

## Chapter Eight: Multivariate Analysis

Up until now, we have covered univariate (“one variable”) analysis and bivariate (“two variables”) analysis. We can also measure the simultaneous effects of two or more independent variables on a dependent variable. This allows us to estimate the effects of each independent variable on the dependent variable, while controlling for the effects of one or more other independent variables. This is called multivariate (“multiple variables”) analysis. In this Chapter we review two ways to do that by using techniques that you have already used: crosstabs and regression analysis.

### Crosstabs Revisited

Recall that the crosstabs procedure is used when variables are nominal (or ordinal). Simple crosstabs, which examine the influence of one variable on another, should be only the first step in the analysis of social science data (refer to Chapter 5). One might hypothesize that people who identify as Republicans are more likely to oppose abortion than those who identify as Democrats, then run the crosstabs, and then conclude you were right. However, this one-step method of hypothesis testing is very limited. What if most of the Republicans in your sample are strongly religious and most of the Democrats are not strongly religious? Is it the political party that best explains your findings or is it religious orientation?

Let’s explore this issue. First, we will test whether political conservatism is related to attitudes toward abortion. Before we run the Cross tabulation, we will recode the independent variable (*partyid*) to make our interpretation easier. Refer back to Chapter 3 to review how to recode into a new variable. Naming your new variable *partyidr* (for *partyid* recode), recode *partyid* into three categories as follows:

<u>Values for <i>partyid</i></u>	<u>Values for <i>partyidr</i></u>	<u>Value Label for <i>partyidr</i></u>
0-2	1	Democrat
3	2	Independent
4-6	3	Republican
All other values	System-missing	

Then, run Crosstabs using *partyidr* as the independent variable (in the column position), and *abany* as the dependent variable (in the row position). You may want to review Chapter 5 for direction on how to do this. You should get results that look like the table shown in Figure 8-1.

As the results show, 42.6% of all respondents think that abortion should be allowed for any reason. However, political party identification does appear to be related to attitudes toward abortion. Just over half (51.9%) of respondents who identify as Democrats are in favor of allowing abortion for any reason, compared to less than a third of those identifying as Republicans (31.6%). So, our hypothesis appears to be supported. But we are still left with the question of whether the strength of religious beliefs actually accounts for this relationship.

We will do a multivariate cross tabulation to test this idea, also called an elaboration analysis. If the relationship between party identification and attitudes toward abortion persists no matter what the strength of religious beliefs, then we would conclude that party identification is the better predictor of these attitudes. If the relationship between party identification and attitudes disappears when the strength of religious beliefs is controlled (that is, nearly the same percentage of Democrats and Republicans approve of abortion within each level of religiosity), then we would conclude that the strength of religious beliefs is the better predictor. But what if the relationship between political party identification is different, depending on the strength of religious beliefs? If that is the case, then we would say that there is an interaction between the two independent variables; they work together in shaping attitudes toward abortion.

abany ABORTION IF WOMAN WANTS FOR ANY REASON * partyidr Crosstabulation						
			partyidr			Total
			1.00 Democrat	2.00 Independent	3.00 Republican	
abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	279	97	131	507
		% within partyidr	51.9%	40.6%	31.6%	42.6%
	2 NO	Count	259	142	283	684
		% within partyidr	48.1%	59.4%	68.4%	57.4%
Total	Count	538	239	414	1191	
	% within partyidr	100.0%	100.0%	100.0%	100.0%	

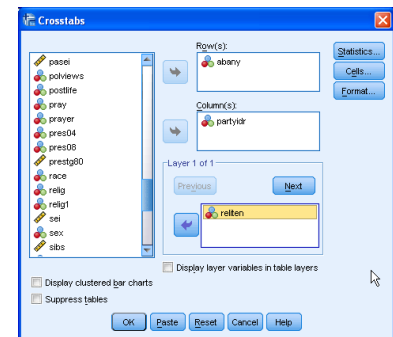
**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	39.593 <sup>a</sup>	2	.000
Likelihood Ratio	39.998	2	.000
Linear-by-Linear Association	39.454	1	.000
N of Valid Cases	1191		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 101.74.

**Figure 8-1**

Recall that your original crosstabs procedure produces one contingency table, with as many rows as there are categories (or values) of the dependent variable, and as many columns as there are categories of the independent variable. When you start using control (sometimes called test) variables, you will get as many separate tables as there are categories of the control variable. There are four categories in the *reliten* variable, the measure of strength of religious beliefs. Thus, we should expect to get four contingency tables, each one showing the relationship between *partyidr* and *abany* for a different category of *reliten*.



