Seminar on Case Studies in Operations Research
Project Plan
S-Bank: Risk Characteristics of Non-maturity Retail Deposits

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1 Background

Our client is S-Bank, the first and only "supermarket bank" in Finland with 3,1 million customers. It is the most rapidly growing bank with a reported profit of 24,8 million euros in 2021. S-Bank is widely known as the secondary bank among Finnish consumers.

In this project, the focus is on the risk characteristics of the transactional retail deposits used on a day-to-day basis by regular people. These are called non-maturity retail deposits, where one usually buys everyday necessities with and gets their salaries credited in.

Non-maturity deposits are deposits for which a contractual maturity has not been stated. The depositors have the possibility to deposit or withdraw funds with no penalty, so the balance of these types of funds might suddenly increase or decrease throughout the day. The depositors value non-maturity deposits through two factors, received value and perceived value. This means that higher interest rates paid to the depositors and more significant barriers to withdraw the deposits create longer-term deposits. Also, when the interest rates rise, the balance of non-maturity deposits tends to fall due to the depositors finding more attractive investment opportunities elsewhere and thus withdrawing at least a part of their funds. Alternatively, when the interest rates are low, non-maturity deposits are a more profitable option to consider. Cipu and Udriste (2009) These changes may have a significant impact on banks, since in 2012 the proportion of non-maturity deposits out of bank's funds was 58% on average. Thus, non-maturity deposits are the primary funding source for an average bank Blöchlinger (2015).

Due to the above reason, non-maturity deposits have been predicted based on the interest rate levels. These models have been more helpful in an environment where the interest rates have changed through time. Moreover, in recent years these have been close to zero, and thus these models are not ideal. Interest rates are not the only reason behind account behaviour and thus can not predict this precisely. For this reason, the other factors that explain the account behavior might be easier to spot when there are no significant interest rate changes in the observed period.

Customer segmentation is a way to categorize customers into smaller groups to provide targeted services and assess the creditworthiness in banks. This segmentation is done

traditionally via demographic or economic criteria such as age or income (Machauer and Morgner (2001)). The problem with this approach is that outliers do not behave as the averages of their segment. More recently, account behavior has been used as part of customers' creditworthiness. These categorizations that have been done for other purposes might give more appropriate approximations for interest rate-based prediction models, or new segmentation might serve this purpose even better. Account activity is also an indicator of how likely the funds are withdrawn – this is one of the features in the data that S-Bank provides us.

The non-maturing deposits, or NMDs, themselves are also commonly segmented as stated by Kalkbrener and Willing (2004). The authors state that it is common for banks to split the total volume of accounts into two; a stable core part and a more volatile floating part, which is the fundamental idea behind the so-called *non-maturation theory*. This is justified as the number of accounts is large, whereas the average volume per account is small in comparison. Typically, the bulk of the accounts do not face large withdrawals – this is more of an exception. In the unlikely event of a *bank run* this phenomenon would most likely not hold, from a modeling perspective this can be argued to be a fair assumption. Subsequently, the modeling would focus on the core part and the floating part with a long and short maturity, respectively.

The most common, and perhaps also most naive, approach to modeling non-maturing deposits is to make static assumptions about the maturity of the deposit. By assigning one maturity for every deposit, the clear benefit is simple cash flow analysis. However, this can be problematic regardless of whether the assumed maturity is longer or shorter than the actual maturity of the deposit. If the assumed maturity is longer than the real maturity, the immediate risk is poor liquidity during a time of withdrawals, although the deposits can be invested. On the other hand, if the assumed maturity is shorter than the actual maturity, the deposits cannot be allocated in a productive way, although liquidity is guaranteed in the case of withdrawals.

A clear improvement to this approach is to utilize the *non-maturation theory* and to split the deposits into two parts with two different maturities. Subsequently, the maturity of the floating part can be modeled using different empirical methods such as the *outflow rate method* OeNB (2008) or using a *replicating portfolio approach*, where different fixed income instruments are combined in order to artificially create similar cash flows as the accounts. Combining different methods is also common, both for the stable part and the volatile part. However, as all the aforementioned methods are deterministic, they do not include any randomness. For this purpose, it is also possible to view the NMDs as options and apply *option-adjusted spread* (OAS) models, where stochastic interest rate term structures are modeled.

In addition to the prevailing interest rate environment as a major factor impacting NMDs, the prevailing unemployment rate is also a factor to be taken into account. As stated by Stavrén and Domin (2019), the unemployment rate is expected to have an inverted correlation with respect to NMD volumes. This is theoretically justified as the mean wealth decreases as a result of increased unemployment, subsequently leading to lower NMD volumes. In their study, Stavrén and Domin (2019) found this relationship to be statistically significant for both savings accounts and corporate savings accounts.

