WHAT ARE QALYS AND DALYS

Lecture 8

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Problem

- Instructor suffers a radial head crack in early December
  - Drives manual transmission car
  - Spends a lot of his work day typing
  - Plays guitar
  - Has a young child & expecting another
- Describe how treatment affects quality of life over time and assess how to compare treatments

Quality Adjusted Life Years

- Outcome measure for cost-utility analysis
  - Specific type of CEA that is main focus of this course
- Measure combines quality and quantity of life
  - How long a person lives how well

Intricacies of QALYs

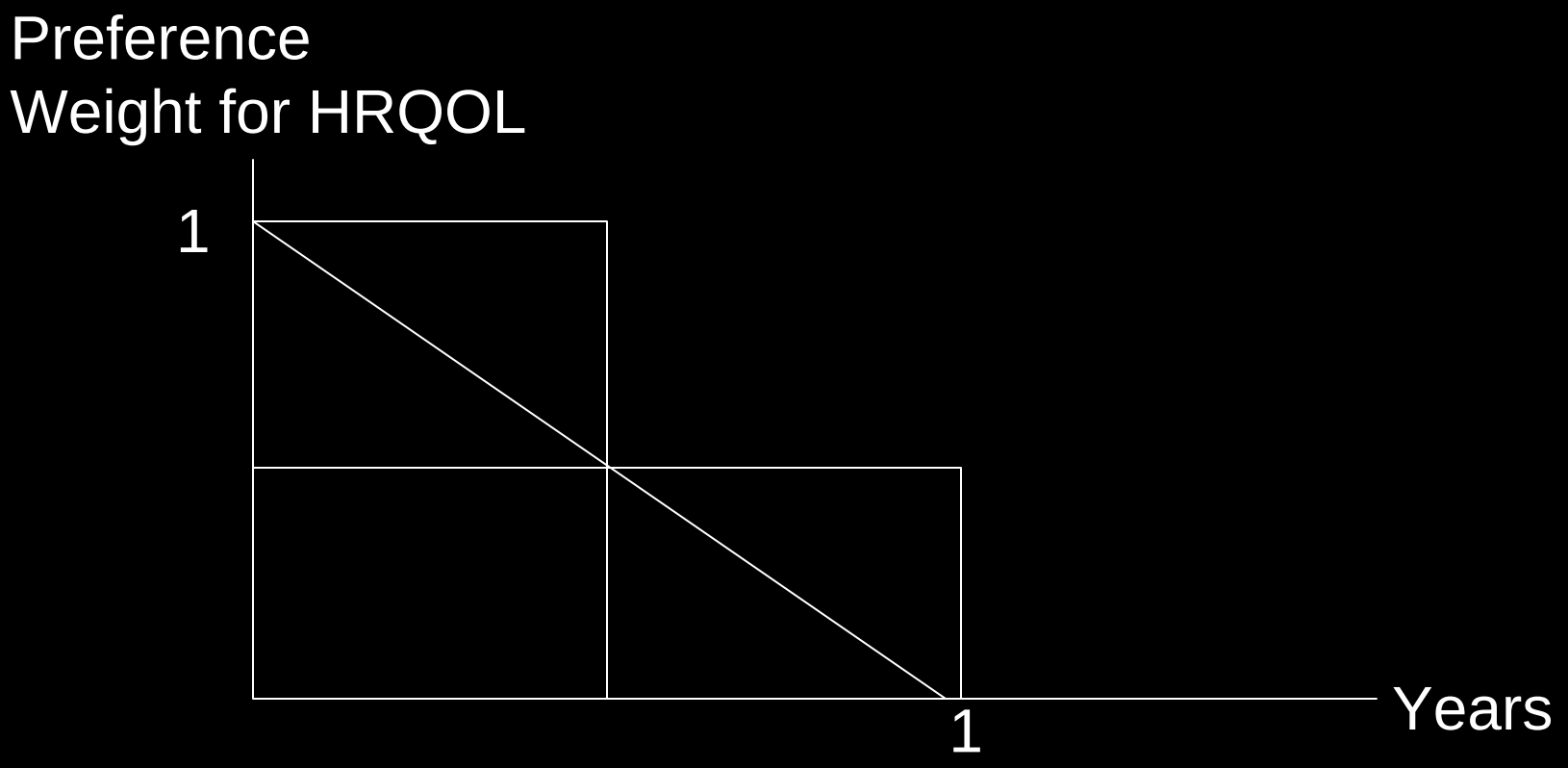
- Except for discounting, the long-term effect of QALYs is a linear function of a one year effect
- The effect of treating multiple individuals similarly is a linear function of the effect on one person

What Data Are Needed to Calculate QALYs?

