Answer Sheet to the Written Exam

Corporate Finance and Incentives

December 2019

In order to achieve the maximal grade 12 for the course, the student must excel in all four problems.

The four problems jointly seek to test fulfillment of the course's learning outcomes: "After completing the course, the student is expected to be able to:

Knowledge:

1. Identify, describe and discuss financial problems encountered by firms and investors,
2. Account for and understand the core models and methodologies in the field of Financial Economics,
3. Define the core concepts of Financial Economics,
4. Criticize and reflect upon the main models in Finance, relating them to current issues in financial markets and corporate finance.

Skills:

1. Select and apply core models and methodologies to analyse standard problems in Finance, partly using Excel,
2. Master the analysis of given problems, assessing models and results, putting results into perspective,
3. Argue about financial problems and issues in a scientific and professional manner, drawing upon the relevant knowledge of the field.

Competencies:

1. Bring into play the achieved knowledge and skills on new formal problems,
2. Select and evaluate solutions to complex, unpredictable situations in financial markets or corporations,
3. Approach more advanced models, methodologies and topics in Finance."

Problems 1–3 are particularly focused on knowledge points 1–3, skills 1–3, competencies 1 and 2. Problem 4 emphasizes knowledge points 1–4, skill 3, and competencies 1 and 3.

Some numerical calculations may differ slightly depending on the commands chosen for computation, so a little slack is allowed when grading the answers.

Problem 1 (Asset pricing 25%)

1) To solve $p = Vd$, note that $d = V^{-1}p$ and use matrix inversion in Excel. The solution is $d = (0.106, 0.299, 0.464, 0.121)^T$.

2) Since all four entries in d are strictly positive, arbitrage is impossible. This follows from the Fundamental Theorem of Asset Pricing, see Sørensen (2019).

3) The risk-free interest rate is $r_f = (1/(d_1 + \cdots + d_4)) - 1 = 1.08\%$. The probabilities satisfy $q_j = d_j(1 + r_f)$ so they are $q = (0.107, 0.302, 0.469, 0.122)^T$.

4) In the absence of arbitrage, the price should be $V_5 d = 9.018$.

5) Find x such that $V_5 = x^T V$, i.e., $x^T = V_5 V^{-1} = (0.727, -2.205, -1.132, 0.856)$. Note, there is no requirement that the elements of x sum to one since this is a model about prices, not returns.

Problem 2 (Corporate Finance 25%)

1) In state L, creditors get $80\%30 = 24$. Otherwise they get 40. At the given probabilities (and zero interest rate), $D_{40} = 37.6$. The interest is 2.4.

2) In state L, equity holders get 0, in state M they get $60 - 40 = 20$, and in state H they get $150 - 28\%(150 - 85 - 2.4) - 40 = 92.472$. Then $E_{40} = 53.236$, and $V_{40} = 90.836$.

3) With default in states L and M, we now find $D_{70} = 55.4$ with interest payment 14.6. Then equity holders get 65.888 in state H, so $E_{70} = 32.944$, and $V_{70} = 88.344$.

4) Initially, it is in the interest of the firms' owners to maximize the value V. Among the two possibilities, then 40 is better than 70. While the interest rate and thus the interest tax shield rise considerably with debt promise 70, also the default costs rise, and this second effect is numerically larger here.

Problem 3 (Options 25%)

1) For time 0, compute the probability p such that

$$500 = \frac{p790 + (1-p)390}{1.0015},$$

solved by $p = 27.7\%$. With the same method for time 1 at the higher node, the probability of the up-branch is 46.3%. At time 1 at the lower node, the probability of the up-branch is 28.7%.

2) Consider first strike price 680. At time 2, the values from top to bottom are $0, 60, 0, 410$. At time 1 at the upper node, its market value will be

$$\frac{46.3\%0 + 53.7\%60}{1.0015} = 32.192.$$

At the lower node, the continuation value is likewise 291.848. At time 0, its market value is $P = 219.626$. The same method with strike 700 gives $P = 234.94$. It may be worth recording that the value at the upper node is 42.923, and the value at the lower node is 308.952.

3) The intrinsic option value is the value if it would have expired immediately. At strike 680, this is 0 at the upper node, and 290 at the lower node. The time value is the amount by which the market value exceeds the intrinsic value. This is 32.192 at the upper node and 1.848 at the lower node. At strike 700, instead, the upper node has intrinsic value 0 and time value 42.923, while the lower node has intrinsic value 310 and time value -1.048.

4) Indeed, the last case had negative time value. In case the option would be American, an investor arriving at this node would prefer to exercise the put option early. [Since the American put option is no less valuable than the European at time 0, its initial market value exceeds the intrinsic 200, so the investor should not exercise at time 0.]

Problem 4 (Various Themes 25%)

1) This claim is found on page 858 in Berk and DeMarzo. It is explained on page 839.

2) The text suggests some market-wide factors of relevance for pricing Asian stocks are moving in an overall unfavorable direction. The APT would predict that many stock prices (with positive loads on these factors) will get lower realized returns. BlackRock believes this, and assesses that it is not yet correctly incorporated in prices, so they see a reason to trade in order to profit. BlackRock is large and may actually be able to directly impact on markets when it conducts large trades, and perhaps indirectly when it broadcasts its opinion.

3) Section 16.5 in Berk and DeMarzo explains this problem.