



## Equity Options

### Introduction to Options

An option is a financial instrument that offers the purchaser the right but not the obligation to buy or sell an asset at a predetermined price at or before a certain date in the future. To obtain the right but not the obligation the purchaser of the option agrees to pay the seller a premium. This can be compared to an insurance premium where the monthly installments are known and certain but the loss if an incident covered by the policy occurs could be significant to the insurer.

This means that the option seller's losses are potentially far greater than the buyer's whose loss is limited to the premium paid. They are optional for the buyer but binding for the seller. Options can be traded by both retail and institutional investors.

There are two types of options traded on the JSE's Equity Derivatives market, call options and put options. Call options give the buyer the right, but not the obligation, to buy the underlying shares at a predetermined price, while put options give the buyer the right, but not the obligation, to sell the underlying shares at a predetermined price.

For example, a SEP09 ABCQ 150 call option gives the buyer the right to buy one futures contract in ABC Corporation for R150 on or before the expiry date of the option in September. If exercised, the seller of this option must sell one futures contract (100 equities) of ABC for R150 regardless of the price of the underlying security at expiry. At the time of the transaction, the option buyer pays the option seller a premium, which is the cost of the option.

As stated previously, the buyer of the option is not obligated to exercise the option. The buyer can sell the option before it expires, or alternatively let the contract lapse at expiry and therefore lose the option premium paid. When the purchaser uses his right to buy or sell the asset it is called *exercising the option*.

There are two styles of options: European style options and American style options.

European style options give the purchaser the right to exercise the option only on the specified day in the future. American style options give the purchaser the right to exercise the option anytime before the option expiry date. Even though the JSE Equity Derivatives Market only supports American style options, research has demonstrated that with Futures Style Options it is suboptimal to exercise early.<sup>1</sup> The main reason for this is that closing your long position completely erodes the time value inherent in the options position.

JSE Equity Options are called Future Style Options as they are based on Equity Futures and follow the same margining process. In other words the purchaser of the equity option buys the right but not the obligation to buy or sell an equity future on the JSE.

---

<sup>1</sup> The Suboptimality of Early Exercise of Futures-Style Options: A Model-Free Result, Robust to Market Imperfections and Performance Bond Requirements  
Rodolfo Oviedo\* Faculty of Management, McGill University  
Facultad de Ciencias Empresariales, Universidad Austral  
First Version: January 22, 2008. This Revision: December 04, 2008

A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future for a predetermined price. The pricing of a futures contract is based on what it would cost to buy the underlying asset today and holding that asset until the contract expires. The cost of holding the asset is called the carry cost. Futures that are traded on an exchange are margined and standardised.

When trading in futures contracts there are two positions that an investor can take:

Long Position – Go Long – Buy Future

Short Position – Go Short – Sell Future

When you 'go long' you are buying exposure to the underlying share because you believe the price of the underlying share will increase. If it does so by the time the contract expires (or before the contract expires) you will realise a profit. If you are long (bought) the futures contract the seller will pay you for each day's increase of the underlying share.

You will 'go short' if you believe the price of the underlying share will decrease, thereby realising a profit if the futures price goes down over the life of the contract. If you are short (sold) the futures contract, the long holder will pay each time the price decreases.

At the expiry of the contract you will pay the market price of the future which is that day's spot price. Because you have received the net difference between the opening price of the contract and the expiry price of the contract, the economic effect is as if you had bought the underlying equities at the initial price.

### **Three main types of futures**

You can trade options on the JSE's Equity Derivatives market that are based on three main types of futures:

- Single Stock Futures Options
- Index Future Options
- Can Do Options

Single Stock Futures are futures contracts that are usually based on 100 underlying shares (also called a nominal of 100). These contracts can be physically settled or cash settled meaning that the buyer will either buy the agreed shares at the agreed price on expiry or just receive the equivalent amount in cash without taking delivery of the underlying shares.

An Index Future is based on a basket of shares. The most traded contract on the Derivatives Exchange is the ALSI contract which is based on the FTSE/JSE TOP40 Index or TOPI. It is always cash settled with a nominal value of R10 per point movement.

Can Do Options are customised baskets or non-standardised options.

### **Features of an Option**

Option contracts have a number of components. These components include:

#### ***Expiry date***

This is the day on which all unexercised options for the specified contract date expire. They generally expire on the third Thursday of March, June, September and December on the JSE's Equity Derivative Market. These dates correspond with the futures market close-out when all the contracts for that expiry are settled.

### ***Underlying securities***

As the JSE's Equity Options are Future Style Options, the underlying security of the option will always be a future contract. Options may therefore be traded on any company with a Single Stock Future (SSF) or an Index Future listed on the JSE's Equity Derivatives market. Options trade like other derivatives, with buyers making bids and sellers making offers. You can trade options on most of SA's largest companies, including firms in the FTSE/JSE TOP 40 index. Options are also available on the FTSE/JSE Top 40 Index (ALSI).

### ***Strike/exercise price***

This is the pre-determined price at which you buy (call) or sell (put) the underlying asset if the option is exercised. The JSE does not set/load the strike prices of our options which allows for complete flexibility when transacting and also allows for more efficient combination positions and strategies. Strike prices for options based on Single Stock Futures do not have strike intervals, allowing any strike price up to 2 decimals. Strike prices for options based on index futures are set to 50 point strike intervals.

### ***Premium***

The premium is simply the price the purchaser pays to obtain the right without the obligation. It serves as an insurance premium for the seller of the option. The JSE lists Futures Style Options. A futures style option's premium is paid in installments each day rather than the entire premium being paid upfront (bullet premium). The JSE makes use of the modified Black formula in order to calculate the value (premium) of the option on a daily basis.

