

FE621HW1.R

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#FE 621- Fall 2019
#HW1-Problem 1

#Install packages
install.packages('quantmod',repos = "http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/jz/bdzw3_17czb8m73z400mcsc0000gn/T//RtmpsGgfpC/downloaded_p
ackages

library('quantmod')

## Warning: package 'quantmod' was built under R version 3.5.2
## Loading required package: xts
## Loading required package: zoo
## Warning: package 'zoo' was built under R version 3.5.2
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##   as.Date, as.Date.numeric
## Loading required package: TTR
## Version 0.4-0 included new data defaults. See ?getSymbols.

install.packages('timeDate',repos = "http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/jz/bdzw3_17czb8m73z400mcsc0000gn/T//RtmpsGgfpC/downloaded_p
ackages

library('timeDate')

#Load Data (Downloaded historical data since re-downloading would result in n
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ew data that have Later expiry)
load('HW1Data.RData')

#Problem 1 part 1
#Function to download data from Yahoo
getData <- function(source="yahoo",symbol,startdate,enddate,option=FALSE,expiry=NULL) {
  if(option==FALSE)
    data = getSymbols(Symbols = symbol,src = source,from = startdate,to = enddate,auto.assign=FALSE, verbose=TRUE)
  if(option==TRUE)
    data = getOptionChain(Symbols = symbol,src = source,Exp = expiry)
  return(data)
}

#Problem 1 part 2
#Extract data-- Code is commented out as data was downloaded and saved locally since it reflects option data as
# on 18.Sep.2019 and 20.Sep.2019

# AMZN = getData(source = "yahoo",symbol = "AMZN",startdate = '2019-09-18',enddate = '2019-09-21',option = FALSE)
# BA = getData(source = "yahoo",symbol = "BA",startdate = '2019-09-18',enddate = '2019-09-21',option = FALSE)
# SPY = getData(source = "yahoo",symbol = "SPY",startdate = '2019-09-18',enddate = '2019-09-21',option = FALSE)
# VIX = getData(source = "yahoo",symbol = "^VIX",startdate = '2019-09-18',enddate = '2019-09-21',option = FALSE)
#
# AMZNopCh20190918 = getData(source = "yahoo",symbol = "AMZN",startdate = '2019-09-18', expiry = NULL, option = TRUE)
# BAopCh20190918 = getData(source = "yahoo",symbol = "BA",startdate = '2019-09-18', expiry = NULL, option = TRUE)
#
# AMZNopCh20190920 = getData(source = "yahoo",symbol = "AMZN",startdate = '2019-09-20', expiry = NULL, option = TRUE)
# BAopCh20190920 = getData(source = "yahoo",symbol = "BA",startdate = '2019-09-20', expiry = NULL, option = TRUE)
#
# SPY = getData(source = "yahoo",symbol = "SPY",startdate = '2019-09-18',enddate = '2019-09-20',option = FALSE)
# VIX = getData(source = "yahoo",symbol = "^VIX",startdate = '2019-09-18',enddate = '2019-09-20',option = FALSE)
# VXX = getData(source = "yahoo",symbol = "VXX",startdate = '2019-09-18',enddate = '2019-09-20',option = FALSE)
#
# SPYopCh20190918 = getData(source = "yahoo",symbol = "SPY",startdate = '2019-09-18', expiry = NULL, option = TRUE)
# VIXopCh20190918 = getData(source = "yahoo",symbol = "^VIX",startdate = '2019-09-18', expiry = NULL, option = TRUE)

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# VXXOpCh20190918 = getData(source = "yahoo",symbol = "VXX",startdate = '2019
-09-18', expiry = NULL, option = TRUE)
#
# SPYOpCh20190920 = getData(source = "yahoo",symbol = "SPY",startdate = '2019
-09-20', expiry = NULL, option = TRUE)
# VIXOpCh20190920 = getData(source = "yahoo",symbol = "^VIX",startdate = '201
9-09-20', expiry = NULL, option = TRUE)
# VXXOpCh20190920 = getData(source = "yahoo",symbol = "VXX",startdate = '2019
-09-20', expiry = NULL, option = TRUE)

#Trim data to use only monthly expiries
AMZNopCh20190918 = AMZNopCh20190918[c('Oct.18.2019','Nov.15.2019','Dec.20.201
9')]
AMZNopCh20190920 = AMZNopCh20190920[c('Oct.18.2019','Nov.15.2019','Dec.20.201
9')]
BAopCh20190918 = BAopCh20190918[c('Oct.18.2019','Nov.15.2019','Dec.20.2019')]
BAopCh20190920 = BAopCh20190920[c('Oct.18.2019','Nov.15.2019','Dec.20.2019')]
SPYOpCh20190918 = SPYOpCh20190918[c('Oct.18.2019','Nov.15.2019','Dec.20.2019'
)]
SPYOpCh20190920 = SPYOpCh20190920[c('Oct.18.2019','Nov.15.2019','Dec.20.2019'
)]

DATA1 <- list(AMZNopCh20190918,BAopCh20190918,SPYOpCh20190918)
names(DATA1) <- c('AMZNopCh20190918','BAopCh20190918','SPYOpCh20190918')

#Note: BA does not have option data for December 20, 2019 maturity
DATA2 <- list(AMZNopCh20190920,BAopCh20190920,SPYOpCh20190920)
names(DATA2) <- c('AMZNopCh20190920','BAopCh20190920','SPYOpCh20190920')

#Problem 1 part 3
cat('SPY is an ETF run by State Street, which replicates the holdings of the
S&P500 index. The VIX Index is a calculation
designed to produce a measure of constant, 30-day expected volatility of the
U.S. stock market,
    derived from real-time, mid-quote prices of SP 500 Index call and put opt
ions.
VXX (iPath S&P 500 VIX Short Term Futures ETN) is the largest and most liquid
in the volatility ETF/ETN universe.')

## SPY is an ETF run by State Street, which replicates the holdings of the S&
P500 index. The VIX Index is a calculation
## designed to produce a measure of constant, 30-day expected volatility of t
he U.S. stock market,
##     derived from real-time, mid-quote prices of SP 500 Index call and put
options.
## VXX (iPath S&P 500 VIX Short Term Futures ETN) is the largest and most liq
uid in the volatility ETF/ETN universe.

#Problem 1 part 4
#Effective federal funds rate from http://www.federalreserve.gov/releases/H15

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/Current/
rate20190918 = 2.25/100
rate20190920 = 1.90/100

#Problem 1 part 5
#Define Black Scholes Option pricing function
BSEuro <- function(K,S,r,sig,t,Type) {
  d1 <- (log(S/K) + ((r + (sig^2)/2)*t)) / (sig*(t^0.5))
  d2 <- d1 - (sig*(t^0.5))
  if(Type=='calls') {
    price = S*pnorm(d1)-K*exp(-r*(t))*pnorm(d2)
  }
  if(Type=='puts') {
    price = S*(pnorm(d1)-1)+K*exp(-r*(t))*(1-pnorm(d2))
  }
  return(price)
}

#Problem 1 part 6
#Define vega
vega <- function(K,S,r,t,sig) {
  d1 = (log(S/K) + (r+(sig^2)/2)*t)/(sig*sqrt(t))
  v <- S*dnorm(d1)*sqrt(t)
  return(v)
}

#Define implied vol. function
impVol <- function(K,S,r,t,Type,m) {
  err = as.numeric(10^-3)
  x0 = as.numeric(0.4)
  delta = BSEuro(K,S,r,x0,t,Type) - m
  while (delta>err) {
    if(vega(K,S,r,t,x0)==0){
      x0=NA
      break
    }
    x0 = x0 - ((BSEuro(K,S,r,x0,t,Type)-m)/vega(K,S,r,t,x0))
    delta = abs(BSEuro(K,S,r,x0,t,Type) - m)
  }
  return(x0)
}

#Create implied vol columns in DATA1
a = 1
for (OpCh in DATA1) {
  b=1
  for (item in OpCh) {
    c=1
    for (callput in item) {

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    IV <- matrix(0,nrow = nrow(callput),ncol = 1,byrow = TRUE)
    callput <- cbind(callput,IV)
    item[[c]] <- callput
    c=c+1
  }
  OpCh[[b]] = item
  b=b+1
}
DATA1[[a]] = OpCh
a=a+1
}

#Function to compute number of days (t)
Nweekdays<- function(D1,D2){
  t = as.numeric(sum(!weekdays(seq(Date1, Date2, "days")) %in% c("Saturday",
"Sunday")))
  return(t)
}

#Compute Implied Vol for DATA1
#Create reporting table
report1 <- data.frame(matrix(ncol = 8))
colnames(report1)<- c('Equity','Option','Maturity','Op.Type','Moneyness','Imp
.Vol.','Avg.Imp.Vol','VIX')

#Nested Loops to navigate list of lists of option chains
a = 1 #counter
eq<- c('AMZN','BA','SPY')
moneyness<- c('In','Out')
op.type<- names(DATA1$AMZNopCh20190918[[1]])
maturity <- names(DATA1[[1]])

#Nested loop to navigate list of lists
for (OpCh in DATA1) {
  if (a==1) {
    Spot = AMZN[1,4] #extract spot price for respective equity
    Date1 <- as.Date(index(AMZN[1]),format = '%Y-%m-%d') #extract date of Spo
t to compute 't'
  }
  if (a==2) {
    Spot = BA[1,4] #extract spot price for respective equity
    Date1 <- as.Date(index(BA[1]),format = '%Y-%m-%d') #extract date of Spot
to compute 't'
  }
  if (a==3) {
    Spot = SPY[1,4] #extract spot price for respective equity
    Date1 <- as.Date(index(SPY[1]),format = '%Y-%m-%d') #extract date of Spot
to compute 't'
  }
}

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b=1 #counter
for (item in OpCh) {
  c=1 #counter
  Date2 <- as.Date(names(OpCh[b]),format = '%b.%d.%Y') #Extract date of op
tion maturity to compute 't'
  t = abs(Nweekdays(Date1,Date2))/360

  for (callput in item) {
    for (row in 1:dim(callput)[1]) { #For loop to iterate through each row
of strike price in option chain
      #Condition to print NA when required values do not exist
      #(or) print NA if "moneyness" condition fails
      if ((is.na(callput$Bid[row])==TRUE)|| (is.na(callput$Ask[row])==TRUE))
{
        callput$IV[row]=NA
        next
      }
      if (((as.numeric(Spot)/as.numeric(callput$Strike[row]))>1.05)|| (as.nu
meric(Spot)/as.numeric(callput$Strike[row]))<0.95){
        callput$IV[row]=NA
        next
      }
      #Compute implied vol for each strike price
      callput$IV[row] = impVol(as.numeric(callput$Strike[row]),as.numeric(S
pot),rate20190918,t,names(item)[c],
                             ((as.numeric(callput$Bid[row]+callput$Ask[ro
w])/2)))
      if (callput$Strike[row]<Spot)
        mon = moneyness[1] #Update moneyness column
      if (callput$Strike[row]>Spot)
        mon = moneyness[2] #Update moneyness column

      #Report for problem 1 part 7
      report1<-rbind(report1,c(eq[a],rownames(callput)[row],names(OpCh)[b],
op.type[c],mon,callput$IV[row],0,0))
    }
    item[[c]] <- callput #Update list with updated dataframe
    c=c+1
  }
  OpCh[[b]] = item #Update list of list with new list
  b=b+1
}
DATA1[[a]] = OpCh #Update list of list with new list
a=a+1
}

#Problem 1 part 7
#Delete empty first row
report1<-report1[-1,]

```

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#Compute average implied volatility
avgVol <- data.frame(matrix(ncol = 6))
colnames(avgVol) <- c("Equity", "Maturity", "Moneyiness", "Op.Type", "Avg.Imp.Vol.", "VIX")
for (item in eq) {
  i = 1 #counter
  for (t in maturity) {
    for (ty in op.type) {
      for (mo in moneyiness) {
        avg = 0
        avgvol = report1[which(report1$Equity==item),]
        avgvol = report1[which(report1$Maturity==t),]
        avgvol = report1[which(report1$Op.Type==ty),]
        avgvol = as.numeric(report1[which(report1$Moneyiness==mo),]$Imp.Vol.)
        avg = mean(avgvol)
        avgVol <- rbind(avgVol, c(item, t, mo, ty, avg, VIX[i,]$VIX.Close/100))
      }
    }
    i = i + 1
  }
}
#Delete empty first row and display average volatility
#Update report with average volatility
avgVol <- avgVol[-1,]
avgVol

```

##	Equity	Maturity	Moneyiness	Op.Type	Avg.Imp.Vol.	VIX
## 2	AMZN	Oct.18.2019	In	calls	0.234951757359371	0.1395
## 3	AMZN	Oct.18.2019	Out	calls	0.217969219313299	0.1395
## 4	AMZN	Oct.18.2019	In	puts	0.234951757359371	0.1395
## 5	AMZN	Oct.18.2019	Out	puts	0.217969219313299	0.1395
## 6	AMZN	Nov.15.2019	In	calls	0.234951757359371	0.1405
## 7	AMZN	Nov.15.2019	Out	calls	0.217969219313299	0.1405
## 8	AMZN	Nov.15.2019	In	puts	0.234951757359371	0.1405
## 9	AMZN	Nov.15.2019	Out	puts	0.217969219313299	0.1405
## 10	AMZN	Dec.20.2019	In	calls	0.234951757359371	0.1532
## 11	AMZN	Dec.20.2019	Out	calls	0.217969219313299	0.1532
## 12	AMZN	Dec.20.2019	In	puts	0.234951757359371	0.1532
## 13	AMZN	Dec.20.2019	Out	puts	0.217969219313299	0.1532
## 14	BA	Oct.18.2019	In	calls	0.234951757359371	0.1395
## 15	BA	Oct.18.2019	Out	calls	0.217969219313299	0.1395
## 16	BA	Oct.18.2019	In	puts	0.234951757359371	0.1395
## 17	BA	Oct.18.2019	Out	puts	0.217969219313299	0.1395
## 18	BA	Nov.15.2019	In	calls	0.234951757359371	0.1405
## 19	BA	Nov.15.2019	Out	calls	0.217969219313299	0.1405
## 20	BA	Nov.15.2019	In	puts	0.234951757359371	0.1405
## 21	BA	Nov.15.2019	Out	puts	0.217969219313299	0.1405
## 22	BA	Dec.20.2019	In	calls	0.234951757359371	0.1532
## 23	BA	Dec.20.2019	Out	calls	0.217969219313299	0.1532

```
## 24    BA Dec.20.2019      In    puts 0.234951757359371 0.1532
## 25    BA Dec.20.2019      Out   puts 0.217969219313299 0.1532
## 26    SPY Oct.18.2019     In    calls 0.234951757359371 0.1395
## 27    SPY Oct.18.2019     Out   calls 0.217969219313299 0.1395
## 28    SPY Oct.18.2019     In    puts 0.234951757359371 0.1395
## 29    SPY Oct.18.2019     Out   puts 0.217969219313299 0.1395
## 30    SPY Nov.15.2019     In    calls 0.234951757359371 0.1405
## 31    SPY Nov.15.2019     Out   calls 0.217969219313299 0.1405
## 32    SPY Nov.15.2019     In    puts 0.234951757359371 0.1405
## 33    SPY Nov.15.2019     Out   puts 0.217969219313299 0.1405
## 34    SPY Dec.20.2019     In    calls 0.234951757359371 0.1532
## 35    SPY Dec.20.2019     Out   calls 0.217969219313299 0.1532
## 36    SPY Dec.20.2019     In    puts 0.234951757359371 0.1532
## 37    SPY Dec.20.2019     Out   puts 0.217969219313299 0.1532
```

#Update report table with avg.vol., VIX and display report

```
for (row in 1:dim(report1)[1]) {
  report1$Avg.Imp.Vol[row] <- avgVol[which((report1$Equity[row]==avgVol$Equity) & (report1$Maturity[row]==avgVol$Maturity)
                                     & (report1$Op.Type[row]==avgVol$Op.
Type) &
                                     (report1$Moneyness[row]==avgVol$M
oneyness)),]$Avg.Imp.Vol
  report1$VIX[row] <- avgVol[which((report1$Equity[row]==avgVol$Equity) & (re
port1$Maturity[row]==avgVol$Maturity)
                                     & (report1$Op.Type[row]==avgVol$Op.
Type) &
                                     (report1$Moneyness[row]==avgVol$M
oneyness)),]$VIX
}
report1
```

##	Equity	Option	Maturity	Op.Type	Moneyness
## 2	AMZN AMZN191018C01735000		Oct.18.2019	calls	In
## 3	AMZN AMZN191018C01740000		Oct.18.2019	calls	In
## 4	AMZN AMZN191018C01745000		Oct.18.2019	calls	In
## 5	AMZN AMZN191018C01750000		Oct.18.2019	calls	In
## 6	AMZN AMZN191018C01755000		Oct.18.2019	calls	In
## 7	AMZN AMZN191018C01760000		Oct.18.2019	calls	In
## 8	AMZN AMZN191018C01765000		Oct.18.2019	calls	In
## 9	AMZN AMZN191018C01770000		Oct.18.2019	calls	In
## 10	AMZN AMZN191018C01775000		Oct.18.2019	calls	In
## 11	AMZN AMZN191018C01780000		Oct.18.2019	calls	In
## 12	AMZN AMZN191018C01785000		Oct.18.2019	calls	In
## 13	AMZN AMZN191018C01790000		Oct.18.2019	calls	In
## 14	AMZN AMZN191018C01795000		Oct.18.2019	calls	In
## 15	AMZN AMZN191018C01800000		Oct.18.2019	calls	In
## 16	AMZN AMZN191018C01805000		Oct.18.2019	calls	In
## 17	AMZN AMZN191018C01810000		Oct.18.2019	calls	In
## 18	AMZN AMZN191018C01815000		Oct.18.2019	calls	In

## 19	AMZN	AMZN191018C01820000	Oct.18.2019	calls	Out
## 20	AMZN	AMZN191018C01825000	Oct.18.2019	calls	Out
## 21	AMZN	AMZN191018C01830000	Oct.18.2019	calls	Out
## 22	AMZN	AMZN191018C01835000	Oct.18.2019	calls	Out
## 23	AMZN	AMZN191018C01840000	Oct.18.2019	calls	Out
## 24	AMZN	AMZN191018C01845000	Oct.18.2019	calls	Out
## 25	AMZN	AMZN191018C01850000	Oct.18.2019	calls	Out
## 26	AMZN	AMZN191018C01855000	Oct.18.2019	calls	Out
## 27	AMZN	AMZN191018C01860000	Oct.18.2019	calls	Out
## 28	AMZN	AMZN191018C01865000	Oct.18.2019	calls	Out
## 29	AMZN	AMZN191018C01870000	Oct.18.2019	calls	Out
## 30	AMZN	AMZN191018C01875000	Oct.18.2019	calls	Out
## 31	AMZN	AMZN191018C01880000	Oct.18.2019	calls	Out
## 32	AMZN	AMZN191018C01885000	Oct.18.2019	calls	Out
## 33	AMZN	AMZN191018C01890000	Oct.18.2019	calls	Out
## 34	AMZN	AMZN191018C01895000	Oct.18.2019	calls	Out
## 35	AMZN	AMZN191018C01900000	Oct.18.2019	calls	Out
## 36	AMZN	AMZN191018C01905000	Oct.18.2019	calls	Out
## 37	AMZN	AMZN191018C01910000	Oct.18.2019	calls	Out
## 38	AMZN	AMZN191018P01735000	Oct.18.2019	puts	In
## 39	AMZN	AMZN191018P01740000	Oct.18.2019	puts	In
## 40	AMZN	AMZN191018P01745000	Oct.18.2019	puts	In
## 41	AMZN	AMZN191018P01750000	Oct.18.2019	puts	In
## 42	AMZN	AMZN191018P01755000	Oct.18.2019	puts	In
## 43	AMZN	AMZN191018P01760000	Oct.18.2019	puts	In
## 44	AMZN	AMZN191018P01765000	Oct.18.2019	puts	In
## 45	AMZN	AMZN191018P01770000	Oct.18.2019	puts	In
## 46	AMZN	AMZN191018P01775000	Oct.18.2019	puts	In
## 47	AMZN	AMZN191018P01780000	Oct.18.2019	puts	In
## 48	AMZN	AMZN191018P01785000	Oct.18.2019	puts	In
## 49	AMZN	AMZN191018P01790000	Oct.18.2019	puts	In
## 50	AMZN	AMZN191018P01795000	Oct.18.2019	puts	In
## 51	AMZN	AMZN191018P01800000	Oct.18.2019	puts	In
## 52	AMZN	AMZN191018P01805000	Oct.18.2019	puts	In
## 53	AMZN	AMZN191018P01810000	Oct.18.2019	puts	In
## 54	AMZN	AMZN191018P01815000	Oct.18.2019	puts	In
## 55	AMZN	AMZN191018P01820000	Oct.18.2019	puts	Out
## 56	AMZN	AMZN191018P01825000	Oct.18.2019	puts	Out
## 57	AMZN	AMZN191018P01830000	Oct.18.2019	puts	Out
## 58	AMZN	AMZN191018P01835000	Oct.18.2019	puts	Out
## 59	AMZN	AMZN191018P01840000	Oct.18.2019	puts	Out
## 60	AMZN	AMZN191018P01845000	Oct.18.2019	puts	Out
## 61	AMZN	AMZN191018P01850000	Oct.18.2019	puts	Out
## 62	AMZN	AMZN191018P01855000	Oct.18.2019	puts	Out
## 63	AMZN	AMZN191018P01860000	Oct.18.2019	puts	Out
## 64	AMZN	AMZN191018P01865000	Oct.18.2019	puts	Out
## 65	AMZN	AMZN191018P01870000	Oct.18.2019	puts	Out
## 66	AMZN	AMZN191018P01875000	Oct.18.2019	puts	Out
## 67	AMZN	AMZN191018P01880000	Oct.18.2019	puts	Out
## 68	AMZN	AMZN191018P01885000	Oct.18.2019	puts	Out

