MA 374: Financial Engineering Lab
LAB 10 Report
Abheek Ghosh - 140123047

Question 1: (Plots at End of Report)
Paramaters
T = 0.5000
K = 105
r = 0.0500
mu = 0.1000
sig = 0.2000
t = 0
s = 100

Asian Option Prices for K = 105
Call = 0.000000
Put = 0.000000

Asian Option Prices for K = 110
Call = 0.000000
Put = 4.808369

Asian Option Prices for K = 90
Call = 14.459556
Put = 0.000000

Call Option Prices varying with T

T	Prices
0.250000	0.000000
0.300000	0.000000
0.350000	0.000000
0.400000	0.000000
0.450000	0.000000
0.500000	0.272045
0.550000	0.493195
0.600000	0.502421
0.650000	0.658004
0.700000	1.075091
0.750000	1.369351

Put Option Prices varying with T

T	Prices
0.250000	1.579001
0.300000	1.252833
0.350000	1.248499
0.400000	0.482938
0.450000	0.423314
0.500000	0.000000
0.550000	0.000000
0.600000	0.000000
0.650000	0.000000
0.700000	0.000000
0.750000	0.000000

Call Option Prices varying with K

K	Prices
52.500000	50.937421
63.000000	40.517843
73.500000	30.712817

84.000000	20.371461
94.500000	10.057681
105.000000	0.000000
115.500000	0.000000
126.000000	0.000000
136.500000	0.000000
147.000000	0.000000
157.500000	0.000000

Put Option Prices varying with K

K	Prices
52.500000	0.000000
63.000000	0.000000
73.500000	0.000000
84.000000	0.000000
94.500000	0.000000
105.000000	0.433137
115.500000	10.337312
126.000000	20.500784
136.500000	30.796067
147.000000	41.051625
157.500000	51.226356

Call Option Prices varying with mu

mu	Prices
0.050000	0.071422
0.060000	0.041265
0.070000	0.000000
0.080000	0.000000
0.090000	0.038462
0.100000	0.000000
0.110000	0.096313
0.120000	0.067291
0.130000	0.085022
0.140000	0.014640
0.150000	0.076388
0.160000	0.397748
0.170000	0.000000
0.180000	0.000000
0.190000	0.018942
0.200000	0.115614

Put Option Prices varying with mu

mu	Prices
0.050000	0.000000
0.060000	0.330845
0.070000	0.000000
0.080000	0.047027
0.090000	0.000000
0.100000	0.155496
0.110000	0.067640
0.120000	0.000000
0.130000	0.106298
0.140000	0.044529
0.150000	0.000000
0.160000	0.000000
0.170000	0.251385
0.180000	0.027549
0.190000	0.000000
0.200000	0.000000

Call Option Prices varying with r

r	Prices
0.025000	0.000000
0.030000	0.000000
0.035000	0.000000
0.040000	0.000000
0.045000	0.000000
0.050000	0.000000
0.055000	0.627649
0.060000	1.006290
0.065000	1.193887
0.070000	2.077104
0.075000	2.357559
0.080000	2.895039
0.085000	3.570610
0.090000	3.856027
0.095000	4.762172
0.100000	5.203800

Put Option Prices varying with r

r	Prices
0.025000	2.617673
0.030000	1.833234
0.035000	1.600049
0.040000	1.134277
0.045000	0.701310
0.050000	0.000000
0.055000	0.000000
0.060000	0.000000
0.065000	0.000000
0.070000	0.000000
0.075000	0.000000
0.080000	0.000000
0.085000	0.000000
0.090000	0.000000
0.095000	0.000000
0.100000	0.000000

Call Option Prices varying with sig

sig	Prices
0.100000	0.000000
0.120000	0.000000
0.140000	0.000000
0.160000	0.000000
0.180000	0.000000
0.200000	0.078086
0.220000	0.372263
0.240000	0.697158
0.260000	1.218059
0.280000	1.551472
0.300000	1.860008
0.320000	2.443850
0.340000	2.402871
0.360000	3.323765
0.380000	4.212319
0.400000	4.859627

Put Option Prices varying with sig

sig	Prices

0.100000	1.941702
0.120000	1.492741
0.140000	1.237456
0.160000	0.747889
0.180000	0.385012
0.200000	0.000000
0.220000	0.000000
0.240000	0.000000
0.260000	0.000000
0.280000	0.000000
0.300000	0.000000
0.320000	0.000000
0.340000	0.000000
0.360000	0.000000
0.380000	0.000000
0.400000	0.000000

Call Option Prices varying with t

t	Prices
0.000000	0.000000
0.100000	0.000000
0.200000	0.000000
0.300000	0.000000
0.400000	0.000000
0.500000	0.000000

Put Option Prices varying with t

t	Prices
0.000000	0.000000
0.100000	0.702423
0.200000	1.215421
0.300000	2.295967
0.400000	3.308963
0.500000	5.000000

Call Option Prices varying with S

S	Prices
80.000000	0.000000
83.000000	0.000000
86.000000	0.000000
89.000000	0.000000
92.000000	0.000000
95.000000	0.000000
98.000000	0.000000
101.000000	0.964835
104.000000	3.995139
107.000000	7.298322
110.000000	10.184681
113.000000	13.365044
116.000000	16.122583
119.000000	19.196395
122.000000	22.329022
125.000000	25.454987
128.000000	28.525765

Put Option Prices varying with S

S	Prices
80.000000	20.577938
83.000000	17.538362
86.000000	14.233116

89.000000	11.276983
92.000000	8.189013
95.000000	4.963856
98.000000	1.844845
101.000000	0.000000
104.000000	0.000000
107.000000	0.000000
110.000000	0.000000
113.000000	0.000000
116.000000	0.000000
119.000000	0.000000
122.000000	0.000000
125.000000	0.000000
128.000000	0.000000

Question 2:

Without Variance Reduction
Asian Option Prices for K = 105
Call = 0.000000
Put = 0.050744

Asian Option Prices for K = 110
Call = 0.000000
Put = 4.968818

Asian Option Prices for K = 90
Call = 14.462912
Put = 0.000000

Using Antithetic Variables
Asian Option Prices for K = 105
Call = 0.000000
Put = 0.058335

Asian Option Prices for K = 110
Call = 0.000000
Put = 4.935425

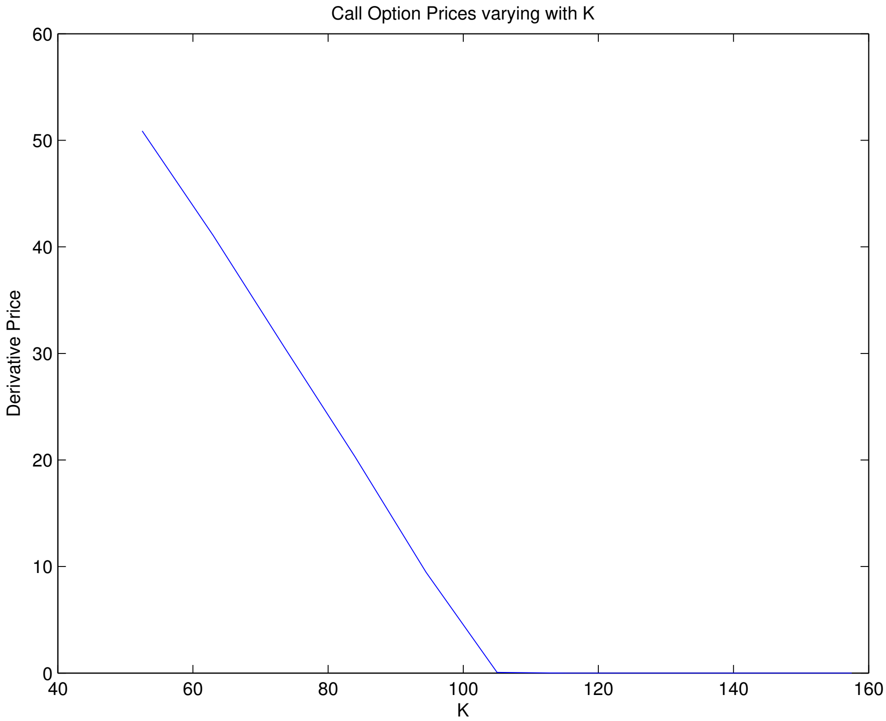
Asian Option Prices for K = 90
Call = 14.572655
Put = 0.000000

