

Option Pricer Report COMP7405

Team member: Lei xiaojing & Wu Meng

Contribution

Wu Meng: Basic Algorithm, code of all the options and test.

Lei Xiaojing: Design the user interface, revise some codes and apply codes to the user interface.

User interface

The main window shows five types of the option that the pricer can calculate. Click the button to choose the calculate type. For European option: Enter the $S(0)$, sigma, r , q , T , K and option type according to the label on the left of the input line. The result will be shown on the text browser after the submit button is clicked. When the Cancel button is clicked, the calculation will be cancelled. For other options, the interfaces are almost the same. When input the option type, input capital letter “C” represents the call option, input capital letter “P” represents the put option. As for the control variate method in Arithmetic Asian option, input “MC” for standard Monte Carlo and “CV” control variate. Click the “cancel” button on the main window to end the pricer. Run the file “Option_pricer.py” can enter the interface.

Functionalities

a. In class EuroOption, the method Op consumes the implied volatility and returns the option price. **b.** The method vega consumes the implied volatility and returns the derivative of the option value. **c.** The method getSigma consumes the option premium and returns the implied volatility of the option. **d.** The method calc in class ArithAsianOption is designed to price arithmetic Asian call/put options using the Monte Carlo method with control variate technique. **e.** The method calc in class

GeoAsianOption is designed to price geometric Asian call/put options. **f.** The method calc in class BiTree is designed to price American call/put options using the Binomial Tree method. **g.** Class MainWindow is the initialization of the program, connect the interface and the function. For every option calculator, it contains the Ui_form.

Test cases and Analysis

Following is the result of Arithmetic Asian option tests.

The number of paths in Monte Carlo simulation is $m = 100,000$.

S	σ	K	n	Type	CV	r	T	price	The 95% confidence interval
100	0.3	100	50	Put	true	0.05	3	7.775	[7.719, 7.857]
100	0.3	100	50	Put	false	0.05	3	7.788	[7.719, 7.857]
100	0.3	100	100	Put	true	0.05	3	7.721	[7.710, 7.848]
100	0.3	100	100	Put	false	0.05	3	7.779	[7.710, 7.848]
100	0.4	100	50	Put	true	0.05	3	11.285	[11.170, 11.350]
100	0.4	100	50	Put	false	0.05	3	11.260	[11.170, 11.350]
100	0.3	100	50	Call	true	0.05	3	14.706	[14.662, 14.952]
100	0.3	100	50	Call	false	0.05	3	14.807	[14.662, 14.952]
100	0.3	100	100	Call	true	0.05	3	14.583	[14.486, 14.773]
100	0.3	100	100	Call	false	0.05	3	14.629	[14.486, 14.773]
100	0.4	100	50	Call	true	0.05	3	18.228	[18.124, 18.532]
100	0.4	100	50	Call	false	0.05	3	18.328	[18.124, 18.532]
80	0.3	100	50	Put	true	0.05	3	16.811	[16.761, 16.944]
50	0.3	100	50	Put	true	0.05	3	39.541	[39.682, 39.857]
100	0.3	100	50	Put	true	0.1	3	4.544	[4.795, 4.898]
100	0.3	100	50	Put	true	0.2	3	0.338	[1.626, 1.679]

100	0.3	120	50	Put	true	0.05	3	17.950	[7.855,18.068]
100	0.3	100	50	Put	true	0.05	1	5.594	[5.546,5.646]

for the last test case, when path number is 500000, the result is 5.593, the 95% confidence interval is [5.589,5.634].

OptionType	S	σ	K	r	n	T	Type	Price
GeoAsian	100	0.3	100	0.05	50	3	Call	13.228
GeoAsian	100	0.4	100	0.05	50	3	Call	8.451
GeoAsian	100	0.3	100	0.05	100	3	Call	13.109
GeoAsian	100	0.3	100	0.05	50	3	Put	8.451
GeoAsian	100	0.4	100	0.05	50	3	Put	12.554
GeoAsian	100	0.3	100	0.05	100	3	Put	8.40
GeoAsian	120	0.3	100	0.05	50	3	Call	26.339
GeoAsian	100	0.3	80	0.05	50	3	Call	24.066
GeoAsian	100	0.3	100	0.1	50	3	Call	15.284
GeoAsian	100	0.3	100	0.05	50	2	Call	10.868

OptionType	S	σ	r	T	n	K	Type	Price
American	50	0.4	0.1	2	200	40	Put	3.418
American	50	0.4	0.1	2	200	50	Put	7.468
American	50	0.4	0.1	2	200	70	Put	20.831
American	100	0.4	0.1	2	200	40	Put	0.310
American	50	0.4	0.1	2	200	40	Call	20.197
American	50	0.5	0.1	2	200	40	Put	5.295
American	50	0.4	0.05	2	200	40	Call	17.972
American	50	0.4	0.1	3	200	40	Call	23.720
American	50	0.4	0.1	2	2000	40	Put	3.416

OptionType	S	σ	r	T	q	K	Type	Price
------------	---	----------	---	---	---	---	------	-------

European	100	0.2	0.01	1	0	100	Put	7.438
European	100	0.2	0.01	1	0	120	Put	21.147
European	100	0.2	0.01	2	0	100	Put	10.173
European	100	0.3	0.01	1	0	100	Put	11.373
European	100	0.2	0.02	1	0	100	Put	6.936
European	100	0.2	0.01	1	0.005	100	Put	7.660
European	100	0.2	0.01	1	0	100	Call	8.433
European	120	0.2	0.01	1	0	100	Put	1.947
European	100	0.2	0.01	3	0	100	Put	12.120

TestType	S	premium	r	T	q	K	Type	result
volatility	100	7.438	0.01	1	0	100	Put	0.200
volatility	100	7.438	0.01	1	0	80	Put	0.445
volatility	120	7.438	0.01	1	0	100	Put	0.364
volatility	100	7.438	0.01	2	0	100	Put	0.151
volatility	100	7.438	0.02	1	0	100	Put	0.213
volatility	100	7.438	0.01	1	0.005	100	Put	0.360
volatility	100	7.438	0.01	1	0	100	Call	0.175
volatility	100	7.438	0.01	1	0	50	Put	0.901
volatility	100	7.438	0.01	3	0	100	Put	0.130
volatility	100	21.147	0.01	1	0	100	Put	0.552

Analysis:

From the test cases above, we can draw the conclusion that when other parameters keep unchanged, for **Arithmetic Asian option**, if the sigma or K or T raises, the put option price raises obviously; if S or r raises, the put price decreases; if observation times or paths raises or with control variate, the put and call price decrease very little. if the sigma or T or S or r raises, the call option price raises obviously; if K raises, the call price decreases. For **Geometric Asian option**, if S or r or T raises, the

call option price raises obviously; if sigma or K raises, the call price decreases; if observation times raise, the call and put price decrease very little. if the sigma or K raises, the call option price raises obviously; if S or r or T raises, the call price decreases. For **American option**, if sigma or r or T raises, the call option price raises obviously; if S or K raises, the call price decreases; if steps raise, the call and put price raise very little. if sigma or K or T raises, the call option price raises obviously; if S or r raises, the call price decreases. For **European option**, if sigma or q or T or K raises, the put option price raises obviously; if S or r raises, the put price decreases; if sigma or S or r or T raises, the call option price raises obviously; if q or K raises, the call price decreases. For **Implied Volatility**, if S or r or q or option premium raises, the sigma result of put option raises obviously; if T or K raises, the sigma result of put option decreases; if q or K or option premium raises, the sigma result of call option raises obviously; if S or r or T raises, the sigma result of call option decreases.