

### Markowitz CCEF example question

The table below shows stock prices for five stocks over a number of time periods.

Period	A	B	C	D	E
0	39.7	3.1	38.2	72.9	3.6
1	73.5	0.5	96.3	60.4	77
2	17.3	42.3	62.2	49.7	91.5
3	31.6	70.8	57.2	5.2	54.7
T=4	64.4	86.9	76.1	27.1	14.3

For example in period 3 the stock/share price for stock A is 31.6.

Plot:

- the unconstrained efficient frontier
  - the cardinality constrained efficient frontier for  $K=2$
- for these stocks.

## Markowitz CCEF example solution

A suitable spreadsheet is shown below

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Stock prices							Returns					
2	A	B	C	D	E	Period		A	B	C	D	E	Period
3	39.7	3.1	38.2	72.9	3.6	0		61.59	-182.45	92.46	-18.81	306.29	1
4	73.5	0.5	96.3	60.4	77	1		-144.66	443.79	-43.71	-19.50	17.25	2
5	17.3	42.3	62.2	49.7	91.5	2		60.25	51.51	-8.38	-225.73	-51.45	3
6	31.6	70.8	57.2	5.2	54.7	3		71.20	20.49	28.55	165.09	-134.16	T=4
7	64.4	86.9	76.1	27.1	14.3	T=4		12.09	83.33	17.23	-24.74	34.48	
8						Average							
9								Covariance COVAR (2dip)					
10	Weights w(i)							A	B	C	D	E	
11	A	B	C	D	E			8208.22	-18726.44	3178.13	253.23	512.54	A
12	0.00	0.00	0.00	1.00	0.00			-18726.44	51384.27	-10464.83	-1304.82	-16280.00	B
13	z(i)							3178.13	-10464.83	2539.47	1855.74	5447.61	C
14	1	0	0	1	0			253.23	-1304.82	1855.74	19123.99	-3305.02	D
15	Working							512.54	-16280.00	5447.61	-3305.02	27499.75	E
16	253.23	-1304.82	1855.74	19123.99	-3305.02								
17								CCEF					
18								Risk	Return	min	max	Risk	Return
19	sum z(i)	2						19123.99	-24.74	-24.74	83.33	19123.99	-24.74
20	sum w(i)	1						7082.73	-6.73			6878.69	-6.73
21	risk	19123.99						2705.97	11.29			1960.55	11.29
22	return	actual	desired	K				286.05	29.30			28.20	29.30
23		-24.74	-24.74	2				6203.45	47.31			3013.59	47.31
24								16637.37	65.32			16637.37	65.32
25	For an array formula:							51384.20	83.33			51384.27	83.33
26	highlight cells where the results will go												
27	type formula												
28	do ctrl-shift-enter												
29													
30													
31													
32													
33													
34													
35													
36													
37													
38													
39													
40													
41													
42													

**Solver Parameters**

Set Target Cell:

Equal To:  Max  Min  Value of:

By Changing Cells:

Subject to the Constraints:

\$A\$12:\$E\$12 <= \$A\$14:\$E\$14

\$A\$12:\$E\$12 <= 1

\$A\$14:\$E\$14 = binary

\$B\$19 = \$D\$23

\$B\$20 = 1

\$B\$23 = \$C\$23

The efficient frontier (more strictly the entire frontier, including both efficient and inefficient parts) is shown below for both the UEF and the CCEF.



