Exercise 3 Bazaar

You are going to create a very simple model of a bazaar. That is a market place for trade in various goods. A trader is tasked to sell x units of shoes every day. Let us assume that this trader has no information on demand or competition. All the agent can do is set a sale price and wait. If at the end of the day it has sold too much, it will raise the price tomorrow. If it has sold too little, it will lower the price. The seller has a daily target of X sales and wants to attract exactly X customers a day. The seller has no power over customers themselves and so it needs to manipulate another variable (sale price) to affect the number of customers attracted. Initially the seller doesn't know what the relationship between sale price and customers attracted is and so proceeds by trial and error. The sales price proposed per pair of shoes is the seller's policy. Since price is the only mechanism that can enable him to enable sales or not. We are considering a non-fixed policy problem.

A. Let us first assume a fixed demand curve of $q=X-5p$ where p is the price asked.
B. Then let us assume a stochastic production and sales curve using the random variable $r \epsilon [0.4, 0.6]$ and r is evenly distributed. This suggests that both demand and supply can deviate up to +/-20%.
C. Our trader is exposed to the competition of a second trader who applies the same models as himself. The demand curve is fixed as in A. How does this competition influence the business of our own trader?

For A- C try to develop a simple decision support system in Python based on 3 different approaches.

1. Assume a genuine zero-intelligence trader that picks a price, $p \epsilon [0,100]$. How long time does the trader need to get rid of his shoe inventory? What is the aggregated cash flow? Can the model used help to determine the actual demand curve?
2. Introduce a PID controller to support instead of the ZI agent. Use the following default parameters:
    a. The proportional coefficient Kp = 0.01, Ki = 0.15, and 0 for the derivative part, Kd=0.0
    b. Change the defaults if needed

    How long does it take for him to sell the shoes with this system? What is the aggregated cash flow this time? Can the model used help to determine the actual demand curve?
3. Introduce some learning here. Use an Evre/Roth model to determine the best price as soon as possible. How long does it take to get rid of the shoes and what is the cash flow? Can the model used help to determine the actual demand curve?

Will the there be a Nash equilibrium in all the cases tested?

For the actual purpose assume X = 100, but play around with different values to determine the behavior of 1-3 above.