FIN 5350- Homework 2

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## Numerical Problems

Please complete the following numerical problems by hand (or in a Rmd document like this one).

##### **Problem 1**

Let , , , , and . Let , , and .

# A. Call

## [1] 0.5

## [1] -38.43158

## [1] 11.56842

# B. Put

## [1] -0.5

## [1] 62.45131

## [1] 12.45131

##### **Problem 2**

Let , , , , and . Let , , and .

# a

## [1] 7.470788

 The premium does equal 7.47.

# b

## [1] 0.7

## [1] -53.80421

## [1] 16.19579

 The theoretical value of the call is 16.1957 which is less than the price of 17. You should sell the call option, buy .7 units of the stock, and borrow 52.8042 dollars to create a synthetic call. This arbitrage position will profit the difference of 0.8043.

# c

 You would want to buy the call because it is undervalued. Then sell .7 unites of a share and lend 53.8042. The arbitrage profit is 0.696.

##### **Problem 3**

Let , , , , , and . Let , , and . Construct the binomial tree for a call option. At each node provide the premium, , and .

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 1

## [1] -91.275

## [1] 38.725

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.225

## [1] -13.83537

## [1] 4.164632

## [1] "Delta, B, Premium"

## [1] 0.6912074

## [1] -49.12705

## [1] 19.99369

## [,1] [,2] [,3]  
## [1,] 19.99369 38.725003 74  
## [2,] 0.00000 4.164632 9  
## [3,] 0.00000 0.000000 0

##### **Problem 4**

Repeat the option price calculation in the previous question for stock prices of , , , , and , but now let . Keep everyting else fixed. What happens to the initial option as the stock price increases?

