Study Questions For Exam 3

1. The cold winter weather in the Midwest keeps people (and their children) from venturing much outside. One consequence of Midwesterners' many hours of winter indoor seclusion is that they often become "cabin crazy" (i.e., they begin to exhibit sudden outbursts of anger, laughter, and generally atypical demeanor). After developing a set of "Cabin Craziness Questions" a child psychologist interviewed 30 children from Louisiana, 20 from Missouri, and 50 from North Dakota—yielding a total sample size of 100. These states had had similar weather (e.g., approximately the same amounts of sunshine, precipitation, etc.) during the last five years, but had had weather of different temperatures (with Louisiana having the warmest and North Dakota the coldest weather). In presenting her results the researcher reported, "The average Cabin Craziness (CC) score among the Louisiana children was 23 points. The average CC score of the children from Missouri was 6 points higher than this. Furthermore, the North Dakota children had, on average, CC scores 15 points higher than children from Louisiana."

   a. Assuming that the three numbers in the researcher's report are unstandardized coefficients from a single regression equation, write down this regression equation. (Hint: Remember to include the numbers in the equation.)

   b. Show how the researcher coded her independent variables. (That is, for each independent variable in the regression equation given in part a, indicate what numerical value was assigned to children in each of the three groups.)

   c. Are the independent variables (described in part b) orthogonal? (Justify your answer using the data given in the introductory paragraph for this problem.)

2. Camp Dee-tra-wana holds one-, three-, and five-day programs for 5th and 6th grade children from local elementary schools. The programs are intended to improve the children's appreciation of wildlife. Children take part in these programs in groups of 10, where each group is either comprised of ten girls or ten boys. Your data are from six of these groups—one group of girls and one of boys that were in the one-day program, one group of girls and one of boys that were in the three-day program, and one group of girls and one of boys that were in the five-day program. Thus your sample size is 60 (six groups of size 10). Children in each group were given a "wildlife appreciation quiz" at the time that they registered for their respective programs. At the end of the last day of their program, the children were again given the same wildlife appreciation quiz. "Change in wildlife appreciation" (CWA) scores were calculated by subtracting each child's pre-program score on the quiz from her/his post-program score. This yielded a change measure that has positive values for children with improved wildlife appreciation, and negative values for children with worsened wildlife appreciation. Fortunately none of the children's CWA scores were negative. In fact, the average CWA score was 50 and the standard deviation among the scores was only 18. Group means on the CWA measure are as follows:
Table 1. Group means on CWA by gender and length of program.

<table>
<thead>
<tr>
<th></th>
<th>one-day program</th>
<th>three-day program</th>
<th>five-day program</th>
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<tbody>
<tr>
<td>girls</td>
<td>40</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>boys</td>
<td>40</td>
<td>45</td>
<td>55</td>
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a. You perform an analysis on the three groups of girls only and conclude, "The average CWA score for girls in the one-day program was 40. In comparison to this score, the average CWA score for girls in the three-day program was 10 points higher and the average score for girls in the five-day program was 30 points higher. Assuming that the three numbers in this conclusion are unstandardized coefficients (i.e., slopes and a constant) from a single regression equation, write down this regression equation, and show how each independent variable was coded. (Hint: Remember to include the numbers in the equation, and to indicate for each independent variable what numerical value was assigned to girls in each of the three programs.)

b. In an analysis that combined the girls' and boys' data you conclude, "The overall average CWA score is 50. Girls in the one-day program had average CWA scores 10 points lower than this. Boys in the one-day program also had average CWA scores 10 points lower than this. Boys in the three-day program had scores 5 points less than the overall average. And finally, both girls and boys in the five-day program had higher CWA scores than overall, with the girls scoring 20 points higher on average and with the boys scoring 5 points higher on average." Again, assuming that the six numbers in this conclusion are unstandardized coefficients (i.e., slopes and a constant) from a single regression equation, write down this regression equation, and show how each independent variable was coded. (Hints: Remember to include the numbers in the equation, and to indicate for each independent variable what numerical value was assigned to children in each of the three programs.)

c. The equation in part b does not have an independent variable associated with girls in the three-day program. Why could you not add such a sixth independent variable to this equation?