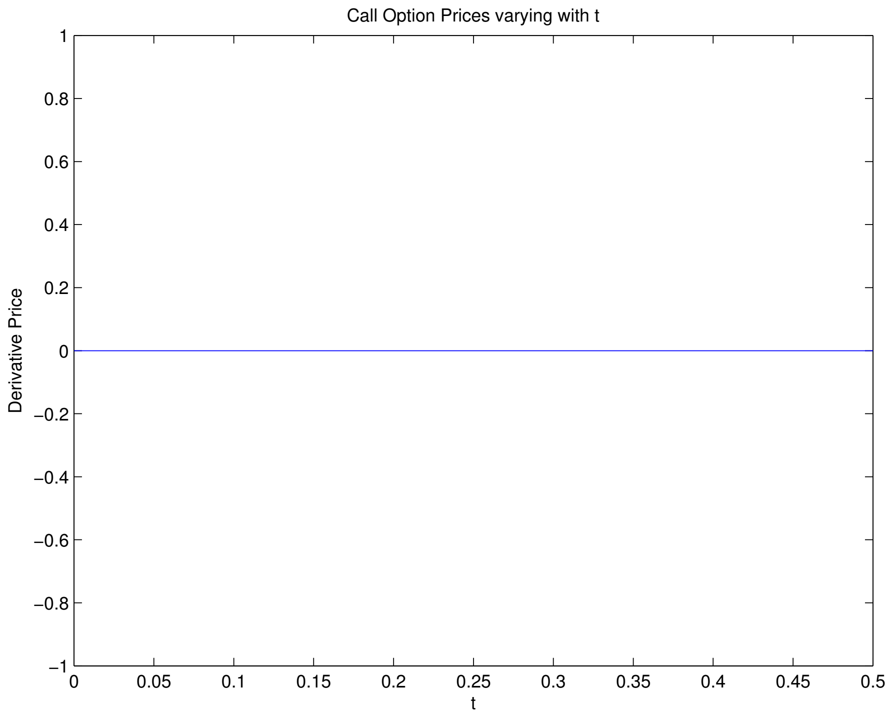
Using Control Variates
Asian Option Prices for K = 105
Call = 0.000000
Put = 0.029127

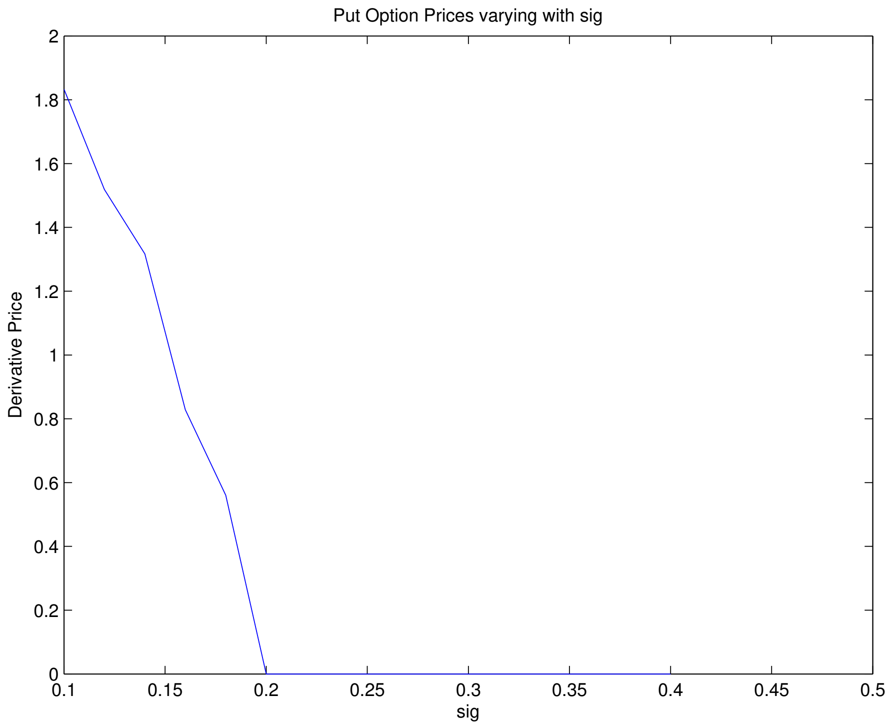
Asian Option Prices for K = 110
Call = 0.000000
Put = 5.008042

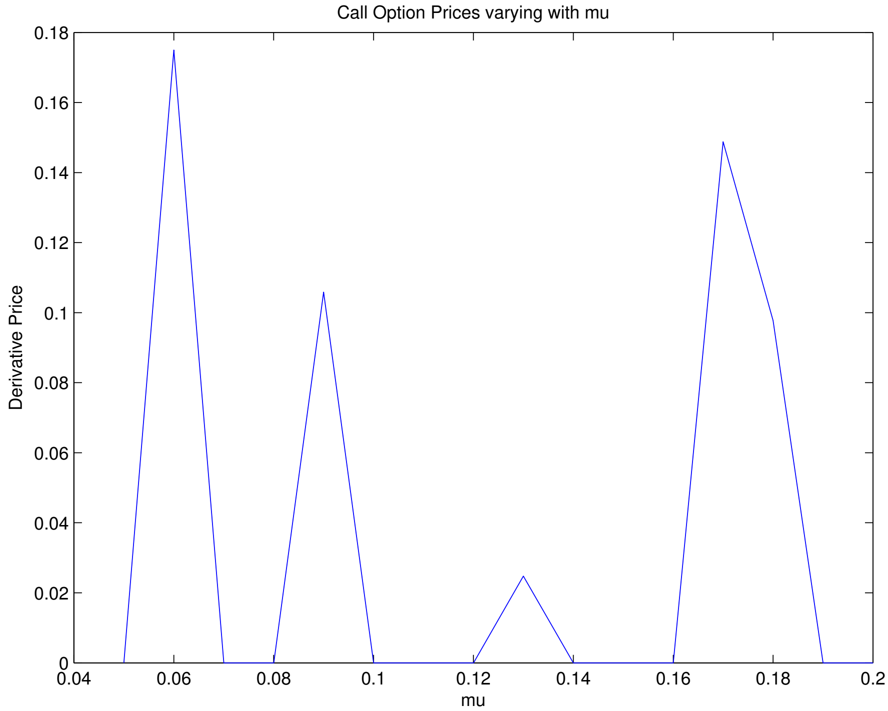
Asian Option Prices for K = 90
Call = 14.500902
Put = 0.000000

