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Methodological Approaches to Community-Based Research

Chapter 10/Web Appendix guide

Web Appendix Guide for Chapter 10/Multilevel Modeling

The Web Appendix materials for Chapter 10 include data sets, SAS syntax, and this set of instructions for loading the data sets into SAS and producing SAS output files for Multilevel Logistic Modeling (MLM). These materials provide the information necessary to run the analyses presented in the chapter.

Overview Materials

- [Basic SAS Instructions.](#) This document describes basic SAS operations such as:
 - Loading data into SAS
 - Basic SAS syntax and tips
- [Variable Description.](#) This document describes the variables and gives specific items.
- [Multilevel Logistic Modeling.](#) This document describes in further detail the use of multilevel modeling for logistic outcomes.
- [Computing the Intraclass Correlation in SAS.](#) This document describes how to compute the intraclass correlation.
- [Setting up the Data File.](#) This document describes how to set up the data set for analysis in SAS.

SAS Syntax: All SAS code is given in a SAS syntax file and in a Word file.

- [Creating Multilevel Datasets.](#)
 - Use this syntax to create a multilevel dataset from the “MLM_build” person-level dataset.
 - Use this syntax to create centered variables, group Level II variables, and the “MLM_group” data set. Running the entire syntax will result in the “MLM_group” and “MLM_complete” datasets.
 - [MLM Graphing.](#) Use this syntax to generate descriptive graphs.
 - [MLM Continuous Prioritization.](#) Use this syntax to model the continuous prioritization outcome.
 - [MLM Logistic Participation.](#) Use this syntax to model the discrete outcome of participation.
-

DATA SETS AND ONLINE TABLES AND FIGURES IN THIS WEB APPENDIX

Data sets: All datasets are given in SAS and SPSS file formats.

- **MLM_build.** A person-level data set containing only individual level variables. The user can practice group- and grand-mean centering individual level variables, and can create group Level II variables.
- **MLM_group.** A group-level data set for computing group-level descriptive statistics.
- **MLM_complete.** The complete data set ready for analysis.

Online Tables and Figures (separate links in the Web Appendix folder):

- **Online Table 10.1:** Example Data File Structure
- **Online Table 10.2:** Example Level 1 and Level 2 Correlation Matrix
- **Online Table 10.3:** Example Table to Report MLM Results
- **Online Figure 10.1:** Regression Lines for Bridging and Social Justice Prioritization for Each Congregation
- **Online Figure 10.2:** Example Follow-Up Interaction Plot for SJ Prioritization
- **Online Figure 10.3:** Example Follow-Up Interaction Plot for SJ Participation

BASIC SAS INSTRUCTIONS

SAS is a flexible and powerful statistical program that uses syntax to manipulate variables and to conduct analyses. The following instructions are a short tutorial to give the reader basic facility in SAS, including the loading of data sets, the loading of data into the workspace, working with variables, and loading SPSS files into SAS. Though not complete, these SAS tips may be helpful when practicing multilevel modeling.

Creating a SAS Data Set from SPSS

1. In SPSS, save the data file as type SASv7 + Windows long extension (*.sas7bdat).

Loading Data Into SAS

1. Save your SAS data set to a folder on your hard drive that is dedicated to SAS datasets. For this exercise, you can label your SAS data set “testaa”.
2. Create a folder on the desktop called “SAS”. Every computer will be different, though you can trace the path information by looking at the top of the folder name. Move “testaa” into this folder.
3. In the SAS program editor, use the following code to designate the path to find the files (note, this is an example, your path will be different):

```
libname sasdata "C:\Users\Nathan\Desktop\SAS";
run;

data testbb;
set sasdata.testaa;
run;
```

The first line of the “libname” command creates a new library called “sasdata”, and the “C:\” tells SAS where to find the files to put in the library.

The next “data” line of code tells the program to create a new file titled “testbb” from the data set “testaa”, located in the library sasdata. This uses the file “testaa” from the library to create a new file called “testbb” in your work folder, called the workspace.

You can also save data sets from your work folder to the SAS library, which then saves the data set on your computer. This is not telling SAS to use the file “testbb” from your work folder, and to create a new file in the library called “testdd”:

```
data sasdata.testdd;
set testbb;
run;
```

**Once you have loaded your data set, check the work folder to make sure it is there!
You are now ready to work with this data set.**

Basic SAS syntax and tips

- Lines MUST end with a semicolon (;).
- Comments can be typed between asterisks (*); note how these turn the lines green.
- Variable names should be 1 to 32 characters in length, beginning with a letter.
- Check the log file to make sure your program runs okay.
- Save your syntax for everything!
- **Data** steps
 - o Create and modify data sets.
- **Proc** steps = Procedures
 - o Performs some procedure or analysis with the data set.