d. Use the five slopes listed in part b to show that the average CWA score for this group (i.e., for the girls in the three-day program) had zero difference with the overall average.

e. Both girls and boys gained higher levels of wildlife appreciation if they attended programs that were more days in length. What complete and reduced models are needed to test whether girls gained more wildlife appreciation than boys from attending longer programs? In describing these models be sure that you have constructed your independent variables as contrasts. Be sure and indicate what numerical value on each contrast corresponds to which children in your study. (Hint: Do NOT calculate any numbers for the constant or slopes in these models.)
f. Explain how you would use the .05 significance level to perform the test described in part e (i.e., whether girls gained more wildlife appreciation than boys from attending longer programs). (Hints: Again, do NOT calculate any constant or slope estimates. All that is being requested here is that you set up the rejection rule appropriate to a hypothesis test.)

3. The "bullet theory of child-depression" argues that parents cause behavioral problems in their children when they use punitive child-rearing methods. These behavioral problems are generally manifest as sporadic aggressive behavior on the part of the child. Developmental psychologists have argued that this is the result of the child's modeling (i.e., imitating) of its parents' punitive aggression. Since other children want no part of such an unpredictably aggressive child, the child becomes isolated and, ultimately, depressed due to this "isolation from its peers." That is, the bullet theory is that the causal ordering is from "physically punitive child-rearing" to "child's sporadic aggressive behavior" to "child's depression." Yet a recent critique of the theory points out that the bullet theory considers only physically punitive child-rearing practices, and that such practices are often accompanied by verbally punitive child-rearing practices (i.e., parental statements that are critical of the child). Moreover, it is this verbal (and not physical) punishment that results in the child's development of a negative self-concept and accompanying depression. (That physical punishment has a direct effect on a child's aggressive behavior but has no direct effect on its depression are well-established facts agreed on both by bullet theorists and their critics.) And it is physical (and not verbal) punishment that results in a child's aggressive behavior. The critique concludes that the association between the child's aggression and its depression is thus a spurious consequence of the association between their distinct types of punitive causes.

You use four variables from a random sample of 93 Iowan 12-year-olds to investigate the relative merits of the bullet theory versus its critique:

\[
\begin{align*}
\text{PHYSICAL} & = \text{the amount of physical punishment by parents in "spankings per week" (a measure of "physically punitive child-rearing")} \\
\text{AGGRESSION} & = \text{the amount of aggressive behavior by the child in "aggressive outbursts per week" (a measure of "child's sporadic aggressive behavior")} \\
\text{DEPRESSION} & = \text{the amount of depression experienced by the child in "depressive episodes per week" (a measure of "child-depression")} \\
\text{VERBAL} & = \text{the amount of verbal punishment by parents in "demeaning statements per week" (a measure of "verbally punitive child-rearing")}
\end{align*}
\]

Correlations among these variables are as follows:
a. Draw a path model in which the association between PHYSICAL and VERBAL remains unanalyzed (i.e., associational), but in which one finds paths either based on well-established facts or asserted to be nonzero either in the "bullet theory of child-depression" or in the recent critique. On a hunch, you decide to evaluate whether or not parents' verbal punishment is associated with their children's aggressive behavior. In brief, you construct a path model with only one overidentifying restriction, namely that PHYSICAL has no direct effect on DEPRESSION. (Show your calculations for all paths and residual coefficients.)

b. Draw a more restricted path model that takes into account suggestions in the recent critique that childhood aggressive behavior and child-depression have distinct (i.e., different, not the same, none alike, . . .) causes. In particular, the critique argues that (contrary to your hunch) a child's aggressive behavior does not result from its parents' verbally punitive child-rearing behaviors. It also argues that the causal role that (according to the bullet theory) childhood aggression is supposed to play in the development of child-depression is a spurious one. (Show your calculations for all paths and residual coefficients.)

c. Based on the least restricted model constructed in part a, what are the direct, indirect, and total effects of VERBAL on DEPRESSION?

d. Use chi-square to compare the relative fit of the path models drawn in parts a and b. Which model provides the better fit? (Use the .05 level of significance.)

e. Do your data provide support for bullet theory or for its critique? (Justify your answer by comparing the better-fitting path model to the model against which it was tested.)

