The main goal of this project is to introduce novel methods that help to better identify and more efficiently validate (backtest) multiple models used e.g. to quantify market risk and financial position performance. In particular, we plan to refine the validation framework for multiple methodologies used within Basel 3.5 or FRTB framework for Market Risk and Counterparty Credit Risk quantification. This includes e.g. Incremental Risk Charge, Default Risk Charge, and capital reserve models based on Value-at-Risk and Expected Shortfall risk measures.

To achieve this goal we plan to use novel techniques that are based on conditional quantile moment analysis, risk unbiasedness concept, and risk-sensitive long-run optimisation. For transparency, the generic research goals of this project are broken down into three tasks. The first task is linked to model identification and validation based on conditional moment analysis. This builds upon the recently obtained results, where it has been shown that quantile trimmed conditional variance could be used to fully classify the distribution of any random variable (up to an additive constant). This idea could be embedded into multiple models e.g. in regression, parameter fitting, weighted moments method, and Machine Learning clustering. The second task relates to novel risk and performance quantification methods. In particular, we want to introduce efficient tail-impact assessment framework and introduce new risk estimation methods that are based on Machine Learning techniques. The third task is linked to the analysis of the long-run equilibrium states in optimisation models. Here, we plan to deepen the link between stochastic control and applied finance methods.

There are four main arguments that motivate our interest in the considered research topic. They relate to innovative nature of the project, promising initial results, lack of golden market standards for validation of multiple market risk aspects, and interdisciplinarity of the research. First, the innovative nature of the project could be traced back to the fact that all core ideas which are planned to be investigated in this project are new. In particular, this relates to (spatial) conditional quantile moment analysis and risk unbiasedness concept. We hope that our research project could open new horizons and research areas. Second, the initial research results we obtained are very promising and already lead to a series of promising papers and applications. Third, it is rather well known that there is a lack of efficient (market standard) verification tools for multiple market risk models aspects, especially when FRTB models are considered. In particular, there is no standard market practice for validation of key model aspects such as adequacy of distributional forecasts, multifactor-copula model correlation matrix adequacy analysis, proper Expected Shortfall backtesting, or reference tail-impact framework. Fourth, the project nature is very interdisciplinary. While our main focus is set on Finance and Market Risk methodologies, the methods and techniques considered in the project could be applied in any area in which e.g. regression, clustering, time-series analysis, or generic statistical shape fit testing is considered.

The project output should allow creation of comprehensive quantitative frameworks that enables development of new tools for finance, econometric, and statistical models. Within the project, a list of specific goals is set. This includes introduction of a novel conditional moment based statistical framework, time-series analysis based of conditional moments, linear dependency structure adequacy assessment, development of new tools for efficient risk estimation and backtesting based on machine learning methods and risk unbiasedness concept, and analysis of long-run risk-sensitive models and their stochastic equilibrium states. In particular, we plan to make contribution within the following three market risk related topics: validation of rating migration and default modelling methodologies used for capital reserve determination; refinement of Probability Integral Transform based backtest frameworks used for Profits and Losses density forecast assessment in capital reserve estimation models; stability analysis of the risk-sensitive long-run investment strategies considered as extensions of the Kelly Criterion. That saying, the research should lead to interdisciplinary output, that could be applied in various disciplines like finance, mathematics, physics, engineering, econometrics, and signal-processing. In fact, our preliminary results already show efficient applications in mining fault diagnostics in engineering, plasma density analysis in physics, and efficient goodness-of-fit design in statistics.