**Explanations of Quiz Solutions for Chapters 8-9**

1. A price of 97 means that the bonds are selling for 97% of their face value. A coupon rate of 8.6% means that each year, the issuer pays the bondholder 8.6% of the face value of the bond. Since the Yield to Maturity will be a percentage as well, it doesn’t matter what face value you use to solve this problem – you will get the same answer.

Using 100 as the face value of the bond, 97 as the price (present value) of the bond, 4.3 (8.6/2) as the semiannual interest payment (remember that bonds pay interest payments semiannually), and 20 as the number of interest payments (twice per year for 10 years), we can use the RATE function in Excel to find the semiannual yield. Use 97 as the PV, 100 as the FV, 4.3 as the PMT, and 20 as the NPER. Remember that either the PV or the PMT and the FV must be a negative (cash outflow) in Excel. The discount rate that equates the present value of the cash flows with the price of the bond is 4.53%. Since these are semiannual payments and the number of semiannual periods, this will be the semiannual yield. By definition, the YTM of a bond is the semiannual yield doubled. So the Yield to Maturity for this bond is 9.06%. Be sure to take out your final answer to the nearest basis point (1/100th of a percent) when it is a percentage.

1. A bond dealer will quote both his bid price and his ask price. The ask price is the price he is willing to sell the bond for and will always be higher than the bid price. So we know that the higher price is the ask in this problem. Treasury bonds are frequently quoted in 32nds, where the number to the right of the colon is a 32nd. So 105:24 means that the price of the bond is 105 and 24/32nd percent of the face value. 24/32 = .75, so the price is 105.75% of the face value. Since the face value is $10,000, we can multiply that by 105.75% (multiply it by 1.0575) to get the price you will pay for this bond. You will pay the ask price, which is $10,575.
2. The price of any financial asset is the present value of its expected future cash flows discounted at the appropriate risk-adjusted interest rate. In the case of bonds, the discount rate is the semiannual yield (one-half of the bond’s yield to maturity). Investors require the same yield (or return) on bonds with similar levels of risk and similar times till maturity. Also, when a bond is price at par value (price equals the face value), its coupon rate will be equal to its YTM. So if similar bonds are yielding 5%, so must this bond. Now we can solve for the price of this bond using the PV function in Excel with 30 as the PMT (a 6% coupon rate means each year 6% of the face value will be paid out as interest – which is 30 every 6 months for a bond with a $1,000 face value), 1,000 as the FV, 16 as the NPER (there are 16 semiannual periods left till maturity), and 2.5% as the RATE (semiannual yield).
3. The prices of Treasury Notes and Treasury Bonds are frequently quoted in 32nds. So a price of 101:12 is 101 and 12/32 percent of the face value. As with problem 1 above, we can use any face value to solve this problem, so it is easiest to use 100. The semiannual yield is the discount rate which equates the price of the bond with the present value of its future scheduled cash flows. With a 7.5% coupon rate (7.5% of the face value being the annual coupon payments), the semiannual payment is 3.75. With 15 years remaining till maturity (it doesn’t matter how long ago the bond was issued), there are 30 coupon payments remaining and the face value will be paid to us 30 semiannual periods from now. Solving for RATE in Excel, we get a semiannual rate of 3.6736%. Since the YTM is the semiannual yield doubled, the YTM is 7.35%.
4. We must first solve for the semiannual yield of Bond A. We can use the RATE function in Excel with 949.63 (the price of the bond) as the PV, 14 (the number of semiannual coupon payments remaining) as the NPER, 1,000 as the FV (the face value of the bond), and 30 as the PMT (the semiannual coupon payments). Be sure to enter either the PV as a negative (cash outflow) or the PMT and FV. We find that the semiannual yield is 3.46% which, if we double it, gives us a YTM of 6.92%.

We know that both bonds have the same yield, so to find the coupon payment for bond B, we use the semiannual yield we found above. Since the coupon rate is a percentage of the face value, we can use any face value for Bond B and we will get the same answer. Using Excel to solve for the PMT, I decided to use 100 as the FV. There are 30 semiannual periods till maturity, so 30 is the NPER, the semiannual yield we found above is the RATE (be sure to reference the Excel cell that calculated the semiannual yield so you don’t have any rounding errors), and the price of 109.98 is the PV. Be sure to enter either the PV or the FV as a negative (cash outflow). Excel solves for a semiannual coupon payment of $4. Since the problem asks for the coupon rate, we need to realize that this bond pays $8 per year in coupon payments which is 8% of its face value, making the coupon rate 8%.

