Course > Week 6 > Stochastic processes in the real world > Problem (3-4)

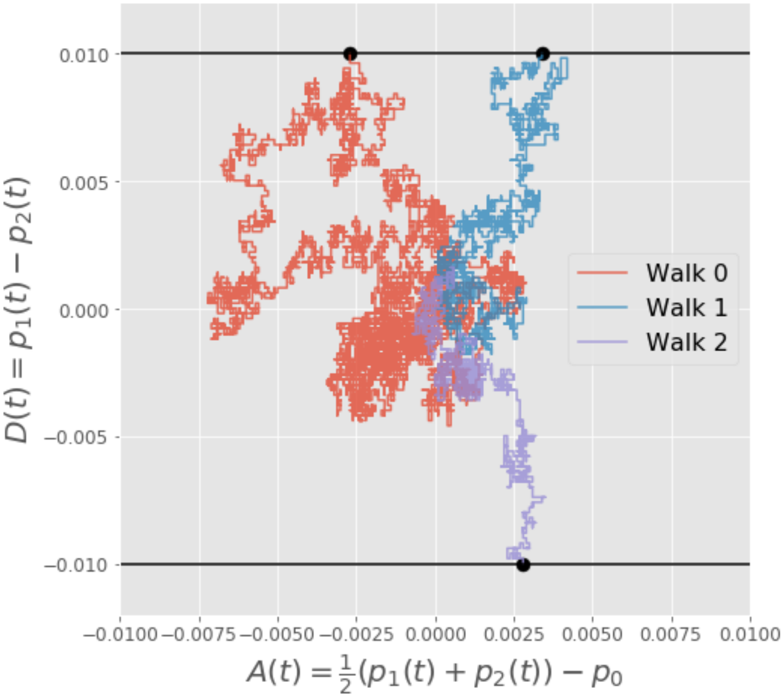
Problem (3-4)

Problem 3

0.0/1.0 point (graded)

In the video, we introduced a Stochastic dealer model in which two agents, 1 and 2 are trading stock with each other. We described this as a Stochastic system, in which the mid-price of each dealer $p_i\,(t)$ $(i = 1, 2)$ is evolving in time following a one-dimensional random walk. The moment when the absolute value of the price difference $D\,(t) = p_1\,(t) - p_2\,(t)$ is larger than some given value $|D\,(t)| \geq L$ (which we called the spread L), we assumed a transaction takes place, in which dealer 1 buys or sells from dealer 2. The price of this transaction defines the market-price P, and it is given by the average price $A\,(t) = \frac{1}{2}(p_1\,(t) + p_2\,(t))$.

We showed how this dealer model, which consists of two 1D random walks, could be recast as a 2D random walk (in $D\,(t)$ vs $A\,(t)$ space) with absorbing boundary conditions (to describe the transaction criterion that determines when the random walk ends and a transaction takes place). We performed three sample simulations for a single trade, using a spread $L = 0.01$ and obtained the following random walks.



Taking into account the fact that the initial condition was $p_1\,(0) = p_2\,(0) = p_0 = 100.25$, who was the buyer in each of the three random walks shown here, and at what price did he or she buy?

- (Walk 0) Dealer 1 buys at $P \simeq 0.01$, (Walk 1) Dealer 1 buys at $P \simeq 0.01$, and (Walk 2) Dealer 2 buys at $P \simeq 0.01$
- (Walk 0) Dealer 1 buys at $P \simeq 0.003$, (Walk 1) Dealer 1 buys at $P \simeq 0.003$, and (Walk 2) Dealer 2 buys at $P \simeq 0.003$
- (Walk 0) Dealer 1 buys at $P \simeq 100.247$, (Walk 1) Dealer 1 buys at $P \simeq 100.253$, and (Walk 2) Dealer 2 buys at $P \simeq 100.253$
- (Walk 0) Dealer 1 buys at $P \simeq 100.253$, (Walk 1) Dealer 1 buys at $P \simeq 100.247$, and (Walk 2) Dealer 2 buys at $P \simeq 100.247$
- (Walk 0) Dealer 2 buys at $P \simeq 0.01$, (Walk 1) Dealer 2 buys at $P \simeq 0.01$, and (Walk 2) Dealer 1 buys at $P \simeq 0.01$
- (Walk 0) Dealer 2 buys at $P \simeq 0.003$, (Walk 1) Dealer 2 buys at $P \simeq 0.003$, and (Walk 2) Dealer 1 buys at $P \simeq 0.003$
- (Walk 0) Dealer 2 buys at $P \simeq 100.247$, (Walk 1) Dealer 2 buys at $P \simeq 100.253$, and (Walk 2) Dealer 1 buys at $P \simeq 100.253$
- (Walk 0) Dealer 2 buys at $P \simeq 100.253$, (Walk 1) Dealer 2 buys at $P \simeq 100.247$, and (Walk 2) Dealer 1 buys at $P \simeq 100.247$