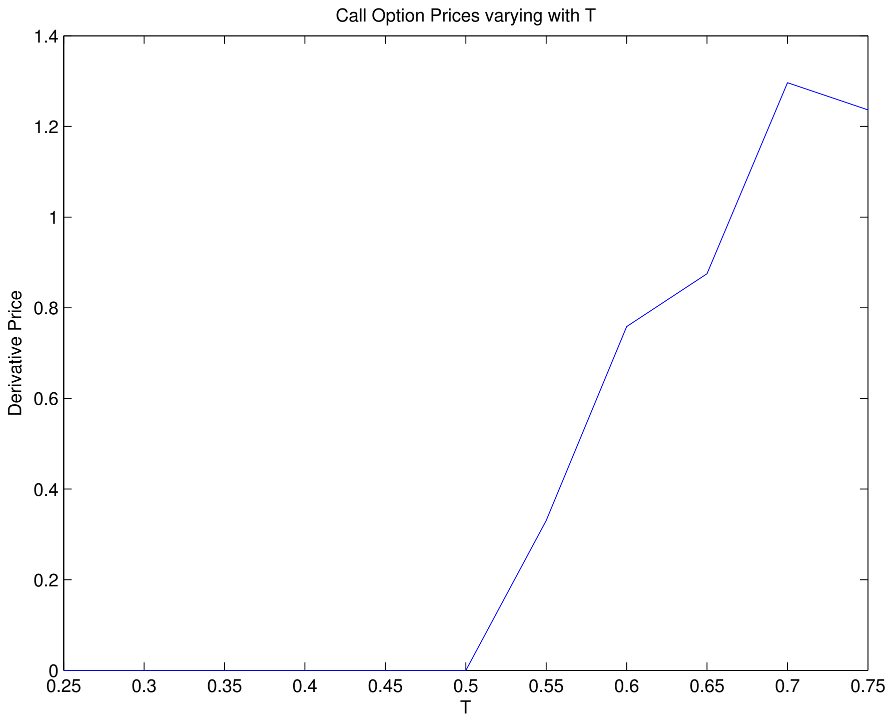
Question 1 Plots

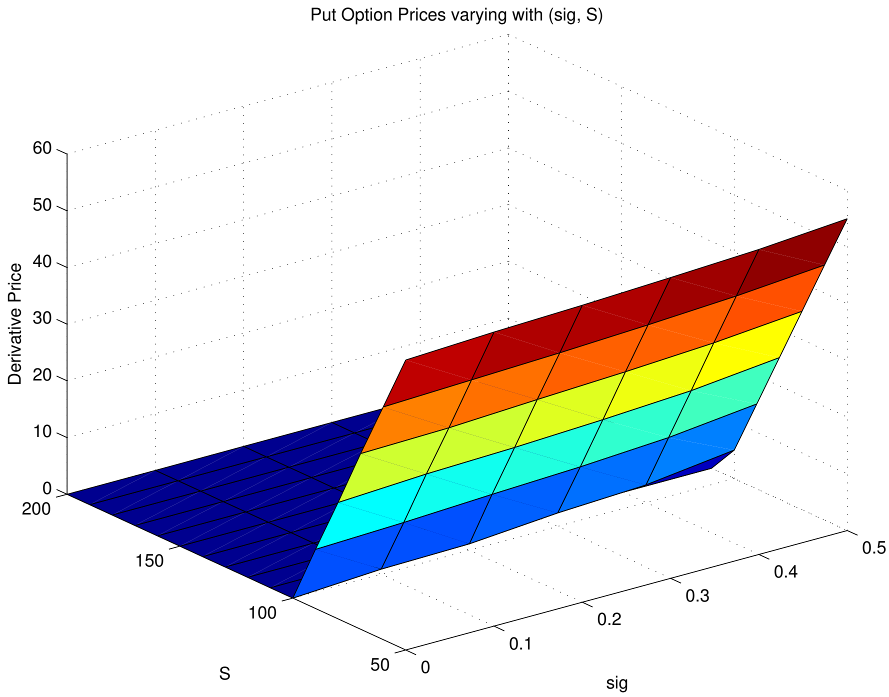



Call Option Prices varying with t
Derivative Price
t
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

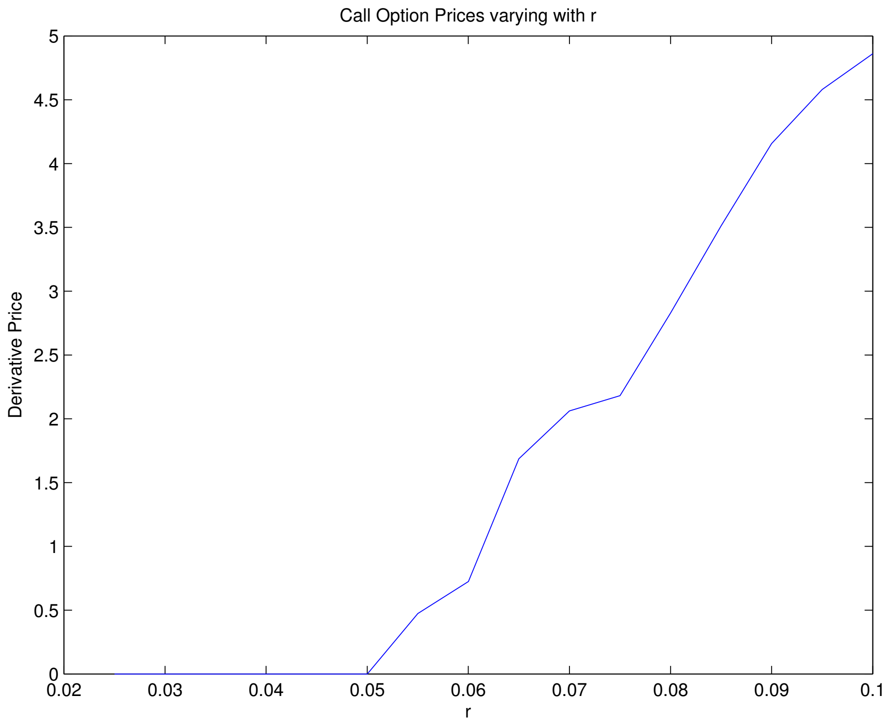

Put Option Prices varying with sig
Derivative Price
sig
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5


Call Option Prices varying with mu
Derivative Price
mu
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2


Call Option Prices varying with T
Derivative Price
T
0
0.2
0.4
0.6
0.8
1
1.2
1.4
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75

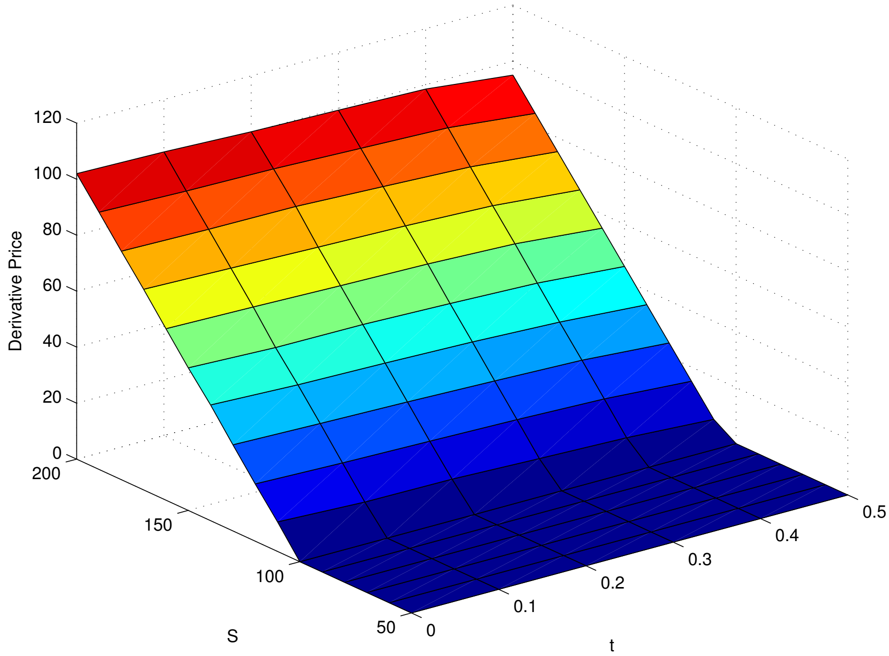


Put Option Prices varying with (sig, S)
Derivative Price
60
50
40
30
20
10
0
200
150
100
50
S
0
0.1
0.2
0.3
0.4
0.5
sig

