Fin516 Project

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1.

    a. The 1 SD of a 44 day price move is $535.6

    b. 1 SD price range is from $1524.4 to $2595.6

```r
setwd("D:/FIN 516/Project")


## Black-Scholes model parameters
## s0  - current stock price
## k    - strike price
## sig - pricing volatility
## t    - time, in years
## q    - dividend yield if any, default is no dividend yield
## typ - typ of option: 'c' for call and 'p' for put

source('OptionAnalytics.r')
s0 <- 2060
k <- seq(1980,2140,by=20)
sig <- 0.26
r <- 0.016
t44 <- 44/365
c1 <- round(BS(s0,k,sig,r,t44),2)
p1 <- round(BS(s0,k,sig,r,t44,typ='p'),2)
## create a data.frame of strikes with call and put prices
opt1 <- data.frame(strike=k,calls=c1,puts=p1)

#option chain
opt1
```

```
##   strike  calls   puts
## 1   1980 122.11  38.30
## 2   2000 109.33  45.48
## 3   2020  97.40  53.50
## 4   2040  86.31  62.38
## 5   2060  76.09  72.12
## 6   2080  66.73  82.72
## 7   2100  58.20  94.16
## 8   2120  50.49 106.41
## 9   2140  43.57 119.44
```

```r
Call <- function(s,k){
  return(ifelse(s-k>0,s-k,0))}

Put <- function(s,k){
  return(ifelse(k-s>0,k-s,0))}

t16 <- 16/365
t30 <- 30/365
```

