Logistic (RLOGIST) Example #6

**SUDAAN Statements and Results Illustrated**
- PRED_EFF
- PREDMARG
- EFFECTS
- SUBPOPX
- REFLEVEL

**Input Data Set(s):** SAMADULTED.SAS

**Example**

Using 2006 NHIS data, determine for white adults whether marital status interacts with gender on the occurrence of not being able to afford prescription medications, controlling for education, age, and region of country.

This example highlights the use of the EFFECTS, PREDMARG, and PRED_EFF statements in performing the following functions in models containing main effects plus interactions: 1) testing simple effects for interaction terms, 2) estimating customized odds ratios for interaction terms, 3) estimating predicted marginal proportions (model-adjusted risks), 4) estimating model-adjusted relative risks, and 5) estimating and testing risk differences.

This example also adds 95% confidence limits to the predicted marginal proportions.

**Solution**

NHIS is an annual multipurpose health sample survey conducted by the National Center for Health Statistics (NCHS). For more information about the data used in this example, see Section 12.7. The 2006 NHIS collected data on approximately 29,200 households; 29,900 families; 75,700 persons; 24,275 sample adults; and 9,800 sample children.

In the 2006 study, each sample adult was asked (variable AHCAFYR1):

“During the PAST 12 MONTHS, was there any time when you needed prescription medicine but didn’t get it because you couldn’t afford it?”

Possible answer codes are yes, no, don’t know, refused, and not ascertained. Only 0.96% of sample adults were coded as something other than yes or no. The constructed variable CANTAFMEDS is created from AHCAFYR1 and is coded as 1=yes (could not afford at least once in the past 12 months) or 0=no (event did not happen). All other responses are coded to missing.

**Example 3** uses the same dataset and shows how to perform the same functions as above in a main-effects-only model via the RLOGIST procedure. This example uses RLOGIST to model the probability that the dependent variable CANTAFMEDS is equal to 1, but fits the model with main effects plus an interaction term (sex*marital status). The EFFECTS, PREDMARG, and PRED_EFF statements are used to obtain estimates and tests concerning the effect of marital status at each level of gender as well as averaged over the interaction.
For variance estimation purposes, the complex sampling plan is described as 300 pseudo-strata with two pseudo-PSUs per stratum. Sampling at the first PSU stage is assumed to be with replacement. Each unit of analysis (sample adult, sample child, person, etc.) is clustered within his/her PSU, and lower level sampling units are not identified.

In this example, we use the sample adult (age 18 and older) data file with 24,275 observations. The stratification and primary sampling unit variables are named STRAT_P and PSU_P, respectively, and appear on the NEST statement. The weight variable for the sample adult file is WTFA_SA and appears on the WEIGHT statement. The PROC statements specify DESIGN=WR (i.e., unequal probability sampling of PSUs with replacement), and Taylor Series linearization is used for variance estimation. The subpopulation is defined as white (MRACRPI2=1) and at least 25 years old (AGE_P >= 25).

The model terms are as follows:

- Sex (SEX: 1=Male, 2=Female);
- Age at three levels (AGE25_3: 1=25-44, 2=45-64, 3=65+);
- Education at three levels (EDUC_3: 1=HS or Less, 2=Some College, 3=College Grad);
- Region of the U.S. at four levels (REGION: 1=NE, 2=Midwest, 3=South, 4=West); and
- Marital status at three levels (MARRY_3: 1=Married, 2=Widowed, 3=Unmarried).

Sex-by-Marital Status interaction effect (specified SEX*MARRY_3)

The SUBPOPX statement restricts the analysis to whites aged 25 years or more. The REFLEVEL statement defines the regression coefficient reference level for sex, region, and marital status to be the first level of each variable (REFLEVEL is used for continuity with Example 3; it serves no key function in this example, and it could have been removed). Since age and education are not included on the REFLEVEL statement, the last level of each of these variables will be used as the reference level for estimating regression coefficients.

