Chapter 1

Ex 1.1

We shall use the **getSymbols** function in the quantmod package to retrieve financial data for General Electric (**GE**).

```r
getSymbols("GE", src = "yahoo", from = "2000-01-01", to = "2009-12-30")
```

```
'getSymbols' currently uses auto.assign=TRUE by default, but will
use auto.assign=FALSE in 0.5-0. You will still be able to use
'loadSymbols' to automatically load data. getOption("getSymbols.env")
and getOption("getSymbols.auto.assign") will still be checked for
alternate defaults.

This message is shown once per session and may be disabled by setting
options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.
```

```
[1] "GE"
```

```r
names(GE)
```

```
[1] "GE.Open"     "GE.High"     "GE.Low"      "GE.Close"    "GE.Volume"
[6] "GE.Adjusted"
```

```r
GE["2000-01-01/2000-01-20"]
```

```
            GE.Open  GE.High   GE.Low GE.Close GE.Volume GE.Adjusted
2000-01-03 49.03846 49.25882 47.81650 48.07692  22952500    26.34747
2000-01-04 47.19552 47.43590 46.15385 46.15385  23006200    25.29357
2000-01-05 46.07372 47.11538 45.69311 46.07372  28384500    25.24966
2000-01-06 45.87340 47.09535 45.71314 46.68970  20668100    25.58724
2000-01-07 47.43590 48.67788 47.11538 48.49760  20947000    26.57802
2000-01-10 48.93830 49.37900 48.43750 48.47757  15835500    26.56703
2000-01-11 48.39743 48.93830 48.27725 48.55769  15727900    26.61095
2000-01-12 48.41747 49.11859 48.25721 48.71795  19075900    26.69878
2000-01-13 49.07853 49.65945 49.03846 49.27885  15551600    27.00616
2000-01-14 49.15865 49.55930 47.93670 48.39743  19219500    26.52312
2000-01-18 47.95673 47.95673 47.03525 47.43590  19028500    25.99617
2000-01-19 46.95513 48.37740 46.87500 47.66627  15443600    26.12242
2000-01-20 47.77644 47.99680 45.71314 46.77484  31989300    25.63389
```

```
geAdj = GE$GE.Adjusted["2000-01-01-/2000-01-20"]; geAdj
```

```
           GE.Adjusted
2000-01-03    26.34747
2000-01-04    25.29357
2000-01-05    25.24966
2000-01-06    25.58724
2000-01-07    26.57802
2000-01-10    26.56703
2000-01-11    26.61095
2000-01-12    26.69878
2000-01-13    27.00616
2000-01-14    26.52312
2000-01-18    25.99617
2000-01-19    26.12242
2000-01-20    25.63389
```

```
max(geAdj); min(geAdj); mean(geAdj)
```

```
[1] 27.00616

[1] 25.24966

[1] 26.17034
```

```
chartSeries(GE)
```

```
chartSeries(GE, TA=NULL, subset='2001-01::2001-02')
```


```
saveRDS(GE, file = "GE.rds")
```

