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trading and risk management tool from
the Chicago Board Options Exchange*

THE CBOE VOLATILITY INDEX® - VIX®

CBOE®

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In 1993, the Chicago Board Options Exchange® (CBOE®) introduced the CBOE Volatility Index®, VIX®, which was originally designed to measure the market's expectation of 30-day volatility implied by at-the-money S&P 100® Index (OEX®) option prices. VIX soon became the premier benchmark for U.S. stock market volatility. It is regularly featured in the *Wall Street Journal*, *Barron's* and other leading financial publications, as well as business news shows on *CNBC*, *Bloomberg TV* and *CNN/Money*, where VIX is often referred to as the “fear index.”

Ten years later in 2003, CBOE together with Goldman Sachs, updated the VIX to reflect a new way to measure expected volatility, one that continues to be widely used by financial theorists, risk managers and volatility traders alike. The new VIX is based on the S&P 500® Index (SPXSM), the core index for U.S. equities, and estimates expected volatility by averaging the weighted prices of SPX puts and calls over a wide range of strike prices. By supplying a script for replicating volatility exposure with a portfolio of SPX options, this new methodology transformed VIX from an abstract concept into a practical standard for trading and hedging volatility.

VOLATILITY AS A TRADABLE ASSET – VIX FUTURES & OPTIONS

On March 24, 2004, CBOE introduced the first exchange-traded VIX futures contract on its new, all-electronic CBOE Futures ExchangeSM (CFE®). Two years later in February 2006, CBOE launched VIX options, the most successful new product in Exchange history. In less than five years, the combined trading activity in VIX options and futures has grown to more than 100,000 contracts per day.

The negative correlation of volatility to stock market returns is well documented and suggests a diversification benefit to including volatility in an investment portfolio. VIX futures and options are designed to deliver pure volatility exposure in a single, efficient package. CBOE/CFE provides a continuous, liquid and transparent market for VIX products that are available to all investors from the smallest retail trader to the largest institutional money managers and hedge funds.

BEYOND VIX

In addition to VIX, CBOE calculates several other volatility indexes including the CBOE Nasdaq-100® Volatility Index (VXNSM), CBOE DJIA® Volatility Index (VXDSM), CBOE Russell 2000® Volatility Index (RVXSM) and CBOE S&P 500® 3-Month Volatility Index (VXVSM). Currently, VXD and RVX futures are listed on CFE; RVX options trade on CBOE.

In 2008, CBOE pioneered the use of the VIX methodology to estimate expected volatility of certain commodities and foreign currencies. The CBOE Crude Oil Volatility Index (OVXSM), CBOE Gold Volatility Index (GVZSM) and CBOE EuroCurrency Volatility Index

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(EVZSM) use exchange-traded fund options based on the United States Oil Fund, LP (USO), SPDR Gold Shares (GLD) and CurrencyShares Euro Trust (FXE), respectively.

HISTORICAL PRICES FOR VIX AND OTHER VOLATILITY INDEXES

Perhaps one of the most valuable features of VIX is the existence of more than 20 years of historical prices. This extensive data set provides investors with a useful perspective of how option prices have behaved in response to a variety of market conditions. Price history for the original CBOE Volatility Index (Ticker – “VXO”) based on OEX options is available from 1986 to the present. CBOE has created a similar historical record for the new VIX dating back to 1990 so that investors can compare the new VIX with VXO, which reflects information about the volatility “skew” or “smile.” Historical prices for VIX, VXO and CBOE’s other volatility indexes may be found on the CBOE website at <http://www.cboe.com/micro/IndexSites.aspx> under *CBOE Volatility Indexes*.

CBOE would like to thank Sandy Rattray and Devesh Shah for their significant contributions to the development of the New VIX calculation.

THE VIX CALCULATION STEP-BY-STEP

Stock indexes, such as the S&P 500, are calculated using the prices of their component stocks. Each index employs rules that govern the selection of component securities and a formula to calculate index values.

VIX is a volatility index comprised of *options* rather than stocks, with the price of each option reflecting the market's expectation of future volatility. Like conventional indexes, VIX employs rules for selecting component options and a formula to calculate index values.

The generalized formula used in the VIX calculation[§] is:

$$\sigma^2 = \frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T} \left[\frac{F}{K_0} - 1 \right]^2 \quad (1)$$

WHERE...

σ	is	$\frac{VIX}{100} \Rightarrow VIX = \sigma \times 100$
T		Time to expiration
F		Forward index level derived from index option prices
K_0		First strike below the forward index level, F
K_i		Strike price of i^{th} out-of-the-money option; a call if $K_i > K_0$ and a put if $K_i < K_0$; both put and call if $K_i = K_0$.
ΔK_i		Interval between strike prices – half the difference between the strike on either side of K_i :

$$\Delta K_i = \frac{K_{i+1} - K_{i-1}}{2}$$

(Note: ΔK for the lowest strike is simply the difference between the lowest strike and the next higher strike. Likewise, ΔK for the highest strike is the difference between the highest strike and the next lower strike.)

R		Risk-free interest rate to expiration
$Q(K_i)$		The midpoint of the bid-ask spread for each option with strike K_i .

§ Please see “*More than you ever wanted to know about volatility swaps*” by Kresimir Demeterfi, Emanuel Derman, Michael Kamal and Joseph Zou, Goldman Sachs Quantitative Strategies Research Notes, March 1999.

GETTING STARTED

VIX measures 30-day expected volatility of the S&P 500 Index. The components of VIX are near- and next-term put and call options, usually in the first and second SPX contract months. “Near-term” options must have at least one week to expiration; a requirement intended to minimize pricing anomalies that might occur close to expiration. When the near-term options have less than a week to expiration, VIX “rolls” to the second and third SPX contract months. For example, on the second Friday in June, VIX would be calculated using SPX options expiring in June and July. On the following Monday, July would replace June as the “near-term” and August would replace July as the “next-term.”

In this hypothetical example, the near-term and next-term options have 9 days and 37 days to expiration, respectively, and reflect prices observed at the open of trading – 8:30 a.m. Chicago time. For the purpose of calculating time to expiration, SPX options are deemed to “expire” at the open of trading on SPX settlement day - the third Friday of the month¹.

The VIX calculation measures time to expiration, T , in calendar days and divides each day into minutes in order to replicate the precision that is commonly used by professional option and volatility traders. The time to expiration is given by the following expression:

$$T = \{M_{\text{Current day}} + M_{\text{Settlement day}} + M_{\text{Other days}}\} / \text{Minutes in a year}$$

WHERE...

