**The title of the project** : Markov Decision Process

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**Part 1**

Assume that the states represent whether the student car is dented i=0 or not i=1

|  |  |  |  |
| --- | --- | --- | --- |
| Decision | Action | State | Immediate cause |
| 1 | Park on the street in one space | 0 | C01 = 0 |
| 2 | Park on the street in two spaces | 0 | C02 = 4.5 |
| 3 | Park in lot | 0 | C03 = 5 |
| 4 | Have it Repaired | 1 | C04= 50 |
| 5 | Drive Dented | 1 | C05 = 9 |

**Transition probability:**

Px n-1, xn = P{ x( tn) = xn / x (tn-1) = xn

p11 p12……… p1m

P = p21 p22……… p2m

Pm1 pm2……… pmm

The transition probabilities can be arranged in a matrix form and such a matrix is called as one step transition matrix

Element in non- negative and sum of elements of each row is unity

m∑j =1 Pij = 1j

i = 1,2,……….m and 0 < Pij < 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| i | Di(R1) | Di(R2) | Di(R3) | Di(R4) | Di(R5) |
| 0 | 1 | 1 | 2 | 2 | 3 |
| 1 | 4 | 5 | 4 | 5 | - |

Policy Transition matrix expected average cost

R1 -

R2 -

R3 -

R4 -

R5 -

The steady state conditions in a regular ergodic Markov chain can be accomplished most readily by computing Pn  for larger values of n

Consider the following table representing average cost of the four policies.

|  |  |  |  |
| --- | --- | --- | --- |
| Policy | Π0 | Π1 | Average cost |
| R1 | 0.909 | 0.091 | 4.55 |
| R2 | 0 | 1 | 9 |
| R3 | 0.98 | 0.02 | 5.41 |
| R4 | 0 | 1 | 9 |
| R5 | 1 | 0 | 5(if initially not dented) |

The policy R1  has the maximum cost, so it is optimal to park on the street in one space of not dented and to have it repaired if dented.

**Part II**

**Formulating a linear programming model for**

Minimizing the equation:

Z = 0 Y01 + 4.5 Y02 + 5 Y03 + 50 Y14 + 9Y15

With subject to,

Y01 + Y02 + Y03 + Y14 + Y15 = 1

Y01 + Y02 + Y03 –(Y14) = 0

Y14 + Y15 – (1/10 Y01 + 1/50 Y02 ) = 0

Yik >= 0 for i = 0,1 k = 1,2,3,4,5

**Part III.**

Number of states = 2

Number of decisions = 5

Cost matrix (Cik) = 0 4.5 5 - -

* - - 50 9

Transition matrix P[ij] [1] : 0.9 0.1

1. 0

0.98 0.02

P[ij][2] : 0 0

P[ij][3] : 1 0

0 0

P[ij][4] : 0 0

0 1

P[ij][5] : 0 0

1. 1

g(R1) = 4.545

V0(R1) = -45.5

V1(R1) = 0

**Policy improvement:**

**State 0:**

0 + 0.9 (- 45.5) + 0.1 (0) - (- 45.5) = 4.545

4.5 + 0.98 (- 45.5 ) + 0.02 (0) - (-45.5 ) = 5.409

5 + 1(- 45.5) + 0 (0) - (- 45.5) = 5

(-) + 0 (- 45.5) + 0 (0) - (- 45.5) = --

(-) + 0 (- 45.5) + 0 (0) - (- 45.5) =--

**State 1:**

(-) + 0 (- 45.5) + 0 (0) - (0) = (-)

(-) + 0 (- 45.5) + 0 (0) - (0) = (-)

(-) + 0 (- 45.5) + 0 (0) - (0) = (-)

50 + 1 (- 45.5) + 0 (0) - (0) = 4.545

9 + 0 (- 45.5) + 1 (0) - (0) = 9

**Optimal policy:**

D0(R2) = 1

V0(R1) = -45.5

D1(R2) = 4

V1(R1) =0

g(R1) = 4.545