

### Index tracking example, downside risk, question

The table below shows the stock prices and index values over a number of time periods, together with the current tracking 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 tracking 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 tracking portfolio contains 5 units (shares) of stock A, 67 of B, etc.

Find tracking portfolios containing  $K=1, 2$  and  $3$  stocks, using a downside risk objective where transaction cost is  $0.15\%$  (15 basis points) of the value traded and where the limit as to the proportion of current worth consumed in transaction cost is  $0.25\%$  (25 basis points).

## Index tracking example, downside risk, solution

The downside risk objective, as presented in the lecture, is  $\sum_{t=1}^T \max[0, R_t - r_t] / T$

A Solver model similar to that we constructed in the lecture is shown below:

	A	B	C	D	E	F	G	H	I	J	K	L
1	Stock prices and index values							Index	New TP	New TP	Return	Max
2	Period	A	B	C	D	E	Index	return (%)	value	return (%)	difference	term
3	0	39.7	3.1	38.2	72.9	3.6	2655.8		1185.2			
4	1	73.5	0.5	96.3	60.4	77	5039.7	64.06006	2303.8	66.46484	-2.40477679	0
5	2	17.3	42.3	62.2	49.7	91.5	4717.7	-6.60252	4631.4	69.82993	-76.4324428	0
6	3	31.6	70.8	57.2	5.2	54.7	4946.7	4.739929	5937.4	24.84121	-20.1012834	0
7	T=4	64.4	86.9	76.1	27.1	14.3	6506.6	27.40964	7058.7	17.29896	10.11067873	10.11068
8							Total (Ctrans)			Objective		2.527674
9	Transaction cost	0.00	0.00	0.00	0.00	0.00	0.00					
10	Current TP x(i)	5	67	8	6	10						
11	New TP x(i)	5	67	8	6	10						
12	Choice z(i)	1.00	1.00	1.00	1.00	1.00						
13	Proportion	0.0456	0.8248	0.0862	0.0230	0.0203						
14												
15	C	7058.7		gamma (%)	0.25	gammaC	17.64675					
16	K	1				C-Ctrans	7058.7					
17	Sum z(i)	5.00										

  

Utilising this Solver model I get the following:

	A	B	C	D	E	Total transaction cost	Error (downside risk)
K=3	10.42264	39.90167	38.266194	0	0	7.97	0
K=2	0	35.10074	52.539585	0	0	10.18	0.606991
K=1	No feasible solution found, presumably (Solver deficiencies aside) because the transaction cost involved in moving from our current tracking portfolio to a new tracking portfolio involving just one stock exceeds the transaction cost limit imposed						