======Report of Level 9A and Level9B======

Jiayuan Li

======Content======

======Implementation======

1. Structure of the project

```
|options.h          // base class of options, virtual class
|options.cpp        // implementation of option class
|European.h         // European option class
|European.cpp       // implementation of European class
|American.h         // American option class
|American.cpp       // implementation of American class
|utils.h            // helper functions dealing with matrix and vector (i.e. matrix pricing, printing)
|utils.cpp          // implementation of helper functions
|main.cpp           // test case
```

2. Detailed Implementation

Class Options

Contains T, K, sig, r, S, C, P, b, delta_c, delta_p, gamma_c, gamma_p as protected member variables.

Public functions:

Getter functions

Protected functions:

```
virtual void calculate_C() = 0;    // pure virtual function
virtual void calculate_P() = 0;    // pure virtual function
virtual void calculate_b() = 0;    // pure virtual function
virtual void calculate_delta() = 0;       // pure virtual function
virtual void calculate_gamma() = 0;       // pure virtual function
```

Class European: public Options

Contains `isfuture`, `m_d1`, `m_d2`, `m_parity_helper` as private member variables.

Public:

```
virtual double C(double P);           // getter using parity (overload)
virtual double P(double C);           // getter using parity (overload)
virtual bool is_parity(double P, double C);         // check for parity
virtual double Numeric_Delta(double h, bool put = false); // approximation for A.2.D
virtual double Numeric_Gamma(double h, bool put = false); // approximation for A.2.D
```

Private:

```
virtual void calculate_b();    // update b
virtual void calculate_C();    // update Call price
virtual void calculate_P();    // update Put price
virtual void calculate_d();    // update d1 and d2
virtual void calculate_delta();       // calculate Greek delta
virtual void calculate_gamma();       // calculate Greek gamma
```

Class American: public Options

Contains `m_y1`, `m_y2`, as private member variables.

Public:

Getter functions

Private:

```
virtual void calculate_b()     // not implemented
virtual void calculate_C();    // update Call price
virtual void calculate_P();    // update Put price
virtual void calculate_y();    // update y1 and y2
virtual void calculate_delta();       // not implemented
```

```
    virtual void calculate_gamma();      // not implemented
```

utils.h

```
// helper function for Group A Part C
vector<double> generate_array(double start, double end, double mesh_size);

// helper function for Group A Part D: generate input matrix
vector<vector<double>> generate_matrix(vector<double> start, vector<double> end,
vector<double> mesh_size);

// helper function for Group A Part D: given an matrix and calculate price
vector<vector<double>> pricing_matrix(vector<vector<double>> input, unsigned mode = 0);

// helper function for Group A Part D: print the result out
void print_matrix(vector<vector<double>> input, unsigned mode = 0);
```

======Output of each question======

--------Group A ---- part 1(a)--------

Batch 1:
  Call Price: 2.13337, Put Price: 5.84628
Batch 2:
  Call Price: 7.96557, Put Price: 7.96557
Batch 3:
  Call Price: 0.204058, Put Price: 4.07326
Batch 4:
  Call Price: 92.1757, Put Price: 1.2475

--------Group A ---- part 1(b)--------

Batch 1:
  Call Price: 2.13337, Put Price: 5.84628
  Satisfy Parity? (correct data): 1
  Satisfy Parity? (wrong data): 1
Batch 2:
  Call Price: 7.96557, Put Price: 7.96557
  Satisfy Parity? (correct data): 1
  Satisfy Parity? (wrong data): 0
Batch 3:
  Call Price: 0.204058, Put Price: 4.07326
  Satisfy Parity? (correct data): 1
  Satisfy Parity? (wrong data): 0
Batch 4:
  Call Price: 92.1757, Put Price: 1.2475
  Satisfy Parity? (correct data): 1
  Satisfy Parity? (wrong data): 0

--------Group A ---- part 1(c)--------

Price as a function of S
(T=0.25,K=65,sig=0.3,r=0.08)

S = 10, C = 7.792e-36, P = 53.7129
S = 11, C = 1.88964e-32, P = 52.7129
S = 12, C = 1.64204e-29, P = 51.7129
S = 13, C = 6.19303e-27, P = 50.7129
S = 14, C = 1.17207e-24, P = 49.7129
S = 15, C = 1.24529e-22, P = 48.7129
S = 16, C = 8.11387e-21, P = 47.7129
S = 17, C = 3.47944e-19, P = 46.7129
S = 18, C = 1.03991e-17, P = 45.7129
S = 19, C = 2.27042e-16, P = 44.7129
S = 20, C = 3.76503e-15, P = 43.7129
S = 21, C = 4.89964e-14, P = 42.7129
S = 22, C = 5.1436e-13, P = 41.7129
S = 23, C = 4.45934e-12, P = 40.7129
S = 24, C = 3.25772e-11, P = 39.7129
S = 25, C = 2.0405e-10, P = 38.7129

S = 26, C = 1.11246e-09, P = 37.7129
S = 27, C = 5.34891e-09, P = 36.7129
S = 28, C = 2.29454e-08, P = 35.7129
S = 29, C = 8.8713e-08, P = 34.7129
S = 30, C = 3.11926e-07, P = 33.7129
S = 31, C = 1.00545e-06, P = 32.7129
S = 32, C = 2.99241e-06, P = 31.7129
S = 33, C = 8.27565e-06, P = 30.7129
S = 34, C = 2.13896e-05, P = 29.7129
S = 35, C = 5.19359e-05, P = 28.713
S = 36, C = 0.000119024, P = 27.713
S = 37, C = 0.000258548, P = 26.7132
S = 38, C = 0.000534403, P = 25.7134
S = 39, C = 0.00105474, P = 24.714
S = 40, C = 0.00199417, P = 23.7149
S = 41, C = 0.00362244, P = 22.7165
S = 42, C = 0.00633924, P = 21.7193
S = 43, C = 0.010714, P = 20.7236
S = 44, C = 0.0175282, P = 19.7304
S = 45, C = 0.0278174, P = 18.7407
S = 46, C = 0.0429083, P = 17.7558
S = 47, C = 0.0644467, P = 16.7774
S = 48, C = 0.0944125, P = 15.8073
S = 49, C = 0.135117, P = 14.848
S = 50, C = 0.189181, P = 13.9021

