A VARIATIONAL FORMULATION OF EUROPEAN OPTION PRICES IN THE 1-HYPERGEOMETRIC STOCHASTIC VOLATILITY MODEL

JOSÉ DA FONSECA* AND WENJUN ZHANG†

Abstract. The paper proposes a variational analysis of the 1-Hypergeometric stochastic volatility model for pricing European options. The methodology involves the derivation of estimates of the weak solution in a weighted Sobolev space. The weight is closely related to the stochastic volatility dynamic of the model. The solution is further analysed using semigroup theory applied to the pricing operator and leads to certain constraints on the model parameters. A full implementation of the model using the finite element method is carried out and illustrates how the model works, in particular how it produces an important option price property observed in the market.

Key words. Stochastic volatility, European option, finite element method, variational method

MSC codes. 00A20, 00B10

*Auckland University of Technology, Business School, Department of Finance, Private Bag 92006, 1142 Auckland, New Zealand. Phone: +64 9 9219999 extn 5063. Email: jose.dafonseca@aut.ac.nz and PRISM Sorbonne EA 4101, Université Paris 1 Panthéon - Sorbonne, 17 rue de la Sorbonne, 75005 Paris, France. ORCID: 0000-0002-6882-4511

†Corresponding author: : Auckland University of Technology, School of Computing and Mathematical Sciences, Private Bag 92006, 1142 Auckland, New Zealand. Phone: +64 9 9219999 extn 5094. Email: wenjun.zhang@aut.ac.nz. ORICD: 0000-0001-7992-8204