## SPSS DEMONSTRATION [GSS18SSDS-A]

### Computing Analysis of Variance Models

Social scientists have examined the association between a woman's fertility decisions (deciding whether and/or when to have a child) and her wages, employment status, and education, along with other socioeconomic and demographic factors. Research has indicated that different social groups may have different norms and values about fertility.[6]

In this example, we'll investigate the relationship between a woman's educational attainment and the age at which her first child was born using GSS2018SSDS-A. We first analyzed this relationship in Exercise 8 of Chapter 4. Using education as the independent variable and age at which her first child was born as the dependent variable, we can assess whether there is a relationship between educational attainment and age at first childbirth.

We'll use two variables for our analysis, the variable DEGREE (five categories of educational attainment) and AGEKDBRN (respondent's age when her first child was born). But first, we'll restrict our analysis to women in the GSS sample (using *Data—Select Cases* command. You will have to select the option "If the condition is satisfied," then type SEX = 2 to restrict your analysis to women).

We can compute the ANOVA model by clicking on *Analyze*, *Compare Means*, then *One-Way ANOVA*. The opening dialog box requires that we insert AGEKDBRN in the box labeled "Dependent List" and in the box labeled "Factor" insert DEGREE.

Click on the *Options* button at the upper right. Click on *Descriptive* in the Statistics box. This will produce a table of means and standard deviations along with the ANOVA statistics. Click on *Continue* in the Options box, then *OK* in the One-Way ANOVA box.

We are interested in the *F* statistic and significance in the ANOVA table (Figure 9.3). Based on the output, *F* is 38.392 significant at the .000 level. The data reveal a positive relationship—the higher one's educational attainment, the

**Figure 9.3**

**Descriptives**

R's age when 1st child born

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| Lt high school | 79 | 19.58 | 4.618 | .520 | 18.55 | 20.62 | 14 | 39 |
| High school | 305 | 22.04 | 4.546 | .260 | 21.53 | 22.55 | 13 | 40 |
| Junior college | 65 | 24.52 | 5.460 | .677 | 23.17 | 25.88 | 16 | 41 |
| Bachelor | 112 | 26.28 | 5.287 | .500 | 25.29 | 27.27 | 15 | 40 |
| Graduate | 57 | 27.42 | 5.254 | .696 | 26.03 | 28.82 | 17 | 40 |
| Total | 618 | 23.25 | 5.421 | .218 | 22.82 | 23.68 | 13 | 41 |

*(Continued)*

**Figure 9.3 (Continued)**

ANOVA

R's age when 1st child born

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 3632.852 | 4 | 908.213 | 38.392 | .000 |
| Within Groups | 14501.273 | 613 | 23.656 | | |
| Total | 18134.125 | 617 | | | |

higher the age of first childbirth. The oldest average age at first childbirth is for women with graduate degrees (27.42 years of age), followed by women with bachelor's degrees (26.28 years of age). The youngest group of first-time mothers is women with less than a high school diploma. On average, women with less than a high school diploma had their first child at 19.58 years of age. When compared with the age of graduate-degree first-time mothers, there is a difference of 7.84 years.

## SPSS PROBLEMS [GSS18SSDS-A AND B]

S1. Let's continue to examine the relationship between fertility decisions and education using GSS18SSDS-A. But this time, we'll analyze the relationship for men.

   a. Run a Select Cases, selecting only men for the analysis.

   b. Compute an ANOVA model for men, using age at first-born child (AGEKDBRN) as the dependent variable and educational degree (DEGREE) as the independent variable. Based on the SPSS output, what can you conclude about the relationship between degree attainment and AGEKDBRN for men? How do these results compare with the results for women in the SPSS demonstration? Use alpha = .05.

S2. Repeat Exercise 1b, substituting respondent's social class (CLASS) as the independent variable in separate models for men and women. What can you conclude about the relationship between CLASS and AGEKDBRN based on an alpha of .01?

S3. What is the ideal number of children a family should have (variable CHLDIDEL)? Use CHLDIDEL as your dependent variable and DEGREE as your independent variable. Is there a significant difference in the number of ideal children among different educational groups? (*Option:*

You can run three sets of analyses—first, for all GSS respondents; second, an ANOVA model for women only; and finally, a model for men. Make sure to select the Descriptives option.) Evaluate your model results based on an alpha of .05.

S4. Using GSS18SSDS-B, treat NEWS (how often do you read the newspaper) as your dependent variable and DEGREE (respondent's educational degree) as your independent variable. Setting alpha = .05, assess the significance of both models. NEWS is coded on a 5-point scale: 1 = *everyday*, 2 = *few times a week*, 3 = *once a week*, 4 = *less than once a week*, and 5 = *never*.