Manually Entering a Data Set Into SAS

Sample SAS program:

- *Reads data that you enter into a SAS data set, stored in WORK folder.
- *Missing data are represented by a single period (.).
- *variables are separated by spaces.
- *data are separated by spaces.
- *note that the \$ after gender designates that the variable is designated by a character.

```
data lab1;
input id gender $ var1 var2 var3;
cards;
1 F 79 80 92
2 M 69 87 79
3 F 78 76 90
4 F 73 85 88
5 M 80 86 94
;
run;
```

To run a program:

1. Select and copy your code.
2. Click on the little person icon near the top of your screen to submit or run your program.

Basic SAS Commands

Sorting Data:

```
proc sort data=testaa;
by gender;
run;
```

Look at data set and observe order to see if sorted by gender. Now sort by id:

```
proc sort data=lab1;
  by id;
run;
```

Descriptive Statistics:

```
proc means data=lab1;
  var var1 var2 var3;
run;
```

Modifying Variables, Merging Data Sets:

To rename variables:

```
data testff;
  set testaa;
  act = var1;
  gpa = var2;
run;
```

This code takes the original variables name, “var1,” and renames it as “act”. It takes the values from the original data set “testaa” and creates a new data set “testff”, where the variables are renamed.

To delete variables:

```
data testgg;
  set testaa;
  drop var1 var2;
run;
```

This code takes the original variables, “var1” and “var2” from the data set “testaa” and drops them in the new data set “testgg”.

To re-code variables from character to numeric:

```
data testhh;
  set testaa;
  if gender = 'M' then gender1 = '1';
  if gender = 'F' then gender1 = '2';
  gendernum = input(gender1,1.0);
  *if you want to dummy code with male as reference group;
  if gendernum = 2 then genddum = 1;
  if gendernum = 1 then genddum = 0;
run;
```

Linear transformations:

```
data testii;
set testaa;
var1a = var1 + 25;
var2a = var2*15;
varscale = (var1 + var2 + var3)/3;
run;
```

To create new variables “var1a” and var2a”, SAS takes the original variables var1 and var2 and computes the mathematical operation of addition (for var1) or multiplication (var2). Any mathematical operation can be used. Varscale takes var1, var2, and var3 to form a scale based on the mean of these variables.

Creating groups:

```
data testjj;
set testaa;
if var1 < 75 then var1grp = 0;
if var1 = 75 then var1grp = 0;
if var1 > 75 then var1grp = 1;
run;
```

Similar to linear transformations, new variables can be created by forming groups. This is helpful when computing groups based on median splits.

Adding a variable and merging data sets:

```
data test1;
input id var1 var2 var3;
cards;
1 3 2 4
2 4 2 1
3 5 2 3
4 1 3 2
5 4 2 3
;
run;
```

```

data testextra;
input id var4;
cards;
1 99
2 76
3 68
4 38
5 99
;
run;

```

To add a variable, you need to merge two data sets together and match by an identifier:

First, sort each data set by the identifier, id:

```

proc sort data=test1;
by id;
run;

proc sort data=testextra;
by id;
run;

```

Now, create a new data set that merges these together:

```

data testcombined;
merge test1 testextra;
by id;
run;

```

The data set “testcombined” should contain variables var1, var2, var3, and now the added variable var4.

VARIABLE DESCRIPTION

These data are individual responses to the *Church and Community Planning Inventory* (CCPI), collected by Dudley (1991) as part of project conducted by the Center for Church and Community Ministries. The project was funded by the Lilly Endowment, and the data are available online at <http://www.thearda.com>. The final data set has 5,123 individuals nested within 62 Christian religious congregations.

Outcome Variables		Description	Scale Anchors
Social Justice Prioritization		Four item scale ($\alpha = .82$) assessing the priority members place on congregational social justice activities such as efforts to relieve poverty and hunger, promote world people and human rights.	1 (<i>lowest</i>) to 5 (<i>highest</i>)
Social Justice Participation		One item asking if people gave time (or not) to congregational social justice programs.	1 (<i>any amount of time</i>) and 0 (<i>no time</i>)
Predictor Variables			
Bridging Social Capital		One item assessing agreement that the congregation values cooperative projects with churches of other denominations.	1 (<i>disagree strongly</i>) to 4 (<i>agree strongly</i>)
Frequency of Religious Attendance		Three item scale ($\alpha = .64$) assessing frequency of attendance at worship services, educational courses, and other church activities.	1 (<i>never</i>) to 7 (<i>every day</i>)
Theological Conservatism		One item that assessing attitudes toward Scripture as literal or metaphoric.	1 (<i>literal</i>) to 4 (<i>metaphoric</i>)
Hypotheses			Corresponding Model from Table XX
Within	There will be a positive association between individual bridging and social justice*.		B and D
Between	There will be a positive association between congregational bridging and social justice.		B
Contextual	Congregational bridging will predict social justice over and above individual bridging.		D
Cross-Level	The association between frequency of religious participation and social justice will be moderated by theological orientation. It is predicted that within liberal congregations the association will be positive and stronger than in conservative congregations.		C

Note. *social justice refers to both SJ prioritization and SJ participation.

