Course information 2015–16
FN3092 Corporate finance

This course is aimed at students who are interested in understanding asset pricing and corporate finance. It provides a theoretical framework used to address issues in project appraisal and financing, the pricing of risk, securities valuation, market efficiency, capital structure, and mergers and acquisitions. It provides students with the tools required for further studies in financial intermediation and investments.

Prerequisite

If taken as part of a BSc degree, courses which must be passed before this course may be attempted:

EC1002 Introduction to economics **and either**
MT105a Mathematics 1 **or**
MT105b Mathematics 2 **or**
MT1174 Calculus

Exclusion

This course may not be taken with AC3059 Financial management.

Aims and objectives

This course provides a theoretical framework used to address issues in project appraisal and financing, the pricing of risk, securities valuation, market efficiency, capital structure, and mergers and acquisitions. It provides students with the tools required for further studies in financial intermediation and investments.

Essential reading

For full details please refer to the reading list.

Grinblatt, M. and S. Titman *Financial Markets and Corporate Strategy*. (Irwin McGraw-Hill)

Assessment

This course is assessed by a three hour unseen written examination.

Learning outcomes

At the end of the course and having completed the essential reading and activities students should be able to:

- ☑ explain how to value projects, and use the key capital budgeting techniques (NPV and IRR)
- ☑ understand the mathematics of portfolios and how risk affects the value of the asset in equilibrium under the fundaments asset pricing paradigms (CAPM and APT)
- ☑ know how to use recent extensions of the CAPM, such as the Fama and French three factor model, to calculate expected returns on risky securities
- ☑ explain the characteristics of derivative assets (forwards, futures and options), and how to use the main pricing techniques (binomial methods in derivatives pricing and the Black–Scholes analysis)
- ☑ discuss the theoretical framework of informational efficiency in financial markets and evaluate the related empirical evidence
- ☑ understand the trade-off firms face between tax advantages of debt and various costs of debt
- ☑ understand and explain the capital structure theory, and how information asymmetries affect it
- ☑ understand and explain the relevance, facts and role of the dividend policy
- ☑ understand how corporate governance can contribute to firm value
- ☑ discuss why merger and acquisition activities exist, and calculate the related gains and losses.

Project evaluation: Hirschleifer analysis and Fisher separation; the NPV rule and IRR rules of investment appraisal; comparison of NPV and IRR; 'wrong' investment appraisal rules: payback and accounting rate of return.

Risk and return – the CAPM and APT: the mathematics of portfolios; mean-variance analysis; two-fund separation and the CAPM; Roll's critique of the CAPM; factor models; the arbitrage pricing theory; recent extensions of the factor framework.

Derivative assets – characteristics and pricing: definitions: forwards and futures; replication, arbitrage and pricing; a general approach to derivative pricing using binomial methods; options: characteristics and types; bounding and linking option prices; the Black–Scholes analysis.

Efficient markets – theory and empirical evidence: underpinning and definitions of market efficiency; weak-form tests: return predictability; the joint hypothesis problem; semi-strong form tests: the event study methodology and examples; strong form tests: tests for private information; long-horizon return predictability.

Capital structure: the Modigliani–Miller theorem: capital structure irrelevancy; taxation, bankruptcy costs and capital structure; weighted average cost of capital; Modigliani-Miller 2nd proposition; the Miller equilibrium; asymmetric information: 1) the under-investment problem, asymmetric information; 2) the risk-shifting problem, asymmetric information; 3) free cash-flow arguments; 4) the pecking order theory; 5) debt overhang.

Dividend theory: the Modigliani–Miller and dividend irrelevancy; Lintner's fact about dividend policy; dividends, taxes and clienteles; asymmetric information and signalling through dividend policy.

Corporate governance: separation of ownership and control; management incentives; management shareholdings and firm value; corporate governance.

Mergers and acquisitions: motivations for merger activity; calculating the gains and losses from merger/takeover; the free-rider problem and takeover activity.

