Applied Mathematics Home Work 3

Emre Ozan Alkan

November 6, 2013

1 Problem 1

For the first day, we have 750 people purchased newspaper and 250 people did not. I constructed v vector for day zero as

$$v_0 = \begin{pmatrix} 750 \\ 250 \end{pmatrix}$$

My Markov matrix, where each column's sum is 1, is created with the given values

$$M = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}$$

1.1 If a person purchased a paper today, how likely is he to purchase a paper on Day 2? Day 3? Day n?

Calculating probability of one person, we should change our v vector as;

$$v_0 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

to represent one person. For calculating, we need to use our Markov Matrix. Then the calculations for Day 2 , Day 3 and Day n is respectively;

$$Day\ 2, v_2 = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix} \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \%55\ likehood\ to\ buy$$

$$Day\ 3, v_3 = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix} \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix} \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \%47.5\ likehood\ to\ buy$$

$$Day\ n, v_n = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}^n \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

1.2 What sales figures can The Computer Visionist expect on Day 2? Day 3? Day n?

To calculate sales figures for whole people, we should consider our v vector in Day zero as;

$$v_0 = \begin{pmatrix} 750 \\ 250 \end{pmatrix}$$

$$Day\ 2, v_2 = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}^2 \begin{pmatrix} 750 \\ 250 \end{pmatrix} = \begin{pmatrix} 487.5 \\ 512.5 \end{pmatrix} = 487.5\ sales$$

$$Day\ 3, v_3 = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}^3 \begin{pmatrix} 750 \\ 250 \end{pmatrix} = \begin{pmatrix} 443.75 \\ 556.25 \end{pmatrix} = 443.75\ sales$$

$$Day\ n, v_{3n} = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}^n \begin{pmatrix} 750 \\ 250 \end{pmatrix}$$

1.3 Will the sales figures fluctuate a great deal from day to day, or are they likely to become stable eventually ?

Here is our Markov Matrix:

$$M = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}$$

For n = 1 to infinity, M^n goes to be stable.

$$M^1 = \begin{bmatrix} 0.7 & 0.2 \\ 0.3 & 0.8 \end{bmatrix}$$

$$M^2 = \begin{bmatrix} 0.55 & 0.3 \\ 0.45 & 0.7 \end{bmatrix}$$

$$\cdots$$

$$M^{10} = \begin{bmatrix} 0.4006 & 0.3996 \\ 0.5994 & 0.6004 \end{bmatrix}$$

$$\cdots$$

$$M^{14} = \begin{bmatrix} 0.4 & 0.4 \\ 0.6 & 0.6 \end{bmatrix}$$

$$\cdots$$

$$M^{20} = \begin{bmatrix} 0.4 & 0.4 \\ 0.6 & 0.6 \end{bmatrix}$$

$$\ldots$$

After 14th day, sales figure become stable.

2 Problem 2

2.1 Summary of the ranking method

2.2 How eigenvalue problem solved

2.3 5x5 Markov matrix, algorithm application

2.4 Matlab Function

2.5 Comments