--------Group A ---- part 1(d)--------

Price as a function of T

T:0.25,K:10,sig:0.05,R:0,S:10
Call Price:0.099733, Put Price:0.099733
T:0.5,K:10,sig:0.05,R:0,S:10
Call Price:0.14104, Put Price:0.14104
T:0.75,K:10,sig:0.05,R:0,S:10
Call Price:0.172734, Put Price:0.172734
T:1,K:10,sig:0.05,R:0,S:10
Call Price:0.19945, Put Price:0.19945
T:1.25,K:10,sig:0.05,R:0,S:10
Call Price:0.222986, Put Price:0.222986
T:1.5,K:10,sig:0.05,R:0,S:10
Call Price:0.244263, Put Price:0.244263
T:1.75,K:10,sig:0.05,R:0,S:10
Call Price:0.263827, Put Price:0.263827
T:2,K:10,sig:0.05,R:0,S:10
Call Price:0.282036, Put Price:0.282036
T:2.25,K:10,sig:0.05,R:0,S:10
Call Price:0.299137, Put Price:0.299137
T:2.5,K:10,sig:0.05,R:0,S:10
Call Price:0.315309, Put Price:0.315309
T:2.75,K:10,sig:0.05,R:0,S:10
Call Price:0.330691, Put Price:0.330691
T:3,K:10,sig:0.05,R:0,S:10
Call Price:0.345386, Put Price:0.345386
T:3.25,K:10,sig:0.05,R:0,S:10
Call Price:0.35948, Put Price:0.35948
T:3.5,K:10,sig:0.05,R:0,S:10
Call Price:0.37304, Put Price:0.37304
T:3.75,K:10,sig:0.05,R:0,S:10
Call Price:0.386123, Put Price:0.386123
T:4,K:10,sig:0.05,R:0,S:10
Call Price:0.398776, Put Price:0.398776
T:4.25,K:10,sig:0.05,R:0,S:10
Call Price:0.411038, Put Price:0.411038
T:4.5,K:10,sig:0.05,R:0,S:10
Call Price:0.422944, Put Price:0.422944
T:4.75,K:10,sig:0.05,R:0,S:10
Call Price:0.434522, Put Price:0.434522
T:5,K:10,sig:0.05,R:0,S:10
Call Price:0.445799, Put Price:0.445799

Price as a function of K

T:0.25,K:10,sig:0.05,R:0,S:10
Call Price:0.099733, Put Price:0.099733
T:0.25,K:14,sig:0.05,R:0,S:10
Call Price:2.96744e-43, Put Price:4
T:0.25,K:18,sig:0.05,R:0,S:10
Call Price:2.21274e-124, Put Price:8
T:0.25,K:22,sig:0.05,R:0,S:10
Call Price:1.5223e-220, Put Price:12
T:0.25,K:26,sig:0.05,R:0,S:10
Call Price:7.90505e-322, Put Price:16
T:0.25,K:30,sig:0.05,R:0,S:10
Call Price:0, Put Price:20
T:0.25,K:34,sig:0.05,R:0,S:10
Call Price:0, Put Price:24
T:0.25,K:38,sig:0.05,R:0,S:10

Call Price:0, Put Price:28
T:0.25,K:42,sig:0.05,R:0,S:10
Call Price:0, Put Price:32
T:0.25,K:46,sig:0.05,R:0,S:10
Call Price:0, Put Price:36
T:0.25,K:50,sig:0.05,R:0,S:10
Call Price:0, Put Price:40
T:0.25,K:54,sig:0.05,R:0,S:10
Call Price:0, Put Price:44
T:0.25,K:58,sig:0.05,R:0,S:10
Call Price:0, Put Price:48
T:0.25,K:62,sig:0.05,R:0,S:10
Call Price:0, Put Price:52
T:0.25,K:66,sig:0.05,R:0,S:10
Call Price:0, Put Price:56
T:0.25,K:70,sig:0.05,R:0,S:10
Call Price:0, Put Price:60
T:0.25,K:74,sig:0.05,R:0,S:10
Call Price:0, Put Price:64
T:0.25,K:78,sig:0.05,R:0,S:10
Call Price:0, Put Price:68
T:0.25,K:82,sig:0.05,R:0,S:10
Call Price:0, Put Price:72
T:0.25,K:86,sig:0.05,R:0,S:10
Call Price:0, Put Price:76
T:0.25,K:90,sig:0.05,R:0,S:10
Call Price:0, Put Price:80

Price as a function of sig

T:0.25,K:10,sig:0.05,R:0,S:10
Call Price:0.099733, Put Price:0.099733
T:0.25,K:10,sig:0.1,R:0,S:10
Call Price:0.19945, Put Price:0.19945
T:0.25,K:10,sig:0.15,R:0,S:10
Call Price:0.299137, Put Price:0.299137
T:0.25,K:10,sig:0.2,R:0,S:10
Call Price:0.398776, Put Price:0.398776
T:0.25,K:10,sig:0.25,R:0,S:10
Call Price:0.498353, Put Price:0.498353
T:0.25,K:10,sig:0.3,R:0,S:10
Call Price:0.597853, Put Price:0.597853
T:0.25,K:10,sig:0.35,R:0,S:10
Call Price:0.697259, Put Price:0.697259
T:0.25,K:10,sig:0.4,R:0,S:10
Call Price:0.796557, Put Price:0.796557
T:0.25,K:10,sig:0.45,R:0,S:10
Call Price:0.89573, Put Price:0.89573
T:0.25,K:10,sig:0.5,R:0,S:10
Call Price:0.994764, Put Price:0.994764
T:0.25,K:10,sig:0.55,R:0,S:10
Call Price:1.09364, Put Price:1.09364
T:0.25,K:10,sig:0.6,R:0,S:10
Call Price:1.19235, Put Price:1.19235
T:0.25,K:10,sig:0.65,R:0,S:10
Call Price:1.29088, Put Price:1.29088
T:0.25,K:10,sig:0.7,R:0,S:10
Call Price:1.3892, Put Price:1.3892
T:0.25,K:10,sig:0.75,R:0,S:10
Call Price:1.48731, Put Price:1.48731
T:0.25,K:10,sig:0.8,R:0,S:10
Call Price:1.58519, Put Price:1.58519
T:0.25,K:10,sig:0.85,R:0,S:10
Call Price:1.68283, Put Price:1.68283
T:0.25,K:10,sig:0.9,R:0,S:10
Call Price:1.78021, Put Price:1.78021
T:0.25,K:10,sig:0.95,R:0,S:10
Call Price:1.87731, Put Price:1.87731