Examiners' commentaries 2015

FN3092 Corporate finance – Zone A

Important note

> This commentary reflects the examination and assessment arrangements for this course in the academic year 2014–15. The format and structure of the examination may change in future years, and any such changes will be publicised on the virtual learning environment (VLE).
>
> ### Information about the subject guide and the Essential reading references
>
> Unless otherwise stated, all cross-references will be to the latest version of the subject guide (2011). You should always attempt to use the most recent edition of any Essential reading textbook, even if the commentary and/or online reading list and/or subject guide refers to an earlier edition. If different editions of Essential reading are listed, please check the VLE for reading supplements – if none are available, please use the contents list and index of the new edition to find the relevant section.

Comments on specific questions

Candidates should answer **FOUR** of the following **EIGHT** questions: **ONE** from Section A, **ONE** from Section B and **TWO** further questions from either section. All questions carry equal marks.

A list of formulas and useufl logarithm and normal distribution tables is given at the end of the paper.

A calculator may be used when answering questions on this paper and it must comply in all respects with the specification given with your Admission Notice. The make and type of machine must be clearly stated on the front cover of the answer book.

Section A

Question 1

a. **A firm with a total asset beta of 0.3 has a third of its assets as excess cash, which is not used in the operations of the firm and is invested in risk-free T-bills. Suppose it pays half of its cash to shareholders and invests the other half in the market. What is the firm's asset beta now? Why does it change? Discuss.** **(10 marks)**

b. **Explain how and why dividend policy can be used as a signal to investors** **(7.5 marks)**

c. **Explain the tax clientele theory for the existence of dividends** **(7.5 marks)**

Reading for this question

Subject guide, Chapters 7, 8 and 9 (respectively).

Approaching the question

a. Yes, it changes. It is higher because the company exchanged a risk-free asset, the cash, for a risky security, the market. The best way to see this is by calculating the new exposure of the company to market risk using the information provided to first back-out the exposure of the non-cash assets to market risk, and then use the new asset structure of the firm to recalculate the exposure to the market. In detail:

$$\frac{1}{3} * 0 + \frac{2}{3} * \beta_{\text{Non cash}} = 0.3$$

$$\beta_{\text{Non cash}} = 0.3 \frac{3}{2} = 0.45$$

Now, 5/6 of the firm is invested in the asset and 1/6 in the market. So the new asset beta is:

$$_{et} = \frac{5}{6} 0.45 + \frac{1}{6} 1 = 0.54$$

b. The simplest way to understand why dividend policy can be used as a signal to investors is by reversing the argument of debt as signalling in the Myers and Majluf model of information asymmetries. Just as debt sends a signal to the market that the company is of good quality, so does paying out a dividend to investors. Best answers may include an example and also mention share repurchases.

c. An example can be best used to explain this theory. Consider a company that currently pays a high dividend and has attracted a clientele whose investment goal is to obtain stock with a high dividend payout. If the company decides to decrease its dividend, these investors will sell their stock, and the company's share price will decline. The company is then somewhat forced to keep paying dividends.

Question 2

a. **Plot the following risky portfolios on a graph** (2 marks)

	A	B	C	D	E	F	G
Expected return (%)	10	11	12.5	15.5	16	18	21
Standard deviation (%)	23	24	21	26	28	32	32

b. **Which of these portfolios are not efficient?** (5 marks)

c. **Suppose you are prepared to tolerate a standard deviation of 26 percent. What is the maximum expected return that you can achieve if you cannot borrow or lend?** (5 marks)

d. **What is your optimal strategy if you can borrow or lend at 12% and are prepared to tolerate a standard deviation of 26%? What is the maximum expected return that you can achieve with this strategy?** (6 marks)

e. **Draw the efficient frontier and locate the market portfolio assuming you can lend and borrow at 12%** (7 marks)

Reading for this question

Subject guide, Chapter 2.

