

MANAGING RISKS IN HIGHWAY WINTER OPERATIONS USING OPTIONS THEORY

Abstract

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Highway agencies often face winter operation expenses beyond what is budgeted due to fluctuations in the severity of winter weather. These agencies always are interested in finding a hedge against the cost of extreme weather in order to reduce the volatility of future snow removal expenses and thereby ensure a relatively more predictable cash flow. A viable method for agencies to accomplish this is purchasing snowfall options, which guarantee a certain payment to the buyer if the seasonal snowfall exceeds a predefined strike level. Specifically, if the actual total snowfall exceeds the strike level, the seller of the option will pay the buyer, in this case the highway agencies, an amount commensurate to the difference of the two levels. This payoff amount will help the agency fund the additional cost of winter operations in those years; but it is crucial that the agency measure the benefits of purchasing snowfall options against the associated costs. There are very few exchange-traded and standardized snowfall options; rather, the majority is customized for over-the-counter trading, which calls for extensive analysis to help the buyer to effectively negotiate with the seller. This dissertation proposes a framework that could be used by a highway agency at the state or local level to price their snowfall options to mitigate the risk of exposure to severe winter weather. The framework includes a model that forecasts the cost of snow removal and a two-step stochastic weather forecast model that combines stochastic frequency modeling with magnitude modeling to forecast the total snowfall during a season. Finally, the framework demonstrates the use of three different methods to price snowfall options in the context of a highway agency's winter maintenance operations. The different pricing methods proposed would enable both buyers and sellers to price customized snowfall options to hedge against severe winter weather.