A Logistic Regression Approach to CoIL Challenge 2000

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Abstract

A logistic regression based solution to the CoIL Challenge 2000 is described. The challenge consists of correctly identifying potential customers for an insurance product, and describing their characteristics.

Keywords: CoIL Challenge, Logistic Regression

Word count: X

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Introduction

Businesses use data science to extract insights from data. It has many practical business applications. Identifying households to include in a marketing campaign is one application. One example using real world data is the Computational Intelligence and Learning (CoIL) Challenge. The CoIL Challenge competition was held from March 17 to May 8 in 2000. The challenge is to:

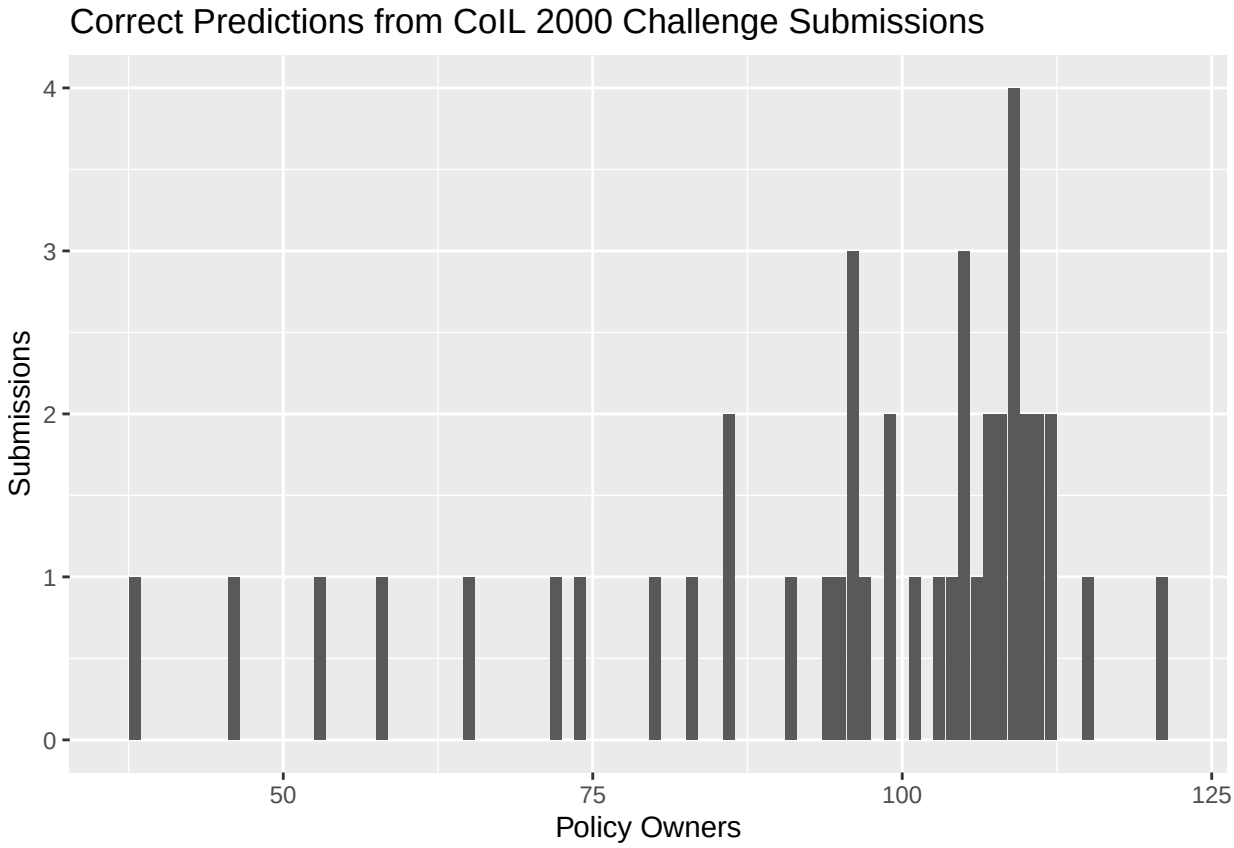
1. Identify potential customers for an insurance policy; and
2. Provide a description of this customer base.

