Evaluating Predictive Models

Comparing Models from SSAS, R, Python, and Azure ML

Dejan Sarka

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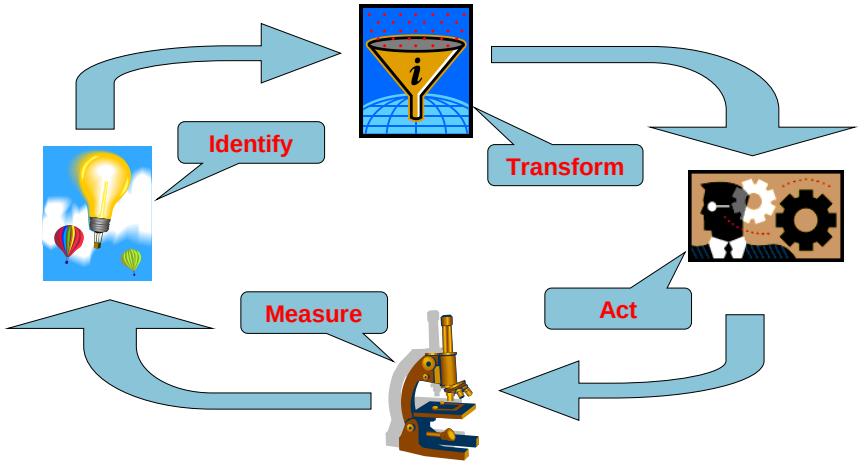
Introduction

- Dejan Sarka (dsarka@solidq.com, dsarka@siol.net, @DejanSarka)
  - 30 years of experience
  - SQL Server MVP, MCT,…
  - 16 books
  - 15+ courses
  - Focus:
    - Data modeling
    - Data mining
    - Data quality

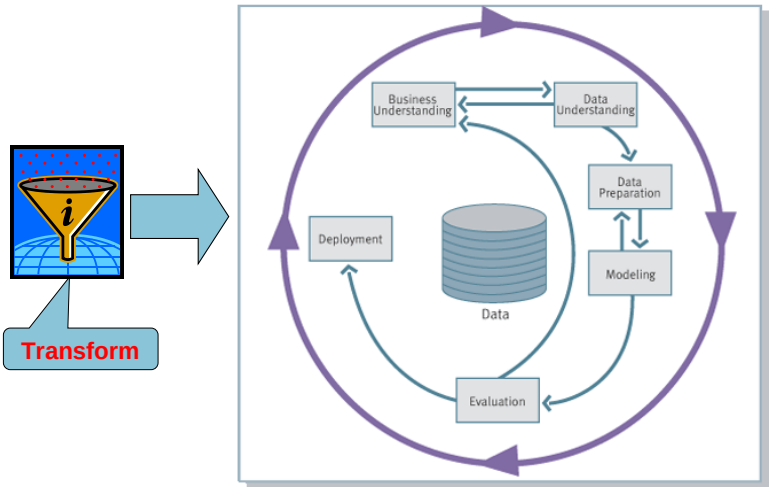
Agenda

- Advanced analytics virtual cycle
- Training and test sets
- Evaluating predictive models
- Classification (confusion) matrix and derivatives
- Evaluating in SSAS, R, Python, and Azure ML models
- Bringing it all together

Advanced Analysis Virtuous Cycle



The CRISP Model



CRISP = Cross Industry Standard Process for Data Mining
(http://en.wikipedia.org/wiki/Cross_Industry_Standard_Process_for_Data_Mining)

Training and Test Sets

- For predictive models, you need to split the data into training and test sets in order to evaluate the models
  - A *training* set is required to build the model (70% of the data)
  - A *test* set is used for predictions (30% of the data)
  - When you know the value of the predicted variable, you can measure the quality of the predictions
- As with every sampling, it is important to *randomly* select the data for each set

