# TECHNIQUES FOR MODEL SCORING ESUG

Sylvain Tremblay
SAS Canada

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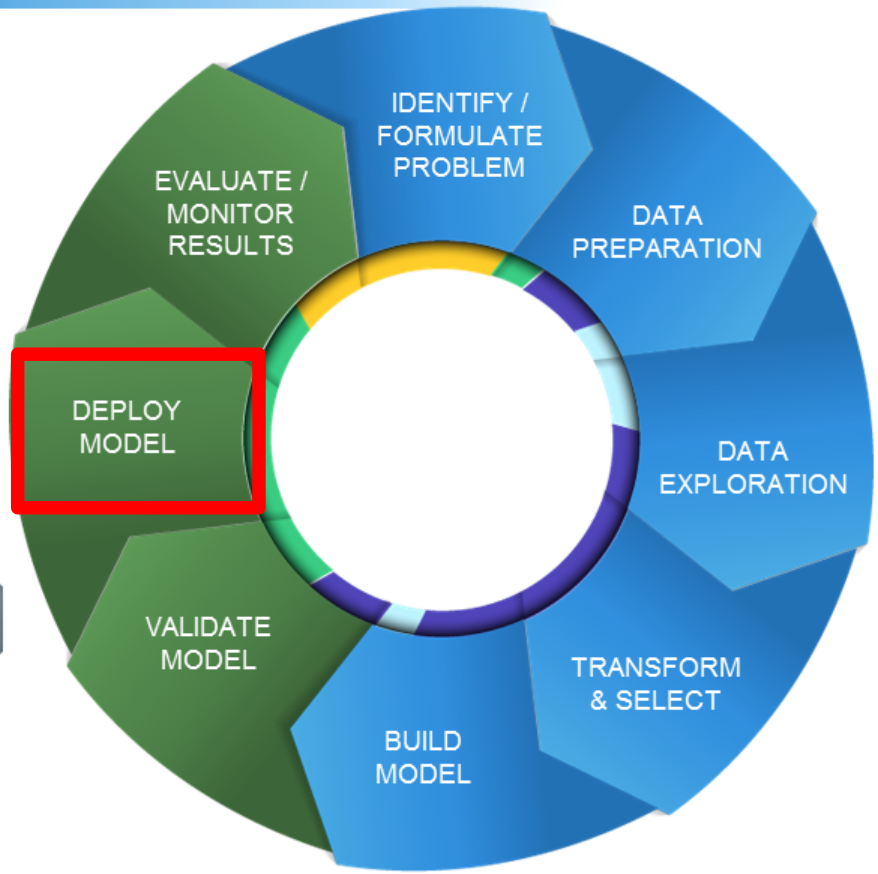
# You are done and have a predictive model…

