# BUSI 2504I - SOLUTIONS TO SUGGESTED EXERCISES
# CHAPTERS 5, 6, 7

**Q5-2**

| PV | N | I/Y | **CPT FV** |
|---|---|---|---|
| 2,250 | 19 | 10 | **13,760.80** |
| 9,310 | 13 | 8 | **25,319.70** |
| 76,355 | 4 | 22 | **169,151.87** |
| 183,796 | 8 | 7 | **315,795.75** |

**Q5-3**

| FV | N | I/Y | **CPT PV** |
|---|---|---|---|
| 15,451 | 6 | 5 | **11,529.77** |
| 51,557 | 9 | 11 | **20,154.91** |
| 886,073 | 23 | 16 | **29,169.95** |
| 550,164 | 18 | 19 | **24,024.09** |

**Q5-4**

| FV | PV | N | **CPT I/Y** |
|---|---|---|---|
| 307 | 265 | 2 | **7.63%** |
| 896 | 360 | 9 | **10.66%** |
| 162,181 | 39,000 | 15 | **9.97%** |
| 483,500 | 46,523 | 30 | **8.12%** |

**Q5-5**

| FV | PV | I/Y | **CPT N** |
|---|---|---|---|
| 1,284 | 625 | 8 | **9.36 yrs** |
| 4,341 | 810 | 7 | **24.81 yrs** |
| 402,662 | 18,400 | 21 | **16.19 yrs** |
| 173,439 | 21,500 | 29 | **8.20 yrs** |

**Q5-6**

$-80,000$ [FV]; 18 [N]; $15,000$ [PV]; [CPT] [I/Y] = **9.75%**

**Q5-8**

$-28,835$ [FV]; 5 [N]; $21,608$ [PV]; [CPT] [I/Y] = **5.94%**

**Q5-10**

$-800,000,000$ [FV]; 20 [N]; 9.5 [I/Y]; [CPT] [PV] = **130,258,959.12**

**Q5-12**

$-50$ [PV]; 102 [N]; 5 [I/Y]; [CPT] [FV] = **7,249.01**

**Q5-14**

$$350,000 \boxed{\text{FV}};\quad 65 \boxed{\text{N}};\quad 26.09 \boxed{\text{I/Y}};\qquad \boxed{\text{CPT}}\boxed{\text{PV}} = \textbf{-0.10}$$

**Q5-16**

$$(a)\qquad 100 \boxed{\text{FV}};\quad 20 \boxed{\text{N}};\quad -29.19 \boxed{\text{PV}};\qquad \boxed{\text{CPT}}\boxed{\text{I/Y}} = \textbf{6.35\%}$$

$$(b)\qquad 35 \boxed{\text{FV}};\quad 1 \boxed{\text{N}};\quad -29.19 \boxed{\text{PV}};\qquad \boxed{\text{CPT}}\boxed{\text{I/Y}} = \textbf{19.90\%}$$

$$(c)\qquad 100 \boxed{\text{FV}};\quad 19 \boxed{\text{N}};\quad -35 \boxed{\text{PV}};\qquad \boxed{\text{CPT}}\boxed{\text{I/Y}} = \textbf{5.68\%}$$

**Q5-18**

$$-2,000 \boxed{\text{PV}};\quad 45 \boxed{\text{N}};\quad 10 \boxed{\text{I/Y}};\qquad \boxed{\text{CPT}}\boxed{\text{FV}} = \textbf{145,780.97}$$

$$-2,000 \boxed{\text{PV}};\quad 35 \boxed{\text{N}};\quad 10 \boxed{\text{I/Y}};\qquad \boxed{\text{CPT}}\boxed{\text{FV}} = \textbf{56,204.87}$$

better to start investing while young...

**Q6-2**

| I/Y | N | PMT | **CPT** **PV** |
|---|---|---|---|
| 5 | 9 | -4,000 | *** **28,431.29** *** |
| 5 | 5 | -6,000 | **25,976.86** |
| 22 | 9 | -4,000 | **15,145.14** |
| 22 | 5 | -6,000 | *** **17,181.84** *** |

PV of Cash flow X has a greater PV at a 5 percent interest rate, but a lower PV at a 22 percent interest rate. The reason is that X has greater total cash flows. At a lower interest rate, the total cash flow is more important since the cost of waiting (the interest rate) is not as great. At a higher interest rate, Y is more valuable since it has larger cash flows. At the higher interest rate, these bigger cash flows early are more important since the cost of waiting (the interest rate) is so much greater.