## 69	AMZN	AMZN191018P01890000	Oct.18.2019	puts	Out
## 70	AMZN	AMZN191018P01895000	Oct.18.2019	puts	Out
## 71	AMZN	AMZN191018P01900000	Oct.18.2019	puts	Out
## 72	AMZN	AMZN191018P01905000	Oct.18.2019	puts	Out
## 73	AMZN	AMZN191018P01910000	Oct.18.2019	puts	Out
## 74	AMZN	AMZN191115C01740000	Nov.15.2019	calls	In
## 75	AMZN	AMZN191115C01750000	Nov.15.2019	calls	In
## 76	AMZN	AMZN191115C01760000	Nov.15.2019	calls	In
## 77	AMZN	AMZN191115C01770000	Nov.15.2019	calls	In
## 78	AMZN	AMZN191115C01780000	Nov.15.2019	calls	In
## 79	AMZN	AMZN191115C01790000	Nov.15.2019	calls	In
## 80	AMZN	AMZN191115C01800000	Nov.15.2019	calls	In
## 81	AMZN	AMZN191115C01805000	Nov.15.2019	calls	In
## 82	AMZN	AMZN191115C01810000	Nov.15.2019	calls	In
## 83	AMZN	AMZN191115C01815000	Nov.15.2019	calls	In
## 84	AMZN	AMZN191115C01820000	Nov.15.2019	calls	Out
## 85	AMZN	AMZN191115C01830000	Nov.15.2019	calls	Out
## 86	AMZN	AMZN191115C01840000	Nov.15.2019	calls	Out
## 87	AMZN	AMZN191115C01845000	Nov.15.2019	calls	Out
## 88	AMZN	AMZN191115C01850000	Nov.15.2019	calls	Out
## 89	AMZN	AMZN191115C01855000	Nov.15.2019	calls	Out
## 90	AMZN	AMZN191115C01860000	Nov.15.2019	calls	Out
## 91	AMZN	AMZN191115C01865000	Nov.15.2019	calls	Out
## 92	AMZN	AMZN191115C01870000	Nov.15.2019	calls	Out
## 93	AMZN	AMZN191115C01875000	Nov.15.2019	calls	Out
## 94	AMZN	AMZN191115C01880000	Nov.15.2019	calls	Out
## 95	AMZN	AMZN191115C01890000	Nov.15.2019	calls	Out
## 96	AMZN	AMZN191115C01900000	Nov.15.2019	calls	Out
## 97	AMZN	AMZN191115C01905000	Nov.15.2019	calls	Out
## 98	AMZN	AMZN191115C01910000	Nov.15.2019	calls	Out
## 99	AMZN	AMZN191115P01740000	Nov.15.2019	puts	In
## 100	AMZN	AMZN191115P01750000	Nov.15.2019	puts	In
## 101	AMZN	AMZN191115P01760000	Nov.15.2019	puts	In
## 102	AMZN	AMZN191115P01765000	Nov.15.2019	puts	In
## 103	AMZN	AMZN191115P01770000	Nov.15.2019	puts	In
## 104	AMZN	AMZN191115P01775000	Nov.15.2019	puts	In
## 105	AMZN	AMZN191115P01780000	Nov.15.2019	puts	In
## 106	AMZN	AMZN191115P01785000	Nov.15.2019	puts	In
## 107	AMZN	AMZN191115P01790000	Nov.15.2019	puts	In
## 108	AMZN	AMZN191115P01795000	Nov.15.2019	puts	In
## 109	AMZN	AMZN191115P01800000	Nov.15.2019	puts	In
## 110	AMZN	AMZN191115P01805000	Nov.15.2019	puts	In
## 111	AMZN	AMZN191115P01810000	Nov.15.2019	puts	In
## 112	AMZN	AMZN191115P01820000	Nov.15.2019	puts	Out
## 113	AMZN	AMZN191115P01825000	Nov.15.2019	puts	Out
## 114	AMZN	AMZN191115P01830000	Nov.15.2019	puts	Out
## 115	AMZN	AMZN191115P01835000	Nov.15.2019	puts	Out
## 116	AMZN	AMZN191115P01840000	Nov.15.2019	puts	Out
## 117	AMZN	AMZN191115P01845000	Nov.15.2019	puts	Out
## 118	AMZN	AMZN191115P01850000	Nov.15.2019	puts	Out

## 119	AMZN	AMZN191115P01855000	Nov.15.2019	puts	Out
## 120	AMZN	AMZN191115P01860000	Nov.15.2019	puts	Out
## 121	AMZN	AMZN191115P01870000	Nov.15.2019	puts	Out
## 122	AMZN	AMZN191115P01880000	Nov.15.2019	puts	Out
## 123	AMZN	AMZN191115P01890000	Nov.15.2019	puts	Out
## 124	AMZN	AMZN191115P01900000	Nov.15.2019	puts	Out
## 125	AMZN	AMZN191115P01905000	Nov.15.2019	puts	Out
## 126	AMZN	AMZN191115P01910000	Nov.15.2019	puts	Out
## 127	AMZN	AMZN191220C01735000	Dec.20.2019	calls	In
## 128	AMZN	AMZN191220C01740000	Dec.20.2019	calls	In
## 129	AMZN	AMZN191220C01750000	Dec.20.2019	calls	In
## 130	AMZN	AMZN191220C01755000	Dec.20.2019	calls	In
## 131	AMZN	AMZN191220C01760000	Dec.20.2019	calls	In
## 132	AMZN	AMZN191220C01765000	Dec.20.2019	calls	In
## 133	AMZN	AMZN191220C01770000	Dec.20.2019	calls	In
## 134	AMZN	AMZN191220C01775000	Dec.20.2019	calls	In
## 135	AMZN	AMZN191220C01780000	Dec.20.2019	calls	In
## 136	AMZN	AMZN191220C01785000	Dec.20.2019	calls	In
## 137	AMZN	AMZN191220C01790000	Dec.20.2019	calls	In
## 138	AMZN	AMZN191220C01795000	Dec.20.2019	calls	In
## 139	AMZN	AMZN191220C01800000	Dec.20.2019	calls	In
## 140	AMZN	AMZN191220C01805000	Dec.20.2019	calls	In
## 141	AMZN	AMZN191220C01810000	Dec.20.2019	calls	In
## 142	AMZN	AMZN191220C01815000	Dec.20.2019	calls	In
## 143	AMZN	AMZN191220C01820000	Dec.20.2019	calls	Out
## 144	AMZN	AMZN191220C01825000	Dec.20.2019	calls	Out
## 145	AMZN	AMZN191220C01830000	Dec.20.2019	calls	Out
## 146	AMZN	AMZN191220C01835000	Dec.20.2019	calls	Out
## 147	AMZN	AMZN191220C01840000	Dec.20.2019	calls	Out
## 148	AMZN	AMZN191220C01845000	Dec.20.2019	calls	Out
## 149	AMZN	AMZN191220C01850000	Dec.20.2019	calls	Out
## 150	AMZN	AMZN191220C01855000	Dec.20.2019	calls	Out
## 151	AMZN	AMZN191220C01860000	Dec.20.2019	calls	Out
## 152	AMZN	AMZN191220C01865000	Dec.20.2019	calls	Out
## 153	AMZN	AMZN191220C01870000	Dec.20.2019	calls	Out
## 154	AMZN	AMZN191220C01875000	Dec.20.2019	calls	Out
## 155	AMZN	AMZN191220C01880000	Dec.20.2019	calls	Out
## 156	AMZN	AMZN191220C01885000	Dec.20.2019	calls	Out
## 157	AMZN	AMZN191220C01890000	Dec.20.2019	calls	Out
## 158	AMZN	AMZN191220C01895000	Dec.20.2019	calls	Out
## 159	AMZN	AMZN191220C01900000	Dec.20.2019	calls	Out
## 160	AMZN	AMZN191220C01910000	Dec.20.2019	calls	Out
## 161	AMZN	AMZN191220P01735000	Dec.20.2019	puts	In
## 162	AMZN	AMZN191220P01740000	Dec.20.2019	puts	In
## 163	AMZN	AMZN191220P01745000	Dec.20.2019	puts	In
## 164	AMZN	AMZN191220P01750000	Dec.20.2019	puts	In
## 165	AMZN	AMZN191220P01755000	Dec.20.2019	puts	In
## 166	AMZN	AMZN191220P01760000	Dec.20.2019	puts	In
## 167	AMZN	AMZN191220P01765000	Dec.20.2019	puts	In
## 168	AMZN	AMZN191220P01770000	Dec.20.2019	puts	In

## 169	AMZN	AMZN191220P01775000	Dec.20.2019	puts	In
## 170	AMZN	AMZN191220P01780000	Dec.20.2019	puts	In
## 171	AMZN	AMZN191220P01785000	Dec.20.2019	puts	In
## 172	AMZN	AMZN191220P01790000	Dec.20.2019	puts	In
## 173	AMZN	AMZN191220P01795000	Dec.20.2019	puts	In
## 174	AMZN	AMZN191220P01800000	Dec.20.2019	puts	In
## 175	AMZN	AMZN191220P01805000	Dec.20.2019	puts	In
## 176	AMZN	AMZN191220P01810000	Dec.20.2019	puts	In
## 177	AMZN	AMZN191220P01815000	Dec.20.2019	puts	In
## 178	AMZN	AMZN191220P01820000	Dec.20.2019	puts	Out
## 179	AMZN	AMZN191220P01825000	Dec.20.2019	puts	Out
## 180	AMZN	AMZN191220P01830000	Dec.20.2019	puts	Out
## 181	AMZN	AMZN191220P01835000	Dec.20.2019	puts	Out
## 182	AMZN	AMZN191220P01840000	Dec.20.2019	puts	Out
## 183	AMZN	AMZN191220P01845000	Dec.20.2019	puts	Out
## 184	AMZN	AMZN191220P01850000	Dec.20.2019	puts	Out
## 185	AMZN	AMZN191220P01855000	Dec.20.2019	puts	Out
## 186	AMZN	AMZN191220P01860000	Dec.20.2019	puts	Out
## 187	AMZN	AMZN191220P01865000	Dec.20.2019	puts	Out
## 188	AMZN	AMZN191220P01870000	Dec.20.2019	puts	Out
## 189	AMZN	AMZN191220P01880000	Dec.20.2019	puts	Out
## 190	AMZN	AMZN191220P01885000	Dec.20.2019	puts	Out
## 191	AMZN	AMZN191220P01890000	Dec.20.2019	puts	Out
## 192	AMZN	AMZN191220P01895000	Dec.20.2019	puts	Out
## 193	AMZN	AMZN191220P01900000	Dec.20.2019	puts	Out
## 194	AMZN	AMZN191220P01910000	Dec.20.2019	puts	Out
## 195	BA	BA191018C00370000	Oct.18.2019	calls	In
## 196	BA	BA191018C00375000	Oct.18.2019	calls	In
## 197	BA	BA191018C00380000	Oct.18.2019	calls	In
## 198	BA	BA191018C00385000	Oct.18.2019	calls	In
## 199	BA	BA191018C00390000	Oct.18.2019	calls	Out
## 200	BA	BA191018C00395000	Oct.18.2019	calls	Out
## 201	BA	BA191018C00400000	Oct.18.2019	calls	Out
## 202	BA	BA191018C00405000	Oct.18.2019	calls	Out
## 203	BA	BA191018P00370000	Oct.18.2019	puts	In
## 204	BA	BA191018P00375000	Oct.18.2019	puts	In
## 205	BA	BA191018P00380000	Oct.18.2019	puts	In
## 206	BA	BA191018P00385000	Oct.18.2019	puts	In
## 207	BA	BA191018P00390000	Oct.18.2019	puts	Out
## 208	BA	BA191018P00395000	Oct.18.2019	puts	Out
## 209	BA	BA191018P00400000	Oct.18.2019	puts	Out
## 210	BA	BA191018P00405000	Oct.18.2019	puts	Out
## 211	BA	BA191115C00370000	Nov.15.2019	calls	In
## 212	BA	BA191115C00375000	Nov.15.2019	calls	In
## 213	BA	BA191115C00380000	Nov.15.2019	calls	In
## 214	BA	BA191115C00385000	Nov.15.2019	calls	In
## 215	BA	BA191115C00390000	Nov.15.2019	calls	Out
## 216	BA	BA191115C00395000	Nov.15.2019	calls	Out
## 217	BA	BA191115C00400000	Nov.15.2019	calls	Out
## 218	BA	BA191115C00405000	Nov.15.2019	calls	Out

## 219	BA	BA191115P00370000	Nov.15.2019	puts	In
## 220	BA	BA191115P00375000	Nov.15.2019	puts	In
## 221	BA	BA191115P00380000	Nov.15.2019	puts	In
## 222	BA	BA191115P00385000	Nov.15.2019	puts	In
## 223	BA	BA191115P00390000	Nov.15.2019	puts	Out
## 224	BA	BA191115P00395000	Nov.15.2019	puts	Out
## 225	BA	BA191115P00400000	Nov.15.2019	puts	Out
## 226	BA	BA191115P00405000	Nov.15.2019	puts	Out
## 227	SPY	SPY191018C00287000	Oct.18.2019	calls	In
## 228	SPY	SPY191018C00288000	Oct.18.2019	calls	In
## 229	SPY	SPY191018C00289000	Oct.18.2019	calls	In
## 230	SPY	SPY191018C00290000	Oct.18.2019	calls	In
## 231	SPY	SPY191018C00291000	Oct.18.2019	calls	In
## 232	SPY	SPY191018C00292000	Oct.18.2019	calls	In
## 233	SPY	SPY191018C00293000	Oct.18.2019	calls	In
## 234	SPY	SPY191018C00294000	Oct.18.2019	calls	In
## 235	SPY	SPY191018C00295000	Oct.18.2019	calls	In
## 236	SPY	SPY191018C00296000	Oct.18.2019	calls	In
## 237	SPY	SPY191018C00297000	Oct.18.2019	calls	In
## 238	SPY	SPY191018C00298000	Oct.18.2019	calls	In
## 239	SPY	SPY191018C00299000	Oct.18.2019	calls	In
## 240	SPY	SPY191018C00300000	Oct.18.2019	calls	In
## 241	SPY	SPY191018C00301000	Oct.18.2019	calls	In
## 242	SPY	SPY191018C00302000	Oct.18.2019	calls	Out
## 243	SPY	SPY191018C00303000	Oct.18.2019	calls	Out
## 244	SPY	SPY191018C00304000	Oct.18.2019	calls	Out
## 245	SPY	SPY191018C00305000	Oct.18.2019	calls	Out
## 246	SPY	SPY191018C00306000	Oct.18.2019	calls	Out
## 247	SPY	SPY191018C00307000	Oct.18.2019	calls	Out
## 248	SPY	SPY191018C00308000	Oct.18.2019	calls	Out
## 249	SPY	SPY191018C00309000	Oct.18.2019	calls	Out
## 250	SPY	SPY191018C00310000	Oct.18.2019	calls	Out
## 251	SPY	SPY191018C00311000	Oct.18.2019	calls	Out
## 252	SPY	SPY191018C00312000	Oct.18.2019	calls	Out
## 253	SPY	SPY191018C00313000	Oct.18.2019	calls	Out
## 254	SPY	SPY191018C00314000	Oct.18.2019	calls	Out
## 255	SPY	SPY191018C00315000	Oct.18.2019	calls	Out
## 256	SPY	SPY191018C00316000	Oct.18.2019	calls	Out
## 257	SPY	SPY191018P00287000	Oct.18.2019	puts	In
## 258	SPY	SPY191018P00288000	Oct.18.2019	puts	In
## 259	SPY	SPY191018P00289000	Oct.18.2019	puts	In
## 260	SPY	SPY191018P00290000	Oct.18.2019	puts	In
## 261	SPY	SPY191018P00291000	Oct.18.2019	puts	In
## 262	SPY	SPY191018P00292000	Oct.18.2019	puts	In
## 263	SPY	SPY191018P00293000	Oct.18.2019	puts	In
## 264	SPY	SPY191018P00294000	Oct.18.2019	puts	In
## 265	SPY	SPY191018P00295000	Oct.18.2019	puts	In
## 266	SPY	SPY191018P00296000	Oct.18.2019	puts	In
## 267	SPY	SPY191018P00297000	Oct.18.2019	puts	In
## 268	SPY	SPY191018P00298000	Oct.18.2019	puts	In

## 269	SPY	SPY191018P00299000	Oct.18.2019	puts	In
## 270	SPY	SPY191018P00300000	Oct.18.2019	puts	In
## 271	SPY	SPY191018P00301000	Oct.18.2019	puts	In
## 272	SPY	SPY191018P00302000	Oct.18.2019	puts	Out
## 273	SPY	SPY191018P00303000	Oct.18.2019	puts	Out
## 274	SPY	SPY191018P00304000	Oct.18.2019	puts	Out
## 275	SPY	SPY191018P00305000	Oct.18.2019	puts	Out
## 276	SPY	SPY191018P00306000	Oct.18.2019	puts	Out
## 277	SPY	SPY191018P00307000	Oct.18.2019	puts	Out
## 278	SPY	SPY191018P00308000	Oct.18.2019	puts	Out
## 279	SPY	SPY191018P00309000	Oct.18.2019	puts	Out
## 280	SPY	SPY191018P00310000	Oct.18.2019	puts	Out
## 281	SPY	SPY191018P00311000	Oct.18.2019	puts	Out
## 282	SPY	SPY191018P00312000	Oct.18.2019	puts	Out
## 283	SPY	SPY191018P00313000	Oct.18.2019	puts	Out
## 284	SPY	SPY191018P00314000	Oct.18.2019	puts	Out
## 285	SPY	SPY191018P00315000	Oct.18.2019	puts	Out
## 286	SPY	SPY191018P00316000	Oct.18.2019	puts	Out
## 287	SPY	SPY191115C00287000	Nov.15.2019	calls	In
## 288	SPY	SPY191115C00288000	Nov.15.2019	calls	In
## 289	SPY	SPY191115C00289000	Nov.15.2019	calls	In
## 290	SPY	SPY191115C00290000	Nov.15.2019	calls	In
## 291	SPY	SPY191115C00291000	Nov.15.2019	calls	In
## 292	SPY	SPY191115C00292000	Nov.15.2019	calls	In
## 293	SPY	SPY191115C00293000	Nov.15.2019	calls	In
## 294	SPY	SPY191115C00294000	Nov.15.2019	calls	In
## 295	SPY	SPY191115C00295000	Nov.15.2019	calls	In
## 296	SPY	SPY191115C00296000	Nov.15.2019	calls	In
## 297	SPY	SPY191115C00297000	Nov.15.2019	calls	In
## 298	SPY	SPY191115C00298000	Nov.15.2019	calls	In
## 299	SPY	SPY191115C00299000	Nov.15.2019	calls	In
## 300	SPY	SPY191115C00300000	Nov.15.2019	calls	In
## 301	SPY	SPY191115C00301000	Nov.15.2019	calls	In
## 302	SPY	SPY191115C00302000	Nov.15.2019	calls	Out
## 303	SPY	SPY191115C00303000	Nov.15.2019	calls	Out
## 304	SPY	SPY191115C00304000	Nov.15.2019	calls	Out
## 305	SPY	SPY191115C00305000	Nov.15.2019	calls	Out
## 306	SPY	SPY191115C00306000	Nov.15.2019	calls	Out
## 307	SPY	SPY191115C00307000	Nov.15.2019	calls	Out
## 308	SPY	SPY191115C00308000	Nov.15.2019	calls	Out
## 309	SPY	SPY191115C00309000	Nov.15.2019	calls	Out
## 310	SPY	SPY191115C00310000	Nov.15.2019	calls	Out
## 311	SPY	SPY191115C00311000	Nov.15.2019	calls	Out
## 312	SPY	SPY191115C00312000	Nov.15.2019	calls	Out
## 313	SPY	SPY191115C00313000	Nov.15.2019	calls	Out
## 314	SPY	SPY191115C00314000	Nov.15.2019	calls	Out
## 315	SPY	SPY191115C00315000	Nov.15.2019	calls	Out
## 316	SPY	SPY191115C00316000	Nov.15.2019	calls	Out
## 317	SPY	SPY191115P00287000	Nov.15.2019	puts	In
## 318	SPY	SPY191115P00288000	Nov.15.2019	puts	In

## 319	SPY	SPY191115P00289000	Nov.15.2019	puts	In
## 320	SPY	SPY191115P00290000	Nov.15.2019	puts	In
## 321	SPY	SPY191115P00291000	Nov.15.2019	puts	In
## 322	SPY	SPY191115P00292000	Nov.15.2019	puts	In
## 323	SPY	SPY191115P00293000	Nov.15.2019	puts	In
## 324	SPY	SPY191115P00294000	Nov.15.2019	puts	In
## 325	SPY	SPY191115P00295000	Nov.15.2019	puts	In
## 326	SPY	SPY191115P00296000	Nov.15.2019	puts	In
## 327	SPY	SPY191115P00297000	Nov.15.2019	puts	In
## 328	SPY	SPY191115P00298000	Nov.15.2019	puts	In
## 329	SPY	SPY191115P00299000	Nov.15.2019	puts	In
## 330	SPY	SPY191115P00300000	Nov.15.2019	puts	In
## 331	SPY	SPY191115P00301000	Nov.15.2019	puts	In
## 332	SPY	SPY191115P00302000	Nov.15.2019	puts	Out
## 333	SPY	SPY191115P00303000	Nov.15.2019	puts	Out
## 334	SPY	SPY191115P00304000	Nov.15.2019	puts	Out
## 335	SPY	SPY191115P00305000	Nov.15.2019	puts	Out
## 336	SPY	SPY191115P00306000	Nov.15.2019	puts	Out
## 337	SPY	SPY191115P00307000	Nov.15.2019	puts	Out
## 338	SPY	SPY191115P00308000	Nov.15.2019	puts	Out
## 339	SPY	SPY191115P00309000	Nov.15.2019	puts	Out
## 340	SPY	SPY191115P00310000	Nov.15.2019	puts	Out
## 341	SPY	SPY191115P00311000	Nov.15.2019	puts	Out
## 342	SPY	SPY191115P00312000	Nov.15.2019	puts	Out
## 343	SPY	SPY191115P00313000	Nov.15.2019	puts	Out
## 344	SPY	SPY191115P00314000	Nov.15.2019	puts	Out
## 345	SPY	SPY191115P00315000	Nov.15.2019	puts	Out
## 346	SPY	SPY191115P00316000	Nov.15.2019	puts	Out
## 347	SPY	SPY191220C00287000	Dec.20.2019	calls	In
## 348	SPY	SPY191220C00288000	Dec.20.2019	calls	In
## 349	SPY	SPY191220C00289000	Dec.20.2019	calls	In
## 350	SPY	SPY191220C00290000	Dec.20.2019	calls	In
## 351	SPY	SPY191220C00291000	Dec.20.2019	calls	In
## 352	SPY	SPY191220C00292000	Dec.20.2019	calls	In
## 353	SPY	SPY191220C00293000	Dec.20.2019	calls	In
## 354	SPY	SPY191220C00294000	Dec.20.2019	calls	In
## 355	SPY	SPY191220C00295000	Dec.20.2019	calls	In
## 356	SPY	SPY191220C00296000	Dec.20.2019	calls	In
## 357	SPY	SPY191220C00297000	Dec.20.2019	calls	In
## 358	SPY	SPY191220C00298000	Dec.20.2019	calls	In
## 359	SPY	SPY191220C00299000	Dec.20.2019	calls	In
## 360	SPY	SPY191220C00300000	Dec.20.2019	calls	In
## 361	SPY	SPY191220C00301000	Dec.20.2019	calls	In
## 362	SPY	SPY191220C00302000	Dec.20.2019	calls	Out
## 363	SPY	SPY191220C00303000	Dec.20.2019	calls	Out
## 364	SPY	SPY191220C00304000	Dec.20.2019	calls	Out
## 365	SPY	SPY191220C00305000	Dec.20.2019	calls	Out
## 366	SPY	SPY191220C00306000	Dec.20.2019	calls	Out
## 367	SPY	SPY191220C00307000	Dec.20.2019	calls	Out
## 368	SPY	SPY191220C00308000	Dec.20.2019	calls	Out

