# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 1. Table 13.5, but with unstructured working correlation

## The GENMOD Procedure

| Model Information | | |
|---|---|---|
| **Data Set** | WORK.A | |
| **Distribution** | Binomial | |
| **Link Function** | Logit | |
| **Dependent Variable** | obesity | Obesity (0=no, 1=yes) |

| | |
|---|---|
| **Number of Observations Read** | 9856 |
| **Number of Observations Used** | 9856 |
| **Number of Events** | 2112 |
| **Number of Trials** | 9856 |

| Class Level Information | | |
|---|---|---|
| **Class** | **Levels** | **Values** |
| **id** | 4856 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 ... |
| **occasion** | 3 | 1 2 3 |

| Response Profile | | |
|---|---|---|
| **Ordered Value** | **obesity** | **Total Frequency** |
| **1** | 1 | 2112 |
| **2** | 0 | 7744 |

## PROC GENMOD is modeling the probability that obesity='1'.

| Parameter Information | |
|---|---|
| **Parameter** | **Effect** |
| **Prm1** | Intercept |
| **Prm2** | gender |
| **Prm3** | cage |
| **Prm4** | cage2 |
| **Prm5** | cage3 |

Algorithm converged.

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 1. Table 13.5, but with unstructured working correlation

## The GENMOD Procedure

| GEE Model Information | |
|---|---|
| **Correlation Structure** | Unstructured |
| **Within-Subject Effect** | occasion (3 levels) |
| **Subject Effect** | id (4856 levels) |
| **Number of Clusters** | 4856 |
| **Correlation Matrix Dimension** | 3 |
| **Maximum Cluster Size** | 3 |
| **Minimum Cluster Size** | 1 |

Algorithm converged.

| Working Correlation Matrix | | | |
|---|---|---|---|
| | **Col1** | **Col2** | **Col3** |
| **Row1** | 1.0000 | 0.6021 | 0.4738 |
| **Row2** | 0.6021 | 1.0000 | 0.5430 |
| **Row3** | 0.4738 | 0.5430 | 1.0000 |

| GEE Fit Criteria | |
|---|---|
| QIC | 10192.5339 |
| QICu | 10191.1758 |

| Analysis Of GEE Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Empirical Standard Error Estimates | | | | | | |
| **Parameter** | **Estimate** | **Standard Error** | **95% Confidence Limits** | | **Z** | **Pr > \|Z\|** |
| **Intercept** | -1.2236 | 0.0477 | -1.3170 | -1.1302 | -25.68 | <.0001 |
| **gender** | 0.1424 | 0.0626 | 0.0197 | 0.2652 | 2.27 | 0.0230 |
| **cage** | 0.0079 | 0.0144 | -0.0204 | 0.0362 | 0.55 | 0.5852 |
| **cage2** | -0.0165 | 0.0024 | -0.0212 | -0.0119 | -6.95 | <.0001 |
| **cage3** | 0.0018 | 0.0006 | 0.0006 | 0.0030 | 2.97 | 0.0030 |

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 2. Table 13.5, but with AR(1) working correlation

## The GENMOD Procedure

| Model Information | | |
|---|---|---|
| **Data Set** | WORK.A | |
| **Distribution** | Binomial | |
| **Link Function** | Logit | |
| **Dependent Variable** | obesity | Obesity (0=no, 1=yes) |

| | |
|---|---|
| **Number of Observations Read** | 9856 |
| **Number of Observations Used** | 9856 |
| **Number of Events** | 2112 |
| **Number of Trials** | 9856 |

| Class Level Information | | |
|---|---|---|
| **Class** | **Levels** | **Values** |
| **id** | 4856 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 ... |
| **occasion** | 3 | 1 2 3 |

| Response Profile | | |
|---|---|---|
| **Ordered Value** | **obesity** | **Total Frequency** |
| **1** | 1 | 2112 |
| **2** | 0 | 7744 |

## PROC GENMOD is modeling the probability that obesity='1'.

| Parameter Information | |
|---|---|
| **Parameter** | **Effect** |
| **Prm1** | Intercept |
| **Prm2** | gender |
| **Prm3** | cage |
| **Prm4** | cage2 |
| **Prm5** | cage3 |

Algorithm converged.

