BASIC CONCEPTS

TIME VALUE OF MONEY

A. Present Value-Based Accounting Measurements
The time value of money is used extensively in accounting. The textbook lists a number of applications. As accounting moves more and more toward fair value accounting we can expect this list to get longer.

B. Variables in Interest Computation
There are several terms that we need to understand.
   1. **Principal** - the amount borrowed or invested on which interest is to be charged
   2. **Interest rate** - the percentage that is applied to the principal
   3. **Time** - the periods that the principal is outstanding

C. Components of Interest
The rate of interest is actually comprised of three components.
   1. **Pure rate (risk free)** - the amount of interest charged on risk free investments
   2. **Credit risk rate** - the risk associated with credit worthiness of the borrower
   3. **Inflation risk rate** - the expected rate of inflation during the time period

D. Simple Interest
The computation of simple interest is based on the original principal amount. It is the same amount each period. For example, if Spencer Company borrows $100,000 at 10% simple interest for five years the interest would be computed as follows:

   | Principal | $100,000 |
   | Interest rate | 10% |
   | Interest per year | $ 10,000 |
   | Number of years outstanding | 5 |
   | Total interest expense | $ 50,000 |

E. Compound Interest
The computation of compound interest takes into account retention of the interest. In effect, the interest is added to the principal balance each period to derive a new principal balance. Using the same example, the computation of compound interest for Spencer Company would be computed as follows:

<table>
<thead>
<tr>
<th>End of Year</th>
<th>Beginning Balance</th>
<th>Interest Rate</th>
<th>Ending Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$100,000</td>
<td>10%</td>
<td>$110,000</td>
</tr>
<tr>
<td>2</td>
<td>110,000</td>
<td>10%</td>
<td>$121,000</td>
</tr>
<tr>
<td>3</td>
<td>121,000</td>
<td>10%</td>
<td>$133,100</td>
</tr>
<tr>
<td>4</td>
<td>133,100</td>
<td>10%</td>
<td>$146,410</td>
</tr>
<tr>
<td>5</td>
<td>146,410</td>
<td>10%</td>
<td>$161,051</td>
</tr>
</tbody>
</table>

By compounding the interest, the total interest over the life of the contract is $61,051.
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As you can see this could become very cumbersome if we had a large number of years to compound the interest. In the following section we will examine the tables contained in the textbook, which simplify this calculation.

F. Future Value of $1 and Present Value of $1 Tables
If you will refer to pages 302-307 in your textbook you will see that the authors have prepared two tables. The future value of $1 table can be used to solve the example that we presented above. The principal amount was $100,000. If we go to the table and look up 5 years (n=5), at 10% interest (i=10) we will find a factor of 1.61051. We use the following formula to calculate Future Value:

\[ FV = PV \times [FV_{1}, n=5, i=10\%] \]

\[ FV = 100,000 \times 1.61051 \]

\[ FV = 161,051 \]

This is clearly easier than building a 10-year table.

If we know the future value and are interested in computing the present value we can use the present value of $1 table. This is called discounting the future value. The formula to calculate Present Value is:

\[ PV = FV \times [PV_{1}, n, i] \]

\[ PV = 161,051 \times 0.62092 \]

\[ PV = 100,000 \]

If we know one amount we can calculate the other by used of the tables. In the above examples we are compounding the interest once per year. In many cases interest is compounded quarterly or monthly. If compounding is more frequent than annually then we divided the annual interest rate by the number of compounding periods during the year. For example if an investment of $10,000 is made for three years at 12% interest compounded quarterly then the number of periods would be 12 (3 years times 4 quarters per year) and the interest rate would be 3% (12% divided by 4 compounding periods per year). Using the future value formula and the table for the FV$1 we get the following:

\[ FV = PV \times [FV_{1}, n=12, i=3\%] \]

\[ FV = 10,000 \times 1.42576 \]

\[ FV = 14,258 \]

G. Fundamental Variables
The fundamental variables that are involved in the computation of compound interest are:

1. **Rate of interest**-annualized interest rate divided by the number of periods of compounding in a year.
Time Value of Money Concepts

2. **Number of time periods**-total number of compounding periods.
3. **Future Value**-the value of the principal plus compounded interest at the end of the last period.
4. **Present Value**-the value today of the future amount discounted at the compound interest rate.

