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 S0, if the oil market is normal or disrupted, then move to S2 (buy 200 Kbbl). But if at S0, 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).

---- 63 PARAMETER td trade ie the Kbbl bought or sold in state (si)

	s0	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
s0 .normal			1.000								
s0 .disrupted			1.000								
s0 .very_disrupted	1.000										
s1 .normal				1.000							
s1 .disrupted				1.000							
s1 .very_disrupted	1.000										
s2 .normal					1.000						
s2 .disrupted					1.000						
s2 .very_disrupted	1.000										
s3 .normal						1.000					
s3 .disrupted					1.000						
s3 .very_disrupted		1.000									
s4 .normal							1.000				
s4 .disrupted					1.000						
s4 .very_disrupted			1.000								
s5 .normal								1.000			
s5 .disrupted					1.000						
s5 .very_disrupted				1.000							
s6 .normal									1.000		
s6 .disrupted					1.000						
s6 .very_disrupted					1.000						
s7 .normal										1.000	
s7 .disrupted						1.000					
s7 .very_disrupted						1.000					
s8 .normal											1.000
s8 .disrupted							1.000				
s8 .very_disrupted							1.000				
s9 .normal											1.000
s9 .disrupted								1.000			
s9 .very_disrupted								1.000			
s10.normal											1.000
s10.disrupted									1.000		
s10.very_disrupted									1.000		

3. **Compute the expected profit.**

Expected profits are as below.

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

	normal	disrupted	very_disr~
s0	635697.500	623778.455	613502.039
s1	642326.841	631494.382	626002.039
s2	648956.182	639210.309	638502.039
s3	654973.581	646710.309	649509.493
s4	660990.980	654210.309	660516.947
s5	666377.609	661710.309	670420.389
s6	671764.238	669210.309	680323.831
s7	676478.567	676518.252	689458.328
s8	681192.896	683826.196	698592.825
s9	685192.896	690684.890	707134.424
s10	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:

	s0
s0 .normal	1.000
s0 .disrupted	1.000
s0 .very_disrupted	1.000
s1 .normal	1.000
s1 .disrupted	1.000
s1 .very_disrupted	1.000
s2 .normal	1.000
s2 .disrupted	1.000
s2 .very_disrupted	1.000
s3 .normal	1.000
s3 .disrupted	1.000
s3 .very_disrupted	1.000
s4 .normal	1.000
s4 .disrupted	1.000
s4 .very_disrupted	1.000
s5 .normal	1.000
s5 .disrupted	1.000
s5 .very_disrupted	1.000
s6 .normal	1.000
s6 .disrupted	1.000
s6 .very_disrupted	1.000
s7 .normal	1.000
s7 .disrupted	1.000
s7 .very_disrupted	1.000
s8 .normal	1.000
s8 .disrupted	1.000
s8 .very_disrupted	1.000
s9 .normal	1.000
s9 .disrupted	1.000
s9 .very_disrupted	1.000

We can see that in any state (of market or inventory), the optimal policy is always to revert to S0 – sell everything.

Expected Profit:

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

          normal   disrupted  very_disr~

s1      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   60000.000  100000.000
s9     36000.000   67500.000  112500.000
s10    40000.000   75000.000  125000.000
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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.