Epi213_Lecture 3

Jan 25, 2018

Agenda

1. Overview
2. New concepts: discounting, inflation, international comparisons, CE plane and dominance, rates vs probabilities
3. Present your ideas
4. Review homework

Key Steps in a Decision Analysis:

- Meaningful question
- Clearly define PICO-HS, particularly Outcomes
- Search for transition probabilities
- Search for outcomes and costs
- Perform a base-case analysis
- Perform sensitivity analyses
- Communicate your findings

General Approach:

- Ask a meaningful question
- Start simple, then iteratively expand/elaborate
- Allocate approximately equal time to the decision tree, data collection, sensitivity analyses, and communication
- Delve into and enjoy modeling. Have fun with the nuances. Master the challenges.

Time Preference:

When given the option of $100 now vs a $100 a year from now (with no risk of default), most choose to have the money now. This could be for a variety of reasons:

- I can invest the money and make some interest or dividend in a year (return on a risk-free investment)
- I really need the money today, and may not need the money next year
- $100 today may be worth less next year than it is today (inflation)

Thus when performing analyses over a long time horizon, we need to estimate the present value of future costs or savings. This involves adjusting for time preference (points 1 and 2 above), as well as for inflation (estimating *real* rather than *nominal* costs; recall that *real* costs imply they've already been adjusted for inflation).

Let's start with time preference (independent of inflation). We adjust for these by discounting future costs and consequences:

Assume that PV = present value, FV = future value, r is the discount rate, and t is the time horizon.

$$PV = \frac{FV_t}{(1+r)^t}$$

2018 $\frac{100}{(1+.03)^1}$

2019 $\frac{100}{(1+0.03)^2}$

and so on. Note that the cycle length for the discount rate and time should be the same. In other words, if you use an annual discount rate of 3% (as is the norm in the US), then time should be measured in years as well.

Discount rate for USA is typically 3% (sens analysis 0-5%) , UK ~3.5%

PDF File

Note that in year 1, discounted and undercounted values are the same.

PDF File

For now, easier to adjust for discounting externally, and build them into your tree.
In TreeAge, it can be done internally too (With the help of markov nodes). By the end of the course, you must be able to perform discounting adjustments internal to the tree.

The case to discount costs is clear. Why do we also discount clinical outcomes?
You also have to discount QALYS → if you don't, the preferred option will always get deferred.

1000 $--> 1000 QALYS today ⇒ 980$--> 1000 QALYS a year from now (So the most cost effective option would be to defer treatment if we DON'T discount QALYS). This is called the Keeler- Cretin paradox.

Caveats:

1. Discount rates vary by country. For LMIC, estimating rates may be more challenging. If no standard rate available, keep your base-case rate between 3-5% and perform sensitivity analyses.
2. When reporting an outcome that is a clinical event eg- number of MIs, strokes, etc- DO NOT DISCOUNT⇒ HARD OUTCOMES do not get discounted. QALYs and life-years typically do.

Next, let's think about inflation. This is the idea that a basket of standard goods that costs $100 today may cost more (or less) than $100 a year from now. When estimating costs in 2016 USD, I may have some references where costs were estimated in 2010 or even 1995. Cant just assume that the costs haven't changed in the interim - need to adjust for inflation. There are two types of adjustors - those based on the consumer price index or on the gross domestic product.

CPI inflation calculator (i prefer this for the US):
https://www.bls.gov/data/inflation_calculator.htm

GDP inflation calculator (I often turn to this information for other countries):
http://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG

I prefer to not use the CPI-medical inflation calculator (for reasons beyond the scope of this class; briefly, adjusting for inflation specific to medicine is challenging as the basket of medical services is changing over time).

Make sure you adjust to your analysis year. Since inflation rates come out mid year, for now, consider adjusting up to 2015 currency.

When making international comparisons:

1. One can convert between currencies using a (mid-year) currency conversion rate. Example conversion rate Indian Rupee —> USD was 67 on July 1,

2016. http://www.xe.com/currencycharts/?from=USD&to=INR&view=1Y

2. One can also adjust for purchasing power. Consider a basket of goods that cost $100 in the US. That may not cost 67*100 = 6700 Rupees in India. Instead, it may cost only 1700 Rupees. So the conversion factor (adjusting for purchasing power) is 17 Indian Rupees = 1 international dollar ($INT). The international dollar is the standard unit for international comparisons; for each country, it is the amount of money in the local currency that would have the same purchasing power in country as 1 USD would in the US. http://data.worldbank.org/indicator/PA.NUS.PPP

CE Plane

It is a way of visualizing costs and effects, with costs usually on the y-axis and effects (e.g. QALYs) on the x-axis. One can show both the control and intervention strategies on this plane, and then the slope of the line connecting the two would be the incremental cost-effectiveness (difference in C/difference in E). The steeper the line, the higher the ICER, and the less cost-effective the strategy.

