1. You are trying to decide between two options for a copier. The first option costs $12,000 now, and then costs $3,000 per year in maintenance. The second option costs $16,000 now, and $2,000 per year in maintenance. The first copier will last for 3 years and the second option will last for 4 years. If your discount rate is 7%, and you need a copier for the foreseeable future, which option should you choose? [8]

The cash flows from the two copiers look like this:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>16</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

The PV of the total cost of copier A is:

\[
PV_A = 12 + \frac{3}{.07} \left[ 1 - \frac{1}{(1.07)^3} \right] = 19.87
\]

The PV of the total cost of copier B is:

\[
PV_B = 16 + \frac{2}{.07} \left[ 1 - \frac{1}{(1.07)^4} \right] = 22.77
\]

The EAC of A: \( EAC_A = \frac{19.87}{.07} \left[ 1 - \frac{1}{(1.07)^3} \right] = 7.57 \)

The EAC if B: \( EAC_B = \frac{22.77}{.07} \left[ 1 - \frac{1}{(1.07)^4} \right] = 6.72 \)

So, you should take B, it has the lower equivalent annual cost, meaning that it is less expensive on a per year basis.

2. You are considering a car lease. You realize that the better the car holds its value, the lower are your lease payments. At the end of the lease, you either give the car back or pay the residual value (the value of the car at the end of the lease). You are looking at a $30,000 car and a 36-month lease with the first payment due in one month. If the interest rate is 4.8% APR, compounded monthly, how high does the residual value have to be in order for your payments to be no more than $500 per month. [8]?

The cash flows for the lease look like this:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2...</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500</td>
<td>500</td>
<td>...</td>
<td>500</td>
</tr>
<tr>
<td>Resid Val</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You are getting $30000 (for the car) in exchange for 36 payments of $500 per month and a residual value at the end. To solve for how much the residual value must be, first solve for the PV of the lease payments and that will tell you how much must be left over for the residual value to cover.

\[
PV = \frac{500}{.004} \left[ 1 - \frac{1}{(1.004)^{36}} \right] = 16732.94, \text{ so the PV of the residual value must be } 30,000 - 16,732.94 = 13,267.06. \text{ The actual amount of the residual value is a FV (it is in 36 months): } 13,267.06 \left( 1.004 \right)^{36} = 15,317.52
\]
3. A payday loan is structured to obscure the true interest rate you are paying. For example, in Washington, you pay a $30 "fee" for a two-week $200 payday loan (when you repay the loan, you pay $230). What is the effective annual interest rate for this loan? [6]

Your 2-week interest rate is 15%: \[ r = \frac{230}{200} - 1 = 0.15. \]
There are 26 two-week periods in a year, so your EAR is \( (1+.15)^{26} - 1 = 36.8568 \), or 3,685.68%!!!!!

Thus, if you took out a $200 payday loan on January 1st, and rolled-it over every 2-weeks, at the end of the year, you would owe: \( 200(1.15)^{26} \approx 7,571.36 \)!

4. What is an IRR and how is it used? [7]

An IRR, or internal rate of return, is the discount rate at which the NPV of the cash flows is zero. It tells you the rate of return from the investment, based on the cash flows. It is often used in making capital budgeting decisions. You would compute the IRR of a project, compare it to your benchmark rate of return (your opportunity cost of capital) and accept the project if the IRR is greater than the benchmark. As we discussed in class, this approach will usually, but not always, lead to the correct decision.

5. Explain and justify the goal of the financial manager. [7]

The goal of the financial manager is to maximize the equity value of the firm (the wealth of the shareholders). The financial manager is the caretaker of the shareholders' investment in the company and his or her job is to make decisions that will maximize the value of that investment. Their money is at risk in the company, they have funded the company and they own the company.


