SAS Analysis Examples Replication C9

* SAS Analysis Examples Replication for ASDA 2nd Edition
* Berglund April 2017
* Chapter 9 ;
libname ncsr "P:\ASDA 2\Data sets\ncsr";
data c9_ncsr;
set ncsr.ncsr_sub_13nov2015;
run;
proc format;
value af 1='18-29' 2='30-44' 3='45-59' 4='60+';
value sf 1='M' 2='F';
value edf 1='0-11' 2='12' 3='13-15' 4='16+';
value mf 1='Currently Married' 2='Previously Married' 3='Never Married';
value yn 1='Yes' 0='No';
run;
ods rtf style=normalprinter bodytitle;
title "Example 9.2.6 Multinomial logistic regression using NCSR data.";
proc surveylogistic;
strata sestrat; cluster seclustr; weight ncsrwtlg;
class wkstat3c (ref=first) sex (ref=last) ed4cat (ref=first) ag4cat (ref=first) mar3cat (ref=first) / param=ref;
model wkstat3c=sex al ad mde ed4cat ag4cat mar3cat / link=glogit;
run;
* Figure 9.4, this cannot be done directly in SAS PROC SURVEYLOGISTIC, see SAS Technical Support paper here for details on approach:
https://support.sas.com/kb/22/604.html;
title "GOF test not available in SAS SURVEYLOGISTIC";
libname d 'P:\asda 2\data sets\ess6 russia';
title "9.3.6 Example: Fitting a Cumulative Logit Regression Model to Complex Sample Survey Data";
data c9_russia;
set d.ess6_russia_2aug2016;
if stflife = . then stflife2 = .;
else if stflife = 0 or stflife = -1 then stflife2 = 1;
else if stflife <= 4 then stflife2 = 2;
else if stflife <= 5 then stflife2 = 3;
else if stflife <= 8 then stflife2 = 4;
else if stflife <= 10 then stflife2 = 5;
run;
title "Figure 9.6, Bar Chart of Satisfaction with Life, Weighted by PSPWGHT";
proc freq data=c9_russia;
tables stflife2 / plots=freqplot;
weight pspwgght;
run;
title "Numbers for Table 9.5 and 9.6 ";
* Note use of descending option for dependent variable, so this matches Stata output;
proc surveylogistic data=c9_russia;
strata stratify; cluster psu; weight pspwgght;
class agecat (ref=first) marcat (ref=first) / param=ref;
model stflife2 (descending) = agecat marcat male;
run;
ods text="No Design-Adjusted GOF test for Ordinal Logistic Regression in SAS";
title "9.4.7 Example: Fitting Poisson and Negative Binomial Regression Models to Complex Sample Survey Data";
ods text="SURVEY PROCEDURES do not include POISSON, NEGATIVE BINOMIAL OR ZERO-INFLATED NB MODELS, see website for user written SAS macros for these models";
libname d2 'p:\asda 2\data sets\hrs 2012 ';
data c9_hrs;
set d2.hrs_sub_28sep2016;
run;
proc univariate data=c9_hrs;
var numfalls24;
where age65p=1;
run;
proc univariate data=c9_hrs;
var numfalls24;
where age65p=1 and numfalls24 >=1;
run;
ods rtf close;
Example 9.2.6  Multinomial logistic regression using NCSR data.

The SURVEYLOGISTIC Procedure

<table>
<thead>
<tr>
<th>Model Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Set</td>
</tr>
<tr>
<td>Response Variable</td>
</tr>
<tr>
<td>Number of Response Levels</td>
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<tr>
<td>Stratum Variable</td>
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<tr>
<td>Number of Strata</td>
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<tr>
<td>Cluster Variable</td>
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<td>Number of Clusters</td>
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<td>Weight Variable</td>
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<tr>
<td>Model</td>
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<tr>
<td>Optimization Technique</td>
</tr>
<tr>
<td>Variance Adjustment</td>
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</table>

<table>
<thead>
<tr>
<th>Variance Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method</td>
</tr>
<tr>
<td>Variance Adjustment</td>
</tr>
</tbody>
</table>

| Number of Observations Read | 9282 |
| Number of Observations Used | 5679 |
| Sum of Weights Read         | 5692 |
| Sum of Weights Used         | 5667.185 |

<table>
<thead>
<tr>
<th>Response Profile</th>
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<tbody>
<tr>
<td>Ordered Value</td>
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<td>------------------</td>
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<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

Logits modeled use WKSTAT3C=1 as the reference category.