In total 147 participants registered and 43 submitted solutions (Putten, Ruiter, & Someren, 2000). In this paper we set out to complete the first part of the COIL Challenge. **SUMARISE FINDINGS?**

Literature Review

Participants used a variety of approaches in formulating their submissions including: Boosted Decision Tree (McKone & Stenger, 2000), Classification and Regressio Tree (CART) (Simmonds, 2000), Classification Trees with Bagging (White & Liu, 2000), C4.5 (Rickets, 2000; Seewald, 2000), Evolutionary Algorithm (Koudijs, 2000), Fuzzy Classifier (János Abonyi, 2000; Kaymak & Setnes, 2000), Genetic Algorithms and Hill-climbers (Carter, 2000), Inductive Learning by Logic Minimization (ILLM) (Gamberger, 2000; Šmuc, 2000), Instance Based Reasoning (iBARET) (Mikšovský & Klema, 2000), K-Means (Vesanto & Sinkkonen, 2000), KXEN (Bera & Lamy, 2000), LOGIT (Doornik & Moyle, 2000), Mask Perceptron with Boosting (Leckie & Ferra, 2000), Midos Algorithm (Krogel, 2000), N-Tuple Classifier (Jorgensen & Linneberg, 2000), Naïve Bayes (Elkan, 2000;

Kontkanen, 2000), Neural Networks(Brierley, 2000; Crocoll, 2000; Kim & Street, 2000; Shtovba & Mashnitskiy, 2000), Phase Intervals and Genetic Algorithms (Shtovba, 2000), Scoring System (Lewandowski, 2000), Support Vector Machines(Keerthi & Ong, 2000), and XCS (Greenyer, 2000).



The maximum number of policyowners that could be found was 238. The submissions identified 95 policy owners on average. The winning model (Elkan, 2000) identified 121 policy owners. Random selection results in identifying 42 policy owners. The standard benchmark tests result in 94 (k-nearest neighbor), 102 (naïve bayes), 105 (neural networks) and 118 (linear) policy owners. (Putten et al., 2000).

Our investigation is similar to Doornik and Moyle (2000) in that we used a LOGIT model. **Reproduce his model and describe the results**

Methodology

Experimentation and Results

Discussion and Conclusions

References

Bera, M., & Lamy, B. (2000). Kxen at coil challenge 2000. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/BERAPS~1.pdf

Brierley, P. (2000). COIL 2000 challenge: Characteristics of caravan insurance policy owners. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/BRIERL~1.pdf

Carter, J. (2000). Coil 2000 challenge submission: Genetic algorithms and hill-climbers. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/CARTER~1.pdf

Crocoll, W. M. (2000). Artificial neural network portion of coil study. Retrieved from http://www.liacs.nl/~putten/library/cc2000/CROCOL~1.pdf

Doornik, J. A., & Moyle, S. (2000). LOGIT modelling. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/MOYLEP~1.pdf

Elkan, C. (2000). CoIL challenge 2000 entry. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/ELKANP~1.pdf

Gamberger, D. (2000). Solution based on illm confirmation rule. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/GAMBER~1.pdf

Greenyer, A. (2000). Coil 2000 competition. The use of a learning classifier system jxcs. Retrieved from http://www.liacs.nl/~putten/library/cc2000/GREENY~1.pdf

János Abonyi, H. R. (2000). A simple fuzzy classifier based on inconsistency analysis of labeled data. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/ABONYI~1.pdf

Jorgensen, T. M., & Linneberg, C. (2000). Subspace projections – an approach to variable selection and modeling. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/JORGEN~1.pdf

Kaymak, U., & Setnes, M. (2000). Target selection based on fuzzy clustering: A volume prototype approach to coil challenge 2000. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/KAYMAK~1.pdf

Keerthi, S. S., & Ong, C. J. (2000). Solution of the coil challenge 2000 task using support vector machines. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/KEERTH~1.pdf

Kim, Y., & Street, W. N. (2000). CoIL challenge 2000: Choosing and explaining likely caravan insurance customers. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/STREET~1.pdf

Kontkanen, P. (2000). CoIL 2000 submission. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/KONTKA~1.pdf