- Utility values for the health states
  - These are the focus of multiple lectures
- Health states over time
  - Describing these is the focus of multiple lectures
- Method of summing health state values over time & population
  - Multiple measurements
  - Multiple individuals
  - Revisit discounting

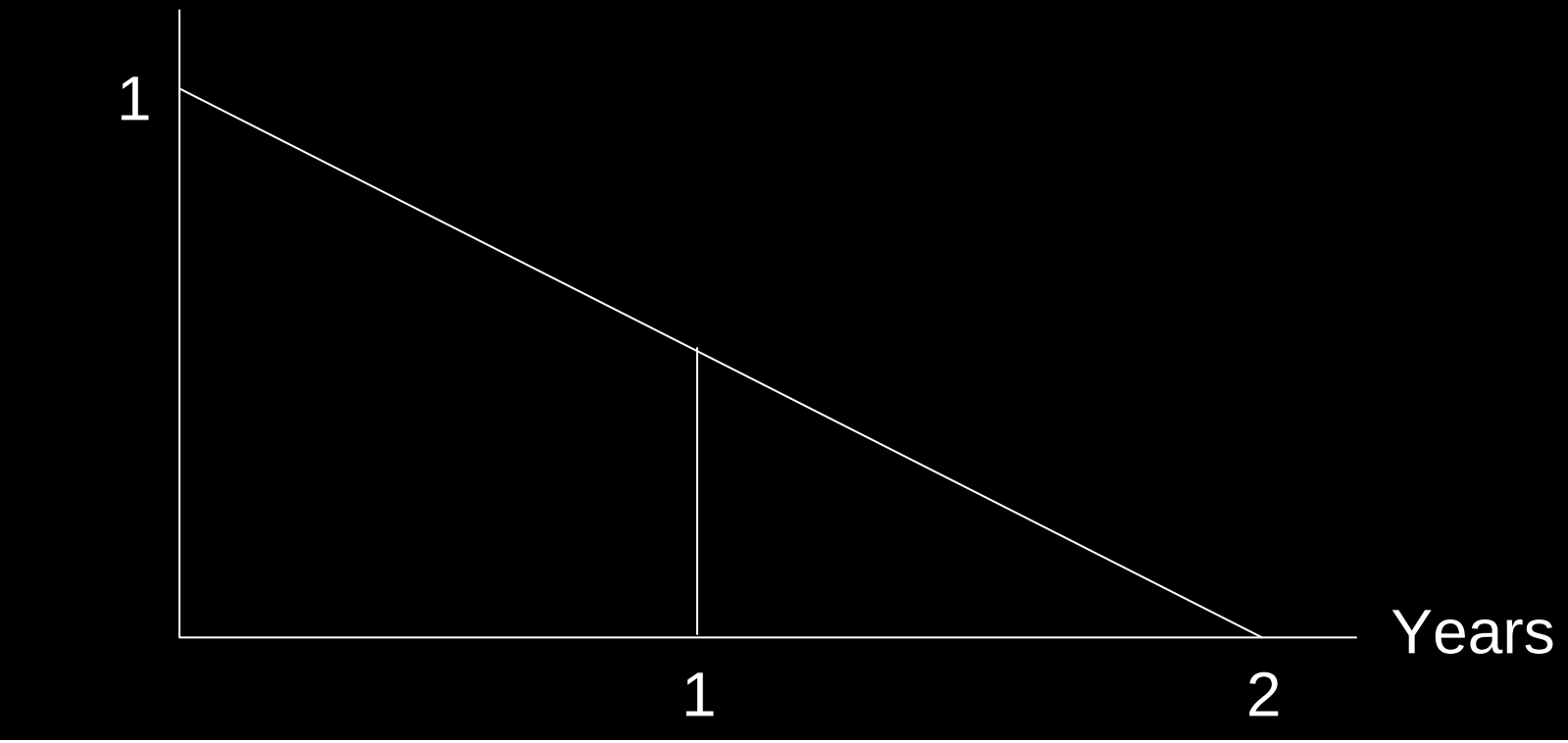
1/2 QALY

Would you feel the same about all 3?



