

# An Empirical investigation of the Black and Scholes Model in Pricing of Index Nifty 50 Call Options

RAJESH KUMAR\*  
RACHNA AGRAWAL\*\*  
MOHD. IMRAN SIDDIQUEI\*\*\*  
VASIM AKRAM\*\*\*\*  
SYED MUNEEB\*\*\*\*

---

---

## Abstract

The Black-Scholes option pricing formula is widely used by investors, traders, all leading stock exchanges and by other participants for pricing options contracts written on the identified underlying assets. This research paper empirically investigates the pricing accuracy of the Black-Scholes model (B&S model) for pricing the Index Nifty 50 call options traded on NSE. The pricing accuracy of 2,829 Call option contracts written on the underlying equity Index Nifty 50 call options are calculated under this model. To gauge pricing errors of this model, the Market closing prices of Index Nifty 50 option and corresponding calculated call option prices under the Black-Scholes model are compared by using the paired t-test, mean error and absolute percentage mean error. Thiel's U statistic has been also used to measure the forecast accuracy of the B&S model. It has been observed that the Black and Scholes model is relatively suitable in pricing of the Index Nifty 50 call options.

---

---

## I. Introduction

BASED ON THE European-style of options, the Black-Scholes (B&S) options pricing model is considered as the most acceptable theories in the areas of financial engineering. F. Black and M. Scholes had published paper titled "The pricing of option and corporate Liabilities" in the Journal of Political Economy in 1973. The financial derivatives tools are particularly designed for minimizing the impact of associated risks. Hence, the Black-Scholes formula is used for options contracts pricing and developing hedging strategies to minimize the impact of risks written on European-style options.

- 
- \* Assistant Professor, GLA University, 17 KM. Stone, NH-2, Mathura Road, Post-Chaumuha, Mathura, Uttar Pradesh 281406, INDIA  
\*\* Associate Professor, Department of Business Studies, J C Bose University of Science and Technology, YMCA Faridabad, Haryana 121006, INDIA  
\*\*\* Assistant Professor, GLA University, 17 KM. Stone, NH-2, Mathura Road, Post-Chaumuha, Mathura, Uttar Pradesh 281406, INDIA  
\*\*\*\* Assistant Professor, GLA University, 17 KM. Stone, NH-2, Mathura Road, Post-Chaumuha, Mathura, Uttar Pradesh 281406, INDIA  
\*\*\*\*\* Assistant Professor, GLA University, 17 KM. Stone, NH-2, Mathura Road, Post-Chaumuha, Mathura, Uttar Pradesh 281406, INDIA

*Submitted January 2020; Accepted June 2020*

*Article accepted under MoU signed with GLA University (India) in 2019-2020*

The produced ME by 0.90 indicates that B&S model under prices index call options. However, these pricing errors are very marginal and comparatively no high (Jordon and Seal, 1986; Blomeyer and Boyd, 1988; Lauterbach and Schultz, 2012). The value of Thiel's U statistic is 0.053, closer to one, indicates a good forecasting accuracy.

#### V. Conclusion

The Black and Scholes model produced pricing has been empirically tested in pricing of Index Nifty 50 call options traded on NSE. The Black-Scholes model is relatively suitable in pricing of the Index Nifty 50 call options. This is in line with the findings of McKenzie, Gerace and Subedar (2007) that the model is relatively suitable in pricing of the call options. But this is also inconsistent with the findings of Gencay and Salih (2003) that the model exhibits pricing error for index call options.

Black and Scholes model is used for the calculation of premium of the European-style of options. An attempt has been made under this researcher paper by the researchers to investigate the produced pricing accuracy of the Black and Scholes model for the underlying assets Index Nifty 50. The theoretical prices have been calculated under this model. The calculated prices have been compared with the market closing prices to gauge the pricing accuracy of the Black and Scholes model. The pricing accuracy produced under the Black and Scholes model has been evaluated by using the paired t-test, Mean Error, Mean Absolute Percentage Error and Theil's U statistic. It has been found that the Black and Scholes model is relatively suitable in pricing of the Index Nifty 50 call options.

