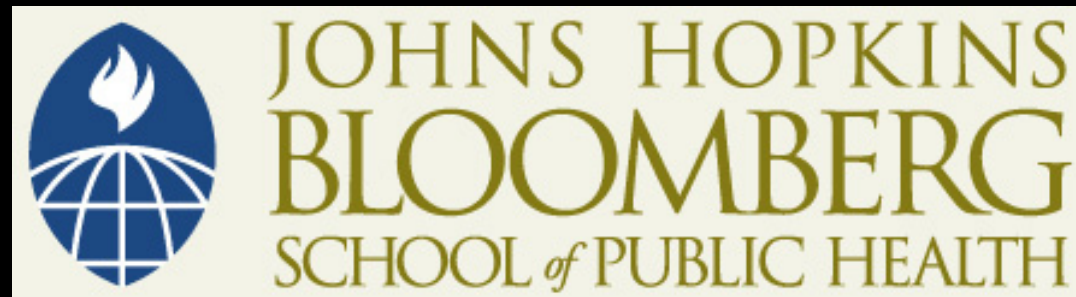


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MULTIATTRIBUTE UTILITY THEORY & INSTRUMENTS

Lecture 10

Kevin Frick

Problem

- Need to measure health change as an input into a cost-effectiveness analysis
- Cannot elicit a preference weight for every possible health state
- Cannot elicit a preference weight from everyone in a randomized trial
- Still need to reflect preferences elicited using tradeoff-based methodology

Multiattribute utility theory

- Early mention of multiattribute utility and health status measurement
 - HSR article in 1975 (Gustafson & Holloway 10: 97-109)
 - Listed several variables with a weight for each

Multiattribute utility measures

- Use attributes to classify health states for the purposes of utility valuation
 - Have multiple levels for each attribute
- Describe a health state by choosing a level for each attribute
 - Similar to the discussion of different domains of health that are considered in the process of generating a health status utility

Potential Attributes

- Physical activity
- Mobility
- Self-care
- School performance
- Sight
- Hearing
- Speech
- Use of limbs
- Play
- Learning ability
- Happiness
- Pain/discomfort
- Cause of health problems
- Age of problem at onset
- Name of disease
- Fertility

Attributes in commonly used instruments

- Quality of Well-Being
 - Mobility
 - Physical activity
 - Social
 - Symptom-problem complex
- Health Utility Index: 1
 - Physical functioning
 - Role Functioning
 - Socio-emotional functioning
 - Health problem
 - (We will see more details on HUI:3 later)

Functional capacity or performance

- Capacity focuses on what is inhibited
- Performance may be a function of what people *choose to do*
 - Could always follow a performance question with a question of whether the reason for failure to perform is health related
 - This can be complicated

Scoring all states by collecting data on some

- Score a subset of states
 - EuroQol scored 42 of 243 states using a time tradeoff methodology
- Run regression to find weight to assign to each non-perfect health response
 - Extrapolate values for 200 states other than perfect health

Assigning health utility scores for a multiattribute instrument

- Process is most useful when there are lots of possible outcomes
 - Avoid having to rate each health state
- The valuation function is defined over multiple attribute system by data collected from a general population (*ideally*)

Interaction between domains

- Does a change in one attribute affect the way in which another attribute affects utility
- Additive (**no interaction**)
 - Weight each score & sum to one if in perfect health
 - Value of social + value of physical + ...
- Multiplicative (**complete interaction**)
 - Weight each score & product is one when person is in perfect health
 - (Value of Social)(Value of Physical) ...

Interaction (2)

- Multilinear (different type of interaction)
 - Weight each, interact terms, and sum to one for an individual in perfect health
 - Value of Social + Value of Physical + Value of Social * Value of Physical + ...

Use of Three Instruments

- EuroQol, Quality of Well Being, Health Utility Index
- Most basic comparison
 - EQ-5D manual is a brochure of less than 20 pages
 - QWB manual is several hundred pages
- To consider when choosing an instrument
 - Complexity & time to administer
 - Length of time being considered by the instrument's questions
 - Implications of how scores are calculated

EuroQol - History

- Originally developed in Europe
 - Scored based on a survey mailed to a representative sample in the UK
- EQ-5D is the second major incarnation
- Now translated into most languages relevant to OECD countries, plus eastern Europe, plus Thai
- Now scored on a US based sample

EuroQol Attributes

- Mobility
- Self-care
- Usual activities
- Pain/discomfort
- Anxiety

Descriptions of attributes in the EQ-5D

- Each attribute has three levels
- Levels are basically identical
 - No problem
 - Some problem
 - Unable to do or extreme problem
- Focus on ability rather than what people do
- # of combinations
 - $3 \times 3 \times 3 \times 3 \times 3 = 243$ [plus death % coma]