1.3.4

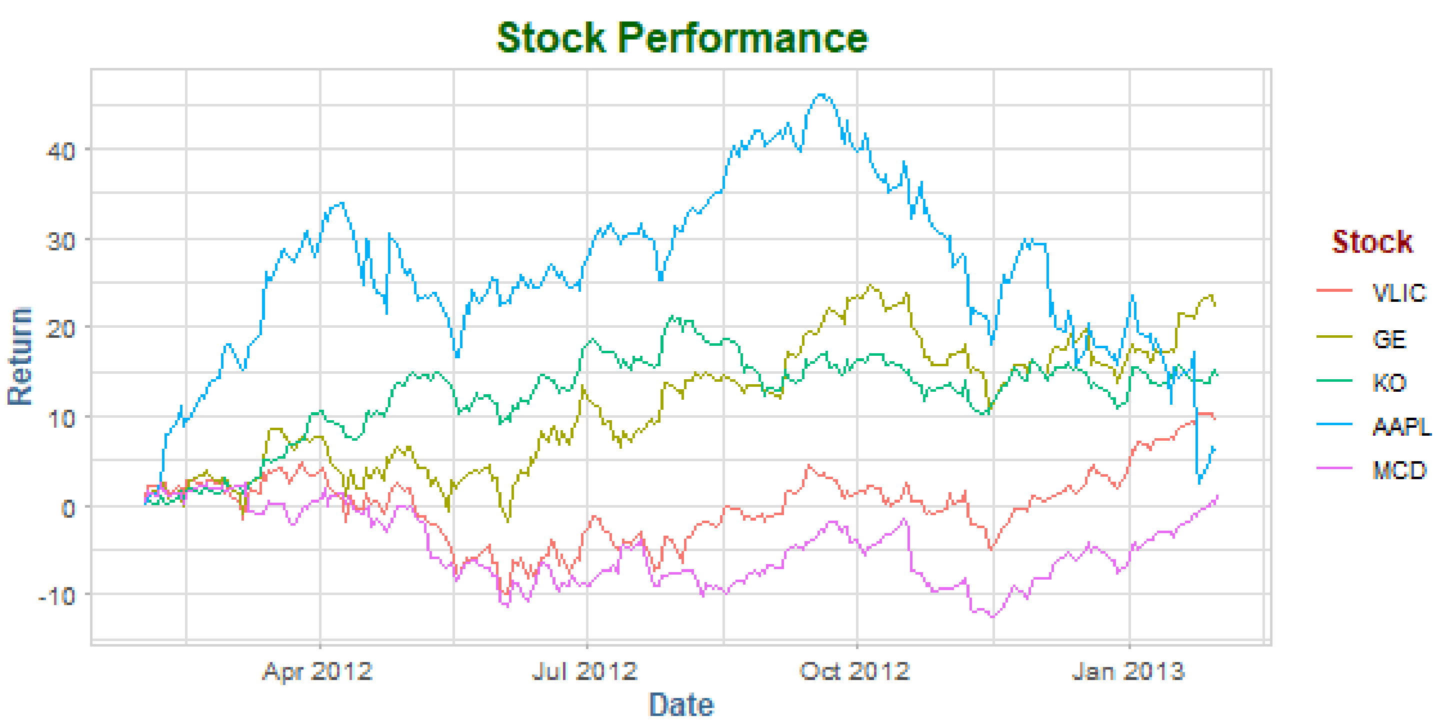
```
symbols <- c('^VLIC', 'GE', 'KO', 'AAPL', 'MCD')
getSymbols( symbols, src = "yahoo", from = "2012-02-01", to = "2013-02-01")
```

```
[1] "^VLIC" "GE"    "KO"    "AAPL"  "MCD"
```

```
# obtain Adjusted Close

VLICad <- VLIC$VLIC.Adjusted; GEad <- GE$GE.Adjusted
KOad <- KO$KO.Adjusted; AAPLad <- AAPL$AAPL.Adjusted
MCDad <- MCD$MCD.Adjusted

# compute cumulative sum (cumsum) of daily returns (Delt)

vl <- cumsum( (Delt(VLICad) * 100)[-1, ])
ge <- cumsum( (Delt(GEad) * 100)[-1, ])
ko <- cumsum( (Delt(KOad) * 100)[-1, ])
ap <- cumsum( (Delt(AAPLad) * 100)[-1, ])
```

```r
md <- cumsum( (Delt(MCDad) * 100)[-1, ])

### Range for the plot

lim <- c(min(vl, ge, ko, ap, md), max(vl, ge, ko, ap, md))
```

```r
### plot

stocks <- data.table( Date = index(vl),
                      VLIC = as.numeric(vl),
                      GE = as.numeric(ge),
                      KO = as.numeric(ko),
                      AAPL = as.numeric(ap),
                      MCD = as.numeric(md))

stocks.long <- melt(stocks,
     id.vars = c("Date"),
     variable.name = c("Stock"),
     value.name = "Return")

ggplot(stocks.long, aes(Date, Return, col = Stock)) +
   geom_line() +
   labs(title = "Stock Performance")
```



1.3.6

Using no arbitrage arguments show that for options on stocks:

i.) the stock's price is an upper bound for the price of a call;

ii.) the strike price is an upper bound for the price of a put.