## 369	SPY	SPY191220C00309000	Dec.20.2019	calls	Out
## 370	SPY	SPY191220C00310000	Dec.20.2019	calls	Out
## 371	SPY	SPY191220C00311000	Dec.20.2019	calls	Out
## 372	SPY	SPY191220C00312000	Dec.20.2019	calls	Out
## 373	SPY	SPY191220C00313000	Dec.20.2019	calls	Out
## 374	SPY	SPY191220C00314000	Dec.20.2019	calls	Out
## 375	SPY	SPY191220C00315000	Dec.20.2019	calls	Out
## 376	SPY	SPY191220C00316000	Dec.20.2019	calls	Out
## 377	SPY	SPY191220P00287000	Dec.20.2019	puts	In
## 378	SPY	SPY191220P00288000	Dec.20.2019	puts	In
## 379	SPY	SPY191220P00289000	Dec.20.2019	puts	In
## 380	SPY	SPY191220P00290000	Dec.20.2019	puts	In
## 381	SPY	SPY191220P00291000	Dec.20.2019	puts	In
## 382	SPY	SPY191220P00292000	Dec.20.2019	puts	In
## 383	SPY	SPY191220P00293000	Dec.20.2019	puts	In
## 384	SPY	SPY191220P00294000	Dec.20.2019	puts	In
## 385	SPY	SPY191220P00295000	Dec.20.2019	puts	In
## 386	SPY	SPY191220P00296000	Dec.20.2019	puts	In
## 387	SPY	SPY191220P00297000	Dec.20.2019	puts	In
## 388	SPY	SPY191220P00298000	Dec.20.2019	puts	In
## 389	SPY	SPY191220P00299000	Dec.20.2019	puts	In
## 390	SPY	SPY191220P00300000	Dec.20.2019	puts	In
## 391	SPY	SPY191220P00301000	Dec.20.2019	puts	In
## 392	SPY	SPY191220P00302000	Dec.20.2019	puts	Out
## 393	SPY	SPY191220P00303000	Dec.20.2019	puts	Out
## 394	SPY	SPY191220P00304000	Dec.20.2019	puts	Out
## 395	SPY	SPY191220P00305000	Dec.20.2019	puts	Out
## 396	SPY	SPY191220P00306000	Dec.20.2019	puts	Out
## 397	SPY	SPY191220P00307000	Dec.20.2019	puts	Out
## 398	SPY	SPY191220P00308000	Dec.20.2019	puts	Out
## 399	SPY	SPY191220P00309000	Dec.20.2019	puts	Out
## 400	SPY	SPY191220P00310000	Dec.20.2019	puts	Out
## 401	SPY	SPY191220P00311000	Dec.20.2019	puts	Out
## 402	SPY	SPY191220P00312000	Dec.20.2019	puts	Out
## 403	SPY	SPY191220P00313000	Dec.20.2019	puts	Out
## 404	SPY	SPY191220P00314000	Dec.20.2019	puts	Out
## 405	SPY	SPY191220P00315000	Dec.20.2019	puts	Out
## 406	SPY	SPY191220P00316000	Dec.20.2019	puts	Out

##	Imp.Vol.	Avg.Imp.Vol	VIX
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## 4	0.270318226683354	0.234951757359371	0.1395
## 5	0.268236817662393	0.234951757359371	0.1395
## 6	0.266433189479149	0.234951757359371	0.1395
## 7	0.264723703755527	0.234951757359371	0.1395
## 8	0.262766099585249	0.234951757359371	0.1395
## 9	0.261023585041051	0.234951757359371	0.1395
## 10	0.259173595202917	0.234951757359371	0.1395
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296 0.148548772580253 0.234951757359371 0.1405
297 0.145762268198152 0.234951757359371 0.1405
298 0.143341305214915 0.234951757359371 0.1405
299 0.140982202574071 0.234951757359371 0.1405
300 0.138403279247239 0.234951757359371 0.1405
301 0.135938362866951 0.234951757359371 0.1405
302 0.133308380103241 0.217969219313299 0.1405
303 0.130839583724386 0.217969219313299 0.1405
304 0.128376998392102 0.217969219313299 0.1405
305 0.126134556126214 0.217969219313299 0.1405
306 0.123845157078197 0.217969219313299 0.1405
307 0.121744475871728 0.217969219313299 0.1405
308 0.119807544194368 0.217969219313299 0.1405
309 0.11793903815656 0.217969219313299 0.1405
310 0.116434273482286 0.217969219313299 0.1405
311 0.115060527882313 0.217969219313299 0.1405
312 0.114043383394991 0.217969219313299 0.1405

313 0.113149750548956 0.217969219313299 0.1405
314 0.112472729848198 0.217969219313299 0.1405
315 0.112148109102851 0.217969219313299 0.1405
316 0.111806603714013 0.217969219313299 0.1405
317 0.206698536697505 0.234951757359371 0.1405
318 0.203850327594017 0.234951757359371 0.1405
319 0.200995897408168 0.234951757359371 0.1405
320 0.19826251906031 0.234951757359371 0.1405
321 0.195193731280211 0.234951757359371 0.1405
322 0.192372555213632 0.234951757359371 0.1405
323 0.189434622770562 0.234951757359371 0.1405
324 0.186531877317061 0.234951757359371 0.1405
325 0.183508621336356 0.234951757359371 0.1405
326 0.18060326676934 0.234951757359371 0.1405
327 0.177659085656741 0.234951757359371 0.1405
328 0.174776630948402 0.234951757359371 0.1405
329 0.171927781214531 0.234951757359371 0.1405
330 0.169207206015924 0.234951757359371 0.1405
331 0.166586440229868 0.234951757359371 0.1405
332 0.164159901405922 0.217969219313299 0.1405
333 0.161903705024291 0.217969219313299 0.1405
334 0.160040306612492 0.217969219313299 0.1405
335 0.157950446040228 0.217969219313299 0.1405
336 0.156724341788961 0.217969219313299 0.1405
337 0.155889125269676 0.217969219313299 0.1405
338 0.155340763122231 0.217969219313299 0.1405
339 0.155369228852785 0.217969219313299 0.1405
340 0.157076223108672 0.217969219313299 0.1405
341 0.157218883959928 0.217969219313299 0.1405
342 0.159216839509495 0.217969219313299 0.1405
343 0.161952387075755 0.217969219313299 0.1405
344 0.165521188797222 0.217969219313299 0.1405
345 0.168947688808688 0.217969219313299 0.1405
346 0.173509005718292 0.217969219313299 0.1405
347 0.182709425292415 0.234951757359371 0.1532
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349 0.178955913719578 0.234951757359371 0.1532
350 0.177162017573252 0.234951757359371 0.1532
351 0.17510676233279 0.234951757359371 0.1532
352 0.173137792605839 0.234951757359371 0.1532
353 0.170983214823823 0.234951757359371 0.1532
354 0.168875340407472 0.234951757359371 0.1532
355 0.166695065796889 0.234951757359371 0.1532
356 0.164431703945822 0.234951757359371 0.1532
357 0.162174138524747 0.234951757359371 0.1532
358 0.159808551766665 0.234951757359371 0.1532
359 0.157420871474297 0.234951757359371 0.1532
360 0.155189587552679 0.234951757359371 0.1532
361 0.153769575458326 0.234951757359371 0.1532
362 0.150259079285005 0.217969219313299 0.1532

```

## 363 0.148009382064373 0.217969219313299 0.1532
## 364 0.145561473863718 0.217969219313299 0.1532
## 365 0.143282532211804 0.217969219313299 0.1532
## 366 0.141062156197044 0.217969219313299 0.1532
## 367 0.138789042261665 0.217969219313299 0.1532
## 368 0.136746079053975 0.217969219313299 0.1532
## 369 0.134629303233272 0.217969219313299 0.1532
## 370 0.132633624141204 0.217969219313299 0.1532
## 371 0.13072769558139 0.217969219313299 0.1532
## 372 0.129067036526084 0.217969219313299 0.1532
## 373 0.12742993350985 0.217969219313299 0.1532
## 374 0.125821338317256 0.217969219313299 0.1532
## 375 0.124625266292326 0.217969219313299 0.1532
## 376 0.123390445822081 0.217969219313299 0.1532
## 377 0.218362519862627 0.234951757359371 0.1532
## 378 0.216075151265227 0.234951757359371 0.1532
## 379 0.214002679712136 0.234951757359371 0.1532
## 380 0.211716424716147 0.234951757359371 0.1532
## 381 0.209431535679558 0.234951757359371 0.1532
## 382 0.207033681691193 0.234951757359371 0.1532
## 383 0.204829470537019 0.234951757359371 0.1532
## 384 0.202494603308435 0.234951757359371 0.1532
## 385 0.20022662587779 0.234951757359371 0.1532
## 386 0.198013451890945 0.234951757359371 0.1532
## 387 0.195744751020527 0.234951757359371 0.1532
## 388 0.193608374332271 0.234951757359371 0.1532
## 389 0.191396801526862 0.234951757359371 0.1532
## 390 0.189295303311699 0.234951757359371 0.1532
## 391 0.187196286087268 0.234951757359371 0.1532
## 392 0.185282258561775 0.217969219313299 0.1532
## 393 0.183447373657125 0.217969219313299 0.1532
## 394 0.18168351132304 0.217969219313299 0.1532
## 395 0.180175602836669 0.217969219313299 0.1532
## 396 0.178341469537184 0.217969219313299 0.1532
## 397 0.177043105572798 0.217969219313299 0.1532
## 398 0.175895994561046 0.217969219313299 0.1532
## 399 0.175198325285134 0.217969219313299 0.1532
## 400 0.174565707320986 0.217969219313299 0.1532
## 401 0.174003384398557 0.217969219313299 0.1532
## 402 0.174135104709138 0.217969219313299 0.1532
## 403 0.174269624149184 0.217969219313299 0.1532
## 404 0.175028317241758 0.217969219313299 0.1532
## 405 0.175627494656367 0.217969219313299 0.1532
## 406 0.176825937903311 0.217969219313299 0.1532

```

#Comment on report observations (problem 1 part 7)

cat('AMZN implied vol ranges from 0.21 to 0.31; BA implied vol ranges from 0.25 to 0.33;

SPY implied vol ranges from 0.09 to 0.20. VIX value is ~0.15 which is much less than implied vol of AMZN and BA

and is almost the average of SPYs implied vol. From the report, it is evident that implied volatility increases as time to maturity increases. When the option strike price increases, the option transitions from in the money to out of the money and the implied volatility decreases')

AMZN implied vol ranges from 0.21 to 0.31; BA implied vol ranges from 0.25 to 0.33;

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and is almost the average of SPYs implied vol. From the report, it is evident that implied volatility increases

as time to maturity increases. When the option strike price increases, the option transitions from

in the money to out of the money and the implied volatility decreases

#Problem 1 part 8

#Create empty computed option price column for DATA2

```
a = 1
for (OpCh in DATA2) {
  b = 1
  for (item in OpCh) {
    c = 1
    for (callput in item) {
      Comp.Op.Price <- matrix(NA, nrow = nrow(callput), ncol = 1, byrow = TRUE)
      callput <- cbind(callput, Comp.Op.Price)
      item[[c]] <- callput
      c = c+1
    }
    OpCh[[b]] = item
    b = b+1
  }
  DATA2[[a]] = OpCh
  a = a+1
}
```

#Compute Option Price using Black Scholes

```
a = 1
op.type <- names(DATA2$AMZNopCh20190920$Oct.20.2019)
maturity <- names(DATA2$AMZNopCh20190920)
for (OpCh in DATA2) {
  if (a==1) {
    Spot = AMZN[3,4]
    Date1 <- as.Date(index(AMZN[3]), format = '%Y-%m-%d')
  }
  if (a==2) {
    Spot = BA[3,4]
    Date1 <- as.Date(index(BA[3]), format = '%Y-%m-%d')
  }
  if (a==3) {
```

```

Spot = SPY[3,4]
Date1 <- as.Date(index(SPY[3]),format = '%Y-%m-%d')
}
b=1
for (item in OpCh) {
  c=1
  Date2 <- as.Date(names(OpCh[b]),format = '%b.%d.%Y')
  t = abs(Nweekdays(Date1,Date2))/360
  for (callput in item) {
    for (row in 1:dim(callput)[1]) {
      #Compute Option Price for each strike price
      sig <- DATA1[[a]][[b]][[c]]$IV[row]
      if(is.na(sig)==TRUE)
        next
      callput$Comp.Op.Price[row] = BSEuro(as.numeric(callput$Strike[row]),a
s.numeric(Spot),rate20190920,sig,t,names(item)[c])
    }
    item[[c]] <- na.omit(callput) #delete rows with NA
    c=c+1
  }
  OpCh[[b]] = item
  b=b+1
}
DATA2[[a]] = OpCh
a=a+1
}

```

#Display DATA2 with computed Black Scholes option price
DATA2

```

## $AMZNopCh20190920
## $AMZNopCh20190920$Oct.18.2019
## $AMZNopCh20190920$Oct.18.2019$calls
##           Strike Last      Chg  Bid  Ask Vol  OI
## AMZN191018C01735000  1735 82.40 -29.199997 81.65 83.35 1 86
## AMZN191018C01740000  1740 79.07 -22.180000 77.95 79.70 5 112
## AMZN191018C01745000  1745 75.56 -24.470001 71.00 78.60 22 170
## AMZN191018C01750000  1750 71.90 -22.299995 70.70 72.05 64 914
## AMZN191018C01755000  1755 75.15 0.000000 67.45 68.50 4 121
## AMZN191018C01760000  1760 61.95 -27.200000 63.80 65.40 66 172
## AMZN191018C01765000  1765 61.50 -7.750000 60.65 62.10 1 97
## AMZN191018C01770000  1770 59.51 -23.410000 57.40 58.85 24 266
## AMZN191018C01775000  1775 55.00 -19.290000 54.55 55.45 9 382
## AMZN191018C01780000  1780 51.95 -23.240002 51.35 52.75 46 236
## AMZN191018C01785000  1785 49.20 -17.749996 48.30 49.75 72 160
## AMZN191018C01790000  1790 46.00 -17.180000 45.60 46.50 67 192
## AMZN191018C01795000  1795 43.40 -20.300000 42.80 43.90 71 182
## AMZN191018C01800000  1800 41.40 -15.599998 40.00 43.65 1298 3844
## AMZN191018C01805000  1805 38.85 -16.450000 34.65 40.45 275 487
## AMZN191018C01810000  1810 35.60 -16.000000 35.35 35.95 146 289

```

##	AMZN191018C01815000	1815	33.60	-14.190002	32.85	33.55	40	364
##	AMZN191018C01820000	1820	31.05	-13.580002	30.25	33.90	396	798
##	AMZN191018C01825000	1825	26.91	-15.270000	28.55	29.40	263	382
##	AMZN191018C01830000	1830	25.45	-13.969997	26.10	26.95	205	1407
##	AMZN191018C01835000	1835	25.00	-11.820000	21.80	27.50	101	1768
##	AMZN191018C01840000	1840	21.50	-12.680000	22.35	23.35	262	1171
##	AMZN191018C01845000	1845	20.82	-11.730000	18.50	23.00	99	108
##	AMZN191018C01850000	1850	19.50	-10.650000	19.25	19.60	556	1466
##	AMZN191018C01855000	1855	17.68	-9.869999	17.45	18.25	91	225
##	AMZN191018C01860000	1860	16.52	-9.180000	16.15	16.70	258	425
##	AMZN191018C01865000	1865	14.50	-9.750000	14.80	15.35	38	180
##	AMZN191018C01870000	1870	12.90	-9.300001	13.30	14.15	67	415
##	AMZN191018C01875000	1875	12.00	-8.549999	12.35	12.80	80	214
##	AMZN191018C01880000	1880	10.94	-8.260001	10.20	12.75	111	429
##	AMZN191018C01885000	1885	10.10	-7.199999	10.00	10.70	39	206
##	AMZN191018C01890000	1890	8.90	-6.950001	8.15	9.75	94	445
##	AMZN191018C01895000	1895	8.83	-5.430000	8.25	8.90	43	499
##	AMZN191018C01900000	1900	8.10	-5.000000	7.40	8.10	785	4314
##	AMZN191018C01905000	1905	6.76	-5.590000	7.00	7.30	78	466
##	AMZN191018C01910000	1910	6.91	-3.890000	6.10	6.85	54	539
##		Comp.Op.Price						
##	AMZN191018C01735000	83.35	8569					
##	AMZN191018C01740000	79.68	0761					
##	AMZN191018C01745000	76.03	9201					
##	AMZN191018C01750000	72.46	0347					
##	AMZN191018C01755000	68.99	5899					
##	AMZN191018C01760000	65.62	0574					
##	AMZN191018C01765000	62.28	0848					
##	AMZN191018C01770000	59.05	4681					
##	AMZN191018C01775000	55.89	1084					
##	AMZN191018C01780000	52.84	0095					
##	AMZN191018C01785000	49.85	1402					
##	AMZN191018C01790000	46.85	1711					
##	AMZN191018C01795000	44.15	9209					
##	AMZN191018C01800000	41.35	8268					
##	AMZN191018C01805000	38.74	0242					
##	AMZN191018C01810000	36.34	9372					
##	AMZN191018C01815000	34.01	7227					
##	AMZN191018C01820000	31.67	4595					
##	AMZN191018C01825000	29.39	2749					
##	AMZN191018C01830000	27.19	4733					
##	AMZN191018C01835000	25.23	6746					
##	AMZN191018C01840000	23.22	5425					
##	AMZN191018C01845000	21.53	6078					
##	AMZN191018C01850000	19.81	4400					
##	AMZN191018C01855000	18.21	2762					
##	AMZN191018C01860000	16.72	8805					
##	AMZN191018C01865000	15.31	8797					
##	AMZN191018C01870000	14.06	2360					
##	AMZN191018C01875000	12.77						

##	AMZN191018C01880000	11.699856					
##	AMZN191018C01885000	10.593145					
##	AMZN191018C01890000	9.612592					
##	AMZN191018C01895000	8.773188					
##	AMZN191018C01900000	7.792216					
##	AMZN191018C01905000	7.024639					
##	AMZN191018C01910000	6.336419					
##							
##	\$AMZNopCh20190920\$Oct.18.2019\$puts						
##		Strike	Last	Chg	Bid	Ask	Vol OI
##	AMZN191018P01735000	1735	22.69	8.410001	20.50	21.10	26 349
##	AMZN191018P01740000	1740	22.62	8.270000	21.70	22.35	70 760
##	AMZN191018P01745000	1745	24.11	7.870001	22.40	26.15	61 300
##	AMZN191018P01750000	1750	26.34	9.040001	24.15	25.15	247 1963
##	AMZN191018P01755000	1755	27.89	10.189999	25.85	26.75	33 281
##	AMZN191018P01760000	1760	28.57	9.740000	27.65	28.40	109 843
##	AMZN191018P01765000	1765	30.10	10.500000	29.30	30.05	105 291
##	AMZN191018P01770000	1770	31.52	8.920000	31.10	32.05	145 335
##	AMZN191018P01775000	1775	34.99	12.070002	32.95	33.80	127 294
##	AMZN191018P01780000	1780	35.03	8.529999	34.90	35.60	125 342
##	AMZN191018P01785000	1785	40.13	14.730001	36.45	37.75	29 103
##	AMZN191018P01790000	1790	39.29	11.040001	38.50	39.70	142 285
##	AMZN191018P01795000	1795	44.30	14.439999	39.50	44.95	69 179
##	AMZN191018P01800000	1800	43.69	11.789999	43.05	44.30	1675 3439
##	AMZN191018P01805000	1805	46.30	12.849998	45.75	46.85	23 317
##	AMZN191018P01810000	1810	49.13	13.760002	48.15	49.65	80 286
##	AMZN191018P01815000	1815	52.02	16.770000	50.65	52.05	49 324
##	AMZN191018P01820000	1820	54.57	14.590000	53.30	54.85	92 285
##	AMZN191018P01825000	1825	59.40	17.500000	56.10	57.55	81 263
##	AMZN191018P01830000	1830	63.60	20.949997	59.00	60.70	82 477
##	AMZN191018P01835000	1835	68.25	22.700000	62.55	63.90	11 308
##	AMZN191018P01840000	1840	68.38	19.229996	65.45	66.90	13 258
##	AMZN191018P01845000	1845	69.06	17.609997	68.65	70.20	123 145
##	AMZN191018P01850000	1850	72.51	19.810001	72.05	73.75	272 891
##	AMZN191018P01855000	1855	75.82	9.620003	75.15	76.85	1 114
##	AMZN191018P01860000	1860	85.15	26.650002	78.70	83.95	18 167
##	AMZN191018P01865000	1865	84.06	19.689995	82.35	84.35	42 104
##	AMZN191018P01870000	1870	79.80	14.480003	86.10	87.95	7 383
##	AMZN191018P01875000	1875	78.24	11.349998	90.10	92.05	3 169
##	AMZN191018P01880000	1880	93.60	14.599998	94.25	96.10	59 617
##	AMZN191018P01885000	1885	102.40	19.849998	97.85	99.85	6 116
##	AMZN191018P01890000	1890	105.20	24.289993	102.00	104.00	56 1037
##	AMZN191018P01895000	1895	103.00	0.000000	106.15	108.20	1 980
##	AMZN191018P01900000	1900	112.37	24.830002	110.60	112.90	45 657
##	AMZN191018P01905000	1905	99.20	0.000000	114.70	116.85	3 93
##	AMZN191018P01910000	1910	125.27	32.070000	119.40	121.70	1 244
##		Comp.Op.Price					
##	AMZN191018P01735000	20.82802					
##	AMZN191018P01740000	22.18578					
##	AMZN191018P01745000	23.55339					

