Math 454 - Spring 2025 - Homework 13

Published: Tuesday, April 8, 2025

Status - Reading Assignments:

Here are the reading assignments to be completed before the first one of this HW.

SCF2 (Shreve – Stoch. Calculus for Finance, II Textbook):

Ch. 1 – 5.

MF454 lecture notes:

Ch.2 – 14

Other:

Stewart Single Variable Calculus ch.3.9 (Antiderivatives) for examples of (ordinary) differential equations.

New reading assignments:

In the following: • MF = MF454 = my course lecture notes • SCF2 = Shreve: Stochastic Calculus for Finance II • WMS = Wackerly, et al = standard Math 447 Textbook

Reading assignment 1 - due Monday, April 14:

- **a.** Review the discussion of Markov processes in MF ch.6.1 and 6.5, and in SCF2 (end of ch.2.3 and ch.3.3.4).
- **b.** Carefully read MF ch.15.1. Less than 6 pages, but very hard to digest! • The better students should make a serious attempt at understanding Note 15.1. • Everyone should be able to recite the essence of the two Feynman–Kac theorems from memory

Reading assignment 2 - due: Wednesday, April 16:

- **a.** Read SCF2 ch.6.1 – 6.4. The material has previously been covered in MF ch.15.1-15.4. See whether the examples help you to better understand the material!

Reading assignment 3 - due Friday, April 18:

- **a.** Carefully read MF ch.15.2. (Very brief.)
- **b.** Carefully read MF ch.15.3. through Theorem 15.4 (Two dimensional Feynman–Kac).

Written assignments are on the next page.

Written assignments:

Written assignment 1: MF ch.10.4: Write from memory the delta hedging rule and the Black–Scholes (deterministic) PDE. Do not forget the terminal condition!

Written assignment 2: Write from memory the Black–Scholes formulas for a European call. Even though I will very likely include them on the reference sheet, also try to write $d_{\pm}(\tau, x)$. I believe that those things are important to know for a quant interview.

Written assignment 3: Find some software to do numerical solutions for puts, calls and forward contracts There may be better apps than the ones I listed in Remark 10.8.

Written assignment 4: What Greeks do you recall? What is the delta of a European call?

Written assignment 5: Be able to do the proof of the three formulas listed in Proposition 10.5.

Written assignment 6:

- **a.** What is the fair price of a forward contract? Why can it not exceed that of a European or American call?
- **b.** How is the forward price defined? What is its connection to a forward contract?

Written assignment 7:

- **a.** State the put–call formula.
- **b.** Review Proposition 10.10 (Linear combinations of contingent claims) in the addenda of Chapter 10 and use it together with $a = a^+ - (-a)^+$ to prove the put–call formula.