**Figure 8-2**

To do the crosstabs, click **Analyze, Descriptive Statistics, Crosstabs**, just as you did for testing the bivariate relationship between *partyidr* and *abany*. This time, click on *reliten* and move it into the box called Layer 1 of 1. The dialog box should look like the one shown in Figure 8-2. Click **OK**. Your results should look like the table shown in Figure 8-3.

Notice that the relationship between *partyidr* and *abany* is different depending on the different categories of *reliten*. What does that tell you?

Try other variables as a control (i.e., in place of *reliten*) to see what happens. As a general rule, here is how to interpret what you find from this elaboration analysis:

- If the partial tables, such as those shown in Figure 8-3 are similar to the zero-order table (this is the original bivariate table shown in Figure 8-1), you have *replicated* your original findings, which means that in spite of the introduction of a particular control variable, the original relationship persists. The only way to convince us that this is indeed a strong, or even causal, relationship is if you control for all the other logical independent variables you can think of, and still find essentially no differences between the zero-order tables and their partials.

abany ABORTION IF WOMAN WANTS FOR ANY REASON \* partyidr \* reliten STRENGTH OF AFFILIATION Crosstabulation

reliten STRENGTH OF AFFILIATION				partyidr			Total
				1.00 Democrat	2.00 Independent	3.00 Republican	
1 STRONG	abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	63	11	31	105
			% within partyidr	38.4%	18.3%	16.1%	25.2%
		2 NO	Count	101	49	162	312
			% within partyidr	61.6%	81.7%	83.9%	74.8%
	Total	Count		164	60	193	417
		% within partyidr		100.0%	100.0%	100.0%	100.0%
2 SOMEWHAT STRONG	abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	6	5	7	18
			% within partyidr	20.0%	19.2%	31.8%	23.1%
		2 NO	Count	24	21	15	60
			% within partyidr	80.0%	80.8%	68.2%	76.9%
	Total	Count		30	26	22	78
		% within partyidr		100.0%	100.0%	100.0%	100.0%
3 NOT VERY STRONG	abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	118	36	75	229
			% within partyidr	57.8%	50.0%	45.2%	51.8%
		2 NO	Count	86	36	91	213
			% within partyidr	42.2%	50.0%	54.8%	48.2%
	Total	Count		204	72	166	442
		% within partyidr		100.0%	100.0%	100.0%	100.0%
4 NO RELIGION	abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	70	39	15	124
			% within partyidr	63.6%	56.5%	55.6%	60.2%
		2 NO	Count	40	30	12	82
			% within partyidr	36.4%	43.5%	44.4%	39.8%
	Total	Count		110	69	27	206
		% within partyidr		100.0%	100.0%	100.0%	100.0%
Total	abany ABORTION IF WOMAN WANTS FOR ANY REASON	1 YES	Count	257	91	128	476
			% within partyidr	50.6%	40.1%	31.4%	41.6%
		2 NO	Count	251	136	280	667
			% within partyidr	49.4%	59.9%	68.6%	58.4%
	Total	Count		508	227	408	1143
		% within partyidr		100.0%	100.0%	100.0%	100.0%

**Figure 8-3**

- If the difference shown in all the partial tables (the separate tables for each category of the control variable) are significantly smaller than those found in the original AND IF your control variable is antecedent (occurs prior in time) to both the other variables, you have found a *spurious* relationship and explained away the original. In other words, the original relationship was due to the influence of that control variable, not the one you first hypothesized.
- If the differences you see in the partial tables are less than you saw in the original table AND IF your control variable is intervening (that is, the control variable occurs in time after the original independent variable), you have *interpreted* the relationship. If the time sequence between the independent and control variable is

not determinable (or otherwise unclear), then you don't know whether you have explanation or interpretation, but you do know that the control variable is important.

- If one or more of the differences shown in the partial tables is stronger than in the original and one or more is weaker, you have discovered the conditions under which the original relationship is strongest. This is referred to as *specification* or the interaction effect.
- If the zero order table showed weak association between the variables, you might still find strong associations in the partials (which is a good argument for keeping on with your initial analysis of the data even if you didn't "find" anything with bivariate analysis). The addition of your control variable showed it to have been acting as a *suppressor* in the original table.
- Last, if a zero order table shows only a weak or moderate association, the partials might show the opposite relationship, due to the presence of a *distorter* variable.

Look at the patterns in each of the four partial tables and compare them to the original (bivariate) table. What do you conclude about the relationships? Try some of your own three-way (or higher) tables using some of the variables in the GSS10A data set. Recall that for this procedure, there should be few categories for each variable, particularly your control variables (so you might need to recode), and you are limited to variables measured at, or recoded to, nominal or ordinal levels.