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 2. Table 13.5, but with AR(1) working correlation

## The GENMOD Procedure

| GEE Model Information | |
|---|---|
| **Correlation Structure** | AR(1) |
| **Within-Subject Effect** | occasion (3 levels) |
| **Subject Effect** | id (4856 levels) |
| **Number of Clusters** | 4856 |
| **Correlation Matrix Dimension** | 3 |
| **Maximum Cluster Size** | 3 |
| **Minimum Cluster Size** | 1 |

Algorithm converged.

| Working Correlation Matrix | | | |
|---|---|---|---|
| | **Col1** | **Col2** | **Col3** |
| **Row1** | 1.0000 | 0.5719 | 0.3270 |
| **Row2** | 0.5719 | 1.0000 | 0.5719 |
| **Row3** | 0.3270 | 0.5719 | 1.0000 |

| GEE Fit Criteria | |
|---|---|
| QIC | 10191.9803 |
| QICu | 10190.4539 |

| Analysis Of GEE Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Empirical Standard Error Estimates | | | | | | |
| **Parameter** | **Estimate** | **Standard Error** | **95% Confidence Limits** | | **Z** | **Pr > \|Z\|** |
| **Intercept** | -1.2162 | 0.0478 | -1.3100 | -1.1224 | -25.42 | <.0001 |
| **gender** | 0.1309 | 0.0628 | 0.0077 | 0.2540 | 2.08 | 0.0372 |
| **cage** | 0.0080 | 0.0146 | -0.0207 | 0.0366 | 0.54 | 0.5863 |
| **cage2** | -0.0170 | 0.0024 | -0.0218 | -0.0123 | -7.05 | <.0001 |
| **cage3** | 0.0017 | 0.0006 | 0.0005 | 0.0029 | 2.74 | 0.0061 |

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 3. Table 13.5, but with exchangeable working correlation

## The GENMOD Procedure

| Model Information | | |
|---|---|---|
| **Data Set** | WORK.A | |
| **Distribution** | Binomial | |
| **Link Function** | Logit | |
| **Dependent Variable** | obesity | Obesity (0=no, 1=yes) |

| | |
|---|---|
| **Number of Observations Read** | 9856 |
| **Number of Observations Used** | 9856 |
| **Number of Events** | 2112 |
| **Number of Trials** | 9856 |

| Class Level Information | | |
|---|---|---|
| **Class** | **Levels** | **Values** |
| **id** | 4856 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 ... |
| **occasion** | 3 | 1 2 3 |

| Response Profile | | |
|---|---|---|
| **Ordered Value** | **obesity** | **Total Frequency** |
| **1** | 1 | 2112 |
| **2** | 0 | 7744 |

## PROC GENMOD is modeling the probability that obesity='1'.

| Parameter Information | |
|---|---|
| **Parameter** | **Effect** |
| **Prm1** | Intercept |
| **Prm2** | gender |
| **Prm3** | cage |
| **Prm4** | cage2 |
| **Prm5** | cage3 |

Algorithm converged.

