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INVARIANT SOLUTIONS OF THE HESTON MODEL FOR EUROPEAN OPTION WITH DIVIDEND YIELD

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Abstract. In this paper, Lie symmetry analysis is exploited to solve the Heston model with stock dividend which defined in a partial differential equation (PDE) by determining the infinitesimal generators. With the infinitesimal generators found, the invariant solutions are obtained through the introduced similarity variables by solving the characteristic equations is suggested.

Keywords. Lie symmetry analysis; Heston model; dividend yield; partial differential equation; invariant solution

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1 Introduction

Partial differential equations (PDEs) are widely used to model real-world problems in various financial fields. From a financial perspective, an option is a contract that gives the holder the right to either purchase (call) or sell (put) the underlying stock at a strike price on or before the expiration date but no obligation to exercise the option. The classical Black-Scholes (BS) model [1, 2] is very useful and widely used in reducing the investment risk. However, the volatility in the BS model is assumed to be constant and this causes the option price could not be capture accurately as the real market price might change during the option maturity. Plenty researches have been done on stochastic volatility model to improve the shortcoming of the BS model [3, 4, 5]. One famous model was proposed by Heston [6], he provided a closed-form solution for the European option. Notwithstanding the closed-form solution is derived but is defined in an integral form which required complicated numerical calculation to obtain the option price. Analytical and numerical work has been studied for the solutions of the Heston model. For