Koudijs, A. (2000). CoIL challenge 2000 submission for the description task. Retrieved from http://www.liacs.nl/~putten/library/cc2000/KOUDIJ~1.pdf

Krogel, M.-A. (2000). A data mining case study. Retrieved from http://www.liacs.nl/~putten/library/cc2000/KROGEL~1.pdf

Leckie, C., & Ferra, H. (2000). COIL challenge 2000 description task. Retrieved from http://www.liacs.nl/~putten/library/cc2000/LECKIE~1.pdf

Lewandowski, A. (2000). How to detect potential customers. Retrieved from http://www.liacs.nl/~putten/library/cc2000/LEWAND~1.pdf

McKone, T., & Stenger, C. (2000). COIL challenge 2000 submission. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/MCKONE~1.pdf

Mikšovský, P., & Klema, J. (2000). CoIL challenge 2000. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/MIKSOV~1.pdf

Putten, P., Ruiter, M., & Someren, M. (2000). CoIL challenge 2000 tasks and results: Predicting and explaining caravan policy ownership. Retrieved from

http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/PUTTEN~1.pdf

Rickets, P. (2000). CoIL challenge 2000 submission. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/RICKET~1.pdf

Seewald, A. (2000). CoIL challenge 2000 submitted solution. Retrieved from http://www.liacs.nl/~putten/library/cc2000/SEEWAL~1.pdf

Shtovba, S. (2000). Phase intervals and genetic algorithms based competition task solution. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/SHTOVB~2.pdf

Shtovba, S., & Mashnitskiy, Y. (2000). The backpropagation multilayer feedforward neural network based competition task solution. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/SHTOVB~1.pdf

Simmonds, R. M. (2000). ACT study report using classification and regression tree (cart) analysis. Retrieved from http://www.liacs.nl/~putten/library/cc2000/SIMMON~1.pdf

Šmuc, T. (2000). COIL 2000 challenge solution based on illm-sg methodology. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/SMUCPS~1.pdf

Vesanto, J., & Sinkkonen, J. (2000). Submission for the coil challenge 2000. Retrieved from http://liacs.leidenuniv.nl/~puttenpwhvander/library/cc2000/VESANT~1.pdf

White, A. P., & Liu, W. Z. (2000). The coil challenge: An application of classification trees with bootstrap aggregation. Retrieved from http://www.liacs.nl/~putten/library/cc2000/WHITEP~1.pdf

Appendices

R statistical programming code.

```
# CoIL Challenge Source Code
library(tidyverse)
# Download the data sets from UCI if they are not present
url <- "https://archive.ics.uci.edu/ml/machine-learning-databases/tic-mld/"
files <- c("ticdata2000.txt", "ticeval2000.txt", "tictgts2000.txt")
for (file_name in files) {
  file_path <- paste0("data/", file_name)
  file_url <- paste0(url, file_name)
  if (!file.exists(file_path)) {
    message(paste("Downloading", file_name))
    download.file(file_url, file_path)
  }
}
# Read in the data
df <- read.delim("data/ticdata2000.txt", header = FALSE)
names(df) <- c("MOSTYPE", "MAANTHUI", "MGEMOMV", "MGEMLEEF", "MOSHOOFD",
               "MGODRK", "MGODPR", "MGODOV", "MGODGE", "MRELGE", "MRELSA",
               "MRELOV", "MFALLEEN", "MFGEKIND", "MFWEKIND", "MOPLHOOG",
               "MOPLMIDD", "MOPLLAAG", "MBERHOOG", "MBERZELF", "MBERBOER",
               "MBERMIDD", "MBERARBG", "MBERARBO", "MSKA", "MSKB1", "MSKB2",
               "MSKC", "MSKD", "MHHUUR", "MHKOOP", "MAUT1", "MAUT2", "MAUT0",
               "MZFONDS", "MZPART", "MINKM30", "MINK3045", "MINK4575",
               "MINK7512", "MINK123M", "MINKGEM", "MKOOPKLA", "PWAPART",
               "PWABEDR", "PWALAND", "PPERSAUT", "PBESAUT", "PMOTSCO",
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                "PVRAAUT",  "PAANHANG", "PTRACTOR", "PWERKT", "PBROM", "PLEVEN",
                "PPERSONG", "PGEZONG", "PWAOREG", "PBRAND", "PZEILPL",
                "PPLEZIER", "PFIETS", "PINBOED", "PBYSTAND", "AWAPART",
                "AWABEDR", "AWALAND", "APERSAUT", "ABESAUT", "AMOTSCO",
                "AVRAAUT", "AAANHANG", "ATRACTOR", "AWERKT", "ABROM", "ALEVEN",
                "APERSONG", "AGEZONG", "AWAOREG",  "ABRAND", "AZEILPL",
                "APLEZIER", "AFIETS", "AINBOED", "ABYSTAND", "CARAVAN")
eval <- read.delim("data/ticeval2000.txt", header = FALSE)
temp <- read.delim("data/tictgts2000.txt", header = FALSE)
eval$CARAVAN <- temp$V1
names(eval) <- names(df)
```