The EFFECTS, PREDMARG, and PRED_EFF statements in Exhibit 1 are used to obtain estimates and tests concerning the effect of marital status at each level of gender as well as averaged over the interaction cells. The EFFECTS statement is used to compute contrasts involving regression coefficients. We use the EFFECTS statement to evaluate the effect of marital status (overall effect, and unmarried vs. married) on not being able to afford prescription medicine under the following conditions:

1. When Sex=1 (Males)
2. When Sex=2 (Females)
3. At the reference level of Sex (1=Males)
4. Averaged over the interaction cells with Sex
The EXP option tells SUDAAN to exponentiate the EFFECTS contrast among regression coefficients. This yields the odds of incurring the event for unmarried vs. married, separately for males and females, and then averaged over the interaction cells. The EXP estimates are the \textit{user-defined odds ratios}.

The PREDMARG statement requests the predicted marginal proportion (\textit{model-adjusted risk}) for each cross-classified level of SEX*MARRY_3. The ADJRR option on the PREDMARG statement computes the ratio of predicted marginal proportions (\textit{model-adjusted risk ratio}) for each marital status group (2=widowed, 3=unmarried) compared to the user-specified reference level (1=married), separately for males and females.

We include multiple PRINT statements, all optional. Multiple PRINT statements allow us to set up different default print environments (SETENV statements) for different PRINT groups. The PRINT statements are used in this example to request the PRINT groups of interest, to specify a variety of formats for those printed statistics, and in some cases, to change the default label for the statistic. Without the PRINT statements, default statistics are produced from each PRINT group, with default formats and labels.

The SETENV statements are optional. They set up default formats for printed statistics and further manipulate the printout to the needs of the user.

The RFORMAT statements associate the SAS formats with the variables used in the RLOGIST procedure. The RLABEL statement defines variable labels for use in the current procedure only. Without the RLABEL statement, SAS variable labels would be produced if already defined.

