

# Machine Learning in Benefit Decisions

Riku Sarlin  
Chief Architect  
Kela, Benefits and Customer Service  
@Rsarln

Kela|Fpa<sup>H</sup>



# The Study in Short

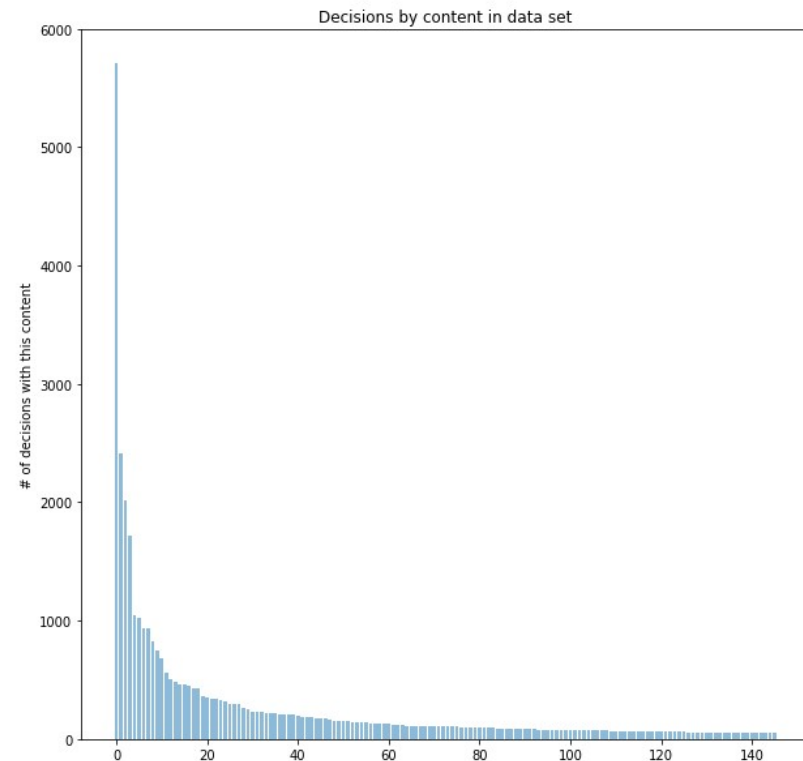
- Currently most of the benefit decisions are made manually. The level of automation varies from benefit to benefit.
  - This study aims at providing means to automate benefit decisions in one the most high-volume manually handled benefits, namely housing benefit
  - The methodology used in the study can be generalized to other benefits
  - Machine learning methods were used in the study – that is, a mathematical model was created based on our existing benefit data, and the model was also tested by predicting results based on existing data
  - Results show that deep learning methods can predict contents of housing benefit decisions quite reliably (99,4%) in selected subsets of housing benefit applications
-

# Use Case

- Benefit decisions in mainframe systems can be represented as a series of phrase codes, such as "C70,C60,C69,C72,C64,C65,C74,Y10,M02,Z01,S03,D11,V01,U03,U04,J02,Q25,Q04,Q01,Q02,Q02,Q06,Q07"
- When the actual decision document is created, these phrase codes are filled with data from the application, other data sources and handling system
- By studying the actual decision documents one can realize that a limited number of input variables affect the contents of the documents
- Still, currently the phrase codes are input largely manually. A typical housing benefit application takes 10 minutes to handle, and there are 400000 applications per year. Any reliable form of automation could make business sense.

# Data Used

- Some data (phrases, outcome, income types, other benefit types and subtypes, household member size) was fetched from DW staging area for all 2018 housing benefit applications. Preliminary study shows that variation across all housing benefits is huge - 357405 decisions made in 2018 produce *93207 different decisions!*
- When limited to new applications only, we have 65947 decisions in 12420 categories.
- Some decision contents are much more popular than others – to the right, 146 most popular decision contents (with over 50 cases)
- Decisions with over 50 cases cover 56% of all applications



# Methods

- Data was pre-processed and studied in IBM Cloud (no sensitive data was used, the data was pseudonymized and kept private)
- From machine learning point of view, this problem falls in the category of “supervised machine learning”. When training and testing the model, we always know what the right answer should be.
- Two machine learning models were created
  - One “traditional” machine learning model used in categorization (Support Vector Machine)
  - The other was a “deep learning” model (a relatively simple 3-layer Neural Network)

# Results

- Traditional machine learning was unable to reach any reliable results. This is probably mainly due to large number of categories related to the rather limited amount of examples and skewed data (some very popular categories)
- Deep learning model, on the other hand, performed impressively, with 99,4 percent accuracy!
- In addition, deep learning model was actually quite fast to train. This is typically the achille's heel of deep learning models. In this case, the relatively small data set works for the model's favor.



## Proposed Next Steps

- The result of deep learning model is very promising and should be considered further
- Linking the model to workflow of the housing benefit mainframe system needs to be studied – it is not trivial
- The method used can be extended to other benefits with untapped automation potential

# Thanks for watching!

Riku Sarlin  
Chief Architect  
Kela, Benefits and Customer Service  
@Rsarln