Multiple Year QALY Example

- < 1 QALY because of discounting

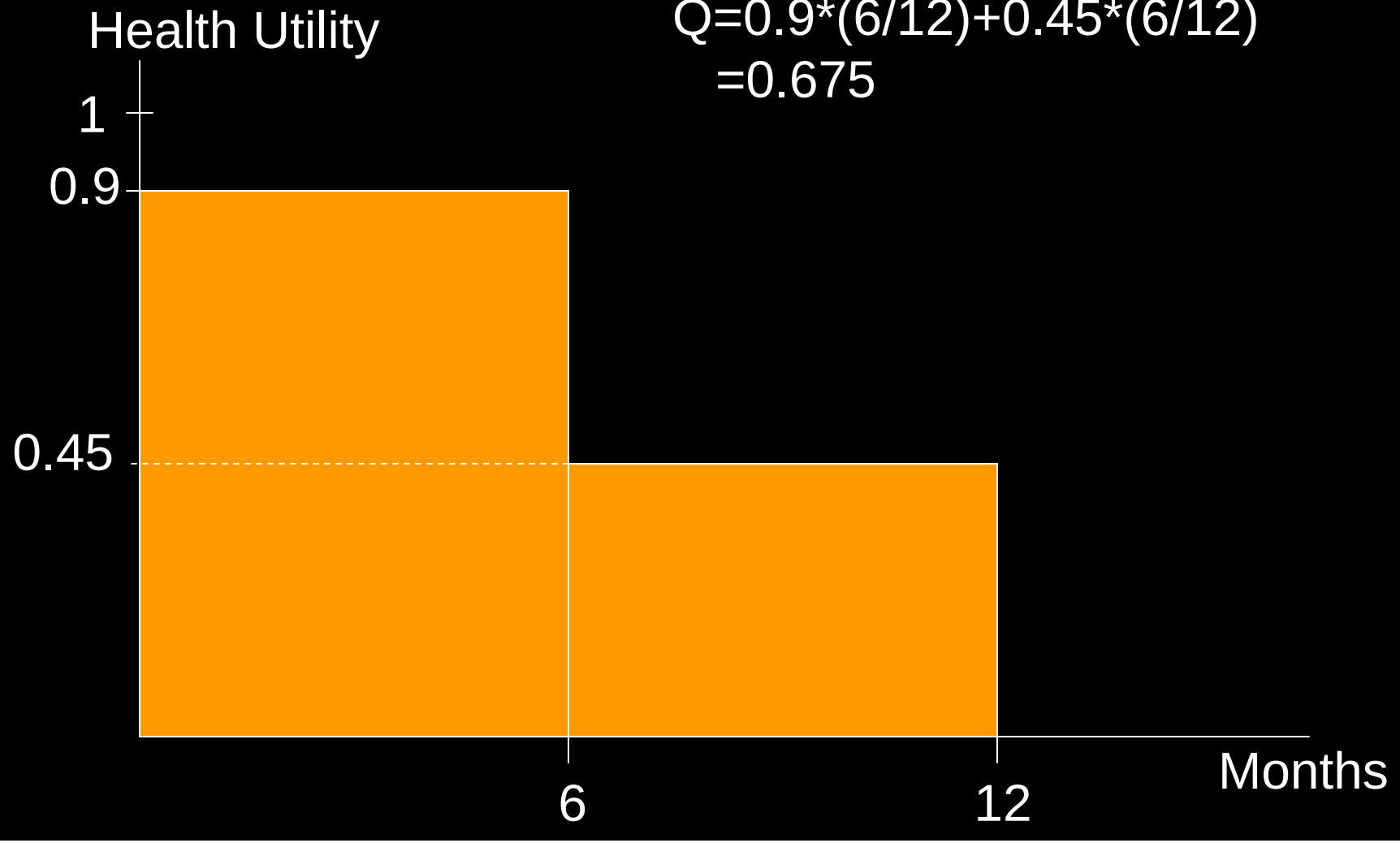


Modeling and Measuring

- When modeling know exact duration of each health state
- When making multiple measurements, usually assume a linear change and can simply take average of ‘adjacent’ observations for QALYs within a year

