A SAS Macro for Univariate Logistic Regression

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Outline

1. Logistic Regression
2. Macro
3. Example
When & Why

◊ Response variable is categorical, often binary: Yes/No
Acceptable/Not acceptable
Phenomena takes place/does not take place

◊ Violates the assumption of linearity in normal regression.

◊ Error terms are heteroscedastic and not normal.

Why can’t I use linear regression?
Area of Application

- **Health Sciences**: questions about disease: yes or no?
- **Social Sciences**: deals with great deal of dichotomous variables: employed vs unemployed, married vs unmarried, etc.
- Used in economics and marketing to study consumer choice.
- Banks use it to assess credit rating of customers
- Public Opinion Polls
- Used in demand forecasting
PROC LOGISTIC

1. PROC LOGISTIC DATA = DATA_SET_NAME OPTIONS;
2. CLASS VARIABLE_NAME;
3. MODEL DEPENDENT_VARIABLE = EXPLANATORY_VARIABLE;
4. OPTIONS;
5. RUN;
6. RUN;
What is SAS Macro

A macro is a larger piece of a program that can contain complex logic including complete DATA and PROC steps, and macro statements such as `%IF-%THEN %-ELSE` and `%DO-%END`. Macros often - but not always - contain macro variables.  

Why use Macro

1. With macros you can make one small change in your program and have SAS echo that change throughout your program.  
2. Macros can allow you to write a piece of code and use it over and over again in the same or different program.  
3. You can make your program data driven, letting SAS decide what to do based on actual data.
## Data

### Alphabetic List of Variables and Attributes

<table>
<thead>
<tr>
<th>#</th>
<th>Variable</th>
<th>Type</th>
<th>Len</th>
<th>Format</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Cylinders</td>
<td>Num</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>DriveTrain</td>
<td>Char</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>EngineSize</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>Engine Size (L)</td>
</tr>
<tr>
<td>10</td>
<td>Horsepower</td>
<td>Num</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Invoice</td>
<td>Num</td>
<td>8</td>
<td>DOLLARS8.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Length</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>Length (IN)</td>
</tr>
<tr>
<td>11</td>
<td>MPG_City</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>MPG (City)</td>
</tr>
<tr>
<td>12</td>
<td>MPG_Highway</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>MPG (Highway)</td>
</tr>
<tr>
<td>6</td>
<td>MSRP</td>
<td>Num</td>
<td>8</td>
<td>DOLLARS8.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Make</td>
<td>Char</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Model</td>
<td>Char</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Origin</td>
<td>Char</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Type</td>
<td>Char</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Weight</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>Weight (LBS)</td>
</tr>
<tr>
<td>14</td>
<td>Wheelbase</td>
<td>Num</td>
<td>8</td>
<td></td>
<td>Wheelbase (IN)</td>
</tr>
</tbody>
</table>
DATA CARS;
    SET SASHELP.CARS;
    IF (MSRP LE 32700) THEN Price = 'Cheap';
    ELSE Price = 'Costly';
    IF (MPG_City LE 20) THEN Efficiency = 'No';
    ELSE Efficiency = 'Yes';
    IF (EngineSize LE 3) THEN Size = 'Small';
    ELSE Size = 'Big';
    IF (Type EQ 'Sedan') THEN Sedan = 'Yes';
    ELSE Sedan = 'No';
    IF (Origin EQ 'USA') THEN USA = 'Yes';
    ELSE USA = 'No';
    IF (Origin EQ 'Asia') THEN Asia = 'Yes';
    ELSE Asia = 'No';
    IF (Origin EQ 'Europe') THEN Europe = 'Yes';
    ELSE Europe = 'No';
    IF (DriveTrain EQ 'Front') THEN FrontWheel = 'Yes';
    ELSE FrontWheel = 'No';
    DROP MSRP MPG_City EngineSize Make Model Type DriveTrain Origin;
RUN;
What predicts what?