### ***Margin***

Options are margined to reduce the risk of default. By having to pay the gains or losses each day the financial risks are greatly reduced as the cash-flows are smaller and more manageable. The risks are further mitigated by a process called "Novation" where the clearing house becomes the counterparty to every trade and uses its financial assets to guarantee each trade. The JSE's futures clearing house is called SAFCOM. There are two types of margin associated with options:

*Initial margin* – This is a deposit which is calculated by the exchange's estimate of the maximum one day's loss and is used to reduce the risk of default. Both the buyer and seller are required to deposit initial margin. It is also sometimes referred to as a performance bond or a good faith deposit. Participants will earn a competitive interest rate on it and it will be returned upon the expiry or closure of the contract. Unlike futures, options' initial margins are recalculated and adjusted daily by the exchange.

*Premium variation margin* – This refers to the cash flow premiums paid or received by the counterparties to the option transaction each day. Each night, the JSE calculates the value of the position using the Modified Black Option pricing formula. This is essentially an estimate of what the position is worth every day. For example, a rise or a fall in the price of the underlying future will cause the option to be worth more or less on the day. The counterparties will therefore either pay or receive premium variation margin. The total premium variation margin at the end of the contract will add up to the originally agreed premium of the option.

### ***Volatility***

This is probably the most important parameter of any option pricing model and is based on the volatility of the underlying security. Refer to the calculation section for more information with regards to volatility.

### **Closeout price**

If the option is kept until the expiry date, the option holder will receive a futures contract at the predetermined strike price. If it is based on a FTSE/JSE TOP40 stock, it will settle on the average of the last traded price per minute taken over 100 minutes between 12:01 and 13:40 in the underlying equities market on closeout day by the JSE. What this means is that the price will be an average of that period and that it will be a true tradable price that allows people to get in or out the market at that level. If the underlying instrument is not a constituent of a Futures Index listed on Safex, it will close at that day's equity closing price as the closeout price.

### **Voting rights**

Options do not provide for voting rights like shares.

### **Calculations**

Mathematical modeling of financial markets can be traced back to Louis Bachelier's 1900 dissertation on speculation in the Paris markets. Financial economics, however, only came of age in 1973 with the publication of the preference-free option pricing formula by Fischer Black, Myron Scholes and Robert Merton. Their model established the everyday use of mathematical models as essential tools in the world of finance, both in the classroom and on the trading floor.

The Black-Scholes option valuation formula was developed as an attempt to determine the fair economic value of an option for both buyer and seller, that is, to determine at what price (exclusive of commissions) both a buyer and seller would break even on the option (and thus lose only their commissions). It uses probability theory, discounted cash flows, and expected value calculations.

While the Black-Scholes model does not perfectly describe real-world options markets, it is still often used in the valuation and trading of options.

One fact we constantly have to remember is that the Black-Scholes model is just a model, an abstraction of reality. Modeling, however, is not merely a collection of techniques but an art in blending the relevant aspects of a problem and its unforeseen consequences with a descriptive, yet tractable, mathematical methodology. Building and analysing models are important.

How should the Black-Scholes model then be used? A good start is to comprehend its limitations and applicability to the case at hand. By considering practicalities like transaction costs, liquidity and frequency of hedging, we will be guided on how to overlay these problems onto the actual bare-bones price of the model and decide whether that's a price we can live with. Trading with a model is definitely not the simple and clinical procedure many people imagine.

Let's look at the Black-Scholes environment created when the formula was developed. They assumed:

- *the underlying stock price* follows a continuous random walk – stock prices diffuse through time linearly proportional to the spot price i.e. constant volatility. The price in the future is unpredictable but will most likely be close to some mean or expected value
- *the efficient market hypothesis holds* - markets are liquid, have price-continuity, are fair, are complete and all players have equal access to information
- *investors live in a risk-neutral world* - they require no compensation for taking risk. There are no arbitrage opportunities and the expected return is the risk-free interest rate. This was perhaps their most important insight leading them to construct a self-financing riskless hedge: in a portfolio of three securities (an option, the underlying stock and a riskless money market security) any two could be used to exactly replicate the third by a trading strategy

- *delta hedging is done continuously* - for the return on the hedge portfolio to remain riskless, the portfolio must continuously be adjusted as the asset price changes over time

Now, let,  $F$  be the futures price and  $K$  the strike price of an option. We assume the option expires after a time interval  $T$ . At expiration (at close-out) an option is always worth its intrinsic value given by

$$V_{call}(T) = \max[F - K, 0]$$

$$V_{put}(T) = \max[K - F, 0]$$

The JSE's options are based on futures, we thus make use of the so-called Modified Black Formula to calculate the premium thereof. The formula is used to calculate the value of the options each night which forms the basis to the premium variation margin. The Black Formula is

$$V = \phi [F N(\phi x) - K N(\phi y)]$$

with

$$x = \frac{1}{\sigma \sqrt{T}} \left\{ \ln\left(\frac{F}{K}\right) + \left(\frac{\sigma^2}{2}\right)T \right\}$$

$$y = x - \sigma \sqrt{T}$$

Here we use a binary variable such that  $\phi = 1$  for a call and  $\phi = -1$  for a put. The quantity  $N(\phi x)$  is called the "Standard Cumulative Normal Distribution". This quantity can be calculated using the Excel function NORMSDIST. The function  $\ln$  is the natural logarithm and  $F/K$  is called the moneyness of the option. It shows how much the option is *in-the-money* or *out-the-money*.

The volatility is represented by the  $\sigma$  variable.

A modified Black calculator is freely available on the JSE's website at the following URL:  
[http://www.safex.co.za/ed/docs/products/JSE\\_Modified\\_%20Black\\_Calculator.xls](http://www.safex.co.za/ed/docs/products/JSE_Modified_%20Black_Calculator.xls)

### Initial margin

The role of the exchange is to organise trading so that option contract defaults are avoided. The exchange therefore requires from the option participant an amount of money at the time the option contract is entered, known as the initial margin.

