# FINC 430 TA Session 8 CAPM Solutions 

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## Question 1 (10-37 in the Textbook)

Suppose the market risk premium is $6.5 \%$ and the risk-free interest rate is $5 \%$. Calculate the cost of capital of investing in a project with a beta of 1.2.

## Steps

1. Determine the MRP and RF
2. Apply the CAPM equation
$\begin{aligned} \text { Cost of Capital } & =E[r]=r_{f}+\beta\left(E\left(R_{m}\right)-r_{f}\right) \\ & =5+1.2(6.5) \\ & =12.8 \%\end{aligned}$

## Question 2 (12-2 in the Textbook)

Suppose the market portfolio has an expected return of $10 \%$ and a volatility of $20 \%$, while Microsoft's stock has a volatility of $30 \%$.
a. Given its higher volatility, should we expect Microsoft to have an equity cost of capital that is higher than 10\%?
b. What would have to be true for Microsoft's equity cost of capital to be equal to $10 \%$ ?

## Steps

- Write Down CAPM regression
- $r_{i}=r_{f}+\beta\left(R_{m}-r_{f}\right)+$ error
- Take variance of both sides
- Write Down CAPM equation
- $E\left[r_{i}\right]=r_{f}+\beta\left(E\left(R_{m}\right)-r_{f}\right)$
- Put in data from the question
a. No, volatility includes diversifiable risk, so it cannot be used to assess the equity cost of capital.
b. Microsoft stock would need to have a beta of 1.


## Question 3 (12-6 in the Textbook)

Suppose Best Buy stock is trading for $\$ 30$ per share for a total market cap of $\$ 9$ billion, and Walt Disney has 1.65 billion shares outstanding. If you hold the market portfolio, and as part of it hold 100 shares of Best Buy, how many shares of Walt Disney do you hold?

## Steps

- Remember: Market is like someone owning every stock. If you hold the market, you just scale this up or down
- Determine number of shares Best Buy has outstanding
- Determine the ratio of DIS shares to Best Buy shares
- Determine \# of DIS shares you hold

Best Buy has $9 / 30=0.3$ billion shares outstanding.
Therefore, you hold $100 \times(1.65 / 0.3)=550$ shares of Disney.

## Question 4 (12-10 in the Textbook)

You need to estimate the equity cost of capital for XYZ Corp. You have the following data available regarding past returns:

| Year | Risk-free return | Market Return | XYZ Return |
| :---: | :---: | :---: | :---: |
| 2007 | $3 \%$ | $6 \%$ | $10 \%$ |
| 2008 | 1 | $-37 \%$ | $-45 \%$ |

a. What was XYZ's average historical return?
b. Compute the market's and XYZ's excess returns for each year. Estimate XYZ's beta.
c. Estimate XYZ's historical alpha.
d. Suppose the current risk-free rate is $3 \%$, and you expect the market's return to be $8 \%$. Use the CAPM to estimate an expected return for XYZ Corp.'s stock.
e. Would you base your estimate of XYZ's equity cost of capital on your answer in part (a) or in part (d)? How does your answer to part (c) affect your estimate? Explain.

## Steps

- Excess Return = Return - Risk Free Return
- Write down CAPM equation

$$
-E\left[r_{i}\right]=r_{f}+\beta\left(E\left(R_{m}\right)-r_{f}\right)
$$

- Solve the CAPM equation for beta
- Once you have beta, you can back out alpha
a. $(10 \%-45 \%) / 2=-17.5 \%$
b. Excess returns:

$$
\begin{aligned}
& \text { MKT } 3 \%,-38 \% \\
& \text { YYZ } 7 \%,-46 \% \\
\beta= & (7-(-46)) /(3-(-38))=1.29
\end{aligned}
$$

$$
\text { c. Alpha }=\text { intercept }=\left(E\left(R_{s}\right)-r_{f}\right)-\beta\left(E\left(R_{m}\right)-r_{f}\right)
$$

$$
=(7 \%-46 \%) / 2-1.29 \times(3 \%-38 \%) / 2=3.1 \%
$$

$$
\text { d. } E[R]=3 \%+1.29 \times(8 \%-3 \%)=9.45 \%
$$

e. Use (d)-CAPM is more reliable than average past returns, which would imply a negative cost of capital in this case!
Ignore (c), as alpha is not persistent.