- Costly or Not
- Efficient or Not
- Big or Small
- Front Wheel Drive or Not

- Response Variable: 4
- Explanatory Variable: 11
- Total Model: 44
/ * This macro runs univariate logistic regression for any number of outcomes and predictors. It summarizes parameter estimates from different models into two data files: one for numeric and one for character variables. Arguments are: 
DS=Input Dataset
Outcome=Output Variable(s)
Numvar=One numeric variable name to generate summary data file
CHARVAR=One Character Variable to generate summary data file
Outvar=One output variable name if there are more than one Outcomes */

%MACRO LOGIS(DS=, OUTCOME=, NUMVAR=, CHARVAR=, OUTVAR=);
DATA _null_;
%* Count number of variables in the ConvertVars parameter;
CALL SYMPUTX("novars", count("&OUTCOME", "") + 1, "G");
%PUT Number of Outcome Variables Count is &novars;
DATA _dsin (DROP=&OUTCOME) ;
SET &DS ;
RUN;
%INCLUDE 'Z:\SAS Work\Macro\Variable_List.sas';
%LST(_dsin);
%LET X=&X ;
%PUT Y=&Y ;
%LET Outvars=1 ;
%DO %WHILE(&Outvars LT (&novars + 1));
%LET newvar = %SCAN(&OUTCOME, &Outvars);
%PUT Processing variable is &newvar;
ODS OUTPUT ParameterEstimates = _summaryc ;
PROC LOGISTIC DATA=&DS DESCENDING ;
CLASS &CHARVAR ;
MODEL &OUTVAR = &CHARVAR / RRSQUARE LACKFIT ;
QUIT;
RUN;
ODS OUTPUT ParameterEstimates = _summaryn ;
/*
This macro runs univariate logistic regression for any number of outcomes and predictors. It summarizes parameter estimates from different models into two data files: one for numeric and one for character variables. Arguments are:
DS=Input Dataset
Outcome=Output Variable(s)
Numvar=One numeric variable name to generate summary data file
CHARVAR=One Character Variable to generate summary data file
Outvar=One output variable name if there are more than one Outcomes */

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DATA _null_;
%* Count number of variables in the ConvertVars parameter;
CALL SYMPUTX("novars", count("&OUTCOME", "") + 1, "G");
%PUT Number of Outcome Variables Count is &novars;
DATA _dsin (DROP=&OUTCOME) ;
SET &DS ;
RUN;
%INCLUDE 'Z:\SAS Work\Macro\Variable_List.sas';
%LST(_dsin);
%LET X=&X ;
%PUT Y=&Y ;
%LET Outvars=1 ;
%DO %WHILE(&Outvars LT (&novars + 1));
%LET newvar = %SCAN(&OUTCOME, &Outvars);
%PUT Processing variable is &newvar;
ODS OUTPUT ParameterEstimates = _summaryc ;
PROC LOGISTIC DATA=&DS DESCENDING ;
CLASS &CHARVAR ;
MODEL &OUTVAR = &CHARVAR / RRSQUARE LACKFIT ;
QUIT;
RUN;
ODS OUTPUT ParameterEstimates = _summaryn ;
*/
PROC LOGISTIC DATA=&DS  DESCENDING;
MODEL &OUTVAR = &NUMVAR /
RSQUARE LACKFIT;
RUN;
QUIT;
ODS OUTPUT CLOSE;
DATA _SUMMARYN;
LENGTH VARIABLE $ 32;
SET _SUMMARYN;
DELETE;
RUN;
%LET DSID=%SYSFUNC(OPEN(_DSin, i));
%LET K=1;
%LET VAR = %SCAN(&X, &K);
%LET L=1;
%LET VART = %SCAN(&Y, &L);
%DO %WHILE("&VAR" NE "");
%IF ("&VART" EQ "C")
%THEN %DO :
ODS OUTPUT ParameterEstimates = _peC&Outvars&K
  OddsRatios = _orC&Outvars&K;
PROC LOGISTIC DATA=&DS  DESCENDING;
CLASS &VAR ;
MODEL &newvar = &VAR /
RSQUARE LACKFIT ;
TITLE1 "Logistic Regression for Predicting &newvar with &VAR (Character) ";
RUN;
QUIT;
ODS OUTPUT ParameterEstimates = _peC&Outvars&K
  OddsRatios = _orC&Outvars&K;
PROC LOGISTIC DATA=&DS  DESCENDING;
CLASS &VAR ;
MODEL &newvar = &VAR /
RSQUARE LACKFIT ;
TITLE1 "Logistic Regression for Predicting &newvar with &VAR (Numeric) ";
RUN;
QUIT;
ODS OUTPUT CLOSE;
DATA _peC&Outvars&K;
LENGTH VARIABLE $ 32;
SET _peC&Outvars&K;
RUN;
PROC APPEND BASE = _SUMMARYC DATA = _peC&Outvars&K FORCE;
RUN;
%END ;
%ELSE %IF ("&VART" EQ "N")
%THEN %DO :
ODS OUTPUT ParameterEstimates = _peN&Outvars&K
  OddsRatios = _orN&Outvars&K;
PROC LOGISTIC DATA=&DS  DESCENDING;
MODEL &newvar = &VAR /
RSQUARE LACKFIT ;
TITLE1 "Logistic Regression for Predicting &newvar with &var (Numeric) ";
Macro Code (Contd.)