The initial margin is determined by considering the possible risk of loss on the option position(s) over a one day period. Given that any option is mainly sensitive to the underlying price and its volatility, the initial margin calculation involves stress testing the underlying price and volatility. Stress testing the underlying volatility and price is a method of estimating the risk of loss on the option position(s) under some of the most extreme historical underlying market movements. The worst case scenario is the underlying price volatility stress test that incurred the biggest option position(s) loss, and this loss amount is taken as the initial margin.

The initial margin is set such that any one day market change will be covered by the initial margin 99.95% of the time. This means there is only a 0.05% chance that the initial margin will not be enough to cover losses.

An initial margin calculator and its operating instructions are freely available on the JSE's website at the following URL: [http://www.safex.co.za/ed/docs/options/safex\\_option\\_IMR.xls](http://www.safex.co.za/ed/docs/options/safex_option_IMR.xls)

The full margining specs are published on the following URL: [http://www.safex.co.za/ed/margining\\_methodology.asp](http://www.safex.co.za/ed/margining_methodology.asp)

## **Volatility**

We will discuss two types of volatility - historical and implied volatility.

### ***Historical volatility***

The most important parameter of any option pricing model is the volatility of the underlying security. In fact, the price of an option is basically the intrinsic value weighted by probabilities that strongly depend on the volatility.

The volatility of the underlying price is a statistical measure of the dispersion of the underlying price returns about a central tendency. In other words, suppose we have a time series of  $n+1$  prices  $F_i$ , we can obtain  $n$  logarithmic price returns denoted by  $u_i$  such that

$$u_i = \ln\left(\frac{F_i}{F_{i-1}}\right).$$

The volatility is then defined as the standard deviation of the  $u_i$  time series. Mathematically the volatility is defined by

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (u_i - \tilde{u})^2} * \sqrt{h}$$

where  $\tilde{u}$  is the mean or average of the  $u_i$  time series.  $h$  is an annualisation factor. If one has daily data,  $h = 252$ ; if one has weekly data,  $h = 52$  and if the data is monthly data, then  $h = 12$ .

Calculating volatility in Excel is easy. One uses the STDEV function multiplied by the  $\sqrt{h}$ . The next picture shows the implementation in Excel. Assume we have a price series for MTN in Excel as shown, we can then calculate the historical volatility. Please note that some of the rows are hidden.

	A	B	C	D	E	F	G	H	I
1		MTN							
2	01/12/2004	4000							
3	02/12/2004	4175	0.04282						
4	03/12/2004	4140	-0.0084186						
5	06/12/2004	4080	-0.0145988						
32	13/01/2005	4379	0.0299014						
33	14/01/2005	4400	0.0047842						
34	17/01/2005	4301	-0.022757						
35	18/01/2005	4150	-0.0357392						
36	19/01/2005	4100	-0.0121214						
37	20/01/2005	4100	0						
38	21/01/2005	4150	0.0121214						
39	24/01/2005	4340	0.044766						
40	25/01/2005	4243	-0.0226038						
41			35.87%						

### Implied volatility

The implied volatility is the volatility implied by the market prices of options. If one knew the option premium, one can use the Modified Black formula to back out the volatility – that is deemed the implied volatility. This volatility is interesting to option participants because it can be used to monitor the market opinion about the volatility of the underlying. The prices of deep *in-the-money* options and deep *out-the-money* options are relatively insensitive to volatility. This is because deep *in-the-money* and deep *out-the-money* option prices are nearly equal to their intrinsic values. *At-the-money* options are very sensitive to changes in volatility.

### At-the-money (ATM) volatility

ATM volatility refers to the volatility level for an option strike price which is equal to the underlying futures price. On a daily basis, the JSE attempts to calculate a new ATM volatility for all Index and Single Stock Options by manually applying the following methodologies:

1. Higher bid, lower offer on-screen between 17:00 and 17:05
2. Option trades during the day
3. JSE calculates ATM Volatility

The above methodologies are applied in the sequence listed above. I.e. If a new ATM Volatility could not be calculated using point 1, the JSE would revert to point 2 and lastly point 3. The rules associated with the methodologies are explained below:

#### 1. Higher bid, lower offer on-screen between 17:00 and 17:05

- Delta Option order “on screen” on the global options window. I.e. trade on volatility (not price)
- Order’s volume must be 100 contracts or more
- Strike of the order must be ATM
- For Indices the strike must be 100 points from where the future closed

- For Single Stocks the strike must be 10% from where the future closed

## 2. Option trades during the day

- Delta Option trade “on screen”. I.e. traded on volatility (not price)
- Trade was in 100 contracts or more
- Strike of the trade must be ATM
- For Indices the strike must be 100 points from where the future closed
- For Single Stocks the strike must be 10% from where the future closed
- Member did not trade with himself or one of his clients

## 3. JSE calculates ATM Volatility

- Linking – The JSE creates a relationship between the ALSI contract and the illiquid contract and adjust the ATM Vols as the ALSI ATM Vol moves up and down. The recent market conditions has however proven this methodology to not be as effective.
- Historic Vol – The JSE calculates a 90 day historic volatility for the last 20 days. The average of the 20 day historic volatility is then used with a discretionary weighting towards the more recent days 90 Day volatilities for the near expiry of the contract. A term structure is applied for the further out expiries.
- Polling – On request of a market participant, the JSE polls open position holders and calculates an average ATM volatility to be used as the new ATM Volatility
- Research – The JSE’s quantitative analysts are continuously investigating alternative ways in order to calculate the ATM Vols. As always, the JSE is open for suggestions from the market on better ways of calculating ATM Vols.