**Q6-4**

| N | I/Y | PMT | **CPT** **PV** |
|---|---|---|---|
| 15 | 10 | -3,600 | **27,381.89** |
| 40 | 10 | -3,600 | **35,204.58** |
| 75 | 10 | -3,600 | **35,971.70** |

To find the PV of a perpetuity, we use the equation:

$$PV = \frac{C}{r} = \frac{3,600}{.10} = \$36,000.00$$

Notice that as the length of the annuity payments increases, the present value of the annuity approaches the present value of the perpetuity. The present value of the 75 year annuity and the present value of the perpetuity imply that the value today of all perpetuity payments beyond 75 years is only \$28.30.

**Q6-6**

$$-80,000\ \boxed{\text{PMT}};\quad 8\ \boxed{\text{N}};\quad 8.2\ \boxed{\text{I/Y}};\quad \boxed{\text{CPT}}\ \boxed{\text{PV}} = \mathbf{456{,}262.25}$$

**Q6-8**

**NOTE: answer 3,327.58 in textbook on page 812 is wrong.**

$$80,000\ \boxed{\text{FV}};\quad 10\ \boxed{\text{N}};\quad 5.8\ \boxed{\text{I/Y}};\quad \boxed{\text{CPT}}\ \boxed{\text{PMT}} = \mathbf{6{,}126.68}$$

**Q6-12**

$$\text{EAR} = \left(1 + \frac{\text{APR}}{m}\right)^m - 1 = \left(1 + \frac{.11}{4}\right)^4 - 1 = \mathbf{11.46\%}$$

$$\text{EAR} = \left(1 + \frac{.07}{12}\right)^{12} - 1 = \mathbf{7.23\%}$$

$$\text{EAR} = \left(1 + \frac{.09}{365}\right)^{365} - 1 = \mathbf{9.42\%}$$

or alternatively using the BA II Plus calculator,

$\boxed{\text{2nd}}\ \boxed{\text{ICONV}}$; NOM = 11 $\boxed{\text{ENTER}}\ \boxed{\downarrow}\ \boxed{\downarrow}$; C/Y = 4 $\boxed{\text{ENTER}}\ \boxed{\uparrow}$; EFF = $\boxed{\text{CPT}}$ **11.46%**

$\boxed{\text{2nd}}\ \boxed{\text{ICONV}}$; NOM = 7 $\boxed{\text{ENTER}}\ \boxed{\downarrow}\ \boxed{\downarrow}$; C/Y = 12 $\boxed{\text{ENTER}}\ \boxed{\uparrow}$; EFF = $\boxed{\text{CPT}}$ **7.23%**

$\boxed{\text{2nd}}\ \boxed{\text{ICONV}}$; NOM = 9 $\boxed{\text{ENTER}}\ \boxed{\downarrow}\ \boxed{\downarrow}$; C/Y = 365 $\boxed{\text{ENTER}}\ \boxed{\uparrow}$; EFF = $\boxed{\text{CPT}}$ **9.42%**

**Q6-14**

For each bank, the EAR is

Royal Canadian Bank: $$\text{EAR} = \left(1 + \frac{.122}{12}\right)^{12} - 1 = \mathbf{12.91\%}$$

First United Bank: $$\text{EAR} = \left(1 + \frac{.124}{2}\right)^{2} - 1 = \mathbf{12.78\%}$$

Higher APR does not necessarily mean the higher EAR. The number of compounding periods within a year will also affect the EAR.

