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CAC and Jon Conrad

Oil Drilling in the Wilderness: At What Cost?

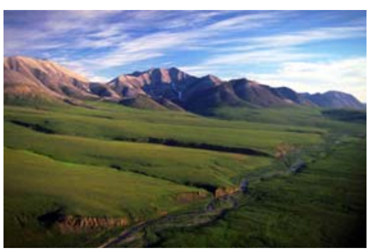
At what trigger price per barrel of foreign oil would drilling in a highly valued wilderness be economically viable?

Find the Answer

Jon Conrad, Professor, Department of Applied Economics and Management, leveraged CAC's expertise in code optimization, C# and Web services to reduce calculation time from 5 days to less than 1 minute.

Oil Drilling in the Wilderness

Exploring for the oil that may lie beneath the Artic National Wildlife Refuge (ANWR) has sparked a heated debate between those wishing to preserve pristine artic wilderness and those seeking to reduce the reliance of the United States on imported, crude oil.



ANWR's pristine beauty is competing with the growing demand for oil

An undisturbed ANWR is an important value to many individuals and development and delivery of any oil beneath ANWR will be costly and risky. Conrad examined the decision whether to drill within a real-option framework, a good choice for evaluating investments that are difficult or very costly to reverse.

Improved Research

Research Metrics

- Optimize: Optimize and parallelize the code and implement it as a Web service call
- Speed: Decrease compute time from days to 1 minute or less on CAC clusters

Research Challenge

Conrad's and Koji Kotani's (a PhD candidate) challenge in creating a real-option decision-making framework was encompassing multiple technical parameters such as the cost of field development, production costs, the cost to deliver oil to west-coast refineries, and the "amenity value" for developing ANWR. Conrad's model assumes that if ANWR is developed, it will be almost impossible to restore the land to wilderness; therefore, what society will irrevocably lose is called a wilderness "amenity value."

The mathematical model takes into account that the price of oil may be evolving according to geometric Brownian motion (GBM) or a mean-reverting (M-R) process. It varies the amenity dividend from $200 million to $300 million per year and then computes the price of oil that would trigger oil production. Implemented in MATLAB, the model took 5 days to run on a desktop.

Solution

CAC first hand optimized the MATLAB code to get run time down to 5 minutes on a dual Xeon system. By then converting the algorithm to C++, the calculation was reduced to 8 minutes. The code was then converted to C#, parallelized, and implemented as a Web service call, which reduced the calculation to 4 minutes, 30 seconds. When ported to a HPC cluster, the run took 30 – 40 seconds. CAC was able to reduce the calculation time from five days to less than a minute.

The user interface for the application is Excel. CAC implemented a Web services solution that can be called within Excel using Visual Studio .NET. The results of the Web service calls are returned to the client to populate cells on the spreadsheet. Once all the calculations are complete, the results are charted versus the amenity value.

The Client

Jon Conrad, Professor, Department of Applied Economics and Management, Cornell University

- Research on the application of dynamic optimization to resource management
- Teaches Resource Economics and Quantitative Methods II

The Collaborative Relationship

Conrad and Kotani worked with senior consultants at CAC who parallelized and optimized their codes and leveraged Web services technologies for an efficient and easy way to use option computation.

“The decision to allow exploration and production of the oil suspected to lie beneath Area 1002 in ANWR has been a contentious issue since 1998. If oil reserves are developed, it may be impossible to restore the area to arctic wilderness. For many people, oil development would result in the permanent loss of an amenity value. The models we have developed assume that this amenity value, or wilderness dividend, ranges from $200 to $300 million per year. Our research applied real option theory to determine the price of crude oil that would justify the investment in field development and the loss of wilderness amenity value.”

Jon Conrad
Professor, Department of Applied Economics and Management
Cornell University