Derivatives Homework 2

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Problem 9

a

```
orderByDate <- function (x){
  x$DateTime <- as.Date(x$Date, "%Y-%m-%d")
  x <- x[order(x$DateTime, decreasing=F),]
  x <- x[complete.cases(x),]
  x
}

qqq <- orderByDate(read.csv("qqq.csv"))

sp500 <- orderByDate(read.csv("sp500.csv"))

orcl <- orderByDate(read.csv("orcl.csv"))

orclSd <- sd(diff(log(orcl$Adj.Close)))
sp500Sd <- sd(diff(log(sp500$Adj.Close)))
qqqSd <- sd(diff(log(qqq$Adj.Close)))

orclSp500 <- cor(diff(log(orcl$Adj.Close)), diff(log(sp500$Adj.Close)))
orclQqq <- cor(diff(log(orcl$Adj.Close)), diff(log(qqq$Adj.Close)))
sp500Qqq <- cor(diff(log(sp500$Adj.Close)), diff(log(qqq$Adj.Close)))


kable(head(data.frame(Sds=c(orclSd, sp500Sd, qqqSd), Cors=c(orclSp500, orclQqq, sp500Qqq))))
```

Sds	Cors
0.0222635	0.7852686
0.0146833	0.8265540
0.0151025	0.9468564

b Due to the fact that the correlation between Oracle and the SP500 is much higher than the correlation between Oracle amd the nasdaq shorting the SP500 would likely be the best hedge when going long oracle.

c

$$H^* = \frac{I_p}{N}\frac{cov(r_p, r_{qqq})}{\sigma^2_{qqq}}$$

(Assume risk free is 0)

```
r_o <- diff(log(orcl$Adj.Close))
r_q <- diff(log(20*qqq$Adj.Close))

I <- 32*2000

sizeOfHedge <- -1*I/length(r_o) * cov(r_o, r_q)/var(r_q)

sdHedge <- sqrt(var(r_q)*I^2*(1-cor(r_o,r_q)^2))

cat("Size of Hedge: " , sizeOfHedge , " Sd Hedge: " , sdHedge)
```

```
## Size of Hedge:  -310.6867  Sd Hedge:  544.0353
```

Problem 12

a

```
tbill <- 100/97.3236

timeToPayment <- c(.5,1,1.5,2)
maturity <- as.Date(c("2012-11-15", "2013-02-15", "2013-11-15", "2014-02-15"), "%Y-%m-%d")
price <- c(97.3236, 94.53473, 91.64757, 88.5045)

spreadsheet <- data.frame(TimeToPayment=timeToPayment, Maturity=maturity, Price = price)
spreadsheet$Rate <- 100/spreadsheet$Price
spreadsheet$Raised <- spreadsheet$Rate^spreadsheet$TimeToPayment
spreadsheet$forwardPrice <- c(NA, spreadsheet$Raised[-1]/spreadsheet$Raised[-length(spreadshee
t$Raised)])

spreadsheet$forwardPrice[1] <- spreadsheet$Raised[1]^spreadsheet$TimeToPayment[1]/spreadshee
t$Rate[1]

spreadsheet$DiscountRate <- exp(-(tbill-1) * spreadsheet$TimeToPayment)
spreadsheet$PresentValueOfPayments <- spreadsheet$DiscountRate * spreadsheet$forwardPrice

swapPrice <- sum(spreadsheet$PresentValueOfPayments/sum(spreadsheet$DiscountRate))

kable(head(spreadsheet))
```

TimeToPayment	Maturity	Price	Rate	Raised	forwardPrice	DiscountRate	PresentValueOfPayments
0.5	2012-11-15	97.32360	1.027500	1.013657	0.9798591	0.9863441	0.9664782
1.0	2013-02-15	94.53473	1.057812	1.057812	1.0435606	0.9728747	1.0152537
1.5	2013-11-15	91.64757	1.091136	1.139773	1.0774818	0.9595892	1.0339399
2.0	2014-02-15	88.50450	1.129886	1.276642	1.1200843	0.9464851	1.0601432