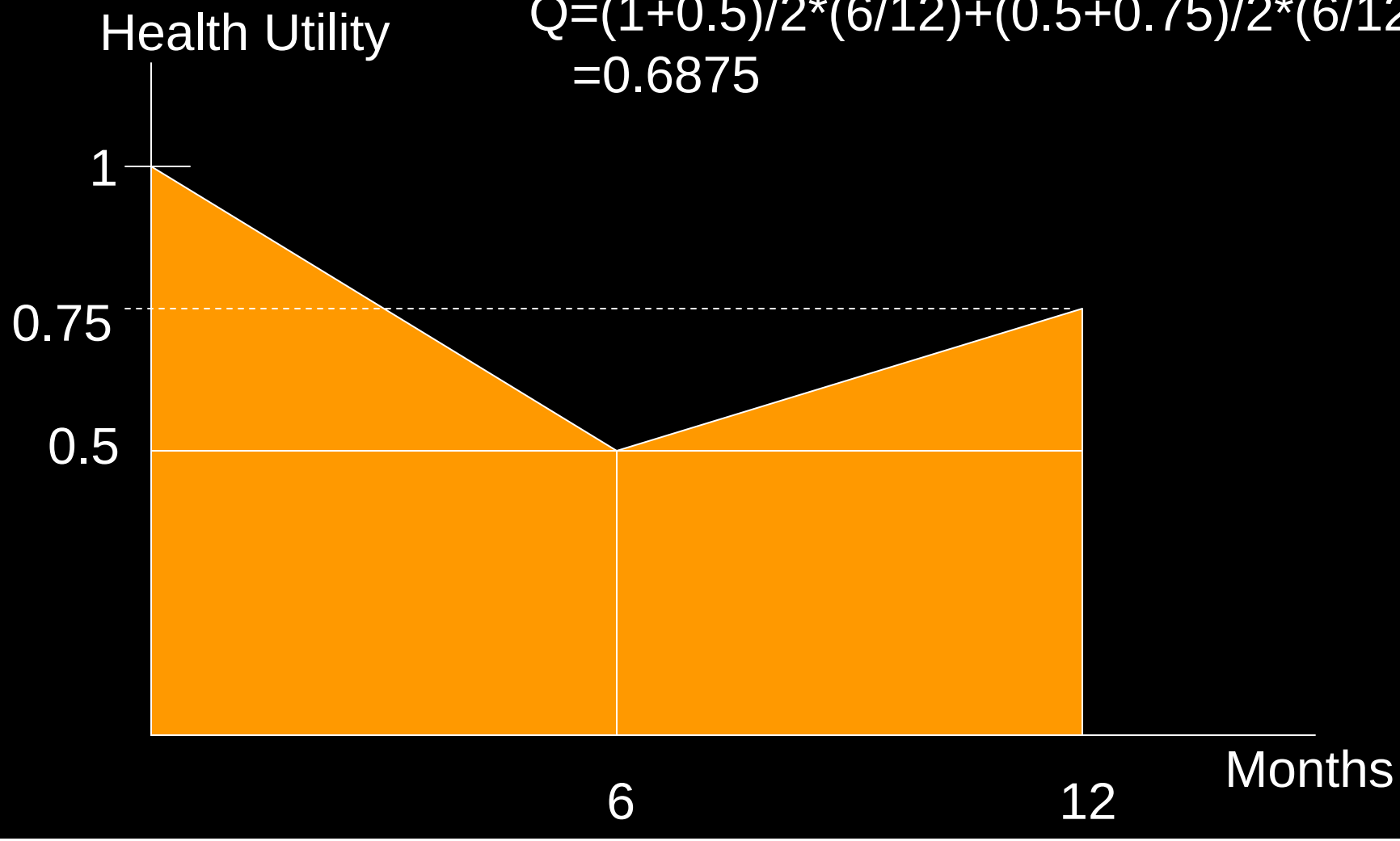
Modeling

Q=0.9*(6/12)+0.45*(6/12)
=0.675



Measuring

Q=(1+0.5)/2*(6/12)+(0.5+0.75)/2*(6/12)
=0.6875

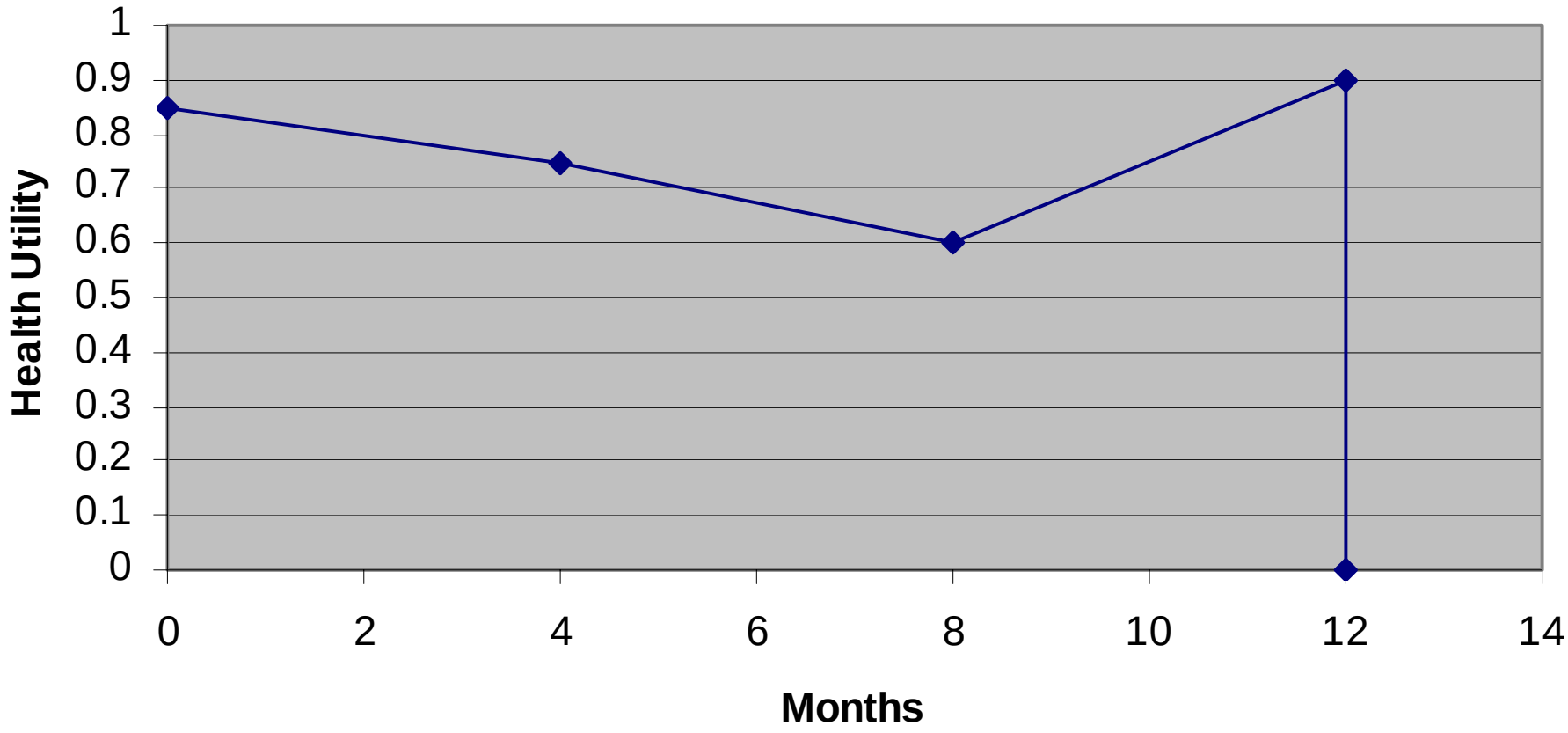


What to Do with Point in Time Observations

1) Average “adjacent” observations
2) Attach points?
3) Count the state as applying to the person between one half the distance to the previous observation and one half the distance to the next?