$M_{\text{Current day}}$ = minutes remaining until midnight of the current day

$M_{\text{Settlement day}}$ = minutes from midnight until 8:30 a.m. on SPX settlement day

$M_{\text{Other days}}$ = total minutes in the days between current day and settlement day

Using 8:30 a.m. as the time of the calculation, T for the near-term and next-term options, T_1 and T_2 , respectively, is:

$$T_1 = \{930 + 510 + 11,520\} / 525,600 = \mathbf{0.0246575}$$

$$T_2 = \{930 + 510 + 51,840\} / 525,600 = \mathbf{0.1013699}$$

The risk-free interest rate, R , is the bond-equivalent yield of the U.S. T-bill maturing closest to the expiration dates of relevant SPX options. As such, the VIX calculation may use different risk-free interest rates for near- and next-term options. In this example, however, assume that $R = 0.38\%$ for both sets of options.

Since many of the interim calculations are repetitive, only representative samples appear below. The complete set of SPX option data and calculations may be found in *Appendix 1*.

¹ Technically, the expiration date for SPX options is the “Saturday following the third Friday of the expiration month.” In this example, however, expiration is deemed to take place at the determination of the exercise settlement value of the SPX, which is based on the opening prices of SPX component securities.

STEP 1 – Select the options to be used in the VIX calculation

The selected options are out-of-the-money SPX calls and out-of-the-money SPX puts centered around an at-the-money strike price, K_0 . Only SPX options quoted with non-zero bid prices are used in the VIX calculation.

One important note: as volatility rises and falls, the strike price range of options with non-zero bids tends to expand and contract. As a result, the number of options used in the VIX calculation may vary from month-to-month, day-to-day and possibly, even minute-to-minute.

For **each** contract month:

- Determine the forward SPX level, F , by identifying the strike price at which the absolute difference between the call and put prices is smallest. The call and put prices in the following table reflect the average of each option's bid / ask quotation. As shown below, the difference between the call and put prices is smallest at the **920** strike for both the near- and next-term options.

Near-Term Options				Next-Term Options			
Strike Price	Call	Put	Absolute Difference	Strike Price	Call	Put	Absolute Difference
.
900	48.95	27.25	21.70	900	73.6	52.8	20.80
905	46.15	29.75	16.40	905	70.35	54.7	15.65
910	42.55	31.70	10.85	910	67.35	56.75	10.60
915	40.05	33.55	6.50	915	64.75	58.9	5.85
920	37.15	36.65	0.50	920	61.55	60.55	1.00
925	33.30	37.70	4.40	925	58.95	63.05	4.10
930	32.45	40.15	7.70	930	55.75	65.4	9.65
935	28.75	42.70	13.95	935	53.05	67.35	14.30
940	27.50	45.30	17.80	940	50.15	69.8	19.65
.

Using the 920 call and put in each contract month and the formula,

$$F = \text{Strike Price} + e^{RT} \times (\text{Call Price} - \text{Put Price}),$$

the forward index prices, F_1 and F_2 , for the near- and next-term options, respectively, are:

$$F_1 = 920 + e^{(0.0038 \times 0.0246575)} \times (37.15 - 36.65) = \mathbf{920.50005}$$

$$F_2 = 920 + e^{(0.0038 \times 0.1013699)} \times (61.55 - 60.55) = \mathbf{921.00039}$$

- Next, determine K_0 - the strike price immediately below the forward index level, F - for the near- and next-term options. In this example, $K_{0,1} = 920$ and $K_{0,2} = 920$.

- Select out-of-the-money put options with strike prices $< K_0$. Start with the put strike immediately lower than K_0 and move to successively lower strike prices. Exclude any put option that has a bid price equal to zero (i.e., no bid). As shown below, once two puts with consecutive strike prices are found to have zero bid prices, no puts with lower strikes are considered for inclusion.

Put Strike	Bid	Ask	Include?
200	0.00	0.05	<i>Not considered following two zero bids</i>
250	0.00	0.05	
300	0.00	0.05	
350	0.00	0.05	No
375	0.00	0.10	No
400	0.05	0.20	Yes
425	0.05	0.20	Yes
450	0.05	0.20	Yes
.	.	.	.

Next, select out-of-the-money call options with strike prices $> K_0$. Start with the call strike immediately higher than K_0 and move to successively higher strike prices, excluding call options that have a bid price of zero. As with the puts, once two consecutive call options are found to have zero bid prices, no calls with higher strikes are considered. (Note that the 1250 call option is not included despite having a non-zero bid price.)

Call Strike	Bid	Ask	Include?
.	.	.	.
1215	0.05	0.50	Yes
1220	0.05	1.00	Yes
1225	0.00	1.00	No
1230	0.00	1.00	No
1235	0.00	0.75	<i>Not considered following two zero bids</i>
1240	0.00	0.50	
1245	0.00	0.15	
1250	0.05	0.10	
1255	0.00	1.00	
.	.	.	

Finally, select **both** the put and call with strike price K_0 . Notice that two options are selected at K_0 , while a single option, either a put or a call, is used for every other strike price.

The following table contains the options used to calculate the VIX in this example. VIX uses the average of quoted bid and ask, or mid-quote, prices for each option selected. The K_0 put and call prices are averaged to produce a single value. The price used for the 920

strike in the near-term is, therefore, $(37.15 + 36.65)/2 = 36.90$; and the price used in the next-term is $(61.55 + 60.55)/2 = 61.05$.

Near-term Strike	Option Type	Mid-quote Price		Next-term Strike	Option Type	Mid-quote Price
400	Put	0.125		200	Put	0.325
425	Put	0.125		300	Put	0.30
450	Put	0.125		350	Put	0.50
.
910	Put	31.70		910	Put	56.75
915	Put	33.55		915	Put	58.90
920	Put/Call Average	36.90		920	Put/Call Average	61.05
925	Call	33.30		925	Call	58.95
930	Call	32.45		930	Call	55.75
.
1210	Call	0.275		1150	Call	0.825
1215	Call	0.275		1155	Call	0.725
1220	Call	0.525		1160	Call	0.60

STEP 2 – Calculate volatility for both near-term and next-term options

Applying the VIX formula (1) to the near-term and next-term options with time to expiration of T_1 and T_2 , respectively, yields:

$$\sigma^2_{T_1} = \frac{2}{T_1} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT_1} Q(K_i) - \frac{1}{T_1} \left[\frac{F_1}{K_0} - 1 \right]^2$$

$$\sigma^2_{T_2} = \frac{2}{T_2} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT_2} Q(K_i) - \frac{1}{T_2} \left[\frac{F_2}{K_0} - 1 \right]^2$$

VIX is an amalgam of the information reflected in the prices of all of the selected options. The contribution of a single option to the VIX value is proportional to ΔK and the price of that option, and inversely proportional to the square of the option's strike price.