1. The price of PPPP stock is the present value of its future dividends. The $2 dividend to be paid tomorrow has a present value of $2. We then use the growing annuity formula to bring the dividends at time 1-4 back to the present. Alternatively, these could be discounted to time zero individually, giving the same result. In the solutions, I first show how to discount the dividends in years 1-4 individually, and then show how to do it using the growing perpetuity formula. The growing annuity formula says that the cash flow (dividend) at time one is multiplied by the value in the brackets. Since next year’s dividend will be 20% more than tomorrow’s $2 dividend, we multiply 2 by 1.2 to find next year’s dividend. The discount rate is 10% (.1) and the growth rate during the time of the growing annuity (the next four years) is 20% (.2). Remember that you have a growing annuity if the growth is constant, but not forever. If it is both constant and forever, it is a growing perpetuity. The terminal value is at time 4 because that is where the constant and permanent growth starts. We need the dividend at time 5 divided by r minus g to find the terminal value at time 4. Since the dividend at time 5 is 7% more than the dividend at time 4, and the $2 dividend at time 0 has been growing at 20% for years 1-4, the dividend at time 5 is $2 (1.2)4 (1.07). Dividing this dividend by r-g (.1-.07) gives us the terminal value at time 4. We now need to discount the terminal value from time 4 back to time 0. We do this by dividing it by (1.1)4 just as we would discount any future value at time 4 back to time 0. The price is the sum of the present value of all these future dividends.
2. The price of Home Depot stock one year from now will be the present value of all the future dividends as of that time (one year from today). Drawing a timeline is very helpful to see this. Since the $1.50 dividend was paid yesterday, the next dividend (which will be 20% more than $1.50, will be paid one year from yesterday. In other words, one year from now, the 1.50 (1.2) dividend will have already been paid the day before. It will therefore be a past dividend and not included in the valuation of the stock. One year from today, the next dividend will be the dividend which is being paid two years from yesterday, and it will need to be discounted one year to be brought back to time 1 (the time period at which we are trying to forecast the stock price). This dividend will be $1.5 (1.2)2. At time 3, the dividend will be 20% more than the dividend at time 2, and it will need to be discounted two years to time 1. The terminal value will be at time 3 because that is where the constant growth (permanently) begins. To get the terminal value at time 3, we need the dividend at time 4 which is 5% more than the dividend at time 3. This makes the dividend at time 4 equal to 1.5 (1.2)3 (1.05). Dividing this time 4 dividend by r-g (.11 - .05) gives us the terminal value at time 3. The terminal value at time 3 is the time 3 value of all the dividends from time 4 through infinity. We need to discount this value to time 1 by dividing by (1.11)2. Summing the terms gives us the present value (as of a year from now) of all the future dividends.
3. Here, we are discounting Free Cash Flows, which (in this case) is cash flows which are available to go to the stockholders and the bondholders. There is $2 million of FCF coming in a year from now, so it is discounted to time 0 at the 10% discount rate. At time 2, we project there to be $2.5 million of FCF. It also is brought back to time 0 in the second term. The terminal value is at time 2 since this is where the constant and permanent growth starts. The terminal value at time 2 is the FCF at time 3 divided by r-g. The FCF at time 3 is 4% more than the FCF at time 2, so [$2.5 million (1.04)]/.10-.04 is the terminal value at time 2. This represents all the FCF from time 3 to infinity brought back to time 2. To bring it back to time 0, just divide by (1.11)2. Adding the terms gives us a time 0 value of all the future FCF of $39,696,970. Since this is cash which is available to both the stockholders and the bondholders, but we only want to value the stock, we must subtract the present market value of the debt which is $3 million, leaving us with the present value of the FCF which is available to stockholders. This sum needs to be divided equally among the 1.5 million shares of stock, resulting in a price per share of $24.46.
4. If the first payment into your retirement plan is made today and the last payment is made exactly 35 years from today, and you make monthly payments, you will make 421 payments into your retirement plan (1-420 is 420 plus the payment at time 0 makes 421). Finding the nominal dollars at retirement is a simple future value of an annuity problem. Since we have monthly payments ($700 each), we must use the monthly rate (.08/12) and the number of monthly payments (421). Remember that there is no such thing as a future value of an annuity due. Since we used nominal dollars (700) and the nominal rate (.08/12), we end up with 1,617,122.52 nominal dollars at retirement.

Since nominal dollars is what your retirement account reads, but real dollars is the time zero purchasing power of that money, we must divide the nominal dollars at retirement by 1 plus the inflation rate raised to the t power to find the purchasing power (real dollars) that we will have at retirement. Since both the investment rate and the inflation rate were given as APRs with monthly compounding, the monthly inflation rate is 2.5%/12. Since there are 420 months from now until when you retire (421 payments of $700, but only 420 months), dividing the nominal amount by (1 + .025)420 tells us how much purchasing power our retirement account will have when we retire. Unfortunately, our real dollars at retirement is considerably less than our nominal dollars at $674,730.82. Note that many students want to try to find the real dollars at retirement by using the same future value of an annuity formula that we used to find the nominal dollars at retirement, but using the real interest rate. Unfortunately, this won’t work because it involves using nominal dollars ($700 per month) and the real interest rate.

1. The price of this bond, like all bonds, is the present value of its cash flows. The calculations can be easily seen if you draw them out on a timeline. There are two delayed annuities of coupon payments and a single face value that must be discounted to the present at the semiannual yield of 5%. The first delayed annuity starts at time 13 (these are semiannual periods) and ends at time 28. This is 16 semiannual coupon payments of $1,200 each. Using the PV function in Excel with 1,200 as PMT, .05 as RATE, and 16 as NPER will give us the present value of the $1,200 coupon payments as of time 12 (as always, one time period before the first cash flow). This is a delayed annuity, so we must discount that value at time 12 back to time 0 being sure to reference the Excel cell where we calculated the value at time 12 as the FV. We follow the same procedure to discount the twelve $1,500 coupon payments which begin at time 29 and end at time 40. They are a delayed annuity, so this is a two-step procedure in Excel where we first find the PV of the annuity as of time 28 and then discount that value 28 periods to time 0. The final step is to simply discount the $20,000 face value to time 0 at the semiannual discount rate of 5%. The face value is paid when the bond matures, 40 semiannual periods from now. With all the cash flows brought back to time 0, they can be summed to find the value (price) of the bond.