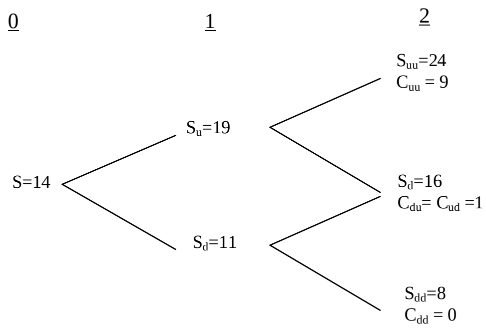
Chapter 21 Problems

Short-Answer

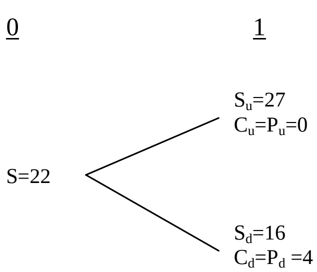
1. LuthorMark Printers has a current stock price of $14 and may rise by $5 per share or fall by $3 per share each of the next two years. Sketch a binomial tree with the possible payoffs on a call two years from today with a strike price of $15. Note: Do not solve for the value of the option today, simply sketch the tree with the option payoffs at the appropriate places on the binomial tree.



2. Assume that Windy's Flapjacks' current stock price is $26 and that a call on Windy's Flapjacks with a $25 strike price currently trades for $4. Assume that this call can be replicated if Δ equals 0.8295 and B = -18.5667 and that the net cost of this replicating portfolio is $3. What specific transactions would create an arbitrage profit for you? Note: you need to list each specific transaction.

   Sell the call; Buy 0.8295 shares; Short sell risk-free bonds worth 18.5667

3. Fjord Motors' current stock price equals $22 per share but by a year from now will either increase by $5 per share or may decline by $6 per share. Sketch a binomial tree with the possible payoffs a year from today on the stock and a put if the strike price on the put is $20. Note: you do not need to solve for the value of the put, simply sketch the tree with the option payoffs at the appropriate places on the binomial tree.



4. Assume that MotorAlong Mobile-Devices' stock is trading for $9 per share, has a beta of 1.4, and has an annual volatility of 42%. If the risk-free rate is 4%, set up to calculate $N(d_1)$ for a call on MotorAlong that has a strike price of $10 and which expires 40 days from today.

   $N(d_1)$ = normsdist(Excel) of d_1 where $d_1 = \dfrac{\ln\left(\dfrac{9}{PV(K)}\right)}{.42\sqrt{\dfrac{40}{365}}} + \dfrac{.42\sqrt{\dfrac{40}{365}}}{2}$

   $PV(K) = \dfrac{10}{(1.04)^{40/365}}$

Chapter 21 Problems

5. Assume that you have just valued shares of DonyMac's Burgers as a call using the Black-Scholes Option Pricing Model. You know the beta of DonyMac's stock is 1.4. What equation would you need to use to determine DonyMac's unlevered equity beta? Note: you only need to list a single equation; you don't need to plug in any numbers.

$$\beta_U = \frac{\beta_E}{\Delta\left(1+\frac{D}{E}\right)}$$

6. Detroit Motors Inc. currently has no debt. Detroit's equity (and assets) have a market value of $40 million and a beta of 0.8. Assume that Detroit is planning to issue debt that matures three years from today for $15 million. Using the Black-Scholes Option Pricing model, Detroit estimates that after the debt issued, its equity will have a market value of $29.76 million and its debt will have a market value of $10.24 million. When calculating these values, Detroit found that d_1 was 1.654, that d_2 was 0.536, that $N(d_1)$ was 0.951 and that $N(d_2)$ was 0.704. Set up to calculate the beta of Detroit's debt.

$$\beta_D = (1-.951)\left(\frac{40}{10.24}\right)(0.8)$$

7. While the book value of Eli Inc's equity is $100,000 and of its debt is $300,000, the market value of its equity is $550,000 and of its debt is $240,000. When Eli's stock is valued as a call on the firm's assets, the implied volatility of the firm's assets is 39.7%, d_1 is 1.70, and d_2 is 0.81. Calculate the beta of Eli's debt if the beta of Eli's assets is 0.7.

$$\beta_D = (1-.95543)\left(\frac{550{,}000+240{,}000}{240{,}000}\right)0.7$$

8. Given the following information, calculate the beta of TJX's debt

Beta of TJX's assets = 0.85

Market value of: TJX's assets = $800 million, TJX's equity = $600 million

If the Black-Scholes Options Pricing model is used to value TJX's equity: $d_1 = 1.80$, $N(d_1) = .964$, $d_2 = 0.79$, $N(d_2) = .786$

$$\beta_D = (1-.964)\left(\frac{800}{800-600}\right)(.85)$$

9. Other things equal, what happens to the beta of a call as the price of the stock on which the call is written falls?

Rises

Problems

1. Baltic Enterprises pays no dividends and has a current stock price of $14. In each of the next two years, Baltic's stock will either go up by $3 or down by $2.50. The one-year risk-free interest rate is 5% per year and is expected to remain unchanged. Using the Binomial Model, calculate the price of a two-year call option on Baltic with a strike price of $15.