1.3.7

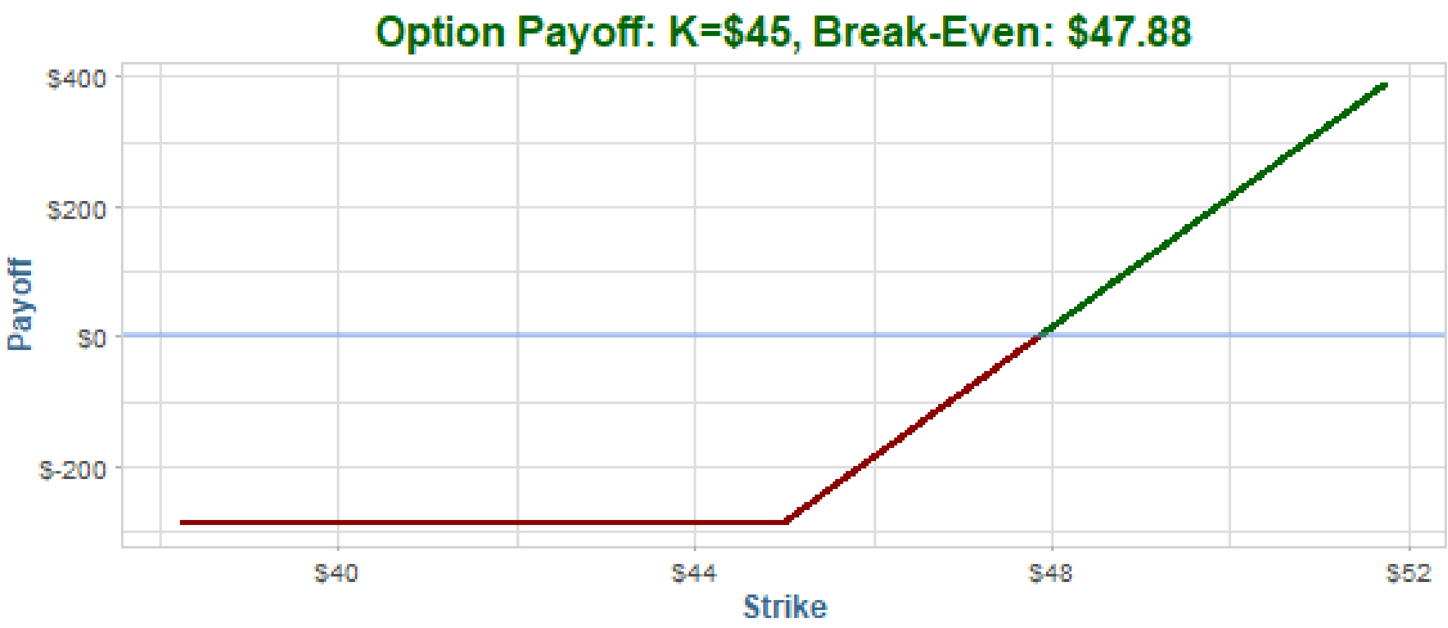
The following is a list of well-known investment strategies obtained by different combinations of put and call options on the same underlying asset. For each one of these strategies compute the payoff function and draw the profit graph.

Additionally, argue about the situations where the strategy is profitable.

```
plot.payoff <- function(payoff, strike) {

  breakeven <- payoff[min(which(payoff$Payoff > 0))]$Strike
  ggplot(payoff) +
    geom_point(aes(Strike, Payoff), col = ifelse(payoff$Payoff < 0, "darkred", "darkgreen"),
    geom_hline(yintercept = 0, col = "cornflowerblue", lwd = 1, alpha = .45) +
    labs(title = paste0("Option Payoff: K=$", strike, ", Break-Even: $", breakeven),
         x = "Strike", y = "Payoff") +
    scale_x_continuous(labels = dollar) +
    scale_y_continuous(labels = dollar)
}
```

