

Option Bionomial Pricing (8-June-2024)

Foreign Stocks: Merck, TESLA

Iranian Stocks: Shasta, Websader

The Excel file `./BONP.xlsx` consists of the CRR trees for stock, call and put Prices.

MERCK

```
%%% ACTUAL PRICES %%%
call = 5.62;
put = 9;

%%% EXCEL CRR PRICING RESULTS %%%
callExel = 4.93162127;
putExel = 6.742568523;

%%% PARAMETERS %%%
% Stock Price
S0 = 110.26;
% Strike Price
X = 115;
% Discount Rate
r = 0.0516;
% Volatility
v = 0.185;
% Time To Maturity (In Years)
T = 0.50;
% Number of Steps
n = 50;

%%% OPTION PRICING %%%

% Black-Scholes Option Pricing
[blsCall, blsPut] = blsprice(S0, X, r, T, v);
% Bionomal Option Pricing
[~, binCall] = binprice(S0, X, r, T, 1/n, v, 1);
binCall = binCall(1);
[~, binPut] = binprice(S0, X, r, T, 1/n, v, 0);
binPut = binPut(1);
% CRR Option Pricing
[crrCall, crrPut] = CRRPricing(S0, X, r, T, v, n);
```

Warning: RateSpec was not created with continuous compounding. Compounding will be set to continuous while leaving discount factor result in the recalculation of the interest rates.

```
%%% CONCOLUSION %%%
MERCK = struct('actual_call', Call, 'actual_put', Put, ...
    'excel_call', callExel, 'excel_put', putExel, ...
    'bls_call', blsCall, 'bls_put', blsPut, ...
    'bin_call', binCall, 'bin_put', binPut, ...
    'crr_call', crrCall, 'crr_put', crrPut);
```

TESLA

```
%%% ACTUAL PRICES %%%
call = 52.55;
put = 31.23;

%%% EXCEL CRR PRICING RESULTS %%%
callExel = 49.1759784;
putExel = 27.23461948;

%%% PARAMETERS %%%
% Stock Price
S0 = 233.59;
% Strike Price
X = 220;
% Discount Rate
r = 0.0516;
% Volatility
v = 0.49;
% Time To Maturity (In Years)
T = 0.75;
% Number of Steps
n = 50;

%%% OPTION PRICING %%%
```

```
% Black-Scholes Option Pricing
[blsCall, blsPut] = blsprice(S0, X, r, T, v);
% Binomial Option Pricing
[~, binCall] = binprice(S0, X, r, T, 1/n, v, 1);
binCall = binCall(1);
[~, binPut] = binprice(S0, X, r, T, 1/n, v, 0);
binPut = binPut(1);
% CRR Option Pricing
[crrCall, crrPut] = CRRPricing(S0, X, r, T, v, n);
```

Warning: RateSpec was not created with continuous compounding. Compounding will be set to continuous while leaving discount factor result in the recalculation of the interest rates.

```
%%% CONCLUSION %%%
TESLA = struct('actual_call', call, 'actual_put', put, ...
    'excel_call', callExel, 'excel_put', putExel, ...
    'bls_call', blsCall, 'bls_put', blsPut, ...
    'bin_call', binCall, 'bin_put', binPut, ...
    'crr_call', crrCall, 'crr_put', crrPut);
```

SHASTA

```
%%% ACTUAL PRICES %%%
call = 194;
put = 124;

%%% EXCEL CRR PRICING RESULTS %%%
callExel = 76.54428113;
putExel = 83.05994403;

%%% PARAMETERS %%%
% Stock Price
S0 = 1383;
% Strike Price
X = 1465;
% Discount Rate
r = 0.23;
% Volatility
v = 0.30;
% Time To Maturity (In Years)
T = 0.23;
% Number of Steps
n = 50;

%%% OPTION PRICING %%%

% Black-Scholes Option Pricing
[blsCall, blsPut] = blsprice(S0, X, r, T, v);
% Binomial Option Pricing
[~, binCall] = binprice(S0, X, r, T, 1/n, v, 1);
binCall = binCall(1);
[~, binPut] = binprice(S0, X, r, T, 1/n, v, 0);
binPut = binPut(1);
% CRR Option Pricing
[crrCall, crrPut] = CRRPricing(S0, X, r, T, v, n);
```

