

### Enhanced indexation example question

The table below shows the stock prices and index values over a number of time periods, together with the current portfolio.

Period	A	B	C	D	E	Index
0	39.7	3.1	38.2	72.9	3.6	2655.8
1	73.5	0.5	96.3	60.4	77	5039.7
2	17.3	42.3	62.2	49.7	91.5	4717.7
3	31.6	70.8	57.2	5.2	54.7	4946.7
T=4	64.4	86.9	76.1	27.1	14.3	6506.6
Current portfolio	5	67	8	6	10	

For example in period 3 the stock/share price for stock A is 31.6 and the index value is 4946.7. The current portfolio contains 5 units (shares) of stock A, 67 of B, etc.

Use this data to construct (enhanced indexation) tracking portfolios containing  $K=3$  stocks with:

- values of  $\lambda$  of 0.99, 0.95, 0.90 and 0.80
- an aim of achieving 0.5% and 1% excess per time period. Here use just the specified and semispecified objectives.

Which of your constructed portfolios do you prefer and why?

## Enhanced indexation example solution

*Recall here that because Solver utilises a heuristic solution technique you will probably get different solutions from those shown below.*

Utilising the enhanced indexation Solver model I get the portfolios shown below for values of  $\lambda$  of 0.99, 0.95, 0.90 and 0.80.

We also show below the average portfolio return as well as the difference between that and the average index return, which for the example dealt with here is 22.40178%

	A	B	C	D	E	Average portfolio return	Difference from index return
$\lambda = 0.99$	0	35.01	48.49	12.06	0	22.76286	0.36108
$\lambda = 0.95$	0	35.04	48.46	12.02	0	22.79549	0.393715
$\lambda = 0.90$	9.20	38.45	41.07	0	0	30.87252	8.470738
$\lambda = 0.80$	0	39.00	48.22	0	0	31.99487	9.593094

Here the lower values of  $\lambda$  (less emphasis on tracking, more emphasis on excess return) give a better performance, as we would have expected.

With an aim of achieving 0.5% and 1% excess per time period and utilising the specified or semispecified objectives we get the results shown below.

Objective	Aim	A	B	C	D	E	Average portfolio return	Difference from index return
Specified	0.5%	0	35.29	48.28	11.72	0	23.04374	0.641963
Semispecified	0.5%	0	35.99	47.79	10.85	0	23.76365	1.361875
Specified	1%	0	35.59	48.07	11.37	0	23.33498	0.933199
Semispecified	1%	13.11	40.71	35.18	0	0	31.64756	9.245784

Note here that the fundamental difference between specified and semispecified is that the specified objective tries to achieve precisely the excess percentage given (and above you can see how well it does). The semispecified objective tries to exceed the excess percentage given.

Here the choice of portfolio comes down to your brain and personal objectives. Recall that all we have done here is to choose portfolios that, on past history, would have achieved the returns given above. This is no guarantee of future performance.

The Excel spreadsheet used is shown below:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Stock prices and index values														
2	Period	A	B	C	D	E	Index	Index return (%)	Artificial index return (%)	New TP value	New TP return (%)	Return difference	Min term semi	Min term sortino	Return difference unspecified
3	0	39.7	3.1	38.2	72.9	3.6	2655.8			2108.279					
4	1	73.5	0.5	96.3	60.4	77	5039.7	64.06006	64.56006289	4799.146	82.25661867	17.69655578	0	0	17.69655578
5	2	17.3	42.3	62.2	49.7	91.5	4717.7	-6.60252	-6.10251638	4379.08	-9.159938801	-3.057422421	-3.05742	-32.0617	-3.057422421
6	3	31.6	70.8	57.2	5.2	54.7	4946.7	4.739929	5.239929489	5354.404	20.10808287	14.86815338	0	-2.7937	14.86815338
7	T=4	64.4	86.9	76.1	27.1	14.3	6506.6	27.40964	27.90963588	7058.7	27.63415066	-0.275485213	-0.27549	0	-0.275485213
8										Objectives	Specified	135.9134489			
9	Current TP X(i)	5	67	8	6	10					Semispecified	2.35593099			
10	New TP x(i)	9.1951554	37.08622	42.6247	0	0					Unspecified	-0.739427104			
11	Choice z(i)	1	1	1	0	0					Sharpe	0.191530725			
12	Proportion	0.0838919	0.45657	0.459538	0	0					Sortino	0.454146896			
13															
14	C	7058.7									Rmean	22.90177797			
15	K	3													
16	Sum z(i)	3													
17															
18	Excess (%)	0.5													
19	Lambda	0.5													
20															
21	Average index return (%)		22.40178												
22	Achieved TP return (%)		30.20973												
23	Difference (%)		7.80795												
24															
25															
26															
27															
28															
29															
30															
31															
32															

**Solver Parameters**

Set Target Cell:

Equal To:  Max  Min  Value of:

By Changing Cells:

Subject to the Constraints:

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