Extra Black-Scholes Option Pricing Problems

1. Since you expect Oracle's stock to fall from its current price of $13.72 to $10 by June 2006 you are thinking about buying a put on Oracle with an exercise price of $12.50. While you plan to only hold your option through June 2006 (3 months from today), you plan to buy a put that expires in January of 2007 (ten months from today). You have also collected the following information.

   The return on Treasury securities vary by maturity as follows:
   March 2006 = 3.82%, April 2006 = 4.58%, May 2006 = 4.59%, June 2006 = 4.70%, Sept 2006 = 4.89%, Dec 2006 = 4.86%, Jan 2007 = 4.84%, Jan 2008 = 4.75%

   The standard deviation of returns on Oracle over: the past 10 months was 35%, the past month was 45%.
   You forecast that the standard deviation of returns: over the next month will be 50%, over the next 3 months (through June 2006) will be 48%, over the next 10 months (through January 2007) will be 39%, over the next 22 months (through January 2008) will be 26%.

   (Note: for all questions set up the sequence of equations and fill in as many numbers as possible).

   a. What is the most you would be willing to pay for the put? What about an equivalent call?
   b. What is the minimum value of the put?
   c. Briefly explain the logic of the number you get in part "b". What is the reason for this number?
   d. Explain the difference between the value you would calculate in part "a" and the minimum value.

2. Assume that you do not think that Grinding Motors (GM) will be able to avoid bankruptcy and so expect their stock price to fall even further in the coming months. As a result, you are interested in buying puts with an exercise price of $20 so that you can benefit from this expected fall. Calculate the fair value of the puts that you are considering buying based on the following information you have collected.

   Market Values: GM's assets = $374,385,000, GM's stock = $12,769,000, GM's debt = $361,616,000
   Book Values: GM's assets = $480,000,000, GM's stock = $27,725,000, GM's debt = $452,275,000
   Maturity value of GMs debt: same as book value
   Number of shares outstanding: 565,000
   Standard Deviations: GM's assets = 35%; GM's stock = 45%; GM's bonds = 22%; put on GM's stock that considering buying = 75%; call on GM's stock that has same terms as the put you are considering = 80%
   Betas: GM's assets = 0.9, GM's stock = 1.25, GM's bonds = 0.7
   Life or maturity: GM's assets = 20 years, GM's debt = 15 years, puts = 6 months
   Returns on Treasury Strips of various maturities: 6 months = 4.41%, 1 year = 4.50%, 15-years = 4.86% 20-years = 4.92%

   Note: Solve for value of call as well.

3. Southwest Airlines has weathered current high fuel prices since it hedged against price increases. This has given Southwest a big cost advantage relative to other airlines. As Southwest uses up these hedge contracts, its fuel costs will become similar to the fuel costs of other airlines and it is expected to raise prices on its tickets. You are convinced that American Airlines' stock price will rise as this happens and you have decided that you would like to profit from this by trading options on American's parent company AMR. Given the following information, what is a fair price for puts and calls on AMR with a strike price of $20?

   Additional information on AMR:

   Market value: stock = $3,250,000; debt = $10,000,000; assets = $13,250,000
   Book value: stock = $1,000,000; debt = $15,000,000; assets = $16,000,000
   Number of shares outstanding = 165,000
   Life/maturity: debt = 10 years; AMR's assets = 15 years; options want to trade = 6 months
   Standard deviation of returns on stock over: next 6 months = 35%, next 10 years = 30%, next 15 years = 25%
   Standard deviation of returns on assets over: next 6 months = 28%, next 10 years = 22%, next 15 years = 18%
   Returns on Treasury Strips of various maturities: 6 months = 4.41%, 1 year = 4.50%, 15-years = 4.86% 20-years = 4.92%

Check figures:

1. $d_1 = 0.5502$; $d_2 = 0.1942$; $N(d_1) = .70884$; $N(d_2) = .57535$; $C_0 = 2.8112$; $P_0 = 1.1084$; Most = 110.84; Note: Value using Excel: $P_0 = 108.97$; $C_0 = 279.25$
2. $d_1 = 0.6110$; $N(d_1) = .72907$; $d_2 = 0.2928$; $N(d_2) = .61409$; $C_0 = 4.46$; $P_0 = 1.43$; Note: Value using Excel: $P_0 = 1.4169$; $C_0 = 4.4438$
3. $d_1 = 0.1492$; $N(d_1) = .55962$; $d_2 = -0.0983$; $N(d_2) = .46017$; $C_0 = 2.016$; $P_0 = 1.892$ Note: Value using Excel: $P_0 = 1.872$; $C_0 = 1.996$