EuroQOL 5D – Instrument (1)

- 5 attributes
 - Pain
 - I have “_____” pain or discomfort
 - No, moderate, extreme
 - Anxiety/Depression
 - I am “_____” anxious or depressed
 - Not, moderately, extremely
 - Self-care
 - I have no problems with self care
 - I have some problems washing or dressing myself
 - I am unable to wash or dress myself

EuroQOL 5D – Instrument (2)

- 5 Attributes continued
 - Usual activities
 - I “_____” my usual activities
 - Have no problems with, have some problems with, am unable to perform
 - Mobility
 - I have no problems in walking about
 - I have some problems in walking about
 - I am confined to bed
- 5 attributes get scored based on prior responses to a time tradeoff
- Also includes a visual analog scale

EuroQol score development

- Cannot possibly rate 245 different states
 - Use regression method based on scores provided for 42 health states
 - Note that some combinations are more likely and others are less likely
 - 42 health states relatively common
 - However, also needed to cover entire range of health states so that can estimate decrements in utility associated with being in worse health

EuroQol Regression

- SP = Some problem, LD = a lot of difficulty
- M=mobility, P=pain, A=anxiety, U=usual activities, S=self-care
- Utility = $1 - b_1 \text{ Any SP} - b_2 \text{ Any LD} - b_3 M_{SP} - b_4 M_{LD} - b_5 P_{SP} - b_6 P_{LD} - b_7 AD_{SP} - b_8 AD_{LD} - b_9 UA_{SP} - b_{10} UA_{LD} - b_{11} SC_{SP} - b_{12} SC_{LD} + e$

EuroQol score calculation

- Adjust for anything not being perfect
- Adjust for anything being in the worst state
- Pain/discomfort has biggest effect for “some problem”
- Pain/discomfort & mobility have comparable and biggest effect of changing from “some problem” to “big problem”
- Score for any state less than perfect health < 0.9

Original EuroQol Scoring

- If not all level 1 subtract 0.081
- If any level III also subtract 0.269

	Level 2	Level 3
Mobility	0.069	0.314
Self-care	0.104	0.214
Usual Act.	0.036	0.094
Pain/Dis	0.123	0.386
Anxiety	0.071	0.236

Range of Original EuroQol multiattribute scores

- Range
 - Perfect health equals 1
 - Death equals zero
 - Unconscious equals -0.40
 - All worst states equals -0.59
- Approximately 70 scores less than zero
 - implies between $\frac{1}{3}$ and $\frac{1}{4}$ of the combinations but not between $\frac{1}{3}$ and $\frac{1}{4}$ of population

Using EuroQol Instrument

- Multi-attribute with societal scores
- Personal VAS
- What might we use each for?
- Problem with personal VAS if different people have a different feeling or worst state imaginable and about death
 - Discussed as a visual analog scale issue in previous lecture

Considerations with EuroQol

- Asks about how you are doing on the day you respond
- Advantages
 - Simple
 - Quick
- Disadvantages
 - VAS difficulty
 - Potential lack of sensitivity
 - Difficulty with cyclical disease

Some unusual observations using the EuroQol

- Ceiling effect for AIDS
 - Surprising
 - Potentially wide interpretations
 - Adaptation can affect multi-attribute scales as well as preference weighting
- Dysfunctional uterine bleeding patients
 - Do not find ceiling effect

EuroQol has been used for...

- Ankylosing spondylitis
- Orthopaedic outpatients unlikely to require surgery
- Hepatitis C patients
- Menorrhagia
- Hearing-Aid Fitting
- Parkinson's disease

US-UK EuroQOL Differences

- Second of two papers
- US researchers asked about same 42 health states
- US researchers obtained UK data
- Ran regression with primary effects of each non-healthy state
- Primary term for US
- Interaction terms between US and each health state
- Terms for age, age-squared, and sex

US-UK Findings

- US respondents gave scores averaging 0.10 higher
- Not same difference in all health states
- US primary effect in regression with interactions was not statistically significant
- US interaction effects were significant for all 10 non-healthy states except big problem with mobility and big problem with self-care
- Biggest differences were for big problem with pain and big problem with anxiety

Potential Reason for Differences

- US version allowed English of Spanish
- Different ethnic mix
- Assessed about 10 years apart

Generalizability of differences

- Differences may not generalize to other valuation methods
 - EQ-5D valued with TTO
- Differences may not generalize to other instruments

System in US

- Mobility
 - Level 2 0.146; Level 3 0.558
- Self-Care
 - Level 2 0.175; Level 3 0.471
- Usual Activities
 - Level 2 0.140; Level 3 0.374
- Pain/Discomfort
 - Level 2 0.173; Level 3 0.537
- Anxiety/Depression
 - Level 2 0.156; Level 3 0.450
- D1 -0.140
- I2-squared 0.011
- I3 0.122
- I3-squared 0.015

