

## Financial derivatives

### Test 3 (numerical methods) – instructions

On exercises, we computed the second time level using implicit scheme for solving a heat equation. Now your task is:

- Compute also the remaining time levels, convert the solution to heat equation into option prices, compare them with the closed form Black-Scholes formula and – if necessary – tune the parameters of the numerical scheme
- Implement the numerical pricing of American options (the outline is given on exercises website, in detail it has been described in lectures).
- Solve the following option pricing problem:  
*The stock price follows a geometrical Brownian motion with parameters  $\mu=0.20$ ,  $\sigma=0.40$ . The stock does not pay dividends. Interest rate equals 10 percent. Compute the price of a put option with expiration in 6 months and exercise price 10 USD for the following stock prices: 0, 2, 4, 6, 8, 10, 12, 14, 16 USD.*  
Prices for a similar option (the only change is the expiration time) are given in practice problems.
- You can work **independently or in a group**, each group consists of **max. 3 people**.
- Submit the results by e-mail
  - [beata.ulohy@gmail.com](mailto:beata.ulohy@gmail.com), subject: **derivatives 2016 – numerical methods - name(s)**
  - send the **option prices rounded to 2 decimal places in the body of the e-mail** (not only in the R script!) and **R script as an attachment**; the prices from the email should be stored in a vector *final.answer* in the script

**Max. 4 points from Test 3** come from this submission. Grading is based on sum of squared distances of the submitted prices and real prices rounded to 2 decimal places; 4 points if this sum is zero, 0 points if it is the same as if submitting European put option prices or larger, otherwise the points are a linear function of the sum of squared differences

**The remaining 6 points** are for a written part of the test. A sample test and a syllabus for it will be given one week before the test. Basically, you need to know what is being done in the numerical implementation, why does it work, answer questions like „what happens with the convergence if I make the following change in the code?“ etc.

When retaking the Test 3 at the end of the term it is possible to retake only this written part. The points from the implementation of numerical option pricing cannot be improved.