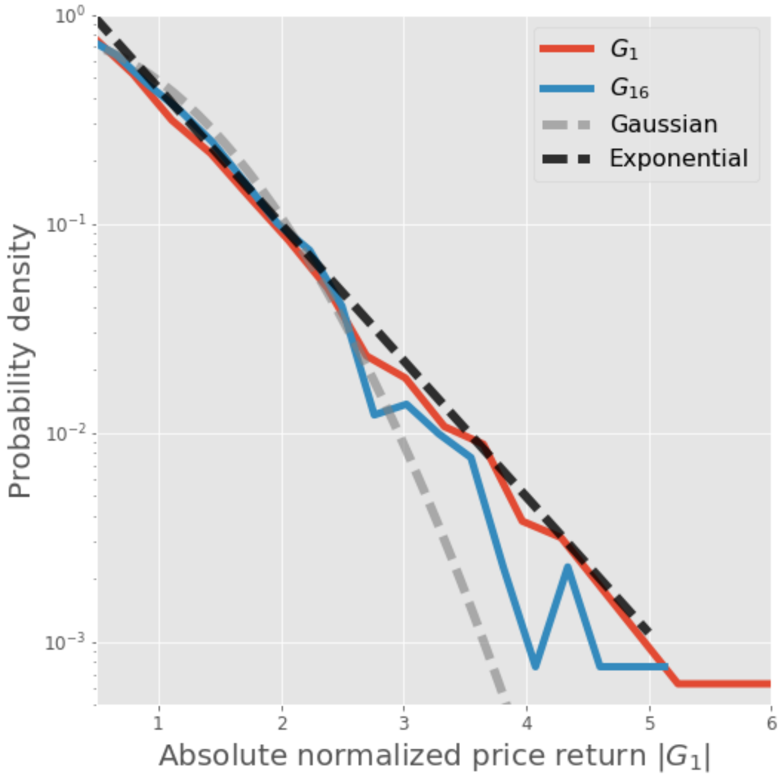
Submit You have used 0 of 2 attempts

Problem 4

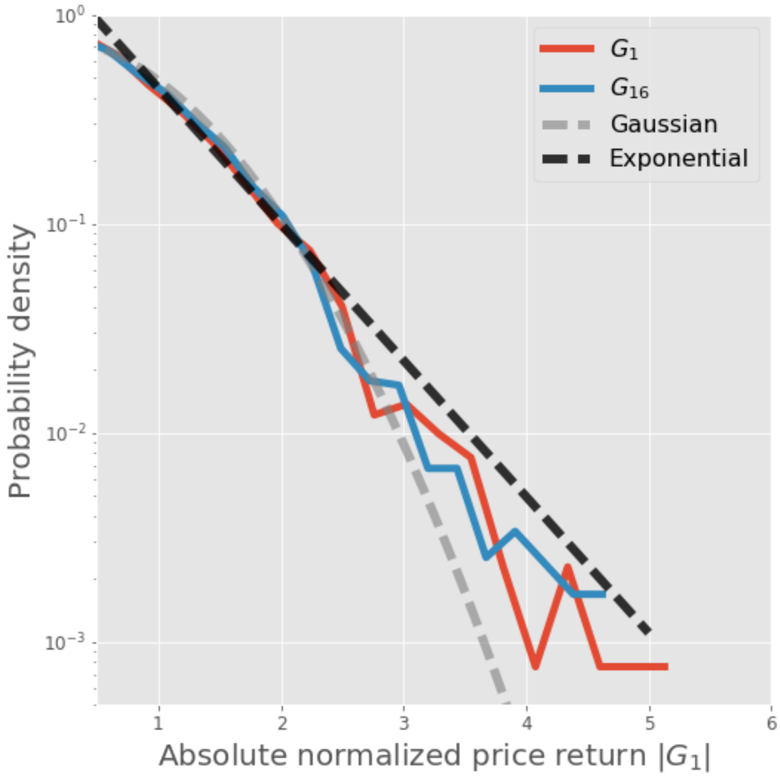
0.0/1.0 point (graded)

Using the simple stochastic dealer model, we obtained the time series data for the stock price P_n (where n is the tick time, which increases by one at each transaction), by simulating over many transactions (random walks). Using this time series data, we computed the logarithmic return G_τ and saw that its distribution followed an exponential decay (at least for $\tau = 1$). To see how this distribution depends on τ, use the code example and data (model1.txt) introduced in the video to calculate the probability distribution function of the absolute normalized price return $|G_\tau|$ for $\tau = 1$ and $\tau = 16$. Use a semi-log plot to visualize the distributions. As a guide to the eye, you should also plot the exponential and Gaussian distributions. Which of the following graphs is the closest to what you obtained (When generating the histogram, use $n = 20$ bins for comparison)?