Observations in More Complex Example

- 4 hypothetical observations
  - Baseline 0.85
  - 4 months 0.75
  - 8 months 0.60
  - 1 year 0.90


Health Utility
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
Months

Alternative Calculations

- Averaging adjacent observations
  - (0.75+0.85)/2*1/3 + (0.60+0.75)/2*1/3 + (0.60 + 0.90)/2*1/3 = 0.741
- ‘Rectangles and triangles’
  - (0.75*1/3+1/3*1/2*0.10) + (0.60*1/3+1/3*1/2*0.15) + (0.60*1/3+1/3*1/3*0.30) = 0.741
- Count health related quality of life preference weight as constant for periods till half way in between observations
  - 0.85*1/6 + 0.75*1/3 + 0.60*1/3 + 0.90*1/6 = 0.741

Summing Over Time

- Arrive at total that is expressed regardless of how it was arrived at
- Can never measure every day
- Lose some precision as a result

Summing Among Individuals

- Have an average per person or population total that is regardless of the distribution
- Lose some of the precision about the variation among individuals

Syringes, and Test Tubes, and Vats, Oh My!

- Each day a person could express utility by filling a syringe in proportion to her quality of life
- Empty each syringe into a test tube and at the end of the year summarize how full the test tube is regardless of how full each day's syringe was
- Within a population, pour all the test tubes into a vat and summarize how full the vat is regardless o how full each person's test tube was

Underlying principles of DALYs

- The burden calculated for like health outcomes should be the same
- The non health characteristics of the individual affected by a health outcome that should be considered in calculating the associated burden of disease should be restricted to age and sex.
- DALYs do not measure welfare in the sense of measuring utility as defined by economics

Disability

- Several definitions over time
- Definitions can be dictated by science and politics
- At the time of the original work by Murray and colleagues there were distinct definitions for impairment, disability, and handicap
  - Handicap is still separate from quality of life

Definitions

- Impairment
  - Loss or abnormality of structure or function
- Disability
  - Restriction or lack of ability to perform an activity in the manner of within the range considered normal for a human being
- Handicap
  - Disadvantage results from an impairment or disability that prevents the fulfillment of a normal role
- Note that current definition mixes prior version of disability and handicap (http://www.who.int/icidh/)