Price as a function of R

T:0.25,K:10,sig:0.05,R:0,S:10
Call Price:0.099733, Put Price:0.099733
T:0.25,K:10,sig:0.05,R:0.05,S:10
Call Price:0.173361, Put Price:0.0491391
T:0.25,K:10,sig:0.05,R:0.1,S:10
Call Price:0.26747, Put Price:0.0205691
T:0.25,K:10,sig:0.05,R:0.15,S:10
Call Price:0.375246, Put Price:0.0071902
T:0.25,K:10,sig:0.05,R:0.2,S:10
Call Price:0.489776, Put Price:0.00207014
T:0.25,K:10,sig:0.05,R:0.25,S:10
Call Price:0.606355, Put Price:0.000485588
T:0.25,K:10,sig:0.05,R:0.3,S:10
Call Price:0.722657, Put Price:9.2016e-05
T:0.25,K:10,sig:0.05,R:0.35,S:10
Call Price:0.837825, Put Price:1.39934e-05
T:0.25,K:10,sig:0.05,R:0.4,S:10
Call Price:0.951628, Put Price:1.69907e-06
T:0.25,K:10,sig:0.05,R:0.45,S:10
Call Price:1.06403, Put Price:1.64048e-07
T:0.25,K:10,sig:0.05,R:0.5,S:10
Call Price:1.17503, Put Price:1.25547e-08
T:0.25,K:10,sig:0.05,R:0.55,S:10
Call Price:1.28466, Put Price:7.5963e-10
T:0.25,K:10,sig:0.05,R:0.6,S:10

Call Price:1.39292, Put Price:3.62621e-11
T:0.25,K:10,sig:0.05,R:0.65,S:10
Call Price:1.49984, Put Price:1.36339e-12
T:0.25,K:10,sig:0.05,R:0.7,S:10
Call Price:1.60543, Put Price:4.03181e-14
T:0.25,K:10,sig:0.05,R:0.75,S:10
Call Price:1.70971, Put Price:9.36657e-16
T:0.25,K:10,sig:0.05,R:0.8,S:10
Call Price:1.81269, Put Price:1.70781e-17
T:0.25,K:10,sig:0.05,R:0.85,S:10
Call Price:1.9144, Put Price:2.44184e-19
T:0.25,K:10,sig:0.05,R:0.9,S:10
Call Price:2.01484, Put Price:2.73594e-21
T:0.25,K:10,sig:0.05,R:0.95,S:10
Call Price:2.11403, Put Price:2.40074e-23
T:0.25,K:10,sig:0.05,R:1,S:10
Call Price:2.21199, Put Price:1.64894e-25

Price as a function of S

T:0.25,K:10,sig:0.05,R:0,S:10
Call Price:0.099733, Put Price:0.099733
T:0.25,K:10,sig:0.05,R:0,S:30
Call Price:20, Put Price:0
T:0.25,K:10,sig:0.05,R:0,S:50
Call Price:40, Put Price:0
T:0.25,K:10,sig:0.05,R:0,S:70
Call Price:60, Put Price:0
T:0.25,K:10,sig:0.05,R:0,S:90
Call Price:80, Put Price:0

--------Group A ---- part 2(a)--------

Gamma for Call: 0.0134936, Gamma for Put: 0.0134936
Delta for Call: 0.594629, Delta for Put: -0.356601

--------Group A ---- part 2(b)--------

Delta under different S

(T=0.25,K=65,sig=0.3,r=0.08)
S = 10, Call Delta = 2.25551e-19, Put Delta = -0.951229
S = 11, Call Delta = 6.18174e-18, Put Delta = -0.951229
S = 12, Call Delta = 1.12536e-16, Put Delta = -0.951229
S = 13, Call Delta = 1.46673e-15, Put Delta = -0.951229
S = 14, Call Delta = 1.44882e-14, Put Delta = -0.951229
S = 15, Call Delta = 1.1336e-13, Put Delta = -0.951229
S = 16, Call Delta = 7.27491e-13, Put Delta = -0.951229
S = 17, Call Delta = 3.93787e-12, Put Delta = -0.951229
S = 18, Call Delta = 1.83921e-11, Put Delta = -0.951229
S = 19, Call Delta = 7.55191e-11, Put Delta = -0.951229
S = 20, Call Delta = 2.76878e-10, Put Delta = -0.951229
S = 21, Call Delta = 9.18317e-10, Put Delta = -0.951229
S = 22, Call Delta = 2.78591e-09, Put Delta = -0.951229
S = 23, Call Delta = 7.80377e-09, Put Delta = -0.951229
S = 24, Call Delta = 2.0348e-08, Put Delta = -0.951229
S = 25, Call Delta = 4.97346e-08, Put Delta = -0.951229
S = 26, Call Delta = 1.14647e-07, Put Delta = -0.951229
S = 27, Call Delta = 2.50577e-07, Put Delta = -0.951229
S = 28, Call Delta = 5.21714e-07, Put Delta = -0.951229
S = 29, Call Delta = 1.03903e-06, Put Delta = -0.951228
S = 30, Call Delta = 1.98667e-06, Put Delta = -0.951227
S = 31, Call Delta = 3.65877e-06, Put Delta = -0.951226

S = 32, Call Delta = 6.5092e-06, Put Delta = -0.951223
S = 33, Call Delta = 1.1216e-05, Put Delta = -0.951218
S = 34, Call Delta = 1.87624e-05, Put Delta = -0.951211
S = 35, Call Delta = 3.05351e-05, Put Delta = -0.951199
S = 36, Call Delta = 4.84406e-05, Put Delta = -0.951181
S = 37, Call Delta = 7.50367e-05, Put Delta = -0.951154
S = 38, Call Delta = 0.00011368, Put Delta = -0.951116
S = 39, Call Delta = 0.000168682, Put Delta = -0.951061
S = 40, Call Delta = 0.000245471, Put Delta = -0.950984
S = 41, Call Delta = 0.000350761, Put Delta = -0.950879
S = 42, Call Delta = 0.000492699, Put Delta = -0.950737
S = 43, Call Delta = 0.000681019, Put Delta = -0.950548
S = 44, Call Delta = 0.000927157, Put Delta = -0.950302
S = 45, Call Delta = 0.00124435, Put Delta = -0.949985
S = 46, Call Delta = 0.00164771, Put Delta = -0.949582
S = 47, Call Delta = 0.00215423, Put Delta = -0.949075
S = 48, Call Delta = 0.00278276, Put Delta = -0.948447
S = 49, Call Delta = 0.00355398, Put Delta = -0.947675
S = 50, Call Delta = 0.00449025, Put Delta = -0.946739

