1. Your company has preferred stock with an annual dividend of $3.50 and a current price of $43.75. What is the investors’ required rate of return on preferred stock?

Recall that the price of preferred stock is $\text{price(preferred stock)} = \frac{\text{dividend}}{r_{ps}}$, where $r_{ps}$ is the investors’ required rate of return on preferred stock. Then, using the information provided in the problem:

$$\text{price(preferred stock)} = \frac{\$3.50}{r_{ps}}$$

$$\$43.75 = \frac{\$3.50}{r_{ps}}$$

$$\iff r_{ps} = \frac{\$3.50}{\$43.75} = 0.08$$

2. NoGrowth Corporation currently pays a dividend of $0.50 per quarter, and it will continue to pay this dividend forever. If the firm’s equity cost of capital is 15% (quoted as an EAR), what is the price per share of NoGrowth’s stock?

NoGrowth Corporation pays $0.50 dividend per quarter forever and its equity cost of capital is 15% annually (quoted as an EAR). First, let’s calculate its quarterly equity cost of capital:

$$(1 + r)^4 = 1.15$$

$$\iff r = (1.15)^{\frac{1}{4}} - 1 = 0.0356$$

Since the dividend stream is not growing and continues forever, NoGrowth’s share price is:

$$P = \frac{\$0.50}{0.0356} = \$14.06$$

3. DFB, Inc., expects earnings this year of $5 per share, and it plans to pay its next dividend of $3 today to shareholders. DFB will retain $2 per share of its earnings to reinvest in new projects that have an expected return of 15% per year. Suppose DFB will maintain the same dividend payout rate, retention rate, and return on new investments in the future and will not change its number of outstanding shares.
(a) What growth rate of earnings would you forecast for DFB?
From a simple model of growth in class,

\[
\text{earnings growth rate} = \text{retention rate} \times \text{return on new investment}
\]

\[
= \frac{\$2}{\$5} \times 0.15
\]

\[
= 0.06
\]

(b) If DFB’s equity cost of capital is 12%, what price would you estimate for DFB’s stock?
Since the retention rate is constant, the growth rate of dividends is the same as the growth rate of earnings, which is 6% as found in part (a). Using the dividend discount model, the price for DFB’s stock is:

\[
P_0 = \frac{\$3}{0.12 - 0.06}
\]

\[
= \$56
\]

(c) Suppose instead that DFB paid a dividend of $4 per share this year and retained only $1 per share in earnings. If DFB maintains this higher payout rate in the future, what stock price would you estimate for the firm now? Should DFB raise its dividend?
First, the new earnings growth rate is:

\[
\text{earnings growth rate} = \text{retention rate} \times \text{return on new investment}
\]

\[
= \frac{\$1}{\$5} \times 0.15
\]

\[
= 0.03
\]

Then, the new price for DFB’s stock is:

\[
P_{0,\text{new}} = \frac{\$4}{0.12 - 0.03}
\]

\[
= \$49.78
\]

The stock price decreases when DFB increases its dividend payout. This is because by investing its earnings at a rate 15%, which is higher than its 12% equity cost of capital, the firm creates shareholder value. When DFB increases its dividend payout, it comes at the expense of a reduction in reinvestment. This is equivalent to not investing in positive NPV projects and results in a reduction in firm value.

4. Your firm is considering a project that would cost $100,000 initially, but would be expected to generate additional cash flows of $30,000 per year for 4 years, starting 1 year from today. Show whether you should take the project if your opportunity cost of capital is 12%. Should you take the project if the additional cash flows start 3 years from today (rather than 1 year from today)?
Based on the cash flows generated and a discount rate of 12%, the net present value of the project is:

\[
NPV = -\$100,000 + \frac{\$30,000}{(1 + 0.12)} + \frac{\$30,000}{(1 + 0.12)^2} + \frac{\$30,000}{(1 + 0.12)^3} + \frac{\$30,000}{(1 + 0.12)^4}
\]

\[
= -\$8,879.52
\]
The NPV is negative, meaning that the PV of the costs outweigh the PV of the benefits and taking this project will reduce the company’s value by $8,879.52 today. The firm’s managers should not take the project. If the cash flows start in 3 years from today, rather than 1 year from today, the net present value of the project is:

\[
NPV = -$100,000 + \frac{$30,000}{(1 + 0.12)^3} + \frac{$30,000}{(1 + 0.12)^4} + \frac{$30,000}{(1 + 0.12)^5} + \frac{$30,000}{(1 + 0.12)^6}
\]

\[= -$27,359.31\]

Since the NPV is still negative, the firm’s managers should still not take the project.