4. Students of marital quality have been hard-pressed to find evidence for either the "modeling theory" or the "disassociation theory" of marital happiness. On the one hand, modeling theory argues that by acting out, or modeling, their parents' happy (or unhappy) marriages, offspring will themselves have happy (or unhappy) marriages. On the other hand, disassociation theory argues that offspring from unhappy marriages will "disassociate" with their parents' modes of interaction, and will create alternative means to build happy marriages with their spouses. Disassociation theory further argues that offspring from happy marriages will develop unreasonable expectations of marital harmony in their own marriages (e.g., the expectation that their marriages will be happy without any effort from them), and will be unhappy in their marriages when they find—as all marriage partners to—that these expectations are not met. (Be sure that you understand that whereas modeling theory predicts a positive effect of parents' marital happiness on offspring's marital happiness, disassociation theory predicts a negative effect here.)
Recent studies provide evidence that modeling is mediated by self-esteem. In particular, findings in these studies show that only people with high self-esteem have happy marriages, and that people who grow up in families with happy marriages are more likely than other people to have high self-esteem. To test modeling and disassociation theories you randomly sample 500 Des Moines residents and obtain data on the following four variables:

**P-MHAPPY**  Parents' marital happiness (on a scale from 1=very unhappy to 100=ecstatic)

**O-MHAPPY**  Offspring's marital happiness (on a scale from 1=very unhappy to 100=ecstatic)

**S-ESTEEM**  Offspring's self-esteem (on a scale from 1=low to 10=high)

**EFFORT**  Offspring's response to the question, "Before getting married, how much effort did you expect would be required for you to keep your marriage happy?" (on a scale from 1=no effort at all to 5=a lot of effort)

(You may assume that each of these variables is interval-level.) The fully recursive path model is as follows:

The following matrix lists all but one of the correlations among the model's four variables:

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td>.062</td>
<td>-.338</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td></td>
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<td>.936</td>
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<td>3</td>
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<td>4</td>
<td>.815</td>
<td>.401</td>
<td>.482</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P-MHAPPY</td>
<td>O-MHAPPY</td>
<td>S-ESTEEM</td>
<td>EFFORT</td>
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<td>--------</td>
</tr>
<tr>
<td>PHYSICAL</td>
<td>1.00</td>
<td>.03</td>
<td>.34</td>
<td>-.35</td>
</tr>
<tr>
<td>O-MHAPPY</td>
<td>.03</td>
<td>1.00</td>
<td>.35</td>
<td>AAAA</td>
</tr>
<tr>
<td>S-ESTEEM</td>
<td>.34</td>
<td>.35</td>
<td>1.00</td>
<td>-.15</td>
</tr>
<tr>
<td>EFFORT</td>
<td>-.35</td>
<td>AAAA</td>
<td>-.15</td>
<td>1.00</td>
</tr>
</tbody>
</table>

a. Solve for AAAA in the correlation matrix.

b. Make up a table of just those direct, indirect, and total effects on O-MHAPPY from this fully recursive path model. Be sure and show how any indirect effects were calculated.

c. Based on the paths in the fully recursive model, do you have evidence in support of modeling or disassociation theory? Explain your answer. (Hint: No test of significance is required here.)

d. Based on the research mentioned in the first paragraph of this problem, you believe that there is no direct effect of parents' marital happiness on offspring's marital happiness. Moreover, you find no theoretical reason for positing a causal relation between self-esteem and the effort that offspring believe is required for them to make their marriages happy. You now estimate a more parsimonious model without the paths associated with each of these arguments. Draw the paths of this more restricted path model in the graphic below. On these paths be sure to place numerical values for residual effects and for effects between variables. Show how all paths were obtained!
e. Use chi-square to test whether the fully recursive or the restricted path model provides the best fit to the data. Which is the best-fitting path model? (Use the .05 level of significance.)