The above guidelines can also be downloaded from the following URL:

[http://www.safex.co.za/ed/docs/options/JSE\\_Options\\_ATM\\_Vol\\_Change\\_Guidelines\\_V0%204.pdf](http://www.safex.co.za/ed/docs/options/JSE_Options_ATM_Vol_Change_Guidelines_V0%204.pdf)

## Volatility skew

Since the market crash of 1987 the demand for *out-the-money* cheap puts has always exceeded the demand for *out-the-money* cheap calls. For this reason, *out-the-money* puts trade at higher implied volatilities than *out-the-money* calls. This inverse relationship between the implied volatilities and strikes is called the volatility skew. It roughly has a parabolic shape with the inflection point being the ATM volatility as shown in figure 1. in practice this means that options with different strikes trade at different implied volatilities.

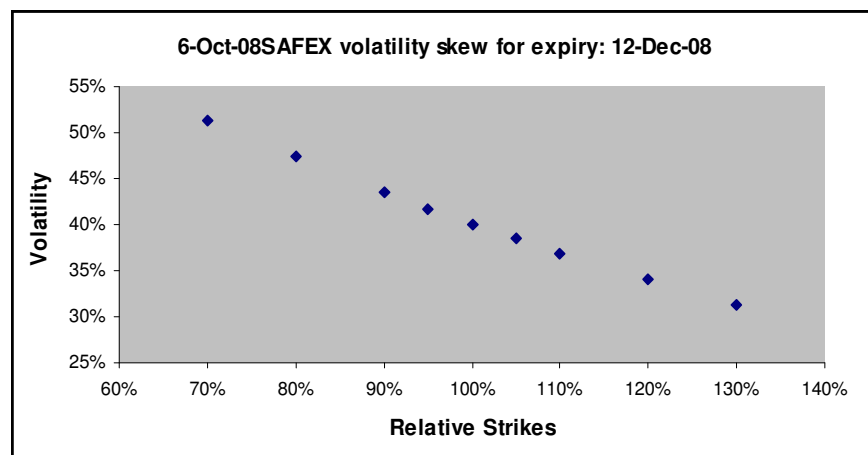


Figure 1: The 6-Oct-08 SAFEX volatility skew for ALSI options expiring 18-Dec-08.



The modeling of the volatility skew and its term structure is not straight forward, at all. The fact that the SAFEX option market data are sparse, makes the task at modeling the skew even more troublesome.

As a first measure to modelling the skew, a simple “Deterministic Volatility Function” (DVF) can be considered – it can be a six parameter quadratic function in option strikes and term. As a first step in determining the goodness of the model, it is compared with the widely known SABR skew model. A plot of the SAFEX skew together with the DVF and the SABR qualitative results, are shown in Figure 2.

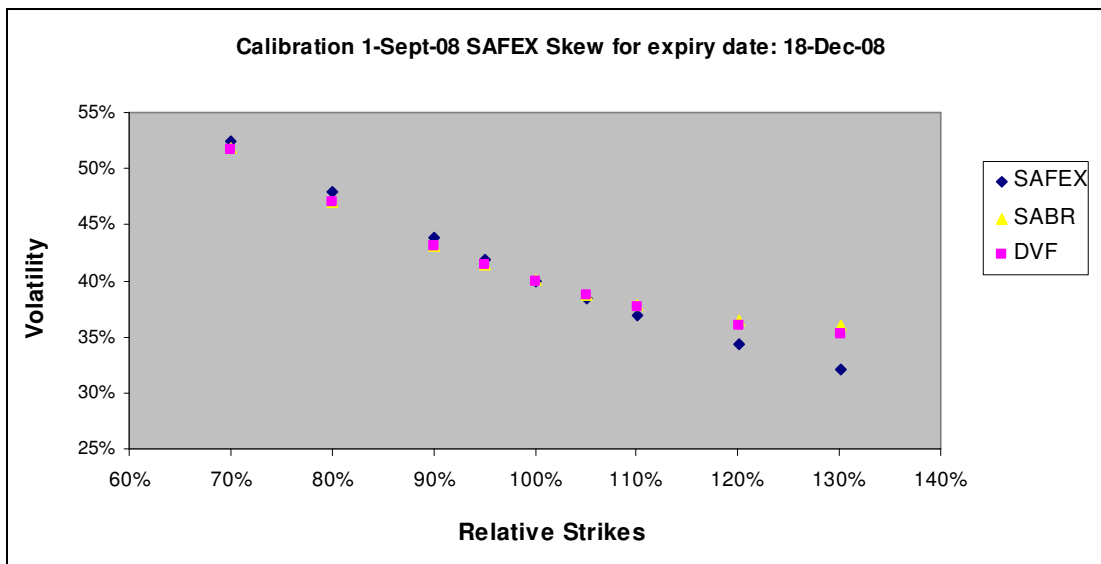


Figure 2: The 1-Sept-08 calibration to the 18-Dec-08 SAFEX skew.

For both the DVF and SABR the calibration error is larger for out-the-money calls (above relative strikes of 100%) compared to that for out-the-money puts (below relative strikes of 100%). the calibration error is negligible for the around-the-money options (relative strikes ranging between 90% and 110%).

The calibration is reasonable, given the fact the calibration error directions are consistent with the importance of the volatility dependency on the pricing of options with different levels of moneyness.

The shape of the skew becomes flatter for further out contracts.

The JSE currently determines volatility skews for the ALSI, FINI and DTOP Index Options on a monthly basis by polling the market on the first Monday of the new month. Market participants contribute their skews to the JSE in any format (Excel, CSV, Moneyness or Strikes). The JSE calculates an averaged volatility skew from the contributed data. this volatility skew will be used for the rest of the month. Since the introduction of the Nutron trading system in August 2008, volatility became a compulsory field for all option trades. The JSE will be using these traded volatilities to calibrate their own volatility skew using a mathematical model to derive the line of best fit without having to poll the market. The JSE will be using the SABR model.