This visualization is particularly helpful when:

1. We are evaluating multiple strategies, or
2. If we are also depicting uncertainty around the base-case value (scatter plots) for each strategy.

Dominance:

We discussed examples of strict and extended dominance. Strict dominance is when one strategy costs less (or the same) as another but has better outcomes. In other words, the strategy is a no-brainer (dominating) compared with the control (dominated).

We also discussed the idea of extended dominance, which may kick in when comparing multiple strategies (see class video for details).

So general approach when comparing multiple strategies:
- Line all up in increasing order of QALYs
- Eliminate any strictly dominated strategies
- Estimate ICERs of each strategy relative to the next best strategy
- Eliminate any strategies by extended dominance
- Re-estimate and report delta costs, delta QALYs, ICERs.

TreeAge Tips:

1. Remember to define your variables at root of tree. Makes it easier to code and easier to debug. And easy to run sensitivity analysis
2. Tree Age has an excellent PDF manual. Link here- http://installers.treeagesoftware.com/treeagepro/TP2007/TreeAgePro2007.pdf Easy to find quick solutions etc.
3. Remember in tree preferences: Cost effectiveness Analysis, click the down arrow to the left of it and in the options given, change the willingness to pay threshold. Or else it will always just default to the cheaper option. Put Willingness to pay at 100,000 $ for now
4. Sometimes inputs may be complex (e.g. varying costs by age and gender). In this case, one may not use variables but tables as inputs. Create those first.
5. When reporting sensitivity analysis results, you may not repeat whole ICER in PICO format, but make sure you mention it either *dropped to* or *increased to__.*
6. Penalty QALYS→ while a person is sick or on a particular medication, their quality-of-life may decline temporarily, and then get the full QALY when cured/better. This can be implemented as a penalty that must be subtracted from the QALYS they gain from the treatment. Remember to account for the right duration you are applying the penalty (e.g., quality-of-life declines by 0.1 for the 6 weeks after surgery; penalty = 0.1*6/52.

Rates and probabilities

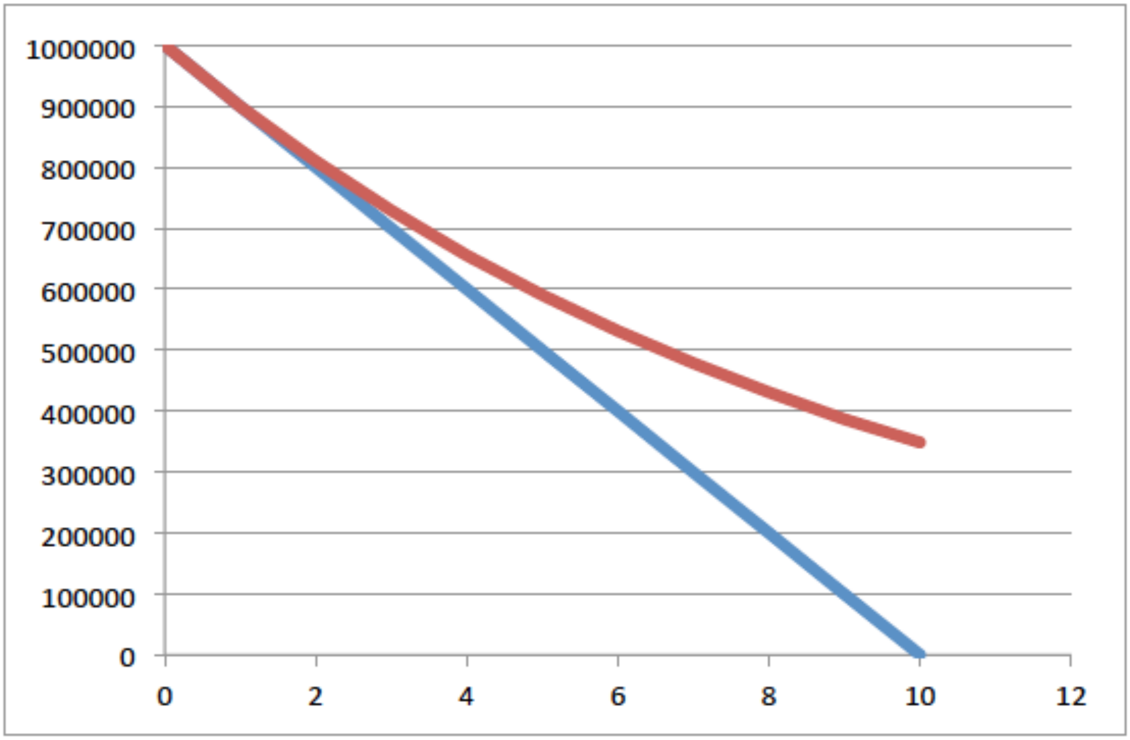
Homework Qs 1-3

1,000,000 people —> mortality 100,000 a year vs. 1,000,000 people —> mortality 10% a year