This example was run in SAS-Callable SUDAAN, and the SAS program and *.LST files are provided.
Exhibit 1. SAS-Callable SUDAAN Code

```
libname in "c:\10winbetatest\AmJEpid";

options nocenter pagesize=70 linesize=95;
proc format;
  value educ 1="1-HS or Less"
            2="2-Some College"
            3="3-College+",
  value age 1="25-44"
            2="45-64"
            3="65+",
  value sex 1="1-Male"
            2="2-Female",
  value region 1="1-N.E.
              2="2-Midwest"
              3="3-South"
              4="4-West",
  value marry 1="1-Married"
             2="2-Widowed"
             3="3-Unmarried",
  value yesno 1="Yes"
           0="No",
Data samadult; set in.samadulted;
  if 0 <= educ1 <= 14 then educ_3=1;
  else if educ1=15 then educ_3=2;
  else if 16 <= educ1 <= 21 then educ_3=3;
  else educ_3= .;
  if 25 <= age_p <= 44 then age25_3=1;
  else if 45 <= age_p <= 64 then age25_3=2;
  else if age_p >= 65 then age25_3=3;
  if r_maritl in (1,2,3) then marry_3=1;
  else if r_maritl=4 then marry_3=2;
  else if r_maritl in (5,6,7,8) then marry_3=3;
  else marry_3= .;
  if ahcafyrl=1 then cantafmeds=1;
  else if ahcafyrl=2 then cantafmeds=0;
  else if ahcafyrl in (7,8,9) then cantafmeds= .;
proc sort data=samadult; by strat_p psu_p;
```
Exhibit 1.  SAS-Callable SUDAAN Code (continued)

```sas
PROC RLOGIST DATA=samadult DESIGN=WR FILETYPE=SAS;
NEST STRAT_P PSU_P;
WEIGHT WTFA_SA;
.SUBPOPX AGE_P>24 AND MRACRPI2-1 / NAME="WHITES AGED 25+";
CLASS SEX AGE25_3 EDUC_3 REGION MARRY_3;
REFLEVEL SEX-1 REGION-1 MARRY_3=1;
MODEL CANTAFMEDS = SEX AGE25_3 EDUC_3 REGION MARRY_3 SEX*MARRY_3;
EFFECTS MARRY_3 / SEX-1 NAME="Married Effect: Males";
EFFECTS MARRY_3 / SEX-2 NAME="Married Effect: Females";
EFFECTS MARRY_3 / REFLEVEL NAME="Married Effect: SEX=Reflevel";
EFFECTS MARRY_3 / AVERAGE NAME="Married Effect: averaged";
EFFECTS MARRY_3=-(-1 0 1) / SEX-1 EXP NAME="Unmarried vs Married, Males";
EFFECTS MARRY_3=-(-1 0 1) / SEX-2 EXP NAME="Unmarried vs Married, Females";
EFFECTS MARRY_3=-(-1 0 1) / REFLEVEL EXP NAME="Unmarried vs Married, Reflevel";
EFFECTS MARRY_3=-(-1 0 1) / AVERAGE EXP NAME="Unmarried vs Married, Averaged";

PREDMARG SEX(1)*MARRY_3(1) / adjrr;
PREDMARG SEX(2)*MARRY_3(1) / adjrr;
PREDMARG SEX(-1)*MARRY_3=(1 0 1) / name="Unmarried vs Married, Males";
PREDMARG SEX(0)*MARRY_3=(1 0 1) / name="Unmarried vs Married, Females";
PREDMARG SEX=-1*MARRY_3=(1 0 1) / name="Unmarried vs Married, M vs F";

setenv labwidth=24 colspce=1;
setenv labwidth=30 colspce=4 decwidth=3;
setenv labwidth=24 decwidth=4 colwidth=6 colspce=2;
setenv labwidth=35 decwidth=4 colwidth=8 colspce=2;
setenv labwidth=40 decwidth=3 colwidth=9 colspce=3;

RFORMAT sex sex.;
RFORMAT age25_3 age.;
RFORMAT educ_3 educ.;
RFORMAT region region.;
RFORMAT marry_3 marry.;
RFORMAT sex sex.;

RTITLE "Modelling Can't Afford Rx Meds (Interaction Model)";
RFOOTNOTE "Data Source: NCHS National Health Interview Survey (2006)";
```
Exhibit 2 indicates that 24,275 observations were read in; 16,469 are in the subpopulation defined as white adults over the age of 25; and 16,042 observations were used in the analysis (due to missing values for one or more model variables). The CLASS variable frequencies were generated but are not displayed here.
Exhibit 3. Regression Coefficients Table

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable CANTAFMEDS: Can't Afford Meds Past 12m
For Subpopulation: WHITES AGED 25+

Modelling Can’t Afford Rx Meds (Interaction Model)

by: Independent Variables and Effects.