5. Innovation Company is thinking about marketing a new software product. Upfront costs to market and develop the product are $5 million. The product is expected to generate profits of $1 million per year for ten years. The company will have to provide product support expected to cost $100,000 per year in perpetuity. Assume all profits and expenses occur at the end of the year. What is the NPV of this investment if the cost of capital is 6%? Repeat the analysis for discount rates of 2% and 11%.

The cash outflows for this product are $5 million today and $100,000 per year in perpetuity. The cash inflows are $1 million per year for ten years. The NPV for this product is:

\[
NPV = -5 + \frac{1}{r} \left( 1 - \frac{1}{(1 + r)^{10}} \right) - \frac{0.1}{r},
\]

where \( r \) is the cost of capital. Note that the first part of the NPV is the upfront cost, the second part is the profits of $1 million per year, and the last part is the product support expected to cost $100,000 per year in perpetuity. At \( r = 6\% \), the NPV is $0.693 million. At \( r = 2\% \), the NPV is $-1.017 million. At \( r = 11\% \), the NPV is $-0.020 million.

6. You are considering making a movie. The movie is expected to cost $10 million upfront and take a year to make. After that, it is expected to make $5 million (at the end of year two) and $2 million per year for the following four years. What is the payback period of this investment? If you require a payback period of two years, will you make the movie? What is the NPV of the movie if the cost of capital is 10%?

The payback period is 5 years, since this is when the initial investment is recouped in nominal terms. Since this is greater than the required payback period of two years, you would not make the movie. The cash flows (in millions) from the project are provided in the table below:

<table>
<thead>
<tr>
<th>Cash Flows</th>
<th>today</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>4 years</th>
<th>5 years</th>
<th>6 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$-10</td>
<td>$0</td>
<td>$5</td>
<td>$2</td>
<td>$2</td>
<td>$2</td>
<td>$2</td>
</tr>
</tbody>
</table>

Using a discount rate of 10%, the net present value (in millions) of the project is:

\[
NPV = -$10 + \frac{$5}{(1 + 0.10)^2} + \frac{$2}{(1 + 0.10)^3} + \frac{$2}{(1 + 0.10)^4} + \frac{$2}{(1 + 0.10)^5} = -$0.628 million,
\]

or equivalently $-638,322. Since the NPV is negative, you would not make the project.
7. Suppose your friend Dirk has created the next trendy iPad game, but he is burned out and wants to take a 3 year vacation. He wants to sell you his game while he is unplugged from civilization. His game generates $4,000 in sales per year (assume those cash flows will be the same for the next 3 years) and, when he gets back, he wants to buy the game back from you for $100,000. You think that the risk is such that the discount rate should be 8%.

(a) Since you want to give your friend Dirk a fair price, you set the price so $NPV = 0$. How much should you pay Dirk for his game?

The cash flows from the project are provided in the table below.

<table>
<thead>
<tr>
<th>Cash Flows</th>
<th>today</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ -I $</td>
<td>$4,000</td>
<td>$4,000</td>
<td>$104,000</td>
<td></td>
</tr>
</tbody>
</table>

Using a discount rate of 8%, you should pay Dirk:

$$NPV = 0 = -I + \frac{\$4,000}{(1 + 0.08)^1} + \frac{\$4,000}{(1 + 0.08)^2} + \frac{\$100,000 + \$4,000}{(1 + 0.08)^3}$$

$$\implies I = \$89,691.61$$

(b) Suppose Dirk wants to sell you the game for $100,000. Should you buy it? What is the NPV?

Since $100,000 > \$89,691.61$, the NPV will be negative and you should not buy the game. The net present value is:

$$NPV = -$100,000 + \frac{\$4,000}{(1 + 0.08)^1} + \frac{\$4,000}{(1 + 0.08)^2} + \frac{\$100,000 + \$4,000}{(1 + 0.08)^3}$$

$$= -$10,308.39$$

(c) Suppose Dirk changes his offer such that he wants to sell you the game and not buy it back. You expect the sales to stay at $4,000 forever. What price would you be willing to pay him so that the project is NPV=0?

Now the cash flows from the project are $4,000 starting next year and continuing forever. Since this is a perpetuity, the net present value is:

$$NPV = 0 = -I + \frac{\$4,000}{0.08}$$

$$\implies I = \$50,000$$