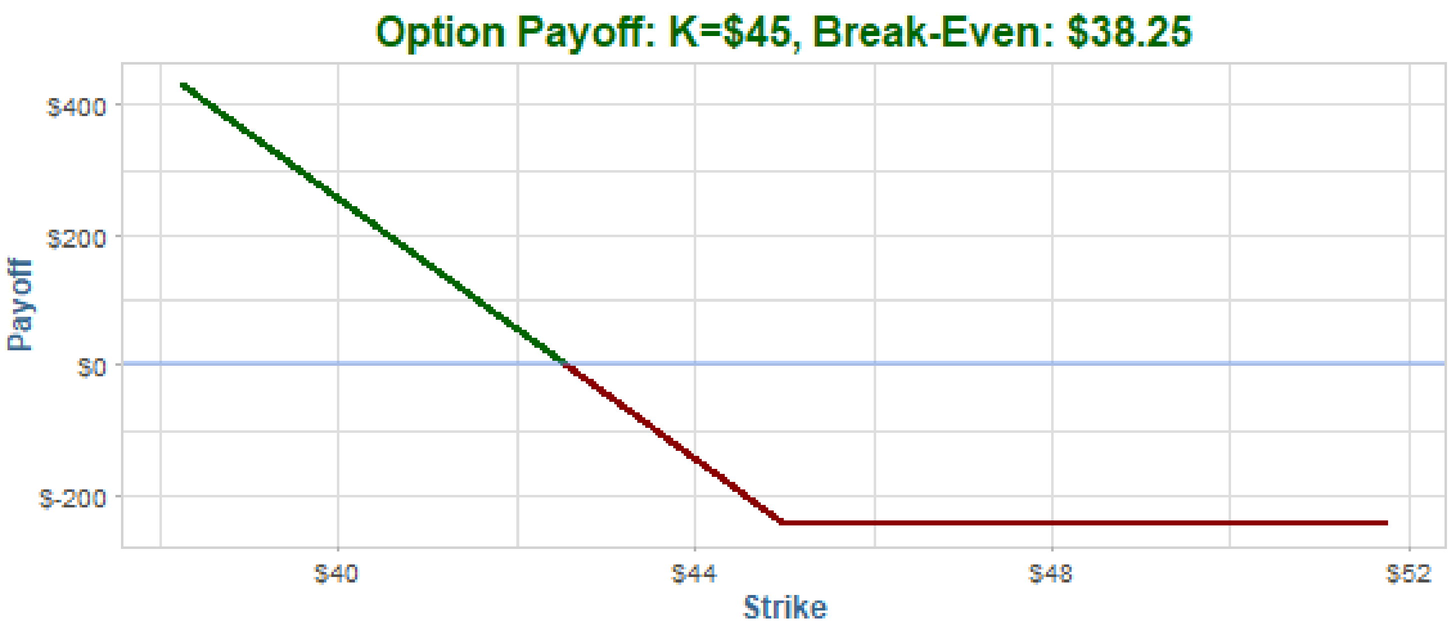
Vanilla Call Payoff

```
call.payoff <- function( strike, initial.price, contracts = 1, contract.size = 100,
                         lower = -.15, upper = .15) {

  cost <- -(initial.price * contract.size) * contracts

  x <- strike + seq(strike*lower, strike*upper, .01)
  y <- ( ( x - strike - initial.price ) * contract.size ) * contracts

  payoff <- ifelse(y < cost, cost, y)

  data.table(Strike = x, Payoff = payoff)
}

K <- 45
plot.payoff(call.payoff(K, 2.88), K)
```



Vanilla Put Payoff

```
put.payoff <- function( strike, initial.price, contracts = 1, contract.size = 100,
                        lower = -.15, upper = .15) {

   cost <- -(initial.price * contract.size) * contracts

   x <- strike + seq(strike*lower, strike*upper, .01)
   y <- ( ( strike - x - initial.price ) * contract.size ) * contracts

   payoff <- ifelse(y < cost, cost, y)

   data.table(Strike = x, Payoff = payoff)
}

K <- 45
plot.payoff(put.payoff(K, 2.45), K)
```