Generally, ΔK_i is half the difference between the strike prices on either side of K_i . For example, the ΔK for the next-term 300 Put is 75: $\Delta K_{300 \text{ Put}} = (350 - 200)/2$. At the upper and lower edges of any given strip of options, ΔK_i is simply the difference between K_i and the adjacent strike price. In this example, the 400 Put is the lowest strike in the strip of near-term options and 425 is the adjacent strike. Therefore, $\Delta K_{400 \text{ Put}} = 25$ (i.e., $425 - 400$).

The contribution of the near-term 400 Put is given by:

$$\frac{\Delta K_{400 \text{ Put}}}{K_{400 \text{ Put}}^2} e^{RT_1} Q(400 \text{ Put}) = \frac{25}{400^2} e^{.0038 (0.0246575)} (0.125) = 0.0000195$$

A similar calculation is performed for each option. The resulting values for the near-term options are then summed and multiplied by $2/T_1$. Likewise, the resulting values for the next-term options are summed and multiplied by $2/T_2$. The table below summarizes the results for each strip of options.

Near-term Strike	Option Type	Mid-quote Price	Contribution by Strike	Next-term Strike	Option Type	Mid-quote Price	Contribution by Strike
400	Put	0.125	0.0000195	200	Put	0.325	0.0008128
425	Put	0.125	0.0000173	300	Put	0.300	0.0002501
450	Put	0.125	0.0000139	350	Put	0.500	0.0001531
.
910	Put	31.70	0.0001914	910	Put	56.75	0.0003428
915	Put	33.55	0.0002004	915	Put	58.90	0.0003519
920	Put/Call Average	36.90	0.0002180	920	Put/Call Average	61.05	0.0003608
925	Call	33.30	0.0001946	925	Call	58.95	0.0003446
930	Call	32.45	0.0001876	930	Call	55.75	0.0003224
.
1210	Call	0.275	0.0000009	1150	Call	0.825	0.0000031
1215	Call	0.275	0.0000009	1155	Call	0.725	0.0000027
1220	Call	0.525	0.0000018	1160	Call	0.600	0.0000022
$\frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i)$			0.4727799				0.3668297

Next, calculate $\frac{1}{T} \left[\frac{F}{K_0} - 1 \right]^2$ for the near-term (T_1) and next-term (T_2):

$$\frac{1}{T_1} \left[\frac{F_1}{K_0} - 1 \right]^2 = \frac{1}{0.0246575} \left[\frac{920.50005}{920} - 1 \right]^2 = 0.0000120$$

$$\frac{1}{T_2} \left[\frac{F_2}{K_0} - 1 \right]^2 = \frac{1}{0.1013699} \left[\frac{921.00039}{920} - 1 \right]^2 = 0.0000117$$

Now calculate σ^2_1 and σ^2_2 :

$$\sigma^2_1 = \frac{2}{T_1} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT_1} Q(K_i) - \frac{1}{T_1} \left[\frac{F_1}{K_0} - 1 \right]^2 = 0.4727799 - 0.0000120 = \mathbf{0.4727679}$$

$$\sigma^2_2 = \frac{2}{T_2} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT_2} Q(K_i) - \frac{1}{T_2} \left[\frac{F_2}{K_0} - 1 \right]^2 = 0.3668297 - 0.0000117 = \mathbf{0.3668180}$$

STEP 3– Calculate the 30-day weighted average of σ^2_1 and σ^2_2 . Then take the square root of that value and multiply by 100 to get VIX.

$$\text{VIX} = 100 \times \sqrt{\left\{ T_1 \sigma_1^2 \left[\frac{N_{T_2} - N_{30}}{N_{T_2} - N_{T_1}} \right] + T_2 \sigma_2^2 \left[\frac{N_{30} - N_{T_1}}{N_{T_2} - N_{T_1}} \right] \right\} \times \frac{N_{365}}{N_{30}}}$$

When the near-term options have less than 30 days to expiration and the next-term options have more than 30 days to expiration, the resulting VIX value reflects an interpolation of σ^2_1 and σ^2_2 ; i.e., each individual weight is less than or equal to 1 and the sum of the weights equals 1.

At the time of the VIX “roll,” both the near-term and next-term options have more than 30 days to expiration. The same formula is used to calculate the 30-day weighted average, but the result is an extrapolation of σ^2_1 and σ^2_2 ; i.e., the sum of the weights is still 1, but the near-term weight is greater than 1 and the next-term weight is negative (e.g., 1.25 and – 0.25).

Returning to the example...

N_{T_1} = number of minutes to settlement of the near-term options (12,960)

N_{T_2} = number of minutes to settlement of the next-term options (53,280)

N_{30} = number of minutes in 30 days ($30 \times 1,440 = 43,200$)

N_{365} = number of minutes in a 365-day year ($365 \times 1,440 = 525,600$)

$$\text{VIX} = 100 \times \sqrt{\left\{ 0.0246575 \times 0.4727679 \times \left[\frac{53,280 - 43,200}{53,280 - 12,960} \right] + 0.1013699 \times 0.3668180 \times \left[\frac{43,200 - 12,960}{53,280 - 12,960} \right] \right\} \times \frac{525,600}{43,200}}$$

$$\boxed{\text{VIX} = 100 \times 0.612179986 = 61.22}$$

NOTES ON CALCULATING OTHER CBOE VOLATILITY INDEXES

BROAD-BASED VOLATILITY INDEXES

CBOE calculates volatility indexes on three other broad-based indexes representing different segments of the U.S. stock market:

- CBOE DJIA Volatility Index (VXD) based on options on the Dow Jones Industrial Average (DJX);
- CBOE Nasdaq-100 Volatility Index (VXN) based on Nasdaq-100 Index (NDX) options; and
- CBOE Russell 2000 Volatility Index (RVX) based on Russell 2000 Index (RUT) options.

For each of these indexes, the selection of component options and calculation are identical to the method detailed in the previous example.