<table>
<thead>
<tr>
<th>Independent Variables and Effects</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>Beta Limit</th>
<th>Beta Limit</th>
<th>T-Test B=0</th>
<th>T-Test B=0</th>
<th>P-value</th>
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<tr>
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<td>-5.4461</td>
<td>-4.6467</td>
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<td></td>
<td></td>
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<tr>
<td>1=Male</td>
<td>0.0000</td>
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</tr>
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<td>2=Female</td>
<td>0.3911</td>
<td>0.1119</td>
<td>0.1708</td>
<td>0.6114</td>
<td>3.49</td>
<td>0.0005</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
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<td>1=HS or Less</td>
<td>0.8969</td>
<td>0.0808</td>
<td>0.7379</td>
<td>1.0560</td>
<td>11.10</td>
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<tr>
<td>2=Some College</td>
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<td>0.1027</td>
<td>0.6860</td>
<td>1.0904</td>
<td>8.65</td>
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</tr>
<tr>
<td>3=College+</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
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<tr>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>1=N.E.</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>2=Midwest</td>
<td>0.3453</td>
<td>0.1271</td>
<td>0.0951</td>
<td>0.5954</td>
<td>2.72</td>
<td>0.0070</td>
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</tr>
<tr>
<td>3=South</td>
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<td>0.1262</td>
<td>0.2568</td>
<td>0.7533</td>
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<td>0.0001</td>
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</tr>
<tr>
<td>4=West</td>
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<td>0.1381</td>
<td>0.0845</td>
<td>0.6281</td>
<td>2.58</td>
<td>0.0104</td>
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<tr>
<td>MARRY_3</td>
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</tr>
<tr>
<td>1=Married</td>
<td>0.0000</td>
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<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
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</tr>
<tr>
<td>2=Widowed</td>
<td>0.7494</td>
<td>0.3283</td>
<td>0.1033</td>
<td>1.3955</td>
<td>2.28</td>
<td>0.0231</td>
<td></td>
</tr>
<tr>
<td>3=Unmarried</td>
<td>0.6162</td>
<td>0.1167</td>
<td>0.3866</td>
<td>0.8458</td>
<td>5.28</td>
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<tr>
<td>Sex, MARRY_3</td>
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</tr>
<tr>
<td>1=Male, 1=Married</td>
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<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>1=Male, 2=Widowed</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
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<td></td>
</tr>
<tr>
<td>1=Male, 3=Unmarried</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
<td>.</td>
<td></td>
</tr>
<tr>
<td>2=Female, 1=Married</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>.</td>
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</tr>
<tr>
<td>2=Female, 2=Widowed</td>
<td>-0.4840</td>
<td>0.3928</td>
<td>-1.1782</td>
<td>0.2102</td>
<td>-1.37</td>
<td>0.1711</td>
<td></td>
</tr>
<tr>
<td>2=Female, 3=Unmarried</td>
<td>0.3210</td>
<td>0.1418</td>
<td>0.0420</td>
<td>0.6001</td>
<td>2.26</td>
<td>0.0243</td>
<td></td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

Care is needed in interpreting the regression coefficients for any main effect in the presence of an interaction term containing that effect (see Exhibit 3). For example, the effect of Marital Status=3 vs. 1 (Unmarried vs. Married) is significant ($\beta=0.6162, p=0.0000$), but this corresponds to SEX at its specified reference cell (males, in accordance with REFLEVEL statement). Among males, the Unmarried group has an increased likelihood of incurring the event compared to the Married group.

The EFFECTS statement makes it easier to test the effect of marital status at any level of sex, or even averaged over the cells of the interaction with sex.
In the ANOVA table (Exhibit 4), SUDAAN provides the test for each term in the model by default. The SEX*MARRY_3 interaction term is significant ($p=0.0142$). This means that the marital status effect is significantly different for males vs. females.

The EFFECTS statement contrasts are contained in the last 8 rows of the table and are generated by the following statements from Exhibit 1:

```plaintext
EFFECTS MARRY_3 / SEX=1 NAME="Married Effect: Males";
EFFECTS MARRY_3 / SEX=2 NAME="Married Effect: Females";
EFFECTS MARRY_3 / REFLEVEL NAME="Married Effect: SEX=Reflevel";
EFFECTS MARRY_3 / AVERAGE NAME="Married Effect: averaged";
EFFECTS MARRY_3=(-1 0 1) / SEX=1 EXP NAME="Unmarried vs Married, Males";
EFFECTS MARRY_3=(-1 0 1) / SEX=2 EXP NAME="Unmarried vs Married, Females";
EFFECTS MARRY_3=(-1 0 1) / REFLEVEL EXP NAME="Unmarried vs Married, Reflevel";
EFFECTS MARRY_3=(-1 0 1) / AVERAGE EXP NAME="Unmarried vs Married, Averaged";
```

We see from Exhibit 4 that the overall effect of marital status (2 df) on being able to afford prescription medicine is significant for males, females, and when averaged over the interaction with sex. It is also significant at the reference level for SEX, which in this example refers to males. Therefore, the effect of marital status is the same when SEX=1 or the REFLEVEL option is specified. The 1 df test for comparing Unmarried vs. Married is significant for Males, Females, REFLEVEL (same as males), and
when averaged over the interaction. Judging by the magnitude of the Wald $F$ statistics, the effect of marital status on the ability to afford prescription medicine is larger among females than males.

