MATH 538 **Computer Project 3** **Zhou Wang**

Due: Friday, March 1, 2019

```
BOPM <- function(S0, K, r, u, d, n, option){
  p <- (1 + r - d)/(u - d); q <- 1 - p
  reward <- function(t, option) {
    diff <- S0 * d^(0:t) * u^(t:0) - K
    if (option == "call") abs(diff) * (diff > 0)
    else abs(diff) * (diff < 0)
  }

  for (t in 0:n) {
    curRe <- reward(t, option); futRe <- reward(t + 1, option)
    fairRet <- sapply(1:(t + 1), function(j) cbind(p, q) %*% futRe[j:(j + 1)])/(1 + r)
    if (all(curRe >= fairRet)) break
  }

  fairRe0 <- t(curRe) %*% dbinom(0:t, t, q)/(1 + r)^t
  ind <- which(curRe != 0) - 1; stocPri <- S0 * d^(ind) * u^(t - ind)

  cat(paste(sprintf("The fair price of the derivative at time 0 is %.5f. \nThe
    derivative should be exercised at time %d", fairRe0, t), c("whatever stock price is
    .", sprintf("provided the stock price is %.5f.", stocPri))[(length(ind) < 2) + 1]))
}
```

(1)

```
BOPM(400, 375, 0.07, 1.25, 0.8, 100, "call")
```

```
The fair price of the derivative at time 0 is 399.57179.
The derivative should be exercised at time 100 whatever stock price is.
```

(2)

```
BOPM(400, 375, 0.07, 1.25, 0.8, 100, "put")
```

```
The fair price of the derivative at time 0 is 20.56075.
The derivative should be exercised at time 1 provided the stock price is 320.00000.
```

For call option, the fair price of derivative at time 0 will converge to the $S_{0,0}$ as $n \to +\infty$, which is 400 in this case.

For put option, the fair price of derivative at time 0 will not change when $n \to +\infty$. I mean we stop early, which is not influenced by huge n.