The CBOE S&P 500 3-Month Volatility Index (VXV) measures the market's expectation of 3-month volatility implied by SPX options that bracket a 93-day maturity. Comparing VIX and VXV provides investors with information about the SPX volatility term structure in the four near-term contract months.

COMMODITY & CURRENCY VOLATILITY INDEXES

CBOE began calculating two commodity volatility indexes and one currency volatility index in 2008:

- CBOE Crude Oil Volatility Index (OVX) based on United States Oil Fund, LP (USO) options;
- CBOE Gold Volatility Index (GVZ) based on the, SPDR Gold Shares (GLD) options; and
- CBOE EuroCurrency Volatility Index (EVZ) based on CurrencyShares Euro Trust (FXE) options

Each of these non-equity volatility indexes are calculated using exchange traded fund, or “ETF”, options that trade like options on individual stocks - they may be exercised prior to their expiration date; exercise results in the delivery of ETF shares rather than cash; and they settle at the close of trading rather than at the open.

For each of the non-equity volatility indexes, the method of selecting component options and the formula are identical to that used for VIX and other broad-based volatility indexes.

However, there is a slight difference in the methodology that accounts for the fact that USO, GLD and FXE options expire at the close rather than at the open. As before, the time to expiration is given by the following expression:

$$T = \{M_{\text{Current day}} + M_{\text{Settlement day}} + M_{\text{Other days}}\} / \text{Minutes in a year}$$

WHERE...

$M_{\text{Current day}}$ = minutes remaining until midnight of the current day

$M_{\text{Other days}}$ = total minutes in the days between current day and settlement day

But now, adjusting for p.m. settlement...

$M_{\text{Settlement day}}$ = minutes from midnight until **3:00 p.m.** on expiration day
= 900 minutes

As with the previous example, assuming near- and next-term options with 9 and 37 days to expiration and 8:30 a.m. as the time of the calculation, T for the near-term and next-term options, T_1 and T_2 , respectively, is:

$$T_1 = \{930 + 900 + 11,520\} / 525,600 = \mathbf{0.0253995}$$

$$T_2 = \{930 + 900 + 51,840\} / 525,600 = \mathbf{0.1021118}$$

Special Note: All CBOE Volatility Indexes – VIX, VXD, VXN, RVX, VXV, OVX, GVZ and EVZ – are calculated using option price quotes from CBOE exclusively.

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APPENDIX 1 - COMPLETE SPX OPTION DATA USED IN SAMPLE VIX CALCULATION

Option Series included in the VIX calculation are **highlighted**.

Near-Term Options					Next-Term Options				
Strike	Calls		Puts		Strike	Calls		Puts	
	Bid	Ask	Bid	Ask		Bid	Ask	Bid	Ask
200	717.60	722.80	0.00	0.05	200	716.40	721.40	0.05	0.60
250	667.60	672.90	0.00	0.05	300	616.60	621.60	0.20	0.40
300	617.90	622.90	0.00	0.05	350	566.80	571.80	0.15	0.85
350	567.90	572.90	0.00	0.05	375	541.70	547.40	0.20	0.50
375	542.90	547.90	0.00	0.10	400	517.10	522.10	0.20	0.85
400	517.70	523.20	0.05	0.20	425	492.30	497.30	0.00	1.00
425	493.50	498.70	0.05	0.20	450	467.30	472.80	0.20	1.20
450	468.00	473.00	0.05	0.20	475	442.90	447.90	0.50	1.50
470	448.00	453.00	0.05	0.25	500	418.10	423.60	1.35	2.00
475	443.00	448.00	0.05	0.25	525	393.90	398.90	1.25	2.50
480	438.00	443.00	0.05	0.30	550	369.60	374.60	1.55	2.75
490	428.00	433.00	0.05	0.80	575	345.20	350.90	2.10	4.30
500	418.00	423.00	0.05	0.30	600	321.70	327.20	3.40	5.40
510	407.80	413.30	0.05	0.40	610	312.20	317.70	3.50	5.70
520	397.80	403.30	0.05	0.75	615	307.20	312.20	3.90	6.10
525	392.80	398.30	0.05	0.80	620	302.70	308.20	4.00	6.40
530	388.60	393.80	0.05	0.80	625	297.80	302.80	4.20	6.90
540	378.10	383.10	0.05	0.75	630	292.80	298.50	4.60	6.90
550	368.10	373.10	0.10	0.20	635	288.10	293.80	4.70	7.30
560	357.90	363.40	0.05	0.70	640	283.50	289.10	5.10	7.50
570	347.90	353.40	0.05	0.75	650	274.10	279.60	5.80	8.10
575	343.20	348.20	0.05	0.40	660	265.00	270.00	6.30	9.00
580	338.20	343.20	0.05	0.80	670	256.00	261.50	7.20	9.70
585	333.00	338.70	0.10	0.75	675	251.40	256.20	7.50	9.80
590	328.00	333.50	0.05	0.75	680	246.40	251.60	8.10	10.40
595	323.50	329.00	0.05	0.45	690	237.70	243.20	8.80	11.40
600	318.30	323.30	0.25	0.50	700	228.70	233.70	9.40	12.40
605	313.10	318.80	0.10	0.80	710	219.30	224.90	10.00	13.60
610	308.10	313.60	0.10	0.80	720	210.40	216.00	11.00	14.70
615	303.40	308.40	0.10	0.85	725	206.40	211.20	11.70	15.90
620	298.20	303.70	0.10	0.85	730	201.80	206.80	12.10	16.20
625	293.70	299.20	0.40	0.90	740	192.90	198.50	13.20	17.60
630	288.50	293.50	0.10	0.90	750	184.70	189.90	15.00	18.80
635	283.30	288.80	0.10	0.95	760	176.00	181.40	16.20	19.90
640	278.60	283.60	0.30	1.05	770	167.40	172.50	17.90	22.00
645	273.40	278.90	0.10	1.10	775	163.20	168.40	18.30	22.90
650	268.50	274.20	0.50	1.10	780	159.00	164.20	19.20	24.00
655	263.80	268.80	0.20	1.25	790	150.90	156.10	20.80	26.00
660	258.60	264.10	0.30	1.30	800	142.80	146.00	22.70	28.00
665	253.70	259.40	0.20	1.30	805	138.80	144.00	23.70	28.90
670	249.00	254.00	0.40	1.45	810	134.90	140.00	25.00	29.70
675	244.10	249.10	0.50	1.50	815	130.90	136.10	25.90	30.50
680	239.20	244.20	0.55	1.55	820	127.10	132.20	26.90	31.90
690	229.40	234.40	0.70	1.85	825	123.20	128.40	27.80	33.30
700	219.40	225.10	1.30	1.70	830	119.40	124.60	29.30	34.50

