

Written exam 14th of June 2024, 09:00 – 17:00

HEVAL5120 – Modeling in economic evaluation I

Results will be available within three weeks on Studentweb.

The exam consists of 5 pages including this one.

THE BEST OF LUCK!

Question 1 60%

You are going use the template Dementia_template

Read all the information in the template (all sheets) carefully

In this task you are going to evaluate 2 new treatment options or patients with diagnosed dementia. There are four health states: Early, Moderate, Severe and Death, where the tree first health states refers to progression of dementia.

In this evaluation you are comparing three treatments

- Standard care (monotor)
- Monotherapy (MONO)
- Combination therapy (COMB)

The effect of Monotherapy and Combination therapy is described in the excel sheet.

The relative effects are estimated relative to standard of care.

Monotherapy both have an impact on progression (rrMONO) and Death (rrDeath_M)

All individuals with dementia starts in Early in Cycle 0

Look at the **model** in the template to understand the movements between health states that are possible

Outcomes: QALYs

Cycles: 1 year

Time-horizon: 24 years

Perspective:

Health care and Societal

c_total_healthcare – total health care costs

cTotal – refers to all costs (healthcare and additional societal costs)

You are going to build the model based on the information in the parameter sheet.

All alternatives should be compared simultaneously.

- a) Estimate primary costs according to health states per cycle:
- EARLY – visit there general practitioner (GP) every second month
 - MODERATE – GP every month
 - SEVERE – GP every second week
 - Cost per visit £40

Answers:

$(40 * 6)$ 240	A
$(40 * 12)$ 480	B
$(40 * 26)$ 1040	C

- b) Travel cost according to health state per cycle. Assume that the travel to primary care – the GP (return – both ways) equal on average 18 km. The cost per km is £0.5

Answers:

$(18 * 0,5 * 6)$ 54	A
$(18 * 0,5 * 12)$ 108	B
$(18 * 0,5 * 26)$ 234	C

- c) Report the deterministic findings both from a healthcare and societal perspective. What is your recommendation if the cost-effectiveness threshold (CET) is £30 000 (both perspectives)? Describe the results and explain what is driving the results (costs and health outcomes).

Cost effectiveness of drug treatment for patients with dementia

Undiscounted and half-cycle corrected results								
Strategy	Health-care costs	Societal costs (total)	QALYs	INCR Health-care COST	INCR Societal costs	INCR QALYs	ICER - Health-care	ICER - Societal
Standard Care	£164 940	£ 199 868	9,5					
Monotherapy	£284 874	£ 333 515	12,9	£119 934	£133 647	3,4	£35 239	£39 268
Combination therapy	£404 324	£ 462 801	15,2	£119 450	£129 286	2,3	£52 062	£56 349

Discounted and half-cycle corrected results								
Strategy	Healthcare costs	Societal costs (total)	QALYs	INCR COST		INCR QALYs	ICER - Health-care	ICER - Societal
Standard Care	£120 019	£ 146 140	7,47					
Monotherapy	£197 365	£ 231 573	9,63	£77 346	£85 433	2,2	£35 783	£39 524
Combination therapy	£274 124	£ 313 943	11,04	£76 759	£82 370	1,4	£54 698	£58 697

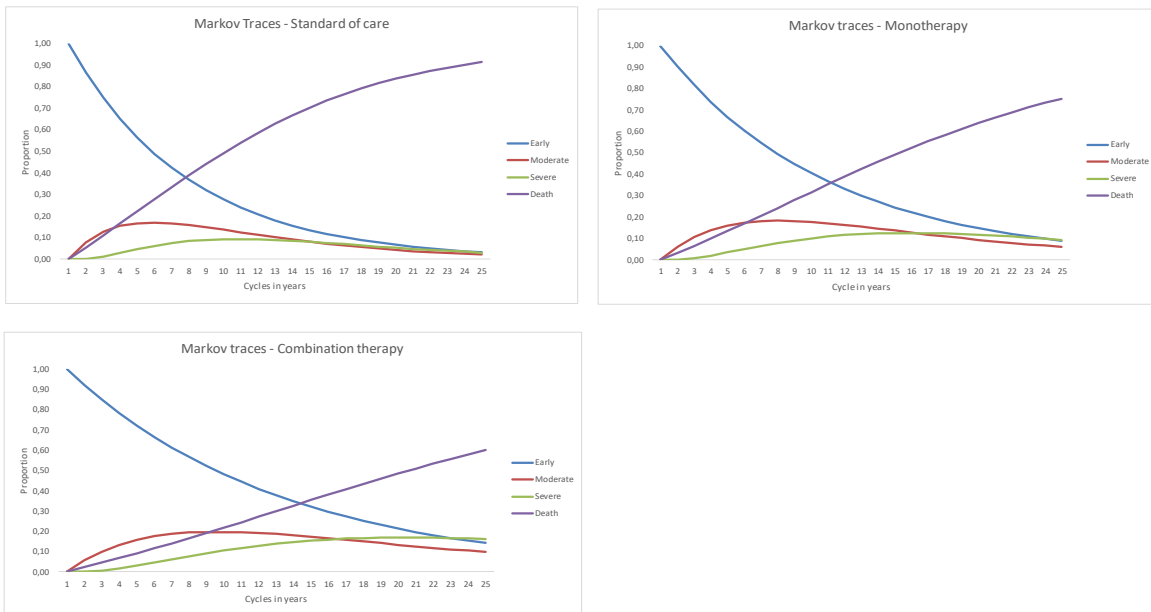
In addition to solving the model, expected to discuss the numbers.