# Now what? It's time to score

## THE ANALYTICS LIFECYCLE




**BUSINESS MANAGER**

Domain Expert
Makes Decisions
Evaluates Processes and ROI

**BUSINESS ANALYST**

Data Exploration
Data Visualization
Report Creation

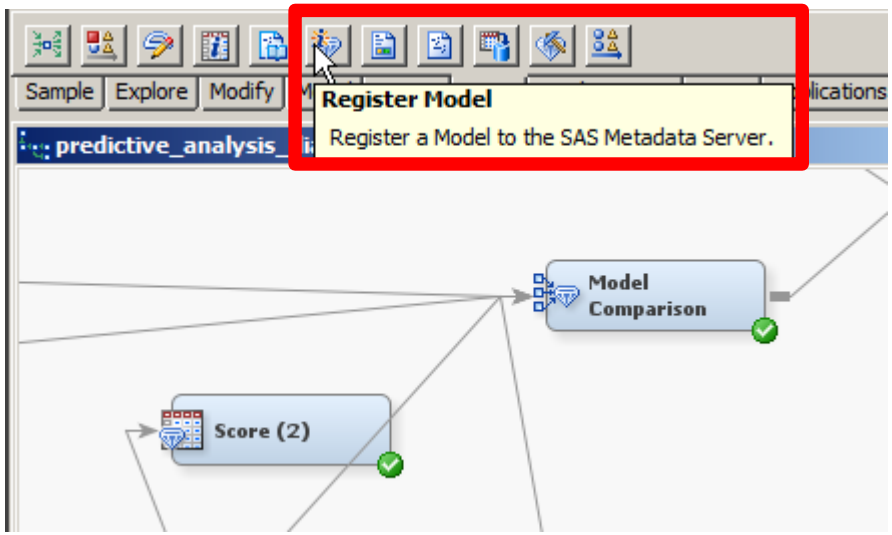
**IT SYSTEMS / MANAGEMENT**

Model Validation
Model Deployment
Model Monitoring
Data Preparation

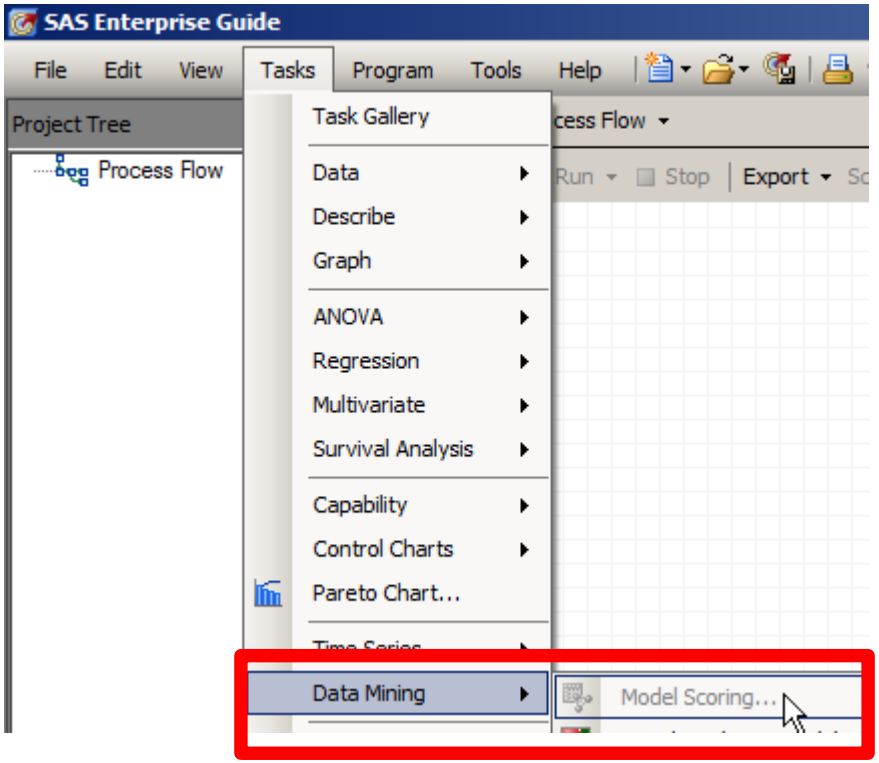
**DATA MINER / STATISTICIAN**

Exploratory Analysis
Descriptive Segmentation
Predictive Modeling

# If you are using Enterprise Miner…




# You can then do the scoring in EG




# What if you are using SAS/Stat ?

# Agenda

- Overview of model scoring
- Proc SCORE
- SCORE statement
- STORE statement and Proc PLM
- CODE STATEMENT
- References + Questions

# Overview of Model Scoring in SAS/Stat

**Many strategies are available:**

1) Output parameter estimates for a model to a SAS dataset and use Proc SCORE

2) Use a SCORE statement in the Proc itself

3) Output your model information in a item store using the STORE statement and then use Proc PLM to score

4) Save score code using a CODE statement

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# Proc SCORE

**Multiplies values from two SAS data sets:**

- One containing the estimated coefficients
- the other containing raw data to be scored

$$\underline{\hat{Y}} = \hat{\beta}_0 + \hat{\beta}_1 X_1 + \ldots + \hat{\beta}_k X_k$$

# Proc SCORE

## Syntax:

```
PROC SCORE  DATA=SAS-data-set <options> ;
     BY  variables ;
     ID  variables ;
     VAR  variables ;
```

Statements:

- ID identifies which variables to be included in the output dataset
- VAR specifies the variables to be used in computing scores
- BY obtain separate analyses of observations in groups

# Proc SCORE

## Syntax:

```
PROC SCORE  DATA=SAS-data-set <options> ;
     BY  variables ;
     ID  variables ;
     VAR  variables ;
```

Usefull options:

- SCORE= Names the data set containing the scoring coefficients
- TYPE= Specifies the obs. that contain scoring coefficients
- PREDICT To produce predicted values
- OUT= Specifies the name of the SAS data set created

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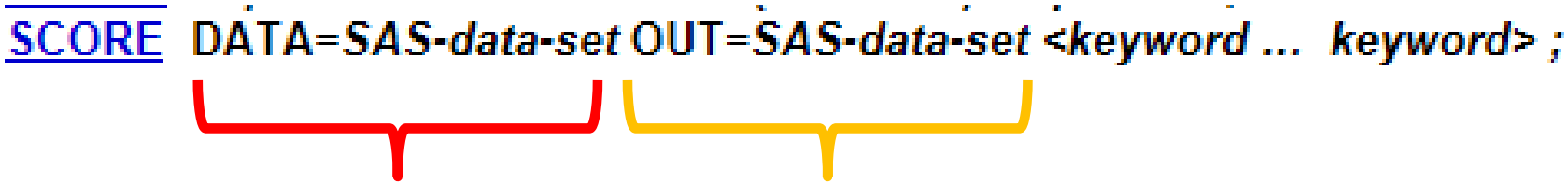
# SCORE Statement