--------Group A ---- part 2(c)--------

Greek as a function of T

T:0.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.489029, Put Delta:-0.462201
T:1,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.47046, Put Delta:-0.434377
T:1.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.451368, Put Delta:-0.40934
T:2,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.432442, Put Delta:-0.386289
T:2.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.413938, Put Delta:-0.364863
T:3,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.395972, Put Delta:-0.344846
T:3.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.378603, Put Delta:-0.326085
T:4,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.361857, Put Delta:-0.308463
T:4.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.345744, Put Delta:-0.291884
T:5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.330262, Put Delta:-0.276268
T:5.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.315403, Put Delta:-0.261547
T:6,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.301154, Put Delta:-0.247658
T:6.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.2875, Put Delta:-0.234546
T:7,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.274424, Put Delta:-0.222162
T:7.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.261907, Put Delta:-0.21046
T:8,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.249931, Put Delta:-0.199398
T:8.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.238476, Put Delta:-0.188939
T:9,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.227524, Put Delta:-0.179046
T:9.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.217054, Put Delta:-0.169687
T:10,K:100,sig:0.1,R:0.1,S:100

Greek as a function of K

Call Delta:0.207049, Put Delta:-0.160831
T:0.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.489029, Put Delta:-0.462201
T:0.5,K:105,sig:0.1,R:0.1,S:100
Call Delta:0.243847, Put Delta:-0.707383
T:0.5,K:110,sig:0.1,R:0.1,S:100
Call Delta:0.0900529, Put Delta:-0.861177
T:0.5,K:115,sig:0.1,R:0.1,S:100
Call Delta:0.0248446, Put Delta:-0.926385

T:0.5,K:120,sig:0.1,R:0.1,S:100
Call Delta:0.00522634, Put Delta:-0.946003
T:0.5,K:125,sig:0.1,R:0.1,S:100
Call Delta:0.000859071, Put Delta:-0.95037
T:0.5,K:130,sig:0.1,R:0.1,S:100
Call Delta:0.000113109, Put Delta:-0.951116
T:0.5,K:135,sig:0.1,R:0.1,S:100
Call Delta:1.22124e-05, Put Delta:-0.951217
T:0.5,K:140,sig:0.1,R:0.1,S:100
Call Delta:1.10485e-06, Put Delta:-0.951228
T:0.5,K:145,sig:0.1,R:0.1,S:100
Call Delta:8.53991e-08, Put Delta:-0.951229
T:0.5,K:150,sig:0.1,R:0.1,S:100
Call Delta:5.7389e-09, Put Delta:-0.951229
T:0.5,K:155,sig:0.1,R:0.1,S:100
Call Delta:3.40554e-10, Put Delta:-0.951229
T:0.5,K:160,sig:0.1,R:0.1,S:100
Call Delta:1.80946e-11, Put Delta:-0.951229
T:0.5,K:165,sig:0.1,R:0.1,S:100
Call Delta:8.71523e-13, Put Delta:-0.951229
T:0.5,K:170,sig:0.1,R:0.1,S:100
Call Delta:3.84733e-14, Put Delta:-0.951229
T:0.5,K:175,sig:0.1,R:0.1,S:100
Call Delta:1.57201e-15, Put Delta:-0.951229
T:0.5,K:180,sig:0.1,R:0.1,S:100
Call Delta:5.99758e-17, Put Delta:-0.951229
T:0.5,K:185,sig:0.1,R:0.1,S:100
Call Delta:2.15344e-18, Put Delta:-0.951229
T:0.5,K:190,sig:0.1,R:0.1,S:100
Call Delta:7.32786e-20, Put Delta:-0.951229
T:0.5,K:195,sig:0.1,R:0.1,S:100
Call Delta:2.37822e-21, Put Delta:-0.951229
T:0.5,K:200,sig:0.1,R:0.1,S:100
Call Delta:7.4032e-23, Put Delta:-0.951229

Greek as a function of sig

T:0.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.489029, Put Delta:-0.462201
T:0.5,K:100,sig:0.15,R:0.1,S:100
Call Delta:0.495731, Put Delta:-0.455499
T:0.5,K:100,sig:0.2,R:0.1,S:100
Call Delta:0.502426, Put Delta:-0.448803
T:0.5,K:100,sig:0.25,R:0.1,S:100
Call Delta:0.509113, Put Delta:-0.442116
T:0.5,K:100,sig:0.3,R:0.1,S:100
Call Delta:0.51579, Put Delta:-0.43544
T:0.5,K:100,sig:0.35,R:0.1,S:100
Call Delta:0.522454, Put Delta:-0.428775
T:0.5,K:100,sig:0.4,R:0.1,S:100
Call Delta:0.529104, Put Delta:-0.422126
T:0.5,K:100,sig:0.45,R:0.1,S:100
Call Delta:0.535737, Put Delta:-0.415493
T:0.5,K:100,sig:0.5,R:0.1,S:100
Call Delta:0.542351, Put Delta:-0.408878
T:0.5,K:100,sig:0.55,R:0.1,S:100
Call Delta:0.548945, Put Delta:-0.402284
T:0.5,K:100,sig:0.6,R:0.1,S:100
Call Delta:0.555516, Put Delta:-0.395713
T:0.5,K:100,sig:0.65,R:0.1,S:100
Call Delta:0.562063, Put Delta:-0.389167
T:0.5,K:100,sig:0.7,R:0.1,S:100
Call Delta:0.568583, Put Delta:-0.382647
T:0.5,K:100,sig:0.75,R:0.1,S:100
Call Delta:0.575074, Put Delta:-0.376155
T:0.5,K:100,sig:0.8,R:0.1,S:100
Call Delta:0.581535, Put Delta:-0.369694
T:0.5,K:100,sig:0.85,R:0.1,S:100
Call Delta:0.587964, Put Delta:-0.363265
T:0.5,K:100,sig:0.9,R:0.1,S:100
Call Delta:0.594359, Put Delta:-0.35687
T:0.5,K:100,sig:0.95,R:0.1,S:100
Call Delta:0.600718, Put Delta:-0.350511
T:0.5,K:100,sig:1,R:0.1,S:100
Call Delta:0.60704, Put Delta:-0.34419