## AMZN191018P01750000	24.93188
## AMZN191018P01755000	26.55545
## AMZN191018P01760000	28.16359
## AMZN191018P01765000	29.78456
## AMZN191018P01770000	31.56956
## AMZN191018P01775000	33.49292
## AMZN191018P01780000	35.32830
## AMZN191018P01785000	37.45124
## AMZN191018P01790000	39.48792
## AMZN191018P01795000	41.78337
## AMZN191018P01800000	43.99494
## AMZN191018P01805000	46.43757
## AMZN191018P01810000	48.94119
## AMZN191018P01815000	51.55293
## AMZN191018P01820000	54.43350
## AMZN191018P01825000	57.16473
## AMZN191018P01830000	59.98010
## AMZN191018P01835000	62.99072
## AMZN191018P01840000	66.12589
## AMZN191018P01845000	69.47027
## AMZN191018P01850000	72.67515
## AMZN191018P01855000	76.08694
## AMZN191018P01860000	79.72039
## AMZN191018P01865000	83.24032
## AMZN191018P01870000	87.05686
## AMZN191018P01875000	90.76317
## AMZN191018P01880000	94.63999
## AMZN191018P01885000	98.62385
## AMZN191018P01890000	102.63615
## AMZN191018P01895000	106.95677
## AMZN191018P01900000	111.15136
## AMZN191018P01905000	115.30001
## AMZN191018P01910000	119.76069

##

##

\$AMZNopCh20190920\$Nov.15.2019

\$AMZNopCh20190920\$Nov.15.2019\$calls

##	Strike	Last	Chg	Bid	Ask	Vol	OI
## AMZN191115C01740000	1740	109.08	-12.769997	109.55	110.65	3	43
## AMZN191115C01750000	1750	102.20	-20.700005	102.95	104.75	96	296
## AMZN191115C01755000	1755	101.10	-21.710000	99.85	101.70	5	3
## AMZN191115C01760000	1760	97.26	-21.320000	93.35	98.55	8	128
## AMZN191115C01765000	1765	96.84	-19.830002	94.10	95.20	1	2
## AMZN191115C01770000	1770	88.60	-19.400002	87.20	94.00	7	147
## AMZN191115C01775000	1775	106.47	0.000000	88.25	89.05	6	6
## AMZN191115C01780000	1780	86.02	-19.020004	85.05	86.55	91	239
## AMZN191115C01785000	1785	83.17	-9.330002	82.65	83.45	15	2
## AMZN191115C01790000	1790	80.50	-17.099998	79.30	81.10	1369	132
## AMZN191115C01795000	1795	77.40	-16.099998	76.45	78.20	22	30
## AMZN191115C01800000	1800	75.10	-14.599998	74.50	75.05	804	1328

##	AMZN191115C01805000	1805	72.20	-15.170006	71.45	72.75	36	13
##	AMZN191115C01810000	1810	67.65	-18.449997	67.10	70.30	136	196
##	AMZN191115C01815000	1815	67.15	-15.199997	66.45	67.60	12	49
##	AMZN191115C01820000	1820	64.78	-13.760002	62.40	67.15	143	568
##	AMZN191115C01825000	1825	62.40	-14.199997	61.60	63.05	10	12
##	AMZN191115C01830000	1830	59.43	-13.180000	59.65	60.30	74	424
##	AMZN191115C01835000	1835	55.77	-14.929996	57.30	58.10	13	101
##	AMZN191115C01840000	1840	54.80	-14.320004	54.90	56.15	47	249
##	AMZN191115C01845000	1845	58.90	-6.400002	51.10	55.75	3	24
##	AMZN191115C01850000	1850	50.85	-13.250000	50.50	52.00	114	2623
##	AMZN191115C01855000	1855	48.22	-15.480000	48.45	50.00	21	3
##	AMZN191115C01860000	1860	47.45	-13.399998	43.00	51.10	33	342
##	AMZN191115C01865000	1865	48.15	-11.299999	45.00	45.95	1	24

Comp.Op.Price

##	AMZN191115C01740000	109.87443
##	AMZN191115C01750000	103.67133
##	AMZN191115C01755000	100.23512
##	AMZN191115C01760000	96.74413
##	AMZN191115C01765000	93.44049
##	AMZN191115C01770000	90.19619
##	AMZN191115C01775000	86.64680
##	AMZN191115C01780000	84.07638
##	AMZN191115C01785000	81.22081
##	AMZN191115C01790000	78.68213
##	AMZN191115C01795000	76.09910
##	AMZN191115C01800000	73.16811
##	AMZN191115C01805000	70.21369
##	AMZN191115C01810000	67.59126
##	AMZN191115C01815000	65.33497
##	AMZN191115C01820000	62.57450
##	AMZN191115C01825000	60.39869
##	AMZN191115C01830000	58.05716
##	AMZN191115C01835000	55.91366
##	AMZN191115C01840000	53.74980
##	AMZN191115C01845000	51.56538
##	AMZN191115C01850000	49.28877
##	AMZN191115C01855000	47.11496
##	AMZN191115C01860000	44.98955
##	AMZN191115C01865000	43.31597

##

\$AMZNopCh20190920\$Nov.15.2019\$puts

##	Strike	Last	Chg	Bid	Ask	Vol	OI
##	AMZN191115P01700000	1700	38.53	8.029999	37.40	39.60	70 944
##	AMZN191115P01710000	1710	40.73	7.930000	38.50	42.70	62 215
##	AMZN191115P01720000	1720	43.77	7.970001	43.10	44.45	109 366
##	AMZN191115P01730000	1730	47.08	9.980003	46.20	50.15	62 202
##	AMZN191115P01740000	1740	50.90	11.200001	47.20	55.00	25 200
##	AMZN191115P01750000	1750	55.00	11.259998	50.75	58.55	56 692
##	AMZN191115P01755000	1755	56.35	13.379997	52.50	60.20	4 8
##	AMZN191115P01760000	1760	59.49	13.890003	54.65	62.55	32 145

##	AMZN191115P01765000	1765	62.31	15.110001	56.00	64.00	7	8
##	AMZN191115P01770000	1770	63.00	14.150002	58.00	64.20	35	168
##	AMZN191115P01775000	1775	64.45	12.849998	61.65	65.80	33	28
##	AMZN191115P01780000	1780	66.45	13.449997	63.75	70.85	28	311
##	AMZN191115P01785000	1785	68.90	9.650002	67.30	68.95	13	17
##	AMZN191115P01790000	1790	71.50	13.400002	67.00	75.20	1404	239
##	AMZN191115P01795000	1795	73.25	15.700001	70.35	74.75	38	17
##	AMZN191115P01800000	1800	77.79	18.490002	72.65	79.75	88	610
##	AMZN191115P01805000	1805	73.80	13.820004	75.00	79.40	13	17
##	AMZN191115P01810000	1810	80.45	14.729996	76.10	84.75	71	183
##	AMZN191115P01815000	1815	83.65	16.050003	78.25	85.55	22	24
##	AMZN191115P01820000	1820	88.50	18.360000	84.15	89.10	50	133
##	AMZN191115P01825000	1825	86.83	14.750000	86.50	91.75	17	14
##	AMZN191115P01830000	1830	93.20	18.949997	87.75	95.15	42	145
##	AMZN191115P01835000	1835	85.65	9.500000	90.45	95.00	16	34
##	AMZN191115P01840000	1840	90.95	12.849998	93.25	98.10	4	85
##	AMZN191115P01845000	1845	77.05	-1.500000	95.00	100.95	1	15
##	AMZN191115P01850000	1850	103.92	18.519997	98.90	103.60	10	210
##	AMZN191115P01860000	1860	112.00	22.300003	104.65	109.75	3	70
##	Comp.Op.Price							
##	AMZN191115P01700000	35.77752						
##	AMZN191115P01710000	38.52635						
##	AMZN191115P01720000	41.56312						
##	AMZN191115P01730000	44.97659						
##	AMZN191115P01740000	48.61405						
##	AMZN191115P01750000	52.43172						
##	AMZN191115P01755000	54.29095						
##	AMZN191115P01760000	56.12975						
##	AMZN191115P01765000	58.16451						
##	AMZN191115P01770000	60.22708						
##	AMZN191115P01775000	62.19713						
##	AMZN191115P01780000	64.24310						
##	AMZN191115P01785000	66.58182						
##	AMZN191115P01790000	68.56718						
##	AMZN191115P01795000	70.83931						
##	AMZN191115P01800000	73.18744						
##	AMZN191115P01805000	75.56348						
##	AMZN191115P01810000	78.01567						
##	AMZN191115P01815000	80.54411						
##	AMZN191115P01820000	83.19716						
##	AMZN191115P01825000	85.78170						

##		Strike	Last	Chg	Bid	Ask	Vol	OI
##	AMZN191220C01690000	1690	183.15	0.000000	162.15	163.90	3	7
##	AMZN191220C01700000	1700	162.00	0.000000	155.20	157.30	3	11
##	AMZN191220C01715000	1715	158.00	0.000000	139.60	150.15	1	1
##	AMZN191220C01720000	1720	148.77	0.000000	142.05	143.40	2	6
##	AMZN191220C01730000	1730	153.42	0.000000	135.55	137.00	1	3
##	AMZN191220C01740000	1740	147.45	0.000000	128.85	130.65	1	6
##	AMZN191220C01745000	1745	143.32	0.000000	120.00	131.15	1	10
##	AMZN191220C01750000	1750	121.47	-20.740005	122.70	124.50	28	5
##	AMZN191220C01760000	1760	120.30	-15.360001	116.80	118.05	1	3
##	AMZN191220C01765000	1765	119.21	-12.439995	113.75	115.60	2	2
##	AMZN191220C01770000	1770	109.05	-13.289993	111.05	112.35	2	3
##	AMZN191220C01775000	1775	108.05	-17.549995	107.70	109.20	25	53
##	AMZN191220C01780000	1780	103.41	-20.539993	105.10	106.30	22	5
##	AMZN191220C01785000	1785	101.16	-16.439995	102.50	104.90	5	16
##	AMZN191220C01790000	1790	97.75	-13.239998	96.00	103.40	11	7
##	AMZN191220C01795000	1795	97.34	-6.540001	96.85	98.60	18	26
##	AMZN191220C01800000	1800	94.30	-16.599998	94.75	95.95	136	95
##	AMZN191220C01805000	1805	92.50	-19.500000	91.55	93.00	39	109
##	AMZN191220C01810000	1810	88.01	-21.360000	86.00	93.50	10	27
##	AMZN191220C01815000	1815	87.09	-15.920006	86.65	88.40	4	113
##	AMZN191220C01820000	1820	84.49	-14.110001	84.05	85.50	289	97
##	AMZN191220C01825000	1825	82.42	-14.830002	82.00	82.95	13	70
##	AMZN191220C01830000	1830	78.07	-16.390000	76.20	84.50	24	52
##	AMZN191220C01835000	1835	76.00	-16.099998	77.35	78.30	15	158
##	AMZN191220C01840000	1840	75.40	-17.949997	74.40	76.00	26	112
##	AMZN191220C01845000	1845	73.96	-13.440002	70.80	75.25	1	63
##	AMZN191220C01850000	1850	70.53	-14.570000	70.10	71.60	26	108
##	AMZN191220C01855000	1855	68.31	-13.040001	68.00	69.40	4	27
##	AMZN191220C01860000	1860	65.75	-13.800003	66.35	67.30	17	53
##		Comp.Op.Price						
##	AMZN191220C01690000	160.32340						
##	AMZN191220C01700000	153.61579						
##	AMZN191220C01715000	143.14121						
##	AMZN191220C01720000	139.84649						
##	AMZN191220C01730000	133.14498						
##	AMZN191220C01740000	126.73420						
##	AMZN191220C01745000	123.63860						
##	AMZN191220C01750000	120.71181						
##	AMZN191220C01760000	114.53157						
##	AMZN191220C01765000	111.58785						


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## AMZN191220C01810000      87.22215
## AMZN191220C01815000      84.73701
## AMZN191220C01820000      82.22981
## AMZN191220C01825000      79.87164
## AMZN191220C01830000      77.36888
## AMZN191220C01835000      75.16272
## AMZN191220C01840000      72.76250
## AMZN191220C01845000      70.63525
## AMZN191220C01850000      68.41198
## AMZN191220C01855000      66.33924
## AMZN191220C01860000      64.04043

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##
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## $AMZNopCh20190920$Dec.20.2019$puts
```

##	Strike	Last	Chg	Bid	Ask	Vol	OI
## AMZN191220P01730000	1730	63.80	11.309998	62.70	63.40	17	39
## AMZN191220P01735000	1735	58.35	4.309998	64.40	65.15	1	12
## AMZN191220P01740000	1740	67.45	11.649998	66.30	67.25	12	161
## AMZN191220P01745000	1745	65.30	-1.250000	66.10	71.55	2	1
## AMZN191220P01750000	1750	70.15	12.100002	69.80	70.95	13	143
## AMZN191220P01755000	1755	67.01	6.860001	71.50	72.80	1	31
## AMZN191220P01760000	1760	75.25	15.000000	73.20	78.65	6	11
## AMZN191220P01765000	1765	70.65	7.450001	75.50	78.30	4	3
## AMZN191220P01770000	1770	79.40	5.800003	77.55	79.10	25	15
## AMZN191220P01775000	1775	75.70	12.599998	80.25	81.05	67	7
## AMZN191220P01780000	1780	83.70	14.809998	82.50	83.00	37	19
## AMZN191220P01785000	1785	87.45	17.019997	84.60	85.65	13	36
## AMZN191220P01790000	1790	88.10	11.400002	86.40	88.15	29	156
## AMZN191220P01795000	1795	91.50	16.260002	88.70	90.15	31	128
## AMZN191220P01800000	1800	94.70	17.349998	89.05	93.75	32	235
## AMZN191220P01805000	1805	88.30	8.900002	93.25	94.90	2	11
## AMZN191220P01810000	1810	97.96	17.960000	96.25	97.15	11	93
## AMZN191220P01815000	1815	99.65	18.599998	98.15	99.60	5	109
## AMZN191220P01820000	1820	105.45	17.829994	101.10	101.90	40	106
## AMZN191220P01825000	1825	108.57	19.419998	103.70	105.05	14	80
## AMZN191220P01830000	1830	102.50	11.349998	105.85	107.45	5	38
## AMZN191220P01835000	1835	114.25	23.010002	108.55	111.40	1	21
## AMZN191220P01840000	1840	113.60	17.650002	111.75	112.70	4	42
## AMZN191220P01845000	1845	116.05	15.400002	114.40	115.40	1	21
## AMZN191220P01850000	1850	119.97	21.720001	113.55	125.00	3	30
## AMZN191220P01855000	1855	103.45	0.000000	119.95	121.15	1	15
## AMZN191220P01860000	1860	124.05	18.000000	122.45	124.30	2	36
## AMZN191220P01865000	1865	115.20	0.000000	125.70	127.20	2	6
## AMZN191220P01870000	1870	119.35	0.000000	128.80	130.15	1	10
## AMZN191220P01890000	1890	137.25	0.000000	141.10	142.45	9	10

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##
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Comp.Op.Price
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## AMZN191220P01730000      62.47176
## AMZN191220P01735000      64.44125
## AMZN191220P01740000      66.21249
## AMZN191220P01745000      68.08608
## AMZN191220P01750000      69.86224

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## AMZN191220P01755000    71.84032
## AMZN191220P01760000    73.79584
## AMZN191220P01765000    75.90279
## AMZN191220P01770000    77.96235
## AMZN191220P01775000    80.09861
## AMZN191220P01780000    82.16312
## AMZN191220P01785000    84.57571
## AMZN191220P01790000    86.86694
## AMZN191220P01795000    88.91467
## AMZN191220P01800000    91.33379
## AMZN191220P01805000    93.90207
## AMZN191220P01810000    96.10541
## AMZN191220P01815000    98.58050
## AMZN191220P01820000   101.08243
## AMZN191220P01825000   103.58691
## AMZN191220P01830000   106.26396
## AMZN191220P01835000   109.04010
## AMZN191220P01840000   111.79406
## AMZN191220P01845000   114.28493
## AMZN191220P01850000   117.23667
## AMZN191220P01855000   120.09410
## AMZN191220P01860000   122.88198
## AMZN191220P01865000   126.03148
## AMZN191220P01870000   128.67685
## AMZN191220P01890000   141.07718

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```
## $BAopCh20190920
```

```
## $BAopCh20190920$Oct.18.2019
```

```
## $BAopCh20190920$Oct.18.2019$calls
```

##	Strike	Last	Chg	Bid	Ask	Vol	OI
## BA191018C00370000	370	16.15	-3.8600006	16.00	16.45	509	2575
## BA191018C00375000	375	13.16	-3.1200008	12.85	13.15	232	3424
## BA191018C00380000	380	10.05	-2.8499994	9.95	10.30	354	3747
## BA191018C00385000	385	7.65	-2.5300002	7.50	7.80	623	1613
## BA191018C00390000	390	5.60	-2.3500000	5.50	5.75	337	2073
## BA191018C00395000	395	4.03	-1.7799997	3.90	4.10	345	2081
## BA191018C00400000	400	2.82	-1.2400000	2.70	2.82	566	3306
## BA191018C00405000	405	1.85	-0.9699999	1.81	1.91	205	1629

```
## Comp.Op.Price
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## BA191018C00370000	16.535303
## BA191018C00375000	13.437283
## BA191018C00380000	10.370253
## BA191018C00385000	7.905549
## BA191018C00390000	5.821953
## BA191018C00395000	4.167472
## BA191018C00400000	2.852193
## BA191018C00405000	1.906057

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##
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## $BAopCh20190920$Oct.18.2019$puts
##          Strike  Last      Chg   Bid   Ask Vol   OI  Comp.Op.Price
## BA191018P00370000    370  6.50 1.050000  6.40  6.70 572 2155    6.752814
## BA191018P00375000    375  8.25 1.300000  8.15  8.40  87 1029    8.477919
## BA191018P00380000    380 10.50 1.750000 10.25 10.60 166 2846   10.589463
## BA191018P00385000    385 12.70 2.099999 12.80 13.05  73  512   13.077944
## BA191018P00390000    390 15.39 2.240001 15.65 16.05  39  253   15.973755
## BA191018P00395000    395 18.50 2.229999 19.10 19.55   2  39    19.280085
## BA191018P00400000    400 23.32 3.719999 22.90 23.40 194  37    23.007277
## BA191018P00405000    405 26.88 5.719999 27.00 27.55   1  11    27.061578
##
##
## $BAopCh20190920$Nov.15.2019
## $BAopCh20190920$Nov.15.2019$calls
##          Strike  Last      Chg   Bid   Ask Vol   OI
## BA191115C00370000    370 21.62 -5.129999 21.75 22.35  22 2174
## BA191115C00375000    375 19.50 -2.600000 18.65 19.30  33 3773
## BA191115C00380000    380 16.05 -3.070002 15.90 16.30 267 3678
## BA191115C00385000    385 13.45 -2.920001 13.45 13.85 201 1206
## BA191115C00390000    390 11.68 -2.519999 11.20 11.60  45 2501
## BA191115C00395000    395  9.52 -2.080000  9.15  9.60  36 1181
## BA191115C00400000    400  7.50 -2.040000  7.40  7.70  94 6372
## BA191115C00405000    405  6.45 -1.300000  6.00  6.35  12  553
##
##          Comp.Op.Price
## BA191115C00370000    22.276364
## BA191115C00375000    19.283840
## BA191115C00380000    16.462816
## BA191115C00385000    13.957570
## BA191115C00390000    11.737725
## BA191115C00395000     9.588658
## BA191115C00400000     7.718192
## BA191115C00405000     6.314493
##
## $BAopCh20190920$Nov.15.2019$puts
##          Strike  Last      Chg   Bid   Ask Vol   OI
## BA191115P00370000    370 12.70 0.9099999 12.85 13.20  74  938
## BA191115P00375000    375 15.00 1.4799995 14.90 15.20 205 1076
## BA191115P00380000    380 17.20 2.0000010 17.15 17.70 485  432
## BA191115P00385000    385 19.40 1.3999996 19.55 20.10 155  411
## BA191115P00390000    390 22.86 3.1100006 22.30 22.85   7  231
## BA191115P00395000    395 25.75 2.6900005 25.35 25.90   5  226
## BA191115P00400000    400 28.39 2.2500000 28.60 29.30   7  637
## BA191115P00405000    405 30.64 2.7899990 32.15 33.05   5   74
##
##          Comp.Op.Price
## BA191115P00370000    13.13075
## BA191115P00375000    15.04923
## BA191115P00380000    17.43441
## BA191115P00385000    19.90915
## BA191115P00390000    22.54913
## BA191115P00395000    25.60907

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## BA191115P00400000      29.00379
## BA191115P00405000      32.34381
##
##
##
## $SPYopCh20190920
## $SPYopCh20190920$Oct.18.2019
## $SPYopCh20190920$Oct.18.2019$calls
##
##      Strike  Last      Chg    Bid    Ask    Vol    OI
## SPY191018C00287000      287 14.03 -0.4200001 12.97 13.13    22 10976
## SPY191018C00288000      288 13.16 -0.3500004 12.13 12.28   112  7203
## SPY191018C00289000      289 11.48 -1.1700001 11.29 11.43    77  5278
## SPY191018C00290000      290 10.50 -1.3299999 10.46 10.60   851 48310
## SPY191018C00291000      291 10.30 -0.7799997   9.65  9.78    42 14661
## SPY191018C00292000      292  9.11 -0.9600000   8.85  8.98    70 23606
## SPY191018C00293000      293  8.31 -0.9399996   8.07  8.19   135 21212
## SPY191018C00294000      294  7.52 -0.9100003   7.31  7.43    95 30038
## SPY191018C00295000      295  6.89 -0.8600001   6.57  6.68   945 33039
## SPY191018C00296000      296  6.04 -0.7800002   5.87  5.92   617 16205
## SPY191018C00297000      297  5.18 -0.9100003   5.18  5.23  1184 15200
## SPY191018C00298000      298  4.55 -0.9499998   4.52  4.56  1528 19956
## SPY191018C00299000      299  3.90 -0.8299999   3.89  3.94  4339 13248
## SPY191018C00300000      300  3.33 -0.6900001   3.31  3.35  9062 55676
## SPY191018C00301000      301  2.79 -0.6400001   2.77  2.81  4878 19303
## SPY191018C00302000      302  2.30 -0.5800002   2.28  2.31  6310 30120
## SPY191018C00303000      303  1.85 -0.5600001   1.84  1.87  5319 73040
## SPY191018C00304000      304  1.45 -0.5000000   1.45  1.48  2449 13853
## SPY191018C00305000      305  1.14 -0.4500000   1.13  1.14 40547 73989
## SPY191018C00306000      306  0.87 -0.3800000   0.85  0.88  8132 38521
## SPY191018C00307000      307  0.64 -0.3400000   0.64  0.66  2877 18276
## SPY191018C00308000      308  0.50 -0.2600000   0.48  0.49  2966 90784
## SPY191018C00309000      309  0.40 -0.1800000   0.35  0.37   955 40153
## SPY191018C00310000      310  0.26 -0.2100000   0.26  0.28  5702 66810
## SPY191018C00311000      311  0.23 -0.1300000   0.20  0.23   286 12046
## SPY191018C00312000      312  0.16 -0.1200000   0.15  0.18   737 19666
## SPY191018C00313000      313  0.13 -0.0900000   0.11  0.13   547 11786
## SPY191018C00314000      314  0.12 -0.0500000   0.10  0.11   451 19849
## SPY191018C00315000      315  0.08 -0.0600000   0.07  0.08  7791 136201
## SPY191018C00316000      316  0.07 -0.0400000   0.06  0.07  3500  4568
##
##      Comp.Op.Price
## SPY191018C00287000      11.66934544
## SPY191018C00288000      10.85483505
## SPY191018C00289000      10.03717533
## SPY191018C00290000       9.19612812
## SPY191018C00291000       8.41546484
## SPY191018C00292000       7.64833476
## SPY191018C00293000       6.90661279
## SPY191018C00294000       6.18611109
## SPY191018C00295000       5.56093779
## SPY191018C00296000       4.87183782

