46-893: Operations and Supply Chain Analytics

(Group) Assignment #4: Energy Price Risk

Due by: April 23, 5:00PM

Note: You need to **show your work** to receive credit. Excel is not acceptable as your only work (but it can be submitted as supporting material). That is, you need to submit a **stand-alone document** with **detailed explanations** of how you arrived at your answers. **Submit** this document through **Canvas**.

Questions

1. (40 points) You are an originator at a merchant energy trading company. It is August 13, 2015. You are evaluating a potential deal that would allow you to purchase between 10,000 MMBtu and 30,000 MMBtu of natural gas per month at Henry Hub, Louisiana, for a unit price of $2.50 for the next 24 months, starting on September 1, 2015. The choice of how much to purchase per month (between these limits) is at your discretion. However, you must purchase at least 150,000 MMBtu and no more than 450,000 MMBtu of natural gas during the contract term. You ask a structurer to obtain the NPV of this proposed contract. The structurer uses a constant risk-free rate equal to 1% per year with continuous compounding normalizing the length of one year to 1, so that the current value of $1 received 15 days from now is exp(-0.01*15/365)*$1, and the Henry Hub natural gas futures price curve available on Canvas.

    1. (25 points) Formulate a linear program to optimize the purchase contract NPV.

    2. (15 points) What is the optimal NPV of this contract?

2. (50 points) Your originator job is keeping you busy. In addition to the purchase contract analyzed in the previous question, you are also negotiating a natural gas storage contract with 24-month term, starting on September 1, 2015. The current date is August 13, 2015. This contract pertains to the Jefferson Island storage facility, located at Henry Hub, Louisiana, and would allow you to inject up to 300,000 MMBtu of natural gas per month, withdraw up to 600,000 MMBtu of natural gas per month, and hold up to 1,000,000 MMBtu of natural gas inventory at any point in time. The storage contract entails an initial inventory of 100,000 MMBtu, which you are free to manage at your discretion. The marginal injection cost is $0.02 per MMBtu and the marginal withdrawal cost is $0.01 per MMBtu. You

approach the same structurer who handled the valuation of the purchase contract to also obtain the NPV of this storage contract. The structurer continues to use a constant risk-free rate of 1% per year with continuous compounding and the Henry Hub natural gas futures price curve available on Canvas. Note that you can no longer purchase for a unit price of $2.50; purchase/sell has to be through futures contracts.

1. (30 points) Formulate a linear program to optimize the storage contract NPV.

2. (10 points) What is the optimal NPV of this contract?

3. (10 points) What are the operating, and trading policies (using Forward sell and Forward buy) for this contract that perfectly hedge this NPV.