Social Justice Prioritization Four Item Scale: $\alpha = .82$

There are many tasks that a church can do. Of those listed below, what priority would you give to each for your church?

1. *Encourage individual members to support local social reforms to relieve poverty and hunger.*
2. *Provide organizational support to groups attempting to promote world peace and justice.*
3. *Provide opportunities for channeling members into actively promoting human rights and well-being.*
4. *Develop church programs which would help people understand local programs and issues.*

Response options ranged from 1 (none) to 5 (highest)

Social Justice Participation Item:

Those who answered yes to the question, "Does your congregation participate directly in any programs to provide a community social service or promote peace and justice?" were then asked,

1. *How much time have you been able to give to these programs?*

Response options ranged from 1 (none) to 5 (More than five hours a week)

Theological Orientation Item:

Which of the following statements best expresses your view of the Bible?"

1. *The Bible is the actual Word of God and is to be taken literally.*
2. *The Bible is the inspired Word of God and its basic moral and religious teachings are clear and true, even if it does contain some human error.*
3. *The Bible is a record of many different people's response to God and because of this, people and churches today are forced to interpret for themselves the Bible's moral and religious teachings.*
4. *The Bible is a valuable book because it was written by wise and good people, but I do not believe it is really God's word.*

Frequency of Religious Participation Three Item Scale: $\alpha = .64$

How often do you personally do the following:

1. *Attend worship service?*
2. *Participate in religious courses or Sunday school?*
3. *Participate in other church activities other than worship?*

Response options ranged from 0 (never) to 7 (every day)

Social Capital Bonding Item:

Of your five closest friends, how many are members of this congregation?

Response options ranged from 0 (0 friends) to 5 (5 friends)

Social Capital Bridging Item:

To what extent do you agree that each statement describes your congregation? A "Don't Know" response is provided, but please use it only when absolutely necessary.

1. *Cooperative projects and joint workshops with churches of other denominations are highly valued.*

Response options ranged from 1 (don't know) through 5 (agree strongly) scale.

MULTILEVEL LOGISTIC MODELING

Multilevel logistic modeling can be used to test the same within, between, contextual, and cross-level interactive hypotheses presented in the chapter, except now the dependent variable is a logistic outcome such as a “success” or “failure” (Raudenbush & Bryk, 2002; Snijders & Bosker, 1999). Community researchers may be interested in logistic outcomes such as recidivism (or not), policy change (or not), if people vote yes (or no), and employ MLM to examine how settings may influence such outcomes. The same models presented in Table 10.1 of the book chapter can be used to test these hypotheses while taking into account possible dependence in the data from people being nested in settings.

The implementation of multilevel *logistic* regression is very similar to multilevel regression, where the same models as those in Table 10.1 of the book chapter are employed to predict a logistic outcome. A main difference lies in the interpretation of the parameter estimates (i.e., $\hat{\beta}$) given that logistic regression is predicting the probability of “success” (e.g., where 0 is “failure” and 1 is “success”). For continuous outcomes, the parameter estimate is interpreted as the amount of predicted change in Y_{ij} for every unit increase in X_{ij} . In contrast, the parameter estimates (i.e., $\hat{\beta}$) in logistic regression are interpreted using odds ratios.

To illustrate, consider a parameter estimate of $\hat{\beta} = .21$ for the continuous predictor of political conservatism predicting if a person votes “yes” or “no.” This estimate indicates that for a one unit increase of conservatism, the odds of a “yes” vote are 1.23 times larger. There is a direct conversion between the parameter estimate .21 and the odds of 1.23 by taking $e^{\hat{\beta}}$, in this case $e^{.21} = 1.23$. Thus, as conservatism increases, the odds of a “yes” vote also increase. Most statistical programs will give the parameter estimate, a statistical test to determine significance, and the odds ratio with a 95% confidence interval. If the 95% confidence interval for the odds ratio does not include one, the parameter estimate is significant. For example, if the 95% confidence interval for the odds ratio of 1.23 was (1.03, 1.43), this indicates a significant odds ratio. A negative parameter estimate (e.g., -.30) indicates a lower probability of success, with the associated odds ratio between 0 and 1, in this case 0.74. Thus, multilevel logistic regression uses independent variables, at both level I and II, to predict the likelihood of a logistic outcome.

Though beyond the scope of Chapter 10, a few issues are presented for the reader interested in using multilevel logistic regression. First, there are two major statistical approaches to modeling nested dichotomous outcomes: generalized linear mixed models (GLMM, Anderson, Verkuilen, & Johnson, in preparation; Hedeker, 2005) and generalized estimating equations (GEE, Hedeker & Gibbons, 2006). The main difference between these approaches is that GEE treat dependence as a nuisance and tries to remove the dependence by examining “population-averaged effects” or “marginal models” whereas GLMM tries to model and understand the nature of the dependence by examining “subject-specific effects” or “conditional models” (Hu, Goldberg, Hedeker, Flay, & Pentz, 1998). There is not agreement as to which approach is best; however, when the purpose is to understand within and between types of effects when individuals are nested in settings, GLMM for individuals nested in groups may be preferred. When the design is longitudinal with strong within-subject dependence, GEE may be more

appropriate (Hedeker & Gibbons, 2006; Molenberghs & Verbeke, 2005). For this chapter and example, GLMM are used since the hypotheses involve within, between, and contextual effects.

