

*Beware of little Expenses: a small Leak
will sink a great Ship.*

Ben Franklin

NOTE: Compute all dollar-denominated answers to the nearest dollar unless otherwise specified, and compute all other answers to four decimal places (*i.e.*, .0001). Unless otherwise stated, all interest rates or rates of return are annual (effective) rates. Excel hints are given in brackets. For the multiple choice questions, give the correct choice and very briefly explain your answer.

1. You earn the following annual returns: 10%, 20%, 5%, -10%, and -5%
 - (a) What is your holding period return?
 - (b) What is your average annual return (arithmetic)? [*AVERAGE*]
 - (c) What is your average annual return (geometric)? [*GEOMEAN*] You'll have to look up how to use the function correctly.
 - (d) Which return better represents your true economic return?
 - (e) Now assume that you earn the same returns but in exactly the reverse order, *i.e.*, -5%, -10%,...etc. Do your answers in a, b, and c change?
 - (f) Now assume that you start with \$10,000 in your investment account, and at the end of each year, you add an additional \$10,000 and the account earns the above annual returns.

For example, using the first sequence of returns in (a), after one year you will have \$11,000 (the \$10,000 starting balance plus a return of 10%)+ \$10,000 (the addition to account made at year end) for a total of \$21,000.

Which of the two sequence of returns above gives you a higher balance at the end of 5 years? It probably best to create two tables that show the beginning balances, returns, additions, ending balance, etc. This is a potentially important issue, especially for those on the cusp of retirement.

2. Answer Q4.35 in Welch. You might want to graph the function. A good place to do so easily is [WolframAlpha](#), and it will also find IRR for you. Another good choice is [Desmos Graphing Calculator](#). For either, I recommend adjusting the x and y axes: $0 < x < 0.9$ and $-10 < y < 10$.
3. Slick Willy offers you an investment that requires a cash outflow of \$10,000 today followed by a cash inflow of \$12,000 in two years. Assume that the investment is risk free, the nominal annual rate of interest is 5%, and the annual inflation rate is 3%.
 - (a) What is the NPV in nominal dollars?

- (b) What is the NPV in real dollars?
4. The YTM (IRR) on a bond:
- (a) Assumes that interim coupons are invested at the coupon rate.
 - (b) Equals the current yield (CY) plus the holding period return.
 - (c) Is below the coupon rate when the bond is selling at a discount, and above the coupon rate when the bond is selling at a premium.
 - (d) Is the discount rate that if applied to compute the present value of all the payments will result in the price today.
5. You have decided to purchase a *coupon* paying U.S. government bond.
- (a) Very briefly describe three risks you face with this bond.
 - (b) What risk do you *not* face with this bond that you would if you purchased a coupon paying bond of Telsa?
 - (c) What can you do to mitigate (at least one of) those risks in (a) while still only considering investing in U.S. government securities?
6. You own a five-year bond with a 5% annual coupon that sells at a YTM of 7% and has a face value of \$1,000.
- (a) Is the bond a discount or premium bond?
 - (b) If interest rates remain constant, one year from today, the price of the bond will be (choose the correct answer and very briefly explain):
 - i. Higher
 - ii. Lower
 - iii. The same
 - iv. Par (Face)
 - (c) If interest rates increase, what will happen to the price of the bond?
7. You observe the following zero-coupon spot rates:

Year	Spot Rate
1	$r_1 = 1.5\%$
2	$r_2 = 2.0\%$
3	$r_3 = 3.5\%$

- (a) Calculate the forward rates for each period ($r_{0,1}$, $r_{1,2}$, $r_{2,3}$).

- (b) Calculate the price and YTM of each of the following Treasury notes (assume annual coupons and \$1,000 par value):
 - i. 3% coupon, 2-year note
 - ii. 3% coupon, 3-year note
 - iii. 5% coupon, 3-year note
 - (c) Briefly explain why the YTM on the 5% note is less than the YTM of the 3% note of the same maturity.
 - (d) If you were to buy a \$50,000, 3-year annuity (3 equal payments of \$50,000 starting one year from today), what would be the annuity's YTM? *Hint: First determine the PV of the annuity and then the annuity's YTM.*
8. Assume that one-year rates are 5% and you purchase a government note with one year remaining term for \$1,000 that will pay a 5% coupon plus the principal (a total of \$1,050) one year from today. Immediately after you purchase the note, interest rates rise to 10%.
- (a) What will be the price of the note now?
 - (b) Have you made or lost money?
 - (c) If you don't sell the note, is your loss realized or unrealized?
 - (d) As some of your eager beaver classmates pointed out, you can continue to hold the bill to maturity and you will receive the promised \$1,050. Therefore, if you don't sell, you won't suffer any financial losses. Briefly explain why this is a mistaken view. To show this, you may wish to consider and compare the financial results of a person who purchases the same bill at the new price and holds it to maturity.
9. You just purchased a 3% (assume annual coupons), 30-year government bond, with a face value of \$100 and a YTM of 3%. Note, Excel has both Modified Duration (*MDuration*) and Macaulay Duration (*Duration*) functions.
- (a) What is the bond's modified duration? [Use 1/1/22 for the settlement date and 1/1/52 for the maturity date.]
 - (b) If the YTM increases by 100 basis points, what is the percentage change in the bond's price?
 - (c) If the YTM decreases by 100 basis points, what is the percentage change in the bond's price?

- (d) Same as above. What's the percentage change in price predicted by the bond's modified duration?
- (e) Why doesn't the bond's modified duration do a good job of predicting the percentage price change of a 100 bps movement in the YTM?
- (f) If you have an equal amount of liabilities with the same modified duration as the bond, very briefly explain why (e) is a potentially a problem?