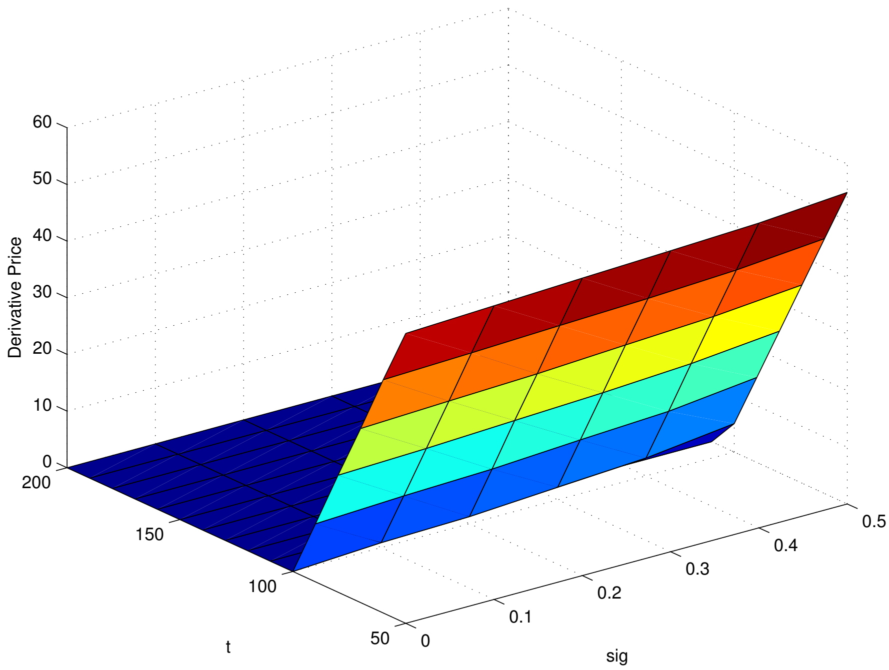


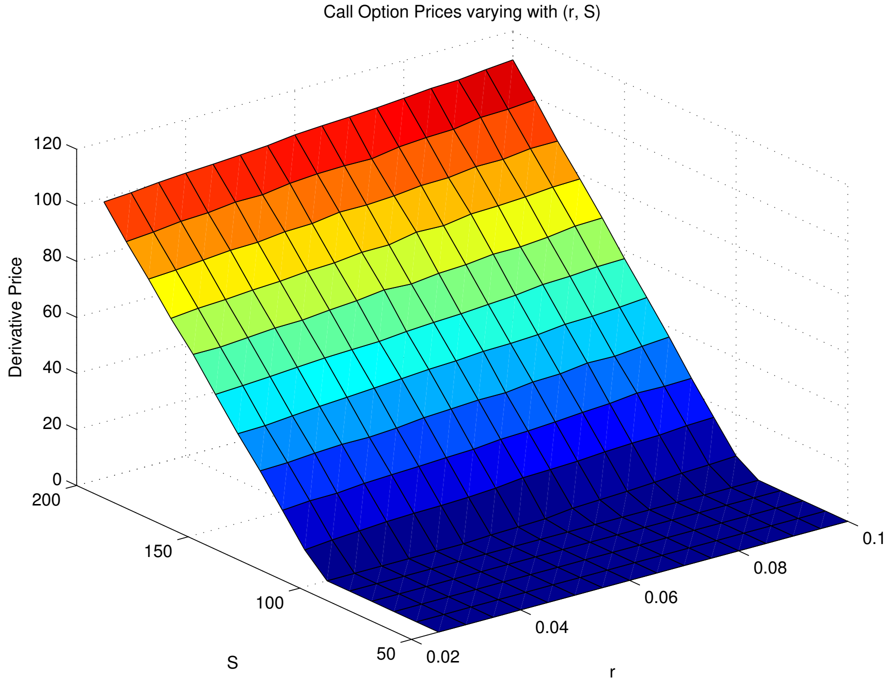
Call Option Prices varying with r
Derivative Price
r
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1

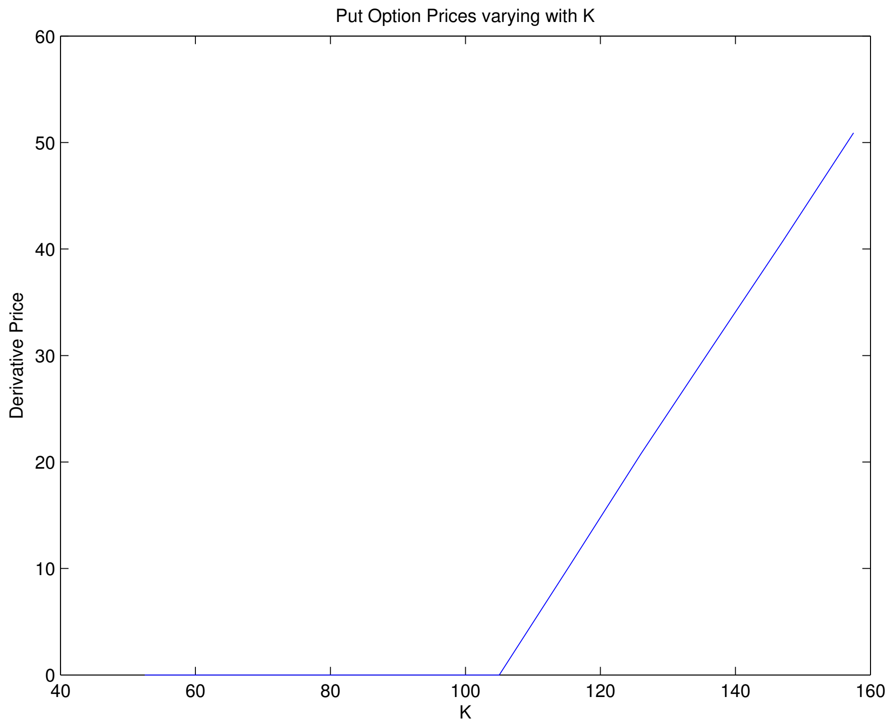
Call Option Prices varying with (t, S)

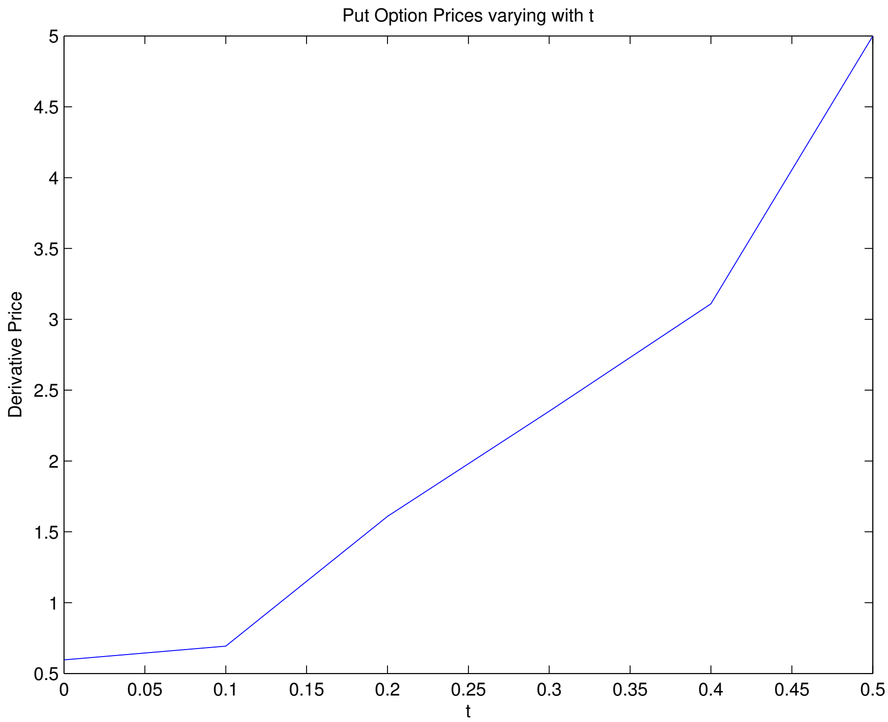


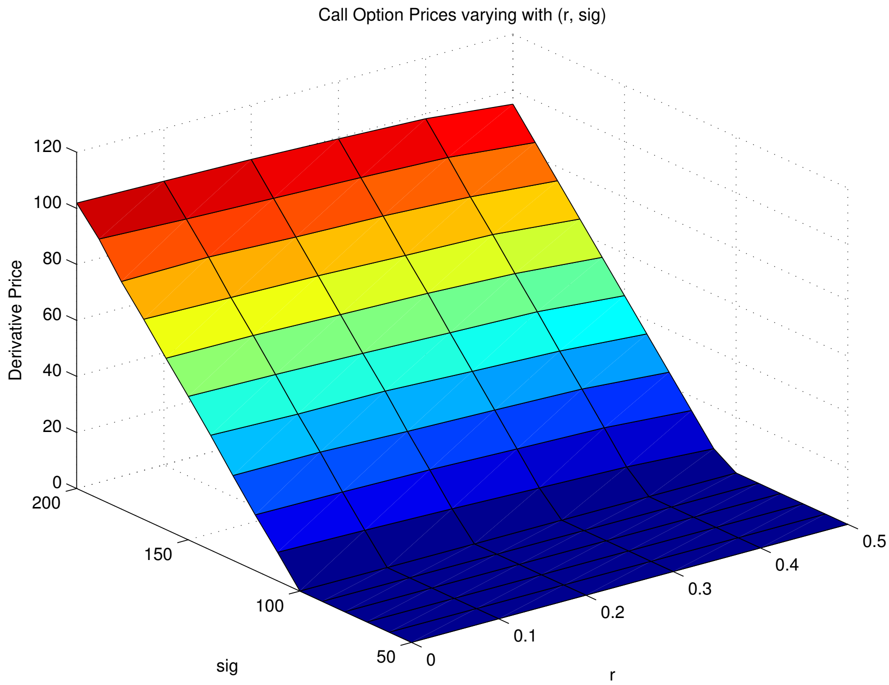
Put Option Prices varying with (sig, t)

