Chapter 14
Statistical Optimization of Option Pricing Factors: Application of Taguchi's DOE

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ABSTRACT

Options are a highly versatile trading tool renowned for mitigating downside risk while offering unlimited upside potential. The effectiveness and profitability of trading options hinge on selecting the right option at the appropriate price. Traditionally, the Binomial option pricing model (BOPM) is employed to estimate the fair value of options. This study delves into the impact of factors such as underlying asset price, strike price, volatility, and period (with a constant interest rate) on put option values. Leveraging Taguchi's design of experiment methodology, the research aims to optimize these factors for option valuation, marking the first instance of such optimization using Taguchi's method. Through a design of experiment (DOE), analysis of variance (ANOVA), regression analysis, and analysis of mean (ANOM), the study examines the effects of input factors, employing MINITAB 18 software for analysis.

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INTRODUCTION

Most research projects begin with an experiment to investigate new areas of interest. An experiment's main goal is to make inferences about the larger population it is investigating. Scientists strive to obtain reliable and practically significant results when performing a statistical investigation. To reveal the latent characteristics of a population, e.g., the influence of different factors on a particular response variable, an experimental setup that allows for the high-precision probing of these features must be designed. Studying different experimental configurations, including full factorial design (FFD), fractional design, Latin square method, Taguchi design approach, and others, is known as Design of Experiments (DOE) in the statistical literature. The main goals are to reduce prediction errors in the response variable and to draw valid conclusions about the impact of various factors on a given response variable, commonly known as yield or output.

The Design of Experiments (DOE) is a statistical technique extensively used in various research fields to clarify how different elements affect the output process. It is used widely, with applications in almost every field that can be imagined. From agriculture (Travisi & Nijkamp, 2008) and social science (Campbell, 2017) to chemistry (Liang et al., 2001), biology (Aslan, 2015), service sectors (Phillips et al., 1984), manufacturing (İç, 2012), and economics (Angrist & Pischke, 2010), DOE has been the subject of intense scrutiny from a wide range of scientists and researchers. This method is useful for improving systems of any complexity since it makes it easier to show the links between variables, such as input and output variables. It is used to improve systems (which may be simple or complex), develop new products, and improve existing products/processes.

The Taguchi approach, a key component of DOE, facilitates the creation of new products and processes while improving the quality of already existing ones. Known as Orthogonal Arrays (OA), Taguchi created a set of partial factorial experimental matrices, each designed for a particular set of circumstances. An OA is made up of a small number of well-calibrated experiments. By holding other parameters constant, the Taguchi method is traditionally used as a sensitivity analysis methodology in which a chosen factor is modified across several levels. All elements are changed simultaneously in the Taguchi approach by predetermined tables called OAs. We refer to choosing the best OA for a certain problem as “experiment design.”

The selection of the Taguchi OA matrix depends on the input factors and levels. One important work of the Taguchi method is selecting suitable OAs. Taguchi simplifies factor assignment using Triangular tables and linear graphs (Goyal, 2013; Ross, 1988).