Existing bonds offer you a fixed deal. The CF’s are fixed at the origination of the contract. When interest rates go up, when you compare the coupons the existing bond is offering to coupons new bonds are offering, the existing bonds look less attractive. As a result, their price has to go down until they look just as attractive as the new bonds.
7. You notice that the yields-to-maturity (YTM) of some zero-coupon Treasury bonds are:

<table>
<thead>
<tr>
<th>Maturity</th>
<th>3 months</th>
<th>6 months</th>
<th>1 year</th>
<th>1.5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>YTM</td>
<td>1%</td>
<td>1.5%</td>
<td>1.8%</td>
<td>2%</td>
</tr>
</tbody>
</table>

All of the YTM’s are quoted as APRs with semi-annual compounding.

a. You are looking at a 1-year zero-coupon corporate bond with a credit spread of 80 basis points. What is its price? [5]

We know the YTM of a 1-year Treasury zero-coupon bond: 1.8%. Since zero-coupon bonds have only one cash flow, the YTM is the spot rate (the discount rate). A credit spread of 80 bps means 0.80%, so the YTM of the corporate bond must be 1.8% + 0.8% = 2.6%. Given that information, we can calculate the price:

\[ \text{PRICE} = \frac{1000}{\left(1 + \frac{.026}{2}\right)^2} = 974.50 \]

b. Would the YTM of a 1.5-year 2% coupon treasury bond be more than, less than or equal to 2%? Why?[4]

It would be less than 2%. The YTM of a 1.5-year zero-coupon bond is 2%. The YTM of a 2% coupon bond must be a weighted average of the 6 month, 1 year and 1.5 year rates. Since the 1 year and 1.5 year rates are less than 2%, the average must be less than 2%.

c. Would the YTM of a 1.5-year 10% coupon bond be more than, less than, or equal to the YTM of a 1.5-year 5% coupon bond? Explain. [4]

This one is harder. The YTM of the 10% coupon bond will be less. This is because the coupon payments for the 10% bond are twice those of the coupon payments of the 5% bonds. Thus, in the weighted average, the 10% bond is putting relatively more weight on the earlier rates, which are the lower rates. So, the weighted average for the 10% bond must be lower than the weighted average for the 5% bond.

8. You need to borrow $100 for 6 months. You can do it on your credit card at an APR of 19.6%, compounded monthly. But, your friend offers to lend you the $100 as long as you pay her back $110 in 6 months. Which is the better deal? [6]

The monthly rate is \( .196/12 = 0.01633 \). Over 6 months, this works out to be \( (1.01633)^6 = 1.10209 \) or 10.209%. Your friend is offering you 10% interest over 6 months, so you should take her offer.
9. After spending $10,000 on client-development, you have just been offered a big production contract by a new client. The contract will add $200,000 to your revenues for each of the next 3 years and it will cost you $100,000 per year to make the additional product. You will have to use some existing equipment and buy new equipment as well. The existing equipment is fully depreciated, but could be sold for $50,000 now. If you use it in the project, it will be worthless at the end of the project. You will buy new equipment valued at $30,000 and straight-line depreciate it to zero over 3 years. It will be worthless at the end of the project. Your current production manager earns $80,000 per year. Since she is busy with ongoing projects, you are planning to hire an assistant at $40,000 per year to help with the expansion. You will have to immediately increase your inventory from $20,000 to $30,000. It will return to $20,000 at the end of the project. Your company’s tax rate is 35% and your discount rate is 15%. Should you accept the contract? [20]

The money spent on client development is irrelevant (sunk cost). The fact that your current production manager makes $80,000 is also irrelevant (existing overhead). The inventory is working capital—increasing working capital is a cash outflow. If you go from 20 to 30, that is an increase in working capital of 10, meaning an outflow of 10. The outflow reverses at the end of the project when the inventory goes back down.

