


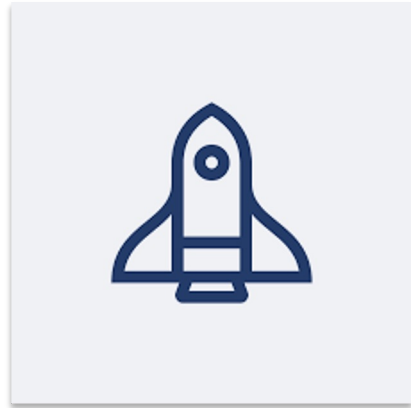
Digital Bank Risk Scorecard Framework: Safeguarding Operations in the Digital Era


April 2024




Partner with Innovairrs – The Innovation Brewery

 Innovairrs



 **Innovairrs** is a premier venture studio specializing in driving innovation and growth in the intersection of financial services, IoT in industrial spaces, digitization of utilities and blockchain technologies. Our mission is to empower businesses to navigate the complexities of these rapidly evolving sectors, leveraging our expertise and strategic insights to unlock their full potential.

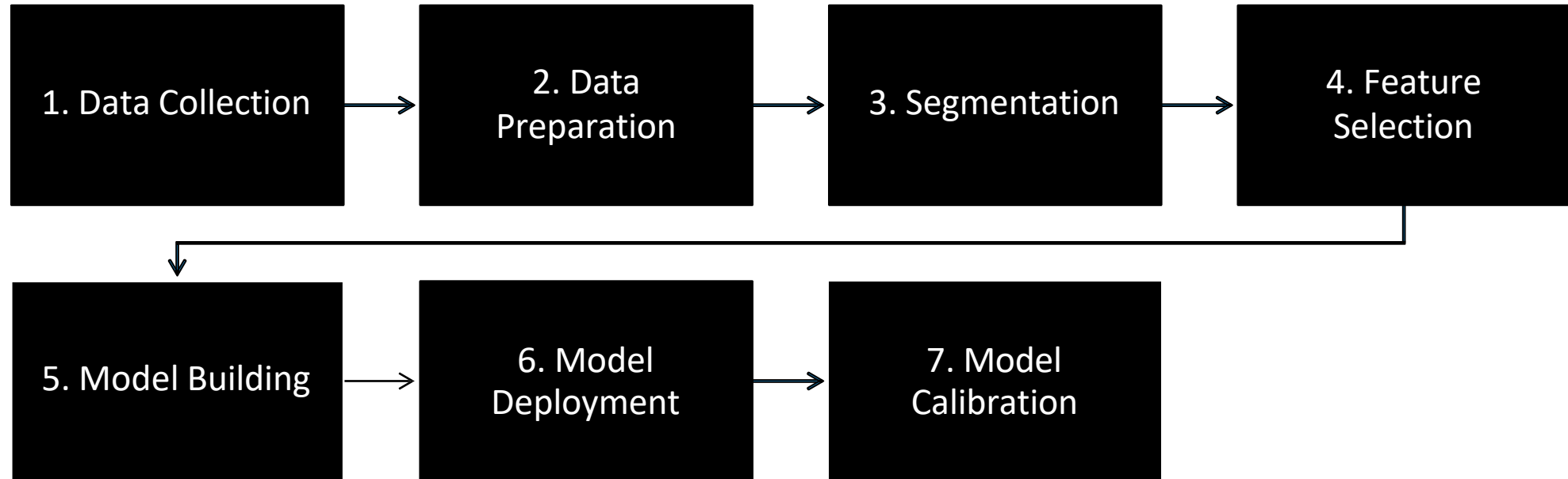
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Digital Risk Score

How it is calculated

End-to-end Scorecard Development Process



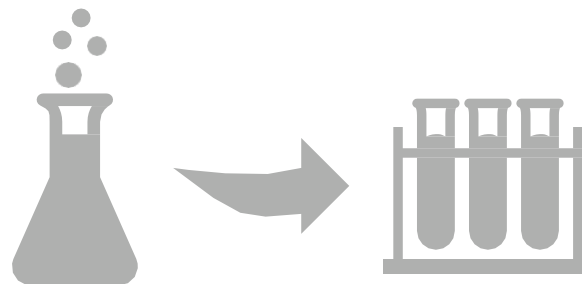
Data collection is the process of gathering and measuring information from the bank users' mobile devices

- The data collected is used to **train** the AI/Machine Learning algorithms used to select the most predictive **delinquent behavioral patterns**.
- In order to build a robust scorecard, Innovairrs recommends to collect metadata of about 5,000 users of which at least **300 to 500 are defaulters**. The total number of uploaded datasets will depend on default rate, approval rate, and penetration of the mobile apps.
- Given the behavioral nature of the score, Innovairrs will **tailor-make each scorecard** based on the particular population and product that the bank wants to assess.
- In order to build a tailor-made scorecard, each bank provides Innovairrs with **performance data** for the disbursed loans alongside the collected metadata. The performance data file contains a binary target indicating if a borrower is “good” or “bad” (from credit risk perspective).