2. Straddle

```r
#Straddle

#Cost
cost0 <- -c1[k==2060]-p1[k==2060]
cost0
```

```
## [1] -148.21
```

a. Option premium: -$148.21

It's a credit

```
s <- seq(1900,2220,by=10)

Straddle_val <- function(s,k,sig,r,t){
  return( -BS(s,k,sig,r,t,typ='c') - BS(s,k,sig,r,t,typ='p'))
  }

Straddle_delta <- function(s,k,sig,r,t){
  return(-BSdelta(s,k,sig,r,t,typ='c') -BSdelta(s,k,sig,r,t,typ='p')) }

### 30 DTE
pl30 <- round(Straddle_val(s,2060,sig,r,t30) - cost0*exp((t44-t30)*r),2)

delta30 <- round(Straddle_delta(s,2060,sig,r,t30),4)


### 16 DTE
pl16 <- round(Straddle_val(s,2060,sig,r,t16) - cost0*exp((t44-t16)*r),2)

delta16 <- round(Straddle_delta(s,2060,sig,r,t16),4)


### 0 DTE
pl0 <- round(-Call(s,2060)-Put(s,2060) - cost0*exp(t44*r), 3)


sig1 <- .16
pl30_16 <- round(Straddle_val(s,2060,sig1,r,t30) - cost0*exp((t44-t30)*r),2)

sig2 <- .36
pl30_36 <- round(Straddle_val(s,2060,sig2,r,t30) - cost0*exp((t44-t30)*r),2)

t10<-10/365
pl10 <- round(Straddle_val(s,2060,sig,r,t10) - cost0*exp((t44-t10)*r),2)
```

```
data.frame(s,pl30,pl16,pl0,delta30,delta16,pl30_16,pl30_36,pl10)
```

```
##       s   pl30   pl16     pl0 delta30 delta16 pl30_16 pl30_36   pl10
## 1  1900 -30.56 -16.88 -11.504  0.6969  0.8516  -12.04  -60.60 -12.71
## 2  1910 -23.76  -8.51  -1.504  0.6626  0.8226   -3.03  -55.48  -3.45
## 3  1920 -17.32  -0.44   8.496  0.6262  0.7897    5.73  -50.68   5.59
## 4  1930 -11.24   7.27  18.496  0.5876  0.7529   14.19  -46.22  14.36
## 5  1940  -5.57  14.60  28.496  0.5469  0.7120   22.30  -42.10  22.81
## 6  1950  -0.31  21.50  38.496  0.5043  0.6670   30.00  -38.32  30.88
## 7  1960   4.51  27.93  48.496  0.4599  0.6179   37.23  -34.90  38.51
## 8  1970   8.88  33.85  58.496  0.4138  0.5649   43.95  -31.85  45.64
## 9  1980  12.78  39.21  68.496  0.3663  0.5082   50.09  -29.15  52.21
## 10 1990  16.20  44.00  78.496  0.3174  0.4481   55.59  -26.83  58.14
## 11 2000  19.12  48.17  88.496  0.2674  0.3850   60.42  -24.89  63.38
## 12 2010  21.54  51.69  98.496  0.2165  0.3191   64.51  -23.32  67.87
## 13 2020  23.45  54.54 108.496  0.1649  0.2511   67.84  -22.13  71.57
## 14 2030  24.84  56.71 118.496  0.1128  0.1814   70.36  -21.32  74.43
## 15 2040  25.71  58.17 128.496  0.0606  0.1106   72.06  -20.89  76.42
## 16 2050  26.05  58.92 138.496  0.0083  0.0393   72.92  -20.84  77.52
## 17 2060  25.87  58.95 148.496 -0.0438 -0.0320   72.93  -21.16  77.71
## 18 2070  25.18  58.28 138.496 -0.0954 -0.1027   72.10  -21.86  77.01
## 19 2080  23.97  56.90 128.496 -0.1464 -0.1723   70.44  -22.94  75.43
## 20 2090  22.25  54.84 118.496 -0.1965 -0.2402   67.97  -24.37  72.98
## 21 2100  20.04  52.11 108.496 -0.2457 -0.3060   64.73  -26.17  69.70
## 22 2110  17.34  48.73  98.496 -0.2936 -0.3692   60.74  -28.33  65.64
## 23 2120  14.17  44.73  88.496 -0.3401 -0.4296   56.05  -30.84  60.84
## 24 2130  10.55  40.15  78.496 -0.3852 -0.4869   50.72  -33.69  55.35
## 25 2140   6.48  35.01  68.496 -0.4286 -0.5407   44.78  -36.88  49.24
## 26 2150   1.98  29.34  58.496 -0.4704 -0.5910   38.29  -40.39  42.55
## 27 2160  -2.93  23.20  48.496 -0.5103 -0.6376   31.30  -44.23  35.36
## 28 2170  -8.22  16.60  38.496 -0.5484 -0.6806   23.86  -48.38  27.71
## 29 2180 -13.89   9.60  28.496 -0.5846 -0.7199   16.03  -52.83  19.67
## 30 2190 -19.91   2.22  18.496 -0.6189 -0.7557    7.85  -57.58  11.29
## 31 2200 -26.26  -5.50   8.496 -0.6512 -0.7880   -0.64  -62.61   2.61
## 32 2210 -32.93 -13.53  -1.504 -0.6816 -0.8169   -9.39  -67.91  -6.32
## 33 2220 -39.89 -21.83 -11.504 -0.7101 -0.8427  -18.36  -73.48 -15.46
```

e. With 10 DTE for the stock price range from $1900 to $2060 profit increases with the increase in stock price and attains a maximum of $77.71 and for the stock price range from $2060 to $2220 profit increases with the decrease in stock price.