## Multiple Regression

Another statistical technique estimating the effects of two or more independent variables on a dependent variable is multiple regression analysis. This technique is appropriate when your variables are measured at the interval or ratio level, although independent variables with only two categories can be treated as interval level (these are generally called "dummy variables" in regression analysis). Although technically designed for interval/ratio variables, it is common for researchers to use multiple regression with ordinal variables as well.

You may remember from a statistics course that when we use regression analysis, we make several assumptions about our data: that there is a linear relationship between each independent variable and the dependent variable, that the distribution of values in your variables follows a normal distribution, and the variables are measured at interval or ratio levels.

The variable *hrsrelax* indicates the amount of leisure time respondents have. Since it is measured in the number of hours per day, it is an

sexr				
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid .00 Male	923	45.2	45.2	45.2
1.00 Female	1121	54.8	54.8	100.0
Total	2044	100.0	100.0	

Figure 8-4

interval level variable. There is much existing research that finds that women have less leisure time than men do. Let's see if this pattern holds for our data as well. Since we are only working with two variables at this stage, we will first do a bivariate regression analysis, just as we did in Chapter 7. But first, we must recode the sex variable. The mathematics on which regression analysis is based requires that variables having two categories be coded as 0 and 1. In the GSS10A data, sex is coded as 1 (male) and 2 (female). So, you must first recode sex. If necessary, review the directions for recoding into a new variable in Chapter 3. Name the new variable *sexr* (sex recoded), and code male as 0 and female as 1. Do a frequency distribution of the new variable to make sure you did it correctly. It should look like the one shown in Figure 8-4. Don't forget to add value labels to the new variable.

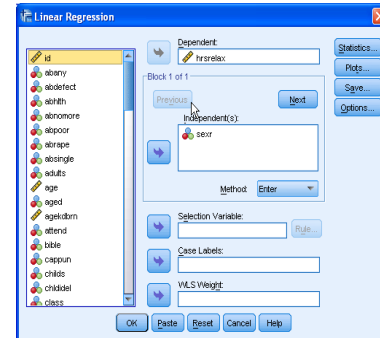


Figure 8-5

Now we are ready to analyze the data. We will start first by examining the relationship between sex and leisure time. On the menu, click **Analyze**, **Regression**, **Linear**. Click on *hrsrelax* and move it into the Dependent box at the top of the dialog box. Click on *sexr* and move it into the Independent(s) box. It should look like the one shown in Figure 8-5. Click OK.

Your results should look like those shown in Figure 8-6. Looking first at the Model Summary table, you will see that the R-squared value is .018. As you recall from Chapter 7, this means that 1.8% of the variation in the dependent variable (hours of relaxation time) is explained by knowing the sex of the respondent. This doesn't seem like very much. However, our goal was not to explain all of the factors that influence how much time people have to relax. Our goal was to find out whether women report having less relaxation time than men do. For this, we need to look at the Coefficients table. If you look at the B coefficient for *sexr*, you will see that it is -.490. If there was absolutely no relationship between *sexr* and *hrsrelax*, the coefficient would be zero. How do we interpret this coefficient? Recall the discussion in Chapter 7: a one unit change in the independent variable (*sexr*) is associated with a change in the dependent variable (*hrsrelax*) equal to the value of B. So, if we increase the value of *sexr* by 1, on average, we get a change of -.490 in *hrsrelax*. Since *sexr* is a dichotomous variable, increasing the value by 1 simply means going from "male" to "female." Here is what one might say in a report: Women

Variables Entered/Removed <sup>a</sup>			
Model	Variables Entered	Variables Removed	Method
1	sexr <sup>a</sup>	.	Enter

a. All requested variables entered.  
b. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.093 <sup>a</sup>	.009	.008	2.619

a. Predictors: (Constant), sexr

ANOVA <sup>a</sup>						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	69.087	1	69.087	10.069	.002 <sup>a</sup>
	Residual	7903.923	1152	6.861		
	Total	7973.010	1153			

a. Predictors: (Constant), sexr  
b. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Coefficients <sup>a</sup>					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1	(Constant)	3.939		35.077	.000
	sexr	-.490	.154	-.093	.002

a. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Figure 8-6

report .490 fewer hours than men in their average amount of relaxation time per day. (It is fewer, because the coefficient is negative; so, when X, the independent variable, goes up, from 0 to 1, Y, the dependent variable, goes down). Notice that the t is statistically significant, with a value of .002. This means that since the sample was randomly selected, the pattern you see in the data is very likely an accurate reflection of the average experiences in the population from which the sample was drawn.