Main conclusion, from the deterministic analysis standard of care is the recommended treatment in both perspective at a CET of £30000. If there were some mistakes in the model, and the ICER were below CET of £30000, we evaluated the interpretation based on the candidates finding.

- d) If the CET is £50 000, would your recommendation change? Discuss both from a health care and societal perspective.

Monotherapy becomes cost-effective in both perspectives. . If there were some mistakes in the model, and the ICER were below CET of £50000, we evaluated the interpretation based on the candidates finding.

e) Make figures of the Markov traces of the three alternatives and describe the figures.



Expected a description and comparason of the traces.

f) In this sub-question you should only compare standard of care with monotherapy.

Consider a CET of £ 30 000.

- Create a one-way sensitivity analysis of the cost of monotherapy from 1000 to 10000 on the ICER. Interpret the results. *(remember to reset the parameters before preceding)*
- Create a two-way sensitivity analysis combining the cost of monotherapy from £1 000 to £10 000 with the rrMONO from 0.500 to 0.98. Report the ICER for the comparison between standard of care and MONO Interpret the findings. *(remember to reset the parameters before preceding)*

cMono	ICER													
1000	12410	24913	0,5	0,55	0,6	0,65	0,7	0,75	0,8	0,85	0,9	0,95	0,98	
1500	14114	1000	2729	4260	5824	7420	9050	10713	12410	14144	15914	17723	18827	
2000	15817	1500	4263	5819	7409	9033	10691	12385	14114	15880	17684	19528	20655	
2500	17520	2000	5796	7378	8994	10646	12333	14056	15817	17616	19454	21334	22482	
3000	19224	2500	7330	8937	10579	12259	13975	15728	17520	19352	21225	23140	24310	
3500	20927	3000	8863	10495	12165	13871	15616	17400	19224	21088	22995	24946	26138	
4000	22630	3500	10397	12054	13750	15484	17258	19072	20927	22824	24765	26751	27966	
4500	24334	4000	11930	13613	15335	17097	18900	20744	22630	24560	26535	28557	29793	
5000	26037	4500	13464	15171	16920	18710	20541	22416	24334	26297	28306	30363	31621	
5500	27740	5000	14998	16730	18505	20322	22183	24088	26037	28033	30076	32169	33449	
6000	29444	5500	16531	18289	20090	21935	23825	25759	27740	29769	31846	33974	35276	
6500	31147	6000	18065	19847	21675	23548	25466	27431	29444	31505	33616	35780	37104	
7000	32850	6500	19598	21406	23260	25161	27108	29103	31147	33241	35387	37586	38932	
7500	34554	7000	21132	22965	24845	26773	28750	30775	32850	34977	37157	39392	40759	
8000	36257	7500	22665	24524	26430	28386	30391	32447	34554	36713	38927	41197	42587	
8500	37960	8000	24199	26082	28015	29999	32033	34119	36257	38449	40697	43003	44415	
9000	39664	8500	25733	27641	29601	31612	33675	35790	37960	40185	42468	44809	46243	
9500	41367	9000	27266	29200	31186	33224	35316	37462	39664	41922	44238	46615	48070	
10000	43070	9500	28800	30758	32771	34837	36958	39134	41367	43658	46008	48420	49898	
		10000	30333	32317	34356	36450	38599	40806	43070	45394	47778	50226	51726	

For both a and b, we expected an interpretation of findings and how the different components influenced ICER (cost and prevalence). If the candidate had different findings, this did not influence the evaluation here.

g) Let's assume that there are no discounting of health outcomes (QALYs). Given a threshold - CET of £30000, what is your recommendation?