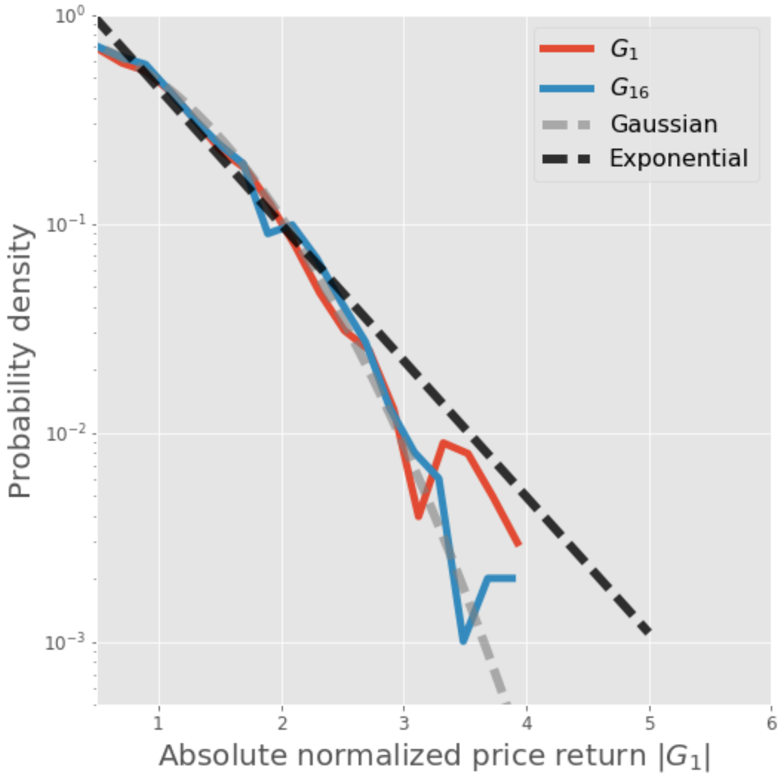
G21



G22

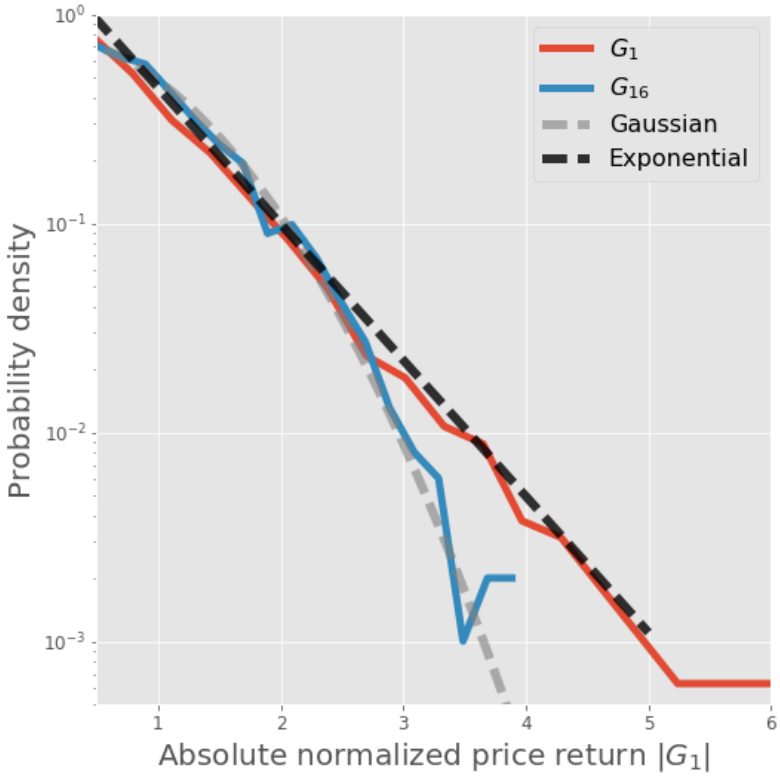


G23



G_1
G_{16}
Gaussian
Exponential
Probability density
Absolute normalized price return $|G_1|$

G24



G_1
G_{16}
Gaussian
Exponential
Probability density
Absolute normalized price return $|G_1|$

- G21
- G22
- G23
- G24

Submit

You have used 0 of 2 attempts