Approaching the question

a. The plot should mimic the standard mean-variance frontier. The best way to approach this question is to plot in a two-dimension plot the

points provided with the standard deviation in the x-axis and returns in the y-axis.

b. Portfolio F is not efficient because the investor can obtain a higher return investing in portfolio G and obtain same standard deviation (same risk) as portfolio F.

c. The maximum expected returns that can be achieved if investor cannot borrow or lend is 15.5 by investing in portfolio D.

d. The best way to find the optimal strategy is to consider a replicating portfolio based on any portfolio (say portfolio G) and the risk free rate as follows:

$$\alpha * (32) + (1 - \alpha) * 0 = 26$$

$$\alpha = \frac{26}{32}$$

$$\frac{26}{32} * (21) + \left(1 - \frac{26}{32}\right) * 12 = 19.31$$

The strategy is thus to lend $\frac{6}{32}$ of the wealth at 12% and invest $\frac{26}{32}$ of the wealth in portfolio G. The maximum expected return is 19.31.

e. Include in the plot a ray extending from the Y-axis (intersection of 12% = Risk free rate) and is tangent to the frontier of risky assets drawn in part a. This is the CML.

Question 3

a. What are event studies and what are they used for? What type of information efficiency can they test? Explain in detail the hypothesis used in event studies and how you would design an even time study (hint: consider an event time study around earnings announcements). **(6.5 marks)**

b. What is undiversifiable risk? Give an example. **(2 marks)**

c. How does CAPM price diversifiable risk? **(6.5 marks)**

d. Describe a result in the empirical literature that argues against the CAPM. What does the result imply with respect to CAPM and market efficiency more generally? **(10 marks)**

Reading for this question

Subject guide, Chapters 2 and 5.

Approaching the question

a. Event studies are important for evaluating the semi-strong form of the efficient market hypothesis, as well as studying the effects of key corporate announcements. Explain what the semi-strong form of the efficient market hypothesis means. Next, explain how you would design an event study to examine the price impact of earnings announcements The semi-strong form of the EMH states that all public information is embedded in asset prices. The study should contain an announcement (e.g. earnings announcements) then an announcement window (including a period leading up to the announcement and a period after the announcement), and investigate the abnormal returns over the announcement window. The test consists of looking at the pattern of abnormal returns. It should have a large jump around the announcement date, and small abnormal returns in the period leading up to the jump and small abnormal returns in the period following the jump. The public announcement should dictate the price jump.

b. Undiversifiable risk, also known as systematic risk, is the volatility in returns of assets due to changes in the market. Any change in a market index, say S&P 500, is an undiversifiable risk.

c. Diversifiable risk is not priced. Rational investors can hedge this type of risk. The best way to see this is by focusing on the pricing equation of the CAPM in which the only compensation for risk demanded by investors, above and beyond the risk-free rate, is exposure to market risk in the form of beta.

d. Empirically, small capitalised firms seem to have a higher expected return than what the CAPM predicts. Fama and French (1992) argue that small size portfolios appear to outperform large size portfolios even after controlling their respective betas. This evidence is often regarded as an anomaly to the CAPM. However, any testing of the CAPM depends very much on how efficient the market is and whether we choose the correct proxies for the market in those tests.

Question 4

a. **The Modigliani and Miller proposition states that in the absence of taxes and other frictions capital structure is irrelevant. Explain.** **(5 marks)**

b. **One potential violation of the Modligiani and Miller assumptions is the existence of agency conflicts. What are they and why do they arise? (5 marks)**

c. **What is empire building? Give an example on how financial policy can mitigate empire building** **(5 marks)**

d. **What is risk shifting? Give an example on how financial policy can mitigate risk shifting.** **(5 marks)**

e. **What is debt overhang? Explain the role of debt restructuring in mitigating this issue** **(5 marks)**

Reading for this question

Subject guide, Chapters 6 and 8.

