

## Financial risk management of the refinery using crude oil futures

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The refinery gets profit from purchasing crude oil, distilling it and selling products. So the profit fluctuates sensitively as prices of crude oil and products and demands change. One method for a risk management is using futures contracts. Futures help refinery reduce the financial risk because they can fix the uncertain price with the current one.

In this research we make a risk-hedge model using futures. Firstly we define the meaning of the financial risk and get the probabilistic profit distribution of a hypothetical refinery company based on the two-stage stochastic programming. Various scenarios are generated with the assumption that the prices and demands follow a geometric Brownian motion. Futures prices are formulated with the cost of carry model. In two-stage stochastic programming we get an optimal planning to maximize the expected profit. Then the ratio of a hedge is optimized to minimize the variance of a profit at the risk-hedge using futures. Lastly we draw the cumulative risk curve to show the risk profile more intuitively. After the hedge it is found that the average of the expected profit increases by 17.46% and the variance reduces by 18.06%.