Answer Sheet to the Written Exam

Corporate Finance and Incentives

December 2018

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 should be able to:

<u>Knowledge:</u>

1. Understand, account for, define and identify the main methodologies, concepts and topics in Finance
2. Solve standard problems in Finance, partly using Excel
3. Criticize and discuss the main models in Finance, relating them to current issues in financial markets and corporate finance

<u>Skills:</u>

1. Manage the main topics and models in Finance
2. Organize material and analyze given problems, assessing standard models and results
3. Argue about financial topics, putting results into perspective, drawing on the relevant knowledge of the field

<u>Competencies:</u>

1. Bring into play the achieved knowledge and skills on new formal problems, and on given descriptions of situations in financial markets or corporations
2. Be prepared for more advanced models and topics in Finance."

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

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 (CAPM 25%)

1) Use matrix inversion in Excel. Compute $z = A^{-1}\mathbf{1} = (3.27, 7.39, 1.33, 3.67, -0.21)^T$, normalized to the minimum-variance portfolio $x_m = (0.21, 0.48, 0.09, 0.24, -0.01)^T$. The expected return is $x_m^T b = 4.47\%$, with variance $x_m^T A x_m = 0.0648$ and standard deviation $\sqrt{x_m^T A x_m} = 25.4\%$.

2) Compute $z = A^{-1}(b - r_f\mathbf{1}) = (0.16, 0.09, -0.01, 0.01, 0.13)^T$, normalized to tangent portfolio $x_e = (0.43, 0.23, -0.02, 0.03, 0.33)^T$. Expected return $x_e^T b = 7.41\%$, variance $x_e^T A x_e = 0.1419$, standard deviation $\sqrt{x_e^T A x_e} = 37.7\%$.

3) According to the Two Mutual Fund Theorem, this efficient frontier is traced by convex combinations of the two efficient portfolios from 1) and 2), with positive weight y on the portfolio from 2). To match the desired return, y must solve $6 = y7.41 + (1-y)\,4.47$, which is $y = 0.52$. The convex combined portfolio is $x_c = yx_e + (1-y)\,x_m = (0.33, 0.35, 0.03, 0.13, 0.16)^T$. Its variance is $x_c^T A x_c = 0.0857$, with standard deviation $\sqrt{x_c^T A x_c} = 29.3\%$.

4) Locating now on the capital market line (the tangent), the investor puts weight $y > 0$ on the tangent portfolio from 2), and weight $1 - y$ on the safe asset. To match the desired return, y must solve $6 = y7.41 + (1-y)\,2$, which is $y = 0.74$. The standard deviation is then $y37.7\% = 27.9\%$.

Problem 2 (Corporate Finance 25%)

1) The present value of debt is $D = (70\%110 + 30\%60)/(1.05) = 90.48$. The present value of equity is $E = (70\%20)/(1.05) = 13.33$. The present value of the firm is $V = D + E = 103.81$.

2) The present value of debt is now $D_a = (70\%110 + 30\%90)/(1.05) = 99.05$. The present value of equity is $E_a = (70\%10)/(1.05) = 6.67$. The present value of the firm is $V_a = D_a + E_a = 105.71$.

3) The equity holders naturally look at the value of equity. Since $E > E_a$, they prefer not to take the action. With their claim on the upside value, they do not benefit from the risk reduction.

4) Taking the costly action raises the value of the firm; it is an action of positive net present value. It is efficient to take this, as it creates more value that can be shared by investors. However, with the given capital structure, creditors take more than 100% of this positive net present value, and equity holders lose. This may be regarded as an underinvestment problem. The conflict of interest may be addressed with measures of corporate governance.

Problem 3 (Options 25%)

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

$$100 = \frac{p130 + (1-p)\,80}{1.015},$$

solved by $p = 43.0\%$. With the same method for time 1 at the higher node, the probability of the up-branch is 70.0%. Finally, at time 1 at the lower node, the probability of the up-branch is 42.4%.

2) Let K denote the strike price. Consider first $K = \$85$ as an example. At time 2, the values from top to bottom are dollars $(65, 5, 25, 0)$. At time 1 at the upper node, its market value will be

$$\frac{70.0\%\$65 + 30.0\%\$5}{1.015} = \$46.25.$$

At the lower node, the continuation value is likewise \$10.44. At time 0, its market value is $C = \$25.46$. The same method for $K = \$100$ gives $C = \$16.94$. For $K = \$115$ it gives $C = \$10.21$.

3) The method is similar to 2). For example, the $K = \$85$ put option has, at time 2, dollar values from top to bottom: $(0, 0, 0, 25)$. Its present value is $P = \$7.97$. For $K = \$100$ this becomes $P = \$14.00$. For $K = \$115$, it is $P = \$21.84$.

4) The key assumptions for the put-call parity are that the options are European on a non-dividend paying asset. These assumptions are satisfied. [As an optional part of this answer, it could be added what is the put-call parity, and an example calculation could verify that it holds with the numbers above.]

Problem 4 (Various Themes 25%)

1) See chapter 6 from Grinblatt and Titman.

2) Chapter 13 in Berk and DeMarzo discusses arbitrage and investor behaviour. It can be discussed whether the cyclical behaviour of junk bond prices described in this text presents an arbitrage opportunity or not. This might be how these assets' prices should efficiently vary with the overall market. But the text points to the fact that some investors have limited arbitrage opportunities, quite relevant in downturns, and the text also suggests that some bond issues are "questionable with hindsight," relevant at the top of the cycle.

3) Section 28.3 in Berk and DeMarzo explains the possible tax savings from a merger.