5. In the social sciences there is a long-standing debate between the “structuralists” and the “functionalists.” Structuralists believe that people develop attitudes that justify their behaviors. For example, structuralists argue that people come to value improving their appearance only after they discover their behaviors to have successfully improved their appearance. Functionalists believe that people must first develop a positive attitude about (i.e., come to value) a behavior before using the behavior. For example, functionalists argue that one must come to value the improvement of one’s appearance before one acts to improve one’s appearance.

You are analyzing survey data on U.S. women’s shopping for fashion items (e.g., cosmetics, jewelry, designer clothing, etc.). As you begin constructing a path diagram that depicts causal relations among your variables, you are unsure whether a structuralist or a functionalist depiction would be more appropriate. On the one hand, your structuralist beliefs lead you to hypothesize that not only does the time a woman spends exercising take time away from her fashion shopping, exercising time also improves the woman’s appearance (thereby instilling in her the importance of her appearance). On the other hand, your functionalist beliefs lead you to hypothesize that the more important a woman’s appearance is to her, the more she will behave in ways (e.g., exercise, shop for fashion items, etc.) to improve her appearance. Your solution is to construct two diagrams: one that corresponds to each perspective.

Your sample is of 300 women on whom you have data for the following 5 variables:

\[ Z_1 = \text{Age (in years at time when the survey was taken)} \]

\[ Z_2 = \text{Family income (in thousands of dollars)} \]

\[ Z_3 = \text{Exercise (in hours per week spent jogging, swimming, etc.)} \]

\[ Z_4 = \text{Importance of one’s appearance (on a scale from 0=of no importance to 100=of paramount importance)} \]

\[ Z_5 = \text{Fashion shopping (in hours per week spent shopping for fashion items)} \]

a. Below are 2 path diagrams. Which depicts the structuralist argument? Which depicts the functionalist one?

The structuralist argument is depicted in Diagram #________.

The functionalist argument is depicted in Diagram #________.
b. Diagram #2 gives neither values for paths between variables nor values for residual paths. Using information provided in Diagram #1 plus the correlation coefficients listed in the table below, obtain (and show how you arrived at) numerical values for the missing paths labeled AAAA, BBBB, ..., KKKK in Diagram #2.
Correlation coefficients

<table>
<thead>
<tr>
<th></th>
<th>Z₁</th>
<th>Z₂</th>
<th>Z₃</th>
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<th>Z₅</th>
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<tr>
<td>Z₅</td>
<td>.24</td>
<td>.24</td>
<td>.52</td>
<td>.02</td>
<td>1.00</td>
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</table>

AAAA equals ________. How arrived at:

BBBBB equals ________. How arrived at:

CCCCC equals ________. How arrived at:

DDDDD equals ________. How arrived at:

EEEEE equals ________. How arrived at:

FFFFF equals ________. How arrived at:

GGGGG equals ________. How arrived at:

HHHHH equals ________. How arrived at:

IIII equals ________. How arrived at:

JJJJJ equals ________. How arrived at:

KKKKK equals ________. How arrived at:

c. The following is a list of R-squared values for regressions of each variable on two, three, or four other variables in your analysis (e.g., \( R^2_{1.23} \) is the R-squared from the regression of \( Z_1 \) on \( Z_2 \) and \( Z_3 \)):