Currently Single Stock Options on the JSE don't have volatility skews and In-and-Out the Money Options therefore get valued of the same volatility. This is obviously not correct and the JSE will be introducing relationship volatility skews from January 2009. with relationship volatility skews the JSE will use the market's most liquid instrument (the ALSI) as a base and create a relationship between the Single Stock Options ATM volatility and the liquid instrument's ATM volatility using the liquid instrument's volatility skew shape.

## **Closeout price and process**

A futures closeout is the day on which all futures and options for that day will expire. On closeout day they must converge with the equity spot or cash market as that is where final hedging will take place. When the closing price for future contracts have been calculated all the futures for that expiry cease to exist. They are then booked the next day by the JSE as reported trades at the closeout price as trades that happened the previous day. For example if Stock XYZ's closeout price was R120 per share at the closeout, it would be booked the next day as a reported trade between the delivering and receiving parties of the futures contracts as a trade between their nominated cash/spot equity brokers.

The closeout prices for Indices and for Single Stock Futures index constituents are based on an average of 100 trades that have taken place in the underlying equities market. The JSE uses the last traded price per minute over 100 minutes between 12h01 and 13h40 on the third Thursday of March, June, September and December. The 100 equity trades are averaged and that average price for all the constituents is then used to calculate the index value for that particular expiry. The JSE publishes the closeout prices of the index usually at or just before 2pm. If the underlying Single Stock Future is not a constituent of a Futures Index listed on Safex, it will closeout at that day's equity closing price.

### ***20 minute rule:***

From the time the closeout prices are published, all option holders (buyers) have 20 minutes to exercise or abandon options that would not be automatically exercised by the exchange. The exchange will automatically exercise all options that are 1 cent or greater in the money unless you abandon your option within this 20 minute period. If your option expires slightly out the money and you would still like to exercise it, you must also do so within the 20 minute period.

## **Cash flow example**

The example below indicates the cash flows for a one year in-the-money call option. It illustrates how the premium of the option is paid over the life of the option and also how the initial margin changes (initial variation margin) as the value of the option changes (in or out-the-money).

The exchange will calculate the value (premium) and initial margin of the options on a daily basis and as a result there might be daily cash flows. The example also indicates that when you add up all the cash flows it will add up to the original agreed premium.

In the example the buyer of the option received the right, but not the obligation, to buy one futures contract in an underlying company for R100 in one year's time. On the date of the agreement (trade date) the futures price of the underlying share is trading at R100. The seller agreed to sell this right to the buyer at a premium of R1,192. Remember that JSE Options are based on a Future contract and that the nominal (number of shares) of a Single Stock Future contract is usually equal to 100 underlying equities.

Date	Option Trade Prem	Futures Price	Vol	Closing Premium (MtM)	Buyer Prem Var Margin	Seller Prem Var Margin	Buyer Initial Margin	Seller Initial Margin	Buyer Initial Var Margin	Seller Initial Var Margin	Buyer Cash Flows	Seller Cash Flows
Trade Date (2008/01/01)	1,192	100	30	1,192	0	0	631	819	-631	-819	-631	-819
3 Months Later (2008/03/31)		106	30	1,393	201	-201	692	867	-61	-48	140	-249
6 Months Later (2008/06/30)		115	30	1,850	457	-457	802	942	-110	-75	347	-532
9 Months Later (2008/09/30)		117	30	1,825	-25	25	814	980	-12	-38	-37	-13
12 Months Later – Close out (2008/12/31)	N/A	120	30	0	-1,825	1,825	0	0	814	980	-	1,011
					-1,192	1,192			0	0	-	1,192

## Cash flow example explained

### **Date**

Exchange traded derivatives are valued on the exchange on a daily basis which might result in daily cash flows. To keep the example simple and clear we've calculated snapshot cash flows every three months as oppose to daily.

### **Option trade premium**

This premium is the price the buyer agreed to pay the seller in order to obtain the right without the obligation. This price is the original agreed premium calculated independently from the exchange and agreed to by the buyer and seller.

### **Futures price**

As the JSE Equity Options are Future Style Options, the underlying security of the option will always be a future contract. This column indicates the price of the underlying future contract at every three month snapshot.

### **Volatility**

This column refers to the implied volatility calculated/maintained by the JSE as explained in the Calculations section of this document under the heading ATM Volatility.