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710	209.90	214.90	1.10	2.40	835	115.60	120.80	30.30	35.40
720	200.00	205.70	1.10	3.00	840	111.90	117.10	31.80	36.90
725	195.20	200.90	2.00	3.00	845	108.20	113.40	32.90	38.00
730	190.60	195.60	1.40	3.50	850	107.00	109.70	34.10	39.60
740	180.80	186.50	1.80	4.00	855	101.30	106.30	35.90	39.00
750	171.30	177.00	3.20	3.90	860	97.40	103.00	37.40	42.50
760	162.10	167.10	2.85	5.00	865	94.80	99.50	38.60	43.70
770	152.80	157.80	4.00	5.60	870	91.30	96.00	40.00	45.10
775	148.20	153.20	3.90	5.90	875	87.90	92.60	41.70	47.10
780	143.60	148.60	4.10	6.70	880	83.60	88.90	43.30	48.70
790	134.60	140.10	4.90	7.50	885	80.30	85.80	44.80	50.30
800	125.60	131.10	6.10	7.50	890	77.50	83.00	47.00	52.10
805	121.00	126.00	6.40	9.10	895	74.00	79.50	48.60	53.80
810	116.50	121.50	7.10	9.50	900	70.80	76.40	50.20	55.40
815	112.20	117.20	7.50	10.30	905	67.60	73.10	52.20	57.20
820	107.60	113.20	8.20	10.80	910	64.60	70.10	54.00	59.50
825	103.70	108.90	8.90	11.50	915	62.40	67.10	56.30	61.50
830	99.10	104.30	9.00	13.00	920	59.10	64.00	57.80	63.30
835	95.30	100.30	9.80	13.70	925	56.20	61.70	60.30	65.80
840	90.90	95.90	10.60	14.30	930	53.00	58.50	62.90	67.90
845	86.70	91.90	11.50	15.20	935	50.30	55.80	64.60	70.10
850	82.60	88.00	13.50	16.00	940	47.60	52.70	67.00	72.60
855	78.70	83.90	13.50	17.50	945	45.70	50.40	69.50	75.00
860	74.90	79.90	14.50	18.70	950	44.80	47.70	72.20	76.60
865	70.90	76.10	15.50	19.90	955	40.40	45.30	74.70	79.70
870	67.20	72.30	17.10	20.90	960	38.10	43.20	77.30	82.30
875	63.80	68.60	18.20	22.20	965	35.60	40.70	79.80	85.30
880	59.80	65.30	19.20	24.00	970	33.40	38.90	82.60	87.90
885	56.60	61.60	20.30	25.40	975	32.40	36.10	85.70	90.70
890	53.70	58.40	22.10	26.80	980	28.90	34.00	88.60	93.40
895	50.30	55.00	23.90	29.00	985	27.00	32.00	91.60	96.80
900	46.20	51.70	25.50	29.00	990	25.40	30.30	94.70	99.80
905	43.40	48.90	27.20	32.30	995	23.20	28.60	97.80	103.00
910	40.00	45.10	29.20	34.20	1000	23.00	26.40	101.00	106.20
915	37.30	42.80	30.80	36.30	1005	20.00	24.70	104.30	109.50
920	35.20	39.10	35.20	38.10	1010	18.40	23.30	107.70	112.90
925	31.40	35.20	35.10	40.30	1015	17.10	21.20	111.10	116.30
930	31.00	33.90	37.40	42.90	1020	18.00	19.80	114.60	119.80
935	26.00	31.50	40.30	45.10	1025	14.40	18.20	118.20	123.40
940	26.00	29.00	42.50	48.10	1030	13.10	16.90	121.90	127.10
945	21.60	26.40	45.30	50.60	1035	11.80	15.80	125.60	130.60
950	21.60	24.40	47.60	53.10	1040	10.70	14.70	128.80	134.30
955	17.20	22.50	51.30	56.50	1045	9.30	13.60	133.10	138.60
960	15.50	19.60	54.40	59.40	1050	10.80	12.00	137.30	142.30
965	13.90	18.00	57.50	62.50	1055	8.10	10.60	140.90	146.60
970	12.00	16.40	60.80	66.00	1060	8.20	9.80	145.20	150.70
975	12.50	14.80	64.30	69.50	1065	6.50	9.00	148.90	154.40
980	9.30	13.10	67.80	73.00	1070	5.60	8.10	153.40	158.60
985	8.00	11.90	71.50	76.70	1075	5.10	7.60	157.40	162.90
990	7.40	9.90	75.10	80.50	1080	4.40	6.80	162.40	167.40
995	6.40	8.70	79.20	84.20	1085	3.80	6.20	166.40	172.10