**VALUING A SINGLE CASH FLOW AMOUNT**

**A. Future Value of a Single Sum**
The algebraic formula for the future value of a single sum was presented in lesson 6.1.

\[
FV = PV \times [FV\$1, n, i]
\]

Where;
- \(FV\) is the future value of the principal plus compound interest
- \(PV\) is the original principal amount
- \(FV\$1, n, i\) is the Table value for the future value of \$1 at \(n\) periods and \(i\) interest rate

We will be using the table on page 302 to calculate future value of a single sum. Let’s assume that Spencer Company borrows \$50,000 for 10 years at 5% interest compounded annually. The calculation of the future value would be as follows:

\[
\begin{align*}
FV &= PV \times [FV\$1, n, i] \\
FV &= 50,000 \times [FV\$1, n=10, i=5\%] \\
FV &= 50,000 \times 1.62889 \\
FV &= 81,445
\end{align*}
\]

**B. Present Value of a Single Sum**
In some cases we may know the future amount but need to compute the present value of this amount. For example, if I need \$50,000 in five years from now, how much would I have to put in the bank if I were going to earn 3% interest compounded annually? The formula for the present value calculation is as follows:

\[
PV = FV \times [PV\$1, n, i]
\]

Where;
- \(PV\) is the future value of the principal plus compound interest
- \(PV\$1, n, i\) is the Table value for the present value of \$1 at \(n\) periods and \(i\) interest rate

We will be using the tables on page 303 to calculate present value. In the example, I need \$50,000 in five years and the bank is willing to pay interest at 3% compounded annually. What amount must I deposit today to have \$50,000 in five years?
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\[
PV = FV \times [PV_{1, n, i}]
\]

\[
PV = 50,000 \times [PV_{1, n=5, i=3\%}]
\]

\[
PV = 50,000 \times 0.86261
\]

\[
PV = 43,131
\]

C. Solving for Unknowns
There are many situations where we may have the present value and future value and maybe even the interest rate but need to know the number of years (periods) that interest will be compounded. Based upon the previous example, assume that we know that we need to deposit $43,131 on at the beginning of the period and that the future value will be $50,000. Also, we know that the bank is only willing to pay 3% interest per annum so we need to know how long (how many periods or years) it will take to get to the future value of $50,000. The amount can be calculated in one of two ways.

**Future Value Approach**

\[
FV = PV \times [FV_{1, n, i}]
\]

\[
50,000 = 43,131 \times [FV_{1, n=?, i=3\%}]
\]

\[
50,000 / 43,131 = [FV_{1, n=?, i=3\%}]
\]

\[
1.15926 = [FV_{1, n=?, i=3\%}]
\]

therefore, \( n = 5 \) years

Once we have calculated the factor based on the information we have available, we can go to the table and find the factor closest to our computed amount. In the case of the future value table if we look up 3% go down the column until we reach a number close to 1.15926 we can determine the approximate number of years that it will take.

**Present Value Approach**

\[
PV = FV \times [PV_{1, n, i}]
\]

\[
43,131 = 50,000 \times [PV_{1, n=?, i=3\%}]
\]

\[
43,131 / 50,000 = [PV_{1, n=?, i=3\%}]
\]

\[
0.86262 = [PV_{1, n=?, i=3\%}]
\]

therefore, \( n = 5 \) years

As with the future value approach, the present value approach involves plugging in what we know and then going to the present value table with 3% and a table factor of .86262. Again, this gives us five years.

**EXPECTED CASH FLOW APPROACH**
The Statement of Financial Accounting Concepts No. 7, Using Cash Flow Information and Present Value in Accounting Measurements, requires preparers of financial statements to use cash flows in measuring many balance sheet items. There are two types of situations requiring measurement.
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If the cash flows are certain because they are contractual the present value of the future cash flows are calculated using the appropriate discount rate (interest rate). If the cash flows are uncertain, the FASB requires that the preparer use the expected cash flows approach. In this approach the specific probabilities of the future cash flows are included in the analysis to come up with future probable cash flows that are then subject to a risk-free rate of interest in calculating the present value.