Greek as a function of r

T:0.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.489029, Put Delta:-0.462201
T:0.5,K:100,sig:0.1,R:0.15,S:100
Call Delta:0.476955, Put Delta:-0.450789
T:0.5,K:100,sig:0.1,R:0.2,S:100
Call Delta:0.465179, Put Delta:-0.439659
T:0.5,K:100,sig:0.1,R:0.25,S:100
Call Delta:0.453693, Put Delta:-0.428804
T:0.5,K:100,sig:0.1,R:0.3,S:100
Call Delta:0.442492, Put Delta:-0.418216
T:0.5,K:100,sig:0.1,R:0.35,S:100
Call Delta:0.431566, Put Delta:-0.407891
T:0.5,K:100,sig:0.1,R:0.4,S:100
Call Delta:0.420911, Put Delta:-0.39782
T:0.5,K:100,sig:0.1,R:0.45,S:100
Call Delta:0.410519, Put Delta:-0.387998
T:0.5,K:100,sig:0.1,R:0.5,S:100
Call Delta:0.400383, Put Delta:-0.378418
T:0.5,K:100,sig:0.1,R:0.55,S:100
Call Delta:0.390497, Put Delta:-0.369075
T:0.5,K:100,sig:0.1,R:0.6,S:100
Call Delta:0.380856, Put Delta:-0.359962

T:0.5,K:100,sig:0.1,R:0.65,S:100
Call Delta:0.371453, Put Delta:-0.351075
T:0.5,K:100,sig:0.1,R:0.7,S:100
Call Delta:0.362281, Put Delta:-0.342407
T:0.5,K:100,sig:0.1,R:0.75,S:100
Call Delta:0.353337, Put Delta:-0.333953
T:0.5,K:100,sig:0.1,R:0.8,S:100
Call Delta:0.344613, Put Delta:-0.325707
T:0.5,K:100,sig:0.1,R:0.85,S:100
Call Delta:0.336104, Put Delta:-0.317666
T:0.5,K:100,sig:0.1,R:0.9,S:100
Call Delta:0.327806, Put Delta:-0.309822
T:0.5,K:100,sig:0.1,R:0.95,S:100
Call Delta:0.319712, Put Delta:-0.302173
T:0.5,K:100,sig:0.1,R:1,S:100
Call Delta:0.311819, Put Delta:-0.294712

Greek as a function of S

T:0.5,K:100,sig:0.1,R:0.1,S:100
Call Delta:0.489029, Put Delta:-0.462201
T:0.5,K:100,sig:0.1,R:0.1,S:105
Call Delta:0.72853, Put Delta:-0.2227
T:0.5,K:100,sig:0.1,R:0.1,S:110
Call Delta:0.871997, Put Delta:-0.0792326
T:0.5,K:100,sig:0.1,R:0.1,S:115
Call Delta:0.930192, Put Delta:-0.0210373
T:0.5,K:100,sig:0.1,R:0.1,S:120
Call Delta:0.94697, Put Delta:-0.00425908
T:0.5,K:100,sig:0.1,R:0.1,S:125
Call Delta:0.950555, Put Delta:-0.000674142
T:0.5,K:100,sig:0.1,R:0.1,S:130
Call Delta:0.951144, Put Delta:-8.55432e-05
T:0.5,K:100,sig:0.1,R:0.1,S:135
Call Delta:0.951221, Put Delta:-8.90991e-06
T:0.5,K:100,sig:0.1,R:0.1,S:140
Call Delta:0.951229, Put Delta:-7.78384e-07
T:0.5,K:100,sig:0.1,R:0.1,S:145
Call Delta:0.951229, Put Delta:-5.81572e-08
T:0.5,K:100,sig:0.1,R:0.1,S:150
Call Delta:0.951229, Put Delta:-3.78152e-09
T:0.5,K:100,sig:0.1,R:0.1,S:155
Call Delta:0.951229, Put Delta:-2.17335e-10
T:0.5,K:100,sig:0.1,R:0.1,S:160
Call Delta:0.951229, Put Delta:-1.11943e-11
T:0.5,K:100,sig:0.1,R:0.1,S:165
Call Delta:0.951229, Put Delta:-5.23137e-13
T:0.5,K:100,sig:0.1,R:0.1,S:170
Call Delta:0.951229, Put Delta:-2.24265e-14
T:0.5,K:100,sig:0.1,R:0.1,S:175
Call Delta:0.951229, Put Delta:-8.88178e-16
T:0.5,K:100,sig:0.1,R:0.1,S:180
Call Delta:0.951229, Put Delta:0
T:0.5,K:100,sig:0.1,R:0.1,S:185
Call Delta:0.951229, Put Delta:0
T:0.5,K:100,sig:0.1,R:0.1,S:190
Call Delta:0.951229, Put Delta:0
T:0.5,K:100,sig:0.1,R:0.1,S:195
Call Delta:0.951229, Put Delta:0
T:0.5,K:100,sig:0.1,R:0.1,S:200
Call Delta:0.951229, Put Delta:0

--------Group A ---- part 2(d)--------

Numeric approximation for Gamma and Delta in (a) under h=0.01

Gamma for Call: 0.0134936, Gamma for Put: 0.0134936
Delta for Call: 0.594629, Delta for Put: -0.356601

Numeric approximation for Delta in (b) under h=0.01 and S between 10 and 50

S = 10, Call Delta = 2.25596e-19, Put Delta = -0.951229
S = 11, Call Delta = 6.18269e-18, Put Delta = -0.951229
S = 12, Call Delta = 1.12549e-16, Put Delta = -0.951229
S = 13, Call Delta = 1.46687e-15, Put Delta = -0.951229
S = 14, Call Delta = 1.44893e-14, Put Delta = -0.951229
S = 15, Call Delta = 1.13367e-13, Put Delta = -0.951229
S = 16, Call Delta = 7.27527e-13, Put Delta = -0.951229