Undiscounted and half-cycle corrected results								
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With interpretation

h) If number of cycles increases with 10 cycles, will this influence the results? If you have time, you can extend number of cycles, but you can also verbally discuss the question.

BONUS

Question 2 (40 %)

Finish the probabilistic model, by solving the decision tree in the excel sheet

SleepApnea_template

Download the file and save the file as **SleepApne_solution.xlsm**

You have to actively choose this option when saving to be able to run the macros

All necessary information is included in the excel sheets. In the model you are comparing screening for sleep apnea in the general population versus do nothing. Screening response is assumed to be 100%. You can use the macro code below to run the simulation.

Define the variables, including assigning appropriate distributions to each of the parameters.

Answer the following questions and provide an explanation based on the results of your analysis:

- a) Estimate the deterministic ICER? Interpret the finding.

Cost effectiveness of screening for sleep apnea in the general population compared to do nothing

Results		
Strategy	Cost	QALY
Do nothing	£ -	0,834
Screening for sleep apnea	£ 946	0,870
Increment	£ 946	0,036
ICER		Incremental cost/QALY £ 26 590

With interpretation

b) Do a 1-way sensitivity analysis of Prevalence range (0.15-0.40)

	ICER
0,22	26590
0,15	33453
0,175	30342
0,2	28040
0,225	26269
0,25	24863
0,275	23721
0,3	22774
0,325	21976
0,35	21295
0,375	20707
0,4	20194

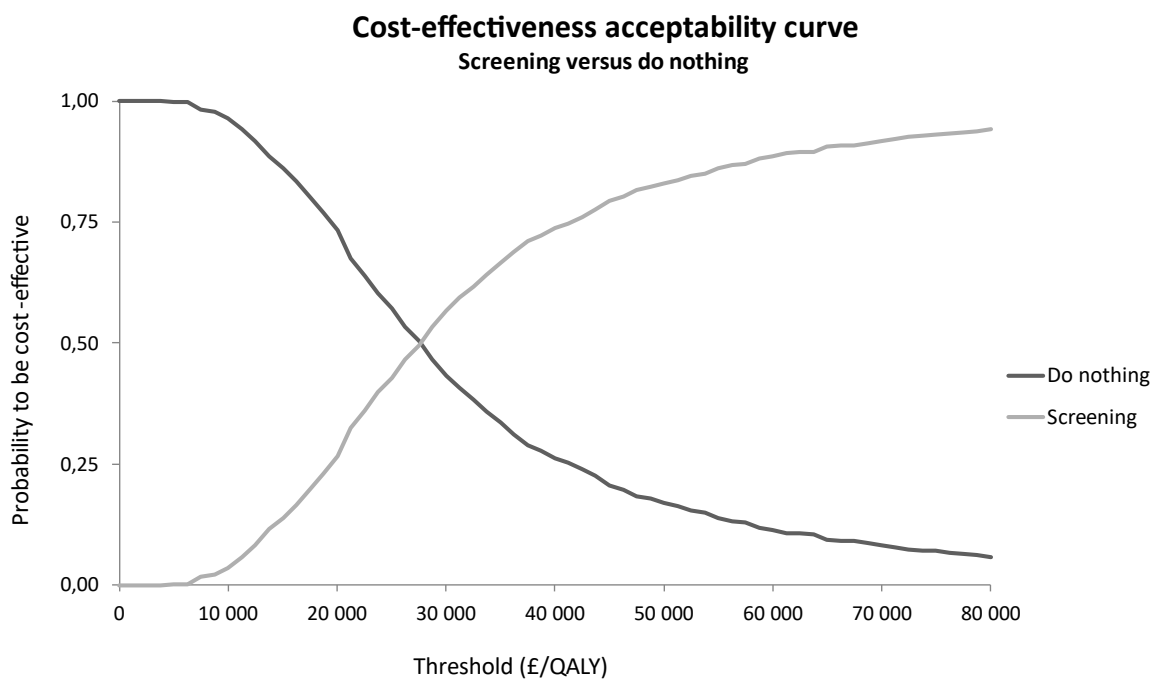
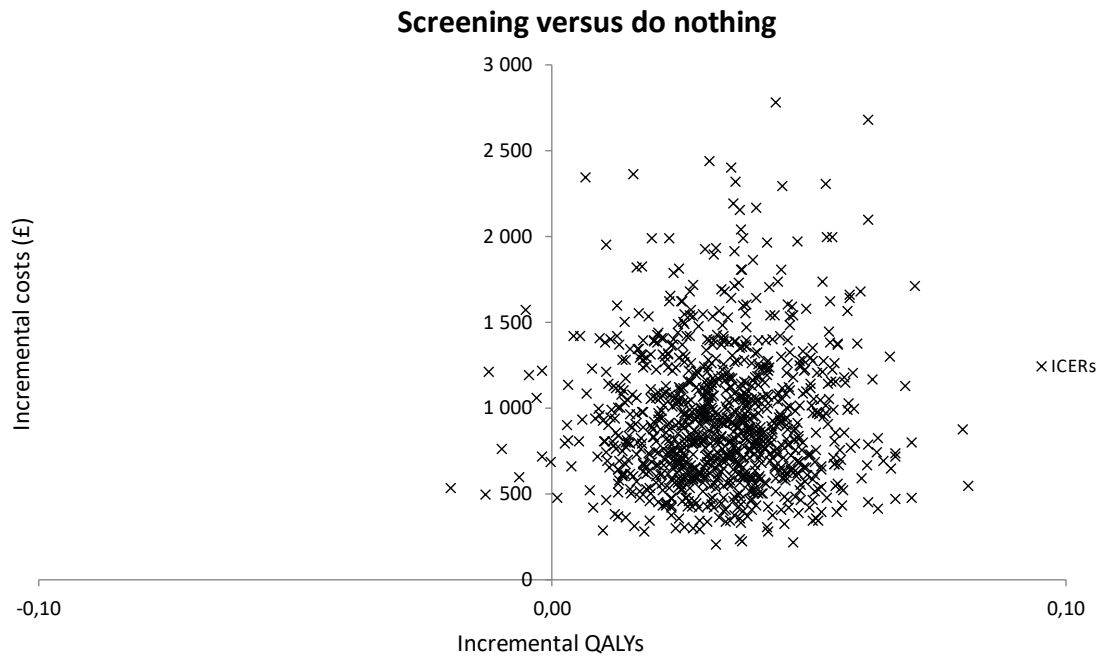
Interpretation