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 3. Table 13.5, but with exchangeable working correlation

## The GENMOD Procedure

| GEE Model Information | |
|---|---|
| **Correlation Structure** | Exchangeable |
| **Within-Subject Effect** | occasion (3 levels) |
| **Subject Effect** | id (4856 levels) |
| **Number of Clusters** | 4856 |
| **Correlation Matrix Dimension** | 3 |
| **Maximum Cluster Size** | 3 |
| **Minimum Cluster Size** | 1 |

Algorithm converged.

| Working Correlation Matrix | | | |
|---|---|---|---|
| | **Col1** | **Col2** | **Col3** |
| **Row1** | 1.0000 | 0.5432 | 0.5432 |
| **Row2** | 0.5432 | 1.0000 | 0.5432 |
| **Row3** | 0.5432 | 0.5432 | 1.0000 |

| Exchangeable Working Correlation | |
|---|---|
| **Correlation** | 0.543209873 |

| GEE Fit Criteria | |
|---|---|
| QIC | 10192.6644 |
| QICu | 10191.2972 |

| Analysis Of GEE Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Empirical Standard Error Estimates | | | | | | |
| **Parameter** | **Estimate** | **Standard Error** | **95% Confidence Limits** | | **Z** | **Pr > \|Z\|** |
| **Intercept** | -1.2219 | 0.0477 | -1.3153 | -1.1285 | -25.63 | <.0001 |
| **gender** | 0.1466 | 0.0627 | 0.0238 | 0.2695 | 2.34 | 0.0193 |
| **cage** | 0.0065 | 0.0144 | -0.0218 | 0.0348 | 0.45 | 0.6517 |
| **cage2** | -0.0167 | 0.0024 | -0.0214 | -0.0121 | -7.05 | <.0001 |
| **cage3** | 0.0019 | 0.0006 | 0.0007 | 0.0031 | 3.09 | 0.0020 |

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 4. Table 13.5, but with independence working correlation

## The GENMOD Procedure

| Model Information | | |
|---|---|---|
| **Data Set** | WORK.A | |
| **Distribution** | Binomial | |
| **Link Function** | Logit | |
| **Dependent Variable** | obesity | Obesity (0=no, 1=yes) |

| | |
|---|---|
| **Number of Observations Read** | 9856 |
| **Number of Observations Used** | 9856 |
| **Number of Events** | 2112 |
| **Number of Trials** | 9856 |

| Class Level Information | | |
|---|---|---|
| **Class** | **Levels** | **Values** |
| **id** | 4856 | 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 ... |
| **occasion** | 3 | 1 2 3 |

| Response Profile | | |
|---|---|---|
| **Ordered Value** | **obesity** | **Total Frequency** |
| **1** | 1 | 2112 |
| **2** | 0 | 7744 |

## PROC GENMOD is modeling the probability that obesity='1'.

| Parameter Information | |
|---|---|
| **Parameter** | **Effect** |
| **Prm1** | Intercept |
| **Prm2** | gender |
| **Prm3** | cage |
| **Prm4** | cage2 |
| **Prm5** | cage3 |

Algorithm converged.

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 4. Table 13.5, but with independence working correlation

## The GENMOD Procedure

| GEE Model Information | |
|---|---|
| **Correlation Structure** | Independent |
| **Within-Subject Effect** | occasion (3 levels) |
| **Subject Effect** | id (4856 levels) |
| **Number of Clusters** | 4856 |
| **Correlation Matrix Dimension** | 3 |
| **Maximum Cluster Size** | 3 |
| **Minimum Cluster Size** | 1 |

Algorithm converged.

| Working Correlation Matrix | | | |
|---|---|---|---|
| | **Col1** | **Col2** | **Col3** |
| **Row1** | 1.0000 | 0.0000 | 0.0000 |
| **Row2** | 0.0000 | 1.0000 | 0.0000 |
| **Row3** | 0.0000 | 0.0000 | 1.0000 |

| GEE Fit Criteria | |
|---|---|
| QIC | 10192.6448 |
| QICu | 10188.9577 |

| Analysis Of GEE Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Empirical Standard Error Estimates | | | | | | |
| **Parameter** | **Estimate** | **Standard Error** | **95% Confidence Limits** | | **Z** | **Pr > \|Z\|** |
| **Intercept** | -1.2245 | 0.0509 | -1.3242 | -1.1248 | -24.07 | <.0001 |
| **gender** | 0.1252 | 0.0650 | -0.0022 | 0.2527 | 1.93 | 0.0541 |
| **cage** | -0.0080 | 0.0168 | -0.0409 | 0.0249 | -0.48 | 0.6327 |
| **cage2** | -0.0173 | 0.0029 | -0.0230 | -0.0117 | -6.00 | <.0001 |
| **cage3** | 0.0021 | 0.0007 | 0.0007 | 0.0035 | 2.94 | 0.0033 |

## mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 4. Table 13.5, but with independence working correlation

### The GENMOD Procedure

| Analysis Of GEE Parameter Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Model-Based Standard Error Estimates | | | | | | |
| Parameter | Estimate | Standard Error | 95% Confidence Limits | | Z | Pr > \|Z\| |
| **Intercept** | -1.2245 | 0.0410 | -1.3049 | -1.1440 | -29.84 | <.0001 |
| **gender** | 0.1252 | 0.0493 | 0.0287 | 0.2218 | 2.54 | 0.0110 |
| **cage** | -0.0080 | 0.0168 | -0.0410 | 0.0250 | -0.48 | 0.6338 |
| **cage2** | -0.0173 | 0.0028 | -0.0228 | -0.0119 | -6.23 | <.0001 |
| **cage3** | 0.0021 | 0.0008 | 0.0006 | 0.0037 | 2.67 | 0.0075 |
| **Scale** | 1.0000 | . | . | . | . | . |

**Note:** The scale parameter was held fixed.

# mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 5. Table 13.5, ignoring correlation (no empirical SE estimates)

## The GENMOD Procedure

| Model Information | | |
|---|---|---|
| **Data Set** | WORK.A | |
| **Distribution** | Binomial | |
| **Link Function** | Logit | |
| **Dependent Variable** | obesity | Obesity (0=no, 1=yes) |

| | |
|---|---|
| **Number of Observations Read** | 9856 |
| **Number of Observations Used** | 9856 |
| **Number of Events** | 2112 |
| **Number of Trials** | 9856 |

| Response Profile | | |
|---|---|---|
| **Ordered Value** | **obesity** | **Total Frequency** |
| **1** | 1 | 2112 |
| **2** | 0 | 7744 |

**PROC GENMOD is modeling the probability that obesity='1'.**

| Criteria For Assessing Goodness Of Fit | | | |
|---|---|---|---|
| **Criterion** | **DF** | **Value** | **Value/DF** |
| **Log Likelihood** | | -5089.4788 | |
| **Full Log Likelihood** | | -5089.4788 | |
| **AIC (smaller is better)** | | 10188.9577 | |
| **AICC (smaller is better)** | | 10188.9638 | |
| **BIC (smaller is better)** | | 10224.9369 | |

Algorithm converged.

| Analysis Of Maximum Likelihood Parameter Estimates | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | **DF** | **Estimate** | **Standard Error** | **Wald 95% Confidence Limits** | | **Wald Chi-Square** | **Pr > ChiSq** |
| **Intercept** | 1 | -1.2245 | 0.0410 | -1.3049 | -1.1440 | 890.61 | <.0001 |
| **gender** | 1 | 0.1252 | 0.0493 | 0.0287 | 0.2218 | 6.46 | 0.0110 |
| **cage** | 1 | -0.0080 | 0.0168 | -0.0410 | 0.0250 | 0.23 | 0.6338 |
| **cage2** | 1 | -0.0173 | 0.0028 | -0.0228 | -0.0119 | 38.79 | <.0001 |
| **cage3** | 1 | 0.0021 | 0.0008 | 0.0006 | 0.0037 | 7.15 | 0.0075 |
| **Scale** | 0 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | | |

## mus005.sas: Marginal Logistic Regression Model for Obesity Muscatine Coronary Risk Factor Study 5. Table 13.5, ignoring correlation (no empirical SE estimates)

### The GENMOD Procedure

**Note:** The scale parameter was held fixed.