

TTA-45026 Financial Engineering

Exam

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This is a closed-book exam, a calculator allowed. You can answer in English or in Finnish. Good luck!

Question 1.

- a) Explain Forward Rate Agreement (FRA) (1 p)
- b) Explain Control Variates in Monte Carlo simulation (3 p)
- c) How can replicate a digital call (cash or nothing call) by a vanilla call and Asset-or-Nothing call? Suppose the options are European. (2 p)

Question 2.

- a) Suppose that Black-Scholes assumptions hold and that you represent a *bank* that has a *short* position on a vanilla European *put* option. Explain how to implement delta hedging strategy in order to mitigate the risk associated to the underlying stock diffusion. Just demonstrate the sequence of necessary actions (step-by-step). (4 p)
- b) Suppose that there are positive transaction costs in the stock markets. How do things change if you update your hedging portfolio every week instead of doing it every day (two consequences)? (2 p)

Question 3. Consider a *Down-and-Out Asset-or-Nothing Call* option that ceases to exist if the asset price, $\{S_t; 0 \leq t \leq T\}$ reaches a barrier $H < S_0$ and otherwise pays

$$\max(S_T, 0),$$

at the maturity T . Here S_0 is the current stock price and S_T the terminal stock price. Suppose that the risk-free interest rate, r , and volatility, σ , are constants, and that the stock price follows geometric Brownian motion.

Please give a pseudo code that prices the above contract using Monte Carlo methods with *antithetic* variates. (6 p)