```

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## SPY191018C00297000    4.22827234
## SPY191018C00298000    3.60927183
## SPY191018C00299000    3.05497004
## SPY191018C00300000    2.53972447
## SPY191018C00301000    2.07714642
## SPY191018C00302000    1.66989082
## SPY191018C00303000    1.31562025
## SPY191018C00304000    1.01580717
## SPY191018C00305000    0.77463053
## SPY191018C00306000    0.57899599
## SPY191018C00307000    0.42656624
## SPY191018C00308000    0.31278717
## SPY191018C00309000    0.23083970
## SPY191018C00310000    0.16918770
## SPY191018C00311000    0.12634232
## SPY191018C00312000    0.09571570
## SPY191018C00313000    0.07411569
## SPY191018C00314000    0.05677562
## SPY191018C00315000    0.04355699
## SPY191018C00316000    0.03424222

```

```
##
```

```
## $SPYopCh20190920$Oct.18.2019$puts
```

```

##           Strike  Last      Chg    Bid   Ask   Vol    OI
## SPY191018P00287000    287  1.75  0.49000000  1.74  1.76  1539  26577
## SPY191018P00288000    288  1.90  0.53999996  1.88  1.91  3206  22266
## SPY191018P00289000    289  2.05  0.58999990  2.04  2.07  2829  17961
## SPY191018P00290000    290  2.23  0.60000000  2.21  2.24  31651  88038
## SPY191018P00291000    291  2.33  0.54999995  2.39  2.43   6080  11937
## SPY191018P00292000    292  2.60  0.66999996  2.59  2.63  13804  22336
## SPY191018P00293000    293  2.87  0.77000000  2.81  2.85   5706  26157
## SPY191018P00294000    294  3.05  0.78999996  3.04  3.08   9285  63924
## SPY191018P00295000    295  3.30  0.80999994  3.29  3.33  20840  71231
## SPY191018P00296000    296  3.63  0.93000007  3.57  3.61   3577  13710
## SPY191018P00297000    297  3.91  1.01000000  3.88  3.92   2952  22206
## SPY191018P00298000    298  4.25  1.00000000  4.22  4.26   6202  14096
## SPY191018P00299000    299  4.64  1.13999990  4.59  4.64   5908  18662
## SPY191018P00300000    300  5.04  1.09999990  5.01  5.05   8764  39463
## SPY191018P00301000    301  5.52  1.15999980  5.41  5.54   5127   9292
## SPY191018P00302000    302  6.04  1.30000020  5.92  6.07   2601   9198
## SPY191018P00303000    303  6.51  1.25000000  6.49  6.64    575  40756
## SPY191018P00304000    304  6.51  0.68000030  7.12  7.28    564   3419
## SPY191018P00305000    305  7.66  1.15999980  7.81  7.98  33454  26411
## SPY191018P00306000    306  7.65  0.49000025  8.55  8.74    20   2839
## SPY191018P00307000    307  9.34  1.54000000  9.36  9.56   932   2371
## SPY191018P00308000    308 10.23  1.51999950 10.22 10.43   760  68527
## SPY191018P00309000    309 10.33  1.57999990 11.13 11.34    14   1268
## SPY191018P00310000    310 12.02  1.26000020 12.07 12.29    101  4559
## SPY191018P00311000    311 12.50  0.80000020 13.04 13.26   1944  1021
## SPY191018P00312000    312 13.85  2.77000050 14.03 14.25     6   438
## SPY191018P00313000    313 13.30  0.61999990 15.03 15.25     7   429

```

## SPY191018P00314000	314	13.66	0.05999947	16.03	16.25	226	1655
## SPY191018P00315000	315	16.40	1.21000000	17.03	17.25	2	869
## SPY191018P00316000	316	16.13	0.63999940	18.03	18.25	5	1240
##	Comp.Op.Price						
## SPY191018P00287000		1.666637					
## SPY191018P00288000		1.819797					
## SPY191018P00289000		1.986689					
## SPY191018P00290000		2.162163					
## SPY191018P00291000		2.362654					
## SPY191018P00292000		2.577627					
## SPY191018P00293000		2.807431					
## SPY191018P00294000		3.062936					
## SPY191018P00295000		3.334799					
## SPY191018P00296000		3.641889					
## SPY191018P00297000		3.975484					
## SPY191018P00298000		4.350627					
## SPY191018P00299000		4.757064					
## SPY191018P00300000		5.213845					
## SPY191018P00301000		5.705797					
## SPY191018P00302000		6.264373					
## SPY191018P00303000		6.886744					
## SPY191018P00304000		7.552719					
## SPY191018P00305000		8.264866					
## SPY191018P00306000		9.045773					
## SPY191018P00307000		9.855854					
## SPY191018P00308000		10.728476					
## SPY191018P00309000		11.643054					
## SPY191018P00310000		12.586559					
## SPY191018P00311000		13.535729					
## SPY191018P00312000		14.528947					
## SPY191018P00313000		15.516610					
## SPY191018P00314000		16.506626					
## SPY191018P00315000		17.510648					
## SPY191018P00316000		18.517413					
##							
##							
## \$SPYopCh20190920\$Nov.15.2019							
## \$SPYopCh20190920\$Nov.15.2019\$calls							
##	Strike	Last	Chg	Bid	Ask	Vol	OI
## SPY191115C00284000	284	18.57	-0.4099998	17.70	17.85	110	2615
## SPY191115C00285000	285	17.74	-0.1700001	16.86	17.01	252	3819
## SPY191115C00286000	286	16.15	-0.8999996	16.04	16.19	215	4195
## SPY191115C00287000	287	16.22	-0.3800011	15.23	15.37	440	11799
## SPY191115C00288000	288	16.07	0.4899998	14.43	14.56	4	4149
## SPY191115C00289000	289	13.36	-1.9900007	13.63	13.77	136	5381
## SPY191115C00290000	290	13.26	-0.7299995	12.85	12.98	330	12599
## SPY191115C00291000	291	12.71	-0.5199995	12.08	12.21	29	4089
## SPY191115C00292000	292	11.56	-0.9499998	11.32	11.45	44	4765
## SPY191115C00293000	293	10.79	-1.1899996	10.58	10.70	10	4401
## SPY191115C00294000	294	10.04	-1.0299997	9.85	9.96	184	6427

## SPY191115C00295000	295	9.81	-0.2699995	9.14	9.19	70	12157
## SPY191115C00296000	296	8.47	-0.8800001	8.44	8.49	289	4894
## SPY191115C00297000	297	7.95	-0.8299999	7.76	7.81	218	8912
## SPY191115C00298000	298	7.36	-0.6600003	7.10	7.15	2717	8579
## SPY191115C00299000	299	6.62	-0.8200002	6.46	6.51	763	6641
## SPY191115C00300000	300	5.86	-0.7500000	5.85	5.89	17209	17409
## SPY191115C00301000	301	5.26	-0.7399998	5.26	5.30	1801	12012
## SPY191115C00302000	302	5.15	-0.2599997	4.70	4.74	1353	6760
## SPY191115C00303000	303	4.19	-0.6399999	4.17	4.21	910	10103
## SPY191115C00304000	304	4.01	-0.2700000	3.68	3.72	1096	8056
## SPY191115C00305000	305	3.30	-0.4600000	3.22	3.25	2752	23980
## SPY191115C00306000	306	2.93	-0.4099998	2.79	2.83	1265	4812
## SPY191115C00307000	307	2.73	-0.1700001	2.40	2.44	436	6470
## SPY191115C00308000	308	2.33	-0.1900001	2.06	2.09	853	4232
## SPY191115C00309000	309	1.84	-0.3000001	1.75	1.78	1104	8067
## SPY191115C00310000	310	1.50	-0.3600000	1.47	1.50	1055	11051
## SPY191115C00311000	311	1.30	-0.2800001	1.23	1.26	375	4183
## SPY191115C00312000	312	1.10	-0.2400000	1.03	1.06	996	8439
## SPY191115C00313000	313	1.00	-0.1400000	0.86	0.88	715	4947
##	Comp.Op.Price						
## SPY191115C00284000	16.4629546						
## SPY191115C00285000	15.6258322						
## SPY191115C00286000	14.7990817						
## SPY191115C00287000	13.9780229						
## SPY191115C00288000	13.1674375						
## SPY191115C00289000	12.3769308						
## SPY191115C00290000	11.5922988						
## SPY191115C00291000	10.8231567						
## SPY191115C00292000	10.0702231						
## SPY191115C00293000	9.3272028						
## SPY191115C00294000	8.5904875						
## SPY191115C00295000	7.8890048						
## SPY191115C00296000	7.2132251						
## SPY191115C00297000	6.5535753						
## SPY191115C00298000	5.9246444						
## SPY191115C00299000	5.3168742						
## SPY191115C00300000	4.7448766						
## SPY191115C00301000	4.2039057						
## SPY191115C00302000	3.7037030						
## SPY191115C00303000	3.2346944						
## SPY191115C00304000	2.8066848						
## SPY191115C00305000	2.4186745						
## SPY191115C00306000	2.0668614						
## SPY191115C00307000	1.7602544						
## SPY191115C00308000	1.4890612						
## SPY191115C00309000	1.2577747						
## SPY191115C00310000	1.0566464						
## SPY191115C00311000	0.8854524						
## SPY191115C00312000	0.7439450						
## SPY191115C00313000	0.6208615						

```

##
## $SPYopCh20190920$Nov.15.2019$puts
##          Strike Last      Chg Bid Ask  Vol  OI
## SPY191115P00275000    275 1.85 0.3900000 1.84 1.87 8235 30475
## SPY191115P00276000    276 1.88 0.3700000 1.94 1.97  730  9632
## SPY191115P00277000    277 1.97 0.3200000 2.05 2.08  806 17025
## SPY191115P00278000    278 2.02 0.2800000 2.16 2.20 1388  7123
## SPY191115P00279000    279 2.27 0.4600000 2.29 2.32  947  6207
## SPY191115P00280000    280 2.44 0.5200001 2.41 2.45 7163 37120
## SPY191115P00281000    281 2.57 0.4700000 2.55 2.58  432 12265
## SPY191115P00282000    282 2.67 0.4500000 2.69 2.72  307  9654
## SPY191115P00283000    283 2.76 0.4200001 2.83 2.87 5739 11918
## SPY191115P00284000    284 3.00 0.6300001 2.99 3.03  594 16159
## SPY191115P00285000    285 3.07 0.4600000 3.15 3.20 1874 39187
## SPY191115P00286000    286 3.23 0.5400000 3.33 3.37 2899  5549
## SPY191115P00287000    287 3.47 0.6100001 3.51 3.55  342 14438
## SPY191115P00288000    288 3.47 0.4600000 3.70 3.74  839 11132
## SPY191115P00289000    289 3.66 0.4600000 3.90 3.95  781  8121
## SPY191115P00290000    290 4.15 0.7500000 4.12 4.16 17112 42308
## SPY191115P00291000    291 4.25 0.7000000 4.34 4.39  855  5599
## SPY191115P00292000    292 4.48 0.7100000 4.58 4.63  682 18760
## SPY191115P00293000    293 4.75 0.9300001 4.83 4.88  985  9321
## SPY191115P00294000    294 5.04 0.8099999 5.10 5.15 1113  7515
## SPY191115P00295000    295 5.42 0.9400001 5.38 5.43 2803 19306
## SPY191115P00296000    296 5.54 0.7599997 5.68 5.73 1529  7766
## SPY191115P00297000    297 5.86 0.9000001 6.00 6.05 1551  8648
## SPY191115P00298000    298 6.43 1.1099997 6.34 6.40 5745  5810
## SPY191115P00299000    299 6.66 0.9899998 6.70 6.76 1360  7843
## SPY191115P00300000    300 7.15 1.0999999 7.09 7.15 21951 26428
## SPY191115P00301000    301 7.52 1.0999999 7.50 7.56 1703  4558
## SPY191115P00302000    302 8.00 1.1700001 7.95 8.00 1880  4839
## SPY191115P00303000    303 8.45 1.1999998 8.41 8.54 2357  2120
## SPY191115P00304000    304 8.22 0.6600003 8.92 9.06 1194  2856
##
##          Comp.Op.Price
## SPY191115P00275000    1.128438
## SPY191115P00276000    1.199786
## SPY191115P00277000    1.276138
## SPY191115P00278000    1.360623
## SPY191115P00279000    1.443794
## SPY191115P00280000    1.538805
## SPY191115P00281000    1.638019
## SPY191115P00282000    1.745510
## SPY191115P00283000    1.857883
## SPY191115P00284000    1.981972
## SPY191115P00285000    2.114394
## SPY191115P00286000    2.258784
## SPY191115P00287000    2.415320
## SPY191115P00288000    2.588039
## SPY191115P00289000    2.777399
## SPY191115P00290000    2.987976

```



```

## SPY191115P00291000      3.220637
## SPY191115P00292000      3.485054
## SPY191115P00293000      3.760532
## SPY191115P00294000      4.088872
## SPY191115P00295000      4.454874
## SPY191115P00296000      4.855994
## SPY191115P00297000      5.304744
## SPY191115P00298000      5.846112
## SPY191115P00299000      6.350593
## SPY191115P00300000      6.954608
## SPY191115P00301000      7.612288
## SPY191115P00302000      8.325654
## SPY191115P00303000      9.054009
## SPY191115P00304000      9.845577

```

```
##
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##
```

```
## $SPYopCh20190920$Dec.20.2019
```

```
## $SPYopCh20190920$Dec.20.2019$calls
```

##	Strike	Last	Chg	Bid	Ask	Vol	OI
## SPY191220C00287000	287	18.40	-0.8400001	17.61	17.77	16	3959
## SPY191220C00288000	288	17.45	-0.7099991	16.84	16.99	8	4620
## SPY191220C00289000	289	17.35	0.1499996	16.07	16.22	32	10474
## SPY191220C00290000	290	15.88	-0.7200003	15.31	15.46	154	75601
## SPY191220C00291000	291	15.10	-0.5799999	14.57	14.71	32	8226
## SPY191220C00292000	292	14.41	-0.4899998	13.83	13.97	161	17418
## SPY191220C00293000	293	13.69	-0.7200003	13.11	13.24	389	30565
## SPY191220C00294000	294	12.95	-0.7399998	12.39	12.52	119	20291
## SPY191220C00295000	295	11.95	-0.8500004	11.72	11.79	159	54773
## SPY191220C00296000	296	11.39	-0.6499996	11.03	11.10	210	44913
## SPY191220C00297000	297	10.70	-0.6199999	10.36	10.43	569	15436
## SPY191220C00298000	298	10.13	-0.8599997	9.70	9.77	634	23091
## SPY191220C00299000	299	9.29	-0.9099999	9.05	9.12	1035	19481
## SPY191220C00300000	300	8.46	-0.5900001	8.43	8.50	964	92559
## SPY191220C00301000	301	8.25	-0.3299999	7.82	7.88	780	16039
## SPY191220C00302000	302	7.69	-0.2500000	7.22	7.29	319	45272
## SPY191220C00303000	303	6.90	-0.5000000	6.66	6.71	715	19750
## SPY191220C00304000	304	6.27	-0.4099998	6.10	6.16	3667	40197
## SPY191220C00305000	305	5.81	-0.4400001	5.58	5.64	2421	67535
## SPY191220C00306000	306	5.45	-0.3400002	5.08	5.13	2089	26464
## SPY191220C00307000	307	4.92	-0.3800001	4.60	4.65	2038	18512
## SPY191220C00308000	308	4.29	-0.6199999	4.15	4.21	1283	16419
## SPY191220C00309000	309	4.02	-0.3099999	3.73	3.78	4089	17410
## SPY191220C00310000	310	3.37	-0.5400002	3.34	3.39	1603	83516
## SPY191220C00311000	311	3.23	-0.3299999	2.97	3.02	2088	15985
## SPY191220C00312000	312	2.70	-0.4300001	2.64	2.68	607	11400
## SPY191220C00313000	313	2.49	-0.2400000	2.33	2.38	1343	9340
## SPY191220C00314000	314	2.13	-0.4299998	2.05	2.09	2590	5797
## SPY191220C00315000	315	1.92	-0.3400000	1.80	1.84	2163	55162
## SPY191220C00316000	316	1.67	-0.2300000	1.57	1.61	532	3413

```
##
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```
Comp.Op.Price
```

## SPY191220C00287000	16.538448
## SPY191220C00288000	15.775280
## SPY191220C00289000	15.023807
## SPY191220C00290000	14.289265
## SPY191220C00291000	13.556052
## SPY191220C00292000	12.840664
## SPY191220C00293000	12.130795
## SPY191220C00294000	11.438081
## SPY191220C00295000	10.757388
## SPY191220C00296000	10.088760
## SPY191220C00297000	9.437291
## SPY191220C00298000	8.797963
## SPY191220C00299000	8.175842
## SPY191220C00300000	7.580812
## SPY191220C00301000	7.046968
## SPY191220C00302000	6.427501
## SPY191220C00303000	5.893626
## SPY191220C00304000	5.372034
## SPY191220C00305000	4.881827
## SPY191220C00306000	4.417968
## SPY191220C00307000	3.975613
## SPY191220C00308000	3.568414
## SPY191220C00309000	3.182311
## SPY191220C00310000	2.826215
## SPY191220C00311000	2.498339
## SPY191220C00312000	2.204230
## SPY191220C00313000	1.933956
## SPY191220C00314000	1.687125
## SPY191220C00315000	1.475686
## SPY191220C00316000	1.282348

##

\$SPYopCh20190920\$Dec.20.2019\$puts

##	Strike	Last	Chg	Bid	Ask	Vol	OI
## SPY191220P00287000	287	5.47	0.5200000	5.81	5.86	195	10707
## SPY191220P00288000	288	6.06	0.8600001	6.05	6.10	140	14479
## SPY191220P00289000	289	6.17	0.7100000	6.29	6.35	353	7929
## SPY191220P00290000	290	6.61	0.9300003	6.55	6.60	1357	92173
## SPY191220P00291000	291	6.70	1.0000000	6.82	6.87	439	8958
## SPY191220P00292000	292	6.99	0.8699999	7.09	7.15	768	11997
## SPY191220P00293000	293	7.26	0.8700004	7.38	7.44	940	6650
## SPY191220P00294000	294	7.41	0.7700000	7.68	7.74	533	4431
## SPY191220P00295000	295	7.93	0.9499998	8.00	8.06	2592	27449
## SPY191220P00296000	296	8.35	1.0600004	8.33	8.38	553	43365
## SPY191220P00297000	297	8.73	1.1299996	8.67	8.73	878	6949
## SPY191220P00298000	298	8.86	0.9699998	9.03	9.09	1113	14778
## SPY191220P00299000	299	9.27	1.0200005	9.40	9.46	2007	6898
## SPY191220P00300000	300	9.89	1.2000008	9.79	9.85	3585	22458
## SPY191220P00301000	301	10.26	1.1800003	10.20	10.26	4400	6530
## SPY191220P00302000	302	10.42	1.0000000	10.63	10.69	1210	3383
## SPY191220P00303000	303	10.93	1.3600006	11.09	11.15	1024	2995

## SPY191220P00304000	304	11.42	1.2799997	11.53	11.68	396	3377
## SPY191220P00305000	305	11.99	1.3199997	12.03	12.19	1781	18082
## SPY191220P00306000	306	12.22	1.2300005	12.56	12.72	407	7491
## SPY191220P00307000	307	12.75	0.8299999	13.11	13.28	186	1363
## SPY191220P00308000	308	13.10	1.1500006	13.69	13.87	6	1329
## SPY191220P00309000	309	13.76	1.3200006	14.29	14.49	12	940
## SPY191220P00310000	310	14.16	0.8199997	14.93	15.13	659	3128
## SPY191220P00311000	311	14.86	0.5099993	15.59	15.80	1474	349
## SPY191220P00312000	312	15.44	-0.2800007	16.28	16.50	8	1621
## SPY191220P00313000	313	15.96	0.6400003	16.99	17.22	1057	503
## SPY191220P00314000	314	16.72	1.3199997	17.73	17.97	414	1748
## SPY191220P00315000	315	17.85	1.9700003	18.50	18.74	715	483
## SPY191220P00316000	316	18.31	1.1700001	19.30	19.54	56	1582
##	Comp.Op.Price						
## SPY191220P00287000		5.835554					
## SPY191220P00288000		6.079962					
## SPY191220P00289000		6.344839					
## SPY191220P00290000		6.610838					
## SPY191220P00291000		6.888251					
## SPY191220P00292000		7.172004					
## SPY191220P00293000		7.477369					
## SPY191220P00294000		7.789106					
## SPY191220P00295000		8.117356					
## SPY191220P00296000		8.462086					
## SPY191220P00297000		8.818270					
## SPY191220P00298000		9.195886					
## SPY191220P00299000		9.584937					
## SPY191220P00300000		9.995315					
## SPY191220P00301000		10.422020					
## SPY191220P00302000		10.874770					
## SPY191220P00303000		11.348528					
## SPY191220P00304000		11.843174					
## SPY191220P00305000		12.368165					
## SPY191220P00306000		12.894630					
## SPY191220P00307000		13.465361					
## SPY191220P00308000		14.060962					
## SPY191220P00309000		14.695191					
## SPY191220P00310000		15.348977					
## SPY191220P00311000		16.022168					
## SPY191220P00312000		16.742056					
## SPY191220P00313000		17.476134					
## SPY191220P00314000		18.250357					
## SPY191220P00315000		19.029811					
## SPY191220P00316000		19.845178					

#HW1-Problem 2