S5. Repeat Exercise S4, separating results by SEX. Does the relationship change when including SEX as a control variable? Explain.

## EXCEL DEMONSTRATION [GSS18SSDS-E]

### Computing Analysis of Variance Models

Although it is a bit tedious for social scientists to run an ANOVA test in Excel owing in part to the fact that we are often interested in mean differences across categorical data like race, highest degree earned, marital status, and so on with unequal sample sizes across categories, it can be done.

In this demonstration, we will use GSS18SSDS-E to examine the relationship between highest degree earned (DEGREE) and perception of the ideal number of children (CHLDIDEL). Do those with more education prefer fewer children than those with less education?

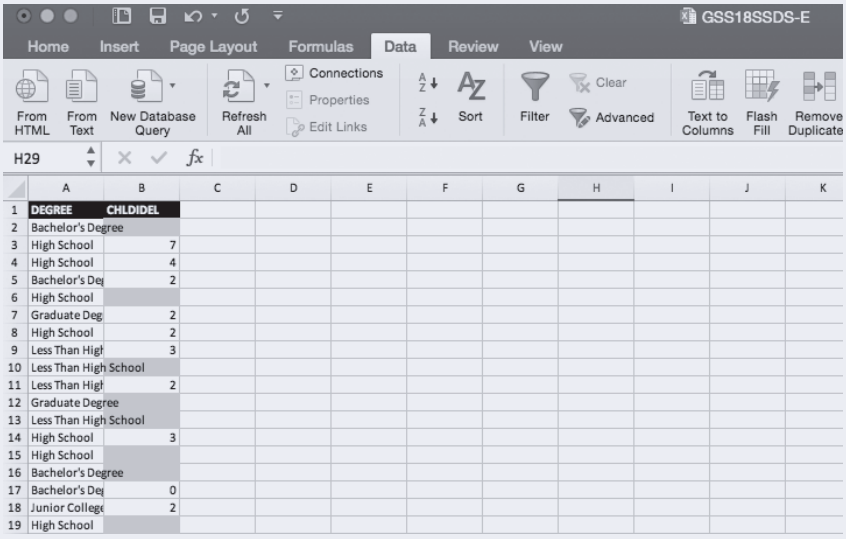
To begin our analysis, copy the DEGREE and CHLDIDEL data from the protected Data View sheet and paste it into a new Excel sheet (see Figure 9.4).

Because Excel's ANOVA feature works with numeric data, we need to reorganize our CHLDIDEL data into five distinct columns with one column for each category (Less Than High School, High School, Junior College, Bachelor's Degree, and Graduate Degree). To do this, we will enter Less Than High School in cell E1, High School in cell F1, and so on (see Figure 9.5). Notice that we widened the columns so the categories are clearly visible.

With all of the data in column A (from A1 to A136) selected, navigate to the Excel *Data* tab. Click on *Sort*. A "Sort Warning" window may appear. Select "Expand the selection" and then hit "Sort." A "Sort" window will appear. Under "Column," choose "Degree" and then hit *OK*. Excel will now sort all of the data by DEGREE (see Figure 9.6).

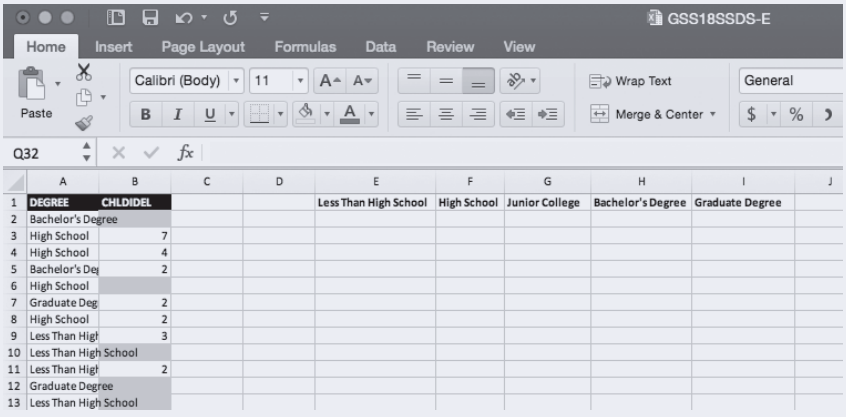
Select all of the CHLDIDEL data for respondents who have "Less Than High School" recorded for their highest degree earned—B114 to B136. On the main Excel toolbar, select *Edit* → *Copy*. Click on cell E2 (the cell directly under "Less Than High School"), and then on the main Excel toolbar, select *Edit* → *Paste*. You just successfully copied and pasted CHLDIDEL data for those who have Less Than High School.