Warning: RateSpec was not created with continuous compounding. Compounding will be set to continuous while leaving discount factor result in the recalculation of the interest rates.

```
%%% CONCLUSION %%%
SHASTA = struct('actual_call', call, 'actual_put', put, ...
    'excel_call', callExel, 'excel_put', putExel, ...
    'bls_call', blsCall, 'bls_put', blsPut, ...
    'bin_call', binCall, 'bin_put', binPut, ...
    'crr_call', crrCall, 'crr_put', crrPut);
```

WEBSADER

```
%%% ACTUAL PRICES %%%
call = 920;
put = '-';

%%% EXCEL CRR PRICING RESULTS %%%
callExel = 739.9876618;
putExel = 18.37346562;

%%% PARAMETERS %%%
% Stock Price
S0 = 2796;
% Strike Price
X = 2200;
```

```
% Discount Rate
r = 0.23;
% Volatility
v = 0.39;
% Time To Maturity (In Years)
T = 0.32;
% Number of Steps
n = 50;

%%% OPTION PRICING %%%

% Black-Scholes Option Pricing
[blsCall, blsPut] = blsprice(S0, X, r, T, v);
% Binomial Option Pricing
[~, binCall] = binprice(S0, X, r, T, 1/n, v, 1);
binCall = binCall(1);
[~, binPut] = binprice(S0, X, r, T, 1/n, v, 0);
binPut = binPut(1);
% CRR Option Pricing
[crrCall, crrPut] = CRRPricing(S0, X, r, T, v, n);
```

Warning: RateSpec was not created with continuous compounding. Compounding will be set to continuous while leaving discount factor result in the recalculation of the interest rates.

```
%%% CONCLUSION %%%
WEBSADER = struct('actual_call', call, 'actual_put', put, ...
    'excel_call', callExel, 'excel_put', putExel, ...
    'bls_call', blsCall, 'bls_put', blsPut, ...
    'bin_call', binCall, 'bin_put', binPut, ...
    'crr_call', crrCall, 'crr_put', crrPut);
```

Conclusion

```
disp('MERCK ==>');
```

MERCK ==>

```
disp(struct2table(MERCK));
```

actual_call	actual_put	excel_call	excel_put	bls_call	bls_put	bin_call	bin_put	crr_call	crr_put
3.662	2.2623	4.9316	6.7426	4.9367	6.7476	4.9694	7.2804	4.9011	6.7842

```
disp('TESLA ==>');
```

TESLA ==>

```
disp(struct2table(TESLA));
```

actual_call	actual_put	excel_call	excel_put	bls_call	bls_put	bin_call	bin_put	crr_call	crr_put
52.55	31.23	49.176	27.235	49.368	27.426	49.589	28.319	49.399	27.677

```
disp('SHASTA ==>');
```

SHASTA ==>

```
disp(struct2table(SHASTA));
```

actual_call	actual_put	excel_call	excel_put	bls_call	bls_put	bin_call	bin_put	crr_call	crr_put
194	124	76.544	83.06	76.284	82.8	76.973	99.616	78.771	87.274

```
disp('WEBSADER ==>');
```

WEBSADER ==>

```
disp(struct2table(WEBSADER));
```

actual_call	actual_put	excel_call	excel_put	bls_call	bls_put	bin_call	bin_put	crr_call	crr_put
920	-	739.99	18.373	770.52	18.412	770.17	19.383	763.32	21.015

- In the Excel file I utilized, I adopted the Cox-Ross-Rubinstein (CRR) binomial pricing model with 50 steps. However, I observed that the results were closer to the Black-Scholes pricing method than to MATLAB's implementation of the CRR Tree pricing model. Notably, the put prices derived from the binomial model were consistently higher than those obtained from other methods, while the call prices were consistently lower.
- When comparing these outcomes with actual prices in Iran, I found that the latter were considerably higher across all methods. The computations were based on a 90-day annualized volatility. However, this may not accurately represent the expected volatility in the upcoming months, which could explain the discrepancy.