```
#Load HW1DATA2.RData
load('HW1DATA2.RData')
```

```

#Trim data to use only monthly expiries
AMZNopCh20190918 = AMZNopCh20190918[c('Oct.18.2019', 'Nov.15.2019', 'Dec.20.2019')]

#Compress Option chains to 10 strike prices using moneyness condition
#Create temp Spot-Strike column in chains (deleted at end of process)
Spot <- as.numeric(AMZN[1,4])
b=1
for (item in AMZNopCh20190918) {
  c=1
  for (callput in item) {
    Imp.Vol <- matrix(0,nrow = nrow(callput),ncol = 1,byrow = TRUE)
    BlSch.Op.Price <- matrix(0,nrow = nrow(callput),ncol = 1,byrow = TRUE)
    BiTree.Op.Price <- matrix(0,nrow = nrow(callput),ncol = 1,byrow = TRUE)
    SpotStrike <- matrix(0,nrow = nrow(callput),ncol = 1,byrow = TRUE)
    callput <- cbind(callput,Imp.Vol,BlSch.Op.Price,BiTree.Op.Price,SpotStrike)
  }
  item[[c]] <- callput
  c=c+1
}
AMZNopCh20190918[[b]] = item
b=b+1
}

#Compute Spot Strike difference to select 10 best strike rows
b=1
for (item in AMZNopCh20190918) {
  c=1
  for (callput in item) {
    callput$SpotStrike <- abs(Spot-as.numeric(callput$Strike))
    callput <- callput[order(callput$SpotStrike),]
    item[[c]] <- callput[1:10,-dim(callput)[2]]
    c=c+1
  }
  AMZNopCh20190918[[b]] <- item
  b=b+1
}

#Compute Implied Vol for Option chain
Date1 <- as.Date(index(AMZN),format = '%Y-%m-%d')
i=1
for (maturity in AMZNopCh20190918) {
  j=1
  Date2 <- as.Date(names(AMZNopCh20190918)[i],format = '%b.%d.%Y')
  t = abs(Nweekdays(Date1,Date2))/360

  for (cp in maturity) {
    for (row in seq(1,dim(cp)[1],1)) {
      if ((is.na(cp$Bid[row])==TRUE) || (is.na(cp$Ask[row])==TRUE)){

```

```

        cp$Imp.Vol[row]=NA
        next
      }
      cp$Imp.Vol[row] = impVol(as.numeric(cp$Strike[row]),Spot,rate20190918,t
, names(maturity)[j]
                                ,(as.numeric(cp$Bid[row])+as.numeric(cp$Ask[ro
w]))/2)
    }
    maturity[[j]] <- cp
    j=j+1
  }
  AMZNopCh20190918[[i]] <- maturity
  i=i+1
}

```

#Binomial tree European option pricing (as implemented in fOptions package)
 BinomialTreeOption =

```

  function(TypeFlag = c("calls", "puts"), S, X, Time, r, b, sigma, n) {
    # Check Flags:
    TypeFlag = TypeFlag[1]
    if (TypeFlag == "calls") z = +1
    if (TypeFlag == "puts") z = -1

    # Parameters:
    dt = Time / n
    u = exp(sigma*sqrt(dt))
    d = 1 / u
    p = (exp(b*dt) - d) / (u - d)
    Df = exp(-r*dt)

    # Algorithm:
    OptionValue = z*(S*u^(0:n)*d^(n:0) - X)
    offset = 1
    Tree = OptionValue = (abs(OptionValue)+OptionValue)/2

    # European Type:
    for (j in (n-1):0) {
      Tree <-c(Tree, rep(0, times=n-j))
      for (i in 0:j) {
        OptionValue[i+offset] = (p*OptionValue[i+1+offset] + (1-p)*OptionValue[i+offset]) * Df
        Tree = c(Tree, OptionValue[i+offset]) } }
      Tree = matrix(rev(Tree), byrow = FALSE, ncol = n+1)
    # Return Value:
    invisible(Tree)
  }

```

#Create reporting table

```
report2 <- data.frame(matrix(ncol = 6))
```

```

colnames(report2)<- c('Option','Maturity','Op.Type','Imp.Vol.','BS Price','Bi
Tree Price')
op.type<- names(AMZNopCh20190918[[1]])
maturity <- names(AMZNopCh20190918)

#Compute option prices using Black Scholes & Binomial Tree
#Nested loop to navigate list of lists
b=1 #counter
for (item in AMZNopCh20190918) {
  c=1
  Date2 <- as.Date(names(AMZNopCh20190918[b]),format = '%b.%d.%Y') #Maturity
date to compute 't'
  t = abs(Nweekdays(Date1,Date2))/360
  for (callput in item) {
    for (row in 1:dim(callput)[1]) {
      #Compute Option Price for each strike price
      sig <- AMZNopCh20190918[[b]][[c]]$Imp.Vol[row]
      if(is.na(sig)==TRUE)
        next
      #Compute black Scholes price
      callput$BlSch.Op.Price[row] = BSEuro(as.numeric(callput$Strike[row]),as
.numeric(Spot),
                                     rate20190918,sig,t,names(item)[c])
      #Compute binomial tree price
      callput$BiTree.Op.Price[row] = BinomialTreeOption(b=0,r=rate20190918,S
= Spot, X = as.numeric(callput$Strike[row]),
                                     sigma = sig,Time = t,
n=round(t*360),TypeFlag = names(item)[c])
      #Apped row to reporting table
      report2 <- rbind(report2,c(rownames(callput)[row],names(AMZNopCh2019091
8)[b],names(item)[c],
                                     sig,callput$BlSch.Op.Price[row],callput$BiTree
.Op.Price[row]))
    }
    item[[c]] <- callput #Update list of lists with new dataframe
    c=c+1
  }
  AMZNopCh20190918[[b]] = item #Update list of list with new list
  b=b+1
}

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

```

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

```

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

## Warning in callput$BiTree.Op.Price[row] <- BinomialTreeOption(b = 0, r =
## rate20190918, : number of items to replace is not a multiple of replacemen
t
## length