**Nonparametric regression procedures cannot output parameter estimates…**

- You can use a SCORE Statement directly in the Modeling procedure itself to produce the scores
- Typically used in non parametric procedures

# SCORE Statement

## Syntax:




Instructions:

- DATA= specifies the input SAS data set to be scored
- OUT= specifies the name of the SAS data set to contain the predictions

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# STORE Statement and Proc PLM

## Efficient post-processing:

- The STORE statement in the modeling procedure saves all of the information needed to recreate and evaluate the model
- The saved information can be read by the PLM procedure, which includes a SCORE statement, as well as many other capabilities

# STORE Statement and Proc PLM

## Syntax

```
STORE <OUT=>item-store-name </ LABEL='label'> ;

PROC PLM RESTORE=item-store-specification <options> ;
    CODE <options> ;
    EFFECTPLOT <plot-type <(plot-definition-options)>> </ options> ;
    ESTIMATE <'label'> estimate-specification <(divisor=n)><, ...<'label'> estimate-specification
<(divisor=n)>> </ options> ;
    FILTER expression ;
    LSMEANS <model-effects> </ options> ;
    LSMESTIMATE model-effect <'label'> values <divisor=n><, ...<'label'> values <divisor=n>>
</ options> ;
    SCORE DATA=SAS-data-set <OUT=SAS-data-set><keyword<=name>> ...
<keyword<=name>> </ options> ;
    SHOW options ;
    SLICE model-effect </ options> ;
    TEST <model-effects> </ options> ;
    WHERE expression ;
```

# STORE Statement and Proc PLM

## Syntax

SCORE DATA=SAS-data-set <OUT=SAS-data-set>
<keyword<=name>>
<keyword<=name>> </ options>;

Usefull option of the SCORE statement: **ilink**

**Model** $\log\left(\frac{\hat{p}}{1-\hat{p}}\right) = \hat{w}_0 + \hat{w}_1 \cdot x_1 + \hat{w}_2 \cdot x_2 = \text{logit}(\hat{p})$

**ilink will create the score for** $\hat{p} = \frac{1}{1 + e^{-\text{logit}(\hat{p})}}$

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# CODE statement

**In SAS/STAT 12.1 (SAS 9.3) the CODE statement was added to several SAS/STAT regression procedures**

- The CODE statement writes DATA step statements into a text file
- You can then use the %INCLUDE statement to insert those statements into a DATA step

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# References

## Techniques for scoring a regression model in SAS

### The DO Loop Blog,  Rick Wicklin

http://blogs.sas.com/content/iml/2014/02/19/scoring-a-regression-model-in-sas/

## SAS/STAT Documentation

### SAS/STAT 13.2 User's Guide

https://support.sas.com/documentation/onlinedoc/stat/

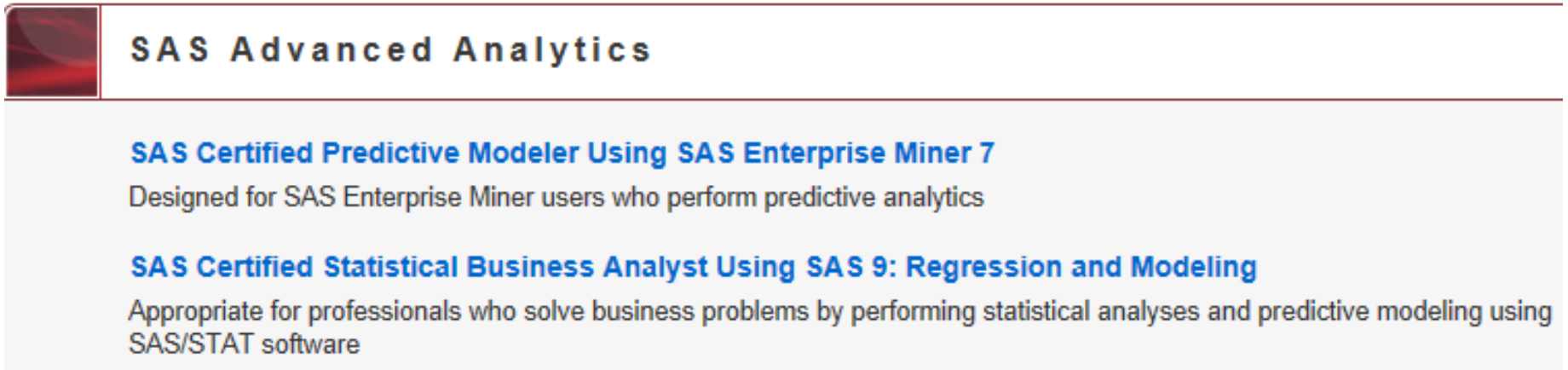
# Training

## SAS Canada Training

http://support.sas.com/training/canada/

## SAS Global Certification program

http://support.sas.com/certify/



# QUESTIONS?


## Thank you!