

# Lecture 14: Options Markets

Economics 252, Spring 2011

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<b>OPTION/STRIKE</b>	<b>EXP</b>	<b>-CALL- VOL LAST</b>	<b>-PUT- VOL LAST</b>
<b>ACE Ltd</b> 40	Nov	...	2500 2.80
<b>AOL TW</b> 20	May	76 2.55	2129 0.85
21.85 22.50	Apr	1493 0.50	619 1.20
21.85 22.50	Jul	963 1.95	14110 2.55
<b>AmOnline</b> 25	Apr	983 0.05	12977 3.30
21.85 25	May	1196 0.45	220 3.60
21.85 25	Jul	1339 1	160 4.20
21.85 25	Oct	1706 1.65	14105 4.30
21.85 27.50	Apr	177 0.05	10097 5.80
21.85 27.50	Oct	1253 1.15	153 6.40
<b>AT&amp;T Cda</b> 22.50	Oct	...	2740 1.90
<b>AT&amp;T</b> 15	Jul	593 1.10	5500 1.10
<b>Abbt L</b> 50	Apr	1231 2.95	605 0.30

# Black-Scholes Formula

$$C = SN(d_1) - e^{-rT} EN(d_2)$$

where

$$d_1 = \frac{\ln\left(\frac{S}{E}\right) + rT + \sigma^2 T / 2}{\sigma \sqrt{T}}$$

$$d_2 = \frac{\ln\left(\frac{S}{E}\right) + rT - \sigma^2 T / 2}{\sigma \sqrt{T}}$$

# Put-Call Parity

- In discrete time: 
$$C + \frac{E}{(1+r)^T} = S + P.$$

- In continuous time: 
$$C + E \times e^{-rT} = S + P.$$

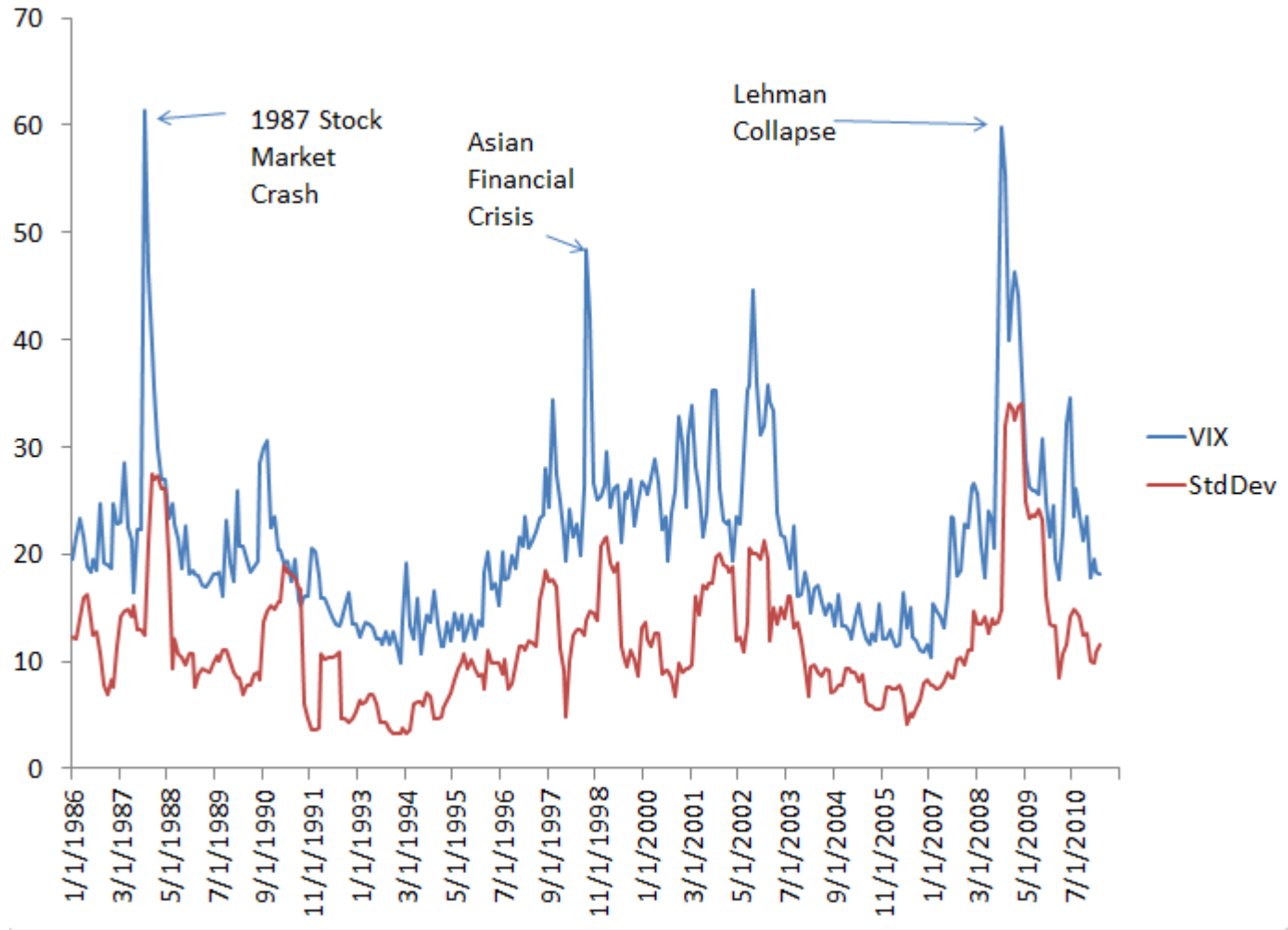
- Variables:

- S: Current stock price.
- C: Price of a European call-option written on stock S with strike price E and with time to maturity T.
- P: Price of a European put-option written on stock S with strike price E and with time to maturity T.
- r: Risk-free rate.

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## Implied and Actual Volatility

### Monthly Jan 1986-Mar 2011



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# Actual S&P 500 Volatility

## Monthly Jan 1872- March 2011