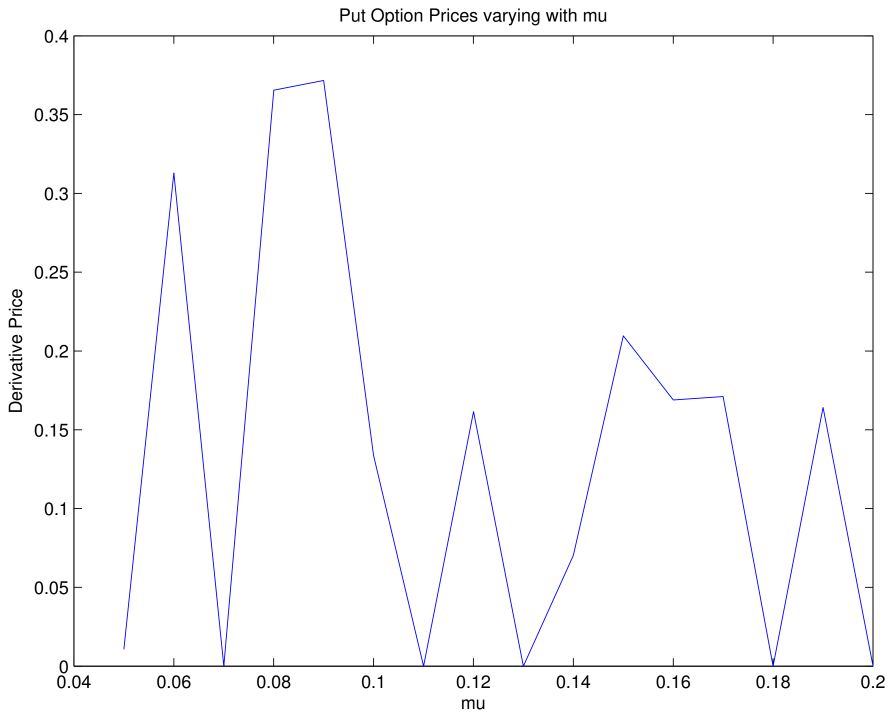


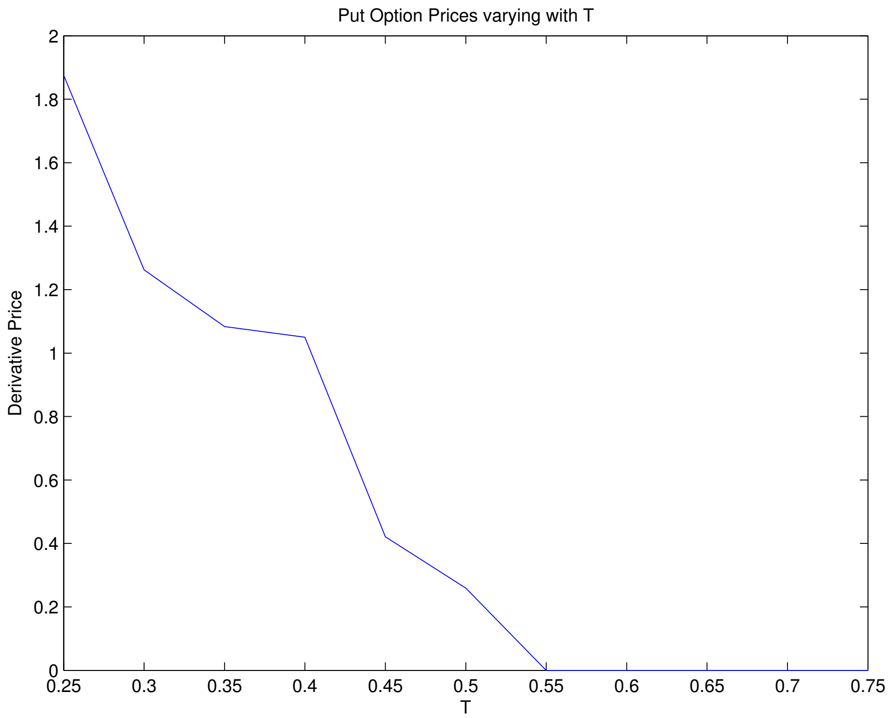

Call Option Prices varying with (r, S)
Derivative Price
120
100
80
60
40
20
0
200
150
100
50
S
0.02
0.04
0.06
0.08
0.1
r

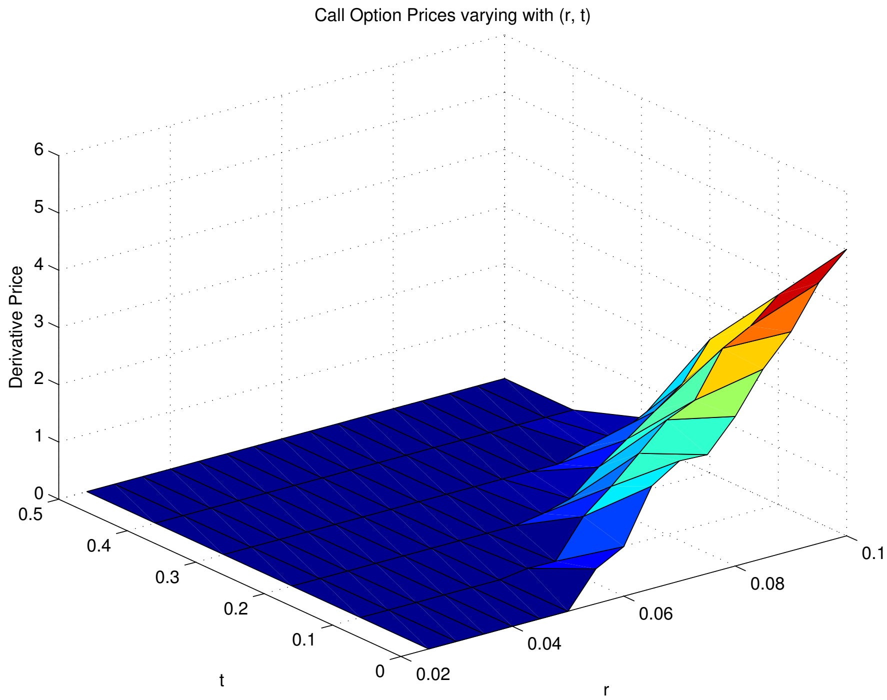

Put Option Prices varying with K
Derivative Price
K
0
10
20
30
40
50
60
40
60
80
100
120
140
160

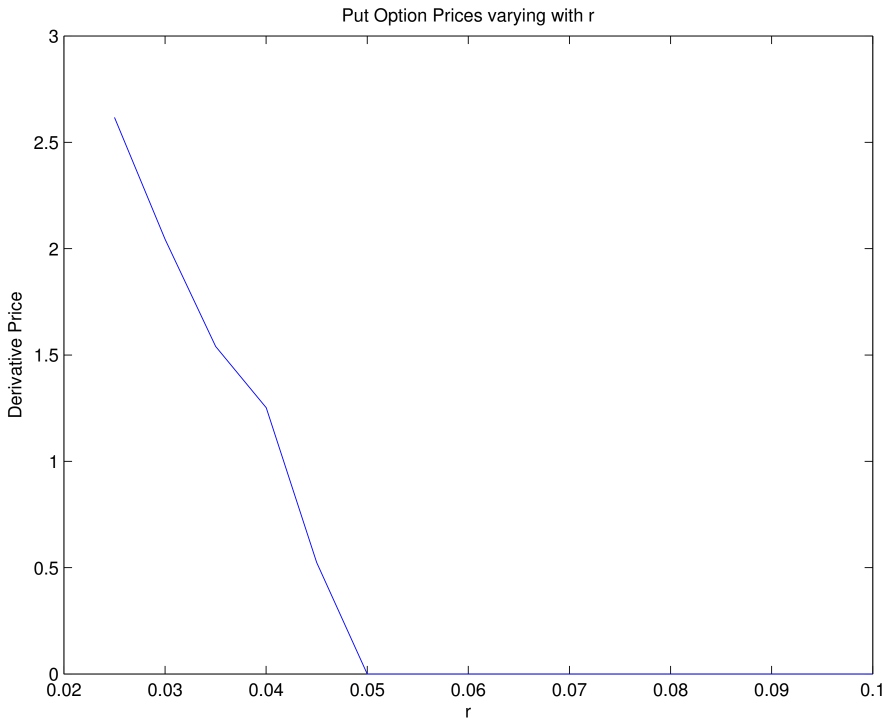

Put Option Prices varying with t
Derivative Price
t
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