(f)Assuming zero commissions, Max Profit = Net Premium Received

Max Profit per option contract = 100*148.21 = $14821

(g)It is preferable to place the trade in a low volatility environment because as it can be seen that lower value of sigma gives higher profits for DTE30

3. Ironfly

```
#Ironfly

#Cost
cost_IF<-p1[k==2020]-c1[k==2060]-p1[k==2060]+c1[k==2100]
cost_IF
```

```
## [1] -36.51
```

    a. Option premiumt: -$36.51

It's a Credit

```r
s <- seq(1940,2180,by=10)
Ironfly_val <- function(s,k,k1,k2,sig,r,t){
  return(BS(s,k1,sig,r,t,typ='p') -BS(s,k,sig,r,t,typ='c') - BS(s,k,sig,r,t,typ='p') +
BS(s,k2,sig,r,t,typ='c'))
}


Ironfly_delta <- function(s,k,k1,k2,sig,r,t){
  return(BSdelta(s,k1,sig,r,t,typ='p')-BSdelta(s,k,sig,r,t,typ='c') -BSdelta(s,k,sig,
r,t,typ='p')+BSdelta(s,k2,sig,r,t,typ='c')) }


### 30 DTE
pl30 <- round(Ironfly_val(s,2060,2020,2100,sig,r,t30) - cost_IF*exp((t44-t30)*r),2)

delta30 <- round(Ironfly_delta(s,2060,2020,2100,sig,r,t30),4)


### 16 DTE
pl16 <- round(Ironfly_val(s,2060,2020,2100,sig,r,t16) - cost_IF*exp((t44-t16)*r),2)

delta16 <- round(Ironfly_delta(s,2060,2020,2100,sig,r,t16),4)


### 0 DTE
pl0 <- round(Put(s,2020)-Call(s,2060)-Put(s,2060)+Call(s,2100) - cost_IF*exp(t44*r),2)


pl30_16 <- round(Ironfly_val(s,2060,2020,2100,0.16,r,t30) - cost_IF*exp((t44-t30)*r),
2)


pl30_36 <- round(Ironfly_val(s,2060,2020,2100,0.36,r,t30) - cost_IF*exp((t44-t30)*r),
2)
```

```r
data.frame(s,pl30,pl16,pl0,delta30,delta16,pl30_16,pl30_36)
```

```
##        s pl30  pl16   pl0 delta30 delta16 pl30_16 pl30_36
## 1  1940 -0.46 -0.35 -3.42  0.0166  0.0317   -0.49   -0.94
## 2  1950 -0.30 -0.04 -3.42  0.0160  0.0318   -0.07   -0.87
## 3  1960 -0.14  0.28 -3.42  0.0152  0.0314    0.37   -0.80
## 4  1970  0.00  0.59 -3.42  0.0142  0.0305    0.81   -0.74
## 5  1980  0.14  0.89 -3.42  0.0131  0.0289    1.24   -0.68
## 6  1990  0.27  1.17 -3.42  0.0118  0.0268    1.66   -0.63
## 7  2000  0.38  1.42 -3.42  0.0104  0.0242    2.05   -0.58
## 8  2010  0.47  1.65 -3.42  0.0089  0.0210    2.39   -0.54
## 9  2020  0.55  1.84 -3.42  0.0073  0.0175    2.69   -0.50
## 10 2030  0.62  2.00  6.58  0.0057  0.0135    2.93   -0.47
## 11 2040  0.67  2.11 16.58  0.0040  0.0094    3.10   -0.45
## 12 2050  0.70  2.18 26.58  0.0022  0.0050    3.20   -0.44
## 13 2060  0.71  2.21 36.58  0.0005  0.0006    3.23   -0.43
## 14 2070  0.71  2.20 26.58 -0.0012 -0.0037    3.19   -0.43
## 15 2080  0.69  2.14 16.58 -0.0029 -0.0079    3.08   -0.43
## 16 2090  0.65  2.04  6.58 -0.0045 -0.0119    2.90   -0.44
## 17 2100  0.60  1.90 -3.42 -0.0061 -0.0155    2.67   -0.46
## 18 2110  0.53  1.73 -3.42 -0.0075 -0.0188    2.38   -0.48
## 19 2120  0.45  1.53 -3.42 -0.0089 -0.0216    2.06   -0.51
## 20 2130  0.35  1.30 -3.42 -0.0101 -0.0239    1.69   -0.54
## 21 2140  0.25  1.05 -3.42 -0.0112 -0.0258    1.31   -0.58
## 22 2150  0.13  0.78 -3.42 -0.0121 -0.0272    0.91   -0.63
## 23 2160  0.00  0.51 -3.42 -0.0130 -0.0280    0.51   -0.68
## 24 2170 -0.13  0.22 -3.42 -0.0136 -0.0285    0.12   -0.73
## 25 2180 -0.27 -0.06 -3.42 -0.0142 -0.0285   -0.27   -0.79
```