Data preparation is the process of transforming raw data so that machine learning algorithms can uncover insights and make predictions

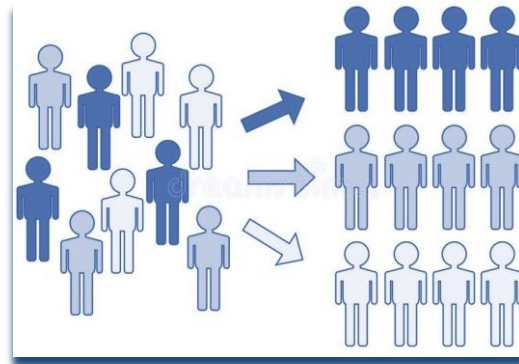
- Innovairrs uses proprietary software and algorithms to transform the raw data collected during the data collection phase into **>500,000 features** which are a foundation of all further steps of a modeling process.
- Feature engineering is fundamental to the application of machine learning. **Feature engineering** is the process of using domain knowledge of the data to create features that make Machine Learning algorithms work.

Note: Over the last 3 years, Innovairrs has developed a **proprietary engine** that semi-automatically engineers features based on mobile device metadata.



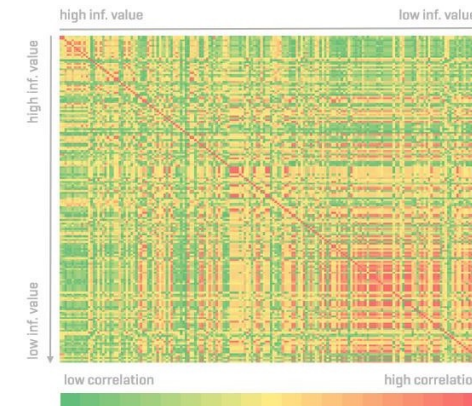
Segmenting, or clustering, is an unsupervised machine learning algorithm where the target is not known

- Innovairrs always tests **different types of segmentation** to make sure the data is homogeneous from a digital footprint point of view.
- Typically, we use Android version, data availability, device brand and other features to **build homogeneous segments** in order to increase the overall predictive power of an ensemble of scorecards.
- **We note that demographic information about the individual phone user is NOT included.** Variables such as age, sex, income level, etc. are NOT considered for modeling nor extracted from the mobile device for any other purpose.



Feature selection eliminates irrelevant or redundant features with the aim of increasing model accuracy

- Innovairrs typically reduces the number of features from 500,000 to about 5,000 via **fast and greedy algorithms**.
- After, we apply sophisticated proprietary algorithms to accurately select a few dozens of the **most predictive and stable features**.
- We always use a few **different feature selection algorithms** to ensure that we focus on features that are relevant to the problem we are trying to solve (predict risk).



Credit risk models are built to provide a quantitative estimate of the probability that a customer will display a defined behavior as provided by the bank with their performance data

- In most cases, Innovairrs uses **elastic net logistic regression** and **tree based gradient boosting with grid search**.
- We always use **out-of-time validation** of our models.
- We continuously test **different Machine Learning algorithms and approaches** to ensure that we provide our clients with the highest quality decision-making support algorithms.
- In our data modeling pipeline, we always divide the available data into a **training set**, a **validation set**, and a **test set**. Consistent with recommended practices, the training set is used for fitting the model, the validation set is optionally used to optimize parameters, and the test set is used for reporting the accuracy of the final model with its chosen parameters. Dividing up the dataset in this way for different purposes serves to provide better estimates of actual model performance on individuals who are either new-to-credit or new-to-bank.

Score normalization (or benchmarking) means adjusting values measured on different scales to a notionally common scale, usually the score range already used by a bank

- The outcome of the model is the **probability of default – p** . This ranges from 0 to 1.
- We transform -p in **Good/Bad (GB) odds**, defined as the probability of being good divided by probability of default:

$$odds = (1 - p) / p$$

- Lastly, we transform the GB odds into the score according to the score range used by the bank. **For example:**

a score of 660 refers to GB odds equal to 72:1

- Note: Odds double every 40 scores. For example:

a score of 620 means GB odds = 36:1 and score 700 x 144:1

$$score = 660 + pdo * \log_2(odds / 72)$$

Model deployment in data science refers to the application of a model for prediction using new data

- Depending on the requirements, the **model deployment phase** can be as simple as generating a report or as complex as implementing a repeatable data science process.
- It will always be the bank, not , who will carry out the deployment steps.
- For example, a credit card issuer may want to deploy a trained model or set of models to quickly identify credit card applications which have a high probability of being fraudulent. However, even if Innovairrs will not carry out the deployment effort it is important for the customer to understand up front what actions will need to be carried out in order to actually make use of the created models.
- Innovairrs always provides the bank with a **manual of the scorecard model**. The manual contains the details of the datasets being used for model building, the subset of features being selected as the most predictive to be included in the final model.
- The manual also includes the model performance (train vs. test) and the charts summarizing the **distribution of the users per risk score**.

