Multi-Attribute Preference Functions
Health Utilities Index

George W. Torrance,1-3 William Furlong,1 David Feeny1,2,4 and Michael Boyle1,5

1 Department of Clinical Epidemiology and Biostatistics, McMaster University, Hamilton, Ontario, Canada
2 Centre for Health Economics and Policy Analysis, Hamilton, Ontario, Canada
3 Department of Management Science, McMaster University, Hamilton, Ontario, Canada
4 Department of Economics, McMaster University, Hamilton, Ontario, Canada
5 Department of Psychiatry, McMaster University, Hamilton, Ontario, Canada

Contents

Summary ........................................................................................................... 503
1. Measurement of Preferences for Health Outcomes .................................. 504
   1.1 Health Outcomes ............................................................................. 504
   1.2 Types of Preferences ...................................................................... 505
   1.3 Measurement Instruments ............................................................... 506
2. Applications of Preference Scores ............................................................. 506
   2.1 Health-Related Quality of Life ....................................................... 506
   2.2 Quality Weights for Quality-Adjusted Life Years .......................... 506
   2.3 Quality Weights for Calculating Health Expectancy ....................... 507
3. Multi-Attribute Utility Theory ................................................................. 507
   3.1 First-Order Utility Independence .................................................. 507
   3.2 Mutual Utility Independence ......................................................... 508
   3.3 Additive Utility Independence ...................................................... 508
4. Applications of Multi-Attribute Utility Theory ........................................ 509
   4.1 Health Utilities Index Mark I .......................................................... 509
   4.2 Health Utilities Index Mark II ......................................................... 510
   4.3 Health Utilities Index Mark III ....................................................... 511
   4.4 Other Systems ................................................................................ 512
5. Methodological Issues .............................................................................. 512
   5.1 Model Appropriateness .................................................................. 512
   5.2 Utilities versus Values .................................................................... 513
   5.3 Reliability ....................................................................................... 514
   5.4 Validity ......................................................................................... 515
6. Using the Health Utilities Index System ................................................... 515
   6.1 Target Population and Health Status Duration .................................. 515
   6.2 Health Status Questionnaire .......................................................... 515
   6.3 Mapping Algorithm ....................................................................... 516
   6.4 Scoring Formulae .......................................................................... 516
7. Examples of Applications of the Health Utilities Index .............................. 516
   7.1 Health-Related Quality of Life ....................................................... 516
   7.2 Cost-Utility Analysis ...................................................................... 516
   7.3 Population Health .......................................................................... 517
8. Conclusions .............................................................................................. 517
Summary

Multi-attribute utility theory, an extension of conventional utility theory, can be applied to model preference scores for health states defined by multi-attribute health status classification systems. The type of preference independence among the attributes determines the type of preference function required: additive, multiplicative or multilinear. In addition, the type of measurement instrument used determines the type of preference score obtained: value or utility.

Multi-attribute utility theory has been applied to 2 recently developed multi-attribute health status classification systems, the Health Utilities Index (HUI) Mark II and Mark III systems. Results are presented for the Mark II system, and ongoing research is described for the Mark III system. The theory is also discussed in the context of other well known multi-attribute systems.

The HUI system is an efficient method of determining a general public-based utility score for a specified health outcome or for the health status of an individual. In clinical populations, the scores can be used to provide a single summary measure of health-related quality of life. In cost-utility analyses, the scores can be used as quality weights for calculating quality-adjusted life years. In general populations, the measure can be used as quality weights for determining population health expectancy.

Von Neumann–Morgenstern utility theory, first postulated in the 1940s, continues to be the dominant normative paradigm for decision making under uncertainty.[1-7] In the 1970s, this theory was extended to the class of problems in which the outcomes are described by multiple attributes.[8-13] This extension is known as multi-attribute utility theory (MAUT). The aim of this article is to describe the application of MAUT to the measurement of preferences for health states that are defined by multiple attributes, with particular emphasis on our recent and ongoing work to use MAUT for scoring the Health Utilities Index (HUI) Mark II and Mark III classification systems. These systems are described elsewhere in this issue.[14]

1. Measurement of Preferences for Health Outcomes

1.1 Health Outcomes

In theory, because future health is always uncertain, the relevant health outcome of any intervention or lack of intervention is always a probability distribution over a large number of possible lifetime paths. Each path consists of a sequence of health states through which an individual would pass up to the point of death. Because the individual could die at any future moment in time, and because there is a large number of possible health states through which the individual could pass, the number of unique paths theoretically approaches infinity.

In practice, the problem of describing outcomes and measuring preferences for them is greatly simplified to make it manageable. Often, a few dominant paths are selected as being representative of all possibilities. In addition, the complexity of multiple states within a path is frequently simplified by reducing the number of states to 1 or 2. For example, a common simplification is to assume that any one path consists of, at most, a short term health state followed by a long term health state. Using this simplification, most of the work to date on the measurement of preferences for health outcomes has been undertaken on the long term health states, assuming that they are chronic. As an aside, research is now under way to measure preferences for more complex paths of changing health states, to investigate the direction and magnitude of error introduced by simplifying assumptions.

Preferences for health states can be elicited from individuals currently in those health states, in which case the states need not be described to the individuals in any detail. Presumably, they already