Approaching the question

a. The main insight from Modigliani and Miller is that under no frictions financial policy only determines how value is distributed among stakeholders, value is only created from assets: security issuances are 0 NPV transactions. One way to see this is to recall the proof of the Modigliani and Miller theorem in Chapter 6 of the subject guide.

b. Agency conflicts arise when stakeholders in a firm have different incentives (preferences). These conflicts are exacerbated by the separation of ownership and control in modern corporations. There are several types of agency conflicts in a firm including those between: debtholders and shareholders, and between CEOs and shareholders.

c. Empire building refers to the desire of CEOs to invest in negative NPV acquisitions if they derive private benefits from exerting control over larger assets, or if their compensation is tied to asset size. Financial policy can mitigate this agency conflict. In particular, debt can be used to reduce available cash flow for acquisitions.

d. An equity stake in a levered firm corresponds to a call option on the cash flow of the firm with strike equal to the face value of debt. This implies that if given the chance, shareholders will always pick risky over safe projects, even if detrimental for firm value, as they are not really affected by the downside but have extraordinary potential gains from the upside (in detriment of debtholders). This tendency of shareholders is known as risk-shifting or asset substitution. One

potential solution is financial restructuring where the face value of debt is reduced.

e. Shareholders in a firm may forgo positive NPV projects if they have a large face value of debt because they will get to appropriate very little from the NPV. This issue is known as debt-overhang. If debt is restructured, such that some of the face value is forgiven, shareholders will be allowed to appropriate more of the positive NPV project and thus will invest. Restructuring is only feasible as long as debtholders remain just as well off after it.

Section B

Question 5

Acquirer Co (AC) has earnings per share of $3. It has 1 million shares outstanding, each of which has a price of $30 per share. AC is thinking of buying Target Limited (TL), which has earnings per share of $2, 1 million shares outstanding, and a price per share of $25. AC will pay for TL by issuing new shares. There are no expected synergies from the transaction.

a. Assume first that AC pays no premium to buy TL. What are the earnings per share of the merged firm after the transaction?   (5 marks)

b. Explain the economic rationale behind the change in the earnings per share (EPS) of TL before and after the merger in point (a). Are the shareholders of AC any better or worse off after the merger? Carefully discuss your arguments.   (5 marks)

c. What will the price-earnings ratio (PE) be after the merger when AC pays no premium? How does this compare to the PE ratio of AC before the merger? Are the shareholders of AC any better or worse off after the merger? Carefully discuss your results.   (5 marks)

d. Your DCF calculations indicate that TL should be trading at 30 per share, what would be an appropriate premium that AC should pay for TL? Carefully discuss your results.   (5 marks)

e. Explain the free rider problem in the context of takeovers as in Grossman and Hart (1980).   (5 marks)

Reading for this question

Subject guide, Chapter 10.

Approaching the question

a. There are no expected synergies from the transaction; hence the new earnings of the firm are just the combined earnings of the previous stand-alone companies. Because TL shares are worth 25 and AC shares are worth $30, AC will have to issue 25/30 (=5/6) shares per share of TL to be able to buy it. That means that, in the aggregate, AC will have to issue 5/6*1 million = 833,333 new shares. After the merger, there will be 1,833,333 shares outstanding and the total earnings will be 5 million. Thus, the new EPS (earnings per share) will be 5 million/1.833 million = 2.72

b. The economic rationale can be best understood as follows. In point (a), the change in EPS simply came from combining the two companies. One is worth $3 per share and the other is worth 2 per share. However, a reduction in the EPS of the shareholders of AC need not mean that they did a bad transaction. Although the shareholders of AC end up with a lower EPS under the transaction, they have paid a fair price, exchanging their 3 per share before the transaction for either lower, but safer EPS after the transaction, or lower EPS that are expected to

grow more in the future. Either way, focusing on EPS alone cannot tell us whether the shareholders of AC are better or worse off.