## Question 5

Consider the following diagram, plotting the standard deviation and expected return of various assets. Assume that the CAPM holds. Asset F is risk-free Treasury bills. Asset M is the market portfolio. Assets $\mathrm{W}, \mathrm{X}, \mathrm{Y}$ and Z are individual risky assets that are all uncorrelated with each other.


## a. Calculate the beta of asset W.

Imagine running two regressions. Regression 1 is a regression of the excess returns of asset $Y$ on the excess returns of asset $M$. Regression 2 is a regression of the excess returns of asset $Z$ on the excess returns of asset $M$.
b. Which of the following is true?
i. The beta coefficient in regression 1 is higher than the beta coefficient in regression 2.
ii. The beta coefficient in regression 1 is lower than the beta coefficient in regression 2.
iii. The beta coefficient in regression 1 is the same as the beta coefficient in regression 2.
iv. You cannot predict the relative magnitudes of the beta coefficients in these regressions.
Explain your answer.
c. Consider the same two regressions. Which of the following is true?
v. The R 2 in regression 1 is higher than the R 2 in regression 2.
vi. The R2 in regression 1 is lower than the $R 2$ in regression 2.
vii. The $R 2$ in regression 1 is the same as the $R 2$ in regression 2 .
viii. You cannot predict the relative magnitudes of the R2 in these regressions.
Explain your answer.
d. Suppose you formed a portfolio $P$ by holding $40 \%$ of your wealth in W and the rest of your wealth in $Z$. Calculate the expected return and the standard deviation of $P$.
a. Calculate the beta of asset W.

$$
\begin{gathered}
E\left(r_{W}\right)-r_{f}=\beta_{W}\left(E\left(r_{M}\right)-r_{f}\right) \\
\beta_{W}=\frac{E\left(r_{W}\right)-r_{f}}{E\left(r_{M}\right)-r_{f}}=\frac{8 \%-3 \%}{13 \%-3 \%}=0.5
\end{gathered}
$$

b. Which of the following is true?
i. The beta coefficient in regression 1 is higher than the beta coefficient in regression 2.
ii. The beta coefficient in regression 1 is lower than the beta coefficient in regression 2.
iii. The beta coefficient in regression 1 is the same as the beta coefficient in regression 2.
iv. You cannot predict the relative magnitudes of the beta coefficients in these regressions.
Explain your answer.

Since asset $Y$ has the same expected return as asset $Z$, they must have the same beta. (Answer iii.)
c. Consider the same two regressions. Which of the following is true?
$v$. The $R 2$ in regression 1 is higher than the $R 2$ in regression 2.
vi. The R2 in regression 1 is lower than the R2 in regression 2.
vii. The R2 in regression 1 is the same as the R2 in regression 2.
viii. You cannot predict the relative magnitudes of the R2 in these regressions.
Explain your answer.
$Y$ and $Z$ have the same systematic risk (because of same betas). However, Z has more overall risk and therefore has more idiosyncratic risk. Therefore, the $\mathrm{R}^{2}$ in regression 1 will be higher, since more of the total risk of $Y$ will be explained by $M$.
(Answer v.)
d. Suppose you formed a portfolio P by holding $40 \%$ of your wealth in W and the rest of your wealth in Z . Calculate the expected return and the standard deviation of $P$.

$$
\begin{aligned}
E\left(r_{P}\right) & =0.40 E\left(r_{W}\right)+0.60 E\left(r_{Z}\right) \\
& =0.40(8 \%)+0.60(14 \%) \\
& =11.6 \%
\end{aligned}
$$

$$
\begin{aligned}
& \sigma_{P}=\sqrt{0.40^{2} \sigma_{W}^{2}+0.60^{2} \sigma_{Z}^{2}+2(0.4)(0.6) \operatorname{Cov}\left(r_{W}, r_{Z}\right)} \\
& =\sqrt{0.40^{2} \sigma_{W}^{2}+0.60^{2} \sigma_{Z}^{2}+2(0.4)(0.6)(0)} \\
& = \\
& =\sqrt{0.40^{2} 0.23^{2}+0.60^{2} 0.38^{2}} \\
& =24.59 \%
\end{aligned}
$$

## Question 6

Answer the following questions using the data from the Excel file. The returns data provided are monthly returns.
a. What is XYZ's beta?
b. According to the CAPM, what percentage of XYZ's return movements is due to firm specific risk?
c. Does the level of firm specific risk of a stock indicate whether the CAPM is a valid theory?