Testing the Sampling

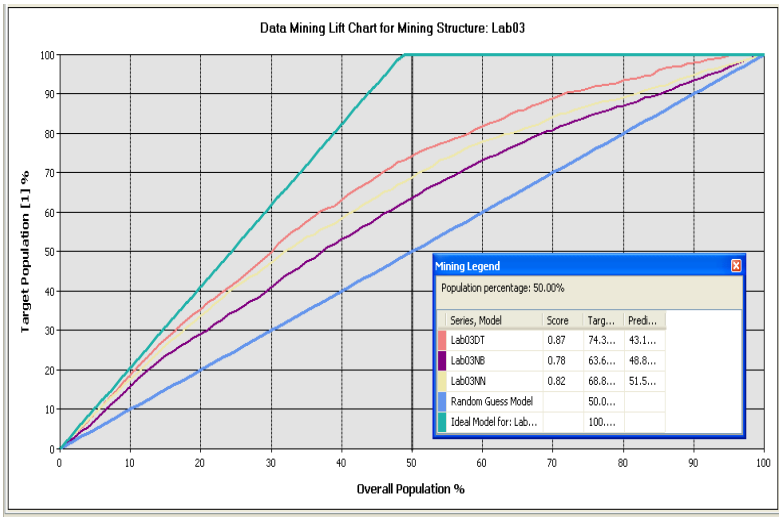
- Test for randomness by creating the two samples and adding a variable that identifies whether a set is a training set or test set (or that identifies the sample)
- Check the null hypothesis that the new variable is not related to other variables
  - Use one-way analysis of variance (ANOVA) and F-tests for continuous variables
  - Use chi-squared test for discrete variables
  - Can also use Decision Trees for discrete variables

Evaluating Predictive Models

- Lift chart
- Cross validation
- Classification (confusion) matrix and derivatives

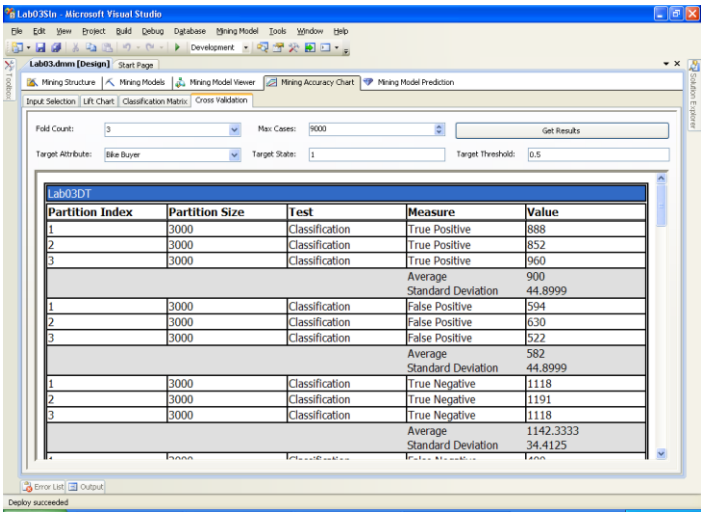
Lift Chart

- No target value: overall performance
- Target value: a percentage of the target audience against a specified percentage of the complete audience



Cross Validation

- Cross validation show robustness of models
  - Splits training set in folds
  - Use one fold for testing, others for training
  - You can see how models perform over different subsets of data



Classification (Confusion) Matrix

- Columns represent items that have been predicted
- Rows represent the actual state of the attribute

		Predicted	
		Negative	Positive
Actual	Negative	TN	FP
	Positive	FN	TP

Derivatives from Confusion Matrix

- Sensitivity, recall, hit rate, or true positive rate (TPR)

$$\frac{TP}{TP + FN}$$

- Specificity or true negative rate (TNR)

$$\frac{TN}{TN + FP}$$

- Precision or positive predictive value (PPV)

$$\frac{TP}{TP + FP}$$

Derivatives from Confusion Matrix

- Negative predictive value (NPV)

$$\frac{TN}{TN + FN}$$

- Miss rate or false negative rate (FNR)

$$\frac{FN}{FN + TP}$$

- Fall-out or false positive rate (FPR)

$$\frac{FP}{FP + TN}$$

Derivatives from Confusion Matrix

- False discovery rate (FDR)

$$\frac{FP}{FP+TP}$$

- False omission rate (FOR)

$$\frac{FN}{FN+TN}$$

- Accuracy (ACC)