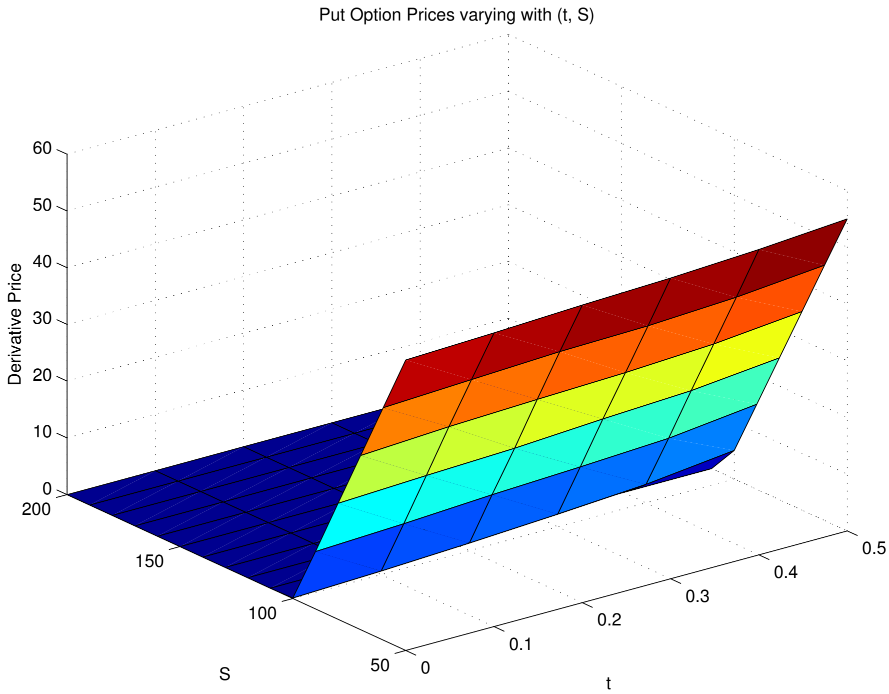

Call Option Prices varying with (r, sig)
Derivative Price
0
20
40
60
80
100
120
200
150
100
50
sig
0
0.1
0.2
0.3
0.4
0.5
r


Put Option Prices varying with mu
Derivative Price
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
mu

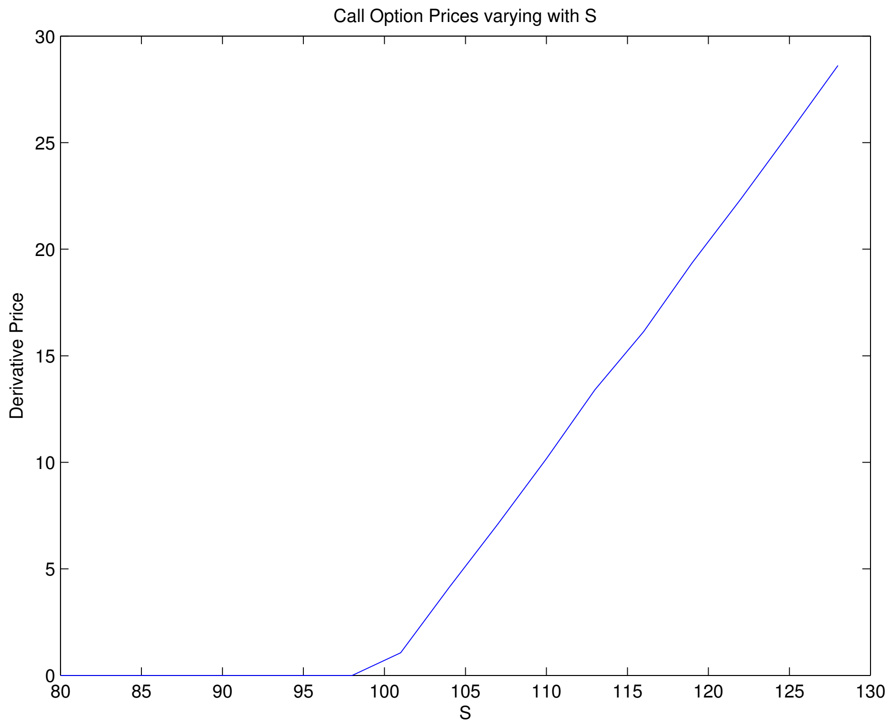

Put Option Prices varying with T
Derivative Price
T
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75

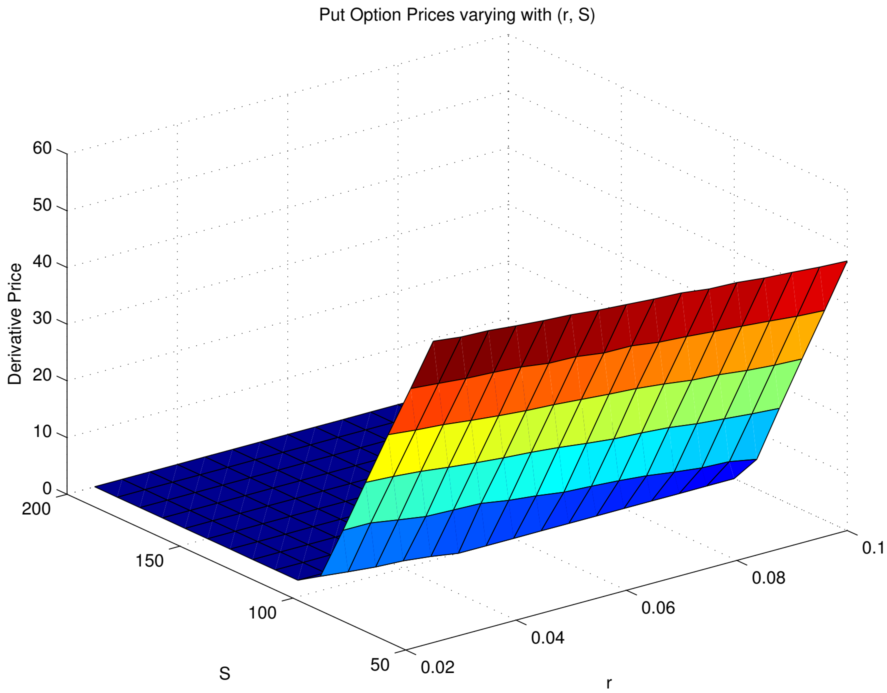

Call Option Prices varying with (r, t)
Derivative Price
0
1
2
3
4
5
6
t
0
0.1
0.2
0.3
0.4
0.5
r
0.02
0.04
0.06
0.08
0.1

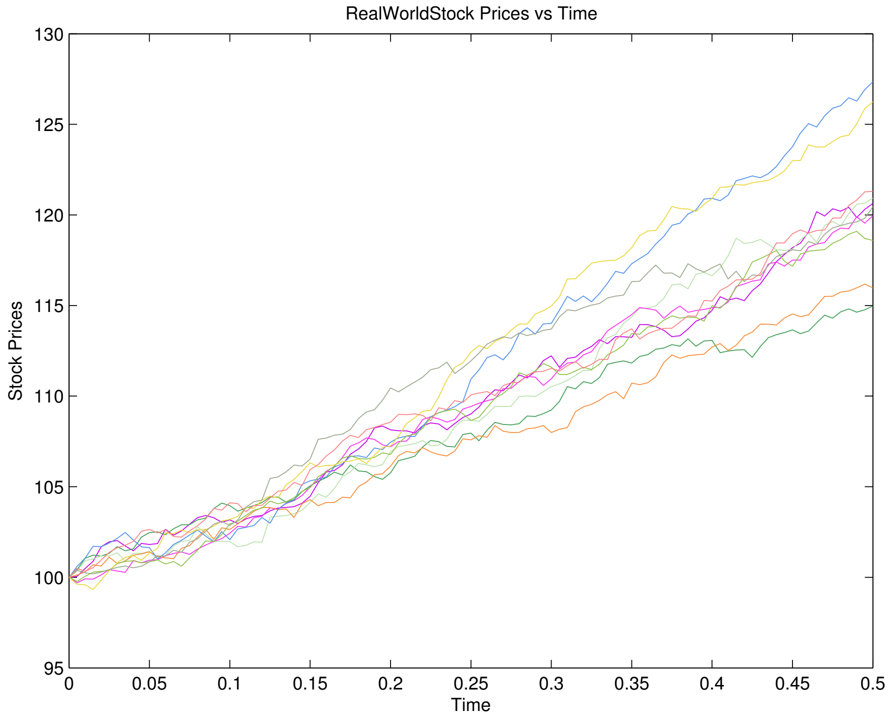

Put Option Prices varying with r
Derivative Price
r
0
0.5
1
1.5
2
2.5
3
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1