# Stock price of 80

## [1] "Delta\_uu, Buu, Premium\_uu"

## [1] 1

## [1] -92.50015

## [1] 42.69985

## [1] "Delta\_dd, Bdd, Premium\_dd"

## [1] 0

## [1] 0

## [1] 0

## [1] "Delta\_ud, Bud, Premium\_ud"

## [1] 0.3163462

## [1] -20.50193

## [1] 5.818073

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 0.709265

## [1] -51.79305

## [1] 21.97051

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.1818148

## [1] -9.063959

## [1] 2.572186

## [1] "Delta, B, Premium"

## [1] 0.4849582

## [1] -27.7161

## [1] 11.08056

# Stock price of 90

## [1] "Delta\_uu, Buu, Premium\_uu"

## [1] 1

## [1] -92.50015

## [1] 59.59985

## [1] "Delta\_dd, Bdd, Premium\_dd"

## [1] 0

## [1] 0

## [1] 0

## [1] "Delta\_ud, Bud, Premium\_ud"

## [1] 0.5700855

## [1] -41.5647

## [1] 11.7953

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 0.8171718

## [1] -62.98966

## [1] 32.61944

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.3276473

## [1] -18.37587

## [1] 5.214736

## [1] "Delta, B, Premium"

## [1] 0.6089935

## [1] -37.6162

## [1] 17.19321

# Stock price of 110

## [1] "Delta\_uu, Buu, Premium\_uu"

## [1] 1

## [1] -92.50015

## [1] 93.39985

## [1] "Delta\_dd, Bdd, Premium\_dd"

## [1] 0

## [1] 0

## [1] 0

## [1] "Delta\_ud, Bud, Premium\_ud"

## [1] 0.9391608

## [1] -83.69024

## [1] 23.74976

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 0.9741272

## [1] -85.38288

## [1] 53.91731

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.5397673

## [1] -36.99969

## [1] 10.49984

## [1] "Delta, B, Premium"

## [1] 0.7894085

## [1] -57.41641

## [1] 29.41853

# Stock price of 120

## [1] "Delta\_uu, Buu, Premium\_uu"

## [1] 1

## [1] -92.50015

## [1] 110.2999

## [1] "Delta\_dd, Bdd, Premium\_dd"

## [1] 0.1260417

## [1] -7.540222

## [1] 2.139778

## [1] "Delta\_ud, Bud, Premium\_ud"

## [1] 1

## [1] -92.50015

## [1] 32.29985

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 1

## [1] -90.06607

## [1] 65.93393

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.6283349

## [1] -44.90283

## [1] 15.41733

## [1] "Delta, B, Premium"

## [1] 0.8419433

## [1] -63.68804

## [1] 37.34516

# Stock price of 130

## [1] "Delta\_uu, Buu, Premium\_uu"

## [1] 1

## [1] -92.50015

## [1] 127.1999

## [1] "Delta\_dd, Bdd, Premium\_dd"

## [1] 0.3163462

## [1] -20.50193

## [1] 5.818073

## [1] "Delta\_ud, Bud, Premium\_ud"

## [1] 1

## [1] -92.50015

## [1] 42.69985

## [1] "Delta\_u, Bu, Premium\_u"

## [1] 1

## [1] -90.06607

## [1] 78.93393

## [1] "Delta\_d, Bd, Premium\_d"

## [1] 0.709265

## [1] -51.79305

## [1] 21.97051

## [1] "Delta, B, Premium"

## [1] 0.8763602

## [1] -67.35077

## [1] 46.57606

##### **Problem 5**

Let , , (continuously compounded), , , and year and .

# a

## [1] "Premium"

## [1] 18.28255

## Payoff\_Suu: 54.14421 < Premium\_uu: 56.64406

## Payoff\_Sud: 10.47812 < Premium\_ud: 15.04033

## Payoff\_Sdd: -20.40352 < Premium\_dd: 0

## Payoff\_Su: 27.12461 < Premium\_u: 33.14932

## Payoff\_Sd: -8.630745 < Premium\_d: 6.68973

# b

# risk neutral binomal pmf????

## [1] "Premium"

## [1] 18.28255

## Payoff\_Suu: 54.14421 < Premium\_uu: 56.64406

## Payoff\_Sud: 10.47812 < Premium\_ud: 15.04033

## Payoff\_Sdd: -20.40352 < Premium\_dd: 0

## Payoff\_Su: 27.12461 < Premium\_u: 33.14932

## Payoff\_Sd: -8.630745 < Premium\_d: 6.68973

# c

## [1] "Premium"

## [1] 5.978605

## Payoff\_Suu: 54.14421 < Premium\_uu: 0

## Payoff\_Sud: 10.47812 < Premium\_ud: 2.062357

## Payoff\_Sdd: -20.40352 < Premium\_dd: 17.90366

## Payoff\_Su: 27.12461 < Premium\_u: 1.09078

## Payoff\_Sd: -8.630745 < Premium\_d: 10.38655

## Call-Put = 12.30395

## PV(Forward-Strike) = 12.30395

# d

## [1] "Premium"

## [1] 6.677901

## Payoff\_Suu: -54.14421 < Premium\_uu: 0

## Payoff\_Sud: -10.47812 < Premium\_ud: 2.062357

## Payoff\_Sdd: 20.40352 < Premium\_dd: 20.40352

## Payoff\_Su: -27.12461 < Premium\_u: 1.09078

## Payoff\_Sd: 8.630745 < Premium\_d: 11.70872

##### **Problem 6**

Let , , (continuously compounded), , , year, and .

## [,1] [,2] [,3] [,4]  
## [1,] 40 45.81847 52.48330 60.11762  
## [2,] 0 35.86415 41.08102 47.05673  
## [3,] 0 0.00000 32.15594 36.83340  
## [4,] 0 0.00000 0.00000 28.83114

# American Call

## [1] "Premium"

## [1] 4.37743

# American Put

## [1] "Premium"

## [1] 2.954228

# European Call

## [1] "Premium"

## [1] 4.37743

# European Put

## [1] "Premium"

## [1] 2.809007