**Exhibit 5. Default Odds Ratios**

<table>
<thead>
<tr>
<th>Independent Variables and Effects</th>
<th>Odds Ratio</th>
<th>Lower 95% Limit OR</th>
<th>Upper 95% Limit OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.006</td>
<td>0.004</td>
<td>0.010</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1=Male</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>2=Female</td>
<td>1.479</td>
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</tr>
<tr>
<td>25-44</td>
<td>3.544</td>
<td>2.632</td>
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</tr>
<tr>
<td>45-64</td>
<td>3.262</td>
<td>2.465</td>
<td>4.315</td>
</tr>
<tr>
<td>65+</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>EDUC_3</td>
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<td></td>
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</tr>
<tr>
<td>1=HS or Less</td>
<td>2.452</td>
<td>2.092</td>
<td>2.875</td>
</tr>
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<td>2=Some College</td>
<td>2.431</td>
<td>1.986</td>
<td>2.975</td>
</tr>
<tr>
<td>3=College+</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Region</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1=N.E.</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>2=Midwest</td>
<td>1.412</td>
<td>1.100</td>
<td>1.814</td>
</tr>
<tr>
<td>3=South</td>
<td>1.657</td>
<td>1.293</td>
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<tr>
<td>4=West</td>
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<td>MARRY_3</td>
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</tr>
<tr>
<td>1=Married</td>
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<td>1.000</td>
</tr>
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<td>2=Widowed</td>
<td>2.116</td>
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</tr>
<tr>
<td>3=Unmarried</td>
<td>1.852</td>
<td>1.472</td>
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<td>2=Female, 2=Widowed</td>
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<td>1.379</td>
<td>1.043</td>
<td>1.822</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

The default odds ratios table (Exhibit 1) should also be interpreted with caution when interaction effects are present. For example, the odds ratio for Unmarried vs. Married is 1.852, but since a sex-by-marital status interaction is present, the odds ratio is for SEX at its reference level (males). So we know there is a 85% increase in odds of not being able to afford prescription medicine for Unmarried white men compared to Married white men.

The EXP option on the EFFECTS statement (results presented next) is used to give us the odds ratio for females. We will be able to tell if the interaction is due to a difference in the magnitude of the marital status effect for males vs. females, or if the marital status effect changes direction for males vs. females. Significant interaction can result from either of these situations.

The user-specified odds ratios are generated by the EXP option on the EFFECTS statements in Exhibit 1.
From Exhibit 6, we see that the odds ratio (for occurrence of can’t afford prescription medications, past 12 months) for Unmarried vs. Married is significantly greater than 1.0 but higher in females (2.553) vs. males (1.852). Both values show increased likelihood for Unmarried vs. Married and neither contain the null value of 1.0. In addition, the confidence limits do not show much overlap, and hence the significant interaction.

Unmarried white women over 25 yrs of age are two and a half times more likely to incur the event than Married women in the same subpopulation. The male odds ratio of 1.852 also appeared in the table of default odds ratios. Unmarried white men over 25 yrs are less than twice as likely as Married men in the same subpopulation to incur the event.

The odds ratio for Unmarried vs. Married when the interacting variable SEX is at its reference cell defaults to males. Recall that the reference cell is either the default last level of the categorical variable, unless a different reference cell is specified on the REFLEVEL statement. In this example, the REFLEVEL statement specifies males as the reference cell for SEX when fitting the model, so the REFLEVEL option on the EFFECTS statement defaults to males. Finally, the odds ratio for Unmarried vs Married when averaged over the interaction cells (SEX)=2.185. This value is midway between that for males and females.