Moreover, many statistical programs will be able to implement GEE or GLMM. In SAS, PROC GENMOD implements GEE whereas PROC GLIMMIX and PROC NLMIXED implement GLMM. Statistics is an evolving field, and likewise the statistical programs used to implement statistical procedures also evolve. For example, both PROC GLIMMIX and PROC NLMIXED implement GLMM, where NLMIXED was an initial procedure now gradually being replaced by GLIMMIX (GLIMMIX is available in SAS 9.2, or can be downloaded from www.sas.com and used with earlier versions of SAS). The differences between these two procedures are beyond the scope of this chapter, though it bears mentioning that NLMIXED is not as user friendly, is slower, and fits a narrower range of models than GLIMMIX. However, the estimates produced by NLMIXED are not biased whereas the estimates from GLIMMIX are slightly downward biased and thus more conservative. In this chapter, we use GLIMMIX because it is more user-friendly, and are of the opinion that with continued development GLIMMIX will produce estimation methods that are less biased, as is already evidenced by the ability of GLIMMIX to use numerical integration methods (Snijders & Bosker, 1999). These issues are important to consider when using multilevel logistic regression.

Application of Multilevel Logistic Modeling

This example focuses on implementing analyses and interpreting results. The same models presented in Table 10.1 of the book chapter, and used in the earlier example of a continuous outcome, are now used with the dichotomous dependent variable of social justice participation (SJ participation is whether people gave time or not to congregational social justice activities). The same models are run, and statistical information can be presented as shown in Online Table 10.3 in this Web Appendix.. However, the interpretation of the parameters is now in terms of odds-ratios, where a larger positive parameter estimate indicates the odds of success becoming more likely with a unit increase in the independent variable. For our example, we found a positive and significant parameter estimate for religious participation in predicting SJ participation (e.g., $\hat{\gamma} = .64$). This indicates that the odds are 1.90 times greater for SJ participation for every unit increase in frequency of religious participation.

Similar to the process of analysis for continuous outcomes, follow up tests are conducted for significant cross-level interactions. In our example there is a significant cross-level interaction between frequency of religious participation and congregational theological orientation in predicting SJ participation. Follow up logistic regression between frequency of religious participation and SJ participation would be conducted separately for liberal and conservative congregations (as defined in the book chapter example). For these data, logistic regressions show a significant association between frequency of religious participation and social justice participation for people in conservative congregations ($\hat{\gamma} = .53$, $SE = .05$, $p < .05$, $OR = 1.70$, $n = 1,608$). There is also a significant and slightly stronger association for people in liberal churches ($\hat{\gamma} = .70$, $SE = .04$, $p < .05$, $OR = 2.02$, $n = 2,227$).

This shows that congregational theological orientation moderates the association between frequency of religious participation such that there were increased odds of social justice participation with increased frequency of participation, with a more pronounced effect in liberal congregations. As displayed in Online Figure 10.3, the logistic curves are plotted for a picture of

the moderation. The intersection of these two logistic curves indicates that an interaction is present. Even though both effects are significant, this graph shows a steeper logistic curve for those in liberal congregations, indicating that the effect is stronger. For a full analysis using the logistic dependent variable of SJ participation, see Todd and Allen (2010).

REFERENCES

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COMPUTING THE INTRACLASS CORRELATION IN SAS

If the statistical program does not automatically give this statistic, compute it by, (1) running the “null” model, which includes a random intercept and no predictor variables, (2) examine the variance at individual (labeled “residual” or “ σ^2 ”) and group (labeled “UN(1, 1)” or “ τ^2 ”) levels, and (3) estimate the intraclass correlation by calculating the ratio of group level unexplained variance to the total unexplained variance: $\rho_I = \tau^2 / (\tau^2 + \sigma^2)$. For these data, the intraclass correlation for the outcome of social justice prioritization is $\rho_I = .06 / (.06 + .54) = .095$. This indicates that 9.5% of the variance on the outcome is explained by the group. Taken in conjunction with the descriptive plots, it appears that a random intercept is appropriate to be included in the model because congregations have different average SJ prioritization scores. Thus, since there is unexplained variance at the congregational level, MLM should be used.