\[
\begin{align*}
R^2_{1.23} &= .911 \\
R^2_{1.24} &= .903 \\
R^2_{1.25} &= .720 \\
R^2_{1.34} &= .261 \\
R^2_{1.45} &= .690 \\
R^2_{1.234} &= .912 \\
R^2_{1.235} &= .912 \\
R^2_{1.245} &= .903 \\
R^2_{1.345} &= .727 \\
R^2_{1.2345} &= .913 \\
R^2_{2.13} &= .904 \\
R^2_{2.14} &= .916 \\
R^2_{2.15} &= .903 \\
R^2_{2.34} &= .733 \\
R^2_{2.35} &= .203 \\
R^2_{2.45} &= .739 \\
R^2_{2.134} &= .916 \\
R^2_{2.135} &= .905 \\
R^2_{2.145} &= .919 \\
R^2_{2.345} &= .750 \\
R^2_{2.1345} &= .920 \\
R^2_{3.12} &= .272 \\
R^2_{3.14} &= .293 \\
R^2_{3.15} &= .428 \\
R^2_{3.24} &= .220 \\
R^2_{3.25} &= .383 \\
R^2_{3.45} &= .354 \\
R^2_{3.124} &= .295 \\
R^2_{3.125} &= .444 \\
R^2_{3.145} &= .432 \\
R^2_{3.245} &= .383 \\
R^2_{3.245} &= .383 \\
R^2_{3.1245} &= .444 \\
R^2_{4.12} &= .690 \\
R^2_{4.13} &= .656 \\
R^2_{4.14} &= .671 \\
R^2_{4.23} &= .696 \\
R^2_{4.25} &= .723 \\
R^2_{4.35} &= .115 \\
R^2_{4.123} &= .700 \\
R^2_{4.125} &= .725 \\
R^2_{4.135} &= .624 \\
R^2_{4.235} &= .723 \\
R^2_{4.1235} &= .725 \\
R^2_{5.12} &= .059 \\
R^2_{5.13} &= .271 \\
R^2_{5.14} &= .140 \\
R^2_{5.23} &= .270 \\
R^2_{5.24} &= .161 \\
R^2_{5.34} &= .291 \\
R^2_{5.123} &= .281 \\
R^2_{5.124} &= .164 \\
R^2_{5.125} &= .309 \\
R^2_{5.134} &= .336 \\
R^2_{5.1234} &= .341
\end{align*}
\]
Using statistics from this list and from previous parts of this problem, determine whether (at $\alpha = .05$) either model provides a good fit to your data.

d. Do your data provide evidence for the structuralist or the functionalist perspective as they are described in the first paragraph of this problem? (Be sure to indicate what evidence you use in support of your answer.)

6. Your hypothesis is that children in urban areas stop believing in Santa Claus earlier than children in rural areas. You have data on three variables from a sample of 25 children:

- $Y$ = Strength of the child’s belief in Santa Claus (on a scale from 0 = absolute disbelief to 100 = total belief)
- $X_1$ = Child’s age (in years)
- $X_2$ = Child’s place of residence (1 = rural and 2 = urban)

a. To test your hypothesis you construct a variable, $X_3$. Explain how this variable was constructed.

b. Give the rejection rule that you would use to test the hypothesis at the .05 significance level.

7. Did you know that hamburger may still contain harmful germs even after cooking it until it no longer has any pink color? Evidently, many Family and Consumer Sciences (erstwhile Home Economics) teachers in Iowa High Schools do not. Of course, these teachers have many topics to teach other than food safety. Yet food safety is something that members of the Iowa Food Safety Council (IFSC) believe Iowa's high school students should be made aware of—most certainly those students who take classes in Family and Consumer Sciences (FCS). And so the IFSC has hired you to investigate what factors might inspire FCS teachers to spend more time instructing their students on the safe handling and preparation of food.

In the literature on teacher-motivation you find considerable evidence not only that teachers interested in a subject (e.g., food safety) will gain knowledge about it, but also that teachers only devote time to topics they are knowledgeable about. Yet this causal chain from interest to knowledge to time-devoted does not pertain to what might inspire teachers’ interest in the first place (i.e., to the IFSC's reason for hiring you). So you delve further into the literature, and find two contrasting theories of motivation.

According to **Reward Theory**, teachers only become interested in teaching topics that they are paid to teach. According to **Concern Theory**, interest in teaching a topic is primarily in reaction to recent social disasters (e.g., food poisonings) caused by
community members' ignorance on the topic. To evaluate your ideas, you collect data on a random sample of 163 FCS teachers employed by Iowa high schools. Your data include the following 5 variables:

Z₁ = Disasters (the number of cases of food poisoning within 10 miles of the high school during the past year)

Z₂ = Rewards (the teacher's supervisor's response to the statement, "I give larger pay increases to FCS teachers who emphasize food safety than to those who do not." on a scale from 1=strongly disagree to 5=strongly agree)

Z₃ = Interest (the teacher's score on a scale from 0=no interest in teaching food safety to 10=extreme interest in teaching food safety)

Z₄ = Knowledge (the teacher's score on a scale from 0=no correct answers on a test about food-safety to 10=all ten test questions answered correctly)

Z₅ = Time (the teacher's report of hours per week spent teaching food safety)

Correlations among these five variables are as follows:

<table>
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<tr>
<th></th>
<th>Z₁</th>
<th>Z₂</th>
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In addition to the causal relations suggested in the literature, you add the following three hypotheses (or paths) to your path model:

1) Despite Reward Theory adherents’ contention that pay motivates interest, you believe that pay primarily motivates teachers to “go through the motions” (i.e., to spend time teaching food safety, regardless of their interest or knowledge of the topic).