RUN;
QUIT;
ODS OUTPUT CLOSE;
DATA _peN&Outvars&K;
LENGTH VARIABLE $ 32;
SET _peN&Outvars&K;
RUN;
PROC APPEND BASE = _SUMMARYN DATA = _peN&Outvars&K FORCE;
RUN;
%END;
%LET K = %EVAL(&K + 1);
%LET VAR = %SCAN(&X, &K);
%LET L = %EVAL(&L + 1);
%LET VART = %SCAN(&Y, &L);
%END;
TITLE1 "Summary of Parameter Estimates for &newvar for Numeric Variables";
PROC PRINT DATA=_SUMMARYN;
RUN;
TITLE1 "Summary of Parameter Estimates for &newvar for Character Variables";
PROC PRINT DATA=_SUMMARYC;
RUN;
PROC DATASETS LIB=WORK NOLIST;
DELETE _SUMMARYC _SUMMARYN;
QUIT;
RUN;
%LET Outvars = %EVAL(&Outvars +1);
%PUT Updated vars loop count &Outvars;
%END;
%LET RC=%SYSFUNC(CLOSE(&DSID));
%MEND LOGIS;

RUN;
QUIT;
ODS OUTPUT CLOSE;
DATA _peN&Outvars&K;
LENGTH VARIABLE $ 32;
SET _peN&Outvars&K;
RUN;
PROC APPEND BASE = _SUMMARYN DATA = _peN&Outvars&K FORCE;
RUN;
%END;
%LET K = %EVAL(&K + 1);
%LET VAR = %SCAN(&X, &K);
%LET L = %EVAL(&L + 1);
%LET VART = %SCAN(&Y, &L);
%END;
TITLE1 "Summary of Parameter Estimates for &newvar for Numeric Variables";
PROC PRINT DATA=_SUMMARYN;
RUN;
TITLE1 "Summary of Parameter Estimates for &newvar for Character Variables";
PROC PRINT DATA=_SUMMARYC;
RUN;
PROC DATASETS LIB=WORK NOLIST;
DELETE _SUMMARYC _SUMMARYN;
QUIT;
RUN;
%LET Outvars = %EVAL(&Outvars +1);
%PUT Updated vars loop count &Outvars;
%END;
%LET RC=%SYSFUNC(CLOSE(&DSID));
%MEND LOGIS;
Macro Code (Contd.)

%LOGIS(
DS=CARS,
OUTCOME= Price Efficiency Size FrontWheel ,
NUMVAR=Cylinders,
CHARVAR=Sedan,
OUTVAR=Price 
);

SAS Enterprise Guide

References

Susan J. Slaughter and Lora D. Delwiche
*SAS Macro Programming for Beginners.*
SUGI 29.