

Homework 1

Due May 1, 10AM

Please turn in hard copy to me on the due date. Show your work or include outputs, whichever is relevant.

1. Use the following matrices to compute the requested quantities by hand (typing is not necessary).

$$\mathbf{A} = \begin{bmatrix} 3 & 4 \\ 0 & 7 \\ 4 & -1 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 2 & 5 \\ 6 & 0 \\ 4 & -1 \end{bmatrix} \quad f = 7$$

- a. $A+B$
- b. $A-B$
- c. B'
- d. AB'
- e. AB
- f. fA

2. Define the following matrix terms **in your own words** (please type these responses).

- a. Diagonal matrix
- b. Identity matrix
- c. Inverse
- d. Determinant
- e. Variance-covariance matrix

3. Use SPSS or R to compute the following quantities using the A and B matrices given above.

- a. $A+B$
- b. $A-B$
- c. B'
- d. AB'
- e. AB

4. Use the SPSS Matrix procedure or R to compute the column means matrix \mathbf{X} below. Assume there are 10 cases for three variables, X_1 , X_2 , X_3 (first column is X_1 , second column is X_2 , and the third column is X_3). Please provide your output and syntax.

$$\mathbf{X} = \begin{bmatrix} 2 & 4 & 7 \\ 10 & 4 & 3 \\ 8 & 6 & 6 \\ 8 & 6 & 4 \\ 4 & 2 & 4 \\ 6 & 3 & 6 \\ 4 & 2 & 5 \\ 6 & 5 & 7 \\ 3 & 3 & 3 \\ 9 & 5 & 5 \end{bmatrix}$$

5. Assume the values in the \mathbf{X} matrix below are deviation scores (i.e., mean subtracted from each raw score) for 5 cases for two variables, X_1 and X_2 (first column is X_1 and second column is X_2).

- a. Compute the variance-covariance matrix for X_1 and X_2 by hand using a matrix approach. Please show your work.

$$\mathbf{X} = \begin{bmatrix} -5 & 0 \\ -1 & 1 \\ -1 & 5 \\ 2 & -4 \\ 5 & -2 \end{bmatrix}$$

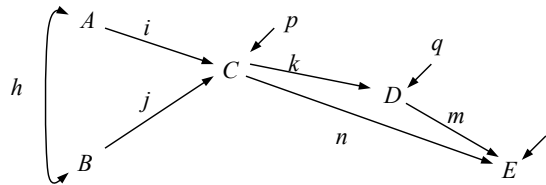
Use SPSS or R to compute the values requested below for the \mathbf{X} matrix above:

- b. Compute a matrix called \mathbf{S} that is variance-covariance matrix of X_1 and X_2 (that is, verify that your answer to Problem 5a is correct)
- c. Obtain the determinant of \mathbf{S} .
- d. Obtain the inverse of \mathbf{S} .
- e. Show that $\mathbf{S}^{-1}\mathbf{S} = \mathbf{I}$

6. Use the SPSS Matrix procedure or R to compute the regression equation for X predicting Y using the matrices below (Hint: there is something missing from the \mathbf{X} matrix). Please provide your output and syntax.

$$\mathbf{X} = \begin{bmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 5 \end{bmatrix} \quad \mathbf{Y} = \begin{bmatrix} 5 \\ 5 \\ 8 \\ 6 \\ 2 \end{bmatrix}$$

7. Consider the following path diagram. Using the letters in the diagram below, write the requested structural equation for each correlation (e.g., $xyz + ab$).



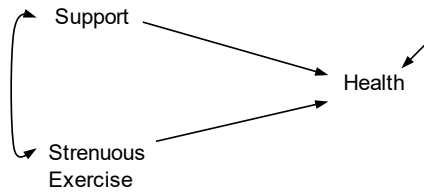
- a. r_{AC}
- b. r_{BD}
- c. r_{AB}
- d. r_{AE}

8. For the next questions, please type your responses and include the relevant printouts with each answer. Answers should be about one paragraph for each question, and they should be written **in your own words** as if they were part of a research report or journal article.

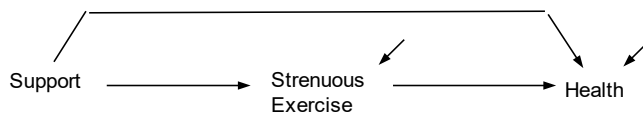
Data for the questions below are a random sample of participants aged 50 and over from a study conducted by Mirowsky and Ross on aging and perceived control.¹ Raw data file is available from the data page: <http://web.pdx.edu/~newsomj/data.htm>. The variables in the data set include the following: a measure of perceived social support (*support*), an average of four questions on the perceived availability of support (e.g., “I have someone I can turn to for support”), each rated on a 4-point scale (1=“strongly disagree” to 4=“strongly agree”); strenuous exercise (*strenex*), based on a self-report of the number of times respondent engaged in strenuous activity over the past month; and perceived health (*health*, global rating from 1=“very poor” to 5=“very good”).

¹ Mirowsky, J., & Ross, C. E. (2001). Age and the effect of economic hardship on depression. *Journal of health and social behavior*, 132-150.

a. Use Mplus or lavaan to test the path model drawn below. Report the unstandardized and standardized path coefficients and whether they were significant (don't worry about fit indices yet). Describe and interpret the conclusions from your analysis.

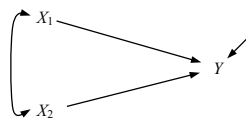


b. Use Mplus or lavaan to test the mediational model drawn below. Use uncorrected bootstrap analysis with at least 1,000 samples to estimate the indirect path coefficient, significance, and confidence intervals. Report the unstandardized and standardized path coefficients and whether they were significant (don't worry about fit indices yet) and report the indirect path coefficient, bootstrap significance, and confidence limits. Describe and interpret the conclusions from your analysis.



9. Use your own data to test the following models. You will need three continuous variables for these problems. They may be individual items (with 5 or more ordinal values) or a composite index of some kind. If you do not have a data set you can use, I can help find you one or provide one. Choose a set of variables in which one variable could be hypothesized to be an outcome and one variable could be hypothesized to be a mediator. If using Lavaan, you will likely be able to directly read in your data from another format into R. If you are using Mplus, please carefully follow the instructions on the handout "Data Set Preparation" to make sure you create an ASCII (text) file correctly. This includes double checking to make sure that the descriptive statistics in the source package and Mplus match **exactly**. In either case, you should use listwise deletion for these problems (we will discuss alternative ways of handling missing data later in the course).

a. Use Mplus or the lavaan R package to test the path model drawn below. Variables X_1 and X_2 in the diagram are any two variables from your data set that can be hypothesized as predictors and Y is any variable that can be hypothesized as an outcome. (Note: make sure that one of the predictors variables you choose for this model can also be hypothesized to be a mediator for the model in the following problem). Report the unstandardized and standardized path coefficients and whether they were significant (don't worry about fit indices yet). Describe and interpret the conclusions from your analysis.



b. Use Mplus or the lavaan R package to test the mediational model drawn below using the same three variables as you used in the preceding problem, designating either X_1 or X_2 from the problem above as the mediator. You do not have to pick a variable that has a significant indirect path coefficient. Use uncorrected bootstrap analysis with at least 500 samples to estimate the indirect path coefficient, significance, and confidence intervals. Report the unstandardized and standardized path coefficients and whether they were significant (don't worry about fit indices yet) and report the indirect path coefficient, bootstrap significance, and confidence limits. Describe and interpret the conclusions from your analysis.

