Farmer Brown Hires a Hedging Consultant

You no doubt have experienced sleepness nights worrying about droughts and tweets causing disruptions to your fairy-tale corn farmer existence. Well, Farmer Brown awoke from her nightmare to realize that the drought had not happened, and Donald Trump had instead chosen hydroxychloroquine as his COVID remedy of choice. Nevertheless, she realized she would need to be smarter in choosing a hedging strategy. Therefore, she has asked you to simulate hedging outcomes and design a suitable strategy for her.

To begin, let's assume the current spot price of corn is $4 in both Chicago and Kansas City. Corn prices are assumed to follow an arithmetic random walk. Here are the parameters of the stochastic processes of the two prices:

	Chicago - CME	Kansas City - KCBOT
Long run mean	4.00	4.50
Monthly volatility	0.80	0.90
Monthly speed of mean reversion	0.10	0.15
Probability of a jump in price	20%	20%
Size of jump	2.00	2.00
Correlation		0.85

It is currently Feb 1, and we are preparing for a July 1 harvest/sale date. Corn futures contracts are for 5000 bu each. The corn will be sold at the spot price on July 1.

The futures price of corn is determined by taking its expected value in July as a function of the spot price and stochastic process parameters. (You may ignore the jump for this calculation, but the futures price should go up when the spot price jumps up.)

The quantity of corn produced can be assumed to be a random number determined by the minimum of either 1,000,000 or a random number with mean 1,000,000 and standard deviation 300,000 bu, reflecting the risk of weather-related performance. The amount of corn is assumed unknown until the harvest date.

QUESTIONS

1. Assume we have a static strategy where we take a single futures position. Simulate, graph and explain the probability distribution of the possible margin requirements per futures contract.
2. Determine the optimal number of contracts she should use to hedge, assuming her objective is to minimize the standard deviation of the total profit/loss as of the harvest date.
3. Repeat (1) and (2) assuming she hedges with the KCBOT futures but sells the corn in Chicago.
4. Prepare a 1-2 page writeup with graphs and texts, making any recommendations to her that you think appropriate.