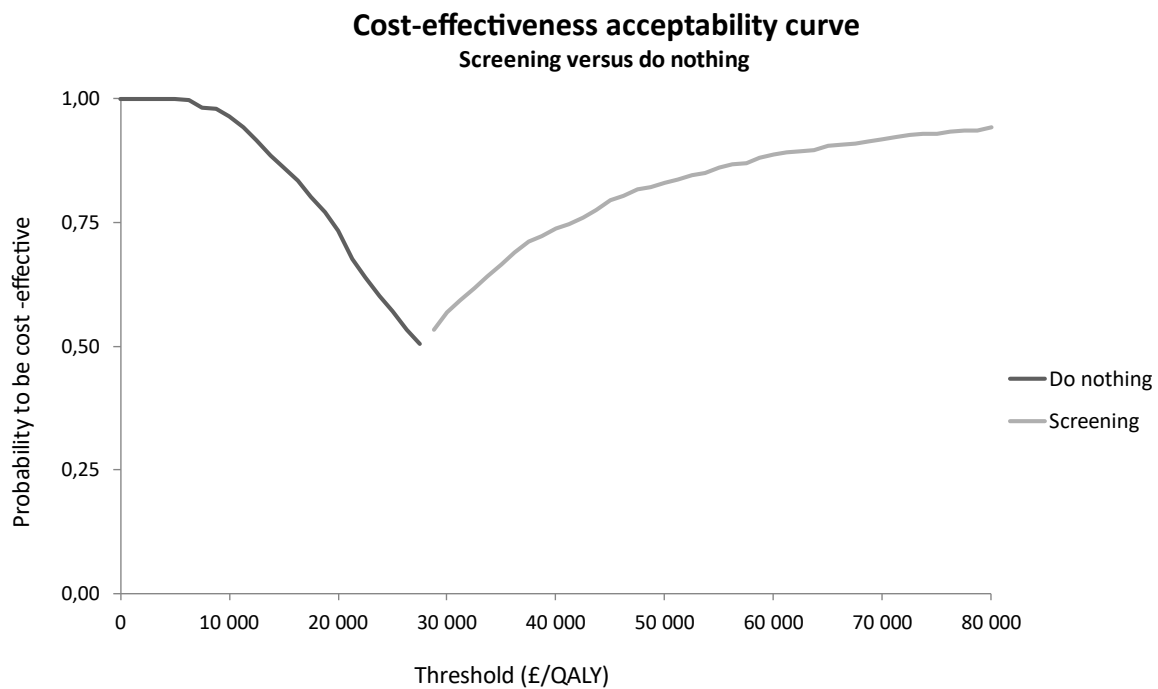
c) Do a 2-way sensitivity analysis of Prevalence range (0.15-0.40) and Sensitivity (0.78-0.99).