    e. Assuming zero commissions, Max profit per option contract = 100*36.51 = $3651

Max loss per option contract = (2060-2020-36.51)*100 = $349

(f)It is preferable to place the trade in a low volatility environment

4. Strangle

```
#Strangle

cost_st<- p1[k==2020]+c1[k==2100]
cost_st
```

```
## [1] 111.7
```

    a. Option premium: 111.7

It's a debit

```r
s <- seq(1900,2220,by=10)
Strangle_val <- function(s,k1,k2,sig,r,t){
  return(BS(s,k1,sig,r,t,typ='p') + BS(s,k2,sig,r,t,typ='c'))
}


Strangle_delta <- function(s,k1,k2,sig,r,t){
  return(BSdelta(s,k1,sig,r,t,typ='p')+BSdelta(s,k2,sig,r,t,typ='c')) }




### 30 DTE
pl30 <- round(Strangle_val(s,2020,2100,sig,r,t30) - cost_st*exp((t44-t30)*r),2)
delta30 <- round(Strangle_delta(s,2020,2100,sig,r,t30),4)




### 16 DTE
pl16 <- round(Strangle_val(s,2020,2100,sig,r,t16) - cost_st*exp((t44-t16)*r),2)
delta16 <- round(Strangle_delta(s,2020,2100,sig,r,t16),4)


### 0 DTE
pl0 <- round(Put(s,2020)+Call(s,2100) - cost_st*exp(t44*r),2)

pl30_16 <- round(Strangle_val(s,2020,2100,0.16,r,t30) - cost_st*exp((t44-t30)*r),2)

pl30_36 <- round(Strangle_val(s,2020,2100,0.36,r,t30) - cost_st*exp((t44-t30)*r),2)
```

```r
data.frame(s,pl30,pl16,pl0,delta30,delta16,pl30_16,pl30_36)
```

```
##         s    pl30    pl16     pl0 delta30 delta16 pl30_16 pl30_36
## 1   1900   29.41   15.34    8.08 -0.6795 -0.8250   10.12   59.32
## 2   1910   22.78    7.24   -1.92 -0.6451 -0.7942    1.41   54.29
## 3   1920   16.51   -0.53  -11.92 -0.6088 -0.7598   -7.00   49.58
## 4   1930   10.61   -7.94  -21.92 -0.5705 -0.7219  -15.09   45.20
## 5   1940    5.11  -14.96  -31.92 -0.5303 -0.6803  -22.79   41.15
## 6   1950    0.01  -21.54  -41.92 -0.4883 -0.6351  -30.07   37.45
## 7   1960   -4.65  -27.65  -51.92 -0.4447 -0.5865  -36.86   34.10
## 8   1970   -8.88  -33.26  -61.92 -0.3996 -0.5344  -43.14   31.11
## 9   1980  -12.64  -38.33  -71.92 -0.3532 -0.4793  -48.84   28.48
## 10  1990  -15.94  -42.83  -81.92 -0.3055 -0.4213  -53.94   26.21
## 11  2000  -18.75  -46.74  -91.92 -0.2569 -0.3608  -58.37   24.31
## 12  2010  -21.07  -50.04 -101.92 -0.2075 -0.2981  -62.12   22.78
## 13  2020  -22.90  -52.70 -111.92 -0.1576 -0.2337  -65.15   21.63
## 14  2030  -24.22  -54.71 -111.92 -0.1072 -0.1679  -67.44   20.85
## 15  2040  -25.04  -56.06 -111.92 -0.0566 -0.1013  -68.96   20.44
## 16  2050  -25.35  -56.73 -111.92 -0.0060 -0.0343  -69.72   20.40
## 17  2060  -25.16  -56.74 -111.92  0.0443  0.0326  -69.70   20.74
## 18  2070  -24.47  -56.08 -111.92  0.0942  0.0990  -68.91   21.44
## 19  2080  -23.28  -54.77 -111.92  0.1435  0.1643  -67.36   22.51
## 20  2090  -21.60  -52.80 -111.92  0.1920  0.2283  -65.07   23.93
## 21  2100  -19.44  -50.21 -111.92  0.2396  0.2904  -62.06   25.72
## 22  2110  -16.81  -47.00 -101.92  0.2860  0.3505  -58.36   27.85
## 23  2120  -13.73  -43.21  -91.92  0.3313  0.4080  -54.00   30.33
## 24  2130  -10.19  -38.85  -81.92  0.3751  0.4629  -49.02   33.14
## 25  2140   -6.23  -33.96  -71.92  0.4175  0.5149  -43.47   36.29
## 26  2150   -1.85  -28.56  -61.92  0.4582  0.5638  -37.37   39.76
## 27  2160    2.93  -22.69  -51.92  0.4974  0.6096  -30.79   43.55
## 28  2170    8.09  -16.38  -41.92  0.5348  0.6522  -23.75   47.65
## 29  2180   13.62   -9.66  -31.92  0.5704  0.6915  -16.30   52.04
## 30  2190   19.50   -2.56  -21.92  0.6043  0.7276   -8.49   56.73
## 31  2200   25.70    4.88  -11.92  0.6364  0.7606   -0.35   61.69
## 32  2210   32.22   12.64   -1.92  0.6666  0.7906    8.07   66.93
## 33  2220   39.03   20.69    8.08  0.6951  0.8176   16.75   72.43
```

