Industrial & Systems Engineering Seminar

Wednesday, September 15, 2010

3:15 PM – Refreshments before the seminar
3:30 PM – Graduate Seminar
Room 4125 A & B Mechanical Engineering

An Approximate Dynamic Programming Approach to Benchmark Practice-Based Heuristics for Natural Gas Storage Valuation[1]

by

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The valuation of the real option to store natural gas is a practically important problem that entails dynamic optimization of inventory trading decisions with capacity constraints in the face of uncertain natural gas price dynamics. Stochastic dynamic programming is a natural approach to this valuation problem, but it does not seem to be widely used in practice because it is at odds with the high-dimensional natural gas price evolution models that are widespread among traders. According to the practice-based literature, practitioners typically value natural gas storage heuristically. The effectiveness of the heuristics discussed in this literature is currently unknown because good upper bounds on the value of storage are not available.

We develop a novel and tractable approximate dynamic programming method that, coupled with Monte Carlo simulation, computes lower and upper bounds on the value of storage, which we use to benchmark these heuristics on a set of realistic instances. We find that these heuristics are extremely fast to execute but significantly suboptimal compared to our upper bound, which appears to be fairly tight and much tighter than a simpler perfect information upper bound; computing our lower bound takes more time than using these heuristics, but our lower bound substantially outperforms them in terms of valuation.

Moreover, with periodic reoptimizations embedded in Monte Carlo simulation, the practice-based heuristics become nearly optimal, with one exception, at the expense of higher computational effort. Our lower bound with reoptimization is also nearly optimal, but exhibits a higher computational requirement than these heuristics. Besides natural gas storage, our results are potentially relevant for the valuation of the real option to store other commodities, such as metals, oil, and petroleum products.

BIO: Nicola Secomandi is an Associate Professor of Operations Management at the Tepper School of Business of the Carnegie Mellon University. His research interests include real options and financial engineering in commodity and energy industries, revenue management, and supply chain management. His research has been published in Interfaces, Management Science, Manufacturing & Service Operations Management, and Operations Research

FOR MORE INFORMATION ON DR. SECOMANDI'S RESEARCH, please visit:
http://public.tepper.cmu.edu/facultydirectory/FacultyDirectoryProfile.aspx?ID=207

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[1] *with Guoming Lai and François Margot, published in OPERATIONS RESEARCH, Vol. 58, No. 3, May–June 2010, pp. 564–582*