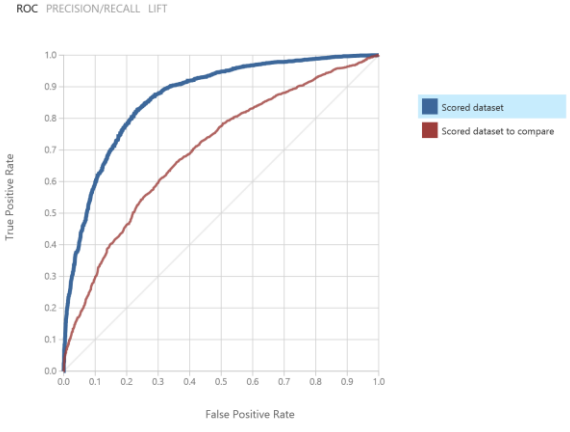
$$\frac{TP+TN}{TP+TN+FP+FN}$$

Derivatives from Confusion Matrix

- Harmonic mean of precision and sensitivity (F1 score)

$$\frac{2*TP}{2*TP+FP+FN}$$

- Receiver operating characteristic (ROC) curve
  - Plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings



Evaluating in SSAS, R, and Azure ML

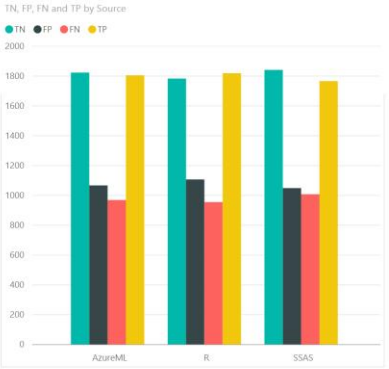
- SSAS
  - Lift chart
  - Cross-validation
  - Classification matrix (basic)
- R, Python
  - Whatever you code☺
- Azure ML
  - ROC
  - Classification matrix (partly)

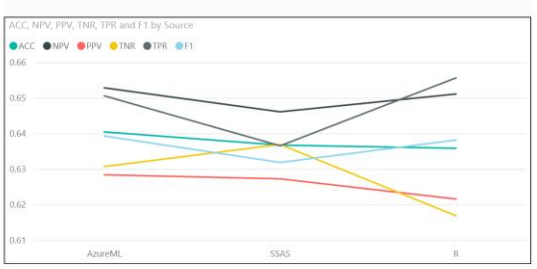
Bringing It All Together

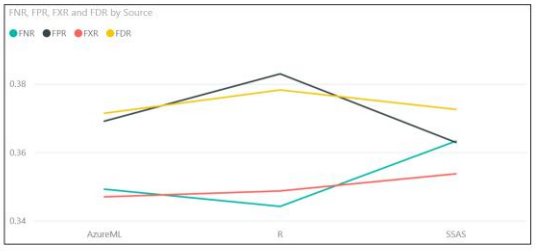
- Use DMX (data mining extensions) query to browse SSAS mining models and perform predictions
- Use T-SQL to execute R and Python code and return tabular format
  - sys. sp_execute_external_script (SQL Server 2016 and 2017)
  - PREDICT() function (2017 only, limited usability)
- Use Azure ML Web services to get predictions from Azure ML models in your application or in Excel
- Use SSIS to union all predictions and create a report

Bringing It All Together

Source	TN	FP	FN	TP
AzureML	1823	1067	969	1805
R	1783	1107	955	1819
SSAS	1841	1049	1008	1766







Q & A

- Thank you!