(e)Max profit = Unlimited

Assuming zero commissions, Max loss per option contract = 100*111.7 = $11170

    f. It is preferable to place the trade in a High volatility environment because as it can be seen that higher value of sigma gives higher profits for DTE30.

5. Ironcondor

```
#Ironcondor

#Cost
cost_IC<- -p1[k==1980]+p1[k==2020]+c1[k==2100]-c1[k==2140]
cost_IC
```

```
## [1] 29.83
```

a. Option premium: $29.83

It's a Debit

```
s <- seq(1900,2220,by=10)
Ironcondor_val <- function(s,k1,k2,k3,k4,sig,r,t){
  return(-BS(s,k1,sig,r,t,typ='p') +BS(s,k2,sig,r,t,typ='c') + BS(s,k3,sig,r,t,typ
='p') - BS(s,k4,sig,r,t,typ='c'))
}


Ironcondor_delta <- function(s,k1,k2,k3,k4,sig,r,t){
  return(-BSdelta(s,k1,sig,r,t,typ='p')+BSdelta(s,k2,sig,r,t,typ='c') +BSdelta(s,k3,si
g,r,t,typ='p')-BSdelta(s,k4,sig,r,t,typ='c')) }


### 30 DTE
pl30 <- round(Ironcondor_val(s,1980,2020,2100,2140,sig,r,t30) - cost_IC*exp((t44-t30)*
r),2)



### 16 DTE
pl16 <- round(Ironcondor_val(s,1980,2020,2100,2140,sig,r,t16) - cost_IC*exp((t44-t16)*
r),2)

### 0 DTE
pl0 <- round(-Put(s,1980)+Call(s,2020)+Put(s,2100)-Call(s,2140) - cost_IC*exp(t44*r),
3)


delta30 <- round(Ironcondor_delta(s,1980,2020,2100,2140,sig,r,t30),4)

delta16 <- round(Ironcondor_delta(s,1980,2020,2100,2140,sig,r,t16),4)

pl30_16 <- round(Ironcondor_val(s,1980,2020,2100,2140,0.16,r,t30) - cost_IC*exp((t44-t
30)*r),2)

pl30_36 <- round(Ironcondor_val(s,1980,2020,2100,2140,0.36,r,t30) - cost_IC*exp((t44-t
30)*r),2)
```

```
data.frame(s,pl30,pl16,pl0,delta30,delta16,pl30_16,pl30_36)
```

```
##         s pl30  pl16    pl0 delta30 delta16 pl30_16 pl30_36
## 1  1900 83.14 84.10 90.112 -0.0502 -0.0775   84.96   83.58
## 2  1910 82.64 83.30 90.112 -0.0502 -0.0817   84.04   83.33
## 3  1920 82.14 82.46 90.112 -0.0497 -0.0850   83.04   83.08
## 4  1930 81.65 81.60 90.112 -0.0487 -0.0872   81.97   82.84
## 5  1940 81.17 80.72 90.112 -0.0472 -0.0882   80.84   82.62
## 6  1950 