c. If AC pays no premium that means, as stated in the problem that there are no expected synergies. Hence, if we simply combine the two companies and there are no synergies as indicated, then the total value of the company will be 30 + 25 = 55 million. The merged firm has earnings totalling 5 million, so that the PE ratio is 55/5 = 11. The PE ratio of AC before the merger was 30/3 = 10 and TL's was 25/2 = 12.5. To determine whether shareholders of AC are any better or worse, recall, just as in Part b, that simply focusing on metrics such as the PE ratio does not tell anything about whether shareholders are worse or better off. The PE ratio of AC went from 10 to 11, but shareholders are no better or worse off.

d. An appropriate premium can be calculated based on the price at which other companies are selling. In particular, if other companies are selling at 30 per share, then a starting point for the premium to pay would be 30/25 = 20% premium.

e. The free-rider problem in the context of Grossman and Hart can be best explained as follows. The efficiency gains from a valuable takeover are a public good: all existing shareholders want the takeover to occur as it increases value, but for the same reason none of them will want to tender their shares because they want to appropriate the increase in value. In other words, shareholders would like to free-ride on others to sell the shares so they can obtain the value gains. The raider will then have to bid for the shares the original price plus the expected increase in value in shares making it extremely difficult for takeovers to occur in practice unless raiders have a pre-existing toehold of shares or there is a freeze out rule, etc.

Question 6

Monsters Incorporated (MI) is ready to launch a new product. Depending upon the success of this product, MI will have a value of either $100 million, $150 million, or $191 million, with each outcome being equally likely. The cash flows are unrelated to the state of the economy (i.e. risk from the project is diversifiable). The risk-free rate is currently 5%. MI has 5.6 million shares of stock outstanding and no debt. Assume that the Modigliani-Miller assumptions hold.

a. What is MI's share price? **(5 marks)**

Suppose now that one of the assumptions of Modigliani and Miller does not hold: in the event of default, 20% of the value of MI's assets will be lost in bankruptcy costs. Assume also that MI issues debt of face value $125 million due next year and uses the proceeds to repurchase shares.

b. What is the cost of debt? Why? **(4 marks)**

c. What is the yield to maturity? Is it the same as the cost of debt? Why? **(5 marks)**

d. What is the new price per share? Why? What is the new number of shares? **(6 marks)**

Suppose now that another of the assumptions of Modigliani and Miller does not hold: there is a corporate tax rate of 35%.

e. Without doing any calculation, how will the existence of taxes affect the calculation of the new price per share? Will it be higher, lower, the same as your answer in d.? Discuss. **(5 marks)**

Reading for this question

Subject guide, Chapters 6 and 8.

Approaching the question

a. To calculate the price we first estimate expected value as follows:

$$_VU = \frac{1/3(100)+1/3(150)+1/3(191)+}{1.05} = \$140 \text{ million}$$

Price per share = $140M / 5.6 million shares = $25.00.

b. The cost of debt is 5% because the risk of cash flows is diversifiable, so investors demand no extra compensation for risk.

c. The yield to maturity corresponds to the interest rate that equates expected value of debt (market value) to its face value. We first have to calculate the expected value of debt as follows:

Value of MI's debt:

$$V_{\text{debt}} = \frac{1/3(100(1-.20))+1/3(125)+1/3(125)+}{1.05} = \$104.76 \text{ million}$$

YTM = $\dfrac{\$125}{\$104.76}$ - 1 = .193182 or 19.3%. No, reflects probability of

bankruptcy and loss in value.

d. To calculate the new price per share we first recalculate the value of equity taking into account the bankruptcy instance.

