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# Uniform Bounds for Black-Scholes Implied Volatility

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In this note, Black-Scholes implied volatility is expressed in terms of various optimization problems. These representations, upper and lower bounds are derived which hold uniformly across moneyness and call price. Various symmetries of the Black-Scholes formula are exploited to derive new bounds. These bounds are used to reprove asymptotic formulas for implied volatility at extreme strikes and /or maturities.

**Keywords :** and /or maturities. **Key words:** implied

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