26590	0,78	0,8	0,82	0,84	0,86	0,88	0,9	0,92	0,94	0,96	0,98	0,99
0,15	34907	34397	33913	33453	33015	32598	32200	31820	31458	31111	30778	30617
0,175	31535	31116	30719	30342	29982	29640	29313	29001	28703	28418	28144	28012
0,2	29043	28691	28358	28040	27738	27450	27176	26913	26662	26422	26192	26081
0,225	27126	26826	26540	26269	26010	25764	25529	25304	25090	24884	24687	24591
0,25	25606	25346	25098	24863	24639	24426	24222	24027	23841	23662	23491	23408
0,275	24371	24143	23927	23721	23525	23337	23159	22988	22825	22668	22518	22446
0,3	23348	23147	22956	22774	22600	22435	22277	22126	21982	21844	21711	21647
0,325	22487	22308	22138	21976	21822	21675	21535	21400	21272	21149	21031	20974
0,35	21752	21592	21440	21295	21157	21026	20900	20780	20665	20556	20450	20399
0,375	21117	20973	20837	20707	20583	20465	20352	20244	20141	20043	19948	19902
0,4	20563	20433	20311	20194	20082	19976	19874	19777	19684	19595	19510	19468

Interpretation both or prevalence and sensitivity. Observe that changes in prevalence changes ICER more than sensitivity. Explain the mechanisms.

d) Run a probabilistic analysis, estimate the ICER, create a cost-effectiveness scatterplot, CEAC and CEAF. Interpret the findings. Remember to set E4 in the parameter sheet to 1 (prepare for probabilistic analysis). When deterministic, this is 0.





Evaluated the choice of distributions in addition to the simulations. For some, there should be a Dirichlet distribution, due to three treatment options.

e) In what quadrants of the cost-effectiveness scatterplot are the simulated ICERs, and what is your interpretation? Explain more generally the link between the scatterplot and the CEAC.

Almost in the NE quadrant, a few in NW.

The CEAC for intervention starts at the proportion of simulation in the SE and SW (here at 0)

The CEAC for the intervention converge to the proportion in the NE quadrant (here almost at 1)

The other way around for no screening.

- f) Given a threshold of £30 000 per QALY gained, what is the probability that screening is cost-effective compared to do nothing? Would you recommend screening as an alternative strategy to do nothing?

Most likely yes, but there could be variation in the simulations.

- g) Change st.error of costs is equal to the mean value. Run a new probabilistic analysis and present the ICER, scatterplot, CEAC and CEAF. Interpret the findings and compare the results with the response in b).

The scatterplots, CEAC and CEAF shows greater uncertainty, based on a broader scatter, less steep CEAC and CEAF.

Macro code for the simulation

```
Sub Simulation()
```

```
'
```

```
' Simulation Macro
```

```
'
```

```
'
```

```
Application.DisplayStatusBar = True
```

```
Index = 0
```

```
Trials = 1000
```

```
Do
```

```
Sheets("PSA").Select
```

```
Range("B10:G10").Select
```

```
Selection.Copy
```

```
Range("B11:G11").Select
```

```
ActiveCell.Offset(Index, 0).Range("A1").Select
```

```
Selection.PasteSpecial Paste:=xlPasteValues, Operation:=xlNone, SkipBlanks _
```

```
:=False, Transpose:=False
```

```
Application.CutCopyMode = False
```

```
Index = Index + 1
```

```
Application.StatusBar = "Simulation " & Index & " of 1000 trials"
```

```
Loop While Index < Trials
```

```
End Sub
```