SETTING UP THE DATA FILE

The data file needs to be constructed in a particular manner for multilevel modeling, though specifics vary depending on the particular MLM software used. The following describes the set up when using SAS, as displayed in Online Table 10.1 in this Web Appendix. First, each level I unit (i.e., individual) should have one row in the data set. Second, there should be a variable that connects each individual to their group (i.e., a column), in this case membership to religious congregation. Third, the outcome variables need to be measured at the level of the individual, and should each have their own column. Fourth, group level variables can be created by taking the average of the variable for each congregation, with the average then assigned to each individual in the group.

It is helpful to name variables consistently to designate them as level I or level II. For this example, “grpMvariable” denotes that the variable is a level II variable formed by the group mean. For example, the group mean for bridging in congregation 100 was 3.02. Thus, each member of congregation 100 is given the same group mean for grpMbridge. Finally, group- and grand-mean centered variables should be created for every participant. Group-mean centered variables are labeled “groupCvariable” and grand-mean centered variables labeled “grandCvariable.”

SAS SYNTAX: CREATING MULTILEVEL DATASETS

OVERVIEW

The following syntax starts with a person-level data-set, and builds both the group ("mlm_group") and multilevel ("mlm_complete") datasets. These datasets are provided in the data sets folder, and if you just want to practice mlm analysis without building the datasets, you can open the other syntax documents for graphing ("mlm_graphing"), modeling SJ prioritization ("mlm_continuous_priorization"), or modeling SJ participation ("mlm_logistic_participation").

See the "Basic_SAS" section in this Guide for instructions on loading data sets.

```
libname sasdata "C:\INSERT YOUR PATH TO THE FOLDER WHERE THE DATA FILES ARE
HERE";
run;
```

```
data mlm_build;
set sasdata.mlm_build;
run;
```

*VARIABLE NAMES USED THROUGHOUT THE ANALYSIS AND SAS SYNTAX

LEVEL I:

```
theolbib = theological orientation
relfreq = frequency of religious attendance
bond = bonding social capital
bridge = bridging social capital
socprior = Social Justice Prioritization
socpartbin = Social Justice Participation (0 = no participation, 1 =
participation)
```

```
bridgegrand = Grand Mean centered bridging social capital
bridgegroup = Group Mean centered bridging social capital
```

```
bondgrand = Grand Mean centered bonding social capital
bondgroup = Group Mean centered bonding social capital
```

```
relfreqgrand = Grand Mean centered frequency of religious attendance
relfreqgroup = Group Mean centered frequency of religious attendance
```

```
theolbibgrand = Grand Mean centered theological orientation
theolbibgroup = Group Mean centered theological orientation
```

Demographics:

```
gender = gender where Male = 1, Female = 2
race = race where White = 1, Black = 2
age = age in years
educ = education where larger numbers indicate higher education
income = income, with higher numbers indicating larger income.
```

LEVEL II:

grpMtheolbib = Group Mean theological orientation for each congregation
 grpMrelfreq = Group Mean frequency of religious attendance for each congregation
 grpMbond = Group mean bonding social capital for each congregation
 grpMbridge = Group mean bridging social capital for each congregation
 grpMsocprior = Group mean social justice prioritization;

FORMING LEVEL TWO VARIABLES: AGGREGATION

This section calculates the group mean for the church on the variable, creating a new data set with the value. The second step merges this data set with the original data set to give each person the mean for the group in a new variable. This is done for each level 1 variable, to form the level:

```
**religious frequency;
proc means data=mlm_build noprint;
class church;
var relfreq;
output out=relfreq mean = grpMrelfreq;
run;
```

***proc sort** is used before the merge, as SAS requires both data sets to be sorted on the variable that is to serve as the matching variable during the merge:

```
proc sort data=mlm_build;
by church;
run;
```

Deleting the Type=0 is done because this value represents the grand-mean:

```
data mlm_builda;
merge relfreq mlm_build;
by church;
if _TYPE_=0 then delete;
run;
```

Repeat this process for each of the individual level variables that are to be made Level II variables, using the data set that was created in the last step:

```
**theolbib;
proc means data=mlm_builda noprint;
class church;
var theolbib;
output out=theolbib mean = grpMtheolbib;
run;
```

```
proc sort data=mlm_builda;
by church;
run;
```

```
data mlm_buildb;
merge theolbib mlm_builda;
by church;
```

```

if _TYPE_=0 then delete;
run;

**bond;
proc means data=mlm_buildb noprint;
class church;
var bond;
output out=bond mean = grpMbond;
run;

proc sort data=mlm_buildb;
by church;
run;

data mlm_buildc;
merge bond mlm_buildb;
by church;
if _TYPE_=0 then delete;
run;

**bridge;
proc means data=mlm_buildc noprint;
class church;
var bridge;
output out=bridge mean = grpMbridge;
run;

proc sort data=mlm_buildc;
by church;
run;

data mlm_buildd;
merge bridge mlm_buildc;
by church;
if _TYPE_=0 then delete;
run;

**social justice prioritization;
proc means data=mlm_buildd noprint;
class church;
var socprior;
output out=socprior mean = grpMsocprior;
run;

proc sort data=mlm_buildd;
by church;
run;

data mlm_builde;
merge socprior mlm_buildd;
by church;
if _TYPE_=0 then delete;
run;

