Machinery Maintenance MDP Example





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Problem Description

(Exercise 41, page 785, of Principles of O.R., by Harvey Wagner):

At the start of each day, an expensive piece of machinery is examined in order to determine whether it is in good working order, in need of minor maintenance, or requiring a major repair.

If the machinery is not in good working order, the company can utilize either of two maintenance-&-repair services:

- the We-Fix-It Service Company (charging \$14 & \$21 for minor & major repairs, respectively)
- the We-Try-To-Fix-It Service Company (charging \$12 & \$19 for minor & major repairs, respectively. The We-Fix-It company does better quality work, reflected in the probabilities that at the beginning of the next day, the equipment is in good working order.

We seek a policy which minimizes expected cost per day.

States

i	name
123	Good condition Minor faults Major faults

Actions

k	name
1	Do nothing
2	Fix-it
3	Try-to-fix-it

Cost Matrix

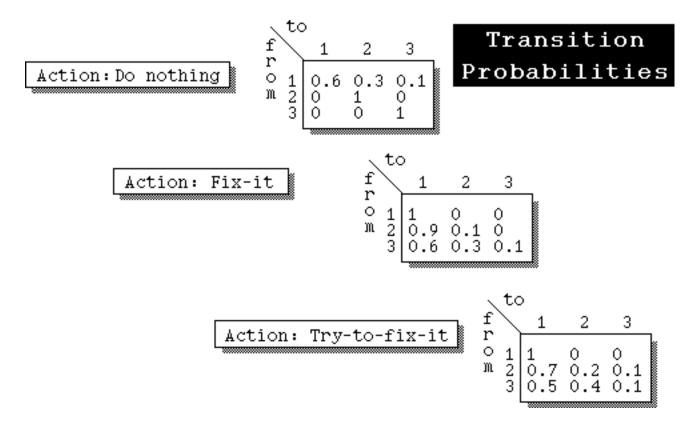
k	name	1	2	3
1	Do nothing	0	999	999
2	Fix-it	999	14	21
3	Try-to-fix-it	999	12	19

(Rows ~ actions, Columns ~ states)

A value of 999 above signals an infeasible action in a state.

States

i	name
123	Good condition Minor faults Major faults



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MDP Machine Maintenance 8/20/00 page 6

LP Tableau

Machinery Maintenance

k:	1	2	3	2	3	R
i:	1	2	2	3	3	н S
Min	0	14	12	21	19	
	0.4 -0.3	-0.9 0.9	-0.7 0.8	-0.6 -0.3	-0.5 -0.4	0
	1	1	1	1	1	1

Machinery Maintenance

Iteration 0

Policy: (Cost= 5.37273)

State	State Action			
1 Good condition	1 Do nothing	0.627273		
2 Minor faults	3 Try-to-fix-it	0.272727		
3 Major faults	2 Fix-it	0.1		

Iteration 0

k:	1	2	3	2	3	
i:	1	2	2	3	3	rhs
Min	0 1 0	-1.19091 -0.190909 1.09091 0.1	0	0	-0.909091 0.0909091 -0.0909091 1	-5.37273 0.627273 0.272727 0.1

Iteration 1

Policy: (Cost= 5.075)

State	Action	P{i}
1 Good condition	1 Do nothing	0.675
2 Minor faults	2 Fix-it	0.25
3 Major faults	2 Fix-it	0.075

MDP Machine Maintenance 8/20/00 page 10

Iteration 1

k:	1	2	3	2	3	
i:	1	2	2	3	3	rhs
Min	0 1 0	0 0 1 0	1.09167 0.175 0.916667 -0.0916667	0	-1.00833 0.075 -0.0833333 1.00833	-5.075 0.675 0.25 0.075

Iteration 2

Policy: (Cost= 5)

	State	Action	P{i}
1	Good condition	1 Do nothing	0.669421
2	Minor faults	2 Fix-it	0.256198
3	Major faults	3 Try-to-fix-it	0.0743802

MDP Machine Maintenance 8/20/00 page 12

Iteration 2

k:	1	2	3	2	3	
i:	1	2	2	3	3	rhs
Min	0 1 0 0	0 0 1 0	1 0.181818 0.909091 -0.0909091	1 -0.0743802 0.0826446 0.991736	0 0 0 1	-5 0.669421 0.256198 0.0743802

Optimal Policy

	State	Action
1	Good condition	1 Do nothing
2	Minor faults	2 Fix-it
3	Major faults	3 Try-to-fix-it