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# A NUMERICAL METHOD FOR PRICING PERPETUAL AMERICAN OPTIONS UNDER REGIME SWITCHING JUMP DIFFUSION MODELS

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**Abstract.** In this paper, a numerical approach is applied to solve Perpetual American options pricing problems under Markov–modulated jump–diffusion models. For this purpose, we reduce the ordinary integro–differential equations arising in this model with free boundaries feature to linear complementarity problems (LCPs). Then the LCPs are discretized by using finite differences method (FDM). We use linear interpolation to approximate the integral term. The discrete maximum principle is applied to the linear complementarity problems to obtain the error estimates. We also illustrate some numerical results in order to demonstrate and compare the accuracy of the method for our problem.

**Keywords.** Perpetual American option, Jump–Diffusion model, Regime–Switching model, Finite Difference method, Free boundary problem, Discrete maximum principle.

**AMS (MOS) subject classification:** 65M06, 65M32, 91G60

## 1 Introduction

Over the last two decades, pricing problem of American options has become one of the most crucial problems in financial and computational mathematics. Due to moving boundaries, the problem leads to a nonlinear problem that has its own difficulties. Among different types of options, Perpetual options have infinite maturities and can be exercised at any time without expiration limit. For these options, the pricing equations can be simplified into ordinary differential equations when $T = \infty$, since partial derivative of option price with respect to time will vanish. In this case the free boundaries (early exercise prices) are constant. Therefore, time–homogeneity feature of these options reduces complexity of finding the free boundaries. Thus, the early exercise prices are easily determined.

Among the variety of alternative models were proposed to overcome limitations and shortcomings of the well–known Black–Scholes model [3], the Jump–Diffusion models [19, 23] and Regime–Switching models [7] have been