S = 17, Call Delta = 3.93804e-12, Put Delta = -0.951229
S = 18, Call Delta = 1.83927e-11, Put Delta = -0.951229
S = 19, Call Delta = 7.55213e-11, Put Delta = -0.951229
S = 20, Call Delta = 2.76885e-10, Put Delta = -0.951229
S = 21, Call Delta = 9.18336e-10, Put Delta = -0.951229
S = 22, Call Delta = 2.78596e-09, Put Delta = -0.951229
S = 23, Call Delta = 7.80389e-09, Put Delta = -0.951229
S = 24, Call Delta = 2.03483e-08, Put Delta = -0.951229
S = 25, Call Delta = 4.97352e-08, Put Delta = -0.951229
S = 26, Call Delta = 1.14648e-07, Put Delta = -0.951229
S = 27, Call Delta = 2.50579e-07, Put Delta = -0.951229
S = 28, Call Delta = 5.21718e-07, Put Delta = -0.951229
S = 29, Call Delta = 1.03904e-06, Put Delta = -0.951228
S = 30, Call Delta = 1.98668e-06, Put Delta = -0.951227
S = 31, Call Delta = 3.65879e-06, Put Delta = -0.951226
S = 32, Call Delta = 6.50923e-06, Put Delta = -0.951223
S = 33, Call Delta = 1.1216e-05, Put Delta = -0.951218
S = 34, Call Delta = 1.87624e-05, Put Delta = -0.951211
S = 35, Call Delta = 3.05352e-05, Put Delta = -0.951199
S = 36, Call Delta = 4.84407e-05, Put Delta = -0.951181
S = 37, Call Delta = 7.50369e-05, Put Delta = -0.951154
S = 38, Call Delta = 0.00011368, Put Delta = -0.951116
S = 39, Call Delta = 0.000168682, Put Delta = -0.951061
S = 40, Call Delta = 0.000245472, Put Delta = -0.950984
S = 41, Call Delta = 0.000350761, Put Delta = -0.950879
S = 42, Call Delta = 0.0004927, Put Delta = -0.950737
S = 43, Call Delta = 0.00068102, Put Delta = -0.950548
S = 44, Call Delta = 0.000927158, Put Delta = -0.950302
S = 45, Call Delta = 0.00124435, Put Delta = -0.949985
S = 46, Call Delta = 0.00164771, Put Delta = -0.949582
S = 47, Call Delta = 0.00215423, Put Delta = -0.949075
S = 48, Call Delta = 0.00278276, Put Delta = -0.948447
S = 49, Call Delta = 0.00355398, Put Delta = -0.947675
S = 50, Call Delta = 0.00449025, Put Delta = -0.946739

Numeric approximation for Gamma under different h

h: 100, Gamma Call: 0.00750379, Gamma Put: 0.00750379
h: 10, Gamma Call: 0.0134098, Gamma Put: 0.0134098
h: 1, Gamma Call: 0.0134928, Gamma Put: 0.0134928
h: 0.1, Gamma Call: 0.0134936, Gamma Put: 0.0134936
h: 0.01, Gamma Call: 0.0134936, Gamma Put: 0.0134936
h: 0.001, Gamma Call: 0.0134937, Gamma Put: 0.0134936
h: 0.0001, Gamma Call: 0.0134946, Gamma Put: 0.0134932
h: 1e-05, Gamma Call: 0.0139977, Gamma Put: 0.0136424
h: 1e-06, Gamma Call: 0.049738, Gamma Put: 0.0284217
h: 1e-07, Gamma Call: 2.84217, Gamma Put: 0
h: 1e-08, Gamma Call: 355.271, Gamma Put: 71.0543

h: 1e-09, Gamma Call: 28421.7, Gamma Put: 7105.43
h: 1e-10, Gamma Call: 710543, Gamma Put: 0
h: 1e-11, Gamma Call: 2.84217e+08, Gamma Put: -7.10543e+07
h: 1e-12, Gamma Call: 2.13163e+10, Gamma Put: 0
h: 1e-13, Gamma Call: 2.13163e+12, Gamma Put: 0
h: 1e-14, Gamma Call: 7.10543e+13, Gamma Put: 7.10543e+13
h: 1e-15, Gamma Call: 0, Gamma Put: 0
h: 1e-16, Gamma Call: 0, Gamma Put: 0
h: 1e-17, Gamma Call: 0, Gamma Put: 0

Numeric approximation for Delta under different h

h: 100, Delta Call: 0.499518, Delta Put: -0.451711
h: 10, Delta Call: 0.589918, Delta Put: -0.361311
h: 1, Delta Call: 0.59458, Delta Put: -0.356649
h: 0.1, Delta Call: 0.594628, Delta Put: -0.356601
h: 0.01, Delta Call: 0.594629, Delta Put: -0.356601
h: 0.001, Delta Call: 0.594629, Delta Put: -0.356601
h: 0.0001, Delta Call: 0.594629, Delta Put: -0.356601
h: 1e-05, Delta Call: 0.594629, Delta Put: -0.356601
h: 1e-06, Delta Call: 0.594629, Delta Put: -0.356601
h: 1e-07, Delta Call: 0.594629, Delta Put: -0.356601
h: 1e-08, Delta Call: 0.594629, Delta Put: -0.3566
h: 1e-09, Delta Call: 0.594625, Delta Put: -0.356604
h: 1e-10, Delta Call: 0.594689, Delta Put: -0.356621
h: 1e-11, Delta Call: 0.594724, Delta Put: -0.357048
h: 1e-12, Delta Call: 0.586198, Delta Put: -0.355271
h: 1e-13, Delta Call: 0.603961, Delta Put: -0.355271
h: 1e-14, Delta Call: 0.355271, Delta Put: -0.355271
h: 1e-15, Delta Call: 0, Delta Put: 0
h: 1e-16, Delta Call: 0, Delta Put: 0
h: 1e-17, Delta Call: 0, Delta Put: 0

--------Group B ---- part b--------

Call Price: 18.5035, Put Price: 3.03106

--------Group B ---- part c--------

(K=100, sig=0.1, r=0.1, b=0.02)
S is between 10 to 50

S = 10, Call Price = 0.00826235, Put Price = 9.03489e+06
S = 11, Call Price = 0.011227, Put Price = 4.99557e+06
S = 12, Call Price = 0.0148535, Put Price = 2.9084e+06