Model calibration happens after a model is deployed in production. Model calibration is the process of fine-tuning and improving the model with new data coming from the same bank

- A model's first results isn't its last. Like tuning a car, machine learning models can be **tuned to improve performance** (predictive power).
- Tuning a model involves **changing** parameters such as learning rate or optimizer. Or model-specific architecture factors such as number of trees for random forests and number of and type of layers for neural networks.
- During the first 12 months, Innvoairrs recommends the bank client to share performance data on a monthly basis. With this data, Innovairrs can fine tune the model and improve it. As the portfolio matures, Innovairrs recommends to perform a **quarterly or semi-annual calibration**.
- Part of the calibration process is again out-of-sample and out-of-time validations. These are important steps to **avoid overfitting**, the practice in which the model fits the empirical data too well which results in less accurate predictive results for the new set of input data.

Depending on local data privacy regulation, client's appetite for data, and unsecured lending product, each client is free to choose its preferred approach

Anonymous

- With the anonymous approach, Innovairrs focuses on protecting the users' data privacy.
- Even if users' data are stolen, it would be impossible to identify neither a user, or any of her contacts, or fetch any other information from a data set.
- Innovairrs does not collect the content of messages or emails, phone numbers, contact names, geolocation or any other personal data.

Non-anonymous

- In this mode, Innovairrs collect the content of text messages, the actual phone numbers, the names and details of contacts in the address book, the geolocation and other personal data.
- This approach allows the Lender to dramatically increase the accuracy of KYC while opening up new use cases including skip tracing and collections management.

What data we process

Innovairrs calculates **~1,000,000*** features on each mobile digital footprint

SMS Log, Email, Network

We analyze SMS, Email and Network communication activity, not actual content, including frequencies, ratios, intervals between actions, distribution, and entropies

Contacts

We analyze the address book and correlate it with the communication activity including existing contacts or unknown ones or short numbers without moving any contact outside the mobile

Device

We analyze all characteristics of the device including the model, display size, RAM size, storage size and utilization, age of the device

Browsing History

We analyze the browsing history including browsing patterns, preferences or simply intent to apply for a lending product

Applications

We analyze the type of apps including competitive lending apps, office applications, e-wallets, and suspicious ones such as TOR or VPN

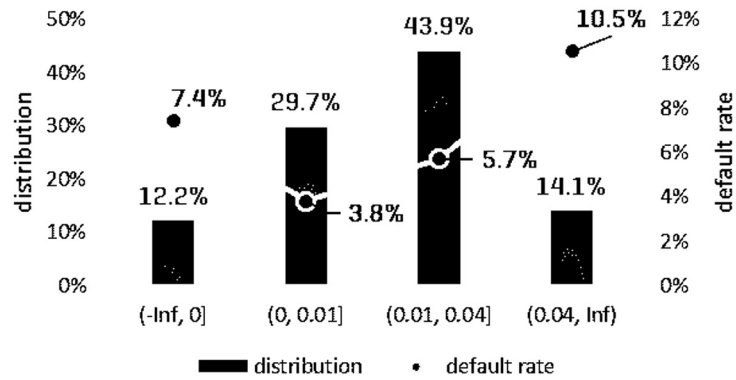
Calendars

We analyze the existence, frequency and recurrence of events, time of events and reminders, number of attendees per events, time zone

