

# INTRODUCTION INTO THE NEW BLOOMBERG IMPLIED VOLATILITY CALCULATIONS

*The purpose of this document is to provide a brief introduction into the  
Bloomberg implied volatility calculations.*

*Certain details have been omitted and others have been simplified to make  
it accessible for even the novice users.*

## ROLL OUT SCHEDULE

### Important notice:

This document applies to options on US Equity/Indices only.

As of March 10<sup>th</sup> 2008 the implied volatilities based on the VG-model will no longer be supported.

Date	IV Dataset available
Monday March 10 <sup>th</sup> 2007	ATM, and Moneyness
Monday March 17 <sup>th</sup> 2007	Delta
Monday March 24 <sup>th</sup> 2007	Sigma

## I. Introduction

The new Bloomberg equity implied volatility datasets consists of implied volatilities for fixed maturities and moneyness levels (%Moneyness, Delta and Sigma) based on out of the money option prices (16:00 closing mid prices).

The methodology can be split up in 2 parts: calculation of the implied forward price and calculation of implied volatility surface consistent with this implied forward price.

## II. Implied Forward Price

To calculate the European prices from mid prices of American options we use implied volatilities from the options monitor OMON<GO>, the **mid**-underlying price ( $S$ ), the rates stripped from the S23-curve (YCRV S23<GO>) and the dividends based on the Bloomberg forecast model (BDVD<Go>). We use these as an input the European option pricer (OV<GO>) to calculate the European option price ( $c^E$  and  $p^E$ ). The pricer assumes constant rates and discrete dividends.

Using put call parity we can calculate the implied forward price from the European call and put prices closest to at-the-money and the interpolated risk free rate.

$$F_{impl} = Strike + e^{rt} (c^E - p^E)$$

We calculate this implied forward for each expiration month. To calculate the implied forward for the fixed maturity points (30, 60, 3m, 6m etc) we transform the forwards into returns with the following formula:

$$r_{impl}(T) = \frac{1}{T} \ln\left(\frac{F_{impl}(T)}{S}\right)$$

and use linear interpolation and flat extrapolation to calculate the return at each fixed maturity point.

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Finally we use:

$$F_{impl}(T) = Spot \cdot e^{r_{impl} \cdot T}$$

to get the implied forward at any time T, e.g. 3 months.

## III. Volatility Surface

The implied volatility ( $\sigma_{impl}$ ) for each maturity and strike level is computed by equating the Black-Scholes formula to the European option price calculated using the methodology of section II and the implied forward price also calculated in section II. E.g.:

$$c^E = e^{-rt} F_{impl} N\left(\frac{\ln(F_{impl} / K) + \frac{1}{2} \sigma_{impl}^2 T}{\sigma_{impl} \sqrt{T}}\right) - K e^{-rt} N\left(\frac{\ln(F_{impl} / K) - \frac{1}{2} \sigma_{impl}^2 T}{\sigma_{impl} \sqrt{T}}\right)$$

To calculate the implied volatility at a fixed level of moneyness we use a non-parametric interpolation in variance space across strikes and to interpolate in time to maturity we use a Hermite cubic spline interpolation in total implied variance space.

## VI. Definition IV datasets

### 1) Moneyness:

$$\% \text{ moneyness} = \frac{\text{Strike}}{\text{Spot}}$$

### 2) Delta:

$$\text{delta} = \frac{\ln\left(\frac{F}{K}\right) + \frac{1}{2}\sigma_k^2 T}{\sigma_K \sqrt{T}}$$

### 3) Sigma:

$$\text{Sigma} = \frac{\ln\left(\frac{K}{F_{\text{implied}}}\right)}{\sigma_{\text{atm}} \sqrt{T}}$$

The Moneyness and Sigma datasets are available for the front month and second month and the following fixed maturities: 30d, 60d, 3m, 6m, 12m, 18m, 24m. The entire dataset normalized by Delta will be released at a later stage.

Options that expire in less than 10 calendar days will not be used when interpolating across expiries.