Aalto University

School of Science

MS-E2177
Seminar on Case Studies in Operations Research

Project Plan

Expert Judgements in Commercial Real Estate Loan Collateral Valuation

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1 Background

Problem Overview

In the banking sector, securing credit requires enough collateral to mitigate credit risk. While banks typically apply standard haircuts, reducing a property's estimated market value to a lower collateral value (e.g., 70%), these standard reductions often fail to reflect the actual recovery amount if a borrower defaults and the property is sold under uncertain circumstances. The ratio of the actual selling price (SV_i) to the estimated market value (V_i) is defined as the haircut: $h_i = \frac{SV_i}{V_i}$ This ratio describes how much the actual selling price deviates from the estimated market value. Finding a robust way to estimate this ratio beyond data-analysis methods is the main objective of this project.

The primary challenges in estimating optimal haircuts using historical data alone involve data availability and the integration of complex risk drivers. Because of **limited data** available for specific collateral types and the relative rarity of default events, reliance solely on historical data-analysis can result in unreliable estimates. While using **risk drivers** such as location, collateral type, and macroeconomic conditions can improve the predictive power and intuitiveness of a model, it significantly increases modeling complexity and requires a more sophisticated approach. This more sophisticated approach could be using expert judgment as the prior distribution for a model.

2 Objectives

The primary objective of this project is to develop a robust framework and methodology for quantifying loan collateral "haircuts" by integrating expert judgments with existing data. While banks typically apply standard valuation reductions to mitigate credit risk, these fixed percentages often fail to reflect the actual recovery value in distressed liquidation scenarios, particularly for complex portfolios like Commercial Real Estate (CRE) where data is limited and defaults are rare. Consequently, the project aims to establish a strict elicitation process—potentially utilizing methods like Delphi or Bayesian techniques—to formalize expert insights into mathematical formulations that can produce scalar estimates with associated uncertainty margins.

Beyond creating these specialized models, the project emphasizes the development of generalizable tools that allow for a transparent understanding of risk drivers and the weighting of different information sources. It is essential that the final framework enables stakeholders to adjust the influence of expert opinion versus empirical data and clearly visualize how specific variables, such as ESG risks or location, impact the final haircut. Ultimately, the study will focus on documenting the entire elicitation and calibration process, providing a clear rationale for the selected methods while addressing the inherent limitations of the model to ensure it is fit for purpose in a professional banking environment.

3 Tasks

3.1 Research

The first step in this project is to research academic articles, industry reports, and banking regulations to identify the key risk drivers that have a significant impact on the collateral haircut. This research addresses the uncertainty in the valuation process and specifically incorporates Loss Given Default (LGD) into the calculation. By investigating the (simulated) historical dataset of OP, we can identify which risk metrics can be calculated and which are not present in the our available data. This step of the project should also focus on identifying suitable internal and external roles for expert selection and determining elicitation methods. Our goal for this stage is to provide a summary of 2-3 most relevant elicitation approaches for further evaluation.

3.2 Selection of Methodologies

Based on our research, we will evaluate the identified approaches so that the method with the best performance is selected for testing and further implementation. It should be an effective framework for converting human opinions into quantitative information that can be used as priors in our Bayesian model. The chosen framework should minimize human bias and uncertainty as much as possible, and it should also consist of a standardized set of eliciting questions.

Another step is to decide how the risk drivers can be incorporated into this process and how they would be weighted in the model, as it should handle both empirical risk metrics and additional, expert-based metrics.

The third methodology to define is the suitable Bayesian modeling techniques for this model so that the data and priors from experts are combined to produce the final haircut distribution and intervals.

3.3 Implementation

After identifying key methodologies, the project would move onto the prototyping phase to refine and test the chosen framework with representatives from OP. Considering the Bayesian model, feature engineering is important to maintain the quality and credibility of the data. Moreover, it is important to note that the model should allow the adjustment of the ratio between historical data and expert judgment in a way that the influences in the haircut interval and the impacts of each risk driver are clear to observe in the decision-making process.

3.4 Validation & Report

To ensure the credibility of the model, the final tasks of the project are validation and performance review. Once the model is finalized, an expert panel exercise will be introduced, and the model would then be applied to a commercial real estate

(CRE) portfolio to evaluate its performance in an empirical context. Finally, the results will be reported.

4 Schedule

Figure 1 shows the initial project schedule.

