

# Econometrics of Option Prices

NES Research Project Proposal for 2017-2018

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## Project Leader

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## Outline

According to the original [Black & Scholes \(1973\)](#) option pricing model, the implied volatilities on European options on common stocks should be the same for options of all maturities and all strike prices. This is an implication of their assumption that the stock price follows a log-normal diffusion with constant volatility. In fact, especially subsequent to the “crash” of October 1987, implied volatilities have exhibited a pronounced smile (or smirk) and a term structure. We see that call options that are deep in the money (put options that are deep out of the money) have higher implied volatilities than those that are nearer the money. Moreover, for a given degree of “out-of-the-moneyness,” options with longer maturities tend to have lower implied volatilities. Neither of these patterns is consistent with the Black-Scholes model.

The above facts motivate the whole subfield of option pricing. The importance of research in this area is hard to overestimate. Options are the simplest derivative securities and, at the same time, are the major building block of more sophisticated state contingent derivative contracts. The majority of dynamic models used in option pricing are based on discrete or continuous time volatility process. However, if one is interested in modeling and predicting the dynamics of implied volatility cross-section (implied volatility surface) over time, this problem could be approached from different angles. One would be more traditional model of stock price dynamics. Another would be a model of evolution of spline-like objects approximating volatility surface itself. Other approaches anywhere in between are possible too.

Students with interests in time series econometrics and quantitative finance are invited to participate in this project. The research in spirit is empirical modeling using real (in more rare cases, simulated) financial data, but with some twists in econometric methodology or theory. The target is producing high-quality research publishable in international journals.

Survey literature: [Bates \(2003\)](#), [Garcia et al. \(2010\)](#), [Christoffersen et al. \(2012\)](#).

## Research directions

Below are some potential research directions, but the project may not be limited to these.

1. Information content of volatility tails and term structure.
2. Semi-parametric risk-neutral density prediction.
3. State-space models for volatility surface evolution.
4. Volatility surface forecasting.

## References

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