S = 13, Call Price = 0.0192158, Put Price = 1.76823e+06
S = 14, Call Price = 0.0243891, Put Price = 1.11544e+06
S = 15, Call Price = 0.03045, Put Price = 726383
S = 16, Call Price = 0.0374762, Put Price = 486308
S = 17, Call Price = 0.0455465, Put Price = 333599
S = 18, Call Price = 0.054741, Put Price = 233828
S = 19, Call Price = 0.0651405, Put Price = 167076
S = 20, Call Price = 0.076827, Put Price = 121457
S = 21, Call Price = 0.0898835, Put Price = 89678.6
S = 22, Call Price = 0.104394, Put Price = 67156
S = 23, Call Price = 0.120442, Put Price = 50940.7
S = 24, Call Price = 0.138115, Put Price = 39097.9
S = 25, Call Price = 0.157497, Put Price = 30334.3
S = 26, Call Price = 0.178677, Put Price = 23770.5
S = 27, Call Price = 0.201742, Put Price = 18799.2
S = 28, Call Price = 0.226781, Put Price = 14995
S = 29, Call Price = 0.253883, Put Price = 12055.9
S = 30, Call Price = 0.283138, Put Price = 9764.83
S = 31, Call Price = 0.314637, Put Price = 7964.02
S = 32, Call Price = 0.348471, Put Price = 6537.48
S = 33, Call Price = 0.384732, Put Price = 5399.17
S = 34, Call Price = 0.423512, Put Price = 4484.6
S = 35, Call Price = 0.464906, Put Price = 3745.05
S = 36, Call Price = 0.509007, Put Price = 3143.37
S = 37, Call Price = 0.555908, Put Price = 2651.05
S = 38, Call Price = 0.605706, Put Price = 2246.02
S = 39, Call Price = 0.658495, Put Price = 1911.08
S = 40, Call Price = 0.714373, Put Price = 1632.76
S = 41, Call Price = 0.773434, Put Price = 1400.4
S = 42, Call Price = 0.835777, Put Price = 1205.56
S = 43, Call Price = 0.901499, Put Price = 1041.49
S = 44, Call Price = 0.970699, Put Price = 902.784
S = 45, Call Price = 1.04347, Put Price = 785.068
S = 46, Call Price = 1.11993, Put Price = 684.8
S = 47, Call Price = 1.20015, Put Price = 599.097
S = 48, Call Price = 1.28425, Put Price = 525.597
S = 49, Call Price = 1.37233, Put Price = 462.36
S = 50, Call Price = 1.46448, Put Price = 407.787

--------Group B ---- part d--------

Price as a function of K

K:100,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:18.5035, Put Price:3.03106
K:105,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:16.6065, Put Price:4.3104
K:110,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:14.9791, Put Price:6.03011
K:115,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:13.5734, Put Price:8.31094
K:120,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:12.3512, Put Price:11.2991
K:125,sig:0.1,r:0.1,S:110,b:0.02
  Call Price:11.2825, Put Price:15.1703
K:130,sig:0.1,r:0.1,S:110,b:0.02

Call Price:10.3429, Put Price:20.1337
K:135,sig:0.1,r:0.1,S:110,b:0.02
Call Price:9.51273, Put Price:26.437
K:140,sig:0.1,r:0.1,S:110,b:0.02
Call Price:8.77585, Put Price:34.3716
K:145,sig:0.1,r:0.1,S:110,b:0.02
Call Price:8.119, Put Price:44.2778
K:150,sig:0.1,r:0.1,S:110,b:0.02
Call Price:7.53115, Put Price:56.5514
K:155,sig:0.1,r:0.1,S:110,b:0.02
Call Price:7.0031, Put Price:71.6501
K:160,sig:0.1,r:0.1,S:110,b:0.02
Call Price:6.52712, Put Price:90.1004
K:165,sig:0.1,r:0.1,S:110,b:0.02
Call Price:6.09669, Put Price:112.506
K:170,sig:0.1,r:0.1,S:110,b:0.02
Call Price:5.70625, Put Price:139.554
K:175,sig:0.1,r:0.1,S:110,b:0.02
Call Price:5.35107, Put Price:172.028
K:180,sig:0.1,r:0.1,S:110,b:0.02
Call Price:5.0271, Put Price:210.811
K:185,sig:0.1,r:0.1,S:110,b:0.02
Call Price:4.73082, Put Price:256.904
K:190,sig:0.1,r:0.1,S:110,b:0.02
Call Price:4.45923, Put Price:311.427
K:195,sig:0.1,r:0.1,S:110,b:0.02
Call Price:4.20969, Put Price:375.64
K:200,sig:0.1,r:0.1,S:110,b:0.02
Call Price:3.97991, Put Price:450.947

Price as a function of sig

K:100,sig:0.1,r:0.1,S:110,b:0.02
Call Price:18.5035, Put Price:3.03106
K:100,sig:0.15,r:0.1,S:110,b:0.02
Call Price:22.5052, Put Price:6.85143
K:100,sig:0.2,r:0.1,S:110,b:0.02
Call Price:26.5984, Put Price:10.9261
K:100,sig:0.25,r:0.1,S:110,b:0.02
Call Price:30.6563, Put Price:15.0293
K:100,sig:0.3,r:0.1,S:110,b:0.02
Call Price:34.6188, Put Price:19.0713
K:100,sig:0.35,r:0.1,S:110,b:0.02
Call Price:38.4512, Put Price:23.0055
K:100,sig:0.4,r:0.1,S:110,b:0.02
Call Price:42.1321, Put Price:26.8039
K:100,sig:0.45,r:0.1,S:110,b:0.02
Call Price:45.6484, Put Price:30.4492
K:100,sig:0.5,r:0.1,S:110,b:0.02
Call Price:48.9929, Put Price:33.9308
K:100,sig:0.55,r:0.1,S:110,b:0.02
Call Price:52.1626, Put Price:37.2432
K:100,sig:0.6,r:0.1,S:110,b:0.02
Call Price:55.158, Put Price:40.3847
K:100,sig:0.65,r:0.1,S:110,b:0.02
Call Price:57.9821, Put Price:43.3567
K:100,sig:0.7,r:0.1,S:110,b:0.02
Call Price:60.6398, Put Price:46.1624
K:100,sig:0.75,r:0.1,S:110,b:0.02
Call Price:63.1375, Put Price:48.8071
K:100,sig:0.8,r:0.1,S:110,b:0.02
Call Price:65.4822, Put Price:51.2969
K:100,sig:0.85,r:0.1,S:110,b:0.02
Call Price:67.6818, Put Price:53.6389
K:100,sig:0.9,r:0.1,S:110,b:0.02
Call Price:69.7443, Put Price:55.8403
K:100,sig:0.95,r:0.1,S:110,b:0.02
Call Price:71.6778, Put Price:57.9091
K:100,sig:1,r:0.1,S:110,b:0.02
Call Price:73.4904, Put Price:59.8527