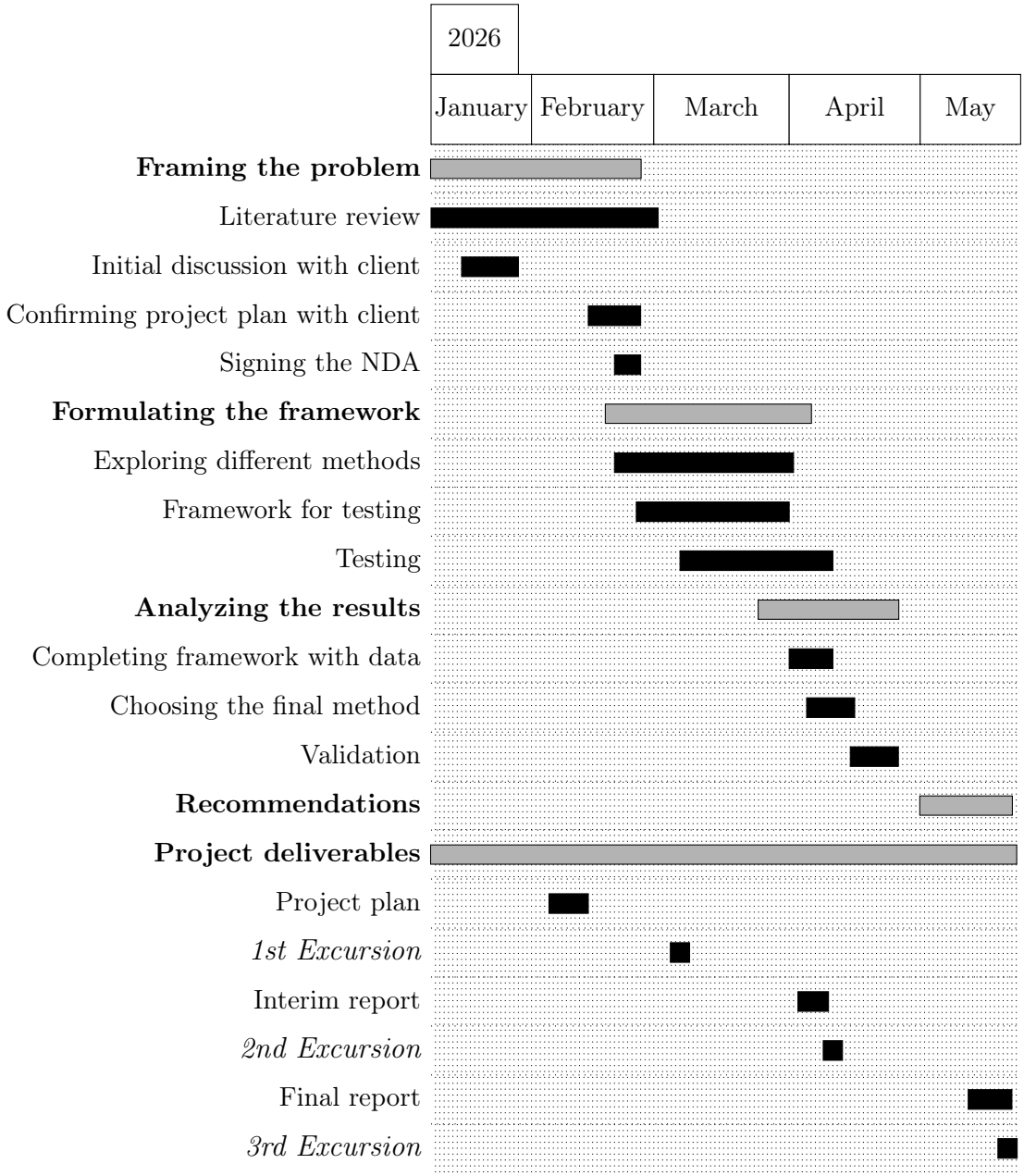

Figure 1: Initial project schedule

5 Resources

The team consists of 5 students, all studying Operations research in their master's. We have a solid background in mathematics and programming which is essential to create the data-analysis part of this project. Our strength is that we come from different backgrounds, the members of the team have, for example, studied in North America, done internships or work currently alongside their studies.

We also have been able to keep regular contact to our supervisor from OP, Jaakko, who has been actively answering questions and booking meetings with the team. Professor Ahti Salo with the course staff will provide support and monitor our progress throughout.

For literature on the topic, we have got in initial reading list from our contacts from OP in addition to finding relevant articles by ourselves. The project has two main topics, figuring the best way to calculate a haircut and finding the optimal way of making expert elicitations. We have references for both, see for example [1, 2, 3]

6 Risks

This section introduces risks related to the process and the desired outcome of this project. Risks are represented in the Table 1 below. Risks with negligible probability are excluded. As the focus of this project is in producing a framework, rather than creating a highly polished mathematical models, we view our biggest risks to lie within communication and alignment.

Risk	**Likelihood**	**Impact**	**Effect**	**Mitigation**
1) Not understanding the actual problem or research question	Medium	High	Outcome of our work doesn't meet the needs of the client. Our work is redundant.	In every meeting with the client, present our approach and validate that we approach the correct problem.
2) Communication with the client isn't sufficient.	Low	High	Increased risk of redundant work as by risk 1).	In addition to the project manager, all group members stay active in initiating conversation with the client.
3) Not meeting the schedule.	Low	High	Work is not submitted in time.	Collaborative responsibility within the group. Proper allocation of tasks and ownership on those tasks.
4) Inactive or non-reliable project team members.	Low	Medium to High	Heavily increases the work load of the rest of the group. Decreased quality of work.	Truthful and continuous communication within the group. Fair allocation of work.
5) Overly ambitious goals and scope	Medium	Medium	Overwhelming workload, resulting in chaotic and non-generalizable results.	Communication within the team and client. Analyzing the achievability of approaches.

Table 1: Risk assessment table

References

[1] Sumit Agarwal, Itzhak Ben-David, and Vincent Yao. "Collateral valuation and borrower financial constraints: Evidence from the residential real estate market". In: *Management Science* 61.9 (2015), pp. 2220–2240.

[2] Luis C Dias, Alec Morton, and John Quigley. "Elicitation: State of the art and science". In: *Elicitation: The science and art of structuring judgement* (2017), pp. 1–14.

[3] Min Qi and Xiaolong Yang. "Loss given default of high loan-to-value residential mortgages". In: *Journal of Banking & Finance* 33.5 (2009), pp. 788–799.