b

```
pr1yr <- spreadsheet$PresentValueOfPayments[2]/spreadsheet$PresentValueOfPayments[1]
pr15yr <- spreadsheet$PresentValueOfPayments[3]/spreadsheet$PresentValueOfPayments[1]
pr2yr <- spreadsheet$PresentValueOfPayments[4]/spreadsheet$PresentValueOfPayments[1]
cat("1 y: ", pr1yr, " 1.5 yr: ", pr15yr, " 2 yr: " , pr2yr)
```

```
## 1 y:  1.050467  1.5 yr:  1.069802  2 yr:  1.096914
```

c

```
newpr <- c(98.60475, 95.80252, 92.87673)
newSpreadsheet <- data.frame(TimeToPayment=c(.25,.75,1.25),Price=newpr)
newSpreadsheet$Rate <- 100/newSpreadsheet$Price
newSpreadsheet$Raised <- newSpreadsheet$Rate^newSpreadsheet$TimeToPayment
newSpreadsheet$forwardPrice <- c(NA, newSpreadsheet$Raised[-1]/newSpreadsheet$Raised[-length(n
ewSpreadsheet$Raised)])

newSpreadsheet$forwardPrice[1] <- newSpreadsheet$Raised[1]^newSpreadsheet$TimeToPayment[1]/new
Spreadsheet$Rate[1]
newSpreadsheet$DiscountRate <- exp(-(tbill-1) * newSpreadsheet$TimeToPayment)
newSpreadsheet$PresentValueOfPayments <- newSpreadsheet$DiscountRate * newSpreadsheet$forwardP
rice
head(newSpreadsheet)
```

```
##   TimeToPayment    Price     Rate   Raised forwardPrice DiscountRate
## 1          0.25 98.60475 1.014150 1.003519    0.9869138    0.9931486
## 2          0.75 95.80252 1.043814 1.032684    1.0290625    0.9795862
## 3          1.25 92.87673 1.076696 1.096772    1.0620600    0.9662091
##   PresentValueOfPayments
## 1               0.980152
## 2               1.008055
## 3               1.026172
```

```
head(spreadsheet)
```

```
##   TimeToPayment   Maturity    Price     Rate   Raised forwardPrice
## 1           0.5 2012-11-15 97.32360 1.027500 1.013657    0.9798591
## 2           1.0 2013-02-15 94.53473 1.057812 1.057812    1.0435606
## 3           1.5 2013-11-15 91.64757 1.091136 1.139774    1.0774818
## 4           2.0 2014-02-15 88.50450 1.129886 1.276642    1.1200843
##   DiscountRate PresentValueOfPayments
## 1    0.9863441              0.9664782
## 2    0.9728747              1.0152537
## 3    0.9595892              1.0339399
## 4    0.9464851              1.0601432
```

```
sum(spreadsheet$PresentValueOfPayments[2:4] - newSpreadsheet$PresentValueOfPayments)
```

```
## [1] 0.09495727
```

Problem 13

$$C = P + S - Ke^{-rT}$$

$$C - P = Se^{-\delta * T} - Ke^{-r_f * T}$$

$$0 \overset{?}{\neq} 19 * e^{-.05*3/12} - 20 * e^{-.12*3/12}$$

$$-.6444 = 19 * e^{-.05*3/12} - 20 * e^{-.12*3/12}$$

Because C < P I would short the put and long the call.

Action	t=0	t=T & St > K	t =T & St < K
Short the Call	+C	K-St	0
Long the Put	-P	0	K-St
Long Stock	$19 * e^{-.05*3/12}$	St	+St
Borrow Tbills	$K * e^{-r_f T}$	-K	-K
Total	P-C	0	0

Problem 14

$$\frac{\$}{€} = 1.328$$

$$r_{€} = .23/100$$

$$r_{\$} = .17/100$$

$$DecemberCall_{\frac{\$1.325}{€}} = .0363$$

$$DecemberCall_{\frac{\$1.325}{€}} = .035$$

$$Notional = 125,000€$$

$$C - P = Se^{-\delta * T} - Ke^{-r_f * T}$$

$$0.0013 \overset{?}{\neq} 1.328 * e^{-.23/100*1/3} - 1.325 * e^{-.17/100*1/3}$$

$$0.0013 \overset{?}{\neq} .0027$$

Action	t=0	t=T & St > K	t =T & St < K
Buy Call	-C	€-K	0
Short Put	+P	0	-K+€
Short Euros	+€	-€	-€
Lend Tailed Euros	$-K * e^{-r_f T}$	+K	+K
Total	-C+P	0	0