80.70 79.84 90.112 -0.0453 -0.0878   79.67   82.40
## 7  1960 80.26 78.97 90.112 -0.0429 -0.0860   78.49   82.20
## 8  1970 79.85 78.13 90.112 -0.0400 -0.0827   77.31   82.02
## 9  1980 79.46 77.32 90.112 -0.0367 -0.0780   76.17   81.85
## 10 1990 79.11 76.57 80.112 -0.0331 -0.0718   75.10   81.70
## 11 2000 78.80 75.89 70.112 -0.0291 -0.0642   74.11   81.56
## 12 2010 78.53 75.29 60.112 -0.0248 -0.0555   73.23   81.44
## 13 2020 78.31 74.79 50.112 -0.0203 -0.0457   72.48   81.34
## 14 2030 78.13 74.38 50.112 -0.0156 -0.0351   71.89   81.26
## 15 2040 78.00 74.09 50.112 -0.0108 -0.0239   71.47   81.20
## 16 2050 77.91 73.90 50.112 -0.0059 -0.0124   71.22   81.16
## 17 2060 77.88 73.84 50.112 -0.0010 -0.0008   71.16   81.13
## 18 2070 77.89 73.89 50.112  0.0038  0.0107   71.27   81.13
## 19 2080 77.96 74.05 50.112  0.0085  0.0218   71.57   81.14
## 20 2090 78.06 74.32 50.112  0.0131  0.0323   72.02   81.18
## 21 2100 78.22 74.70 50.112  0.0174  0.0420   72.63   81.23
## 22 2110 78.41 75.16 60.112  0.0215  0.0507   73.37   81.29
## 23 2120 78.64 75.71 70.112  0.0252  0.0583   74.22   81.38
## 24 2130 78.91 76.32 80.112  0.0287  0.0648   75.16   81.48
## 25 2140 79.22 77.00 90.112  0.0318  0.0700   76.16   81.60
## 26 2150 79.55 77.72 90.112  0.0345  0.0740   77.21   81.73
## 27 2160 79.91 78.47 90.112  0.0369  0.0767   78.28   81.87
## 28 2170 80.28 79.25 90.112  0.0388  0.0782   79.35   82.03
## 29 2180 80.68 80.03 90.112  0.0404  0.0787   80.40   82.20
## 30 2190 81.09 80.82 90.112  0.0416  0.0781   81.42   82.37
## 31 2200 81.51 81.59 90.112  0.0425  0.0765   82.39   82.56
## 32 2210 81.94 82.35 90.112  0.0430  0.0742   83.31   82.76
## 33 2220 82.37 83.07 90.112  0.0431  0.0713   84.16   82.96
```

e. Max profit per option contract = (2020-1980-29.83)*100 = $1017

Assuming zero commissions, Max loss per option contract = 100*29.83 = $2983

f. It is preferable to place the trade in a High volatility environment