## See Excel file for the solutions

## Firm Specific Risk

- Write Down CAPM regression
- $r_{i}=r_{f}+\beta\left(R_{m}-r_{f}\right)+$ error
- Take variance of both sides


## EXTRA QUESTIONS

## Question 7

On Sunday, March 5, 2006, AT\&T announced that it would be acquiring Bell South. You have the following information:

|  | AT\&T | BellSouth |
| :--- | :--- | :--- |
| Number of shares outstanding | 3.88 billion | 1.80 billion |
| Beta $(\beta)$ | 0.80 | 0.83 |
| Alpha $(\alpha)$ | 0.00 | 0.00 |
| Closing price per share on Friday, March 3 | $\$ 27.99$ | $\$ 31.46$ |
| Closing price per share on Monday, March 6 | $\$ 27.02$ | $\$ 34.50$ |

You also know that the return on the market portfolio of stocks was -0.70 \% (-0.007) on March 6 (calculated based on the closing values of the S\&P 500 index on March 3 and March 6). Assume that the riskless rate is zero and that no dividends were paid on March 3 or March 6.
a. What was the firm-specific return for AT\&T on March 6, $\varepsilon_{A T \& T, M a r c h} 6$ (in percent)? What was the firm-specific return for BellSouth on March 6, $\varepsilon_{\text {BellSouth,March } 6}$ (in percent)?
b. Assume that for both AT\&T and for BellSouth, the only firm-specific news that arrived between the end of trading on Friday March 3 and the end of trading on March 6 was the news about AT\&T's acquisition of BellSouth. How much value (in dollars) did the announcement of the acquisition create/destroy for AT\&T shareholders? How much value (in dollars) did the announcement of the acquisition create/destroy for BellSouth shareholders? Does the proposed acquisition seem to create or destroy value overall?
(End of question)
a. To compute the firm-specific return, solve the CAPM regression

$$
r_{i, t}-r_{f, t}=\alpha_{i}+\beta_{i}\left(r_{m, t}-r_{f, t}\right)+\varepsilon_{i, t}
$$

for $\varepsilon_{i, t}$ using the return on the firm

$$
r_{i, t}=\frac{P_{i, t}-P_{i, t-1}}{P_{i, t-1}}
$$

(since there are no dividends here). Hence:

$$
\begin{aligned}
& \varepsilon_{A T \& T, M a r c h ~ 6}=r_{A T \& T, M a r c h ~ 6}-\left[\alpha_{A T \& T}+\beta_{A T \& T}\left(r_{m, M a r c h ~ 6}-r_{f, M a r c h} 6\right)\right] \\
& =\frac{27.02-27.99}{27.02}-[0+0.8(-0.0070-0)] \\
& =-0.0291, \text { or } 2.91 \% \\
& \varepsilon_{\text {BellSouth }, \text { March } 6}=r_{\text {BellSouth }, \text { March } 6}-\left[\alpha_{\text {BellSouth }}+\beta_{\text {BellSouth }}\left(r_{m, \text { March } 6}-r_{f, \text { March } 6}\right)\right] \\
& =\frac{34.50-31.46}{31.46}-[0+0.83(-0.0070-0)] \\
& =0.1024 \text {, or } 10.24 \%
\end{aligned}
$$

b. The value created or destroyed is the firm-specific return times the initial total market value of the firm. Thus:

Value created/destroyed for AT\&T
$=(A T \& T$ market value on March 3$) \times \varepsilon_{A T \& T, M a r c h ~} 6$

$$
=\$ 27.99 \times 3.88 \mathrm{~B} \times(-0.0291)
$$

$$
=-\$ 3.16 \mathrm{~B}
$$

Value created/destroyed for BellSouth

$$
\begin{aligned}
& =(\text { BellSouth market value on March } 3) \times \varepsilon_{\text {BellSouth,March } 6} \\
& =\$ 31.46 \times 1.8 \mathrm{~B} \times(0.1024) \\
& =\$ 5.80 \mathrm{~B}
\end{aligned}
$$

Since $-\$ 3.16 \mathrm{~B}+\$ 5.80 \mathrm{~B}>0$ the deal is creating value overall (i.e. for AT\&T and BellSouth overall).