Survival:

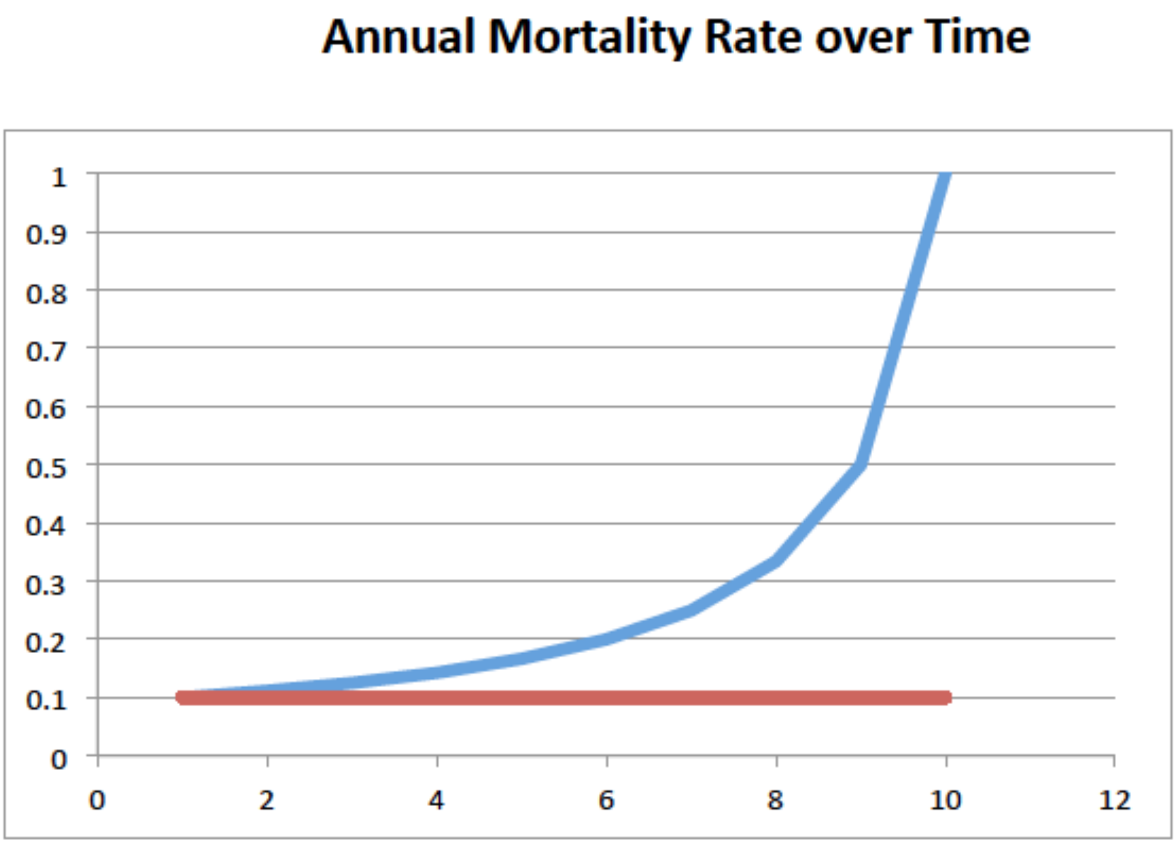
Time (year)	Scenario 1: Persons alive	Scenario 2: Persons Alive
0	1000000	1000000
1	900000	900000
2	800000	810000
3	700000	729000
4	600000	656100
5	500000	590490
6	400000	531441
7	300000	478297
8	200000	430467
9	100000	387420
10	0	348678

Surivival over Time



Annual Mortality Rate:

Time (year)	Scenario 1: Persons alive	Scenario 2: Persons Alive		Scenario 1: Annual Mortality Rate	Scenario 2: Annual Mortality Rate
0	1000000	1000000			
1	900000	900000		0.1	0.1
2	800000	810000		0.11111111	0.1
3	700000	729000		0.125	0.1
4	600000	656100		0.14285714	0.1
5	500000	590490		0.16666667	0.1
6	400000	531441		0.2	0.1
7	300000	478297		0.25	0.1
8	200000	430467		0.33333333	0.1
9	100000	387420		0.5	0.1
10	0	348678		1	0.1



Why do we care?
(mathematical transformation and time trends)

Converting rates to probabilities

Probability to rate

$$\mathbf{Rate} = \frac{-\ln(1-p)}{t}$$

Rate to probability

$$\mathbf{Probability} = 1 - exp^{(-rt)}$$