#### References

- Asche, F., and G.A. Guttormsen, (2002), "Lead Lag Relationship between Futures Spot Prices", Working paper No. 2/02, SNF Project No. 7220, Institute for research in Economics and Business Administration, Bergen, Norway, 2002
- Ackert, L.F., and Y.S. Tian, (2000), "Evidence of the Efficiency of Index Options Markets", *Economic Review*, Vol. 85, No. 1, pp. 40-52
- Baile, W., (1987), "An Empirical Investigation of the Market for comex Gold Future Options", *Journal of Finance*, Vol. 42, No. 5, pp. 1187-1194
- Bharadwaj A., and J.B. Wiggins, (2001), "Box spread and put-call parity tests for the SandP 500 Index LEAPS market", *Journal of Derivatives*, Vol. 8, No. 4, pp. 62-71
- Black, F., (1975), "Fact and Fantasy in the use of options", *Financial analyst journal*, Vol. 31, pp. 36-41
- Black, F., and M. Scholes, (1972), "The valuation of option contracts and a test of market efficiency", *Journal of Finance*, Vol. 27, pp. 399-417
- Black, F., and M. Scholes, (1973), "The Pricing of Options and Corporate Liabilities", *The Journal of Political Economy*, Vol. 81, No. 3, pp. 637-654
- Blomeyer, E., and J. Boyd, (1998), "Empirical Test of Boundary Conditions for Options on Treasury Bond Futures", *The Journal of Futures Markets*, Vol. 8, pp. 185-198
- Cook S., (2006), "Understanding the construction and interpretation of forecast evaluation statistics using computer-based tutorial exercises", The Economics network, Swansea University, October 2006

Draper, P., and J.K.W. Fung, (2002), "A study of arbitrage efficiency between the FTSE- 100 Index futures and options contracts", *Journal of Futures Markets*, Vol.22, No. 1, pp. 31-58

Fleming, J.B., Ostdiek, and R.E. Whaley, (1996), "Trading costs and the relative rates of price discovery in stock, futures, and option markets", *Journal of Futures Markets*, Vol. 16, No. 4, pp. 353-387

Fung, J.K.W., and K.C. Chan, (1994), "On the arbitrage free pricing relationship between index futures and index options: A note" *Journal of Futures Markets*, Vol. 14, No. 8, pp. 957-962

Fung, J.K.W., (1997), "The intraday pricing efficiency of Hang Seng Index options and futures markets", *Journal of Futures Markets*, Vol. 17, No. 7, pp. 327-331

Fung, J.K.W., and A.K.W. Fung, (1997), "Mispricing of futures contracts: A study of index futures versus index options contracts", *Journal of Derivatives*, Vol. 5, pp. 37-45

Fung, J.K.W, and H.M.K. Mok, (2001), "Index options-futures arbitrage: A comparative study with bid/ask and transaction data", *Financial Review*, Vol. 36, No. 1, pp. 71-94

Gencay, R., and Aslihan Salih, (2003), "Degree of mispricing with the Black-Scholes model and nonparametric cures", *Annals of Economics and Finance*, Vol. 4, pp. 73-101

Garay, U., (2003), "Tests of the put-call parity relation using options on futures on the SandP 500 Index", *Derivatives Use, Trading and Regulation*, Vol. 9, No. 3, pp. 259-280

Hull, J.C., *"Options, Futures, and other Derivatives"*, Sixth Edition, Pearson prentice-Hall, India, 2007

Jordan, J.V., (1987), "Transaction Data Tests of the Black model for Soyabean Futures option", *The Journal of Future Markets*, Vol. 7, No. 5, pp 535-554

Jordan, J.V., and W.E. Seale, (1986), "Transaction Data Tests of Minimum Prices and Call Call Parity for Treasury Bond Future Options", *Advances in Futures and Options Research*, Vol. 1, pp 63-87

Kakati, R. P., (2006), "Effectiveness of the Black-Scholes Model for Pricing Options in Indian Option Market", *The ICFAI Journal of Derivatives Market*, Vol. 3, No. 1, pp. 7-19

Kumar, Das, and Reza, (2013), "Effect of Return and Volatility Calculation on Option Pricing: Using BANKNIFTY", *International Journal of Innovation, Management and Technology*, Vol. 4, No. 4, pp. 33-41