**Q6-16**

It is important to note that compounding occurs semiannually. To account for this, we will divide the interest rate by two (the number of compounding periods in a year), and multiply the number of periods by two. Doing so, we get:

$$800 \boxed{\text{PV}}; \quad \frac{10.4}{2} = 5.2 \boxed{\text{I/Y}}; \quad 20 \times 2 = 40 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{FV}} = \mathbf{6{,}077.42}$$

**Q6-18**

It is important to note that compounding occurs daily. To account for this, we will divide the interest rate by 365 (the number of days in a year, ignoring leap year), and multiply the number of periods by 365. Doing so, we get:

$$24,000 \boxed{\text{FV}}; \quad \frac{11}{365} = .0301 \boxed{\text{I/Y}}; \quad 6 \times 365 = 2,190 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{PV}} = \mathbf{12{,}405.67}$$

**Q6-20**

We first need to find the annuity payment

$$56,850 \boxed{\text{PV}}; \quad \frac{8.2}{12} = .6833 \boxed{\text{I/Y}}; \quad 60 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{PMT}} = \mathbf{-1{,}158.16}$$

To find the EAR, we use the EAR equation

$$\text{EAR} = \left(1 + \frac{.082}{12}\right)^{12} - 1 = \mathbf{8.52\%}$$

or alternatively using the BA II Plus calculator,

$$\boxed{\text{2nd}} \boxed{\text{ICONV}}; \ \text{NOM} = 8.2 \boxed{\text{ENTER}} \boxed{\downarrow} \boxed{\downarrow}; \ \text{C/Y} = 12 \boxed{\text{ENTER}} \boxed{\uparrow}; \ \text{EFF} = \boxed{\text{CPT}} \ \mathbf{8.52\%}$$

**Q6-22**

Here we are trying to find the interest rate when we know the PV and FV

$$3 \boxed{\text{PV}}; \quad -4 \boxed{\text{FV}}; \quad 1 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{I/Y}} = \mathbf{33.33\%}$$

The interest rate is 33.33% per week. To find the APR, we multiply this rate by the number of weeks in a year

$$\text{APR} = (52)(33.33\%) = \mathbf{1{,}733.33\%}$$

and using the equation to find the EAR

$$\text{EAR} = \left(1 + \frac{.3333}{52}\right)^{52} - 1 = \mathbf{313{,}916{,}515.69\%}$$

**Q6-24**

$$-150 \boxed{\text{PMT}}; \quad \frac{11}{12} = .9167 \boxed{\text{I/Y}}; \quad 20 \times 12 = 240 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{FV}} = \mathbf{129{,}845.71}$$

**Q6-26**

The cash flows are simply an annuity with four payments per year for four years, ie. 16 payments

$$-1,200 \boxed{\text{PMT}}; \quad .5 \boxed{\text{I/Y}}; \quad 16 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{PV}} = \mathbf{18{,}407.91}$$

**Q6-28**

Here the cash flows are annual and the given interest rate is annual, so we can use the interest rate given

$$\boxed{\text{CF}}$$

$$\text{CF}_0 = 0 \boxed{\downarrow};$$

$$\text{C01} = 2,800 \boxed{\text{ENTER}} \boxed{\downarrow}; \ \text{F01} = 1 \boxed{\downarrow};$$

$$\text{C02} = 0 \boxed{\text{ENTER}} \boxed{\downarrow}; \ \text{F02} = 1 \boxed{\downarrow};$$

$$\text{C03} = 8,100 \boxed{\text{ENTER}} \boxed{\downarrow}; \ \text{F03} = 1 \boxed{\downarrow};$$

$$\text{C04} = 1,940 \boxed{\text{ENTER}} \boxed{\downarrow}; \ \text{F04} = 1 \boxed{\downarrow};$$

$$\boxed{\text{NPV}};$$

$$\text{I} = 9.75 \boxed{\text{ENTER}} \boxed{\downarrow};$$

$$\text{NPV} = \boxed{\text{CPT}} \ \mathbf{10{,}015.75}$$

**Q6-62**

First we will find the APR and EAR for the loan with the refundable fee. Remember, we need to use the actual cash flows of the loan to find the interest rate. With the $1,500 application fee, you will need to borrow $201,500 to have $200,000 after deducting the fee. Solving for the payment under these circumstances, we get

$$201,500 \boxed{\text{PMT}}; \quad \frac{7.5}{12} = .625 \boxed{\text{I/Y}}; \quad 30 \times 12 = 360 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{PMT}} = -1,408.92$$

We can now use this payment amount with the original amount we wished to borrow, $200,000. Solving for the rate, we find

$$200,000 \boxed{\text{PV}}; \quad -1,408.92 \boxed{\text{PMT}}; \quad 30 \times 12 = 360 \boxed{\text{N}}; \quad \boxed{\text{CPT}} \boxed{\text{I/Y}} = .6314\%$$