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1000	6.50	7.50	82.50	88.00	1090	3.30	5.50	171.30	176.30
1005	4.40	6.80	86.90	92.50	1095	2.90	4.90	175.80	180.80
1010	3.60	6.00	91.10	96.50	1100	3.30	4.50	180.10	185.60
1015	3.10	5.10	95.40	101.10	1105	2.00	4.10	184.20	189.70
1020	3.50	4.60	99.80	105.40	1110	2.00	3.60	189.30	194.80
1025	2.00	4.10	104.70	109.70	1115	1.65	3.30	194.20	199.20
1030	1.60	3.50	108.50	114.00	1120	1.45	3.00	198.90	203.90
1035	1.20	3.10	113.60	119.10	1125	2.00	2.40	202.90	208.40
1040	1.25	2.50	118.50	123.50	1130	0.90	2.20	208.40	213.40
1045	0.85	2.10	123.20	128.20	1135	0.70	1.90	212.70	218.40
1050	1.30	1.80	127.70	133.20	1140	1.00	1.75	218.00	223.00
1055	0.40	1.65	132.50	138.00	1145	0.50	1.50	222.80	227.80
1060	0.90	1.40	137.60	142.60	1150	0.35	1.30	227.40	232.90
1065	0.20	1.25	142.20	147.70	1155	0.25	1.20	232.30	237.80
1070	0.15	1.15	147.30	152.30	1160	0.10	1.10	236.70	242.20
1075	0.50	1.00	152.20	157.20	1165	0.00	1.00	241.60	247.10
1080	0.40	0.95	156.90	162.40	1170	0.00	0.90	247.00	252.50
1085	0.20	0.90	161.80	167.30	1175	0.30	0.85	251.90	257.40
1090	0.30	0.85	167.00	172.00	1180	0.00	0.85	257.10	262.10
1095	0.20	0.75	171.70	177.20	1185	0.00	0.80	261.30	266.50
1100	0.30	0.45	176.90	181.90	1190	0.00	0.50	267.00	272.00
1105	0.20	0.75	181.60	187.10	1190	0.00	0.00	0.00	0.00
1110	0.20	0.35	186.80	191.80	1195	0.00	0.75	271.20	276.40
1115	0.05	0.80	191.80	196.80	1200	0.30	0.60	276.90	281.90
1120	0.05	0.50	196.80	201.80	1205	0.00	0.75	281.60	287.10
1125	0.15	0.50	201.50	207.00	1210	0.00	0.60	286.80	291.80
1130	0.05	0.90	206.70	211.70	1215	0.00	0.85	291.80	296.80
1135	0.05	0.90	211.70	216.70	1220	0.00	0.75	296.80	301.80
1140	0.05	0.70	216.70	221.70	1225	0.00	0.80	301.50	307.00
1145	0.05	0.95	221.70	226.70	1230	0.00	0.80	306.70	311.70
1150	0.05	0.35	226.70	231.70	1235	0.00	0.80	311.70	316.70
1155	0.05	0.95	231.70	236.70	1240	0.10	0.75	316.70	321.70
1160	0.05	0.50	236.70	241.70	1245	0.00	0.75	321.70	326.70
1165	0.05	0.35	241.70	246.70	1250	0.00	1.00	326.70	331.20
1170	0.05	0.45	246.40	251.90	1255	0.00	0.75	331.40	336.90
1175	0.05	0.15	251.40	256.90	1260	0.00	0.70	335.90	341.10
1180	0.05	0.80	256.40	261.90	1265	0.00	0.70	341.60	346.60
1185	0.05	0.25	260.90	266.10	1270	0.00	0.70	346.60	351.60
1190	0.05	0.50	266.60	271.60	1275	0.05	0.20	351.60	356.60
1195	0.05	1.00	271.60	276.60	1280	0.00	0.75	356.60	361.60
1200	0.05	0.15	276.60	281.60	1290	0.00	0.75	366.60	371.60
1205	0.05	1.00	281.60	286.60	1300	0.05	0.45	375.70	381.00
1210	0.05	0.50	286.60	291.60	1315	0.00	0.50	390.70	395.90
1215	0.05	0.50	291.60	296.60	1320	0.00	0.75	396.50	401.50
1220	0.05	1.00	296.60	301.60	1325	0.00	0.50	399.90	405.90
1225	0.00	1.00	301.60	306.60	1335	0.00	0.75	411.50	416.50
1230	0.00	1.00	306.60	311.60	1340	0.00	0.75	416.50	421.50
1235	0.00	0.75	311.60	316.60	1345	0.00	0.75	421.50	426.50
1240	0.00	0.50	316.60	321.60	1350	0.00	0.50	425.60	430.80
1245	0.00	0.15	321.60	326.60	1360	0.00	0.75	435.70	440.90
1250	0.05	0.10	326.60	331.60	1375	0.00	0.55	451.40	456.40

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1255	0.00	1.00	331.60	336.60	1380	0.00	0.75	456.40	461.40
1260	0.00	1.00	336.60	341.60	1395	0.00	0.50	471.40	476.40
1265	0.00	1.00	341.60	346.60	1400	0.00	0.50	475.50	480.70
1270	0.00	0.30	346.60	351.60	1420	0.00	0.75	496.30	501.30
1275	0.00	0.10	351.60	356.60	1425	0.00	0.75	501.30	506.30
1280	0.00	0.15	356.60	361.60	1440	0.00	0.75	516.30	521.30
1285	0.00	0.15	361.60	366.60	1450	0.00	0.50	525.30	530.60
1290	0.00	0.15	366.60	371.60	1475	0.00	0.75	551.20	556.20
1295	0.00	0.15	371.60	376.60	1480	0.00	0.75	556.20	561.20
1300	0.00	0.10	376.60	381.60	1500	0.00	0.50	575.20	580.50
1305	0.00	0.10	381.60	386.60	1525	0.00	0.75	601.10	606.10
1310	0.00	0.10	386.60	391.60	1550	0.00	0.50	625.10	630.90
1315	0.00	0.10	391.60	396.60	1575	0.00	0.75	650.80	656.30
1320	0.00	0.10	396.10	401.80	1600	0.00	0.50	675.00	680.20
1325	0.00	0.10	401.30	406.80	1625	0.00	0.75	700.70	706.20
1330	0.00	0.10	406.30	411.80	1650	0.00	0.50	724.10	730.10
1335	0.00	0.10	411.30	416.80	1680	0.00	0.75	755.60	761.10
1340	0.00	0.10	416.30	421.80	1690	0.00	0.75	765.80	770.80
1345	0.00	0.10	421.30	426.80	1700	0.00	0.50	775.80	780.80
1350	0.00	0.05	425.80	431.00	1735	0.00	0.75	810.50	816.00
1355	0.00	0.10	430.80	436.00	1750	0.00	0.75	825.70	830.70
1360	0.00	0.10	435.80	441.00	1775	0.00	0.20	850.70	855.70
1365	0.00	0.10	441.50	446.50	1800	0.00	0.75	875.60	880.60
1370	0.00	0.10	446.50	451.50	1850	0.00	0.75	925.50	930.50
1375	0.00	0.10	451.50	456.50	1900	0.00	0.20	974.70	979.90
1380	0.00	0.10	456.50	461.50	1950	0.00	0.75	1025.10	1030.60
1385	0.00	0.10	461.50	466.50	2000	0.00	0.20	1074.80	1079.80
1390	0.00	0.10	466.50	471.50					
1395	0.00	0.10	471.50	476.50					
1400	0.00	0.05	476.50	481.50					
1405	0.00	0.10	481.50	486.50					
1410	0.00	0.10	486.50	491.50					
1415	0.00	0.10	491.50	496.50					
1420	0.00	0.10	496.50	501.50					
1425	0.00	0.10	501.50	506.50					
1430	0.00	0.10	506.50	511.50					
1435	0.00	0.10	511.50	516.50					
1440	0.00	0.10	516.50	521.50					
1445	0.00	0.10	521.50	526.50					
1450	0.00	0.10	526.50	531.50					
1460	0.00	0.10	536.50	541.50					
1470	0.00	0.10	546.50	551.50					
1475	0.00	0.10	551.50	556.50					
1480	0.00	0.10	556.50	561.50					
1490	0.00	1.00	566.50	571.50					
1500	0.00	0.05	576.50	581.50					
1650	0.00	1.00	726.40	731.40					
1700	0.00	1.00	776.10	781.60					