Lauterbach, B., and P. Schultz, (2012), "Pricing Warrants: An Empirical Study of the Black-Scholes Model and Its Alternatives", *The Journal of Finance*, Vol. 45, pp. 1181-1209

Mandelbrot, B.B., (1963), "The Variation of Certain Speculative Prices", *Journal of Business*, Vol. 36, pp. 394-419

MacBeth, J.D., and L.J. Merville, (1979), "An Emperical Examination of the Black-Scholes Call Option Prices", *Journal of Finance*, Vol. 34, pp. 1173-1186

Mckenzie, S., D.G. Gerace, and Z. Subedar, (2007), "An Empirical Investigation of the Black-Scholes Model: Evidence from the Australian Stock Exchange, *The Australasian Accounting Business and Finance Journal*, pp. 71

Mitra, S.K., (20012), "Pricing of Index Options Using Black's Model", *Global Journal of Management Business Research*, Vol. 12, No. 3, pp. 10

- Mohanti, D., (2015), "A Multimodal test of market efficiency of Index options The Indian evidence", Unpublished Doctoral dissertation, 2015
- Mukherjee, K.N., and R.K. Mishra, (2006), "Lead-Lag Relationship between Equities and Stock Index Futures Market and its Variation around Information Release: Empirical Evidence from India", National Stock Exchange of India, 2006
- Nagendran, R., and S. Venketeswar, (2014), "Validating Black-Scholes Model in pricing Indian Call option", *Journal of Applied Finance and Banking*, Vol. 4, No. 3, pp 89-101
- Quigley, L., and D. Ramsey, (2008), "Statistical analysis of the log returns of financial assets", *Financial mathematic*, Vol. 32
- Ramaswamy, K. and S.M. Sunder, (1985), "The Valuation of Options on Futures Contracts", *Journal of Finance*, Vol. XL, No. 5, pp. 1319-1340
- Rinalini, K.P., (2006), "Effectiveness of the Black-Scholes Model for Pricing Options in Indian Option Market", *The ICFAI Journal of Derivatives Market*, pp. 6-19
- Robert, Geske, and R. Richard, (1984), "On valuing American call option with the Black-Scholes European Formula", *The Journal of Finance*, Vol. 39, No. 2, pp. 443-445
- Rubinstein, M., (1985), "Non-parametric Test of Alternative Option Pricing Models Using all Reported Trade and quotes on the 30 Most Active CBOE Option Classes from August 23, 1976 Through August 31, 1978", *Journal of Finance*, Vol. 40, No. 2, pp. 445-480
- Savikas, R., (2001), "A Simple Option Pricing Formula (New Version)" SSRN Network, 2001
- Sharma, M., (2012), "An Analytical Study of Price Discovery of Equity Options in India", Unpublished Doctoral dissertation, 2012
- Shastri, K., and K. Tandon, (1986), "An Empirical Test of a Valuation Model for American Options on Futures Contracts", *Journal of Financial and Quantitative Analysis*, Vol. 21, No. 4, pp. 377-392
- Sternberg, J.S., (1994), "A Re-examination of Put-Call Parity on Index Futures", *Journal of Futures Markets*, Vol. 14, No. 1, pp. 801-824
- Thiel, H., (1961), "Economic Forecast and Policy", 2<sup>nd</sup> Revised Edition, North Holland Publishing co., Amsterdam, 1961
- Varma, V.R., (2002), "Mispricing of Volatility In the Indian Index Options Market", Working paper, IIM Ahmedabad
- Vohra, N.D., and B.R. Bhagri, (2007), "Futures and Options", Second edition, Tata McGraw-Hill
- Whaley, R.E., (1982), "Valuation of American Call Options on Dividend-Paying Stocks", *Journal of Financial Economics*, pp. 29-58
- Whaley, R.E., (1986), "Valuation of American Future Options: Theory and Empirical Tests", *Journal of Finance*, Vol. 41, pp. 127-150
- Yakoob, M. Y., (2002), "An Empirical Analysis of Option Valuation Techniques using stock Index Options", Working Paper, Duke University, Durham, 2002