Note: 2649 observations were deleted due to missing values for the response or explanatory variables.

Note: 954 observations having nonpositive frequencies or weights were excluded since they do not contribute to the analysis.

<table>
<thead>
<tr>
<th>Class Level Information</th>
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<tbody>
<tr>
<td>Class Value Design Variables</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>ED4CAT</td>
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<tr>
<td></td>
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<tr>
<td>MAR3CAT</td>
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<td></td>
</tr>
</tbody>
</table>
Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

<table>
<thead>
<tr>
<th>Model Fit Statistics</th>
<th>Intercept Only</th>
<th>Intercept and Covariates</th>
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<tbody>
<tr>
<td>AIC</td>
<td>9011.140</td>
<td>7399.903</td>
</tr>
<tr>
<td>SC</td>
<td>9024.425</td>
<td>7559.322</td>
</tr>
<tr>
<td>-2 Log L</td>
<td>9007.140</td>
<td>7351.903</td>
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</table>

Testing Global Null Hypothesis: BETA=0

<table>
<thead>
<tr>
<th>Test</th>
<th>F Value</th>
<th>Num DF</th>
<th>Den DF</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood Ratio</td>
<td>78.21</td>
<td>12.6078</td>
<td>529.53</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Score</td>
<td>29.89</td>
<td>22</td>
<td>21</td>
<td>&lt;.0001</td>
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<tr>
<td>Wald</td>
<td>73.62</td>
<td>22</td>
<td>21</td>
<td>&lt;.0001</td>
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</table>

NOTE: Second-order Rao-Scott design correction 0.7450 applied to the Likelihood Ratio test.

Type 3 Analysis of Effects

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<th>Num DF</th>
<th>Den DF</th>
<th>Pr &gt; F</th>
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<td>41</td>
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<td>ald</td>
<td>5.03</td>
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<td>41</td>
<td>0.0111</td>
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<td>1.13</td>
<td>2</td>
<td>41</td>
<td>0.3316</td>
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<td>37</td>
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<td>6</td>
<td>37</td>
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<td>24.72</td>
<td>4</td>
<td>39</td>
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Analysis of Maximum Likelihood Estimates

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<tr>
<th>Parameter</th>
<th>WKSTAT3C</th>
<th>Estimate</th>
<th>Standard Error</th>
<th>t Value</th>
<th>Pr &gt;</th>
<th>t</th>
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<tbody>
<tr>
<td>Intercept</td>
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<td>-0.6438</td>
<td>0.2967</td>
<td>-2.17</td>
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<td>Intercept</td>
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<td>0.1103</td>
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<td>0.0650</td>
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<td>0.38</td>
<td>0.7062</td>
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<td>1.8284</td>
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<tr>
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<td>-0.5899</td>
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<td>0.5528</td>
<td>0.1326</td>
<td>4.17</td>
<td>0.0002</td>
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</tr>
</tbody>
</table>
### Analysis of Maximum Likelihood Estimates

| Parameter | WKSTAT3C | Estimate | Standard Error | t Value | Pr > |t| |
|-----------|----------|----------|----------------|---------|-------|---|
|           |          |          |                |         |       |   |

NOTE: The degrees of freedom for the t tests is 42.

