• The delta of a security or portfolio measures the sensitivity of the value of the position (or portfolio) with respect to the price of the underlying asset.

• For example, if a call option on IBM stock has delta 0.7, this means that if the IBM stock price goes up by $1, the value of the call option will go up by 70 cents.

• Delta ranges between -1 and 1.

• Each share of the underlying asset, by definition, is one delta point.

• A long position in a call option has positive delta, whereas a short position in a call option has negative delta. Accordingly, buying call options increases the delta, whereas selling (writing) call options decreases delta.

• A long position in a put option has negative delta, whereas a short position in a put option has positive delta. Accordingly, buying put options decreases the delta, whereas selling (writing) put options increases delta.

• Exercise 1: Suppose it is February 10, 2006 and you have a portfolio of 1000 shares of a stock and the current stock price is $40. You want to reduce your position delta by 40%. Suppose call option contracts on the stock with March expiration and strike price $38 have a delta of 0.480 and they trade at $2. How many of these call contracts should you buy or sell to reduce the position delta by 40%?

\[1000 - N \times 100 \times 0.48 = 600 \Rightarrow N = 8.33\]
• **Exercise 2**: Suppose you have a portfolio of 400 shares of a stock. If you buy 20 call contracts on that stock with delta 0.35 and sell 15 put option contracts on the same stock with delta -0.28, what is your final position delta? Note that each call (put) contract gives the right to buy (sell) 100 shares of the stock.

\[ 400 + (20 \times 100(0.35)) - 15 \times 100 \times (-0.28) = 1520. \]

• **Exercise 3**: Find the portfolio delta for the following portfolio:

- 5000 shares of a stock.
- Short position in 20 call contracts on the stock with delta 0.355.
- Long position in 10 put contracts on the stock with delta -0.250.

\[ 5000 - 20 \times 100(0.355) + 10(100)(-0.250) = 4040 \]

• **Exercise 4**: If the following portfolio has 1200 delta points, what is \( x \)?:

- \( x \) shares of a stock.
- Long position in 10 call contracts on the stock with delta 0.480.
- Short position in 20 put contracts on the stock with delta -0.300.

\[
1200 = x + (10 \times 100(0.48)) - 20(100) \times (-0.3) \\
\Rightarrow x = 120
\]

• **Exercise 5**: Consider the following portfolio:

- 1000 shares of a stock.
- Short position in 5 call contracts on the stock with delta 0.240.

Suppose the portfolio owner wants to increase the portfolio delta to 2000, and a put option contract on the stock with delta -0.220 is available. How many put contracts should the owner buy or sell to increase portfolio delta to 2000?

\[ 1000 - 5(100)(0.24) - (N \times 100 \times (-0.22)) = 2000 \Rightarrow N = 51 \]
Exercise 6: Suppose the following two portfolios have the same delta. Find $x$.

- **Portfolio A**: 500 shares of a stock and 20 short call contracts on the stock with delta $0.25$.
- **Portfolio B**: $x$ shares of a stock and 40 long put contracts on the stock with delta $-0.20$.

\[
\Delta_A = 500 - 20(100)(0.25) = 0
\]
\[
\Delta_B = x + 40(100)(-0.25) \Rightarrow x = 1000
\]