

## AGEC 643

### Options Exercise 2

You will partially re-produce the results of Du and Hennessey (2010) for the year 2002. Use the monthly new-crop futures price data for 2002 provided on the class website.

Specific steps:

1. Retrieve the data from the class website. There are time series of month-ending Nov. 2002 soybean futures prices and month-ending Dec. 2002 corn futures. These specific delivery months are considered the standard “new-crop” delivery months for these commodities. Note for purposes of your calculations later that futures delivery price data are provided in cents/bu. Data arriving in varying units is a fact of life that you must accept.
2. Calculate returns from the futures prices. Consider the last observation as the price at time  $T_0$  for each commodity for delivery at harvest time.
3. Calculate the annualized standard deviations of the returns for each series. Recall that the observation frequency is monthly.
4. Calculate the correlation between returns for the two series
5. Jointly simulate (i.e., account for returns correlation) planting time (denoted  $T_1$  in the paper) futures prices. Assume that the difference (in years) between contract signing time ( $T_0$ ) and planting time ( $T_1$ ) is exactly 9/12. Do not simulate the nitrogen price or the basis. Note that holding a futures contract does not involve a convenience yield, or any other stream of benefits. Holding a futures contract is also costless (we are abstracting from margin deposits here). The expected return to a futures position is zero. The appropriate stochastic process for futures contracts is therefore

$$dF = \sigma F dz$$

and the discrete time stochastic process for futures returns is

$$\ln F_{t+1} - \ln F_t = -0.5\sigma^2\Delta t + \sigma\varepsilon(\Delta t)^{0.5}$$

where  $\varepsilon$  is a standard normal draw as usual.

6. Assume production costs are deterministic. Use the 2002 values for production costs for each commodity from the paper (Table 3). Nitrogen is included in these costs. Do not try to include nitrogen separately.
7. Assume that yields are deterministic. Assume that the corn yield is 130 bu./acre and the soybean yield is 55 bu./acre.
8. Calculate the theoretical rental rate (the value of the planting option at time  $T_0$ ) assuming that the most profitable crop as of  $T_1$  will be planted (ignore basis). When calculating the profits for planting each crop, remember the units issues from step 1. Assume that the risk-free interest rate is 2.0% per annum in your calculations. Use 1,000 draws in your simulation.