```

FORMING THE GROUP LEVEL DATA SET

To form a group level data set with the level two variables, merge the bond, bridge, relfreq, theolbib, socprior datasets together. This data set can be used for group level descriptives:

```
data mlm_group;
merge bond bridge relfreq theolbib socprior;
by church;
if _TYPE_=0 then delete;
run;

proc means data=mlm_group;
var grpMbond grpMbridge grpMrelfreq grpMtheolbib grpMsocprior;
run;

proc corr data=mlm_group;
var grpMbond grpMbridge grpMrelfreq grpMtheolbib grpMsocprior;
run;

data sasdata.mlm_group;
set mlm_group;
run;
```

FORMING THE CENTERED VARIABLES

Variables with “grand” in the title are grand mean centered. Variables with “group” in the title are group mean centered. These means are for the entire data set, and will be used for the grand mean centered variables:

```
proc means data=mlm_builde;
var bridge relfreq theolbib bond;
run;
```

The new, centered variables are formed below:

```
data mlm_buildf;
set mlm_builde;

bridgegrand = (bridge - 3.0721695);
bridgegroup = (bridge - grpMbridge);

bondgrand = (bond - 2.0527035);
bondgroup = (bond - grpMbond);

relfreqgrand = (relfreq - 4.1686418);
relfreqgroup = (relfreq - grpMrelfreq);

theolbibgrand = (theolbib - 2.1900741);
theolbibgroup = (theolbib - grpMtheolbib);
run;
```

CREATING VARIABLE FOR LIBERAL AND CONSERVATIVE CONGREGATIONS

```
proc freq data=mlm_group;
table grpMtheolbib;
```

```
run;
```

After examining the frequencies, if we form conservative congregations as less than 2.19, approximately 50% of congregations will be classified as liberal, and approximately 50% as conservative:

```
data mlm_complete;  
set mlm_buildf;  
if grpMtheolbib < 2.141 then grptheolbiblibcon = 0;  
if grpMtheolbib > 2.141 then grptheolbiblibcon = 1;  
run;
```

The data set "mlm_complete" now contains all individual and group level variables needed for analysis. To save this dataset to your computer, use the following:

```
data sasdata.mlm_complete;  
set mlm_complete;  
run;
```

SAS SYNTAX: MLM GRAPHING

OVERVIEW

This syntax is for producing graphs. Graphs are very helpful when understanding whether or not to include a random intercept or random slope. See the "Basic_SAS" section of this Guide for instructions on loading data sets.

```
libname sasdata "C:\INSERT YOUR PATH TO THE FOLDER WHERE THE DATA FILES ARE
HERE";
run;
```

```
data mlm_complete;
set sasdata.mlm_complete;
run;
```

SEPARATE REGRESSION LINES FOR EACH CONGREGATION, ALL ON ONE PLOT

Note that before creating new graphs it is helpful to run the "goptions reset" to reset the graphing space; that is why this command is given before any graph:

```
goptions reset=(axis, legend, pattern, symbol, title, footnote) norotate
          hpos=0 vpos=0 htext=2 ftext=swiss ctext=black target= gaccess=
gsfmode=
          colors= csymbol=;
goptions device=WIN ctext=black graphrc interpol=rl;

axis1 color=black width=2.2 label=('Bridging' );
axis2 color=black width=2.2 label=(angle=90 'Social Justice
Prioritization' );
```

```
proc gplot data = mlm_complete;
plot socprior * bridge = church / haxis=axis1 vaxis=axis2 frame nolegend;
  title1 'Bridging and Social Justice Prioritization';
run;
```

If you want a legend, delete the "nolegend" command:

```
proc gplot data = mlm_complete;
plot socprior * bridge = church / haxis=axis1 vaxis=axis2 frame;
  title1 'Bridging and Social Justice Prioritization';
run;
```

To examine each church separately:

```
goptions reset=(axis, legend, pattern, symbol, title, footnote) norotate
          hpos=0 vpos=0 htext=2.5 ftext=swiss ctext=black target= gaccess=
gsfmode=
          colors= csymbol=;
goptions device=WIN ctext=black graphrc interpol=join;
symbol1 c=black i=rl v=none ;
symbol2 c=blue height=3 i=none v=dot ;
axis1 color=black width=2.5 label=('Bridging' );
```

```
axis2 color=black width=2.5 label=(height=2 angle=90 'Social Justice
Prioritization' );
goptions nodisplay;
```