INDIVIDUAL OPTION CONTRIBUTIONS – $K_0 = 920$

Near term Strike	Option Type	Mid-quote Price	Delta-K	Contribution by Strike	Next term Strike	Option Type	Mid-quote Price	Delta-K	Contribution by Strike
400	Put	0.125	25.0	0.0000195	200	Put	0.325	100	0.0008128
425	Put	0.125	25.0	0.0000173	300	Put	0.300	75.0	0.0002501
450	Put	0.125	22.5	0.0000139	350	Put	0.500	37.5	0.0001531
470	Put	0.150	12.5	0.0000085	375	Put	0.350	25.0	0.0000622
475	Put	0.150	5.0	0.0000033	400	Put	0.525	37.5	0.0001231
480	Put	0.175	7.5	0.0000057	450	Put	0.700	37.5	0.0001297
490	Put	0.425	10.0	0.0000177	475	Put	1.000	25.0	0.0001108
500	Put	0.175	10.0	0.0000070	500	Put	1.675	25.0	0.0001676
510	Put	0.225	10.0	0.0000087	525	Put	1.875	25.0	0.0001701
520	Put	0.400	7.5	0.0000111	550	Put	2.150	25.0	0.0001778
525	Put	0.425	5.0	0.0000077	575	Put	3.200	25.0	0.0002421
530	Put	0.425	7.5	0.0000113	600	Put	4.400	17.5	0.0002140
540	Put	0.400	10.0	0.0000137	610	Put	4.600	7.5	0.0000928
550	Put	0.150	10.0	0.0000050	615	Put	5.000	5.0	0.0000661
560	Put	0.375	10.0	0.0000120	620	Put	5.200	5.0	0.0000677
570	Put	0.400	7.5	0.0000092	625	Put	5.550	5.0	0.0000711
575	Put	0.225	5.0	0.0000034	630	Put	5.750	5.0	0.0000725
580	Put	0.425	5.0	0.0000063	635	Put	6.000	5.0	0.0000744
585	Put	0.425	5.0	0.0000062	640	Put	6.300	7.5	0.0001154
590	Put	0.400	5.0	0.0000057	650	Put	6.950	10.0	0.0001646
595	Put	0.250	5.0	0.0000035	660	Put	7.650	10.0	0.0001757
600	Put	0.375	5.0	0.0000052	670	Put	8.450	7.5	0.0001412
605	Put	0.450	5.0	0.0000061	675	Put	8.650	5.0	0.0000950
610	Put	0.450	5.0	0.0000060	680	Put	9.250	7.5	0.0001501
615	Put	0.475	5.0	0.0000063	690	Put	10.100	10.0	0.0002122
620	Put	0.475	5.0	0.0000062	700	Put	10.900	10.0	0.0002225
625	Put	0.650	5.0	0.0000083	710	Put	11.800	10.0	0.0002342
630	Put	0.500	5.0	0.0000063	720	Put	12.850	7.5	0.0001860
635	Put	0.525	5.0	0.0000065	725	Put	13.800	5.0	0.0001313
640	Put	0.675	5.0	0.0000082	730	Put	14.150	7.5	0.0001992
645	Put	0.600	5.0	0.0000072	740	Put	15.400	10.0	0.0002813
650	Put	0.800	5.0	0.0000095	750	Put	16.900	10.0	0.0003006
655	Put	0.725	5.0	0.0000085	760	Put	18.050	10.0	0.0003126
660	Put	0.800	5.0	0.0000092	770	Put	19.950	7.5	0.0002525
665	Put	0.750	5.0	0.0000085	775	Put	20.600	5.0	0.0001716
670	Put	0.925	5.0	0.0000103	780	Put	21.600	7.5	0.0002664
675	Put	1.000	5.0	0.0000110	790	Put	23.400	10.0	0.0003751
680	Put	1.050	7.5	0.0000170	800	Put	25.350	7.5	0.0002972
690	Put	1.275	10.0	0.0000268	805	Put	26.300	5.0	0.0002030
700	Put	1.500	10.0	0.0000306	810	Put	27.350	5.0	0.0002085
710	Put	1.750	10.0	0.0000347	815	Put	28.200	5.0	0.0002124
720	Put	2.050	7.5	0.0000297	820	Put	29.400	5.0	0.0002187
725	Put	2.500	5.0	0.0000238	825	Put	30.550	5.0	0.0002245
730	Put	2.450	7.5	0.0000345	830	Put	31.900	5.0	0.0002316