### Odds Ratio Estimates

<table>
<thead>
<tr>
<th>Effect</th>
<th>WKSTAT3C</th>
<th>Point Estimate</th>
<th>95% Confidence Limits</th>
</tr>
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<tbody>
<tr>
<td>SEX 1 vs 2</td>
<td>2</td>
<td>0.248</td>
<td>0.166 0.370</td>
</tr>
<tr>
<td>SEX 1 vs 3</td>
<td>3</td>
<td>0.527</td>
<td>0.422 0.659</td>
</tr>
<tr>
<td>ald 2</td>
<td></td>
<td>0.849</td>
<td>0.412 1.747</td>
</tr>
<tr>
<td>ald 3</td>
<td></td>
<td>1.395</td>
<td>1.072 1.816</td>
</tr>
<tr>
<td>mde 2</td>
<td></td>
<td>0.870</td>
<td>0.633 1.195</td>
</tr>
<tr>
<td>mde 3</td>
<td></td>
<td>1.104</td>
<td>0.924 1.318</td>
</tr>
<tr>
<td>ED4CAT 2 vs 1</td>
<td>2</td>
<td>0.429</td>
<td>0.266 0.690</td>
</tr>
<tr>
<td>ED4CAT 2 vs 3</td>
<td>3</td>
<td>0.521</td>
<td>0.392 0.693</td>
</tr>
<tr>
<td>ED4CAT 3 vs 1</td>
<td>2</td>
<td>0.255</td>
<td>0.152 0.430</td>
</tr>
<tr>
<td>ED4CAT 3 vs 3</td>
<td>3</td>
<td>0.400</td>
<td>0.297 0.538</td>
</tr>
<tr>
<td>ED4CAT 4 vs 1</td>
<td>2</td>
<td>0.177</td>
<td>0.095 0.332</td>
</tr>
<tr>
<td>ED4CAT 4 vs 3</td>
<td>3</td>
<td>0.292</td>
<td>0.212 0.404</td>
</tr>
<tr>
<td>ag4cat 2 vs 1</td>
<td>2</td>
<td>0.426</td>
<td>0.235 0.774</td>
</tr>
<tr>
<td>ag4cat 2 vs 3</td>
<td>3</td>
<td>0.729</td>
<td>0.562 0.946</td>
</tr>
<tr>
<td>ag4cat 3 vs 1</td>
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<td>0.433</td>
<td>0.257 0.729</td>
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<td>6.224</td>
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<tr>
<td>ag4cat 4 vs 3</td>
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<td>10.811</td>
<td>7.614 15.352</td>
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<tr>
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<tr>
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<tr>
<td>MAR3CAT 3 vs 3</td>
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<td>1.738</td>
<td>1.330 2.272</td>
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</table>

NOTE: The degrees of freedom in computing the confidence limits is 42.
Figure 9.6, Bar Chart of Satisfaction with Life, Weighted by PSPWGHT

The FREQ Procedure

<table>
<thead>
<tr>
<th>stlife2</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Frequency</th>
<th>Cumulative Percent</th>
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<tbody>
<tr>
<td>1</td>
<td>111.1011</td>
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<td>111.1011</td>
<td>4.52</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>1041.598</td>
<td>42.41</td>
<td>2158.176</td>
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<tr>
<td>5</td>
<td>298.0937</td>
<td>12.14</td>
<td>2456.27</td>
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</table>

Frequency Missing = 27.729974041

Distribution of stlife2
Numbers for Table 9.5 and 9.6

The SURVEYLOGISTIC Procedure

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<tr>
<th>Model Information</th>
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<tr>
<td>Data Set</td>
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<tr>
<td>Stratum Variable</td>
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<td>Number of Strata</td>
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<td>Cluster Variable</td>
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<td>Optimization Technique</td>
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<td>Variance Adjustment</td>
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<table>
<thead>
<tr>
<th>Variance Estimation</th>
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<tbody>
<tr>
<td>Method</td>
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<td>Variance Adjustment</td>
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<table>
<thead>
<tr>
<th>Number of Observations Read</th>
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</tr>
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<td>Sum of Weights Read</td>
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</tr>
<tr>
<td>Sum of Weights Used</td>
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</table>

<table>
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<th>Response Profile</th>
</tr>
</thead>
<tbody>
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<td>Ordered Value</td>
</tr>
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<td>3</td>
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<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
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</table>

Probabilities modeled are cumulated over the lower Ordered Values.

