Large Project 2015

In this year's Large Project we shall extend existing packages by additional functionality or missing data. This software has to be written for an end-user who uses financial instruments in its everyday operations and is not an expert in numerical analysis and computational finance. The project will be the continuation of the project from the last year. The project is a library of functions performing different tasks. A number of functions is already available. We shall only modify some of existing functions and write few new functions.

The main task of the project is to extend the functionality of the main module (main program) which manages all functions, supplies data to them, provides the communication between the functions and solves the problem of communication with an end-user interface. A large part of this module is ready but it needs some extensions.

The main module is split into two separate sub-modules: one which uses individual users accounts and performs complicated calculations with market data provided by the user as separate files, and the second one (a simple calculator) which is accessible on-line by everybody and calculate prices of simple instruments (that which possess analytic formulas for prices) after entering necessary data from keyboard. The simple calculator is in its final version. We shall extend however the real data calculator. This goal should be complemented with some modifications of existing functions and writing few specific functions.

The project consists of the following tasks:

1. Processing part of input data for Fixed Income Market – term structure of swaption volatilities. Available volatilities are implied swaption volatilities. We need volatilities for different time moments and periods. Recovering term structure of these volatilities from swaption volatilities is a complicated operation. The good reference is Section 7.7 of the book by Brigo and Mercurio and original papers of Brigo&Morini. Recovering volatility structure from swaption quotations requires the knowledge of the forward rates covariance matrix. There are several simplified approaches to calibrate that matrix. Estimation of that matrix is not a goal of the task, but the program should give the possibility of different formulation of approximation. We shall stick to a simple approach as described in Section 6.9 of the book by Brigo and Mercurio.

2. Processing input data for Equity Market – recovering implied volatilities of European options from market quotations. There exist already a module which computes term structure of stock volatilities from implied volatilities of European options. The problem is that quoted equity options are American options. We need a function which recalculates quoted American option prices into implied volatilities of European options. The procedure is described in the paper by Shkolnikov. The described algorithm has to be implemented and tested.

3. Computation of Greek parameters for European barrier options in the Black-Scholes model applying Monte Carlo approach. There exist a module which computes prices of European and American barrier options with the Monte Carlo method (Longstaff&Schwartz algorithm for American options). The goal is to supplement this algorithm with the computation of Greeks for European options. That task can be completed in many different ways. The suggestion is to use smoothing of the barrier as in the master thesis of Papatheodorou. Possible extension to American options can be investigated. This module should be implemented in a way which can be easily adapted to both FX and equity markets.

Documentation. It is absolutely essential to describe carefully the theoretical background of every function. But also the documentation of the computer code has to be provided. A particular attention

should be put on the structure of the programme (block scheme), the format of input and output data, signaling choices, etc. The participants of the project should be aware that this is already a seventh year of the project development and during all previous years some part of the code was extended in subsequent years. This means that the documentation has to be detailed enough to enable the development of the existing code and not forcing new participants to write the code from the beginning.

References

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