Next, we present the model-adjusted risks (via predicted marginal proportions) for the cross-classification of sex-by-marital status. Note that the values in parentheses and the ADJRR option are related to estimating risk ratios and are not needed to produce marginals.

```
PREDMARG SEX(1)*MARRY_3(1) / adjrr;
PREDMARG SEX(2)*MARRY_3(1) / adjrr;
```
Exhibit 7.  Predicted Marginal Proportions (Model-Adjusted Risks)

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable CANTAFMEDS: Can't Afford Meds Past 12m
For Subpopulation: WHITES AGED 25+

Modelling Can’t Afford Rx Meds (Interaction Model)

by: Predicted Marginal #1.

<table>
<thead>
<tr>
<th>Predicted Marginal #1</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
<th>T:Marg=0</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREDMARG</td>
<td>SE</td>
<td>Limit</td>
<td>Limit</td>
<td>T:Marg=0</td>
</tr>
<tr>
<td>Sex, MARRY_3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Male, 1-Married</td>
<td>0.0476</td>
<td>0.0401</td>
<td>0.0564</td>
<td>11.51</td>
</tr>
<tr>
<td>1-Male, 2-Widowed</td>
<td>0.0944</td>
<td>0.0537</td>
<td>0.1608</td>
<td>3.57</td>
</tr>
<tr>
<td>1-Male, 3-Unmarried</td>
<td>0.0839</td>
<td>0.0720</td>
<td>0.0974</td>
<td>13.04</td>
</tr>
<tr>
<td>2-Female, 1-Married</td>
<td>0.0684</td>
<td>0.0608</td>
<td>0.0769</td>
<td>16.81</td>
</tr>
<tr>
<td>2-Female, 2-Widowed</td>
<td>0.0869</td>
<td>0.0640</td>
<td>0.1171</td>
<td>6.51</td>
</tr>
<tr>
<td>2-Female, 3-Unmarried</td>
<td>0.1543</td>
<td>0.1404</td>
<td>0.1693</td>
<td>21.05</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

Exhibit 7 suggests that the risk for not being able to afford prescription medicine is higher in general among females than males. Both sexes show increases in risk for Widowed and Unmarried vs. Married. The significant interaction appears to result from a larger marital status effect in females vs. males.

Exhibit 7 also contains the 95% confidence limits for the predictive margins. The non-overlapping confidence intervals for Unmarried vs. Married points to significant differences between these groups.
Next, we present the model-adjusted risk ratios. The ADJRR option on the PREDMARG statement computes the ratio of predicted marginal proportions (model-adjusted risk ratio) for each marital status group (2=Widowed, 3=Unmarried) compared to the user-specified reference level (1=Married), separately for males and females. Note that the REFLEVEL statement has no effect in determining reference levels for risk ratios. Reference levels for risk ratios are by default the last level of each variable, unless a different level is specified in parentheses by the user. We specified MARRY_3(1) (i.e., married) to be the reference cell in each case.

**Exhibit 8. Model-Adjusted Risk Ratios (Reference Cell=Male)**

<table>
<thead>
<tr>
<th>Predicted Marginal Risk Ratio #1</th>
<th>PREDMARG Risk Ratio</th>
<th>Lower 95% Limit</th>
<th>Upper 95% Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARRY_3=1=Married</td>
<td>1.437</td>
<td>1.171</td>
<td>1.764</td>
</tr>
<tr>
<td>SEX: 2=Female vs. 1=Male</td>
<td>1.271</td>
<td>1.119</td>
<td>1.426</td>
</tr>
<tr>
<td>MARRY_3: 2=Widowed vs. 1=Married</td>
<td>1.762</td>
<td>1.426</td>
<td>2.176</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

The last line in each table is of main interest in this example. The estimated risk ratio for Unmarried vs. Married is 1.76 for males, 2.26 for females. These values are similar to the odds ratios in this example.

