Joint Maximum Likelihood Estimation

Ray Adams. 7 June 2010

ConQuest 3 is able to implement either joint maximum likelihood (JML) or marginal maximum likelihood (MML) estimation. This note is concerned with the ConQuest 3 implementation of JML.

While it is not ConQuest's default estimation method ConQuest is able to implement the JML routine as developed by Ben Wright and his colleagues and commonly referred to by him as unconditional maximum likelihood (UCON) (Wright and Masters 1982; Wright, and Panchapakesan, 1969; Wright and Stone, 1979, Linacre, 1994).

While the ConQuest model normally requires the specification of two components, the item response model and the population model, in the case of JML the population model is redundant and population parameters are not estimated. As an alternative location parameters are estimated for each case. The consequence of this is that, if specified, the `regression` command is ignored and population parameter estimates, EAP case estimates and plausible values are not applicable.

To obtain estimates of population characteristics (eg means, variances and percentiles) the `descriptive` command can be used. Note, however, that it is widely recognised that the estimates of population parameters derived from JML estimation are flawed.

To request JML estimation the option `method=jml`, is used in the `estimate` command.

Model Limitations for JML

Due to the generality of the ConQuest model the ConQuest JML routine is a little slower than that implemented in other software, but its speed still compares favourably to that of MML. Further, there are some restrictions on the models with which JML can be used. Firstly, JML is restricted to use with Rasch models; that is, item scores (discrimination parameters) cannot be estimated. Secondly, in the case of multidimensional models, every case must have a valid response for at least one item from each dimension.

Controlling the Estimation

The `iterations=n` and `convergence=n` options of the `estimate` command can be used to control the number of iterations and the accuracy of the estimation. The convergence criterion applies to both item and person parameters.

Users should also note the `innerloops=n` option for the `set` command. In the case of JML this command controls the number of Newton loops used in the estimation of the case parameters at each iteration. For large problems setting `innerloops=1` can increase the speed of the algorithm.

Nulls, Zeros and Perfects

JML estimation cannot estimate parameters for items or cases with either zero or perfect scores. Further, if a category within a partial credit item has a zero count then estimation cannot proceed. To deal with perfects and zero value the user can use the `set` option `zero/perfect=n` to set a small value to use as a replacement for zero. In the case of a maximum the small value is subtracted from the maximum possible.

For zero count categories the recode and score commands can be used in combination to implement techniques as described in Wilson and Masters (1993).

References

Wilson, M.R., and Masters, G.N. "The partial credit model and null categories" *Psychometrika* 58.1 (1993): 87-99.

Wright, B.D., and Masters, G.N. 1982. Rating Scale Analysis: Rasch Measurement. Chicago: MESA Press.

Wright, B.D., and Panchapakesan, N. 1969. A procedure for sample-free item analysis, *Educational and Psychological Measurement, 29,* 23–48.

Wright, B.D., and Stone, M. 1979. *Best Test Design: Rasch Measurement*. Chicago: MESA Press.