2) Social disasters (e.g., food poisonings) are usually accompanied by considerable media coverage—coverage that includes information on how to prevent such disasters from happening in the future. As a consequence, such disasters will yield not only FCS teachers’ increased interest in food safety, but also their increased knowledge on the topic from viewing this type of accompanying media coverage.

3) Social disasters are also likely to increase the rewards offered to persons who might help in their future prevention. Thus, you also hypothesize that if many food poisonings have occurred near their high school during the past year, FCS teachers’ supervisors would be more likely to reward their teachers for teaching food safety than if there were to have been fewer such food poisonings.

a. In the space provided below and on the next page, draw a single path diagram.
that includes paths corresponding to each of the findings that you located in the literature (including findings in support of Reward and Concern Theories), plus paths related to your three additional hypotheses and all residual paths. Place the value of each path coefficient adjacent to its corresponding arrow in the diagram. (Hint: If any endogenous variable has more than 2 paths other than the residual path leading to it, you have drawn the diagram incorrectly.)

b. Here are five statements about the path diagram in part a. Indicate whether each is true or false:

1) Part of the association between Knowledge (Z4) and Time (Z5) is depicted as spurious. True  False

2) No part of the association between any pair of variables is unanalyzed. True  False

3) The diagram depicts a nonrecursive path model. True  False

4) The normal equations associated with Interest (Z3) have as many equations as unknowns. True  False

5) Interest (Z3) has no effect on Time (Z5). True  False

c. Based on the overidentified path diagram in part a, how much of the effect of Disasters (Z1) on Knowledge (Z4) is direct, indirect, spurious, and unanalyzed?

d. Given the decomposition performed in part c, is there evidence of an increase (or a decrease) in teachers’ knowledge about food safety when there is a rise in the number of cases of food poisoning near the high school in which they teach? Explain your answer based on the path diagram drawn in part a.

e. Draw a more restricted path diagram in which two paths have been eliminated from the diagram drawn in part a. In particular, eliminate the paths from Rewards (Z2) to Interest (Z3) and from Disasters (Z1) to Knowledge (Z4). Use chi-square to determine (at α=.05) which model provides the better fit to your data.

8. Most students of the social sciences have heard of the Asch experiments, in which people were asked to report which two lines from among three were the same length. Asch found that people perceived lines of different lengths (rather than same-lengthed lines) to be of the same length after hearing others report these lines to be of the same length. Instead of “believing their eyes,” people commonly accept social norms agreed upon by others. Subsequent work on perception has found that people generally see certain shapes (e.g., right angles) as normative. For example, if someone looks at the corner of a cabinet or of a building and sees it as “leaning” one way or another, they will perceive it to be further-from-a-right-angle than it actually is. Cabinets and corners of
buildings are “supposed to be” constructed at 90-degree angles. When they are not, people see them as further from this norm than they are in fact.

Imagine an experiment in which subjects are briefly shown a “nonnormative” 94-degree angle on a screen. Then the subjects are asked to judge which of two angles comes closest to the just-shown angle—one angle is 99 degrees, the other is 89 degrees (i.e., each comparison angle is an equidistant 5 degrees from the initial angle). Yet, the former (99-degree) angle is less normative than the latter (89-degree) one, allowing you to test whether subjects judge nonnormative angles (e.g., ones with 94 and 99 degrees) to be “closer” to each other than angles, one of which is relatively normative (89 degrees) and the other of which is relatively nonnormative (94 degrees).