Therefore

$$\text{APR} = (12)(0.6314\%) = \mathbf{7.58\%}$$

and

$$\text{EAR} = (1 + .006314)^{12} - 1 = \mathbf{7.85\%}$$

With the nonrefundable fee, the APR of the loan is simply the quoted APR since the fee is not considered part of the loan, so

$$\text{APR} = \mathbf{7.50\%}$$

$$\text{EAR} = \left(1 + \frac{.075}{12}\right)^{12} - 1 = \mathbf{7.76\%}$$

**Q6-72a**

The APR is the interest rate per week times 52 weeks in a year, so

$$\text{APR} = (52)(10\%) = \mathbf{520\%}$$

$$\text{EAR} = (1 + .10)^{52} - 1 = \mathbf{14{,}104.29\%}$$

**Q7-2**

Price and yield move in opposite directions; if interest rates rise, the price of the bond will fall. This is because the fixed coupon payments determined by the fixed coupon rate are not as valuable when interest rates rise - hence, the price of the bond decreases.

**Q7-6**

To find the price of this bond, we need to realize that the maturity of the bond is 10 years. The bond was issued one year ago, with 11 years to maturity, so there are 10 years left on the bond. Also, the coupons are semiannual, so we need to use the semiannual interest rate

$$\frac{7.4\%}{2} = 3.7\%$$

and the number of semiannual periods

$$(10 \text{ years}) \times (2 \ \frac{\text{periods}}{\text{year}}) = 20 \text{ semiannual periods}$$

The bond pays has an 8.2% coupon rate, and therefore pays two coupons per year of

$$\frac{(\$1000) \times (8.2\%)}{2 \text{ coupons}} = \$41.00$$

We then have to find the PV of the coupon payments discounted at 3.7%

$$41 \boxed{\text{PMT}}; \quad 3.7 \boxed{\text{I/Y}}; \quad 20 \boxed{\text{N}}; \qquad \boxed{\text{CPT}} \boxed{\text{PV}} = -572.30$$

and the par value paid back at maturity also discounted at 3.7%

$$1,000 \boxed{\text{FV}}; \quad 3.7 \boxed{\text{I/Y}}; \quad 20 \boxed{\text{N}}; \qquad \boxed{\text{CPT}} \boxed{\text{PV}} = -482.53$$

PMT and FV are positive because the bondholder receives these amounts. Both PVs are negative because to buy this bond, you have to pay money. The total price of the bond is the sum of the PV of series of coupon payments and PV of par at maturity

$$572.30 + 482.53 = \mathbf{1{,}055.83}$$

Alternatively, we can get the bond price in a single step by considering both the coupon payments (PMT) and par value at maturity (FV) in the same TVM[1] problem

$$41 \boxed{\text{PMT}}; \quad 1{,}000 \boxed{\text{FV}}; \quad 3.7 \boxed{\text{I/Y}}; \quad 20 \boxed{\text{N}}; \qquad \boxed{\text{CPT}} \boxed{\text{PV}} = \mathbf{-1{,}055.83}$$

Note that the current market interest rate, also known as the yield to maturity (YTM), is 7.4% which is less than the bond coupon rate of 8.2%. As a result, this bond is worth more than its par value, ie. it is currently selling at a premium ($\$1,055.83 > \$1,000$).

## Q7-8

Here we need to find the coupon rate of the bond. First, we need to set up the bond pricing TVM problem and solve for the semiannual coupon payment

$$-1{,}145 \boxed{\text{PV}}; \quad 1{,}000 \boxed{\text{FV}}; \quad 3.75 \boxed{\text{I/Y}}; \quad 29 \boxed{\text{N}}; \qquad \boxed{\text{CPT}} \boxed{\text{PMT}} = 45.79$$

since the *price* of the bonds ($1,145) is a negative PV, the *par* ($1,000) is a positive FV, the applicable *discount rate* is YTM divided by two

$$\frac{7.5\%}{2} = 3.75\%$$

and 14.5 years is equal to 29 semiannual *periods*. Next, we get the *annual coupon payment* by doubling the semiannual coupon payment

