Short Bio Carlos Vázquez

Carlos Vázquez holds a five years Batchelor in Mathematical Sciences and also the same in Economic Sciences, as well as a PhD in Mathematical Sciences, all from Santiago University (Spain). Also holds a Doctorat Troisième Cicle Mathématiques Apliquées from Université de Lyon (France). Full Professor in Applied Mathematics at University of A Coruña since 2000.

Research activity in mathematical and numerical analysis of differential equations that model phenomena of applied sciences and engineering, in particular with applications in finance, insurance, economics, fluids and solids mechanics, thermodynamics, tribology, glaciology and biology. He has advised 23 PhD thesis.

Author of more than 150 articles in scientific journals. He has also been main researcher of international, national and regional reseach projects, currently leading a Spanish-German project on emission and renevable energy certificates. Formerly, he was local coordinator of 2 European Industrial Doctorates of MSCA call related to financial mathematics. Also, he has lead research projects with industry: with BBVA, Santander, Abanca, Analistas Financieros Internacionales, among other companies and administrations

Editor in Chief of SeMA Journal and co-editor in Chief of Mathematics and Computers in Simulation. He is also Associate Editor of Journal of Computational Finance, Applied Mathematics and Computation, International Journal of Computer Methods, , Journal of Computational Mathematics and Data Science.

Former coordinator in the UDC of the official masters of Mathematical Engineering and Industrial Mathematics. Current coordinator of the PhD Program of Mathematical Methods and Numerical Simulation in Engineering and Applied Sciences. Former president of SeMA (2006-2010) and former head of the Mathematics Department at UDC (2017-2025).

Abstract

The talk is divided into two parts.

In the first part of the talk a short introduction to the pricing of financial options and derivatives will be presented, mainly to get familiar with some concepts and methodologies that arise in quantitative finance to use PDEs model to price these financial products. We start with a motivation and definition of financial options, briefly explain some methodologies related to their pricing models and end up with the pricing of European and American options in the Black-Scholes simplest framework. This introduction allows a better understanding of more complex products and methods that are used in the second part.

In the second part of the talk, PDEs based methodologies are proposed to price renewable energy certificates. Renewable Energy Certificates (RECs) or green bonds are used to foster the development of renewable energies to obtain electricity. More precisely, the generators of electricity from renewables receive one certificate per a

certain amount of electricity produced, which is refered to as REC. Some pricing methods for RECs and associated derivatives products are presented. For this purpose, starting from a system of forward-backward differential equations (FBSDEs), we first propose a mathematical model based on a semilinear partial differential equation (PDE) arising from the consideration of two stochastic underlying factors: the accumulated green certificates sold by an authorized generator and the natural logarithm of the renewable electricity generation rate. A set of numerical methods will be proposed and a real case numerical example will be presented.

Moreover, we state the mathematical model that governs the valuation of derivatives whose underlying is a REC, in particular we study European options and futures contracts. Thus, we derive the PDE model to price these derivatives, study the existence of solution and propose how to solve the models by using appropriate numerical techniques. Finally, we show some numerical results that illustrate the performance of the proposed model and the numerical methods.