Production Planning via Markov Decision Model

This Hypercard stack was prepared by:
Dennis L. Bricker,
Dept. of Industrial Engineering,
University of Iowa,
Iowa City, Iowa 52242
e-mail: dbricker@icaen.uiowa.edu

author

Production Planning Problem

Maximum inventory level = 3

Maximum batch size = 2

Demand Distribution

d	0	1	2
P{d}	0.2	0.5	0.3

States

i	states
1	Inventory= 0
2	Inventory= 1
3	Inventory= 2
4	Inventory= 3

Inventory Storage Costs

i	1	2	3
C[i]	2	3	4

Production Costs

x	1	2
C[x]	20	25

Shortage Costs

s	1	2
C[s]	40	60

Cost Matrix

k	actions	states 1	2	3	4
1	Produce 0	38	14	3	4
2	Produce 1	32	22	23	24
3	Produce 2	25	27	28	29

(Rows ~ actions, Columns ~ states)

States

i	states
1	Inventory= 0
2	Inventory= 1
3	Inventory= 2
4	Inventory= 3

Action: Produce 0

from \ to	1	2	3	4
1	1	0	0	0
2	0.8	0.2	0	0
3	0.3	0.5	0.2	0
4	0	0.3	0.5	0.2

Action: Produce 1

from \ to	1	2	3	4
1	0.8	0.2	0	0
2	0.3	0.5	0.2	0
3	0	0.3	0.5	0.2
4	0	0	0.3	0.7

i	states
1	Inventory= 0
2	Inventory= 1
3	Inventory= 2
4	Inventory= 3

Action: Produce 2

from \ to	1	2	3	4
1	0.3	0.5	0.2	0
2	0	0.3	0.5	0.2
3	0	0	0.3	0.7
4	0	0	0	1

Transition Probabilities

LP Tableau

i~state, k~action

k:	1	2	3	1	2	3	1	2	3	1	2	3	RHS
i:	1	1	1	2	2	2	3	3	3	4	4	4	
Min	38	32	25	14	22	27	3	23	28	4	24	29	
	0	0.2	0.7	-0.8	-0.3	0	-0.3	0	0	0	0	0	0
	0	-0.2	-0.5	0.8	0.5	0.7	-0.5	-0.3	0	-0.3	0	0	0
	0	0	-0.2	0	-0.2	-0.5	0.8	0.5	0.7	-0.5	-0.3	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1

Iteration 0

Policy: (Cost= 21.42)

State		Action		P{i}
1	Inventory= 0	3	Produce 2	0.18
2	Inventory= 1	2	Produce 1	0.42
3	Inventory= 2	2	Produce 1	0.32
4	Inventory= 3	1	Produce 0	0.08

Initial policy (basic feasible solution):
produce a quantity sufficient to replace any units which were removed from inventory

Iteration 1

Policy: (Cost= 19.1)

State		Action		P{i}
1	Inventory= 0	3	Produce 2	0.3
2	Inventory= 1	2	Produce 1	0.5
3	Inventory= 2	1	Produce 0	0.2
4	Inventory= 3	1	Produce 0	0

Iteration 2

Optimal Policy: (Cost= 16)

State		Action		P{i}
1	Inventory= 0	3	Produce 2	0.15
2	Inventory= 1	3	Produce 2	0.4
3	Inventory= 2	1	Produce 0	0.35
4	Inventory= 3	1	Produce 0	0.1

Optimal policy:
If inventory level is less than 2, produce a quantity sufficient to fill the inventory to its capacity