Score for All 3's in US

- $1 - 0.558 - 0.471 - 0.374 - 0.537 - 0.450 - (-0.140 * 4) - (-0.122 * 4) - (-0.015 * 4^2) =$
- $-1.39 + 0.560 + 0.488 + 0.240 = -0.102$

Quality of Well Being: Scoring

- Score = 1 + Symptom Score + Mobility + Physical Activity + Social Activity
 - Each adjustment is negative relative to perfect health
 - Score for each of the three domains
 - Score for worst symptom on a given day
 - No interaction between attributes or symptoms
 - Symptom scores averaged over six days

QWB: Symptoms

- 27 choices
- Having eyeglasses or contact lenses
-0.101
- Breathing smog
-0.101
- Headache
-0.244
- Substantial decrements for these

QWB: Attributes

- Mobility
 - No limits, problems (-0.062), hospitalized
- Physical
 - Not able to control wheelchair (-0.077)
- Social
 - No major role activity and help in self-care (-0.106)

Considerations in judging the QWB

- Used extensively in the United States
- Weights based on a sample in San Diego
- Attribute levels by age/social role
- Symptoms measured over six days
- Respondent burden
- Only three attributes
- “Symptoms” are not purely symptoms
- Lose data on comorbidities
- Questions of performance rather than capacity

QWB has been used for...

- Osteoarthritis
- Schizophrenia
- Prostate cancer
- Diabetes
- Dementia
- Cystic fibrosis

Health Utility Index: Background

- Three measures developed over time
- HUI: 1 similar to the QWB
- HUI: 2 has six attributes including sensation, mobility, emotion, cognition, self-care and pain
- HUI: 3 has eight attributes including vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain

Health Utilities Index 3 – Vision

- Able to see well enough to read ordinary newsprint and recognize a friend on the other side of the street, without glasses or contact lenses
- Able to see well enough to read ordinary newsprint and recognize a friend on the other side of the street, but with glasses
- Able to read ordinary newsprint with or without glasses but unable to recognize a friend on the other side of the street, even with glasses
- Able to recognize a friend on the other side of the street with or without glasses but unable to read ordinary newsprint, even with glasses
- Unable to read ordinary newsprint and unable to recognize a friend on the other side of the street, even with glasses
- Unable to see at all

Health Utilities Index 3 – Hearing (1)

- Able to hear what is said in a group conversation with at least three other people, without a hearing aid
- Able to hear what is said in a conversation with one other person in a quiet room without a hearing aid, but requires a hearing aid to hear what is said in a group conversation with at least three other people
- Able to hear what is said in a conversation with one other person in a quiet room with a hearing aid, and able to hear what is said in a group conversation with at least three other people, with a hearing aid

Health Utilities Index 3 – Hearing (2)

- Able to hear what is said in a conversation with one other person in a quiet room, without a hearing aid, but unable to hear what is said in a group conversation with at least three other people even with a hearing aid
- Able to hear what is said in a conversation with one other person in a quiet room with a hearing aid, but unable to hear what is said in a group conversation with at least three other people even with a hearing aid
- Unable to hear at all

Health Utilities Index 3 - Speech

- Able to be understood completely when speaking with strangers or friends
- Able to be understood partially when speaking with strangers but able to be understood completely when speaking with people who know me well
- Able to be understood partially when speaking with strangers or people who know me well
- Unable to be understood when speaking with strangers but able to be understood partially by people who know me well
- Unable to be understood when speaking to other people (or unable to speak at all).

Health Utilities Index 3 – Ambulation (1)

- Able to walk around the neighborhood without difficulty, and without walking equipment
- Able to walk around the neighborhood with difficulty; but does not require walking equipment or the help of another person
- Able to walk around the neighborhood with walking equipment, but without the help of another person
- Able to walk only short distances with walking equipment, and requires a wheelchair to get around the neighborhood

Health Utilities Index 3 – Ambulation (2)

- Unable to walk alone, even with walking equipment. Able to walk short distances with the help of another person, and requires a wheelchair to get around the neighborhood
- Cannot walk at all

Health Utilities Index 3 – Dexterity (1)

- Full use of two hands and ten fingers
- Limitations in the use of hands or fingers, but does not require special tools or help of another person
- Limitations in the use of hands or fingers, is independent with use of special tools (does not require the help of another person)
- Limitations in the use of hands or fingers, requires the help of another person for some tasks (not independent even with use of special tools)

Health Utilities Index 3 – Dexterity (2)

- Limitations in use of hands or fingers, requires the help of another person for most tasks (not independent even with use of special tools)
- Limitations in use of hands or fingers, requires the help of another person for all tasks (not independent even with use of special tools)