FOR CONSERVATIVE AND LIBERAL CHURCHES:

```
proc sort data=mlm_complete;
by grptheolbiblibcon;
run;

goptions reset=(axis, legend, pattern, symbol, title, footnote) norotate
hpos=0 vpos=0 htext=2 ftext=swiss ctext=black target= gaccess=
gsfmode=
colors= csymbol=;
goptions device=WIN ctext=black graphrc interpol=rl;

axis1 color=black width=2.2 label=('Bridging' );
axis2 color=black width=2.2 label=(angle=90 'Social Justice Engagement'
);

proc gplot data = mlm_complete;
plot socprior * relfreq = grptheolbiblibcon / haxis=axis1 vaxis=axis2 frame;
title1 'Bridging and Social Justice Engagement in Liberal and Conservative
Congregations';
run;
```

To find the graphs, go to the “work” folder and click on “bridge_socprior”. Each graph is labeled with the church number at the top:

```
proc sort data=mlm_complete;
by church;
run;

proc gplot data=mlm_complete gout=bridge_socprior;
by church;
plot socprior*bridge=1 socprior*bridge=2/ overlay haxis=axis1 vaxis=axis2
frame nolegend;
* title1 'Religious Frequency x Social Prioritization';
run;
```

These same graphs can be constructed for any variable!

SAS SYNTAX: MLM CONTINUOUS PRIORITIZATION

OVERVIEW

This syntax is for modeling the continuous outcome of SJ prioritization. See the "Basic_SAS" section of this Guide for instructions on loading data sets.

Put the path to your data set in the “libname” statement:

```
libname sasdata "C:\INSERT YOUR PATH TO THE FOLDER WHERE THE DATA FILES ARE
HERE";
run;

data mlm_complete;
set sasdata.mlm_complete;
run;
```

GENERAL EXPLANATION OF THE SAS CODE

```
*Example SAS Code for Continuous Outcomes:
*proc mixed data=example1 noclprint covtest method=ml ic;
*class church;
*model sjprior = GroupCBridge MBridge / solution ;
*random intercept / subject = church type=un;
*run;
```

The model statement in SAS is a regression equation, where the outcome (i.e., SJ prioritization “sjprior”) is predicted from group centered bridging and average church bridging. The random statement tells SAS that the intercept is random for each of the different churches. The important point here is that the terms from the linear mixed model are directly entered into SAS to test the specific hypothesis. If one wanted to test the contextual effect, then the terms listed in Table 10.1/ Model D with the grand-mean centered variables would be entered into the SAS program.

Null model

The null model is used to calculate the intraclass correlation. The model is called "null" because there are no predictors in the model. Thus the individual and group level variance terms are the unexplained variance at these different levels and can be used to construct the intraclass correlation:

```
proc mixed data=mlm_complete noclprint covtest method=ml ic;
class church;
model socprior = / solution ;
random intercept / subject = church type=un;
title 'null model';
run;
```

MODEL I: Group mean centered

Group mean centered is used to tease apart within and between effects, where grpMbridge represents the between effect:

```
proc mixed data=mlm_complete noclprint covtest method=ml ic;
class church;
model socprior = bridgegroup grpMbridge / solution ;
random intercept / subject = church type=un;
title 'Model I: group-mean centered model';
run;
```

MODEL II: Grand mean centered

Grand mean centering is used to test the contextual effect of congregational bridging, or how much individual level social justice prioritization can be predicted by congregational bridging over and above individual level bridging:

```
proc mixed data=mlm_complete noclprint covtest method=ml ic;
class church;
model socprior = bridgegrand grpMbridge / solution ;
random intercept / subject = church type=un;
title 'Model II: grand-mean centered model';
run;
```

Model III: Cross level interaction

The cross level interaction tests if congregational theological orientation moderates the association between frequency of religious participation and social justice prioritization. Note how the terms in the model are the SAME as those from the linear mixed model in Table 10.1/ C. To test the cross level interaction, examine if "relfreq*grpMtheolbib" is significant:

```
proc mixed data=mlm_complete noclprint covtest method=ml ic;
title'H1: Model1: RI: bridge';
class church;
model socprior = theolbib relfreq grpMtheolbib relfreq*grpMtheolbib /
solution ;
random intercept relfreq / subject = church type=un;
title 'Model III: Cross-level interaction model';
run;
```

Breaking down the interaction in liberal and conservative congregations

Create a variable to group congregations as liberal or conservative. This syntax is in "creating_multilevel" where a variable "grptheolbiblibcon" was created where "0" indicates a conservative congregation, and "1" a liberal congregation. Run the regressions between frequency of religious attendance and SJ prioritization separately for conservative and liberal congregations, to see how the associations are different in the different types of congregations:

```
proc sort data=mlm_complete;  
by grptheolbiblibcon;  
run;  
  
proc reg data=mlm_complete;  
by grptheolbiblibcon;  
model socprior = relfreq;  
title 'regression for conservative (0) and liberal (1) congregations';  
run;
```

The warning about the variable `_NAME_` or `_Type_` can be ignored.