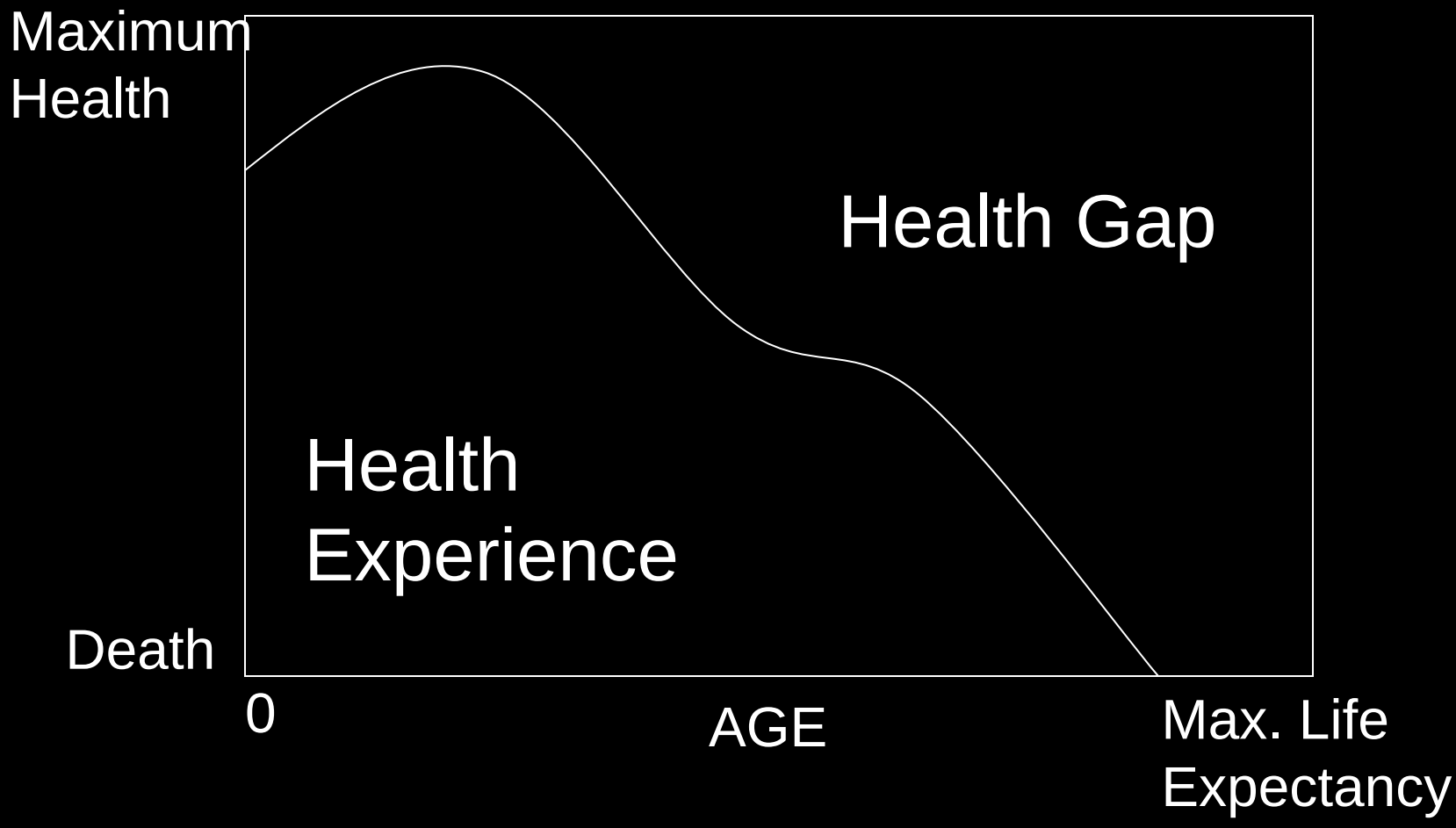
Examples

Disease/ Disorder	Impairment	Disability	Handicap
Polio	Paralyzed muscles of the legs	Inability to walk	Unemployed due to belief that person cannot work
Brain injury retardation at birth	Mild mental retardation	Difficulty learning	Social isolation

Measure of health gap

- Scale from 0 (no disability) to 1 (death)
- Opposite of the QALY scale
- Compare to a life with no disability during the maximum life expectancy
  - Defined using life tables
  - Separate for female and male
    - For males, actually use a female table

Graphical interpretation of a health gap measure



Interaction of disabilities

- Additive
- Little initial exploration of interactions of a more complex nature
- Could add up to more than “death”

Calculation of DALYs

- DALYs = YLD + YLL
  - Years of life with disability
  - Years of life lost
- Basic measure (using “optimal” life tables) is a measure of burden of disease
- Most interested in comparison of burden of disease without and with a new intervention
  - Necessary for cost-effectiveness

YLD and YLL

- YLL is a function of an age weighting factor, the age at death, the life expectancy at death, and a discount rate
- YLD is a complex function of a similar list of factors plus the disability weight
- Using only one life table allows for a uniform formula

Age weighting

- Hump shaped age weighting
- Based on need for support
- Short run effects greater for “prime age” individuals than for children
- Children’s effects include those during “prime age” but they are discounted
- Not required to use age weighting

Discounting

- 3% is the standard
- Formula allows for no discounting
- With no discounting
  - DALYs = Disability Weight * Duration of Disability + Life Expectancy at Death

Calculating YLL

- Discount rate: r; Age weighting: b & K, a is age at death, L is standard life expectancy at age a
- In GDB r=0.03, b = 0.04, K=1, C=0.1658
- If K = 0 then uniform age weights
- If r = 0 no discounting

$$YLL = \frac{KCe^{ra}}{(r+\beta)^2}\left[e^{-(r+\beta)(L+a)}\left[-(r+\beta)(L+a)-1\right]-e^{-(r+\beta)a}\left[-(r+\beta)a-1\right]\right] + \frac{1-K}{r}\left(1-e^{-rL}\right)$$

YLD

- Age of disability onset = a; L = duration of disability
- YLD with no discounting and no age weighting = DL

$$YLD = D\left\{\frac{KCe^{ra}}{(r+\beta)^2}\left[e^{-(r+\beta)(L+a)}\left[-(r+\beta)(L+a)-1\right]-\right.\right.$$
$$\left.\left.e^{-(r+\beta)a}\left[-(r+\beta)a-1\right]\right]\right\}$$
$$+\frac{1-K}{r}\left(1-e^{-rL}\right)$$