**Chapter Four**

**Net Present Value**

---

**Chapter Outline**

4.1 The One-Period Case  
4.2 The Multiperiod Case  
   - Present Value  
   - Future Value  
   - Uneven Cash Flows  
4.3 Compounding Periods  
4.4 Simplifications  
4.5 What Is a Firm Worth?  
4.6 Summary and Conclusions

---

**4.6 Summary and Conclusions (continued)**

- **Four Basic Problems Types:**  
  - Perpetuity/Growing Perpetuity  
    \[ PV_n = \frac{(Cash\ Flow_{n+1})}{(Interest\ Rate-growth\ rate)} \]  
  - Time Value of Money (PV, FV, N, PMT, I)  
  - Uneven Cash Flows (NPV and IRR)  
  - Multi-Step Problems  
    - Time Value of Money (solve for missing inputs before solving for answer)  
    - Future Value of Uneven Cash Flows (solve for NPV of known cash flows, use this known cash flow to solve for unknown cash flows)

---

**4.4 How do you get to Carnegie Hall?**

- **Practice, practice, practice.**  
- It's easy to watch Olympic gymnasts and convince yourself that you are a leotard purchase away from a triple back flip.  
- It's also easy to watch your finance professor do time value of money problems and convince yourself that you can do them too.  
- There is no substitute for getting out the calculator and flogging the keys until you can do these correctly and quickly.
### TVM-Growing Annuity

- You will receive $8500 next year, and this amount will grow for 5 years at a nominal 7%. If your required return is 12%, what is the present value of these five future cash flows?

### PV of Growing Annuity Using TVM Keys

First, set your calculator to 1 payment per year.

<table>
<thead>
<tr>
<th>N</th>
<th>I/Y</th>
<th>FV</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.67</td>
<td>7,973.93</td>
<td>34,706.26</td>
</tr>
</tbody>
</table>

\[
\text{PV} = \frac{1.12}{1.07} - 1 \times 100
\]

\[
- 34,706.26
\]

\[
7,973.93 = \frac{8,500}{1.07}
\]

### Problems

- You have $30,000 in student loans that call for monthly payments over 10 years.
  - $15,000 is financed at seven percent APR
  - $8,000 is financed at eight percent APR and
  - $7,000 at 15 percent APR
- What is the interest rate on your portfolio of debt?

Hint: don't even think about doing this:

\[
\frac{15,000}{30,000} \times 7\% + \frac{8,000}{30,000} \times 8\% + \frac{7,000}{30,000} \times 15\%
\]

### Problems – NPV of uneven cash flows

- You are considering the purchase of a prepaid tuition plan for your 8-year old daughter. She will start college in exactly 10 years, with the first tuition payment of $12,500 due at the start of the year. Sophomore year tuition will be $15,000, junior year tuition $18,000, and senior year tuition $22,000. How much money will you have to pay today to fully fund her tuition expenses? The discount rate is 14%

### Problems- TVM multi-step

You are thinking of buying a new car. You bought your current car exactly 3 years ago for $25,000 and financed it at 7% APR for 60 months. You need to estimate how much you owe on the loan to make sure that you can pay it off when you sell the old car.
Problems—solve for NPV then FV

You have just landed a job and are going to start saving for a down-payment on a house. You want to save 20 percent of the purchase price and then borrow the rest from a bank. You have an investment that pays 10 percent APR. Houses that you like and can afford currently cost $100,000. Real estate has been appreciating in price at 5 percent per year and you expect this trend to continue.

How much should you save every month in order to have a down payment saved five years from today?

Problems

- First we estimate that in 5 years, a house that costs $100,000 today will cost $127,628.16
- Next we estimate the monthly payment required to save up that much in 60 months.

\[
\begin{align*}
N & = 5 & N & = 5 \times 12 = 60 \\
I/Y & = 5 & I/Y & = 10/12 = 0.833333 \\
PV & = 100,000 & PV & = 0 \\
PMT & = 0 & PMT & = -329.63 \\
FV & = 127,628.16 & FV & = 25,525.63 = 0.20 \times 127,628.16
\end{align*}
\]

EAR on a financial Calculator

**Hewlett Packard 10B**

<table>
<thead>
<tr>
<th>keys:</th>
<th>display:</th>
<th>description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 [gold] [P/YR]</td>
<td>12.00</td>
<td>Sets 12 P/YR.</td>
</tr>
<tr>
<td>18 [gold] [NOM%]</td>
<td>18.00</td>
<td>Sets 18 APR.</td>
</tr>
<tr>
<td>[gold] [EFF%]</td>
<td>19.56</td>
<td></td>
</tr>
</tbody>
</table>

**Texas Instruments BAII Plus**

<table>
<thead>
<tr>
<th>keys:</th>
<th>description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[2nd] [ICONV]</td>
<td>Opens interest rate conversion menu</td>
</tr>
<tr>
<td>[1] [C/Y=] 12</td>
<td>Sets 12 payments per year</td>
</tr>
<tr>
<td>[LN] [NOM=] 18 [ENTER]</td>
<td>Sets 18 APR.</td>
</tr>
<tr>
<td>[LN] [EFF=] [CPT]</td>
<td>19.56</td>
</tr>
</tbody>
</table>