#Delete initial NA row in report and display report
report2 <- report2[-1,]
report2

```

##	Option	Maturity	Op.Type	Imp.Vol.
## 2	AMZN191018C01815000	Oct.18.2019	calls	0.246175904250786
## 3	AMZN191018C01820000	Oct.18.2019	calls	0.244427648701446
## 4	AMZN191018C01810000	Oct.18.2019	calls	0.247314009744158
## 5	AMZN191018C01825000	Oct.18.2019	calls	0.242474107516298
## 6	AMZN191018C01805000	Oct.18.2019	calls	0.248254835256777
## 7	AMZN191018C01830000	Oct.18.2019	calls	0.240442872063326
## 8	AMZN191018C01800000	Oct.18.2019	calls	0.2499760728792
## 9	AMZN191018C01835000	Oct.18.2019	calls	0.239284623145462
## 10	AMZN191018C01795000	Oct.18.2019	calls	0.25222592642957
## 11	AMZN191018C01840000	Oct.18.2019	calls	0.237212885049517
## 12	AMZN191018P01815000	Oct.18.2019	puts	0.238608466672235
## 13	AMZN191018P01820000	Oct.18.2019	puts	0.238146001178067
## 14	AMZN191018P01810000	Oct.18.2019	puts	0.240085912958706
## 15	AMZN191018P01825000	Oct.18.2019	puts	0.236234050118853
## 16	AMZN191018P01805000	Oct.18.2019	puts	0.241632397173762
## 17	AMZN191018P01830000	Oct.18.2019	puts	0.234231231581565
## 18	AMZN191018P01800000	Oct.18.2019	puts	0.242980078328596
## 19	AMZN191018P01835000	Oct.18.2019	puts	0.23281379012441
## 20	AMZN191018P01795000	Oct.18.2019	puts	0.245119810756583
## 21	AMZN191018P01840000	Oct.18.2019	puts	0.231570035583193
## 22	AMZN191115C01815000	Nov.15.2019	calls	0.30966413335092
## 23	AMZN191115C01820000	Nov.15.2019	calls	0.309109838997212
## 24	AMZN191115C01810000	Nov.15.2019	calls	0.30981441922952
## 25	AMZN191115C01805000	Nov.15.2019	calls	0.311068971801005
## 26	AMZN191115C01830000	Nov.15.2019	calls	0.30689574975417
## 27	AMZN191115C01800000	Nov.15.2019	calls	0.310911129397649
## 28	AMZN191115C01840000	Nov.15.2019	calls	0.304368997746347
## 29	AMZN191115C01790000	Nov.15.2019	calls	0.314662698067742
## 30	AMZN191115C01845000	Nov.15.2019	calls	0.302997304847396
## 31	AMZN191115C01850000	Nov.15.2019	calls	0.302920359318908
## 32	AMZN191115P01820000	Nov.15.2019	puts	0.300990315373122
## 33	AMZN191115P01810000	Nov.15.2019	puts	0.303055154416625
## 34	AMZN191115P01825000	Nov.15.2019	puts	0.299899019816447
## 35	AMZN191115P01805000	Nov.15.2019	puts	0.303426313639018
## 36	AMZN191115P01830000	Nov.15.2019	puts	0.29889983408321
## 37	AMZN191115P01800000	Nov.15.2019	puts	0.30480231545069
## 38	AMZN191115P01835000	Nov.15.2019	puts	0.297791918579314
## 39	AMZN191115P01795000	Nov.15.2019	puts	0.306282780347191
## 40	AMZN191115P01840000	Nov.15.2019	puts	0.296773755804187
## 41	AMZN191115P01790000	Nov.15.2019	puts	0.30715622932211
## 42	AMZN191220C01815000	Dec.20.2019	calls	0.305359078842326
## 43	AMZN191220C01820000	Dec.20.2019	calls	0.304549590679874
## 44	AMZN191220C01810000	Dec.20.2019	calls	0.306280338653331
## 45	AMZN191220C01825000	Dec.20.2019	calls	0.304486704877652
## 46	AMZN191220C01805000	Dec.20.2019	calls	0.307154511662051
## 47	AMZN191220C01830000	Dec.20.2019	calls	0.303578870575537
## 48	AMZN191220C01800000	Dec.20.2019	calls	0.308545445909857
## 49	AMZN191220C01835000	Dec.20.2019	calls	0.302542694188966
## 50	AMZN191220C01795000	Dec.20.2019	calls	0.309490135006621

## 51	AMZN191220C01840000	Dec.20.2019	calls	0.301695065492004
## 52	AMZN191220P01815000	Dec.20.2019	puts	0.297163028884638
## 53	AMZN191220P01820000	Dec.20.2019	puts	0.296358354600151
## 54	AMZN191220P01810000	Dec.20.2019	puts	0.298715890199061
## 55	AMZN191220P01825000	Dec.20.2019	puts	0.295501554745078
## 56	AMZN191220P01805000	Dec.20.2019	puts	0.298938094144518
## 57	AMZN191220P01830000	Dec.20.2019	puts	0.294512825557134
## 58	AMZN191220P01800000	Dec.20.2019	puts	0.299508467167736
## 59	AMZN191220P01835000	Dec.20.2019	puts	0.293947323528612
## 60	AMZN191220P01795000	Dec.20.2019	puts	0.301158516533735
## 61	AMZN191220P01840000	Dec.20.2019	puts	0.293566009913489
##	BS Price	BiTree Price		
## 2	47.6250000003323	46.7333920838598		
## 3	44.8249999983814	43.9761211363628		
## 4	50.4000000150612	49.3771800395752		
## 5	42.0750000003966	41.1799196288707		
## 6	53.2250003742936	51.9840341560449		
## 7	39.400000018388	38.368305036297		
## 8	56.2750024301454	54.7340207007776		
## 9	36.9750005169855	35.7178627278608		
## 10	59.5000091414101	57.5802700475198		
## 11	34.4750040018045	32.8968626140499		
## 12	41.1750000004367	42.8785867545509		
## 13	43.5999999981747	45.3501301399099		
## 14	39.0250000226555	40.5941090202691		
## 15	45.850000000502	47.5528461349124		
## 16	36.9750005195478	38.3216004265646		
## 17	48.1750000260776	49.7377256217973		
## 18	34.9750033968071	36.011718550609		
## 19	50.7000007091879	52.0303542886996		
## 20	33.2000127875237	33.8467047402318		
## 21	53.3500052151306	54.3901347269163		
## 22	81.1249999993382	78.976662048292		
## 23	78.5499999978371	76.4511698207863		
## 24	83.6500000000814	81.4005801444415		
## 25	86.5000000005891	84.1006123633041		
## 26	73.2749999993811	71.1205793267255		
## 27	89.0500000136703	86.446968328534		
## 28	68.1250000011985	65.7079495665176		
## 29	95.3000002216206	92.1531597231898		
## 30	65.600000024057	62.9729248229456		
## 31	63.4500001300461	60.9537575197051		
## 32	74.1749999971001	76.9448530050755		
## 33	69.65000000012	72.2674744582684		
## 34	76.4999999970784	79.2676590501299		
## 35	67.3000000011406	69.7622933819443		
## 36	78.8999999993069	81.6129106573214		
## 37	65.2500000208656	67.5078754848646		
## 38	81.3250000001365	83.9300437082885		
## 39	63.275000106961	65.278562358211		

40 83.8250000022124 86.2690794396167
41 61.2000003595346 62.8970067255079
42 101.049999994719 96.6735348503153
43 98.3749999885888 94.0665000595187
44 103.79999999954 99.5579552193286
45 95.9749999857762 91.9277780720613
46 106.575000000392 102.426937360179
47 93.3499999877492 89.524516905506
48 109.550000000592 105.455574039163
49 90.7249999936735 87.080250075977
50 112.42500001376 108.344669999588
51 88.1999999993627 84.6942779458477
52 88.3249999936049 91.6688746754687
53 90.6249999850561 94.0385917641167
54 86.299999999219 89.7747162186023
55 92.949999980539 96.6269738481615
56 83.9000000005457 87.4655105237075
57 95.2749999835254 99.1733210108361
58 81.6500000015517 85.2642058850824
59 97.7749999922889 101.851499860887
60 79.7750000257116 83.3971324284239
61 100.374999999897 104.587015793029

REPORT1 (For easy viewing)

Equity	Option	Maturity	Op.Type	Moneyness	Imp.Vol.	Avg.Imp.Vol	VIX
AMZN	AMZN191018C01735000	Oct.18.2019	calls	In	0.274222349	0.234951757	0.1395
AMZN	AMZN191018C01740000	Oct.18.2019	calls	In	0.272368101	0.234951757	0.1395
AMZN	AMZN191018C01745000	Oct.18.2019	calls	In	0.270318227	0.234951757	0.1395
AMZN	AMZN191018C01750000	Oct.18.2019	calls	In	0.268236818	0.234951757	0.1395
AMZN	AMZN191018C01755000	Oct.18.2019	calls	In	0.266433189	0.234951757	0.1395
AMZN	AMZN191018C01760000	Oct.18.2019	calls	In	0.264723704	0.234951757	0.1395
AMZN	AMZN191018C01765000	Oct.18.2019	calls	In	0.2627661	0.234951757	0.1395
AMZN	AMZN191018C01770000	Oct.18.2019	calls	In	0.261023585	0.234951757	0.1395
AMZN	AMZN191018C01775000	Oct.18.2019	calls	In	0.259173595	0.234951757	0.1395
AMZN	AMZN191018C01780000	Oct.18.2019	calls	In	0.257500909	0.234951757	0.1395
AMZN	AMZN191018C01785000	Oct.18.2019	calls	In	0.25569631	0.234951757	0.1395
AMZN	AMZN191018C01790000	Oct.18.2019	calls	In	0.253325783	0.234951757	0.1395
AMZN	AMZN191018C01795000	Oct.18.2019	calls	In	0.252225926	0.234951757	0.1395
AMZN	AMZN191018C01800000	Oct.18.2019	calls	In	0.249976073	0.234951757	0.1395
AMZN	AMZN191018C01805000	Oct.18.2019	calls	In	0.248254835	0.234951757	0.1395
AMZN	AMZN191018C01810000	Oct.18.2019	calls	In	0.24731401	0.234951757	0.1395
AMZN	AMZN191018C01815000	Oct.18.2019	calls	In	0.246175904	0.234951757	0.1395
AMZN	AMZN191018C01820000	Oct.18.2019	calls	Out	0.244427649	0.217969219	0.1395
AMZN	AMZN191018C01825000	Oct.18.2019	calls	Out	0.242474108	0.217969219	0.1395
AMZN	AMZN191018C01830000	Oct.18.2019	calls	Out	0.240442872	0.217969219	0.1395
AMZN	AMZN191018C01835000	Oct.18.2019	calls	Out	0.239284623	0.217969219	0.1395
AMZN	AMZN191018C01840000	Oct.18.2019	calls	Out	0.237212885	0.217969219	0.1395
AMZN	AMZN191018C01845000	Oct.18.2019	calls	Out	0.23656846	0.217969219	0.1395
AMZN	AMZN191018C01850000	Oct.18.2019	calls	Out	0.23514049	0.217969219	0.1395
AMZN	AMZN191018C01855000	Oct.18.2019	calls	Out	0.233899416	0.217969219	0.1395
AMZN	AMZN191018C01860000	Oct.18.2019	calls	Out	0.232853786	0.217969219	0.1395
AMZN	AMZN191018C01865000	Oct.18.2019	calls	Out	0.231722504	0.217969219	0.1395
AMZN	AMZN191018C01870000	Oct.18.2019	calls	Out	0.231097311	0.217969219	0.1395
AMZN	AMZN191018C01875000	Oct.18.2019	calls	Out	0.229649365	0.217969219	0.1395
AMZN	AMZN191018C01880000	Oct.18.2019	calls	Out	0.229207565	0.217969219	0.1395
AMZN	AMZN191018C01885000	Oct.18.2019	calls	Out	0.227924855	0.217969219	0.1395
AMZN	AMZN191018C01890000	Oct.18.2019	calls	Out	0.227068614	0.217969219	0.1395
AMZN	AMZN191018C01895000	Oct.18.2019	calls	Out	0.226862111	0.217969219	0.1395
AMZN	AMZN191018C01900000	Oct.18.2019	calls	Out	0.224725694	0.217969219	0.1395
AMZN	AMZN191018C01905000	Oct.18.2019	calls	Out	0.223959831	0.217969219	0.1395
AMZN	AMZN191018C01910000	Oct.18.2019	calls	Out	0.223401808	0.217969219	0.1395

AMZN	AMZN191018P01735000	Oct.18.2019	puts	In	0.264391864	0.234951757	0.1395
AMZN	AMZN191018P01740000	Oct.18.2019	puts	In	0.263029983	0.234951757	0.1395
AMZN	AMZN191018P01745000	Oct.18.2019	puts	In	0.261268159	0.234951757	0.1395
AMZN	AMZN191018P01750000	Oct.18.2019	puts	In	0.259122117	0.234951757	0.1395
AMZN	AMZN191018P01755000	Oct.18.2019	puts	In	0.258066978	0.234951757	0.1395
AMZN	AMZN191018P01760000	Oct.18.2019	puts	In	0.256424182	0.234951757	0.1395
AMZN	AMZN191018P01765000	Oct.18.2019	puts	In	0.254380016	0.234951757	0.1395
AMZN	AMZN191018P01770000	Oct.18.2019	puts	In	0.252843728	0.234951757	0.1395
AMZN	AMZN191018P01775000	Oct.18.2019	puts	In	0.251631015	0.234951757	0.1395
AMZN	AMZN191018P01780000	Oct.18.2019	puts	In	0.2493904	0.234951757	0.1395
AMZN	AMZN191018P01785000	Oct.18.2019	puts	In	0.24832661	0.234951757	0.1395
AMZN	AMZN191018P01790000	Oct.18.2019	puts	In	0.246236422	0.234951757	0.1395
AMZN	AMZN191018P01795000	Oct.18.2019	puts	In	0.245119811	0.234951757	0.1395
AMZN	AMZN191018P01800000	Oct.18.2019	puts	In	0.242980078	0.234951757	0.1395
AMZN	AMZN191018P01805000	Oct.18.2019	puts	In	0.241632397	0.234951757	0.1395
AMZN	AMZN191018P01810000	Oct.18.2019	puts	In	0.240085913	0.234951757	0.1395
AMZN	AMZN191018P01815000	Oct.18.2019	puts	In	0.238608467	0.234951757	0.1395
AMZN	AMZN191018P01820000	Oct.18.2019	puts	Out	0.238146001	0.217969219	0.1395
AMZN	AMZN191018P01825000	Oct.18.2019	puts	Out	0.23623405	0.217969219	0.1395
AMZN	AMZN191018P01830000	Oct.18.2019	puts	Out	0.234231232	0.217969219	0.1395
AMZN	AMZN191018P01835000	Oct.18.2019	puts	Out	0.23281379	0.217969219	0.1395
AMZN	AMZN191018P01840000	Oct.18.2019	puts	Out	0.231570036	0.217969219	0.1395
AMZN	AMZN191018P01845000	Oct.18.2019	puts	Out	0.231058115	0.217969219	0.1395
AMZN	AMZN191018P01850000	Oct.18.2019	puts	Out	0.229048035	0.217969219	0.1395
AMZN	AMZN191018P01855000	Oct.18.2019	puts	Out	0.227767923	0.217969219	0.1395
AMZN	AMZN191018P01860000	Oct.18.2019	puts	Out	0.227394036	0.217969219	0.1395
AMZN	AMZN191018P01865000	Oct.18.2019	puts	Out	0.225616867	0.217969219	0.1395
AMZN	AMZN191018P01870000	Oct.18.2019	puts	Out	0.225362957	0.217969219	0.1395
AMZN	AMZN191018P01875000	Oct.18.2019	puts	Out	0.223670217	0.217969219	0.1395
AMZN	AMZN191018P01880000	Oct.18.2019	puts	Out	0.222649734	0.217969219	0.1395
AMZN	AMZN191018P01885000	Oct.18.2019	puts	Out	0.221877053	0.217969219	0.1395
AMZN	AMZN191018P01890000	Oct.18.2019	puts	Out	0.220714446	0.217969219	0.1395
AMZN	AMZN191018P01895000	Oct.18.2019	puts	Out	0.221742579	0.217969219	0.1395
AMZN	AMZN191018P01900000	Oct.18.2019	puts	Out	0.221075506	0.217969219	0.1395
AMZN	AMZN191018P01905000	Oct.18.2019	puts	Out	0.219288305	0.217969219	0.1395
AMZN	AMZN191018P01910000	Oct.18.2019	puts	Out	0.220150886	0.217969219	0.1395
AMZN	AMZN191115C01740000	Nov.15.2019	calls	In	0.326274012	0.234951757	0.1405
AMZN	AMZN191115C01750000	Nov.15.2019	calls	In	0.324726581	0.234951757	0.1405
AMZN	AMZN191115C01760000	Nov.15.2019	calls	In	0.322203575	0.234951757	0.1405

AMZN	AMZN191115C01770000	Nov.15.2019	calls	In	0.3192622	0.234951757	0.1405
AMZN	AMZN191115C01780000	Nov.15.2019	calls	In	0.316933993	0.234951757	0.1405
AMZN	AMZN191115C01790000	Nov.15.2019	calls	In	0.314662698	0.234951757	0.1405
AMZN	AMZN191115C01800000	Nov.15.2019	calls	In	0.310911129	0.234951757	0.1405
AMZN	AMZN191115C01805000	Nov.15.2019	calls	In	0.311068972	0.234951757	0.1405
AMZN	AMZN191115C01810000	Nov.15.2019	calls	In	0.309814419	0.234951757	0.1405
AMZN	AMZN191115C01815000	Nov.15.2019	calls	In	0.309664133	0.234951757	0.1405
AMZN	AMZN191115C01820000	Nov.15.2019	calls	Out	0.309109839	0.217969219	0.1405
AMZN	AMZN191115C01830000	Nov.15.2019	calls	Out	0.30689575	0.217969219	0.1405
AMZN	AMZN191115C01840000	Nov.15.2019	calls	Out	0.304368998	0.217969219	0.1405
AMZN	AMZN191115C01845000	Nov.15.2019	calls	Out	0.302997305	0.217969219	0.1405
AMZN	AMZN191115C01850000	Nov.15.2019	calls	Out	0.302920359	0.217969219	0.1405
AMZN	AMZN191115C01855000	Nov.15.2019	calls	Out	0.300530845	0.217969219	0.1405
AMZN	AMZN191115C01860000	Nov.15.2019	calls	Out	0.300342943	0.217969219	0.1405
AMZN	AMZN191115C01865000	Nov.15.2019	calls	Out	0.299242641	0.217969219	0.1405
AMZN	AMZN191115C01870000	Nov.15.2019	calls	Out	0.298744252	0.217969219	0.1405
AMZN	AMZN191115C01875000	Nov.15.2019	calls	Out	0.297936884	0.217969219	0.1405
AMZN	AMZN191115C01880000	Nov.15.2019	calls	Out	0.296815809	0.217969219	0.1405
AMZN	AMZN191115C01890000	Nov.15.2019	calls	Out	0.295070738	0.217969219	0.1405
AMZN	AMZN191115C01900000	Nov.15.2019	calls	Out	0.293524218	0.217969219	0.1405
AMZN	AMZN191115C01905000	Nov.15.2019	calls	Out	0.291944513	0.217969219	0.1405
AMZN	AMZN191115C01910000	Nov.15.2019	calls	Out	0.292089564	0.217969219	0.1405
AMZN	AMZN191115P01740000	Nov.15.2019	puts	In	0.318270777	0.234951757	0.1405
AMZN	AMZN191115P01750000	Nov.15.2019	puts	In	0.315706678	0.234951757	0.1405
AMZN	AMZN191115P01760000	Nov.15.2019	puts	In	0.313688045	0.234951757	0.1405
AMZN	AMZN191115P01765000	Nov.15.2019	puts	In	0.312548046	0.234951757	0.1405
AMZN	AMZN191115P01770000	Nov.15.2019	puts	In	0.311530823	0.234951757	0.1405
AMZN	AMZN191115P01775000	Nov.15.2019	puts	In	0.310422146	0.234951757	0.1405
AMZN	AMZN191115P01780000	Nov.15.2019	puts	In	0.309325227	0.234951757	0.1405
AMZN	AMZN191115P01785000	Nov.15.2019	puts	In	0.307928787	0.234951757	0.1405
AMZN	AMZN191115P01790000	Nov.15.2019	puts	In	0.307156229	0.234951757	0.1405
AMZN	AMZN191115P01795000	Nov.15.2019	puts	In	0.30628278	0.234951757	0.1405
AMZN	AMZN191115P01800000	Nov.15.2019	puts	In	0.304802315	0.234951757	0.1405
AMZN	AMZN191115P01805000	Nov.15.2019	puts	In	0.303426314	0.234951757	0.1405
AMZN	AMZN191115P01810000	Nov.15.2019	puts	In	0.303055154	0.234951757	0.1405
AMZN	AMZN191115P01820000	Nov.15.2019	puts	Out	0.300990315	0.217969219	0.1405
AMZN	AMZN191115P01825000	Nov.15.2019	puts	Out	0.29989902	0.217969219	0.1405
AMZN	AMZN191115P01830000	Nov.15.2019	puts	Out	0.298899834	0.217969219	0.1405
AMZN	AMZN191115P01835000	Nov.15.2019	puts	Out	0.297791919	0.217969219	0.1405

AMZN	AMZN191115P01840000	Nov.15.2019	puts	Out	0.296773756	0.217969219	0.1405
AMZN	AMZN191115P01845000	Nov.15.2019	puts	Out	0.295844674	0.217969219	0.1405
AMZN	AMZN191115P01850000	Nov.15.2019	puts	Out	0.295204995	0.217969219	0.1405
AMZN	AMZN191115P01855000	Nov.15.2019	puts	Out	0.294052642	0.217969219	0.1405
AMZN	AMZN191115P01860000	Nov.15.2019	puts	Out	0.292684935	0.217969219	0.1405
AMZN	AMZN191115P01870000	Nov.15.2019	puts	Out	0.291326619	0.217969219	0.1405
AMZN	AMZN191115P01880000	Nov.15.2019	puts	Out	0.289105598	0.217969219	0.1405
AMZN	AMZN191115P01890000	Nov.15.2019	puts	Out	0.288610439	0.217969219	0.1405
AMZN	AMZN191115P01900000	Nov.15.2019	puts	Out	0.286630193	0.217969219	0.1405
AMZN	AMZN191115P01905000	Nov.15.2019	puts	Out	0.285788819	0.217969219	0.1405
AMZN	AMZN191115P01910000	Nov.15.2019	puts	Out	0.285052891	0.217969219	0.1405
AMZN	AMZN191220C01735000	Dec.20.2019	calls	In	0.321415996	0.234951757	0.1532
AMZN	AMZN191220C01740000	Dec.20.2019	calls	In	0.320356761	0.234951757	0.1532
AMZN	AMZN191220C01750000	Dec.20.2019	calls	In	0.318311312	0.234951757	0.1532
AMZN	AMZN191220C01755000	Dec.20.2019	calls	In	0.317405699	0.234951757	0.1532
AMZN	AMZN191220C01760000	Dec.20.2019	calls	In	0.316294699	0.234951757	0.1532
AMZN	AMZN191220C01765000	Dec.20.2019	calls	In	0.315397743	0.234951757	0.1532
AMZN	AMZN191220C01770000	Dec.20.2019	calls	In	0.314295493	0.234951757	0.1532
AMZN	AMZN191220C01775000	Dec.20.2019	calls	In	0.312825662	0.234951757	0.1532
AMZN	AMZN191220C01780000	Dec.20.2019	calls	In	0.31238529	0.234951757	0.1532
AMZN	AMZN191220C01785000	Dec.20.2019	calls	In	0.31075688	0.234951757	0.1532
AMZN	AMZN191220C01790000	Dec.20.2019	calls	In	0.309903358	0.234951757	0.1532
AMZN	AMZN191220C01795000	Dec.20.2019	calls	In	0.309490135	0.234951757	0.1532
AMZN	AMZN191220C01800000	Dec.20.2019	calls	In	0.308545446	0.234951757	0.1532
AMZN	AMZN191220C01805000	Dec.20.2019	calls	In	0.307154512	0.234951757	0.1532
AMZN	AMZN191220C01810000	Dec.20.2019	calls	In	0.306280339	0.234951757	0.1532
AMZN	AMZN191220C01815000	Dec.20.2019	calls	In	0.305359079	0.234951757	0.1532
AMZN	AMZN191220C01820000	Dec.20.2019	calls	Out	0.304549591	0.217969219	0.1532
AMZN	AMZN191220C01825000	Dec.20.2019	calls	Out	0.304486705	0.217969219	0.1532
AMZN	AMZN191220C01830000	Dec.20.2019	calls	Out	0.303578871	0.217969219	0.1532
AMZN	AMZN191220C01835000	Dec.20.2019	calls	Out	0.302542694	0.217969219	0.1532
AMZN	AMZN191220C01840000	Dec.20.2019	calls	Out	0.301695065	0.217969219	0.1532
AMZN	AMZN191220C01845000	Dec.20.2019	calls	Out	0.301194062	0.217969219	0.1532
AMZN	AMZN191220C01850000	Dec.20.2019	calls	Out	0.300166584	0.217969219	0.1532
AMZN	AMZN191220C01855000	Dec.20.2019	calls	Out	0.29932639	0.217969219	0.1532
AMZN	AMZN191220C01860000	Dec.20.2019	calls	Out	0.298594191	0.217969219	0.1532
AMZN	AMZN191220C01865000	Dec.20.2019	calls	Out	0.297651394	0.217969219	0.1532
AMZN	AMZN191220C01870000	Dec.20.2019	calls	Out	0.297056032	0.217969219	0.1532
AMZN	AMZN191220C01875000	Dec.20.2019	calls	Out	0.295848788	0.217969219	0.1532

AMZN	AMZN191220C01880000	Dec.20.2019	calls	Out	0.295471701	0.217969219	0.1532
AMZN	AMZN191220C01885000	Dec.20.2019	calls	Out	0.294318828	0.217969219	0.1532
AMZN	AMZN191220C01890000	Dec.20.2019	calls	Out	0.293921636	0.217969219	0.1532
AMZN	AMZN191220C01895000	Dec.20.2019	calls	Out	0.293068416	0.217969219	0.1532
AMZN	AMZN191220C01900000	Dec.20.2019	calls	Out	0.292571813	0.217969219	0.1532
AMZN	AMZN191220C01910000	Dec.20.2019	calls	Out	0.291183072	0.217969219	0.1532
AMZN	AMZN191220P01735000	Dec.20.2019	puts	In	0.311090202	0.234951757	0.1532
AMZN	AMZN191220P01740000	Dec.20.2019	puts	In	0.31079956	0.234951757	0.1532
AMZN	AMZN191220P01745000	Dec.20.2019	puts	In	0.309686854	0.234951757	0.1532
AMZN	AMZN191220P01750000	Dec.20.2019	puts	In	0.30879454	0.234951757	0.1532
AMZN	AMZN191220P01755000	Dec.20.2019	puts	In	0.307438848	0.234951757	0.1532
AMZN	AMZN191220P01760000	Dec.20.2019	puts	In	0.306636977	0.234951757	0.1532
AMZN	AMZN191220P01765000	Dec.20.2019	puts	In	0.305624635	0.234951757	0.1532
AMZN	AMZN191220P01770000	Dec.20.2019	puts	In	0.30498529	0.234951757	0.1532
AMZN	AMZN191220P01775000	Dec.20.2019	puts	In	0.304051391	0.234951757	0.1532
AMZN	AMZN191220P01780000	Dec.20.2019	puts	In	0.303236906	0.234951757	0.1532
AMZN	AMZN191220P01785000	Dec.20.2019	puts	In	0.302049476	0.234951757	0.1532
AMZN	AMZN191220P01790000	Dec.20.2019	puts	In	0.301873379	0.234951757	0.1532
AMZN	AMZN191220P01795000	Dec.20.2019	puts	In	0.301158517	0.234951757	0.1532
AMZN	AMZN191220P01800000	Dec.20.2019	puts	In	0.299508467	0.234951757	0.1532
AMZN	AMZN191220P01805000	Dec.20.2019	puts	In	0.298938094	0.234951757	0.1532
AMZN	AMZN191220P01810000	Dec.20.2019	puts	In	0.29871589	0.234951757	0.1532
AMZN	AMZN191220P01815000	Dec.20.2019	puts	In	0.297163029	0.234951757	0.1532
AMZN	AMZN191220P01820000	Dec.20.2019	puts	Out	0.296358355	0.217969219	0.1532
AMZN	AMZN191220P01825000	Dec.20.2019	puts	Out	0.295501555	0.217969219	0.1532
AMZN	AMZN191220P01830000	Dec.20.2019	puts	Out	0.294512826	0.217969219	0.1532
AMZN	AMZN191220P01835000	Dec.20.2019	puts	Out	0.293947324	0.217969219	0.1532
AMZN	AMZN191220P01840000	Dec.20.2019	puts	Out	0.29356601	0.217969219	0.1532
AMZN	AMZN191220P01845000	Dec.20.2019	puts	Out	0.292972162	0.217969219	0.1532
AMZN	AMZN191220P01850000	Dec.20.2019	puts	Out	0.291371491	0.217969219	0.1532
AMZN	AMZN191220P01855000	Dec.20.2019	puts	Out	0.291145479	0.217969219	0.1532
AMZN	AMZN191220P01860000	Dec.20.2019	puts	Out	0.290467997	0.217969219	0.1532
AMZN	AMZN191220P01865000	Dec.20.2019	puts	Out	0.289416595	0.217969219	0.1532