Data Dictionary

Name	Description
MOSTYPE	Customer Subtype
MAANTHUI	Number of houses
MGEMOMV	Avg size household
MGEMLEEF	Avg age
MOSHOOFD	Customer main type
MGODRK	Roman catholic
MGODPR	Protestant
MGODOV	Other religion
MGODGE	No religion
MRELGE	Married
MRELSA	Living together
MRELOV	Other relation
MFALLEEN	Singles
MFGEKIND	Household without children
MFWEKIND	Household with children
MOPLHOOG	High level education
MOPLMIDD	Medium level education
MOPLLAAG	Lower level education
MBERHOOG	High status
MBERZELF	Entrepreneur
MBERBOER	Farmer
MBERMIDD	Middle management
MBERARBG	Skilled labourers
MBERARBO	Unskilled labourers
MSKA	Social class A

(continued)

Name	Description
MSKB1	Social class B1
MSKB2	Social class B2
MSKC	Social class C
MSKD	Social class D
MHHUUR	Rented house
MHKOOP	Home owners
MAUT1	1 car
MAUT2	2 cars
MAUT0	No car
MZFONDS	National Health Service
MZPART	Private health insurance
MINKM30	Income < 30.000
MINK3045	Income 30-45.000
MINK4575	Income 45-75.000
MINK7512	Income 75-122.000
MINK123M	Income >123.000
MINKGEM	Average income
MKOOPKLA	Purchasing power class
PWAPART	Contribution private third party insurance
PWABEDR	Contribution third party insurance (firms)
PWAAND	Contribution third party insurane (agriculture)
PPERSAUT	Contribution car policies
PBESAUT	Contribution delivery van policies
PMOTSCO	Contribution motorcycle/scooter policies

(continued)

Name	Description
PVRAAUT	Contribution lorry policies
PAANHANG	Contribution trailer policies
PTRACTOR	Contribution tractor policies
PWERKT	Contribution agricultural machines policies
PBROM	Contribution moped policies
PLEVEN	Contribution life insurances
PPERSONG	Contribution private accident insurance policies
PGEZONG	Contribution family accidents insurance policies
PWAOREG	Contribution disability insurance policies
PBRAND	Contribution fire policies
PZEILPL	Contribution surfboard policies
PPLEZIER	Contribution boat policies
PFIETS	Contribution bicycle policies
PINBOED	Contribution property insurance policies
PBYSTAND	Contribution social security insurance policies
AWAPART	Number of private third party insurance
AWABEDR	Number of third party insurance (firms)
AWALAND	Number of third party insurane (agriculture)
APERSAUT	Number of car policies
ABESAUT	Number of delivery van policies
AMOTSCO	Number of motorcycle/scooter policies
AVRAAUT	Number of lorry policies
AAANHANG	Number of trailer policies
ATRACTOR	Number of tractor policies

(continued)

Name	Description
AWERKT	Number of agricultural machines policies
ABROM	Number of moped policies
ALEVEN	Number of life insurances
APERSONG	Number of private accident insurance policies
AGEZONG	Number of family accidents insurance policies
AWAOREG	Number of disability insurance policies
ABRAND	Number of fire policies
AZEILPL	Number of surfboard policies
APLEZIER	Number of boat policies
AFIETS	Number of bicycle policies
AINBOED	Number of property insurance policies
ABYSTAND	Number of social security insurance policies
CARAVAN	Number of mobile home policy