Price as a function of r

K:100,sig:0.1,r:0.1,S:110,b:0.02
Call Price:18.5035, Put Price:3.03106
K:100,sig:0.1,r:0.15,S:110,b:0.02
Call Price:14.9385, Put Price:2.41857
K:100,sig:0.1,r:0.2,S:110,b:0.02
Call Price:13.1933, Put Price:2.02021
K:100,sig:0.1,r:0.25,S:110,b:0.02
Call Price:12.165, Put Price:1.7358
K:100,sig:0.1,r:0.3,S:110,b:0.02
Call Price:11.4978, Put Price:1.52065
K:100,sig:0.1,r:0.35,S:110,b:0.02
Call Price:11.04, Put Price:1.35131
K:100,sig:0.1,r:0.4,S:110,b:0.02
Call Price:10.7154, Put Price:1.21409
K:100,sig:0.1,r:0.45,S:110,b:0.02
Call Price:10.4812, Put Price:1.10041
K:100,sig:0.1,r:0.5,S:110,b:0.02
Call Price:10.3117, Put Price:1.00455
K:100,sig:0.1,r:0.55,S:110,b:0.02
Call Price:10.19, Put Price:0.922553
K:100,sig:0.1,r:0.6,S:110,b:0.02
Call Price:10.1049, Put Price:0.851579
K:100,sig:0.1,r:0.65,S:110,b:0.02
Call Price:10.0487, Put Price:0.789526
K:100,sig:0.1,r:0.7,S:110,b:0.02

Call Price:10.0155, Put Price:0.734805
K:100,sig:0.1,r:0.75,S:110,b:0.02
Call Price:10.0012, Put Price:0.686189
K:100,sig:0.1,r:0.8,S:110,b:0.02
Call Price:10.0025, Put Price:0.642717
K:100,sig:0.1,r:0.85,S:110,b:0.02
Call Price:10.0171, Put Price:0.603619
K:100,sig:0.1,r:0.9,S:110,b:0.02
Call Price:10.0428, Put Price:0.568275
K:100,sig:0.1,r:0.95,S:110,b:0.02
Call Price:10.0783, Put Price:0.536179
K:100,sig:0.1,r:1,S:110,b:0.02
Call Price:10.1223, Put Price:0.50691

Price as a function of S

K:100,sig:0.1,r:0.1,S:110,b:0.02
Call Price:18.5035, Put Price:3.03106
K:100,sig:0.1,r:0.1,S:115,b:0.02
Call Price:21.3481, Put Price:2.29919
K:100,sig:0.1,r:0.1,S:120,b:0.02
Call Price:24.4804, Put Price:1.76467
K:100,sig:0.1,r:0.1,S:125,b:0.02
Call Price:27.916, Put Price:1.36913
K:100,sig:0.1,r:0.1,S:130,b:0.02
Call Price:31.67, Put Price:1.07287
K:100,sig:0.1,r:0.1,S:135,b:0.02
Call Price:35.7583, Put Price:0.848494
K:100,sig:0.1,r:0.1,S:140,b:0.02
Call Price:40.1963, Put Price:0.676793
K:100,sig:0.1,r:0.1,S:145,b:0.02
Call Price:45.0001, Put Price:0.544138
K:100,sig:0.1,r:0.1,S:150,b:0.02
Call Price:50.1855, Put Price:0.440732
K:100,sig:0.1,r:0.1,S:155,b:0.02
Call Price:55.7685, Put Price:0.359453
K:100,sig:0.1,r:0.1,S:160,b:0.02
Call Price:61.7655, Put Price:0.295067
K:100,sig:0.1,r:0.1,S:165,b:0.02
Call Price:68.1927, Put Price:0.24369
K:100,sig:0.1,r:0.1,S:170,b:0.02
Call Price:75.0665, Put Price:0.202411
K:100,sig:0.1,r:0.1,S:175,b:0.02
Call Price:82.4034, Put Price:0.169031
K:100,sig:0.1,r:0.1,S:180,b:0.02
Call Price:90.2201, Put Price:0.141875
K:100,sig:0.1,r:0.1,S:185,b:0.02
Call Price:98.5333, Put Price:0.119654
K:100,sig:0.1,r:0.1,S:190,b:0.02
Call Price:107.36, Put Price:0.101373
K:100,sig:0.1,r:0.1,S:195,b:0.02
Call Price:116.717, Put Price:0.0862562
K:100,sig:0.1,r:0.1,S:200,b:0.02
Call Price:126.621, Put Price:0.073694

Price as a function of b

K:100,sig:0.1,r:0.1,S:110,b:0.02
Call Price:18.5035, Put Price:3.03106
K:100,sig:0.1,r:0.1,S:110,b:0.03
Call Price:22.456, Put Price:2.1912
K:100,sig:0.1,r:0.1,S:110,b:0.04
Call Price:27.3822, Put Price:1.58538
K:100,sig:0.1,r:0.1,S:110,b:0.05
Call Price:33.4204, Put Price:1.15397
K:100,sig:0.1,r:0.1,S:110,b:0.06
Call Price:40.8219, Put Price:0.846901
K:100,sig:0.1,r:0.1,S:110,b:0.07
Call Price:50.0413, Put Price:0.626991
K:100,sig:0.1,r:0.1,S:110,b:0.08
Call Price:61.9543, Put Price:0.468088
K:100,sig:0.1,r:0.1,S:110,b:0.09
Call Price:78.588, Put Price:0.352155
K:100,sig:0.1,r:0.1,S:110,b:0.1
Call Price:-nan(ind), Put Price:0.266772
K:100,sig:0.1,r:0.1,S:110,b:0.11
Call Price:-nan(ind), Put Price:0.203339
K:100,sig:0.1,r:0.1,S:110,b:0.12
Call Price:-nan(ind), Put Price:0.155839
K:100,sig:0.1,r:0.1,S:110,b:0.13
Call Price:-nan(ind), Put Price:0.120016
K:100,sig:0.1,r:0.1,S:110,b:0.14
Call Price:-nan(ind), Put Price:0.0928288
K:100,sig:0.1,r:0.1,S:110,b:0.15
Call Price:-nan(ind), Put Price:0.0720786
K:100,sig:0.1,r:0.1,S:110,b:0.16
Call Price:-nan(ind), Put Price:0.0561613
K:100,sig:0.1,r:0.1,S:110,b:0.17
Call Price:-nan(ind), Put Price:0.0438961
K:100,sig:0.1,r:0.1,S:110,b:0.18
Call Price:-nan(ind), Put Price:0.0344066
K:100,sig:0.1,r:0.1,S:110,b:0.19
Call Price:-nan(ind), Put Price:0.0270379
K:100,sig:0.1,r:0.1,S:110,b:0.2
Call Price:-nan(ind), Put Price:0.021297