NATIONAL UNIVERSITY OF SINGAPORE
Department of Mathematics

2016/2017 **QF4102 Financial Modelling** **Semester I**

QF4102 Assignment 2

A2.1 (i) Consider an American floating-strike arithmetic-average call option which was initiated 0.125 year ago, and still has 0.25 year to its expiry. The underlier has a current price of \$1.05, volatility of 0.40, dividend yield of 0.02 and a running average of \$0.95 (taken over the earlier period of 0.125 year). The risk free rate is 0.05.

- Write a Matlab function to implement the two-state-variable FSGM (with linear interpolation) for pricing the above option.
- With $\rho = 1/2$, use your function to generate results for the number of time periods in the lattice being 40, 80 and 160 respectively.
- With $\rho = 1/3$, use your function to generate results for the number of time periods in the lattice being 40, 80 and 160 respectively.
- With $\rho = 1/4$, use your function to generate results for the number of time periods in the lattice being 40, 80 and 160 respectively.
- Comment on your numerical results and computation times taken.

(ii) Consider an American floating strike lookback put option which was initiated 0.125 year ago, and still has 0.25 year to its expiry. The underlier has a current price of \$1.35, volatility of 0.45, dividend yield of 0.02 and a running maximum of \$1.55 (taken over the earlier period of 0.125 year). The risk free rate is 0.05.

- Write a Matlab function to implement the two-state-variable FSGM for pricing the above option.
- Use your function to generate results for the number of time periods in the lattice being 60, 120, 240 and 480 respectively.
- Comment on your numerical results and computation times taken.

A2.2 Write a Matlab function which implements the explicit difference scheme for the transformed Black-Scholes PDE (see slides 33-34 of Chapter 3) for pricing European vanilla options. Your function must have the function heading

```
function [c, p] = eds_European_vanilla(S0, X, r, T, sig, N, dx, xmin, xmax)
```

where `c` and `p` are the prices of call and put respectively, `dx` the step size in x, and [`xmin`, `xmax`] gives the truncated domain for the variable x.

Test your implementation with a European vanilla option which has a strike price of \$0.5 and time to maturity of 0.25 year. The underlier pays no dividend and has a current price of \$0.65, volatility of 0.4. The risk free rate is 0.05.

- For `dx` $= 0.05$, `xmin` $= -5$ and `xmax` $= 2$, obtain the estimate to the option values for both call and put, and for $N = 10, 20, 40, 80, 160$ respectively.
- For `dx` $= 0.025$, `xmin` $= -5$ and `xmax` $= 2$, obtain the estimate to the option values for both call and put, and for $N = 10, 20, 40, 80, 160$ respectively.
- Comment on your numerical results.

Due date, requirement, guidelines and regulations

(i) The due date/time for the Matlab programmes and brief report is **2359hr on 23 October, 2016**. No late submission will be accepted.

(ii) Work on the assignment problems should commence soonest possible as programming and debugging can be time consuming.

(iii) Use **Matlab** for all programming tasks.
Please add suitable amount of comments to your codes and test your codes thoroughly. The first line of each Matlab m-file should have a comment line containing the names of the group members.

(v) Prepare your report in the Windows Word format or the PDF format with a description of your work done plus supporting figures and tables etc, as well as all necessary analysis and comments.

(vi) The .doc/.pdf and all .m files should all be archived in a single Zip/Rar file. Name your .zip/.rar file with your group index (such as Gxx_Assignment.zip or Gxx_Assignment.rar where Gxx is your assigned group index), and submit it online to the IVLE workbin set up for this purpose. Only one such archive file from each group will be used in the grading process.

(vi) This assignment counts 10% towards the final assessment score of this module.

(vii) Plagiarism (copying work from fellow students, groups or others) **would not be tolerated and all parties involved would be penalized severely**.
Please refer to `http://emodule.nus.edu.sg/ac/` for more information on NUS's disciplinary process on plagiarism.

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