DSC5211C Quantitative Risk Management Session 7 Workshop

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1. Represent the problem analytically:

Objective Function:

Minimize expected cost Z – sum of V(s,i) profit in state s,i (dual – maximize the overall expected profit)

objfn.. z = e = sum((s,i),v(s,i))

Subject to:

S <= 1000 Kbbl Sp <= 200 Kbbl

U(i,s,sp) – decision_profit(i,s,sp) - profit on action (s to sp) in state of inventory, oil market - s,i

i – is the random component – state of oil market that we don't know

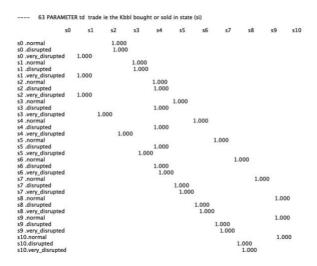
To calculate the state value:

stateValue(s0,normal,s1).. v(s0,normal) - 0.796*v(s1,normal) - 0.0995*v(s1,disrupted) - 0.0995*v(s1,very disrupted) = G= -4002; (LHS = 0)

2. Identify the optimal policy:

Optimal policy includes, if at SO, if the oil market is normal or disrupted, then move to S2 (buy 200 Kbbl). But if at SO, if the oil market is very disrupted, then move to S1 (buy 100 Kbbl).

Another part of the optimal policy, if at S5, the oil market is very disrupted, then move to S3 (sell 200 Kbbl). The rest of the policy can be interpreted from the screenshot (Solution Report of GAMS).



3. Compute the expected profit.

Expected profits are as below.

```
0 ---- 63 VARIABLE v.L present value of the profit in state (si)

normal disrupted very_disr~

so 635697.500 623778.455 613502.039

so 642326.841 631494.382 626002.039

so 648956.182 639210.309 638502.039

so 654973.581 646710.309 649509.493

so 660990.980 654210.309 660516.947

so 666377.609 661710.309 670420.389

so 6671764.238 669210.309 680323.831

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so 676478.567 676518.252 689458.328

so 681192.896 683826.196 698592.825

so 685192.896 690684.890 707134.424

so 689192.896 697543.584 715676.022
```

4. How would the optimal policy change if the discount factor was 90% and if there was no restriction on the maximum trading per month and if transition matrix changes?

Optimal Policy:

We can see that in any state (of market or inventory), the optimal policy is always to revert to SO – sell everything.

Expected Profit:

```
--- 63 VARIABLE v.L present value of the profit in state (si)

normal disrupted very_disr~

sl 4000.000 7500.000 12500.000
s2 8000.000 15000.000 25000.000
s3 12000.000 22500.000 37500.000
s4 16000.000 30000.000 50000.000
s5 20000.000 37500.000 62500.000
s6 24000.000 45000.000 75000.000
s7 28000.000 52500.000 87500.000
s8 32000.000 67500.000 112500.000
s9 36000.000 67500.000 125000.000
s10 40000.000 75000.000 125000.000
```

5. Which parameters are more important for the speculator success? Justify your answer.

The transition matrix doesn't change drastically from the previous case to this, so we attribute the lower values of expected profits to the drop in the discount factor.