1. Review of Literature:

There is enough material available on the website about the topic in question. There are authors who criticize the Black and Scholes’ Formula very aggressively. Prominent among them are Nassim Nicholas Taleb and Espen Gaarder Haug.

Nassim Nicholas Taleb was the pioneer of the ‘tail risk hedging’ (now sometimes called as the “black swan protection”) where investors are insured against extreme market moves. He proposes that one should dwell in the land of “Mediocristan” (is an investment which earns average income) and “Extremistan” (is an investment where black swans can happen).

Nassim Nicholas Taleb and Espen Gaarder Haug wrote a paper on why nobody used the Black-Scholes-Merton formula. Taleb also charged that Scholes was responsible for financial crises of 2007. He is impractical and his funds have been blown up twice. He also said that the formula that the derived was not their own and literature showed that it was earlier developed by Ed Thorp a mathematician.

He has extensively talked about the impracticability of the Black-Scholes-Merton’s formula due to unrealistic assumptions. There are authors who quote that the formula is not the original one and such formulas were derived much earlier. The following formulas were available in the literature that I have searched.

Formulas that were developed earlier and resembled the B-S Model:

a. Sprinkle (1964) was the first to assume lognormal distribution (i.e. Geometric Brownian Motion), but he attempted to adjust the risk, which was neither necessary nor correct. In addition he assumed zero interest rate.

b. Boness (1964) added a non zero interest rate but improperly adjusted for the risk.

c. Samuelson (1965) also incorrectly attempted to adjust risk.

d. Black and Scholes first attempted to derive the equation by using CAPM.

There is much talk about the risk statistics, namely the variability that should be used for arriving at the option price of the formula. Volatility smile is the concept which is much talked about and is the matter of the text books.

What I could trace in the literature is as follows:

This discussion revolves around the use of Volatility or Standard Deviation of annual returns as input in the Black-Scholes formula.

The discussion mentions various measures of Volatility as follows:

1. Volatility calculated from the historical data over the past umpteen years. For this the poser is should we use,
   a. Annual returns?
   b. Monthly returns (multiplied by SQRT (12) to get annualized returns?)
   c. Daily returns (multiplied by SQRT (365, 360 or 300) to get annualized return?)

2. Volatility also differs if we use different formulas to calculate it such as,
a. To determine a stock’s historical volatility, we calculate midpoint of the stock’s price range. Then by dividing the difference between the highest point and the midpoint by the midpoint we can calculate the percentage of the volatility.

b. Volatility can also be calculated from daily changes in prices.

c. There is also confusion about using N or N-1 in the denominator while calculating the volatility.

d. Or should we take the present day standard deviation by dividing the difference between the highest and lowest price by six? (Mine).

3. The discussion is also about the implied volatility.

4. The discussion also mentions that the option prices are more sensitive to volatility rather that the risk free interest rate.

5. The discussion mentions that the option prices derived from using standard deviation of monthly returns for the past year multiplied by SQRT (12) to get an annualized standard deviation, gives good results.

In summary the discussion points out the infirmity in the formula for the reason that the volatility, which is crucial for evaluation of the option value cannot be determined precisely and therefore the use of the formula for determining the precise option value has serious limitations.

But there are authors like Paul Wilmott, who were earlier critics of the Black and Scholes Model in the beginning of the career, when they did not faced the hard data and real insight into the efficacy of the formula and subsequently turned out to be the supporter of the formula and say that the formula is quite robust and stand the test of utility if used quite often and on an average (sample size being more than thousand)

But his views changed for the following reasons:

- It is remarkably robust model that copes very well even when its underline assumptions are violated.
- Black-Scholes is correct on averages. i.e. if you trade one option in a year, then it may not work. But if you are trading thousands in a year then the model works well.
- As far volatility modeling, the average profit you make from an option is very insensitive to what volatility you use for hedging. That alone is enough reason to stick with the uncomplicated B-S model. It shows how robust the model is to changes in volatility! One cannot say that a calibrated stochastic volatility model is similarly robust.
- When it comes to fat tails, such events are rare and for the sake of accommodating such once in a life time events we should not be making the model complicated throughout the life when we use it.
- The faults in B-S are visible. The improvements suggested on the B-S Model are rarely improvements. They only are better at hiding the faults.
- As a financial model is perfect in having just the right number of free parameters. Had the model had many unobservable parameters it would have been useless, totally impractical. Had its all parameters been observable then it would have been equally useless since there would be no
room for disagreement over value. Having one unobservable parameter makes the model ideal for traders.