Value of MI's equity:

$$V = \frac{\frac{1}{3} * 0 + \frac{1}{3} * 25 + \frac{1}{3} * 66}{1.05} = 28.89$$

Total Value = $V^L + V_{\text{debt}}$ = $28.89 + $104.765 = $133.6508 million

Price per Share = $133.65M / 5.6 million shares = $23.87

Shares repurchased: 125/23.87 = 5.237. New number of shares: 5.6 – 5.237 = 0.36.

e. The price will be lower because with taxes part of the value is appropriated by government.

Question 7

Pepso is a well-established company that sells apple juice, the value of the assets in place is 100 and it has no leverage. The CEO of Pepso is considering entering into the pear juice business. The net cost to the firm of entering this business is 20 (i.e., the costs exceed the benefits by 20), and the private benefits to the CEO of this business equal 1.5. The CEO owns 5% of the company and the discount rate is 0.

a. Find the NPV of investing in the pear juice business for the firm and the CEO. Would the CEO invest in the pear juice business if Pepso had enough internal resources? **(5 marks)**

The board of Pepso meets to discuss how to use financial policy to align management interests. They ask you to provide an alternative capital structure that can discipline the manager.

b. What is the minimum level of debt that aligns CEO preferences to those of the board? Assume that in the recapitalization the CEO shares are not tendered, and that outside investors are naïve such that they do not infer any potential agency conflicts from the financial policy of the firm. **(6 marks)**

c. Assume that Pepso's board decides to follow your advice and recapitalizes the company. The board decides to issue debt with face value of 80, and use the proceeds to buy back shares.

d. What is the new equity stake of the CEO in the firm?   (3 marks)

After the recapitalization, Pepso's main competitor, Appleok, decides to launch an aggressive competitive attack. The Head of Research and Development at Pepso comes up with a counterattack move that involves investing in a new and risky technology of apple juice production, which in case of success can stop the attack, and increase the value of the assets in place to 150. In case of failure the value of the assets in place decreases to 80. The probability that the technology is successful is 0.5. Investing in the technology has a cost of 20. Pepso must raise external equity finance to invest in the technology. You are hired by Pepso's board to structure the deal.

e. What is the equity stake that an outside investor will require in exchange of the investment cost of 20?   (6 marks)

f. Explain the concepts of debt overhang and risk shifting   (5 marks)

Reading for this question

Subject guide, Chapters 6 and 8.

Approaching the question

a. We need to compare the NPV of the business with the outside option of the firm which is to derive value from the assets in place. For the CEO it is important to recall that he has private benefits from the pear investment.

NPV(pear project) = 100 − 20 = 80 ≤ 100 = Value Assets in Place

NPV(pear project) for CEO = 5%(100 − 20) + 1.5 = 5.5 ≥ 5
           = 5%(Value Assets in Place)

Given our calculations above, we conclude that: yes, the CEO will invest because his benefit of investing is higher than the value of his stake of the assets in place.

b. The board would like to issue debt with face value of D and use the proceeds to buy back shares, in order to discipline the manager. Because investors are naïve the recapitalisation does not change the value of the assets in place, the new equity stake of the CEO, after the recapitalisation can be calculated as:

$$5\% (100) = \alpha\%(100 - D) \rightarrow \alpha\% = \frac{5}{100 \ - \ D}$$

The minimum value of debt for the CEO not to invest in the pear project is defined by the following inequality, where the value to the CEO from the project (after the recapitalisation) is forced to be lower than the value of the assets in place ≤ 5:

$$\frac{5}{100 \ - \ D} (80 - D) + 1.5 \leq 5$$

$$D \geq 33.33$$

c. The equity stake of the CEO corresponds to the number of shares he started out with divided by the new number of shares, which is smaller because some of the shares have been repurchased as part of the recapitalisation.

$$\alpha = \frac{5}{100-80} = 25\%$$

d. The outside investors just desire to break even, so we use the break-even condition to price the debt:

$$\beta \left[0.5 * 0 + 0.5 * (100 - 80)\right] = 20$$

$$\beta = \frac{20}{10} > 1$$

The equity stake is prohibitive (i.e. higher than 1), which means that Pepso cannot invest in the technology. The problem here is one of debt overhang.

