Here is a sample research proposal on Applied Probability & Mathematical Finance:

Title: "Modeling and Predicting Financial Market Volatility using Stochastic Processes"

Objective: The goal of this research project is to develop and evaluate statistical models for predicting financial market volatility using stochastic processes.

Background: Volatility is a key characteristic of financial markets, and understanding and predicting it is critical for a wide range of applications, including risk management, portfolio optimization, and asset pricing. There are several approaches to modeling and predicting volatility, including traditional time series models such as ARCH and GARCH, and more recent methods based on stochastic processes such as the Heston model and the Kou model. In this project, we will focus on the latter class of models, which have gained popularity in recent years due to their ability to capture important features of market dynamics such as jumps and heavy tails.

Methodology: We will begin by reviewing the relevant literature on stochastic process models for financial markets, with a focus on the Heston and Kou models. We will then apply these models to historical data from a variety of financial markets, including equities, bonds, and foreign exchange. We will use standard evaluation metrics such as mean squared error and mean absolute error to compare the performance of different models and to assess the accuracy of their predictions.

Expected Results: We expect to find that the stochastic process models perform well in predicting financial market volatility, and that they are able to capture important features of market dynamics that are not captured by traditional time series models. We also expect to identify specific model parameters that are particularly important for accurate prediction, and to explore the sensitivity of the results to different assumptions about these parameters.

Conclusion: This research project will contribute to the understanding of financial market volatility and its prediction, and will provide valuable insights for practitioners in the field of finance. The results of this project will be of interest to a wide range of stakeholders, including academics, policymakers, and industry professionals.