t=1: u:

$$\Delta = \frac{5-0}{20-14.50}$$
$$B = \frac{0-14.50\Delta}{1.05}$$
$$C_u = 17\Delta + B$$

t=1: d:

$$C_d = 0$$

Today:

$$\Delta = \frac{C_u - 0}{17-11.50}$$
$$B = \frac{0-11.50\Delta}{1.05}$$
$$C = 14\Delta + B$$

2. You are considering buying two call contracts on Blockbuster Inc. with a strike price of $7.50 per share that expire ten months from today. You are considering this purchase because while you expect Blockbuster's stock price to fall from its current $6.70 per share to $5 per share by 2 months from today, you expect its price to rise to $9 per share by 7 months from today. Seven months from today you plan to close out your position. You expect the standard deviation of returns on Blockbuster stock to equal 62% and the standard deviation of returns on the calls to equal 191%. The return on Treasuries depends on maturity as follows: 2-months = 5.01%; 7-months = 4.99%; 10-months = 4.87%; What cash flow can you expect today as you buy the call contracts? Note: use a "+" to represent an inflow and a "-" to represent an outflow.

$$PV(K) = \frac{7.50}{(1.0487)^{10/12}}$$

$$d_1 = \frac{\ln\left(\frac{6.70}{PV(K)}\right)}{.62\sqrt{\frac{10}{12}}} + \frac{.62\sqrt{\frac{10}{12}}}{2};$$

$$d_2 = d_1 - .62\sqrt{\frac{10}{12}}$$

$$C = 6.70 \times N(d_1) - PV(K) \times N(d_2)$$

$N(d_1)$ and $N(d_2)$ = cumulative normal distribution of d_1 and d_2. In Excel: =normsdist(d).

CF = -Cx2x100

3. Assume that DoPunt Inc.'s stock, which has a market value of $9,000,000, has a beta of 1.15. Assume also that DoPunt's zero-coupon debt that matures 7-years from today for $25,000,000 has a market value of $11,300,000. Finally, assume that the risk-free rate is 4%. Calculate the beta of DoPunt's assets (or unlevered equity) and its debt?

Note: Be sure to state which variables you will need to solve for.

A = 9 + 11.3 = 20.3

$$PV(K) = \frac{25}{(1.04)^7}$$

$$d_1 = \frac{\ln\left(\frac{20.3}{PV(K)}\right)}{\sigma\sqrt{7}} + \frac{\sigma\sqrt{7}}{2}$$

$$d_2 = d_1 - \sigma\sqrt{7}$$

E = 9 = 20.3x$N(d_1)$ – PV(K)x$N(d_2)$ where N() = cumulative normal distribution of d_1 and d_2

=> solve for σ that makes this hold

$\Delta = N(d_1)$

$$\beta_U = \frac{1.15}{\Delta\left(1 + \frac{11.3}{9}\right)}$$

$$\beta_D = (1 - \Delta)\frac{20.3}{11.3}\beta_U$$

4. Hewitt Packing (HP) has a current market price of $25 per share. In each of the next two years, HP's stock price will either increase by $5 per share or decrease by $3 per share. Calculate the value today of a put with a strike price of $30 if the risk-free rate is 2% and is not expected to change.

$S = 25$; $S_u = 25 + 5 = 30$; $S_d = 25 – 3 = 22$
$S_{uu} = 25 + 5 + 5 = 35$; $S_{ud} = S_{du} = 25 + 5 – 3 = 25 – 3 + 5 = 27$; $S_{dd} = 25 – 3 – 3 = 19$
$P_{uu} = \max(30 – 35, 0) = 0$; $P_{ud} = P_{du} = \max(30 – 27, 0) = 3$; $P_{dd} = \max(30 – 19, 0) = 11$

$$\Delta_u = \frac{P_{uu} - P_{ud}}{S_{uu} - S_{ud}} = \frac{0-3}{35-27}$$

$$B_u = \frac{P_{ud} - S_{ud}\Delta_u}{1+r_f} = \frac{3-27\Delta_u}{1.02}$$

$$P_u = S_u\Delta_u + B_u = 30\Delta_u + B_u$$

$$\Delta_d = \frac{P_{ud} - P_{dd}}{S_{ud} - S_{dd}} = \frac{3-11}{27-19}$$

$$B_d = \frac{P_{dd} - S_{dd}\Delta_d}{1+r_f} = \frac{11-19\Delta_d}{1.02}$$

$$P_d = S_d\Delta_d + B_d = 22\Delta_d + B_d$$

$$\Delta = \frac{P_u - P_d}{S_u - S_d} = \frac{P_u - P_d}{30-22}$$

$$B = \frac{P_d - S_d\Delta_d}{1+r_f} = \frac{P_d - 22\Delta}{1.02}$$

$$P = S\Delta + B = 25\Delta + B$$

5. FewBucks Coffee Company's current stock price is $21 per share. In each of the next two years, FewBucks will go up by $3 per share or down by $2 per share. The risk-free rate is currently 3% per year and is not expected to change. Using the binomial option pricing model, calculate the value of a put with a strike price of $20 that expires 2 years from today.