SAS SYNTAX: MLM LOGISTIC PARTICIPATION

OVERVIEW

This syntax is for modeling the logistic outcome of SJ participation. See the "Basic_SAS" section of this Guide for instructions on loading data sets. Put the path to your data set in the "libname" statement:

```
libname sasdata "C:\INSERT YOUR PATH TO THE FOLDER WHERE THE DATA FILES ARE
HERE";
run;

data mlm_complete;
set sasdata.mlm_complete;
run;

proc sort data=mlm_complete;
by church;
run;
```

EXPLANATION OF SAS CODE

Model

Thus in SAS we use "proc glimmix" as displayed below:

```
*proc glimmix data=example2 method=laplace ic=pq;
*class church;
*model socpartbin = relfreq relfreq*grpMtheolbib / solution link=logit
dist=bin;
*random intercept relfreq / subject = church type=un;
*run;
```

The SAS code is almost identical to the "proc mixed" used for continuous outcomes. However, the method of estimation is specified of "laplace" as this is a maximum likelihood estimation technique. Also, in the solution statement a specific "link=logit" and "dist=bin" have been specified to indicate that the data are logistic, and that a binomial distribution should be used.

Null model

For logistic outcomes it is not appropriate to calculate the intraclass correlation, and thus no null model is needed.

THIS EXAMPLE TESTS IF FREQUENCY OF RELIGIOUS ATTENDANCE PREDICTS SOCIAL JUSTICE PARTICIPATION. BRIDGING IS NOT USED SINCE IT IS NON-SIGNIFICANT.

Grand mean centered

Grand mean centering is used to test the contextual effect of congregational religious frequency, or how much individual level social justice participation can be predicted by congregational

religious frequency of attendance over and above individual level frequency of religious attendance. The contextual effect here is non-significant:

```
proc glimmix data=mlm_complete method=laplace ic=pq;
class church;
model socpartbin = relfreqgrand grpMrelfreq / solution link=logit dist=bin;
random intercept / subject = church type=un;
title 'grand-mean centered model';
run;
```

Group mean centered

Group mean centered is used to tease apart within and between effects, where “grpMrelfreq” represents the between effect:

```
proc glimmix data=mlm_complete method=laplace ic=pq;
class church;
model socpartbin = relfreqgroup grpMrelfreq / solution link=logit dist=bin;
random intercept / subject = church type=un;
title 'group-mean centered model';
run;
```

CROSS LEVEL INTERACTION

The cross level interaction tests if congregational theological orientation moderates the association between frequency of religious participation and social justice participation. Note how the terms in the model are the SAME as those from the linear mixed model in Table 10.1/C. To test the cross level interaction, examine if “relfreq*grpMtheolbib” is significant:

```
**model CROSS LEVEL INTERACTION;
proc sort data=mlm_complete;
by socpartbin;
run;

proc glimmix data=mlm_complete method=laplace ic=pq;
class church;
model socpartbin = theolbib relfreq grpMtheolbib relfreq*grpMtheolbib /
solution link=logit dist=bin;
random intercept relfreq / subject = church type=un;
title 'cross-level interaction model';
run;
```

Breaking down the interaction in liberal and conservative congregations

Create a variable to group congregations as liberal or conservative. This syntax is in “creating_multilevel” where a variable “grptheolbiblibcon” was created where “0” indicates a conservative congregation, and “1” a liberal congregation. Run the regressions between frequency of religious attendance and SJ participation separately for conservative and liberal congregations, to see how the associations are different in the different types of congregations:

```
proc sort data=mlm_complete;
by grptheolbiblibcon;
run;

proc logistic data=mlm_complete;
```

```
by grptheolbiblibcon;
model socpartbin(event='1') = relfreq;
title 'Logistic regression for conservative (0) and liberal (1)
congregations';
run;
```

Follow-up logistic curve

Getting the logistic curves can be rather tricky, so the code is given below:

```
proc sort data=mlm_complete;
by grptheolbiblibcon;
run;

options reset=(axis, legend, pattern, symbol, title, footnote) norotate
          hpos=0 vpos=0 htext=2 ftext=swiss ctext=black target= gaccess=
gsfmode=
          colors= csymbol=value interpol=spline;

axis1 color=black width=2.2 label=('Frequency of Religious Participation'
);
axis2 color=black width=2.2 label=(angle=90 'Social Justic Participation'
);

proc logistic data=mlm_complete order=data;
by grptheolbiblibcon;
model socpartbin(event='1') = relfreq;
output out = newaa p=pred;
run;

proc sort data=newaa;
by grptheolbiblibcon relfreq;

proc gplot data=newaa;
symbol1 interpol=spline value=triangle;
symbol2 interpol=spline value=circle;
plot pred*relfreq=grptheolbiblibcon / haxis=axis1 vaxis=axis2 frame;
title1 'Cong. Theological Orientation Moderating Frequency of Religious
Participation and SJ Participation';
run;
```

If you are unable to see the graph, go to the "view" menu in the upper left hand part of the screen, and select "graph". The graph should then be visible.