You construct a set of angles to be shown to Psychology 101 students at ISU. The angle to be initially shown to the students (i.e., their ISA) varies according to its degrees of difference from a 90-degree (i.e., normative) angle. You keep the difference in degrees between the subsequently shown angles (i.e., the SSAs) fixed at 10 degrees. (For example, in the previous paragraph, this difference is 99 degrees minus 89 degrees.) However, you vary the SSAs such that the more normative angle in the pair (i.e., the angle closer to 90 degrees) varies in how far it is in fact from the ISA. (For example, from the SSAs in the previous paragraph the more normative angle of 89 degrees is 5 degrees from the ISA of 94 degrees. In your research it varies from zero to ten.) Thus, you begin with the following two independent variables:

DIFFNORM the number of degrees difference between the ISA and a 90-degree angle, ranging from zero (a 90-degree angle) to 5 (either a 95-degree or an 85-degree angle)

DIFFFACT the number of degrees difference between the ISA and the more normative of the SSAs, ranging from zero (the ISA and the normative SSA are identical) to 5 (the ISA is five degrees from both SSAs) to 10 (the ISA and the nonnormative SSA are identical)

You set up a balanced research design in which you randomly assign one of 66 Psychology 101 students to each of the 66 possible combinations of values among DIFFNORM and DIFFFACT. (That is, you fix your design matrix such that Student #1’s scores on both DIFFNORM and DIFFFACT are zero. For Student #2, DIFFNORM=0 and DIFFFACT=1. And so on up until Student #66, for whom DIFFNORM=5 and DIFFFACT=10.) Your dependent variable is each student’s score on how certain s/he is that one versus the other SSA is closer to the ISA. This variable is defined as follows:

CERTNORM the value on a 21-point scale, ranging from -10 (certain that the ISA and the nonnormative SSA are closest) to zero (no idea which SSA is closest to the ISA) to 10 (certain that the ISA and the normative SSA are closest)

a. Given your research design, what is the correlation between DIFFNORM and DIFFFACT? Explain your answer.
b. Show how you would construct a contrast (i.e., specify the contrast’s values under specific conditions) with which to test the following hypothesis: The more degrees of difference between the ISA and a 90-degree (or normative) angle, the less certain a student will be that the normative SSA is closest to the ISA.

c. Show how you would construct a contrast (i.e., specify the contrast’s values under specific conditions) with which to test the following hypothesis: The more degrees of difference between the ISA and a 90-degree (or normative) angle, the less likely the ISA’s actual closeness to the normative SSA will make students more certain that the normative SSA (and not the nonnormative SSA) is closer to the ISA.

d. What complete and reduced regression equations would you compare in testing the hypothesis stated in part c?

e. What two pieces of information (i.e., what tests) would you need to justify claiming empirical support for the hypothesis stated in part c? Be as specific as possible when explaining your answer.

Based on your results and on data obtained during exit interviews with the 66 students, you discover that the normative versus nonnormative character of the ISA has much more influence on CERTNORM among students from urban (than those from rural) settings. Your hunch is that cities (given their numerous buildings) have more right angles than the countryside, leaving people from rural settings less likely to see such angles as normative. You also find that effects vary according to intelligence (smart folks accept norms less readily than not-so-smart people) and eyesight (those who see poorly are more likely to accept, normatively, what their better-sighted peers tell them). You develop a questionnaire and obtain data on the following variables for a second sample of 66 Psychology 101 students:

- $Z_1$ Hometown population density in people per square mile
- $Z_2$ Eyesight on a scale from 0=blind to 10=perfect 20-20 vision
- $Z_3$ IQ (Intelligence Quotient), for which 100 indicates average intelligence

After filling in your questionnaire, each student is shown 60 sets of angles that were developed for your previous experiment. (You do not show sets in which DIFFFACT=0, that is in which both ISAs are equidistant from the ISA.) This time you use the following outcome measure:

- $Z_4$ The number correct identifications of “the SSA that is closer to the ISA” (Scores on this variable range from zero [not one of the closer-SSAs is correctly identified] to 60 [all closer-SSAs are correctly identified])