S_u = 21 + 3 = 24, S_d = 21 – 2 = 19 S_{uu} = 21 + 3 + 3 = 27, S_{ud} = S_{du} = 21 + 3 – 2 = 22, S_{dd} = 21 – 2 – 2 = 17

P_{uu} = 0, P_{ud} = P_{du} = 0, P_{dd} = 20 – 17 = 3

P_u = 0 since only possible payoff = 0

P_d:

$$\Delta_d = \frac{0-3}{22-17}$$

$$B_d = \frac{3-17\Delta_d}{1.03}$$

$$P_d = C_d = 19\Delta + B_d$$

P:

$$\Delta = \frac{0-P_d}{24-19}$$

$$B = \frac{P_d - 19\Delta}{1.03}$$

$$P = C = 21\Delta + B$$

Multiple-Choice

1. Golden Socks Inc's stock price currently equals \$16 per share and is expected to equal either \$12 or \$20 per share a year from today. Calculate B you would use in determining the value of a put with a \$15 strike price if the risk-free rate is 2% and Δ equals – 0.375.

a. 9.31
B. 7.35
c. 4.41
d. 12.25
e. – 1.47

2. OOPS Inc. has a current stock price of \$22 and its shares may rise to \$26 per share one year from today. Its shares may also drop in value. You have short-sold \$9.3204 of risk-free bonds earning a rate of 3% and purchased 0.6 shares. A call with what strike price will provide the same payoff as your portfolio one year from today?

a. \$28
B. \$20
c. \$26
d. \$6
e. there is not enough information

3. Assume that you want to calculate the beta of a put with a strike price of \$20 that matures 40 days from today. Assume that the stock currently trades for \$21 and has a beta of 0.7. Using the Black-Scholes option pricing model, you have determined that d_1 equals 0.554 and that d_2 equals 0.448. You have also determined that $N(d_1)$ equals 0.7102 and that $N(d_2)$ equals 0.6730. Finally, you have calculated the present value of the strike price as 19.914. Which of the following will calculate the beta of the option?

a. $\left(\dfrac{-(1-.554)\times 20}{-(1-.554)\times 20+19.914\times(1-.448)}\right)\times .7$
b. $\left(\dfrac{-(1-.7102)\times 20}{-(1-.7102)\times 20+19.914\times(1-.6730)}\right)\times .7$
c. $\left(\dfrac{-(1-.554)\times 21}{-(1-.554)\times 21+19.914\times(1-.448)}\right)\times .7$
D. $\left(\dfrac{-(1-.7102)\times 21}{-(1-.7102)\times 21+19.914\times(1-.6730)}\right)\times .7$
e. $\left(\dfrac{-(1-.7102)\times 21}{-(1-.7102)\times 21+19.914}\right)\times .7$

4. Assume you are planning to value a put on Microsoft that expires in 3 months using the Black-Scholes Option Pricing Model. What rate should you use to calculate the present value of K if you plan to exercise the put in 2 months?

A. the return on a 3-month Treasury
b. the return on a 2-month Treasury
c. the return on a 1-month Treasury bill
d. the return on a 1-year Treasury bill
e. the required return (using the CAPM) on Microsoft stock

Chapter 21 Problems

5. CitiDivide Inc's stock price currently equals $8 per share and is expected to equal either $5 or $12 per share a year from today. Calculate Δ you would use in determining the value of a put with a $10 strike price that expires one year from today if the risk-free interest rate is 4%.

a. – 0.2857
b. – 0.4286
C. – 0.7143
d. – 0.5714
e. none of the above

6. Assume that you have calculated the value of Chrysis Motors' stock as equaling $50 million by viewing the stock as a call on Chrysis' assets. In your calculations, you used the following data: the debt matures for $330 million in 7 years and has a current market value of $150 million; the risk-free rate on a 7-year Treasury is 2%; the calculated values for d_1 is 0.0803 and for d_2 is – 0.8548. Calculate the beta of Chrysis' debt if the beta on its assets is 0.52.

a. 0.56
b. 0.69
C. 0.32
d. 0.64
e. 0.28

7. Assume that in valuing a two-period option using the binomial option pricing model you have determined that at time t = 0, Δ equals 0.6743 and that B equals -10.4558. If at t = 1, the stock price rises from its current $21 to $27, then Δ will equal 1 and B will equal -19.5122. If the risk-free rate of interest is 2.5%, how will you need to change your borrowing at t = 1?

a. short-sell risk-free bonds worth $19.03
b. sort-sell risk-free bonds worth $9.06
C. short-sell risk-free bonds worth $8.80
d. buy and return all bonds that have sold short
e. sort-sell bonds worth $8.58