

March 23, 2014

### Abstract

## 1 PRMIA Section 2C

### 1.1 Partial Differentiation (Black Scholes)

$$\frac{\partial W}{\partial t} + rs \frac{\partial W}{\partial s} + \frac{\sigma^2}{2} \frac{\partial^2 W}{\partial s^2} = rW$$

**W** Value of a derivative security

**s** value of an underlying security

$\sigma$  Volatility

**r** Risk free rate of return

### 1.2 Example (Page 84)

Suppose  $w$  is a function of three variables

$$w = x^4 + xz^3 + xy - 4y^3$$

#### Solutions

$$\frac{\partial w}{\partial x} = 4x^3 + z^3 + y$$

$$\frac{\partial w}{\partial y} = x - 12y^2$$

$$\frac{\partial w}{\partial z} = 3xz^2$$

### 1.3 Hessian

$$\begin{pmatrix} \frac{\partial^2 w}{\partial x^2} & \frac{\partial^2 w}{\partial x \partial y} & \frac{\partial^2 w}{\partial x \partial z} \\ \frac{\partial^2 w}{\partial x \partial y} & \frac{\partial^2 w}{\partial y^2} & \frac{\partial^2 w}{\partial y \partial z} \\ \frac{\partial^2 w}{\partial x \partial z} & \frac{\partial^2 w}{\partial y \partial z} & \frac{\partial^2 w}{\partial z^2} \end{pmatrix}$$

## 1.4 Vega

Vega is the the rate of change of an option value wrt to the volatility of the underlying.