### **Closing premium (M-t-M)**

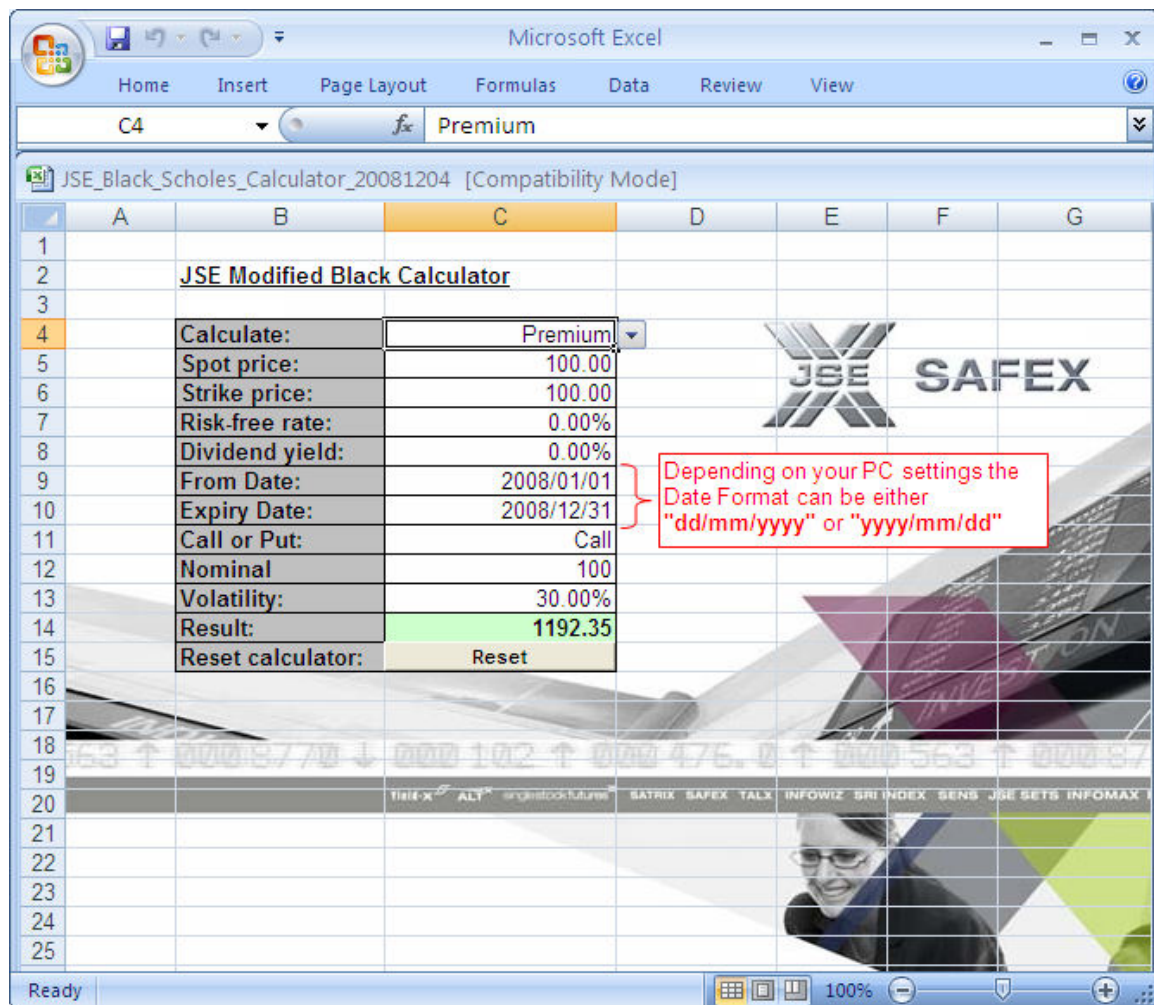
During the end-of-day Mark-to-Model process, the JSE calculates the closing premium by using the modified Black options valuation formula. A modified black calculator is freely available on the JSE's website at the following URL:

[http://www.safex.co.za/ed/docs/products/JSE\\_Modified\\_%20Black\\_Calculator.xls](http://www.safex.co.za/ed/docs/products/JSE_Modified_%20Black_Calculator.xls)

The input parameters into the JSE Modified Black Calculator can be explained as follows:

- *Calculate*: this is a powerful calculator that could be used to calculate the option's value (premium), the implied volatility and the greeks (delta, gamma, vega, kappa, rho and theta).
- *Futures price*: JSE options are based on the future and this value therefore refers to the underlying future contract's value.
- *Strike price*: this is the pre-determined price at which you buy (call) or sell (put) the underlying asset if the option is exercised.
- *Risk-free rate*: JSE options are based on the future and the futures price already includes the interest rate. The value you enter in this field is therefore 0.
- *Dividend yield*: JSE options are based on the future and the futures price already includes the dividend yield. The value you enter in this field is therefore 0.
- *From date*: the date for which you want to calculate the value of the option.
- *Expiry date*: the pre-agreed future date on which the option contract will be exercised or expired.
- *Call or put*: the right to buy (call) or sell (put) the underlying equity in the future.
- *Nominal*: JSE options are based on the future and 1 Single Stock Future contract equals 100 underlying shares. For Index Futures the user needs to supply a nominal of 10 as they're valued R10 per point.
- *Volatility*: the implied volatility associated with the option's strike price.
- *Result*: this is the calculator's output value and would be the result of the selected first field called "calculate". In the example below it's the premium.

Below is a screenshot of the JSE's Modified Black Calculator. Note that it's populated with the Trade Date (2008/01/01) data from the Cash Flow Example. By changing the input data, users can easily calculate all Premiums used in the Cash Flow Example themselves.



### **Buyer/seller premium variation margin**

The difference between every day's premium. If the premium goes up from day one to day two the buyer's option is worth more and he will therefore receive the difference in premium from the seller. If the premium goes down, the buyer's option is worth less and as a result he will have to pay the difference in premium to the seller.

### **Buyer/seller initial margin**

This is a deposit which is calculated by the exchange. It is an estimate of the largest potential one day's loss and is used to reduce the risk of non-payment. Both the buyer and seller are required to deposit initial margin. An Initial Margin Requirement (IMR) calculator spreadsheet and its operating instructions are freely available on the JSE's website at the following URL:

[http://www.safex.co.za/ed/docs/options/safex\\_option\\_IMR.xls](http://www.safex.co.za/ed/docs/options/safex_option_IMR.xls)

**Note:** This initial margin calculator does not include offsets. It only looks at one position at a time. If you have any other positions your initial margins may be offset and thus this calculation will not be accurate.

The input parameters to the spreadsheet calculator (SSF Option IMR Tab) are explained below:

- *Single Stock Futures Price*: JSE options are based on the future and the future's MtM value must therefore be populated in this field. MtM future prices are published daily at the following URL on the JSE'S website:  
<http://www.safex.co.za/pub/mtmdata/Mtm%20All.xls>
- *Strike Price*: The Strike Price of the Option.
- *Current Date/Valuation Date*: the date on which the trade is done or on which the option's initial margin is calculated.
- *T+1*: This field is automatically calculated by the calculator and refers to the settlement date which is the next business day on Safex.
- *Maturity/Expiry Date*: the pre-agreed future date on which the option contract will be exercised or expired.
- *Volatility*: The implied volatility associated with the option's strike price. For Single Stock Options this is the At-the-Money Volatility. *The JSE* maintains and publishes the ATM Volatilities daily in the "vol" column of the "MTM Data" spreadsheet which can be found at the following URL: <http://www.safex.co.za/pub/mtmdata/Mtm%20All.xls>. For Index Options the Volatility is interpolated from the relevant Volatility Skew which can be found at the following URL: <http://www.safex.co.za/pub/mtmdata/Vol%20Skew%20Indices/>
- *Call or Put*: The right to buy (call) or sell (put) the underlying equity in the future.
- *Time till Expiry*: This field is automatically calculated by the calculator and refers to the number of days to expiry divided by 365.
- *Volatility Scanning Range (VSR)*: This field refers to the maximum increase or decrease in the volatility used to determine the volatility scenarios of the calculator. A full list of the VSR values associated with the different Safex options can be found at the following URL: [http://www.safex.co.za/pub/margin\\_requirements/](http://www.safex.co.za/pub/margin_requirements/)
- *Risk Parameter (S)*: This is a risk parameter set by the JSE at 3.5 standard deviations. It means that the Initial Margin will be adequate to cover a one day loss 99.95% of the time.
- *Fixed Initial Margin per Futures Contract*: JSE options are based on the future and the future's initial margin must therefore be populated in this field. A full list of future's initial margin requirements can be found at the following URL:  
[http://www.safex.co.za/pub/margin\\_requirements/](http://www.safex.co.za/pub/margin_requirements/)
- *Margin Requirement per Contract Table*: This table displays the buyer and seller IMR. It indicates an IMR with or without Volatility Scenarios. Please note that Safex uses the IMR with Volatility Scenarios rounded to the nearest Rand.
- *Scenario Analysis Table*: There are 2 methodologies used in this table:
  - Including Volatility Scenario – This is the correct methodology used by Safex
  - Excluding Volatility Scenario – This methodology assumes a flat volatility and is not used by Safex
- The "Including Volatility Scenario" methodology creates 18 scenarios. These are used to create risk arrays which are tables setting out the maximum likely loss for both the buyer and the seller of the option. Below is a description of how these risk-arrays are created.
  - The 18 scenarios are calculated using 9 Futures Prices (1 MTM, 4 Higher and 4 Lower). This range of 9 Futures Prices is calculated by taking the JSE's published *Fixed Initial Margin per Contract* into account.
  - This range of 9 values is the MTM price plus or minus the *Fixed Initial Margin per Contract* in 25% intervals up to 100% positive and 100% negative. This is known as the price range and is shown on row 30 of the IMR spreadsheet, screenshot below.
  - For the seller of the option a set of 9 higher volatilities (see row 32 of the spreadsheet, screenshot below) are used to generate the worst case scenario and for the buyer of the option a set of 9 lower volatilities will be used (see row 35 of the spreadsheet, screenshot below). The set of 18 volatilities are calculated using the VSR and RPVE.

- The 9 Futures Prices and volatility combinations are then put through the Modified Black Option Pricing formula. This generates 9 upper volatility scenarios and 9 lower volatility scenarios. This is shown in rows 34 and 37 in the screenshot respectively.
- The worst case scenario e.g., the maximum loss of the upper volatility scenario gives the IMR for the seller and maximum loss of the lower volatility scenario gives the IMR for the buyer.

Below is a screenshot of the JSE's Initial Margin Calculator spreadsheet. Note that it's populated with the Trade Date (2008/01/01) data from the Cash Flow Example. By changing the input data, users can easily calculate all Initial Margins used in the Cash Flow Example themselves.

OPTION DESCRIPTION	Input Parameters
Single Stock Futures Price	100.00
Strike Price	100.00
Current Date/Valuation date	01-Jan-08
T+1	02-Jan-08
Maturity/Expiry Date	31-Dec-08
Volatility	30.00%
Call/Put	Call
Time to Expiry	1.0000
Volatility Scanning Range (VSR)	± 5.0%
Risk Parameter (S)	3.50
Fixed Initial Margin per Futures Contract	1,000.00

	Margin Requirement per Contract	No of Contracts	Total Margin
IMR with Volatility Scenario - sell option	816.72	1.00	820
IMR with Volatility Scenario - buy option	630.90		630
Sell IMR no Volatility Scenario	797.74		
Buy IMR no Volatility Scenario	649.14		

Scenario Analysis									
Volatility Scenario Set (VSS)	1.00	(1.00)							
Price Scenario Set (PSS)	(1.00)	(0.75)	(0.50)	(0.25)	-	0.25	0.50	0.75	1.00
Range Price Volatility Effect (RPVE -> N.E.)	315.00								
ATM Option Value Today	1,192.35								
Price Range due to PSS	90.00	92.50	95.00	97.50	100.00	102.50	105.00	107.50	110.00
<b>IMR including Volatility Scenario</b>									
Volatility Scenario Up	35.029%	34.776%	34.598%	34.489%	34.452%	34.489%	34.598%	34.776%	35.029%
Option Values	877.75	884.85	1,101.80	1,228.77	1,365.83	1,512.87	1,669.67	1,835.89	2,011.07
Difference with ATM	(314.80)	(207.50)	(90.55)	36.42	173.47	320.51	477.31	643.53	818.72
Volatility Scenario Down	26.029%	26.776%	26.598%	26.489%	26.452%	26.489%	26.598%	26.776%	26.029%
Option Values	581.45	605.54	761.99	879.98	1,011.29	1,155.18	1,311.28	1,478.97	1,657.48
Difference with ATM	630.90	537.01	430.97	312.37	181.07	37.18	(118.92)	(286.62)	(465.14)
<b>IMR excluding Volatility Scenario</b>									
Volatility Scenario Up	34.500%	34.500%	34.500%	34.500%	34.500%	34.500%	34.500%	34.500%	34.500%
Option Values	858.94	974.62	1,058.11	1,229.21	1,367.70	1,513.31	1,665.78	1,824.81	1,990.10
Difference with ATM	(333.42)	(217.74)	(94.25)	36.86	175.34	320.86	473.43	632.46	797.74
Volatility Scenario Down	25.500%	25.500%	25.500%	25.500%	25.500%	25.500%	25.500%	25.500%	25.500%
Option Values	643.21	645.25	757.70	880.42	1,013.17	1,155.83	1,307.40	1,468.02	1,637.02
Difference with ATM	649.14	547.10	434.65	311.93	179.18	38.73	(115.04)	(275.67)	(444.66)

### Buyer/seller initial variation margin

This is the difference between every day's buyer and seller's initial margin calculation. If the initial margin goes up from day one to day two the buyer or seller needs pay in more initial margin to the exchange. If the initial margin goes down from day one to day two the buyer or seller will receive initial margin back from the exchange.