2 Objectives

This project aims to analyse the interest rate and liquidity risk characteristics of non-maturing retail deposits. This will be done through the following objectives

- Developing a justified and documented model based on several variables such as
  - The economic environment (interest rates, GDP, unemployment...)
  - Product type (S-account vs. S-Tuottotili)
  - Customer segment (based on used products, activity and account behavioural criteria)
  - Calendar effects
- Comparing the obtained results to Finnish/European aggregate index data
- Finding out whether there is any structural change or regime shift present in the data due to the Covid-19 pandemic

Historically, the NMDs have been modeled with respect to interests rates due to opportunity cost at the investment markets. Thus, customer segmentation based on risk attitudes might provide good results for us. Traditional customer segmentation could improve the model accuracy, but account behavior could serve our client better. However, this kind of segmentation may not be the best approach for ones who only use S-Bank as a secondary bank due to fewer transactions. This issue is however avoided since account activity is one attribute in S-Bank's data.

3 Tasks

We have aggregate data from Finland and other European countries, which we will initially familiarize ourselves with. Furthermore, our literature review on the topic helps us broaden our knowledge of the topic. We have received the final data sample and next we aim to identify the characteristics of the data.

To develop a model capable of achieving our objectives, the literature review is carried out to familiarize ourselves with existing frameworks based on different variables such as interest rates (Jarrow and van Deventer (1998) & Janosi et al. (1999)), unemployment (Stavrén and Domin (2019)) and customer segments (Machauer and Morgner (2001)). At the time of the project plan submission, no variables or models have been selected. These are done after a comparison of the models with real data.

Customer segmentation is one part of the project. This segmentation is done based on transactions on the accounts, and the goal is to use this segmentation as a variable in the model if it increases the prediction accuracy.

There are two possible approaches to develop the model. First, can consider all the possible attributes that affect the non-maturity deposits. However, the resulting model may be inaccurate due to collinearity and correlations between the attributes. In that case, we create a simpler model that considers only one variable at the time, like interest rates, unemployment, or GDP. The assessment of accuracy is carried out throughout the the project, and the most accurate model is chosen.

4 Schedule

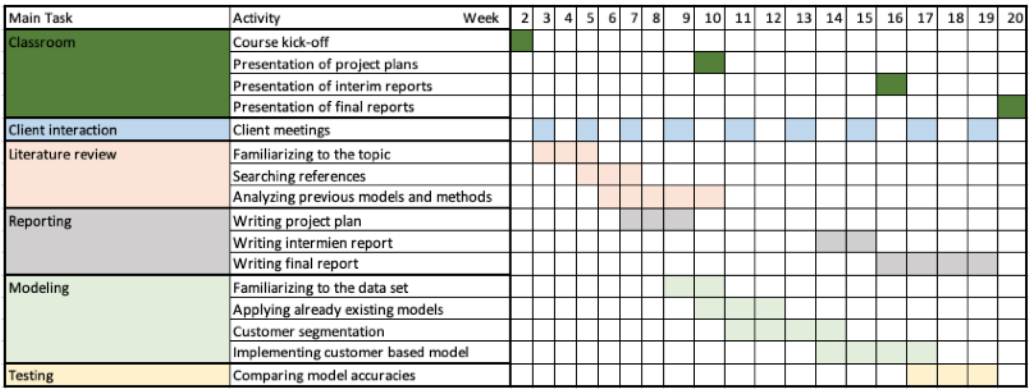

Figure 1: Tentative schedule.

5 Resources

Our project team consist of five Systems and Operations Research students with different bachelor's degree background, such as Automation and Information Networks. Team's advantage is that one of our members, Toni Huuhka, has direct connections with our client as he is currently employed by S-Bank. Each students has a good set of skills on programming, statistical analysis and other mathematical methods. The tasks of the project will be distributed as evenly as possible with the consideration of each member's strengths. Our project manager Joonas Rasa will make sure that this will hold along with the fact that each member is committed to do their part in the project.

One of our contact at S-Bank will be Senior Risk Analyst Niko Nivanaho who will provide useful links for literature review and assistance on the technical side of the project. Niko will also be providing the NDA restricted non-maturity deposit data of the customers of S-Bank which the project team will process, model and generate necessary visualizations. The other contact at S-Bank is Chief Risk Officer Petri Viertiö who will be providing analytical assistance and general guidance on the topic throughout the project. The course teacher Professor Ahti Salo will supervise and assist us on problems related to the course but outside of the topic.

The programming language to process and model the data is mainly going to be Python, but R is not totally excluded of usage.

6 Risks

Table 1

Risk	**Probability**	**Effect**	**Impact**	**Prevention**
Collinearity of explanatory variables	High	Errors in explanatory variable significance	High	Instead of including collinear variables into the same model, creating separate models for each variable that has collinearity with other variables
Overly complex model	Medium	Loss of predictive power due to overfitting	High	Not losing sight of what is important, not including unnecessary variables or features
Inner functional errors in Python packages	Medium	Incorrect calculations on the auto-correlation of the residuals and the parameters of SARIMA-model	High	Alternatively use R language for data analysis
Poor data quality	Low	Time spent on cleaning the data, model fits poorly due to poor data	Medium	Getting familiar with the dataset quickly so data quality can be discussed with the client if necessary
Data breach	Low	Violation of the NDA contract	High	Making sure we understand which parts of the data are private by discussing it with the client
Lack of stakeholder involvements	Low	The final project does not meet the expectations of the client due to lack of professional knowledge	High	Taking initiative in communicating with the client
Team member inactivity	Low	Workload increases for other members	Medium	Active communication, clear allocation of tasks, clear schedule

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