CSE 6740: Computational Data Analysis
Assignment #4

Due on Tuesday, December 3, 2019

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Q4 – Programming

To solve this problem, we can implement the forward-backward approach. At first, let's define,

$$\alpha_i(t) = P(O_1, \dots, O_t, S_t = i|\theta) \quad \text{and} \quad \beta_i(t) = P(O_{t+1}, \dots, O_T|S_t = i; \theta).$$

With this definition, we can write,

$$\alpha_i(1) = \pi_i b_i(O_1), \quad \alpha_i(t+1) = b_i(O_{t+1}) \sum_{j=1}^{N} \alpha_j(t) a_{ij}$$

and,

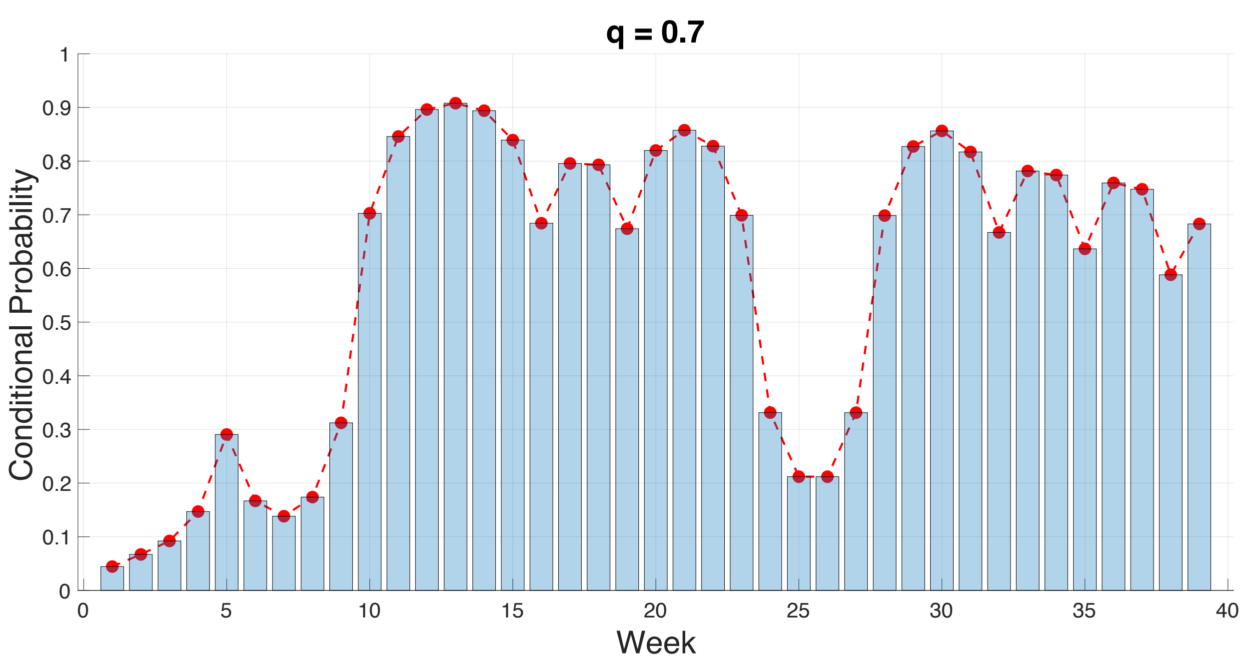
$$\beta_i(T) = 1, \quad \beta_i(t) = \sum_{j=1}^{N} \beta_j(t+1) a_{ij} b_j(O_{t+1})$$

$$\gamma_i(t) = P(S_t = i|O, \theta) = \frac{\alpha_i(t)\beta_i(t)}{\sum_{j=1}^{N} \alpha_j(t)\beta_j(t)}$$

In addition to implementing this approach in algorithm.m function, to make it easier to execute, I created a new m-file main.m which directly runs all the required parts of this question.

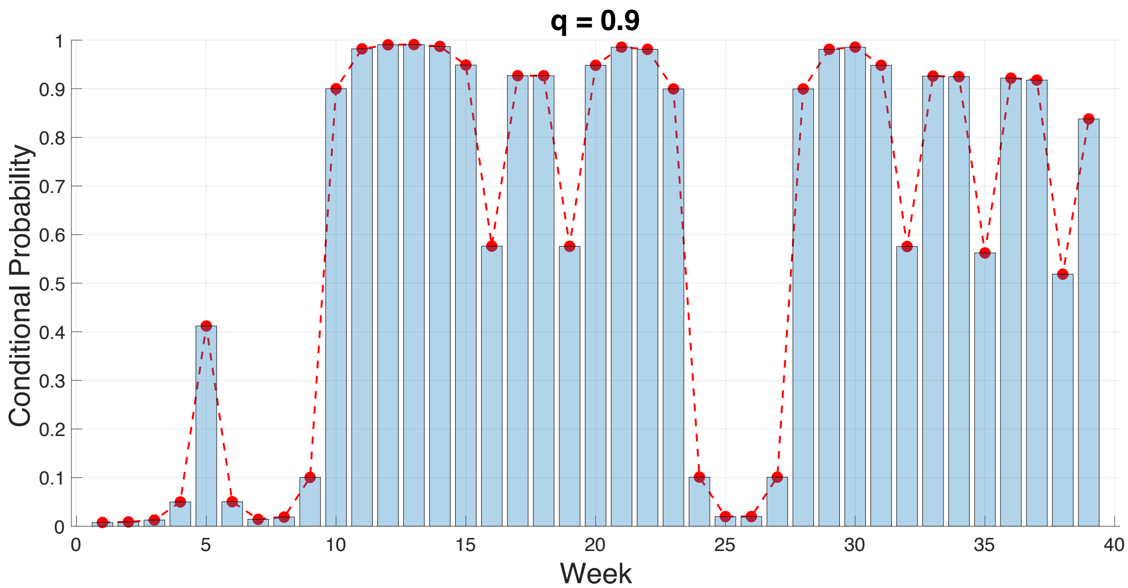
Part (a)

The following graph illustrates $P_{(X_t|Y)}(x_t = \text{good}|y)$, and the probability that the economy is in a good state in the week of week 39 is equal to $\boxed{0.6830}$.



Part (b)

The following graph illustrates $P_{(X_t|Y)}(x_t = \text{good}|y)$, and the probability that the economy is in a good state in the week of week 39 is equal to $\boxed{0.8379}$.



By increasing q (for instance, here, from 0.7 to 0.9) the condition probability of good economy shows more volatility. That implies increasing in more increase in price given a good economy state or more decrease given a bad economy state. This happens because by increasing q, the correlation between stock price and the economy state increases.