### Buyer/seller cash flows

This column indicates the net economic effect of the buyer/seller premium variation margin and the buyer/seller initial variation margin columns. It also indicates that when you add up all the cash flows it will add up to the original agreed premium which the buyer agreed to pay the seller.

### The example's expiry explained

It's important to note that on the expiry date of the option the option's premium will be made zero as it is worthless on this day. If the option buyer decides he wants to exercise his right he will receive a future contract at the agreed strike price.

If we refer back to our example, on closeout the option holder (buyer) will exercise his option as it is deep in the money. As a result he will receive a future at the strike price of R100. That night the option holder is now a future holder and as a result will receive R2,000  $((R120 - R100) \times 100)$  variation margin during the end of day future's M-t-M process as indicated in the table below.

Date	Future Trade Price	Closeout Price (MtM)	Variation Margin	Buyer Cash Flows	Seller Cash Flows
<b>Close out (2008/12/31)</b>	100.00	120.00	2,000.00	2,000.00	2,000.00

If the option was based on a physical delivered future, the buyer of the call option will have to go the next day into the underlying equity market and buy the physical 100 shares in the spot market at the closeout price of R120 per share. His profit will therefore be the profit from the future less premium paid for option  $(R2,000 - R1,192) =$  Overall Profit of R808 or a profit of R8.08 per share.

### How to trade

To trade on the market you need to go through a stock broker or securities trader that is a member of our market. Traders on any of the JSE's markets are required to write several exams and to have adequate controls and procedures in place for the protection of all clients. Our membership requirements help to protect investors. A full list of JSE Equity Derivative members can be found at the following URL:

[http://www.safex.co.za/ed/list\\_members.asp](http://www.safex.co.za/ed/list_members.asp)

### Costs Associated with trading Options

The JSE charges 1 basis point of the notional exposure of the Option Contract capped at 70 cents per contract. Brokers and Clearing Members will charge an additional amount over and above the JSE's booking fees for their services rendered. The URL below refers to the JSE Booking Fees:

[http://www.safex.co.za/ed/docs/trading\\_info/Booking%20Fees.xls](http://www.safex.co.za/ed/docs/trading_info/Booking%20Fees.xls)

For additional information contact:

#### JSE Limited – Derivatives Trading Division

Tel: +2711 520 7000

Email: [derivativestrading@jse.co.za](mailto:derivativestrading@jse.co.za)

[www.jse.co.za](http://www.jse.co.za)

#### Disclaimer:

This document is intended to provide general information regarding the JSE Limited ("JSE") and its products and services, and is not intended to, nor does it, constitute investment or other professional advice. It is prudent to consult professional advisers before making any investment decision or taking any action which might affect your personal finances or business. All information as set out in this document is provided for information purposes only and no responsibility or liability (including in negligence) will be accepted by the JSE for any errors contained in, or for any loss arising from use of, or reliance on this document. All rights, including copyright, in this document shall vest in the JSE. "JSE" is a trade mark of the JSE. No part of this document may be reproduced or amended without the prior written consent of the JSE.



**SUMMARY OF REFERENCES TO THE WEB:**

**Equity Options Homepage:** [http://www.safex.co.za/ed/products\\_equity\\_options.asp](http://www.safex.co.za/ed/products_equity_options.asp)

**ATM Volatility Change Guidelines:**

[http://www.safex.co.za/ed/docs/options/JSE\\_Options\\_ATM\\_Vol\\_Change\\_Guidelines\\_V0%204.pdf](http://www.safex.co.za/ed/docs/options/JSE_Options_ATM_Vol_Change_Guidelines_V0%204.pdf)

**JSE's Modified Black Calculator:**

[http://www.safex.co.za/ed/docs/products/JSE\\_Modified\\_%20Black\\_Calculator.xls](http://www.safex.co.za/ed/docs/products/JSE_Modified_%20Black_Calculator.xls)

**JSE's Initial Margin Calculator Spreadsheet:**

[http://www.safex.co.za/ed/docs/options/safex\\_option\\_IMR.xls](http://www.safex.co.za/ed/docs/options/safex_option_IMR.xls)

**Contract specific Initial Margin Requirements:**

[http://www.safex.co.za/pub/margin\\_requirements/](http://www.safex.co.za/pub/margin_requirements/)

**JSE Equity Derivative market daily Futures MtM and ATM Vol Stats:**

<http://www.safex.co.za/pub/mtmdata/Mtm%20All.xls>

**JSE Equity Derivative market daily Futures / Options MtM and Volatility Stats:**

<http://www.safex.co.za/pub/EdmStats/>

**JSE full margining specifications:**

[http://www.safex.co.za/ed/margining\\_methodology.asp](http://www.safex.co.za/ed/margining_methodology.asp)

**Safex Broker/Member list:**

[http://www.safex.co.za/ed/list\\_members.asp](http://www.safex.co.za/ed/list_members.asp)

**JSE Safex booking fees:**

[http://www.safex.co.za/ed/docs/trading\\_info/Booking%20Fees.xls](http://www.safex.co.za/ed/docs/trading_info/Booking%20Fees.xls)