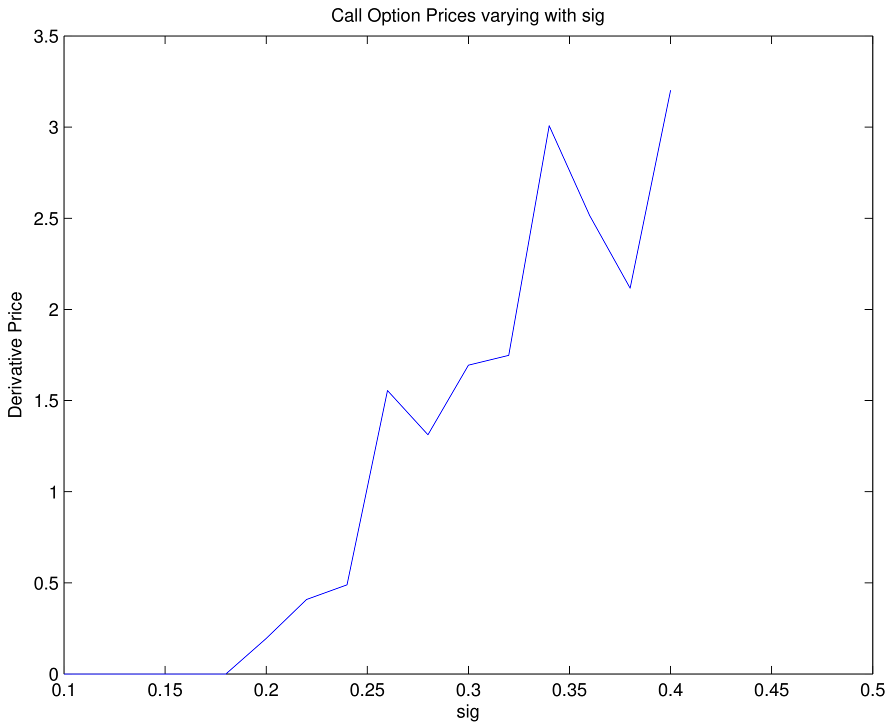


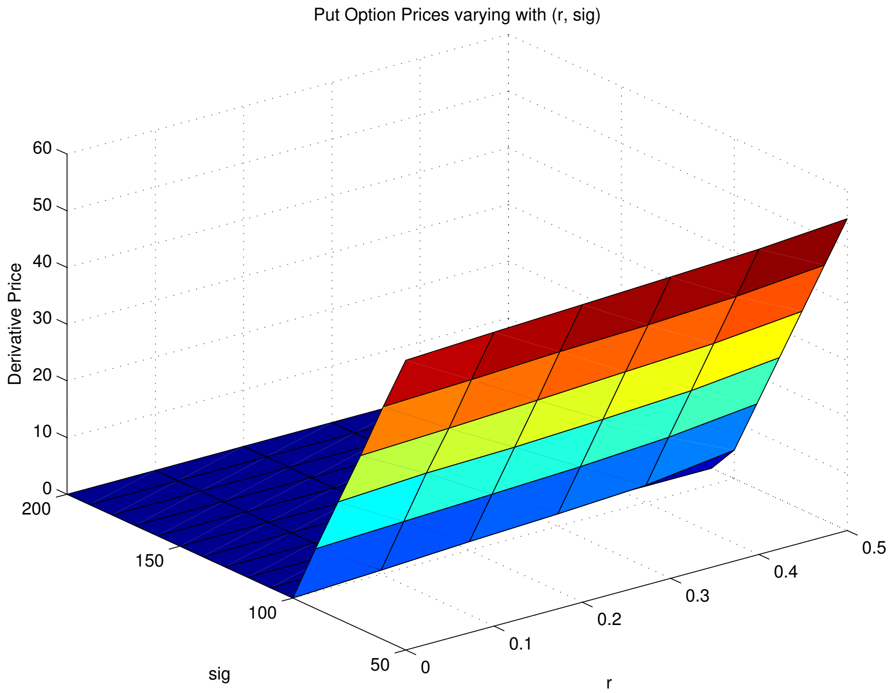
Put Option Prices varying with (t, S)
Derivative Price
60
50
40
30
20
10
0
200
150
100
50
S
0
0.1
0.2
0.3
0.4
0.5
t

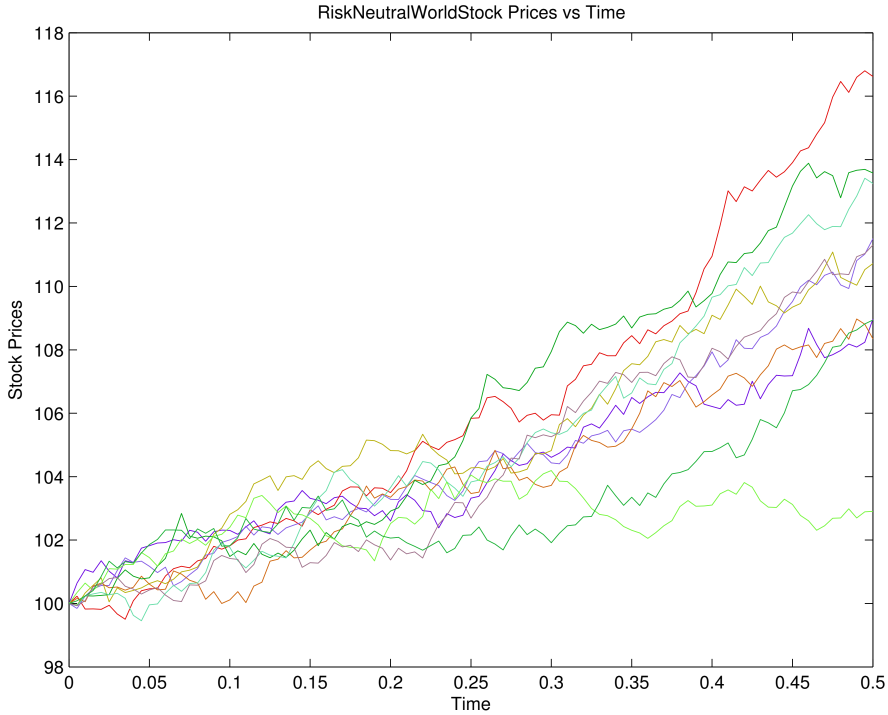

Call Option Prices varying with S
Derivative Price
S
0
5
10
15
20
25
30
80
85
90
95
100
105
110
115
120
125
130


Put Option Prices varying with (r, S)
Derivative Price
60
50
40
30
20
10
0
200
150
100
50
S
0.02
0.04
0.06
0.08
0.1
r