Note: 69 observations were deleted due to missing values for the response or explanatory variables.

<table>
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<th>Class Level Information</th>
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<tr>
<td>2</td>
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</table>

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

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<th>Score Test for the Proportional Odds Assumption</th>
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### Score Test for the Proportional Odds Assumption

<table>
<thead>
<tr>
<th>Chi-Square</th>
<th>DF</th>
<th>Pr &gt; ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.4126</td>
<td>18</td>
<td>0.2142</td>
</tr>
</tbody>
</table>

### Model Fit Statistics

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Intercept Only</th>
<th>Intercept and Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIC</td>
<td>6827.069</td>
<td>6766.264</td>
</tr>
<tr>
<td>SC</td>
<td>6850.238</td>
<td>6824.188</td>
</tr>
<tr>
<td>-2 Log L</td>
<td>6819.069</td>
<td>6746.264</td>
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### Testing Global Null Hypothesis: BETA=0

<table>
<thead>
<tr>
<th>Test</th>
<th>F Value</th>
<th>Num DF</th>
<th>Den DF</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood Ratio</td>
<td>11.25</td>
<td>5.6214</td>
<td>989.37</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Score</td>
<td>8.33</td>
<td>6</td>
<td>171</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Wald</td>
<td>7.60</td>
<td>6</td>
<td>171</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

**NOTE:** Second-order Rao-Scott design correction 0.0673 applied to the Likelihood Ratio test.

### Type 3 Analysis of Effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>F Value</th>
<th>Num DF</th>
<th>Den DF</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>agecat</td>
<td>9.94</td>
<td>3</td>
<td>174</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>marcat</td>
<td>2.18</td>
<td>2</td>
<td>175</td>
<td>0.1166</td>
</tr>
<tr>
<td>male</td>
<td>1.33</td>
<td>1</td>
<td>176</td>
<td>0.2509</td>
</tr>
</tbody>
</table>

### Analysis of Maximum Likelihood Estimates

| Parameter | Estimate | Standard Error | t Value | Pr > |t| |
|-----------|----------|----------------|---------|------|---|
| Intercept 5 | -1.3841  | 0.1575          | -8.79   | <.0001 |
| Intercept 4 | 0.8348   | 0.1643          | 5.08    | <.0001 |
| Intercept 3 | 1.7928   | 0.1713          | 10.47   | <.0001 |
| Intercept 2 | 3.7111   | 0.2176          | 17.05   | <.0001 |
| agecat 2   | -0.5293  | 0.1392          | -3.80   | 0.0002 |
| agecat 3   | -0.7455  | 0.1463          | -5.10   | <.0001 |
| agecat 4   | -0.8081  | 0.1661          | -4.86   | <.0001 |
| marcat 2   | -0.2089  | 0.1049          | -1.99   | 0.0480 |
| marcat 3   | -0.1372  | 0.1349          | -1.02   | 0.3105 |
| male       | -0.1096  | 0.0952          | -1.15   | 0.2509 |

**NOTE:** The degrees of freedom for the t tests is 176.

### Odds Ratio Estimates

<table>
<thead>
<tr>
<th>Effect</th>
<th>Point Estimate</th>
<th>95% Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>agecat 2 vs 1</td>
<td>0.589</td>
<td>0.448 0.775</td>
</tr>
<tr>
<td>agecat 3 vs 1</td>
<td>0.474</td>
<td>0.356 0.633</td>
</tr>
<tr>
<td>agecat 4 vs 1</td>
<td>0.446</td>
<td>0.321 0.619</td>
</tr>
<tr>
<td>marcat 2 vs 1</td>
<td>0.811</td>
<td>0.660 0.998</td>
</tr>
<tr>
<td>marcat 3 vs 1</td>
<td>0.872</td>
<td>0.668 1.138</td>
</tr>
<tr>
<td>male</td>
<td>0.896</td>
<td>0.743 1.081</td>
</tr>
</tbody>
</table>