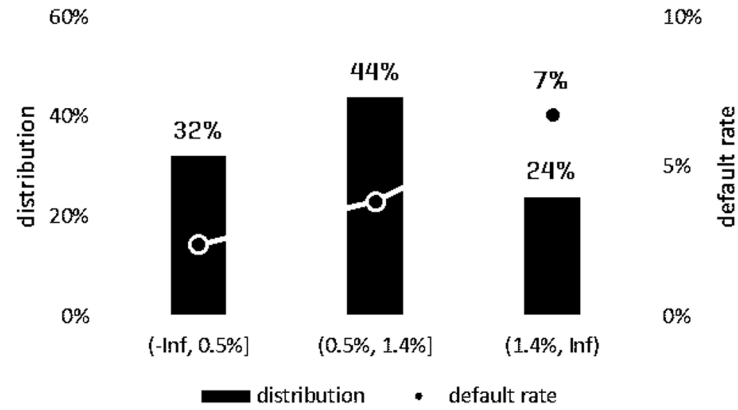
Example of features

% of repeated missed calls, iv = 0.13

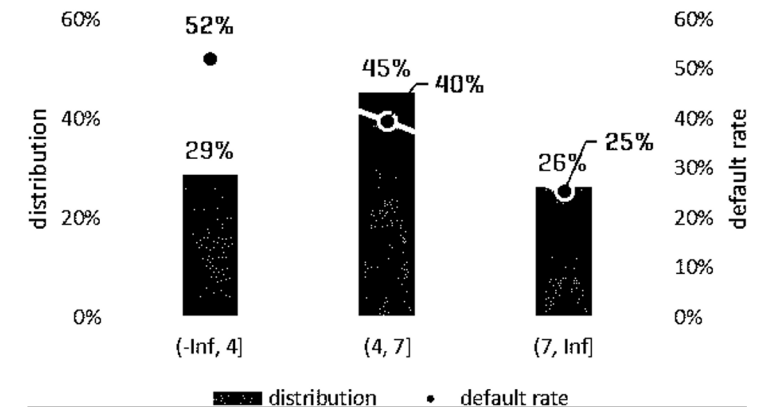
2- and greater missed calls in a row during 1 hour



share of apps installed last week, iv = 0.16

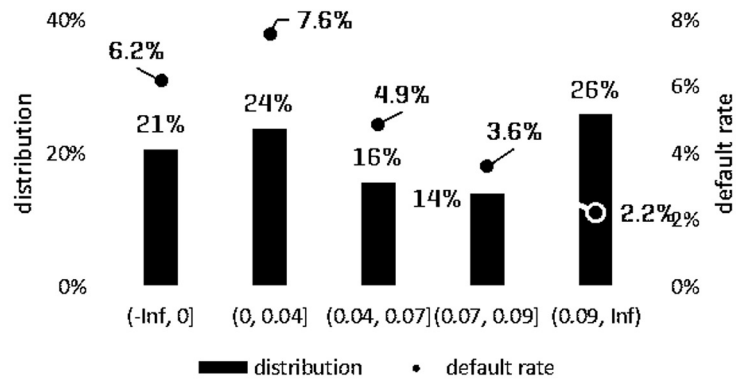


of registered accounts, iv = 0.18

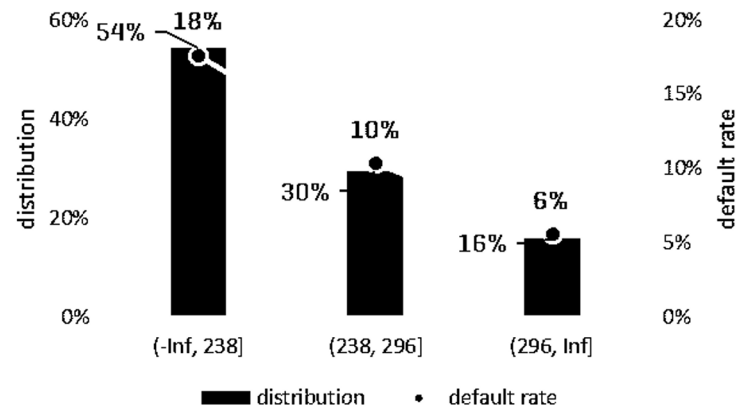


freq of 7-days periods w/o calls, iv = 0.21

from the same p/n

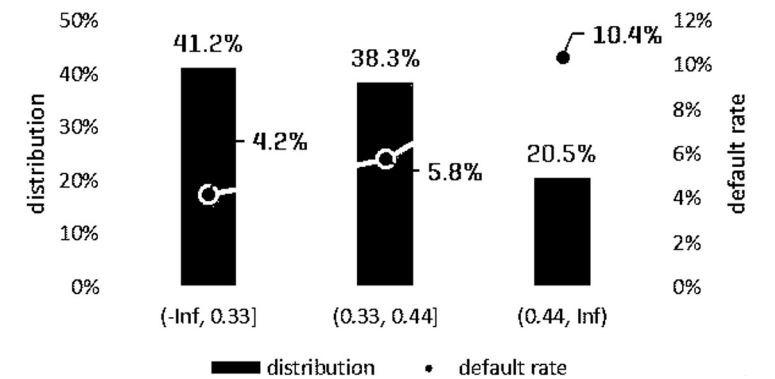


total # of updated apps, iv = 0.19



% of failed outgoing calls, iv = 0.15

working day, p/n from phonebook





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