Now, that analysis tells us that women report fewer hours of relaxation per week, but it doesn't tell us why. Two variables that might be relevant are the number of children that people have, and their income level. One reason might be because most women spend more time doing childcare and housework than most men and therefore have fewer hours of relaxation time. So, we would expect to see a negative relationship between the number of children and the amount of leisure time. Another might be income; the higher the family income, the more money there is available to hire others to do some of the work, like house cleaning, babysitting, gardening, etc., making more time for leisure. If that is the case, then we would expect to find a positive relationship between income and leisure time. Finally, if these two variables explain why women have less leisure time than men do, then controlling for them should result in a smaller B coefficient for *sexr*. Lets test this out using multiple regression analysis.

Once again, click Analyze, Regression, Linear. Click on *hrsrelax* and move it into the Dependent box at the top of the dialog box. Click on *sexr* and move it into the Independent(s) box. Then, move *childs* and *income06* into Independent(s) box as well. It should look like the one shown in Figure 8-7. Click OK.

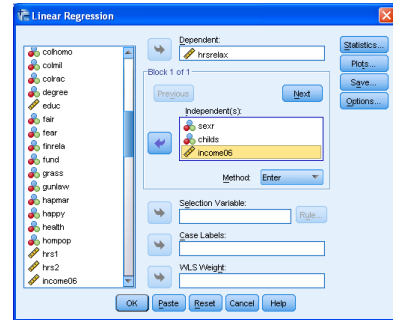


Figure 8-7

Model	Variables Entered	Variables Removed	Method
1	income06 TOTAL FAMILY INCOME, childs NUMBER OF CHILDREN, sexr	.	Enter

a. All requested variables entered.  
b. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.124 <sup>a</sup>	.015	.013	2.607

a. Predictors: (Constant), income06 TOTAL FAMILY INCOME, childs NUMBER OF CHILDREN, sexr

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	112.932	3	37.644	5.539	.001 <sup>a</sup>
	Residual	7238.129	1065	6.796		
	Total	7351.061	1068			

a. Predictors: (Constant), income06 TOTAL FAMILY INCOME, childs NUMBER OF CHILDREN, sexr  
b. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.772	.310		15.386	.000
	sexr	-.472	.161	-.090	-2.940	.003
	childs NUMBER OF CHILDREN	-.020	.052	-.012	-.392	.695
	income06 TOTAL FAMILY INCOME	-.046	.015	-.095	-3.096	.002

a. Dependent Variable: hrsrelax HOURS PER DAY R HAVE TO RELAX

Figure 8-8

Look at the B values in the Coefficients in the table (your results should look like those in Figure 8-8).

Notice that none of the B coefficients are 0, meaning that each of the three independent variables have some relationship with the number of hours of relaxation per week, when the effects of the others are controlled. Furthermore, for two of the variable, the t statistic is significant ( $p \leq .05$ ), so that you can generalize the patterns you see in the data to the population from which the sample was drawn. In contrast, the t statistics is not statistically significant for the remaining variable (*chlds*). Thus, even though the results are that all three independent variables have some relationship to the dependent variable (the B is not 0), we can generalize these results to the population for only two – sex and total family income. How do we interpret these patterns? First, we would say that the number of children does not appear to be related to the number of hours of relaxation time, controlling for sex and family income. Family income is related to relaxation time, but not in the expected direction. The effect of income is also negative—those who earn more have fewer hours of relaxation, a result which was contrary to our hypothesis. Thus, even though the results show that a relationship exists, our hypothesis is not supported (because we predicted in the wrong direction). So, neither of our hypotheses were supported by the data. Interestingly, the decrease in the value of B was very small from the bivariate analysis (-.490) to the multivariate analysis (-.472). This suggests that the number of children does not appear to account for the pattern in which women report working fewer hours per week than men. What do you think accounts for this difference?

## Chapter Eight Exercises

1. How would you hypothesize the relationship between *fear* (Afraid to walk at night in neighborhood) and *sex*?
  - a. Write out your hypothesis.
  - b. Run a crosstabs to test your hypothesis and report your results.
  - c. Now, do a second crosstabs, this time controlling for *class*. Report your results.
  - d. Now run *fear* and *sex* but control for *trust*. Report your results.
2. Choose three independent variables from the dataset that you think influence the number of hours people watch television (*tvhours*, the dependent variable).
  - a. Write up your hypotheses (how and why each independent variable is associated with the dependent variable).
  - b. Run a multivariate regression to test your hypotheses and report your results.