1. Predictiong Bond Values. A bond you are interested in pays an annual coupon of 4, FV 1000 percent, has a yield to maturity of 6 percent and has 13 years to maturity. If interest rates remain unchanges, at what price would you expect this bond to be selling 8 years from now? Ten years from now?

   N = 13 years
   FV =1,000
   C = 0,04 p.a.
   I = 0,06 p.a.

Price = PV of all future CFs

Pattern of CFs

time	0	1 year	2 year	3 year	8 year	9 year
		40	40	40	40	40
	10 year		11 year	12 year		13 year
	40		40	40		40 +1000
CF	P=?					

$$P_8 = \sum_{i=1}^{5} \frac{CF_i}{(1+i)^i} = ???$$

$$P_{10} = \sum_{i=1}^{3} \frac{CF_i}{(1+i)^i} = ???$$

2. Calculate the duration of an 8 percent, $1,000 par bond that matures in three years if the bond's YTM is 10 percent and interest is paid semiannually.
   a. Calculate this bond's modified duration.
   b. Assuming the bond's YTM goes from 10 percent to 9.5 percent, calculate an estimate of the price change.

   N = 3Y – 6 periods
   C = 0,08 p.a. – 0,04 p.s.
   FV = 1000
   I = 0,1 p.a. – 0,05 p.s.

   Duration = time-weighted CFs/ bond price

$$Duration = \frac{1*\frac{40}{(1+0,05)^1}+2*\frac{40}{(1+0,05)^2}+3*\frac{40}{(1+0,05)^3}+4*\frac{40}{(1+0,05)^4}+5*\frac{40}{(1+0,05)^5}+6*\frac{40}{(1+0,05)^6}}{P_0=\frac{40}{(1+0,05)^1}+\frac{40}{(1+0,05)^2}+\frac{40}{(1+0,05)^3}+\frac{40}{(1+0,05)^4}+\frac{40}{(1+0,05)^5}+\frac{40}{(1+0,05)^6}}$$

$$Duration = \frac{5159,03898}{949,2431}$$

$$Duration = 5{,}4349\ semi - annual\ periods$$
$$\boldsymbol{Duration = 2{,}71745\ years}$$
$$\boldsymbol{Modified\ duration = \frac{Duration}{(1 + yield\ in\ period)}}$$

$$\boldsymbol{Modified\ duration = \frac{2{,}71745}{(1 + 0{,}05)}}$$
$$\boldsymbol{Modified\ duration = 2{,}5880}$$

$$Effect\ in\ bond\ price\ in\ \% = -Modified\ duration * (\Delta yield\ in\ \%)$$

$$\boldsymbol{Effect\ of\ duration\ in\ a\ bond\ price\ in\ \% = -2{,}5880 * (-0{,}5\%)}$$ **= 1,2940 %**

Approx. Price (for yield = 0,095) = 949,2431*(1+0,01294) = 961,5263

3. A semiannual bond for the Webster Corporation has the following characteristics:
   Maturity—12 years
   Coupon—10%
   Yield to maturity—9.50%
   Macaulay duration—5.7 years
   Convexity—48
   Noncallable

   a. Calculate the approximate price change for this bond using only its duration assuming its yield to maturity increased by 150 basis points.

$$\Delta yield\ in\ \% = 1{,}5\ \%$$
$$Modified\ duration = \frac{Duration}{(1 + yield\ in\ period)}$$

$$Modified\ duration = \frac{5{,}7}{(1 + 0{,}0475)}$$
$$Modified\ duration = 5{,}4415$$

$$\boldsymbol{Effect\ in\ bond\ price\ in\ \% = -5{,}4415 * (1{,}5\%)}$$ **= -8,1623 %**

   b. Calculate the approximate price change for this bond (using only its duration) if its yield to maturity declined by 300 basis points.

$$\boldsymbol{Effect\ of\ duration\ in\ a\ bond\ price\ in\ \% = -5{,}4415 * (-3\%)}$$ **= 16,3246 %**

4. Philip Morris has issued bonds that pay semiannually with the following characteristics:

Coupon/ Yield to Maturity/ Maturity/ Macaulay Duration
8%/ 8%/ 15 years/ 10 years

a. Calculate modified duration using the preceding information.

$$Modified\ duration = \frac{Duration}{(1 + yield\ in\ period)}$$

$$Modified\ duration = \frac{10}{(1 + 0{,}04)}$$
$$Modified\ duration = 9{,}6154$$

b. Identify the direction of change in modified duration if

(1) the coupon of the bond were 4 percent, not 8 percent.

If coupon ↓ $\Rightarrow$ **duration** ↑

(2) the maturity of the bond were 7 years, not 15 years.

If maturity ↓ $\Rightarrow$ **duration** ↓

5. Using the information in the following table, calculate the projected price change for Bond B if the yield to maturity for this bond falls by 75 basis points.

Bond A (callable)/ Bond B (noncallable)
Maturity 2016/ 2016
Coupon 11.50% /7.25%
Current price 125.75/ 100.00
Yield to maturity 7.70%/ 7.25%
Modified duration to maturity 6.20/ 6.80
Convexity to maturity 0.50/ 0.60
Call date 2010/ —
Call price 105/ —
Yield to call 5.10%/ —
Modified duration to call 3.10/ —

$$\boldsymbol{Effect\ of\ duration\ in\ a\ bond\ price\ in}\ \% = \ \mathbf{-6,8 * (-0,75\%)}$$ **= 5,1 %**

$$\boldsymbol{Effect\ of\ convexity\ in\ a\ bond\ price} = \ \mathbf{0,5 * 0,60(-0,0075)^2}$$ **= 0,000016875**
$\Rightarrow$ **0,0016875 %**

Both effects = 5,1% + 0,0016875%=5,1016875 % which is the projected price change.
New Price = 100*(1+0,051016875) = 105.102