Written Exam at the Department of Economics summer 2020

Pricing Financial Assets

Final Exam

9 June 2020

(3-hour open book exam)

Answers only in English.

The paper must be uploaded as <u>one PDF document</u>. The PDF document must be named with exam number only (e.g. '127.pdf') and uploaded to Digital Exam.

This exam question consists of 2 pages in total

This exam has been changed from a written Peter Bangsvej exam to a take-home exam with helping aids. Please read the following text carefully in order to avoid exam cheating.

Be careful not to cheat at exams!
You cheat at an exam, if you during the exam:

- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text. This also applies to text from old grading instructions.
- Make your exam answers available for other students to use during the exam
- Communicate with or otherwise receive help from other people
- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts
- Use parts of a paper/exam answer that you have submitted before and received a passed grade for without making use of source referencing (self plagiarism)

You can read more about the rules on exam cheating on the study information pages in KUnet and in the common part of the curriculum section 4.12.

Exam cheating is always sanctioned with a warning and dispelling from the exam. In most cases, the student is also expelled from the university for one semester.

The Exam consists of 3 problems that will enter the evaluation with equal weights.

1. Consider a stock that does not pay dividends during the period under analysis. Let the price be S_t at time t.
   At time 0 the stock price is 200, and during the next year the price can go up by 10% or down by 15%. The one year risk free interest rate is 0.

   a) Find the arbitrage free price p_0 at time 0 of a put option with strike 200 and expiry after one year by constructing a risk free portfolio of the stock and the option.

   b) What is the risk neutral probability q of the up-move in the stock price?

   c) Suppose that the real world probability p of an up-move is $4/5$. Why would you expect $p > q$? What is the expected return on the put option? Explain the result.

2. In a tranched CDS (also a synthetic CDO) compare the most senior, the mezzanine and the most junior (also called "equity") tranches.

   a) Explain how the tranches are exposed to the risk of defaults from the total underlying portfolio. Explain what is meant by "attachment point" and "detachment point".

   b) Assume a large set of obligors (or "names") in the underlying portfolio. If correlation is not perfect, which tranche will gain proportionally the most by a lower credit spread on the underlying portfolio?

   c) For a given credit spread on the underlying portfolio of CDS, which tranche will benefit from an increase in implied (i.e. derived from market prices) correlation?

3. Consider an economy with a (continuously compounded) risk free interest rate of r and a stock with price S_t at time t. Suppose that the stock pays a deterministic continuous dividend rate of δ.

   a) What is the forward price at time t on the stock for maturity $T > t$?

   b) Suppose that a forward contract on the stock with forward price K exists. What will the value $V(S_t, t; K)$ of that contract be at time t?

   c) The Black-Scholes-Merton partial differential equation for the price V of some general derivative is
   $$\frac{\partial V}{\partial t} + \tfrac{1}{2}\sigma^2 S^2 \tfrac{\partial^2 V}{\partial S^2} + (r - \delta) S \frac{\partial V}{\partial S} - rV = 0$$
   Show that the value of the forward contract satisfies this equation.