Traveler's 2020 modeling competition

Insurance modeling

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To handle the unbalanced data

- The failure of Accuracy. AUC or Gini index instead.

		Truth	
		0 majority	1minority
	0 majority	990	10
Predict	1minority	0	0

- Two general solution: Sampling or weighted loss.

$$1 : 100 \to 100 : 100$$
$$\to 1 : 1$$

$$\ell_T(x, y) = w_0 \ell(x, y \,|y = 0) + w_1 \ell(x, y \,|y = 1)$$
$$w_0 : w_1 = \#\{y = 1\} / \#\{y = 0\}$$

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Combined model of frequency and severity

In the chapter 6 of the book

Predictive modeling applications in actuarial science

author gives a modeling pattern for the cost:

$$\begin{aligned}
&frequency = claim_count/exposure \\
&severity = loss/claim_count \\
&frequency \sim \quad P(\lambda) \quad or \quad NB(n, m, \mu) \\
&severity \sim G(\alpha, \beta)
\end{aligned}$$

Tweedie regression

In the article

- An index which distinguishes between some important exponential families

by Maurice Tweedie, the author proposed a tweedie distribution constructed by

$$Cost = X_1 + \cdots + X_N$$
$$X_i \overset{iid}{\sim} G(\alpha, \beta)$$
$$N \sim P(\lambda)$$

Comparison between Freq-Severity and Tweedie:

- Loss Cost Modeling vs. Frequency and Severity Modeling, Jun Yan

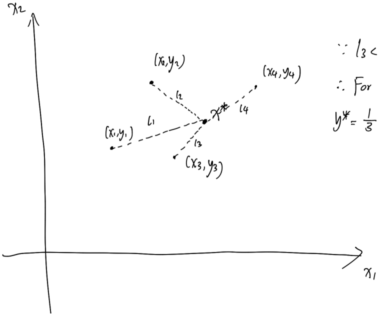
Link is here.

Sample based matching from the external data

K-nearest-neighbor (KNN), with $\left\{\vec{x}_i, y_i\right\}_1^n$ as the samples, for a new given $\vec{x}^*$, we set

$$y^* = \frac{1}{k}\sum_{j\in K} y_j$$

$$K = \arg\min_{T,|T|=k} \sum_{i\in T} \left\|\vec{x}_i - \vec{x}^*\right\|^2$$



$\because l_3 < l_4 < l_2 < l_1$

$\therefore$ For 3-NN,

$y^* = \frac{1}{3}(y_2 + y_3 + y_4)$.

Sample based matching from the external data

The data scource: The dataset "dataCar" under the package "insuranceData".

Possible enhancement: Using kernel trick. In K-NN, the sample with different distance have same weights, while we can use the kernel function like Gaussian kernel to assign them with weights "proportional" to the distance.

$$y^* = \sum_{j \in K} w_j y_j$$

$$K = \underset{T, |T| = k}{\arg\min} \sum_{i \in T} \left\| \vec{x}_i - \vec{x}^* \right\|^2$$

$$\textstyle\sum_j w_j = 1$$

$$w_j \propto \exp\left(- \frac{\left\| \vec{x}_i - \vec{x}^* \right\|^2}{2\sigma^2} \right)$$

Sufficient dimension reduction (SDR) and SDR with categorical data

With the continuous x.

$$y \perp x \,\Big|\, \beta^T x$$

Sliced inverse regression for dimension reduction, Li, Ker-Chau

With the continuous x and categorical W.

$$y \perp x \,\Big|\, \left(\beta^T x, W\right)$$

Sufficient dimensions reduction in regressions with categorical predictors, Li, Bing

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Special Correlation measures

Distance correlation is hot topic in stats recently

Measuring and testing dependence by correlation of distances, Szekely, Gabor J

It is used to measure the distance between vector, so it can be adopted in the testing issue related to features and target. We test:

$$T^* = \frac{ndCov\left(X_i, Y\right)}{\frac{1}{n^2}\sum_{k.l=1}^{n}\left\|X_{ik} - X_{il}\right\|_p \frac{1}{n^2}\sum_{k.l=1}^{n}\left\|Y_k - Y_l\right\|_p} > \left(\Phi^{-1}\left(1 - \alpha/2\right)\right)^2$$

Advantage: Regardless of the continuous or discrete type of variables

Useful info

Git: Git here.

Our department website is Department of Statistics.

Our website for statistical data science lab at Uconn is Data Science Lab