Your fully recursive model looks as follows:
Correlations among the four variables are as follows:

\[
\begin{array}{cccc}
  Z_1 & Z_2 & Z_3 & Z_4 \\
  Z_1 & 1.00 & & \\
  Z_2 & 0.05 & 1.00 & \\
  Z_3 & 0.35 & -0.20 & 1.00 \\
  Z_4 & AAA & 0.45 & 0.35 & 1.00 \\
\end{array}
\]

f. Solve for AAA in the above correlation matrix.

g. What is the total effect of Density (Z_1) on Correct (Z_4)? Show your work!

h. Does the fully recursive model provide a significantly better fit to the data than a model with the overidentifying restrictions that \( p_{21} = p_{41} = 0 \)? Use the .05 significance level in justifying your answer.

9. Imperial Palace Hotels (IPH) has built a hotel in the Philippines, becoming the first South Korean hotel chain to develop a property outside the country. In October 2007 construction was completed on the 668-room hotel, located on Mactan Island in the central part of the Philippines. You have been asked to analyze satisfaction data obtained from a random sample of the hotel’s customers during its first two months of operation. Your variables consist of 200 customers’ responses to the following questions:

\[ Z_1 = \text{How satisfied are you with the location of our hotel?} \]
\[ Z_2 = \text{How satisfied are you with the friendliness of our hotel’s service?} \]
\[ Z_3 = \text{How satisfied are you with the comfortableness of your room?} \]
\[ Z_4 = \text{How likely are you to stay in our hotel again if you return to this part of the Philippines?} \]
Responses to $Z_1$, $Z_2$, and $Z_3$ are each along a 10-point scale from 1="entirely unsatisfied" to 10="completely satisfied". Responses to $Z_4$ are along a 10-point scale from 1="I'll never return" to 10="I'll certainly return." Correlations among these variables are as follows:

\[
\begin{array}{cccc}
Z_1 & Z_2 & Z_3 & Z_4 \\
--- & --- & --- & --- \\
Z_1 & 1.00 & & \\
Z_2 & -0.50 & 1.00 & \\
Z_3 & 0.15 & 0.30 & 1.00 \\
Z_4 & 0.60 & 0.20 & 0.40 & 1.00 \\
\end{array}
\]

In a preliminary examination of your data, you construct the following path model:

a. Obtain the value of the path, AAA, using the data provided above.

b. Obtain the value of the path, BBB, using the data provided above.

c. Obtain the value of the residual path, CCC, using the data provided above.

d. Does convenient location or friendly service have a greater total effect on customers' intention to return to the Philippine Imperial Palace Hotel? (Show your work!)

e. Does the fully recursive model (i.e., the path model provided at the beginning of this problem) fit your data as well as a more restricted model in which the path, $p_{43}$, has been set equal to zero? (Use the .05 significance level.)
Probably the most striking finding from your survey is the strong negative correlation (namely, \( r_{12} = -0.50 \)) between customers’ reports on the hotel’s convenient location and their reports on its friendly service. It seems that the Philippine customers’ experiences have been that more conveniently located hotels have less friendly service but that less conveniently located ones have more friendly service. (Evidently, more service is required to attract customers to a poorly located hotel than to a well located hotel.) Since you have never had such a finding when analyzing similar data from Korea, you believe that this negative association is due to cultural factors specific to the Philippines.

Fortunately you are able to test this belief directly, because you have data that were collected last year when you administered the same survey to a random sample of 100 customers from the Imperial Palace Hotel (IPH) in Seoul, South Korea. You merge these data with your Philippine data in preparation for testing the hypothesis, “A negative linear relation between ‘the convenience of the IPH’s location’ and ‘the friendliness of its service’ is stronger among IPH’s Philippine than its Korean customers.”

f. What complete and reduced models would you compare in conducting a test of this hypothesis (i.e., the hypothesis in quotation marks at the end of the previous paragraph)? (Hints: Explain how you obtained each of these models’ not-previously-defined-variables [namely, any variable other than \( Z_1, Z_2, Z_3, \) or \( Z_4 \)].)

g. What two pieces of evidence would you need to justify claiming empirical support for the hypothesis referred to in part f? Although you cannot actually obtain these pieces of evidence, be as specific as possible when explaining the tests you would perform in the process of obtaining them.