

An Analysis of Dynamic Applications of Black-Scholes

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Period 5 Computer Systems Research 2009-2010

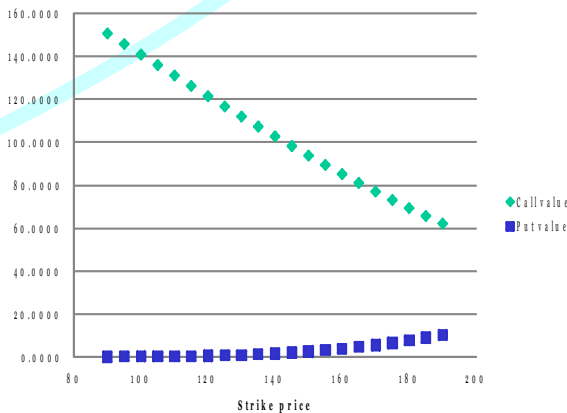
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For decades people have invested in the stock market in with stocks, options, and bonds. One of the earliest is Black-Scholes. Developed by Fischer Black and Merton Scholes in 1973, it remains one of the most prevalent tools used by European investors today. Figure 1 to the right depicts a screenshot of the output of the program.

	B	C	D	E	F	G	H	I	J
1	Stock price	Strike Price	Time to Maturity	Risk free rate	Volatility	Equation d1	Equation d2	Call value	Put value
2	194.97	194.97	0.06	0.35%	40.0%	0.0501	-0.0459	7.5555	7.5159
4	195.29	195.29	0.05	0.35%	40.0%	0.0499	-0.0448	7.3455	7.3078
5	195.48	195.48	0.05	0.35%	40.0%	0.0496	-0.0438	7.1883	7.1525
6	193.32	193.32	0.05	0.35%	40.0%	0.0484	-0.0425	6.9546	6.9312
7	188.05	188.05	0.05	0.35%	40.0%	0.0461	-0.0413	6.5201	6.4893
8	189.87	189.87	0.04	0.35%	40.0%	0.0457	-0.0405	6.3555	6.3258
9	197.8	197.8	0.04	0.35%	40.0%	0.0423	-0.0388	6.4108	6.3823
10	195.43	195.43	0.04	0.35%	40.0%	0.0409	-0.0375	6.1502	6.1238
11	194.67	194.67	0.04	0.35%	40.0%	0.0394	-0.0361	5.8730	5.8488
12	195.98	195.98	0.03	0.35%	40.0%	0.0379	-0.0347	5.7092	5.6858
13	194.17	194.17	0.03	0.35%	40.0%	0.0352	-0.0332	5.3874	5.3674
14	195.03	195.03	0.03	0.35%	40.0%	0.0346	-0.0317	5.1596	5.1409
15	191.86	191.86	0.02	0.35%	40.0%	0.0328	-0.0300	4.8148	4.7983
16	195.43	195.43	0.02	0.35%	40.0%	0.0309	-0.0283	4.5236	4.5087
17	198.29	198.29	0.02	0.35%	40.0%	0.0289	-0.0265	4.1886	4.1733
18	200.36	200.36	0.02	0.35%	40.0%	0.0268	-0.0246	4.1565	4.0930
19	202.1	202.1	0.01	0.35%	40.0%	0.0244	-0.0224	3.7750	3.7654
20	209.04	209.04	0.01	0.35%	40.0%	0.0219	-0.0200	3.4958	3.4877
21	211.61	211.61	0.01	0.35%	40.0%	0.0189	-0.0173	3.0642	3.0581
22	209.1	209.1	0.01	0.35%	40.0%	0.0165	-0.0142	2.9715	2.9679
23	211.64	211.64	0.00	0.35%	40.0%	0.0100	-0.0100	1.7487	1.7487

Figure 1: The Black-Scholes Spreadsheet

Figure 2: Estimated Calls and Puts of AAPL



The Black-Scholes involves several main variables: stock price, strike price, volatility, time until maturity, and the risk-free interest rate. We assume that the valuation of options follows a Geometric Brownian motion and the return is normally distributed with no limits on shorting, no arbitrage, no dividends, and no transaction costs or taxes. The volatility is calculated through a logarithmic function from historical data; the risk free rate is estimated by the U.S. T-bond rate. The generated values are then compared with actual values.

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In a study case of Apple, Inc. (NASDAQ: AAPL), it was found that the Black-Scholes model was more accurate in the short term. In addition, call value estimates were far more accurate than put value estimates. In any case, the investor should be reminded that no matter how good the model is, investments are always unpredictable. Models do not account for many human factors, and personal judgment is needed when investing.

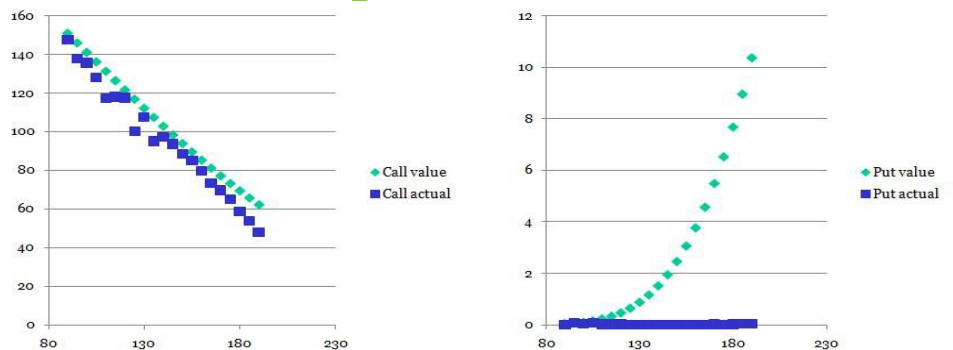


Figure 3: Comparative graphs of call actual vs. call calculated and put actual vs. put calculated. From this graph we can see the discrepancies between the behavior of the real stock market and the predicted behavior by the model.