AMZN	AMZN191220P01870000	Dec.20.2019	puts	Out	0.289428572	0.217969219	0.1532
AMZN	AMZN191220P01880000	Dec.20.2019	puts	Out	0.287609359	0.217969219	0.1532
AMZN	AMZN191220P01885000	Dec.20.2019	puts	Out	0.286897735	0.217969219	0.1532
AMZN	AMZN191220P01890000	Dec.20.2019	puts	Out	0.286293362	0.217969219	0.1532
AMZN	AMZN191220P01895000	Dec.20.2019	puts	Out	0.285553207	0.217969219	0.1532
AMZN	AMZN191220P01900000	Dec.20.2019	puts	Out	0.285003975	0.217969219	0.1532

AMZN	AMZN191220P01910000	Dec.20.2019	puts	Out	0.284660558	0.217969219	0.1532
BA	BA191018C00370000	Oct.18.2019	calls	In	0.303392829	0.234951757	0.1395
BA	BA191018C00375000	Oct.18.2019	calls	In	0.299206373	0.234951757	0.1395
BA	BA191018C00380000	Oct.18.2019	calls	In	0.286248155	0.234951757	0.1395
BA	BA191018C00385000	Oct.18.2019	calls	In	0.279642141	0.234951757	0.1395
BA	BA191018C00390000	Oct.18.2019	calls	Out	0.272862403	0.217969219	0.1395
BA	BA191018C00395000	Oct.18.2019	calls	Out	0.267491813	0.217969219	0.1395
BA	BA191018C00400000	Oct.18.2019	calls	Out	0.261501075	0.217969219	0.1395
BA	BA191018C00405000	Oct.18.2019	calls	Out	0.257466568	0.217969219	0.1395
BA	BA191018P00370000	Oct.18.2019	puts	In	0.303906599	0.234951757	0.1395
BA	BA191018P00375000	Oct.18.2019	puts	In	0.294897741	0.234951757	0.1395
BA	BA191018P00380000	Oct.18.2019	puts	In	0.287073477	0.234951757	0.1395
BA	BA191018P00385000	Oct.18.2019	puts	In	0.27933373	0.234951757	0.1395
BA	BA191018P00390000	Oct.18.2019	puts	Out	0.272095895	0.217969219	0.1395
BA	BA191018P00395000	Oct.18.2019	puts	Out	0.265558969	0.217969219	0.1395
BA	BA191018P00400000	Oct.18.2019	puts	Out	0.261059857	0.217969219	0.1395
BA	BA191018P00405000	Oct.18.2019	puts	Out	0.257202699	0.217969219	0.1395
BA	BA191115C00370000	Nov.15.2019	calls	In	0.33137008	0.234951757	0.1405
BA	BA191115C00375000	Nov.15.2019	calls	In	0.326491355	0.234951757	0.1405
BA	BA191115C00380000	Nov.15.2019	calls	In	0.32047703	0.234951757	0.1405
BA	BA191115C00385000	Nov.15.2019	calls	In	0.316004329	0.234951757	0.1405
BA	BA191115C00390000	Nov.15.2019	calls	Out	0.312392773	0.217969219	0.1405
BA	BA191115C00395000	Nov.15.2019	calls	Out	0.305299172	0.217969219	0.1405
BA	BA191115C00400000	Nov.15.2019	calls	Out	0.298795121	0.217969219	0.1405
BA	BA191115C00405000	Nov.15.2019	calls	Out	0.297405616	0.217969219	0.1405
BA	BA191115P00370000	Nov.15.2019	puts	In	0.352713542	0.234951757	0.1405
BA	BA191115P00375000	Nov.15.2019	puts	In	0.34570675	0.234951757	0.1405
BA	BA191115P00380000	Nov.15.2019	puts	In	0.343680694	0.234951757	0.1405
BA	BA191115P00385000	Nov.15.2019	puts	In	0.339023291	0.234951757	0.1405
BA	BA191115P00390000	Nov.15.2019	puts	Out	0.333170547	0.217969219	0.1405
BA	BA191115P00395000	Nov.15.2019	puts	Out	0.331204355	0.217969219	0.1405
BA	BA191115P00400000	Nov.15.2019	puts	Out	0.331789852	0.217969219	0.1405
BA	BA191115P00405000	Nov.15.2019	puts	Out	0.326853938	0.217969219	0.1405
SPY	SPY191018C00287000	Oct.18.2019	calls	In	0.08726249	0.234951757	0.1395
SPY	SPY191018C00288000	Oct.18.2019	calls	In	0.104906257	0.234951757	0.1395
SPY	SPY191018C00289000	Oct.18.2019	calls	In	0.112017748	0.234951757	0.1395
SPY	SPY191018C00290000	Oct.18.2019	calls	In	0.113836087	0.234951757	0.1395
SPY	SPY191018C00291000	Oct.18.2019	calls	In	0.116902968	0.234951757	0.1395
SPY	SPY191018C00292000	Oct.18.2019	calls	In	0.118402499	0.234951757	0.1395

SPY	SPY191018C00293000	Oct.18.2019	calls	In	0.11919202	0.234951757	0.1395
SPY	SPY191018C00294000	Oct.18.2019	calls	In	0.119168193	0.234951757	0.1395
SPY	SPY191018C00295000	Oct.18.2019	calls	In	0.121225218	0.234951757	0.1395
SPY	SPY191018C00296000	Oct.18.2019	calls	In	0.119188951	0.234951757	0.1395
SPY	SPY191018C00297000	Oct.18.2019	calls	In	0.117323141	0.234951757	0.1395
SPY	SPY191018C00298000	Oct.18.2019	calls	In	0.114776385	0.234951757	0.1395
SPY	SPY191018C00299000	Oct.18.2019	calls	In	0.112860281	0.234951757	0.1395
SPY	SPY191018C00300000	Oct.18.2019	calls	In	0.110586226	0.234951757	0.1395
SPY	SPY191018C00301000	Oct.18.2019	calls	In	0.108357079	0.234951757	0.1395
SPY	SPY191018C00302000	Oct.18.2019	calls	Out	0.10622856	0.217969219	0.1395
SPY	SPY191018C00303000	Oct.18.2019	calls	Out	0.104111448	0.217969219	0.1395
SPY	SPY191018C00304000	Oct.18.2019	calls	Out	0.102111205	0.217969219	0.1395
SPY	SPY191018C00305000	Oct.18.2019	calls	Out	0.100579557	0.217969219	0.1395
SPY	SPY191018C00306000	Oct.18.2019	calls	Out	0.09915175	0.217969219	0.1395
SPY	SPY191018C00307000	Oct.18.2019	calls	Out	0.098008992	0.217969219	0.1395
SPY	SPY191018C00308000	Oct.18.2019	calls	Out	0.097339752	0.217969219	0.1395
SPY	SPY191018C00309000	Oct.18.2019	calls	Out	0.097265632	0.217969219	0.1395
SPY	SPY191018C00310000	Oct.18.2019	calls	Out	0.097344437	0.217969219	0.1395
SPY	SPY191018C00311000	Oct.18.2019	calls	Out	0.098015095	0.217969219	0.1395
SPY	SPY191018C00312000	Oct.18.2019	calls	Out	0.099060105	0.217969219	0.1395
SPY	SPY191018C00313000	Oct.18.2019	calls	Out	0.100520868	0.217969219	0.1395
SPY	SPY191018C00314000	Oct.18.2019	calls	Out	0.101812941	0.217969219	0.1395
SPY	SPY191018C00315000	Oct.18.2019	calls	Out	0.103137854	0.217969219	0.1395
SPY	SPY191018C00316000	Oct.18.2019	calls	Out	0.104808101	0.217969219	0.1395
SPY	SPY191018P00287000	Oct.18.2019	puts	In	0.201534378	0.234951757	0.1395
SPY	SPY191018P00288000	Oct.18.2019	puts	In	0.198161523	0.234951757	0.1395
SPY	SPY191018P00289000	Oct.18.2019	puts	In	0.194743922	0.234951757	0.1395
SPY	SPY191018P00290000	Oct.18.2019	puts	In	0.191005243	0.234951757	0.1395
SPY	SPY191018P00291000	Oct.18.2019	puts	In	0.187603493	0.234951757	0.1395
SPY	SPY191018P00292000	Oct.18.2019	puts	In	0.184015594	0.234951757	0.1395
SPY	SPY191018P00293000	Oct.18.2019	puts	In	0.180207945	0.234951757	0.1395
SPY	SPY191018P00294000	Oct.18.2019	puts	In	0.176538492	0.234951757	0.1395
SPY	SPY191018P00295000	Oct.18.2019	puts	In	0.172582073	0.234951757	0.1395
SPY	SPY191018P00296000	Oct.18.2019	puts	In	0.168957479	0.234951757	0.1395
SPY	SPY191018P00297000	Oct.18.2019	puts	In	0.1652618	0.234951757	0.1395
SPY	SPY191018P00298000	Oct.18.2019	puts	In	0.161945128	0.234951757	0.1395
SPY	SPY191018P00299000	Oct.18.2019	puts	In	0.158569167	0.234951757	0.1395
SPY	SPY191018P00300000	Oct.18.2019	puts	In	0.155730205	0.234951757	0.1395
SPY	SPY191018P00301000	Oct.18.2019	puts	In	0.15284521	0.234951757	0.1395

SPY	SPY191018P00302000	Oct.18.2019	puts	Out	0.151005795	0.217969219	0.1395
SPY	SPY191018P00303000	Oct.18.2019	puts	Out	0.150170692	0.217969219	0.1395
SPY	SPY191018P00304000	Oct.18.2019	puts	Out	0.149680872	0.217969219	0.1395
SPY	SPY191018P00305000	Oct.18.2019	puts	Out	0.149734945	0.217969219	0.1395
SPY	SPY191018P00306000	Oct.18.2019	puts	Out	0.151460318	0.217969219	0.1395
SPY	SPY191018P00307000	Oct.18.2019	puts	Out	0.15343542	0.217969219	0.1395
SPY	SPY191018P00308000	Oct.18.2019	puts	Out	0.157408491	0.217969219	0.1395
SPY	SPY191018P00309000	Oct.18.2019	puts	Out	0.162774587	0.217969219	0.1395
SPY	SPY191018P00310000	Oct.18.2019	puts	Out	0.169140104	0.217969219	0.1395
SPY	SPY191018P00311000	Oct.18.2019	puts	Out	0.175441697	0.217969219	0.1395
SPY	SPY191018P00312000	Oct.18.2019	puts	Out	0.183867477	0.217969219	0.1395
SPY	SPY191018P00313000	Oct.18.2019	puts	Out	0.19181275	0.217969219	0.1395
SPY	SPY191018P00314000	Oct.18.2019	puts	Out	0.199727088	0.217969219	0.1395
SPY	SPY191018P00315000	Oct.18.2019	puts	Out	0.208326232	0.217969219	0.1395
SPY	SPY191018P00316000	Oct.18.2019	puts	Out	0.216985258	0.217969219	0.1395
SPY	SPY191115C00287000	Nov.15.2019	calls	In	0.165076475	0.234951757	0.1405
SPY	SPY191115C00288000	Nov.15.2019	calls	In	0.163829266	0.234951757	0.1405
SPY	SPY191115C00289000	Nov.15.2019	calls	In	0.162446831	0.234951757	0.1405
SPY	SPY191115C00290000	Nov.15.2019	calls	In	0.160757885	0.234951757	0.1405
SPY	SPY191115C00291000	Nov.15.2019	calls	In	0.158923625	0.234951757	0.1405
SPY	SPY191115C00292000	Nov.15.2019	calls	In	0.157227036	0.234951757	0.1405
SPY	SPY191115C00293000	Nov.15.2019	calls	In	0.155195916	0.234951757	0.1405
SPY	SPY191115C00294000	Nov.15.2019	calls	In	0.153109965	0.234951757	0.1405
SPY	SPY191115C00295000	Nov.15.2019	calls	In	0.150960966	0.234951757	0.1405
SPY	SPY191115C00296000	Nov.15.2019	calls	In	0.148548773	0.234951757	0.1405
SPY	SPY191115C00297000	Nov.15.2019	calls	In	0.145762268	0.234951757	0.1405
SPY	SPY191115C00298000	Nov.15.2019	calls	In	0.143341305	0.234951757	0.1405
SPY	SPY191115C00299000	Nov.15.2019	calls	In	0.140982203	0.234951757	0.1405
SPY	SPY191115C00300000	Nov.15.2019	calls	In	0.138403279	0.234951757	0.1405
SPY	SPY191115C00301000	Nov.15.2019	calls	In	0.135938363	0.234951757	0.1405
SPY	SPY191115C00302000	Nov.15.2019	calls	Out	0.13330838	0.217969219	0.1405
SPY	SPY191115C00303000	Nov.15.2019	calls	Out	0.130839584	0.217969219	0.1405
SPY	SPY191115C00304000	Nov.15.2019	calls	Out	0.128376998	0.217969219	0.1405
SPY	SPY191115C00305000	Nov.15.2019	calls	Out	0.126134556	0.217969219	0.1405
SPY	SPY191115C00306000	Nov.15.2019	calls	Out	0.123845157	0.217969219	0.1405
SPY	SPY191115C00307000	Nov.15.2019	calls	Out	0.121744476	0.217969219	0.1405
SPY	SPY191115C00308000	Nov.15.2019	calls	Out	0.119807544	0.217969219	0.1405
SPY	SPY191115C00309000	Nov.15.2019	calls	Out	0.117939038	0.217969219	0.1405
SPY	SPY191115C00310000	Nov.15.2019	calls	Out	0.116434273	0.217969219	0.1405

SPY	SPY191115C00311000	Nov.15.2019	calls	Out	0.115060528	0.217969219	0.1405
SPY	SPY191115C00312000	Nov.15.2019	calls	Out	0.114043383	0.217969219	0.1405
SPY	SPY191115C00313000	Nov.15.2019	calls	Out	0.113149751	0.217969219	0.1405
SPY	SPY191115C00314000	Nov.15.2019	calls	Out	0.11247273	0.217969219	0.1405
SPY	SPY191115C00315000	Nov.15.2019	calls	Out	0.112148109	0.217969219	0.1405
SPY	SPY191115C00316000	Nov.15.2019	calls	Out	0.111806604	0.217969219	0.1405
SPY	SPY191115P00287000	Nov.15.2019	puts	In	0.206698537	0.234951757	0.1405
SPY	SPY191115P00288000	Nov.15.2019	puts	In	0.203850328	0.234951757	0.1405
SPY	SPY191115P00289000	Nov.15.2019	puts	In	0.200995897	0.234951757	0.1405
SPY	SPY191115P00290000	Nov.15.2019	puts	In	0.198262519	0.234951757	0.1405
SPY	SPY191115P00291000	Nov.15.2019	puts	In	0.195193731	0.234951757	0.1405
SPY	SPY191115P00292000	Nov.15.2019	puts	In	0.192372555	0.234951757	0.1405
SPY	SPY191115P00293000	Nov.15.2019	puts	In	0.189434623	0.234951757	0.1405
SPY	SPY191115P00294000	Nov.15.2019	puts	In	0.186531877	0.234951757	0.1405
SPY	SPY191115P00295000	Nov.15.2019	puts	In	0.183508621	0.234951757	0.1405
SPY	SPY191115P00296000	Nov.15.2019	puts	In	0.180603267	0.234951757	0.1405
SPY	SPY191115P00297000	Nov.15.2019	puts	In	0.177659086	0.234951757	0.1405
SPY	SPY191115P00298000	Nov.15.2019	puts	In	0.174776631	0.234951757	0.1405
SPY	SPY191115P00299000	Nov.15.2019	puts	In	0.171927781	0.234951757	0.1405
SPY	SPY191115P00300000	Nov.15.2019	puts	In	0.169207206	0.234951757	0.1405
SPY	SPY191115P00301000	Nov.15.2019	puts	In	0.16658644	0.234951757	0.1405
SPY	SPY191115P00302000	Nov.15.2019	puts	Out	0.164159901	0.217969219	0.1405
SPY	SPY191115P00303000	Nov.15.2019	puts	Out	0.161903705	0.217969219	0.1405
SPY	SPY191115P00304000	Nov.15.2019	puts	Out	0.160040307	0.217969219	0.1405
SPY	SPY191115P00305000	Nov.15.2019	puts	Out	0.157950446	0.217969219	0.1405
SPY	SPY191115P00306000	Nov.15.2019	puts	Out	0.156724342	0.217969219	0.1405
SPY	SPY191115P00307000	Nov.15.2019	puts	Out	0.155889125	0.217969219	0.1405
SPY	SPY191115P00308000	Nov.15.2019	puts	Out	0.155340763	0.217969219	0.1405
SPY	SPY191115P00309000	Nov.15.2019	puts	Out	0.155369229	0.217969219	0.1405
SPY	SPY191115P00310000	Nov.15.2019	puts	Out	0.157076223	0.217969219	0.1405
SPY	SPY191115P00311000	Nov.15.2019	puts	Out	0.157218884	0.217969219	0.1405
SPY	SPY191115P00312000	Nov.15.2019	puts	Out	0.15921684	0.217969219	0.1405
SPY	SPY191115P00313000	Nov.15.2019	puts	Out	0.161952387	0.217969219	0.1405
SPY	SPY191115P00314000	Nov.15.2019	puts	Out	0.165521189	0.217969219	0.1405
SPY	SPY191115P00315000	Nov.15.2019	puts	Out	0.168947689	0.217969219	0.1405
SPY	SPY191115P00316000	Nov.15.2019	puts	Out	0.173509006	0.217969219	0.1405
SPY	SPY191220C00287000	Dec.20.2019	calls	In	0.182709425	0.234951757	0.1532
SPY	SPY191220C00288000	Dec.20.2019	calls	In	0.180839198	0.234951757	0.1532
SPY	SPY191220C00289000	Dec.20.2019	calls	In	0.178955914	0.234951757	0.1532

SPY	SPY191220C00290000	Dec.20.2019	calls	In	0.177162018	0.234951757	0.1532
SPY	SPY191220C00291000	Dec.20.2019	calls	In	0.175106762	0.234951757	0.1532
SPY	SPY191220C00292000	Dec.20.2019	calls	In	0.173137793	0.234951757	0.1532
SPY	SPY191220C00293000	Dec.20.2019	calls	In	0.170983215	0.234951757	0.1532
SPY	SPY191220C00294000	Dec.20.2019	calls	In	0.16887534	0.234951757	0.1532
SPY	SPY191220C00295000	Dec.20.2019	calls	In	0.166695066	0.234951757	0.1532
SPY	SPY191220C00296000	Dec.20.2019	calls	In	0.164431704	0.234951757	0.1532
SPY	SPY191220C00297000	Dec.20.2019	calls	In	0.162174139	0.234951757	0.1532
SPY	SPY191220C00298000	Dec.20.2019	calls	In	0.159808552	0.234951757	0.1532
SPY	SPY191220C00299000	Dec.20.2019	calls	In	0.157420871	0.234951757	0.1532
SPY	SPY191220C00300000	Dec.20.2019	calls	In	0.155189588	0.234951757	0.1532
SPY	SPY191220C00301000	Dec.20.2019	calls	In	0.153769575	0.234951757	0.1532
SPY	SPY191220C00302000	Dec.20.2019	calls	Out	0.150259079	0.217969219	0.1532
SPY	SPY191220C00303000	Dec.20.2019	calls	Out	0.148009382	0.217969219	0.1532
SPY	SPY191220C00304000	Dec.20.2019	calls	Out	0.145561474	0.217969219	0.1532
SPY	SPY191220C00305000	Dec.20.2019	calls	Out	0.143282532	0.217969219	0.1532
SPY	SPY191220C00306000	Dec.20.2019	calls	Out	0.141062156	0.217969219	0.1532
SPY	SPY191220C00307000	Dec.20.2019	calls	Out	0.138789042	0.217969219	0.1532
SPY	SPY191220C00308000	Dec.20.2019	calls	Out	0.136746079	0.217969219	0.1532
SPY	SPY191220C00309000	Dec.20.2019	calls	Out	0.134629303	0.217969219	0.1532
SPY	SPY191220C00310000	Dec.20.2019	calls	Out	0.132633624	0.217969219	0.1532
SPY	SPY191220C00311000	Dec.20.2019	calls	Out	0.130727696	0.217969219	0.1532
SPY	SPY191220C00312000	Dec.20.2019	calls	Out	0.129067037	0.217969219	0.1532
SPY	SPY191220C00313000	Dec.20.2019	calls	Out	0.127429934	0.217969219	0.1532
SPY	SPY191220C00314000	Dec.20.2019	calls	Out	0.125821338	0.217969219	0.1532
SPY	SPY191220C00315000	Dec.20.2019	calls	Out	0.124625266	0.217969219	0.1532
SPY	SPY191220C00316000	Dec.20.2019	calls	Out	0.123390446	0.217969219	0.1532
SPY	SPY191220P00287000	Dec.20.2019	puts	In	0.21836252	0.234951757	0.1532
SPY	SPY191220P00288000	Dec.20.2019	puts	In	0.216075151	0.234951757	0.1532
SPY	SPY191220P00289000	Dec.20.2019	puts	In	0.21400268	0.234951757	0.1532
SPY	SPY191220P00290000	Dec.20.2019	puts	In	0.211716425	0.234951757	0.1532
SPY	SPY191220P00291000	Dec.20.2019	puts	In	0.209431536	0.234951757	0.1532
SPY	SPY191220P00292000	Dec.20.2019	puts	In	0.207033682	0.234951757	0.1532
SPY	SPY191220P00293000	Dec.20.2019	puts	In	0.204829471	0.234951757	0.1532
SPY	SPY191220P00294000	Dec.20.2019	puts	In	0.202494603	0.234951757	0.1532
SPY	SPY191220P00295000	Dec.20.2019	puts	In	0.200226626	0.234951757	0.1532
SPY	SPY191220P00296000	Dec.20.2019	puts	In	0.198013452	0.234951757	0.1532
SPY	SPY191220P00297000	Dec.20.2019	puts	In	0.195744751	0.234951757	0.1532
SPY	SPY191220P00298000	Dec.20.2019	puts	In	0.193608374	0.234951757	0.1532

SPY	SPY191220P00299000	Dec.20.2019	puts	In	0.191396802	0.234951757	0.1532
SPY	SPY191220P00300000	Dec.20.2019	puts	In	0.189295303	0.234951757	0.1532
SPY	SPY191220P00301000	Dec.20.2019	puts	In	0.187196286	0.234951757	0.1532
SPY	SPY191220P00302000	Dec.20.2019	puts	Out	0.185282259	0.217969219	0.1532
SPY	SPY191220P00303000	Dec.20.2019	puts	Out	0.183447374	0.217969219	0.1532
SPY	SPY191220P00304000	Dec.20.2019	puts	Out	0.181683511	0.217969219	0.1532
SPY	SPY191220P00305000	Dec.20.2019	puts	Out	0.180175603	0.217969219	0.1532
SPY	SPY191220P00306000	Dec.20.2019	puts	Out	0.17834147	0.217969219	0.1532
SPY	SPY191220P00307000	Dec.20.2019	puts	Out	0.177043106	0.217969219	0.1532
SPY	SPY191220P00308000	Dec.20.2019	puts	Out	0.175895995	0.217969219	0.1532
SPY	SPY191220P00309000	Dec.20.2019	puts	Out	0.175198325	0.217969219	0.1532
SPY	SPY191220P00310000	Dec.20.2019	puts	Out	0.174565707	0.217969219	0.1532
SPY	SPY191220P00311000	Dec.20.2019	puts	Out	0.174003384	0.217969219	0.1532
SPY	SPY191220P00312000	Dec.20.2019	puts	Out	0.174135105	0.217969219	0.1532
SPY	SPY191220P00313000	Dec.20.2019	puts	Out	0.174269624	0.217969219	0.1532
SPY	SPY191220P00314000	Dec.20.2019	puts	Out	0.175028317	0.217969219	0.1532
SPY	SPY191220P00315000	Dec.20.2019	puts	Out	0.175627495	0.217969219	0.1532
SPY	SPY191220P00316000	Dec.20.2019	puts	Out	0.176825938	0.217969219	0.1532

REPORT2:

Option	Maturity	Op.Type	Imp.Vol.	BS Price	BiTree Price
AMZN191018C01815000	Oct.18.2019	calls	0.246175904	47.625	46.73339208
AMZN191018C01820000	Oct.18.2019	calls	0.244427649	44.825	43.97612114
AMZN191018C01810000	Oct.18.2019	calls	0.24731401	50.40000002	49.37718004
AMZN191018C01825000	Oct.18.2019	calls	0.242474108	42.075	41.17991963
AMZN191018C01805000	Oct.18.2019	calls	0.248254835	53.22500037	51.98403416
AMZN191018C01830000	Oct.18.2019	calls	0.240442872	39.40000002	38.36830504
AMZN191018C01800000	Oct.18.2019	calls	0.249976073	56.27500243	54.7340207
AMZN191018C01835000	Oct.18.2019	calls	0.239284623	36.97500052	35.71786273
AMZN191018C01795000	Oct.18.2019	calls	0.252225926	59.50000914	57.58027005
AMZN191018C01840000	Oct.18.2019	calls	0.237212885	34.475004	32.89686261
AMZN191018P01815000	Oct.18.2019	puts	0.238608467	41.175	42.87858675
AMZN191018P01820000	Oct.18.2019	puts	0.238146001	43.6	45.35013014
AMZN191018P01810000	Oct.18.2019	puts	0.240085913	39.02500002	40.59410902
AMZN191018P01825000	Oct.18.2019	puts	0.23623405	45.85	47.55284613
AMZN191018P01805000	Oct.18.2019	puts	0.241632397	36.97500052	38.32160043

AMZN191018P01830000	Oct.18.2019	puts	0.234231232	48.17500003	49.73772562
AMZN191018P01800000	Oct.18.2019	puts	0.242980078	34.9750034	36.01171855
AMZN191018P01835000	Oct.18.2019	puts	0.23281379	50.70000071	52.03035429
AMZN191018P01795000	Oct.18.2019	puts	0.245119811	33.20001279	33.84670474
AMZN191018P01840000	Oct.18.2019	puts	0.231570036	53.35000522	54.39013473
AMZN191115C01815000	Nov.15.2019	calls	0.309664133	81.125	78.9766662
AMZN191115C01820000	Nov.15.2019	calls	0.309109839	78.55	76.45116982
AMZN191115C01810000	Nov.15.2019	calls	0.309814419	83.65	81.40058014
AMZN191115C01805000	Nov.15.2019	calls	0.311068972	86.5	84.10061236
AMZN191115C01830000	Nov.15.2019	calls	0.30689575	73.275	71.12057933
AMZN191115C01800000	Nov.15.2019	calls	0.310911129	89.05000001	86.44696833
AMZN191115C01840000	Nov.15.2019	calls	0.304368998	68.125	65.70794957
AMZN191115C01790000	Nov.15.2019	calls	0.314662698	95.30000022	92.15315972
AMZN191115C01845000	Nov.15.2019	calls	0.302997305	65.60000002	62.97292482
AMZN191115C01850000	Nov.15.2019	calls	0.302920359	63.45000013	60.95375752
AMZN191115P01820000	Nov.15.2019	puts	0.300990315	74.175	76.94485301
AMZN191115P01810000	Nov.15.2019	puts	0.303055154	69.65	72.26747446
AMZN191115P01825000	Nov.15.2019	puts	0.29989902	76.5	79.26765905
AMZN191115P01805000	Nov.15.2019	puts	0.303426314	67.3	69.76229338
AMZN191115P01830000	Nov.15.2019	puts	0.298899834	78.9	81.61291066
AMZN191115P01800000	Nov.15.2019	puts	0.304802315	65.25000002	67.50787548
AMZN191115P01835000	Nov.15.2019	puts	0.297791919	81.325	83.93004371
AMZN191115P01795000	Nov.15.2019	puts	0.30628278	63.27500011	65.27856236
AMZN191115P01840000	Nov.15.2019	puts	0.296773756	83.825	86.26907944
AMZN191115P01790000	Nov.15.2019	puts	0.307156229	61.20000036	62.89700673
AMZN191220C01815000	Dec.20.2019	calls	0.305359079	101.05	96.67353485
AMZN191220C01820000	Dec.20.2019	calls	0.304549591	98.37499999	94.06650006
AMZN191220C01810000	Dec.20.2019	calls	0.306280339	103.8	99.55795522
AMZN191220C01825000	Dec.20.2019	calls	0.304486705	95.97499999	91.92777807
AMZN191220C01805000	Dec.20.2019	calls	0.307154512	106.575	102.4269374
AMZN191220C01830000	Dec.20.2019	calls	0.303578871	93.34999999	89.52451691
AMZN191220C01800000	Dec.20.2019	calls	0.308545446	109.55	105.455574
AMZN191220C01835000	Dec.20.2019	calls	0.302542694	90.72499999	87.08025008
AMZN191220C01795000	Dec.20.2019	calls	0.309490135	112.425	108.34467
AMZN191220C01840000	Dec.20.2019	calls	0.301695065	88.2	84.69427795
AMZN191220P01815000	Dec.20.2019	puts	0.297163029	88.32499999	91.66887468
AMZN191220P01820000	Dec.20.2019	puts	0.296358355	90.62499999	94.03859176
AMZN191220P01810000	Dec.20.2019	puts	0.29871589	86.3	89.77471622
AMZN191220P01825000	Dec.20.2019	puts	0.295501555	92.94999998	96.62697385

AMZN191220P01805000	Dec.20.2019	puts	0.298938094	83.9	87.46551052
AMZN191220P01830000	Dec.20.2019	puts	0.294512826	95.27499998	99.17332101
AMZN191220P01800000	Dec.20.2019	puts	0.299508467	81.65	85.26420589
AMZN191220P01835000	Dec.20.2019	puts	0.293947324	97.77499999	101.8514999
AMZN191220P01795000	Dec.20.2019	puts	0.301158517	79.77500003	83.39713243
AMZN191220P01840000	Dec.20.2019	puts	0.29356601	100.375	104.5870158