Health Utilities Index 3 - Emotion

- Happy and interested in life
- Somewhat happy
- Somewhat unhappy
- Very unhappy
- So unhappy that life is not worthwhile

Health Utilities Index 3 – Cognition (1)

- Able to remember most things, think clearly and solve day to day problems
- Able to remember most things, but have a little difficulty when trying to think and solve day to day problems
- Somewhat forgetful, but able to think clearly and solve day to day problems
- Somewhat forgetful, and have a little difficulty when trying to think or solve day to day problems

Health Utilities Index 3 – Cognition (2)

- Very forgetful, and have great difficulty when trying to think or solve day to day problems
- Unable to remember anything at all, and unable to think or solve day to day problems

Health Utilities Index 3 - Pain

- Free of pain and discomfort
- Mild to moderate pain that prevents no activities
- Moderate pain that prevents a few activities
- Moderate to severe pain that prevents some activities
- Severe pain that prevents most activities

Health Utilities Index Scoring (1)

Vision		Hearing		Speech		Ambulation	
x1	b1	x2	b2	x3	b3	x4	b4
1	1.00	1	1.00	1	1.00	1	1.00
2	0.98	2	0.95	2	0.94	2	0.93
3	0.89	3	0.89	3	0.89	3	0.86
4	0.84	4	0.80	4	0.81	4	0.73
5	0.75	5	0.74	5	0.68	5	0.65
6	0.61	6	0.61			6	0.58

Health Utilities Index Scoring (2)

Dexterity		Emotion		Cognition		Pain	
x5	b5	x6	b6	x7	b7	x8	b8
1	1.00	1	1.00	1	1.00	1	1.00
2	0.95	2	0.95	2	0.92	2	0.96
3	0.88	3	0.85	3	0.95	3	0.90
4	0.76	4	0.64	4	0.83	4	0.77
5	0.65	5	0.46	5	0.60	5	0.55
6	0.56			6	0.42		

Health Utilities Index Scoring (3)

- $u^* =$
 $1.371 (b_1 * b_2 * b_3 * b_4 * b_5 * b_6 * b_7 * b_8) - 0.371$
- Max = 1
- Min = $1.371 * (0.61 * 0.61 * 0.68 * 0.58 * 0.56 * 0.46 * 0.42 * 0.55) - 0.371 = -0.359$

HUI: Details

- Two different scoring methods for 2 & 3
 - “Value” based on a visual analog scale and “utility” based on the TTO or SG
- HUI: 3 is available in English and French-Canadian
- Much more complex interaction of attributes

HUI has been used for...

- Hepatitis C
- Cystic Fibrosis
- Prostate Cancer
- Lipid Lowering Drugs
- Bilateral cochlear implant
- Hemophilia
- Meningitis sequelae

Assessment of Quality of Life (Hawthorne)

- 15 items
- 5 scales
 - Illness
 - Independent living
 - Social relationships
 - Physical senses
 - Psychological well-being
- Multiplicative
- Minimum utility = -0.04

Simple Methods Comparison

- Wearing glasses
 - EQ 1 (probably)
 - VAS: ?
 - QWB: 0.899
 - HUI: 0.99

Health States Used in Head to Head Comparison

- Deafness
- Mild hearing loss
- Epilepsy
- Mild mental retardation
- Severe mental retardation combined with tetraplegia
- Paresis of the leg
- Mild mental retardation combined with epilepsy and paresis of the leg

How Were Health States Described?

- Case descriptions of a hypothetical 6 year old
- Approximately 200 words
- Describe domains
 - Mobility
 - Self care
 - Usual activities including school, hobbies, and social activities
 - Emotion
 - Pain
 - Other symptoms

Average Utilities in Head to Head Comparison

	EQ-5D	HUI-3
Deafness	0.81	0.28
Mild Hearing Loss	0.91	0.65
Epilepsy	0.83	0.7
MR	0.62	0.24
SMR & Tetraplegia	0.15	0.33
Leg paresis	0.67	0.51
Epilepsy, Mild MR, Leg Paresis	0.47	0.02

Final Thoughts on Head to Head Comparison

- Similar feasibility
 - For provider rather than patient
- Difference in health utilities
 - HUI has more of an ICIDH focus on disability
 - EQ-5D more of a focus on handicap
 - EQ-5D lacks “cognition”
 - EQ-5D has nothing specific on sensation
 - Note that lower score implies there is more to gain from avoiding a condition
 - Will have an effect on cost-utility analyses

Linking SF Instruments to Health Utility

- SF36 and SF12 were not originally designed to be health utility instruments
- Some researchers have used the SF36 (or SF12) and the EuroQoL or QWB in the same study and then “mapped”
- Brazier has developed the SF6D although it provides scores down to only