$$2 \times 45.79 = \$91.58$$

and the *coupon rate* is the annual coupon payment divided by par value

$$\frac{\$91.58}{\$1,000} = \mathbf{9.16\%}$$

## Q7-10

It is important to note that most interest rates, including Treasury Bill rates, are quoted in nominal terms (textbook, p.198). The *Fisher equation*, which shows the exact relationship between the *nominal interest rate (R)*, *real interest rate (r)*, and *inflation (h)* is

$$(1 + R) = (1 + r)(1 + h) = (1 + .04)(1 + .025) = 1.0660$$

and so

$$R = 1.0660 - 1 = .0660 = \mathbf{6.60\%}$$

[1] time value of money

**Q7-12**

We again use the Fisher equation relating the nominal rate, real rate and inflation, but this time we need to solve for $r$ instead of $R$

$$(1+R)=(1+r)(1+h) \;\Rightarrow\; 1+r=\frac{1+R}{1+h}=\frac{1.134}{1.045}=1.0852 \;\Rightarrow\; r=1.0852-1=.0852=\mathbf{8.52\%}$$

**Q7-16**

Any bond that sells at par has a YTM equal to the coupon rate. Both bonds sell at par, so the initial YTM on both bonds is the coupon rate, 10 percent. If the YTM suddenly rises to 12 percent, then the price of Bond Sam is

$$\frac{(1,000)(10\%)}{2}=50\ \boxed{\text{PMT}};\ 1,000\ \boxed{\text{FV}};\ \frac{12}{2}=6\ \boxed{\text{I/Y}};\ 2\times 2=4\ \boxed{\text{N}};\quad \boxed{\text{CPT}}\ \boxed{\text{PV}}=-965.35$$

and similarly the price of Bond Dave is

$$\frac{(1,000)(10\%)}{2}=50\ \boxed{\text{PMT}};\ 1,000\ \boxed{\text{FV}};\ \frac{12}{2}=6\ \boxed{\text{I/Y}};\ 15\times 2=30\ \boxed{\text{N}};\quad \boxed{\text{CPT}}\ \boxed{\text{PV}}=-862.35$$

The percentage change in price is calculated as

$$\Delta P\%=\frac{\text{new price}-\text{original price}}{\text{original price}}$$

so

$$\Delta P_{Sam}\%=\frac{965.35-1,000}{1,000}=-3.47\%$$

and

$$\Delta P_{Dave}\%=\frac{862.35-1,000}{1,000}=-13.76\%$$

Now, if the YTM suddenly falls to 8 percent

$$\frac{(1,000)(10\%)}{2}=50\ \boxed{\text{PMT}};\ 1,000\ \boxed{\text{FV}};\ \frac{8}{2}=4\ \boxed{\text{I/Y}};\ 2\times 2=4\ \boxed{\text{N}};\quad \boxed{\text{CPT}}\ \boxed{\text{PV}}=-1,036.30$$

$$\frac{(1,000)(10\%)}{2}=50\ \boxed{\text{PMT}};\ 1,000\ \boxed{\text{FV}};\ \frac{8}{2}=4\ \boxed{\text{I/Y}};\ 15\times 2=30\ \boxed{\text{N}};\quad \boxed{\text{CPT}}\ \boxed{\text{PV}}=-1,172.92$$

and

$$\Delta P_{Sam}\%=\frac{1,036.30-1,000}{1,000}=+3.63\%$$

$$\Delta P_{Dave}\%=\frac{1,172.92-1,000}{1,000}=+17.29\%$$

All else the same, the longer the maturity of a bond, the greater is its price sensitivity to changes in interest rates. This is known as *interest rate risk*.

**Q7-24**

(a) The bond price is the present value of the cash flows from a bond. The YTM is the discount rate used in valuing the cash flows from a bond.

(b) If the coupon rate is higher than the required return on a bond, the bond will sell at a premium, since it provides periodic income in the form of coupon payments in excess of that required by investors on other similar bonds. If the coupon rate is lower than the required return on a bond, the bond will sell at a discount since it provides insufficient coupon payments compared to that required by investors on other similar bonds. For premium bonds, the coupon rate exceeds the YTM; for discount bonds, the YTM exceeds the coupon rate, and for bonds selling at par, the YTM is equal to the coupon rate.