

## Procurement Assignment Part 1: Supply Contract Homework

A recent trend for many industrial manufacturers has been outsourcing; firms are considering outsourcing everything from production and manufacturing to the procurement function itself. Indeed, in the mid 90s, there was a significant increase in purchasing volume as a percentage of the firm's total sales. More recently, between 1998 and 2000, outsourcing in the electronic industry has increased from 15 percent of all components to 40 percent.

Of course, the increase in the level of outsourcing implies that the procurement function becomes critical for a manufacturer to remain in control of its destiny. Thus, an effective procurement strategy has to focus on both driving costs down and reducing risks. These risks include both *inventory* and *financial* risks. By inventory risks we refer to inventory shortages while financial risks refers to the purchasing price which is uncertain if the procurement strategy depends on spot markets.

A traditional procurement strategy that eliminates financial risk is the use of fixed commitment contracts. These contracts specify a fixed amount of supply to be delivered at some point in the future; the supplier and the manufacturer agree on both the price and the quantity delivered to the manufacturer. Thus, in this case, the manufacturer bears no financial risk while taking huge inventory risks due to uncertainty in demand and the inability to adjust order quantities.

One way to reduce inventory risk is through option contracts, in which the buyer pre-pays a relatively small fraction of the product price up-front, in return for a commitment from the supplier to reserve capacity up to a certain level. The initial payment is typically referred to as reservation price or premium. If the buyer does not exercise the option, the initial payment is lost. The buyer can purchase any amount of supply up to the option level, by paying an additional price, agreed to at the time the contract is signed, for each unit purchased. This additional price is referred to as execution price or exercise price. Of course, the total price (reservation plus execution price) paid by the manufacturer for each purchased unit is typically higher than the unit price in a fixed commitment contract.

Evidently, option contracts provide the manufacturer with flexibility to adjust order quantities depending on realized demand and hence these contracts reduce inventory risk. Thus, these contracts shift risks from the manufacturer to the supplier since the supplier is now exposed to customer demand uncertainty. This is in contrast to fixed commitment contracts in which the manufacturer takes all the risk.

Our objective in this question is to develop models and techniques to optimize procurement decisions. Thus, consider a single manufacturer and a single supplier. Six months before demand is realized the manufacturer has to sign a supply contract with the supplier.

The sequence of events is as follows. Procurement contracts are signed in February and demand is realized during a short period of ten weeks that starts in August. Components are delivered from the supplier to the manufacturer at the beginning of August and the manufacturer produces items to customer orders. Thus, we can ignore any inventory holding cost. We will assume that unsold items at the end of the ten week selling period have zero value. The objective is to identify a procurement strategy so as to maximize expected profit.

Specifically, consider a manufacturer that needs to find supply sources for electricity. The manufacturer produces and sells products to end customers at a unit price, \$15, and we assume that the only contributor to the production cost is the cost of electricity. To simplify the example we assume that a unit of electricity is required to produce a unit of finished good. The manufacturer thus has information on the distribution of the demand for electricity. More precisely, she knows that demand for electricity follows the probabilistic forecast described in Table 1.

Two power companies are available for supply:

- Company 1 offers a fixed commitment contract with the following conditions: power is bought in advance at a price \$11 per unit.
- Company 2 offers an option contract with reservation price of \$3 per unit paid in advance and then \$9 per unit paid for each unit delivered.

What is the procurement strategy that should be used by the manufacturer?

Table 1: Demand Forecast

Demand	Probability
800	11%
1000	11%
1200	28%
1400	22%
1600	18%
1800	10%