

SIMON FRASER UNIVERSITY  
*Department of Economics*  
**Advanced Final Examination**

ECON 818  
Advanced Derivative Securities

07-1

**Rules for Submitting Final Exam:** For questions with multiple parts, answer all parts. Assignment is due in my office no later than 7PM on Apr. 11, 2007.

**CHOOSE THREE OF FOUR QUESTIONS (Do all parts of each question)**

1. Provide brief definitions for the following:

- i) standard Weiner process (Brownian motion)
- ii) Mean reverting OU process
- iii) Bessel function of the first kind
- iv) Fokker-Planck equation (forward equation) for a geometric Brownian motion
- v) Constant elasticity of variance process
- vi) Laplace transform (in general) and the Laplace transform for  $e^{-rt^*}$

2. a) Outline the continuous time derivation of the Bachelier option pricing model. (Hint: Use the Black-Scholes assumptions, substituting an arithmetic Brownian motion for the geometric Brownian motion used by Black-Scholes and solve the riskless hedge portfolio problem.)

b) What are the limitations of applying this model to actual options prices (being sure to identify what amendments have to be made to the Bachelier formula to, say, incorporate dividend paying stocks or allow for options on forward prices)?

3. a) **Describe** the delta, gamma and theta for a long position in a straddle spread and a strangle spread. If both spreads are constructed to be delta neutral and have the same initial value (the  $V$  is the same), then what can be said about the relative gamma and theta of the two spread positions? (Hint: Be sure to determine the number of options used in both spread positions.)

b) Explain how to create a position which is delta positive and gamma neutral and contains a short stock position. Describe a specific example of how the position would be implemented.

4. a) **Describe** the delta, gamma and theta for a long position in a time spread and a butterfly spread, both using puts.

b) If  $G = XYZ$  where  $X$ ,  $Y$  and  $Z$  are geometric Brownian motion diffusion processes satisfying the conditions required for Ito's lemma, and the covariances between the Brownian motions are all positive, determine the diffusion process for  $G$ .