**NOTE:** The degrees of freedom in computing the confidence limits is 176.
No Design-Adjusted GOF test for Ordinal Logistic Regression in SAS

SURVEY PROCEDURES do not include POISSON, NEGATIVE BINOMIAL OR ZERO-INFLATED NB MODELS, see website for user written SAS macros for these models
9.4.7 Example: Fitting Poisson and Negative Binomial Regression Models to Complex Sample Survey Data, NOT AVAILABLE IN SAS SURVEY PROCEDURES

The UNIVARIATE Procedure
Variable: numfalls24  (Number of Falls Past 2 Years)

<table>
<thead>
<tr>
<th>Moments</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>10594</td>
<td>Sum Weights 10594</td>
</tr>
<tr>
<td>Mean</td>
<td>1.19124032</td>
<td>Sum Observations 12620</td>
</tr>
<tr>
<td>Std Deviation</td>
<td>3.3183257</td>
<td>Variance 11.0112855</td>
</tr>
<tr>
<td>Skewness</td>
<td>7.98181453</td>
<td>Kurtosis 90.9991099</td>
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<tr>
<td>Uncorrected SS</td>
<td>131676</td>
<td>Corrected SS 116642.547</td>
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<tr>
<td>Coeff Variation</td>
<td>278.560559</td>
<td>Std Error Mean 0.03223955</td>
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<table>
<thead>
<tr>
<th>Basic Statistical Measures</th>
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<tbody>
<tr>
<td>Location</td>
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<tr>
<td>Mean</td>
</tr>
<tr>
<td>Median</td>
</tr>
<tr>
<td>Mode</td>
</tr>
<tr>
<td>Interquartile Range</td>
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</table>

<table>
<thead>
<tr>
<th>Tests for Location: Mu=0</th>
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<tr>
<td>Test</td>
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<tr>
<td>Student's t</td>
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<td>Signed Rank</td>
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<tr>
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<tr>
<td>95%</td>
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<tr>
<td>90%</td>
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<tr>
<td>75% Q3</td>
</tr>
<tr>
<td>50% Median</td>
</tr>
<tr>
<td>25% Q1</td>
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<tr>
<td>10%</td>
</tr>
<tr>
<td>5%</td>
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<tr>
<td>1%</td>
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<tr>
<td>0% Min</td>
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<table>
<thead>
<tr>
<th>Extreme Observations</th>
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<tbody>
<tr>
<td>Lowest</td>
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<td>Value</td>
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<table>
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<tr>
<th>Missing Values</th>
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<tbody>
<tr>
<td>Missing Value</td>
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</tbody>
</table>
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The UNIVARIATE Procedure

Variable: numfalls24 (Number of Falls Past 2 Years)

<table>
<thead>
<tr>
<th>Moments</th>
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<tbody>
<tr>
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<td>Sum Weights 3835</td>
</tr>
<tr>
<td>Mean</td>
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<tr>
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<td>Coeff Variation</td>
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<table>
<thead>
<tr>
<th>Basic Statistical Measures</th>
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<td>Location</td>
<td>Variability</td>
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<th>Tests for Location: Mu0=0</th>
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<th>p Value</th>
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<tbody>
<tr>
<td>Student's t</td>
<td>t</td>
<td>Pr &gt;</td>
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<tr>
<td>Sign</td>
<td>M</td>
<td>Pr &gt;=</td>
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<tr>
<td>Signed Rank</td>
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<td>Pr &gt;=</td>
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<table>
<thead>
<tr>
<th>Quantiles (Definition 5)</th>
<th>Level</th>
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<tbody>
<tr>
<td>100% Max</td>
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<tr>
<td>0% Min</td>
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<table>
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<tr>
<th>Extreme Observations</th>
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