**Interest Calculation**

**Handout**

<http://www.financeformulas.net/index.html>

There are four interest calculations that are of interest to us at a beginning stage:

Simple Interest

Compounded Interest

Future Value

Present Value

**Simple Interest:**

 S = P(r)(t)

S= Simple Interest

P = Principle

r = interest rate

t = time (in years or portions of year)

Using example of a $1000 account with a 10% rate, after 3 years the balance would be $1300. This can be determined by multiplying the $1000 original balance times [1+(10%)(3)], or times 1.30.

**Compounded Interest**



The compound interest formula calculates the amount of interest earned on an account or investment where the amount earned is reinvested. By reinvesting the amount earned, an investment will earn money based on the effect of compounding.

Compounding is the concept that any amount earned on an investment can be reinvested to create additional earnings that would not be realized based on the original principal, or original balance, alone. The interest on the original balance alone would be called simple interest. The additional earnings plus simple interest would equal the total amount earned from compound interest.

**Example of Compound Interest Formula**

Suppose an account with an original balance of $1000 is earning 12% per year and is compounded monthly. Due to being compounded monthly, the number of periods for one year would be 12 and the rate would be 1% (per month). Putting these variables into the compound interest formula would show



The second portion of the formula would be 1.12683 minus 1. By multiplying the original principal by the second portion of the formula, the interest earned is $126.83.

**Simple Interest vs. Compound Interest**

Using the prior example, the simple interest would be calculated as principal times rate times time. Given this, the interest earned would be $1000 times 1 year times 12%. After using this formula, the simple interest earned would be $120. Using compound interest, the amount earned would be $126.83. The additional $6.83 earned would be due to the effect of compounding. If the account was compounded daily, the amount earned would be higher.

**Compound Interest Formula in Relation to APY**

The compound interest formula contains the annual percentage yield formula of



This is due to the annual percentage yield calculating the effective rate on an account, based on the effect of compounding. Using the prior example, the effective rate would be 12.683%. The compound interest earned could be determined by multiplying the principal balance by the effective rate.

**Future Value**



Future Value (FV) is a formula used in finance to calculate the value of a cash flow at a later date than originally received. This idea that an amount today is worth a different amount than at a future time is based on the time value of money.

The time value of money is the concept that an amount received earlier is worth more than if the same amount is received at a later time. For example, if one was offered $100 today or $100 five years from now, the idea is that it is better to receive this amount today. The opportunity cost for not having this amount in an investment or savings is quantified using the future value formula. If one wanted to determine what amount they would like to receive one year from now in lieu of receiving $100 today, the individual would use the future value formula. See example at the bottom of the page.

The future value formula also looks at the effect of compounding. Earning .5% per month is not the same as earning 6% per year, assuming that the monthly earnings are reinvested. As the months continue along, the next month's earnings will make additional monies on the earnings from the prior months. For example, if one earns interest of $40 in month one, the next month will earn interest on the original balance plus the $40 from the previous month. This is known as compound interest.

**Example of Future Value Formula**

An individual would like to determine their ending balance after one year on an account that earns .5% per month and is compounded monthly. The original balance on the account is $1000. For this example, the original balance, which can also be referred to as initial cash flow or present value, would be $1000, ***r*** would be .005(.5%), and ***n*** would be 12 (months).

Putting this into the formula, we would have:



After solving, the ending balance after 12 months would be $1061.68.

As a side note, notice that 6% of $1000 is $60. The additional $1.68 earned in this example is due to compounding.

**Present Value**



Present Value (PV) is a formula used in Finance that calculates the present day value of an amount that is received at a future date. The premise of the equation is that there is "time value of money".

Time value of money is the concept that receiving something today is worth more than receiving the same item at a future date. The presumption is that it is preferable to receive $100 today than it is to receive the same amount one year from today, but what if the choice is between $100 present day or $106 a year from today? A formula is needed to provide a quantifiable comparison between an amount today and an amount at a future time, in terms of its present day value.

**Use of Present Value Formula**

The Present Value formula has a broad range of uses and may be applied to various areas of finance including corporate finance, banking finance, and investment finance. Apart from the various areas of finance that present value analysis is used, the formula is also used as a component of other financial formulas.

**Example of use of Present Value Formula**

If we are offered 100 a year from now, and interest rates are 5%, the present value (value today) of the $100 is:

 PV = $100/1.05 = $95.24

That is, $95.24 dollars deposited in a savings account today would be worth $100 one year from now.

Similarly, using compounded interest, we can calculate the value of the same $100 three years from now:

 PV = $100/1.053 = $100/1.157625 = $86.3837

**Amortization**

 PMT = PV .

 1 - [1/(1+i)n ]

 i

example: Assume a $25,000 loan at 8% interest for six years, payments made annually

 = 25,000 .

 1 - [1/(1+.08)6 ]

 0.08

 = 25,000

 4.6229

 = $5,407.88

**Real Rate of Interest
(net of inflation)**

Where:

r = nominal rate of interest

r\* = real rate of interest

I = inflation rate

r = (1 + r\*) X (1 + I) – 1

where:

r\* = 2.4695% or .024695

I = 4% or .04

Then: r = (1 + .024695) X (1 + .04) - 1

 = (1.024695) X (1.04) - 1

 = 1.0656828 -1

 = .0656828 = 6.56828%