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740	Put	2.900	10.0	0.0000530	835	Put	32.850	5.0	0.0002357
750	Put	3.550	10.0	0.0000631	840	Put	34.350	5.0	0.0002435
760	Put	3.925	10.0	0.0000680	845	Put	35.450	5.0	0.0002483
770	Put	4.800	7.5	0.0000607	850	Put	36.850	5.0	0.0002551
775	Put	4.900	5.0	0.0000408	855	Put	37.450	5.0	0.0002562
780	Put	5.400	7.5	0.0000666	860	Put	39.950	5.0	0.0002702
790	Put	6.200	10.0	0.0000994	865	Put	41.150	5.0	0.0002751
800	Put	6.800	7.5	0.0000797	870	Put	42.550	5.0	0.0002812
805	Put	7.750	5.0	0.0000598	875	Put	44.400	5.0	0.0002901
810	Put	8.300	5.0	0.0000633	880	Put	46.000	5.0	0.0002971
815	Put	8.900	5.0	0.0000670	885	Put	47.550	5.0	0.0003037
820	Put	9.500	5.0	0.0000706	890	Put	49.550	5.0	0.0003129
825	Put	10.200	5.0	0.0000749	895	Put	51.200	5.0	0.0003197
830	Put	11.000	5.0	0.0000798	900	Put	52.800	5.0	0.0003261
835	Put	11.750	5.0	0.0000843	905	Put	54.700	5.0	0.0003341
840	Put	12.450	5.0	0.0000882	910	Put	56.750	5.0	0.0003428
845	Put	13.350	5.0	0.0000935	915	Put	58.900	5.0	0.0003519
850	Put	14.750	5.0	0.0001021	920	Put/Call Average	61.050	5.0	0.0003608
855	Put	15.500	5.0	0.0001060	925	Call	58.950	5.0	0.0003446
860	Put	16.600	5.0	0.0001122	930	Call	55.750	5.0	0.0003224
865	Put	17.700	5.0	0.0001183	935	Call	53.050	5.0	0.0003035
870	Put	19.000	5.0	0.0001255	940	Call	50.150	5.0	0.0002839
875	Put	20.200	5.0	0.0001319	945	Call	48.050	5.0	0.0002691
880	Put	21.600	5.0	0.0001395	950	Call	46.250	5.0	0.0002563
885	Put	22.850	5.0	0.0001459	955	Call	42.850	5.0	0.0002350
890	Put	24.450	5.0	0.0001544	960	Call	40.650	5.0	0.0002206
895	Put	26.450	5.0	0.0001651	965	Call	38.150	5.0	0.0002049
900	Put	27.250	5.0	0.0001682	970	Call	36.150	5.0	0.0001922
905	Put	29.750	5.0	0.0001816	975	Call	34.250	5.0	0.0001802
910	Put	31.700	5.0	0.0001914	980	Call	31.450	5.0	0.0001638
915	Put	33.550	5.0	0.0002004	985	Call	29.500	5.0	0.0001521
920	Put/Call Average	36.900	5.0	0.0002180	990	Call	27.850	5.0	0.0001421
925	Call	33.300	5.0	0.0001946	995	Call	25.900	5.0	0.0001309
930	Call	32.450	5.0	0.0001876	1000	Call	24.700	5.0	0.0001235
935	Call	28.750	5.0	0.0001644	1005	Call	22.350	5.0	0.0001107
940	Call	27.500	5.0	0.0001556	1010	Call	20.850	5.0	0.0001022
945	Call	24.000	5.0	0.0001344	1015	Call	19.150	5.0	0.0000930
950	Call	23.000	5.0	0.0001274	1020	Call	18.900	5.0	0.0000909
955	Call	19.850	5.0	0.0001088	1025	Call	16.300	5.0	0.0000776
960	Call	17.550	5.0	0.0000952	1030	Call	15.000	5.0	0.0000707
965	Call	15.950	5.0	0.0000856	1035	Call	13.800	5.0	0.0000644
970	Call	14.200	5.0	0.0000755	1040	Call	12.700	5.0	0.0000587
975	Call	13.650	5.0	0.0000718	1045	Call	11.450	5.0	0.0000524
980	Call	11.200	5.0	0.0000583	1050	Call	11.400	5.0	0.0000517
985	Call	9.950	5.0	0.0000513	1055	Call	9.350	5.0	0.0000420
990	Call	8.650	5.0	0.0000441	1060	Call	9.000	5.0	0.0000401
995	Call	7.550	5.0	0.0000381	1065	Call	7.750	5.0	0.0000342
1000	Call	7.000	5.0	0.0000350	1070	Call	6.850	5.0	0.0000299
1005	Call	5.600	5.0	0.0000277	1075	Call	6.350	5.0	0.0000275

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1010	Call	4.800	5.0	0.0000235	1080	Call	5.600	5.0	0.0000240
1015	Call	4.100	5.0	0.0000199	1085	Call	5.000	5.0	0.0000212
1020	Call	4.050	5.0	0.0000195	1090	Call	4.400	5.0	0.0000185
1025	Call	3.050	5.0	0.0000145	1095	Call	3.900	5.0	0.0000163
1030	Call	2.550	5.0	0.0000120	1100	Call	3.900	5.0	0.0000161
1035	Call	2.150	5.0	0.0000100	1105	Call	3.050	5.0	0.0000125
1040	Call	1.875	5.0	0.0000087	1110	Call	2.800	5.0	0.0000114
1045	Call	1.475	5.0	0.0000068	1115	Call	2.475	5.0	0.0000100
1050	Call	1.550	5.0	0.0000070	1120	Call	2.225	5.0	0.0000089
1055	Call	1.025	5.0	0.0000046	1125	Call	2.200	5.0	0.0000087
1060	Call	1.150	5.0	0.0000051	1130	Call	1.550	5.0	0.0000061
1065	Call	0.725	5.0	0.0000032	1135	Call	1.300	5.0	0.0000050
1070	Call	0.650	5.0	0.0000028	1140	Call	1.375	5.0	0.0000053
1075	Call	0.750	5.0	0.0000032	1145	Call	1.000	5.0	0.0000038
1080	Call	0.675	5.0	0.0000029	1150	Call	0.825	5.0	0.0000031
1085	Call	0.550	5.0	0.0000023	1155	Call	0.725	5.0	0.0000027
1090	Call	0.575	5.0	0.0000024	1160	Call	0.600	5.0	0.0000022
1095	Call	0.475	5.0	0.0000020					
1100	Call	0.375	5.0	0.0000015					
1105	Call	0.475	5.0	0.0000019					
1110	Call	0.275	5.0	0.0000011					
1115	Call	0.425	5.0	0.0000017					
1120	Call	0.275	5.0	0.0000011					
1125	Call	0.325	5.0	0.0000013					
1130	Call	0.475	5.0	0.0000019					
1135	Call	0.475	5.0	0.0000018					
1140	Call	0.375	5.0	0.0000014					
1145	Call	0.500	5.0	0.0000019					
1150	Call	0.200	5.0	0.0000008					
1155	Call	0.500	5.0	0.0000019					
1160	Call	0.275	5.0	0.0000010					
1165	Call	0.200	5.0	0.0000007					
1170	Call	0.250	5.0	0.0000009					
1175	Call	0.100	5.0	0.0000004					
1180	Call	0.425	5.0	0.0000015					
1185	Call	0.150	5.0	0.0000005					
1190	Call	0.275	5.0	0.0000010					
1195	Call	0.525	5.0	0.0000018					
1200	Call	0.100	5.0	0.0000003					
1205	Call	0.525	5.0	0.0000018					
1210	Call	0.275	5.0	0.0000009					
1215	Call	0.275	5.0	0.0000009					
1220	Call	0.525	5.0	0.0000018					
Sum of Individual Contributions				0.0058288	Sum of Individual Contributions				0.0185927
$\frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i)$				0.47277799	$\frac{2}{T} \sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i)$				0.3668297