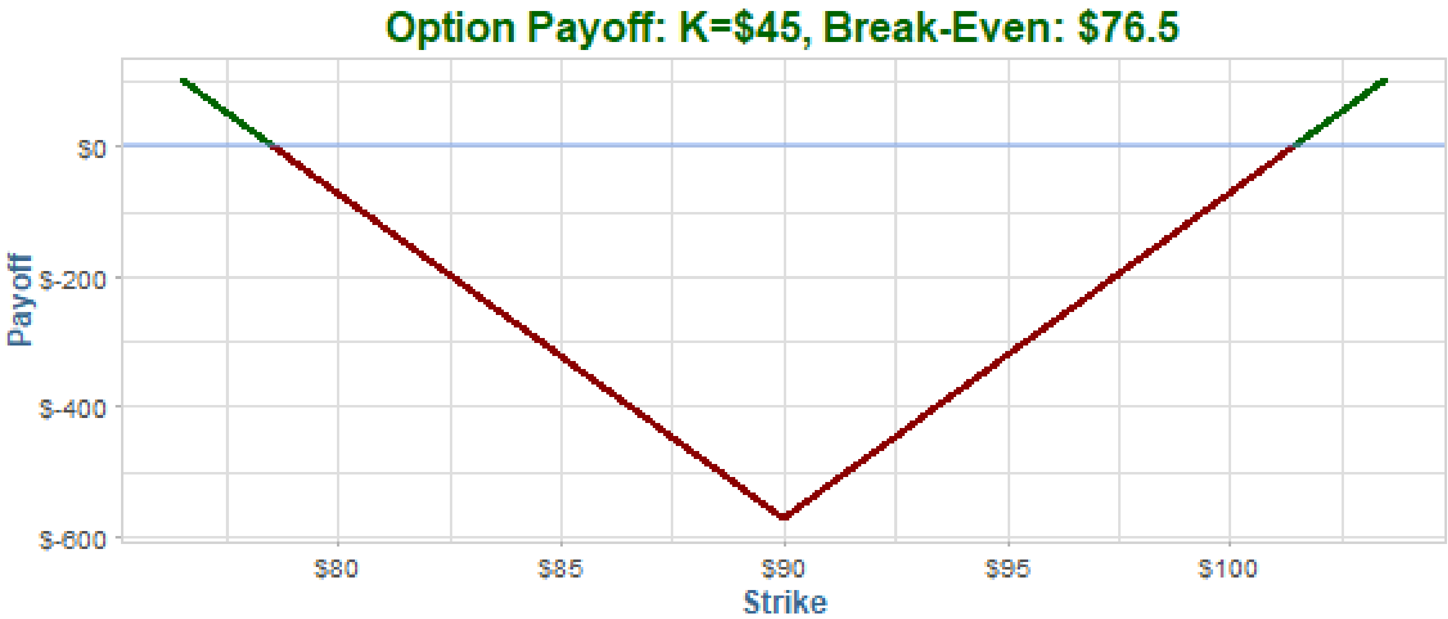
The Straddle:

The straddle strategy consists of two legs, one long and one short, both with the same strike and expiration date.

The main idea behind the straddle is that it is a non-directional long volatility strategy. It is generally suitable when you expect the underlying security to be very volatile and move a lot, but you are not sure whether the price move will be up or down. The position makes a profit when your expectation is correct and the underlying does make a big move to one side or the other. If the underlying price stays more or less the same, the trade makes a loss.

Straddle Payoff:

```
K <- 45
plot.payoff(call.payoff(K, 2.85) + put.payoff(K, 2.88), K)
```



The strangle:

Similar to the straddle. It consists on buying a put and a call with the same expiration date, but different strike prices. If K_c is the strike price for the call, and K_p is the strike price for the put, then the strategy requires $K_c > K_p$.

The strip:

This strategy consists of long positions in one call and two puts, all with the same strike price and expiration date.

The strap:

This one consists of long positions in two calls and one put, all with the same strike price and expiration date.

The butterfly spread:

This is made with options of the same type. Suppose we use calls and athe underlying assset is a stock. Then a butterfly spread of calls consists on short selling two calls waith strike price K_0 close to the current stock price, and buying two calls, one with strike price $K_0 - c$ and the other with strike price $K_0 + c$, where 2c > 0 is the length of the spread chosen by the investor.