e. The concepts of risk shifting and debt overhang are as follows: An equity stake in a levered firm corresponds to a call option on the cash flow of the firm with strike equal to the face value of debt. This implies that if given the chance, shareholders will always pick risky over safe projects, even if detrimental for firm value, as they are not really affected by the downside but have extraordinary potential gains from the upside (in detriment of debtholders). This tendency of shareholders is known as risk-shifting or asset substitution. One potential solution is financial restructuring where the face value of debt is reduced. Shareholders in a firm may forgo positive NPV projects if they have a large face value of debt because they will get to appropriate very little from the NPV. This issue is known as debt-overhang. If debt is restructured, such that some of the face value is forgiven, shareholders will be allowed to appropriate more of the positive NPV project and thus will invest. Restructuring is only feasible as long as debtholders remain just as well off after it.

Question 8

Carrie International (CI) is considering entering the shoe business in the US. The manager of CI believes that there exists a very narrow window for entering this market. Because of the Christmas demand, the time is right to invest is either today or exactly a year from now. Other than these two opportunities, there is no alternative opportunity to break into this market.

It will cost CI £35 million to enter the shoe market. Because other shoe manufactures exist and they are public companies, the manager of CI reckons that the current value of a comparable shoe company is £36 million. The manager of CI also reckons that 15% percent of the value of the firm is attributable to the value of the expected free cash flows in the first year of operation.

The flow of customers is uncertain, and so is the value of the shoe company. The volatility of the expected firm value is 25% per year. The risk free rate is 4%.

a. What is the expected value for CI of entering the shoe business this year?

(4 marks)

b. What is the value of the option to wait to enter the shoe market next year? When should CI enter the shoe business? (Hint: use discrete discounting)

(8 marks)

c. How should the decision of CI change if the expected value of the shoe company is £40 million instead of £36 million? (8 marks)

d. Without doing any calculation, explain how would your decision change if (i) the volatility of the expected firm value is 50%? (ii) if the window for entering is not 1 year but 2 years? Explain your answer in the context of call option pricing (5 marks)

Reading for this question

Subject guide, Chapter 4.

Approaching the question

a. The value of investing today corresponds to the difference between the value of a comparable company and the costs: $36 - 35 = 1$.

b. We apply the Black-Scholes formula, First, we adjust the value of the underlying, which in this case is the cash flow, to reflect the loss of the sales during the first year. $S^{*} = -PV(Cash) = 36 \times (1 - 0.15)$. Then we find the present value of the strike, which in this case is the cost of entering the market $PV(K) = ((35)/(1.04)) = 33.6538$. Then using the information provided on volatility of cash flows and knowing that the option last for a year we calculate the constants: $d_1 = 0.2555$, $d_2 = -0.5055$. Plugging the information in the formula we have that the value of the call option (and the value of waiting) is $C = 1.90$. This value is higher than the value of waiting of investing today (i.e. $1.90 > 1$). Hence Carrie International should wait.

c. We follow the same procedure as that in point b but now the expected cash flow is 40 as opposed to 36. First we adjust the value of the underlying, which in this case is the cash flow, to reflect the loss of the sales during the first year. $S^{*} = S - PV(Cash) = 40 \times (1 - 0.15)$. Then we find the present value of the strike, which in this case is the cost of entering the market $PV(K) = ((35)/(1.04)) = 33.6538$. Then using the information provided on volatility of cash flows and knowing that the option last for a year we calculate the constants: $d_1 = 0.1659$, $d_2 = 0.0841$. Plugging the information in the formula we have that the value of the call option (and the value of waiting) is $C = 3.54$. It is thus more valuable to enter now ($5 > 3.54$). There is no value in waiting.

d. Because as seen in class and as explained in the guidebook the value of a call option is increasing in volatility and time, the value of waiting also increases with volatility and time.