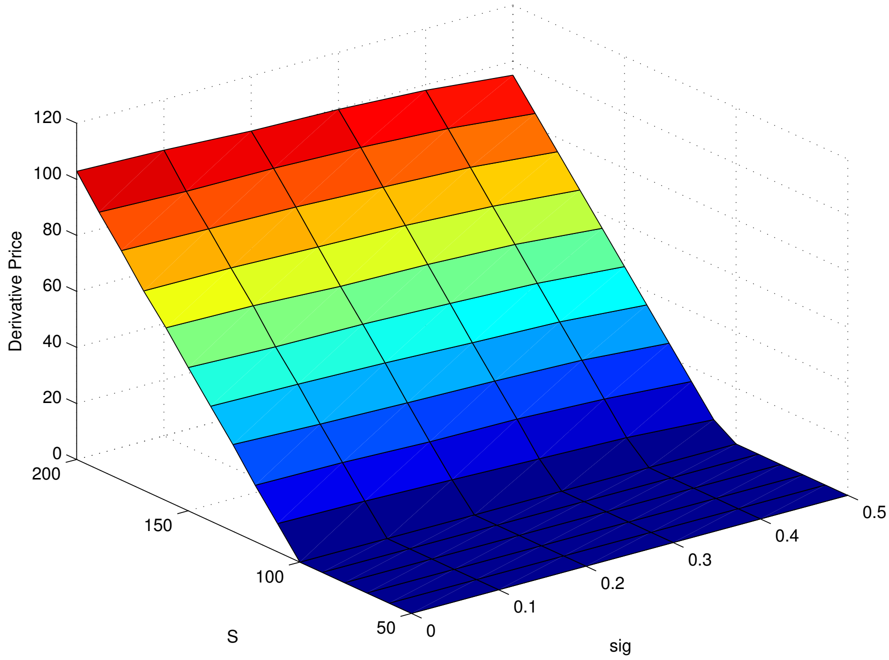

RealWorldStock Prices vs Time
Stock Prices
Time
130
125
120
115
110
105
100
95
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5


Call Option Prices varying with sig
Derivative Price
sig
0
0.5
1
1.5
2
2.5
3
3.5
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

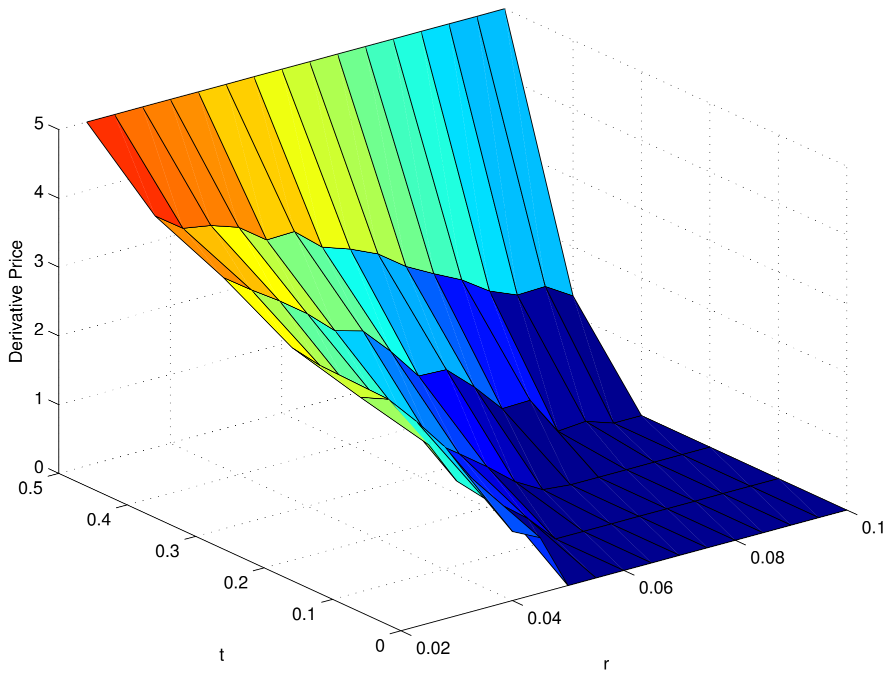

Put Option Prices varying with (r, sig)
Derivative Price
60
50
40
30
20
10
0
200
150
100
50
sig
0
0.1
0.2
0.3
0.4
0.5
r

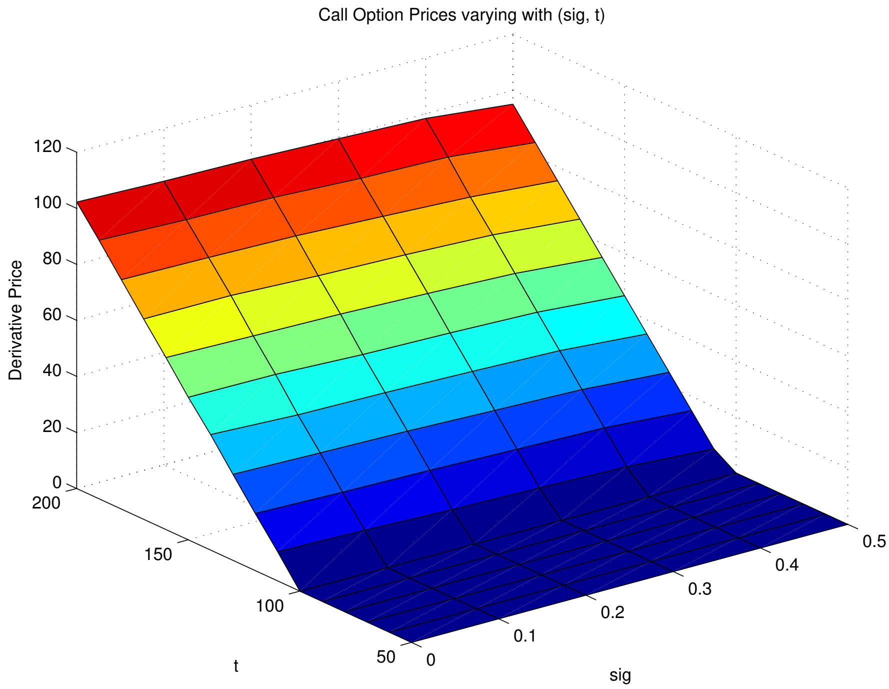

RiskNeutralWorldStock Prices vs Time
Stock Prices
Time
118
116
114
112
110
108
106
104
102
100
98
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5

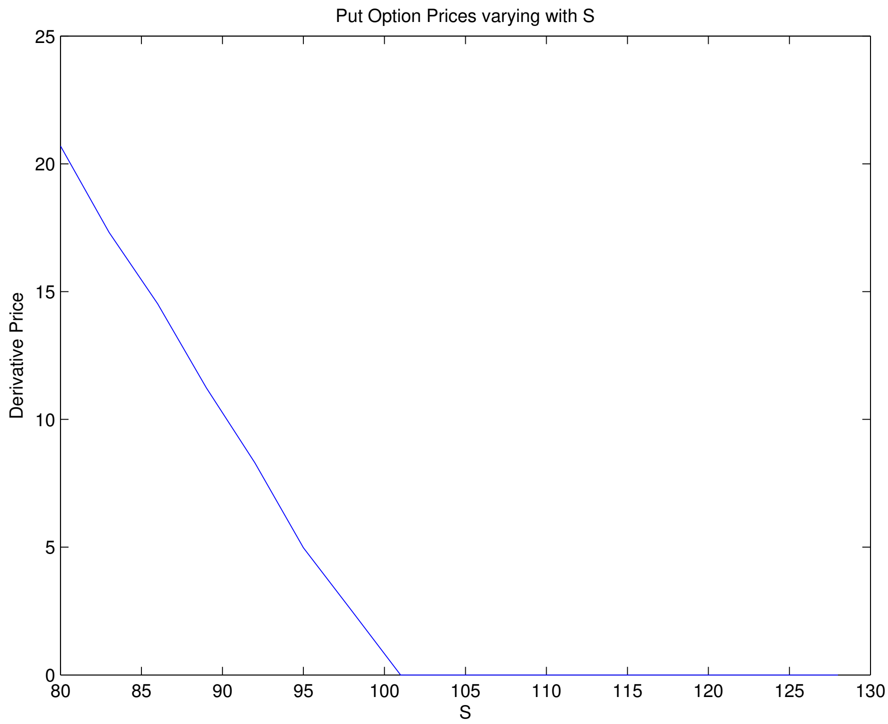
Call Option Prices varying with (sig, S)



Put Option Prices varying with (r, t)




Call Option Prices varying with (sig, t)
Derivative Price
0
20
40
60
80
100
120
200
150
100
50
t
0
0.1
0.2
0.3
0.4
0.5
sig


Put Option Prices varying with S
Derivative Price
S
0
5
10
15
20
25
80
85
90
95
100
105
110
115
120
125
130