence, and information measures, the following programs will also transform odds and evidence to the rest of the other measures. Unfortunately, while it is

quite easy to transform probabilities into information measures (see Equation 3), it is not easy to transform information measures to probabilities.

The Program. Conversion 1 is a program designed to convert any specific probability to the corresponding transformed values of odds, evidence, and information measures. In order to do that, it uses Equations 1, 2, and 3.

Input. Any specific probability.

Output. The odds, evidence, and information measures associated with that probability.

The Program. Conversion 2 is a program designed to convert any specific odds to the corresponding transformed values of probability, evidence, and information measures. In order to do that, the program first transforms odds to probabilities by using equation

$$p\hat{\Lambda} = \frac{O\hat{\Lambda}}{1+O\hat{\Lambda}}. \quad (4)$$

It then uses Equations 2 and 3 to obtain the evidence and information measures associated with that probability.

Input. Any specific odds.

Output. The probability, evidence, and information measures associated with those odds.

The Program. Conversion 3 is a program which is designed to transform any specific evidence to the corresponding transformed values of probability odds and information measures. In order to do that, the program first transforms evidence measures to odds by using Equation 5.

$$O\hat{\Lambda} = 10^{(E\hat{\Lambda}/10)}. \quad (5)$$

It then transforms the odds obtained into the corresponding probability value using Equation 4 and the corresponding value of information.

Input. Any specific evidence.

Output. The probability, odds, and information measures associated with those odds.

Restriction. The programs Conversion 1, 2, and 3 are written in FORTRAN IV, so any computer system which supports FORTRAN IV will run it. It takes 1.7 sec to run each of these programs on the Burroughs B6700.

In all these programs the computer cannot calculate directly the information value using Equation 3 since it does not have an option for log base 2. Therefore, we have to use Equation 6, which overcomes that problem:

$$I\hat{\Lambda} = -p\hat{\Lambda} \frac{\log_{10} p\hat{\Lambda}}{\log_{10} 2}. \quad (6)$$

The above programs were used on the same data that

McGee presented and were found in agreement with his results, except for one case. McGee (1971, p. 335) obtained an evidence measure of 25.952, and, when he transformed it to odds, he found that "this evidence corresponds to odds of about 500 to 1 in favor of H_1 ." Using the program Conversion 3, it was found that the odds corresponding to that evidence measure are 393.731.

The next three programs, Conversions 4, 5, and 6, use the same principles as the previous three programs. However, instead of converting any specific measure to the corresponding value of the other measures, they produce full tables over a whole range of values. These tables are more detailed than McGee's (1971).

The Program. Conversion 4 is a program designed to increment probabilities in steps of .0001 and to transform each probability to the corresponding values of odds, evidence, and information measures.

Input. Probabilities varying from .0001 to 1.000 in steps of .0001.

Output. The corresponding values of odds, evidence, and information measures.

The Program. Conversion 5 is a program which is designed to increment odds in steps of 1 and to transform them to the corresponding values of probabilities, odds, and information measures.

Input. Odds varying from 1 to 1,000 in steps of 1.

Output. The corresponding values of probabilities, evidence, and information measures.

The Program. Conversion 6 is a program designed to increment evidence values in steps of .1 and to transform each evidence value to the corresponding values of probabilities, odds, and information measures.

Input. Evidence varying from -39.89 (which corresponds to probability .0001) to 39.89 (which corresponds to probability .9999).

Output. The corresponding values of probabilities, odds, and evidence measures.

Restrictions. All the above three programs are written in FORTRAN IV, so any computer system which supports FORTRAN IV will run it. Conversion 4 takes 48.4 sec, Conversion 5 takes 56.1 sec, and Conversion 6 takes 44.7 sec to run on the Burroughs B6700 computer.

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.

REFERENCE

McGEE, V. E. *Principles of statistics: Traditional and Bayesian*. New York: Appleton-Century-Crofts, 1971.

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