**Exhibit 9. Model-Adjusted Risk Ratios (Reference Cell=Female)**

<table>
<thead>
<tr>
<th>Predicted Marginal Risk Ratio #2</th>
<th>PREDMARG Risk Ratio</th>
<th>Lower 95% Limit</th>
<th>Upper 95% Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARRY_3=1=Married</td>
<td>0.696</td>
<td>0.567</td>
<td>0.854</td>
</tr>
<tr>
<td>SEX: 1=Male vs. 2=Female</td>
<td>1.271</td>
<td>0.927</td>
<td>1.743</td>
</tr>
<tr>
<td>MARRY_3: 2=Widowed vs. 1=Married</td>
<td>2.256</td>
<td>1.953</td>
<td>2.606</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)
Again, we see that the effect of Unmarried vs. Married is greater for females than for males. Unmarried white women over 25 yrs of age are more than twice as likely as Married white women to have difficulty affording prescription medicine. At the same time, Married white men over 25 yrs of age are less than twice as likely as Unmarried white men to incur the event.

The first two PRED_EFF statements compute the difference in predicted marginal proportions (risk differences) for Unmarried vs. Married adults, separately for males and females. The third PRED_EFF statement computes the difference of differences—to determine if the marriage effect for males is significantly different from the marriage effect for females.

```
PRED_EFF SEX=(1 0)*MARRY_3=(-1 0 1) / name="Unmarried vs Married, Males";
PRED_EFF SEX=(0 1)*MARRY_3=(-1 0 1) / name="Unmarried vs Married, Females"
PRED_EFF SEX=(1 -1)*MARRY_3=(-1 0 1) / name="Unmarried vs Married, M vs F"
```

**Exhibit 10.  Risk Differences (Unmarried vs. Married, Males)**

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable CANTAFMEDS: Can't Afford Meds Past 12m
For Subpopulation: WHITES AGED 25+

Modelling Can't Afford Rx Meds (Interaction Model)

<table>
<thead>
<tr>
<th>Contrasted Predicted Marginal #1</th>
<th>PREDMARG</th>
<th>SE</th>
<th>T-Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmarried vs Married, Males</td>
<td>0.0363</td>
<td>0.0071</td>
<td>5.08</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

The above output (Exhibit 10) is the estimated risk difference for males. There is an absolute difference in risk of 3.63% \( (p=0.0000) \) for Unmarried vs. Married males.
**Exhibit 11. Risk Differences (Unmarried vs. Married, Females)**

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable CANTAFMEDS: Can't Afford Meds Past 12m
For Subpopulation: WHITES AGED 25+
Modelling Can’t Afford Rx Meds (Interaction Model)

by: Contrasted Predicted Marginal #2.

<table>
<thead>
<tr>
<th>Contrast</th>
<th>SE</th>
<th>T-Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmarried vs Married, Females</td>
<td>0.0081</td>
<td>10.59</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

The above output (*Exhibit 11*) is the estimated risk difference for females. There is an absolute difference in risk of 8.59% for Unmarried vs. Married females ($p=0.0000$). So the estimated risk difference for Unmarried vs. Married is higher among females (8.59%) than among males (3.63%).

**Exhibit 12. Risk Differences (Marriage Effect, Males vs. Females)**

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable CANTAFMEDS: Can't Afford Meds Past 12m
For Subpopulation: WHITES AGED 25+
Modelling Can’t Afford Rx Meds (Interaction Model)

by: Contrasted Predicted Marginal #3.

<table>
<thead>
<tr>
<th>Contrast</th>
<th>SE</th>
<th>T-Stat</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmarried vs Married, M vs F</td>
<td>0.0107</td>
<td>-4.64</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Data Source: NCHS National Health Interview Survey (2006)

The above output (*Exhibit 12*) is the estimated difference of risk differences—that is, the marriage effect (Unmarried vs. Married) for males minus females. The difference of differences is computed from 3.63% - 8.59% = -4.97% ($p=0.0000$). So the marriage effect on the risk of not being able to afford prescription medications in the past year is significantly higher in females compared to males.