The existing equipment represents an opportunity cost. It is fully depreciated, so it has a BV of 0. If you don’t take the contract, you can sell the existing equipment and keep 50 - (50-0)(.35)=32.5 after tax.

\[
\begin{array}{c|c|c|c|c}
 & 0 & 1 & 2 & 3 \\
\hline
\text{Revs} & 200 & 200 & 200 \\
\text{Exp} & 100 & 100 & 100 \\
\text{New Salary} & 40 & 40 & 40 \\
\text{Depr} & 10 & 10 & 10 \\
\hline
\text{Taxable Income} & 50 & 50 & 50 \\
\text{Tax (35\%)} & 17.5 & 17.5 & 17.5 \\
\text{Net Income} & 32.5 & 32.5 & 32.5 \\
\hline
\text{Add back Depr} & 10 & 10 & 10 \\
\text{CF fr ΔWC} & -10 & & +10 \\
\text{Opp Cost} & -32.5 & & \\
\text{New Equip} & & -30 & \\
\hline
\text{FCF} & -72.5 & 42.5 & 42.5 & 52.5 \\
\end{array}
\]

\[
NPV = -72.5 + \frac{42.5}{(1.15)} + \frac{42.5}{(1.15)^2} + \frac{52.5}{(1.15)^3} = 31.11 , \text{ so take the contract. Note that the question asks you for a decision. Full credit requires you to say what to do (show that you can apply the NPV rule).}
\]
10. You are considering two mortgages. Each is for $300,000 with a 6% APR, compounded monthly. One is for 15 years (180 months) and the other is for 30 years (360 months). Show that the payment for the 15-year mortgage is less than twice the payment for the 30-year mortgage and explain why this is the case. [8]

The PV of the mortgage is the amount of the loan: $300,000. The monthly rate is \(0.06/12=0.005\). Solving for the mortgage payment is just solving for the CF in an annuity. For the 30-year mortgage, there are 360 months and for the 15-year mortgage, there are 180 months.

\[
300,000 = CF \left[ \frac{1}{0.005} - \frac{1}{0.005(1.005)^{360}} \right] \Rightarrow CF = 1798.65
\]

\[
300,000 = CF \left[ \frac{1}{0.005} - \frac{1}{0.005(1.005)^{180}} \right] \Rightarrow CF = 2531.57
\]

The fact that you are paying the loan off more quickly in the 15-year loan means that you are paying down the principal more rapidly and so are paying less interest. This allows you to retire the loan in half the time, but paying far less than twice the 30-year payment.

11. Here's a common retirement problem: you want to retire with $10,000 per month in real income from your investments. How many nominal dollars do you need to have saved when you retire? Assume the following: 43 years until retirement, nominal monthly discount rate of 0.7012%, monthly inflation rate of 0.3%, 25-year retirement, first withdrawal from your savings occurs one month after you retire. [if you get stuck, assume a nominal income of $10,000 per month and you can get partial credit] [8]

First, let’s get the real rate: \(1.007012/1.003 -1 = .004\) per month.

Now, we start with the real value you will need to have in your account one month before you start making retirement withdrawals. This is the PV of a real annuity of 25 x 12 = 300 months of $10,000 per month:

\[
REAL\ PV_{43\ years\ from\ now} = \frac{10000}{.004} \left[ 1 - \frac{1}{(1.004)^{300}} \right] = 1,745,209.95
\]

This real amount is in terms of TODAY’s purchasing power. We need to convert that real amount into a nominal amount, by adding in the 43 x 12 = 516 months of inflation that will have passed between now and your retirement:

\[
1745209.95(1.003)^{516} = \$8,187,081.60
\]

12. You bought a 6% coupon bond (semi-annual coupons) for $1020. If you sold it for par after receiving one coupon, what would your return be? [2]

Par is $1000 by default. 6% coupon bond with semi-annual coupons means $60 per year paid as $30 every 6 months. If you sell it for $1000 after the first coupon, you will have received $30 in coupons and you will have lost $20 ($1020 - $1000) on the purchase and sale. Your total return is

\[
\frac{($30 - $20)}{$1020} = 0.0098
\]