## Figure 9.4




| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DEGREE | CHLDIDEL | | | | | | | | | |
| 2 | Bachelor's Degree | | | | | | | | | | |
| 3 | High School | 7 | | | | | | | | | |
| 4 | High School | 4 | | | | | | | | | |
| 5 | Bachelor's Deg | 2 | | | | | | | | | |
| 6 | High School | | | | | | | | | | |
| 7 | Graduate Deg | 2 | | | | | | | | | |
| 8 | High School | 2 | | | | | | | | | |
| 9 | Less Than High | 3 | | | | | | | | | |
| 10 | Less Than High School | | | | | | | | | | |
| 11 | Less Than High | 2 | | | | | | | | | |
| 12 | Graduate Degree | | | | | | | | | | |
| 13 | Less Than High School | | | | | | | | | | |
| 14 | High School | 3 | | | | | | | | | |
| 15 | High School | | | | | | | | | | |
| 16 | Bachelor's Degree | | | | | | | | | | |
| 17 | Bachelor's Deg | 0 | | | | | | | | | |
| 18 | Junior College | 2 | | | | | | | | | |
| 19 | High School | | | | | | | | | | |

## Figure 9.5

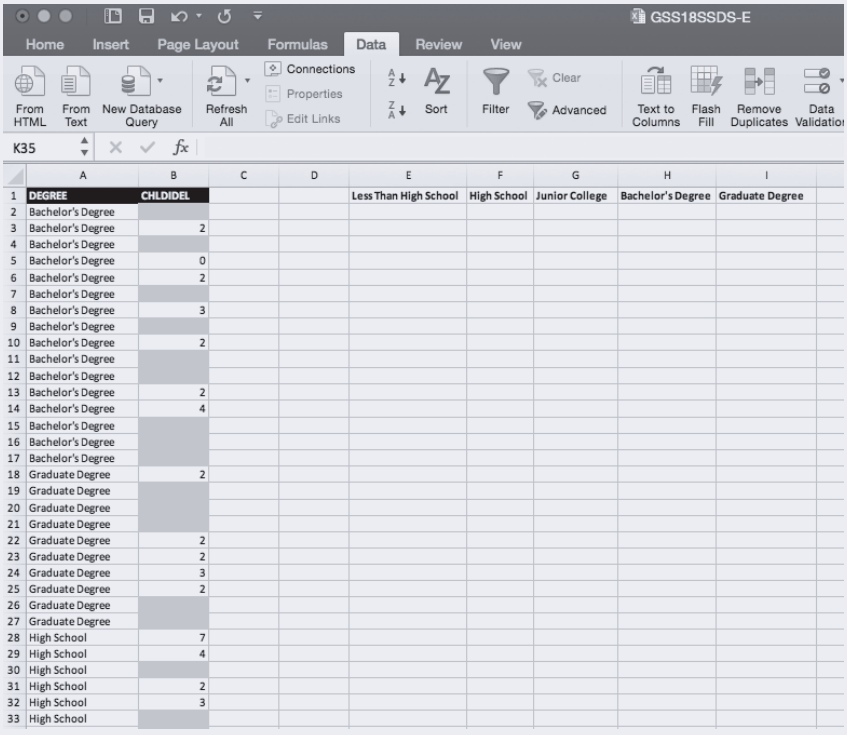



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DEGREE | CHLDIDEL | | | Less Than High School | High School | Junior College | Bachelor's Degree | Graduate Degree | |
| 2 | Bachelor's Degree | | | | | | | | | |
| 3 | High School | 7 | | | | | | | | |
| 4 | High School | 4 | | | | | | | | |
| 5 | Bachelor's Deg | 2 | | | | | | | | |
| 6 | High School | | | | | | | | | |
| 7 | Graduate Deg | 2 | | | | | | | | |
| 8 | High School | 2 | | | | | | | | |
| 9 | Less Than High | 3 | | | | | | | | |
| 10 | Less Than High School | | | | | | | | | |
| 11 | Less Than High | 2 | | | | | | | | |
| 12 | Graduate Degree | | | | | | | | | |
| 13 | Less Than High School | | | | | | | | | |

Repeat these steps for the other degree categories. For High School you will select CHLDIDEL data from B28 to B103. For Junior College, you will select CHLDIDEL data from B104 to B113. For Bachelor's Degree, you will select CHLDIDEL data from B2 to B17. And, last, for Graduate Degree, you will select CHLDIDEL data from B18 to B27. We can now use Excel to run an ANOVA test to examine the relationship between highest degree earned and ideal number of children (see Figure 9.7).

Navigate to Excel's *Data* tab. Select *Data Analysis*. A Data Analysis window will appear. Choose "Anova: Single Factor" and hit *OK*.

**Figure 9.6**

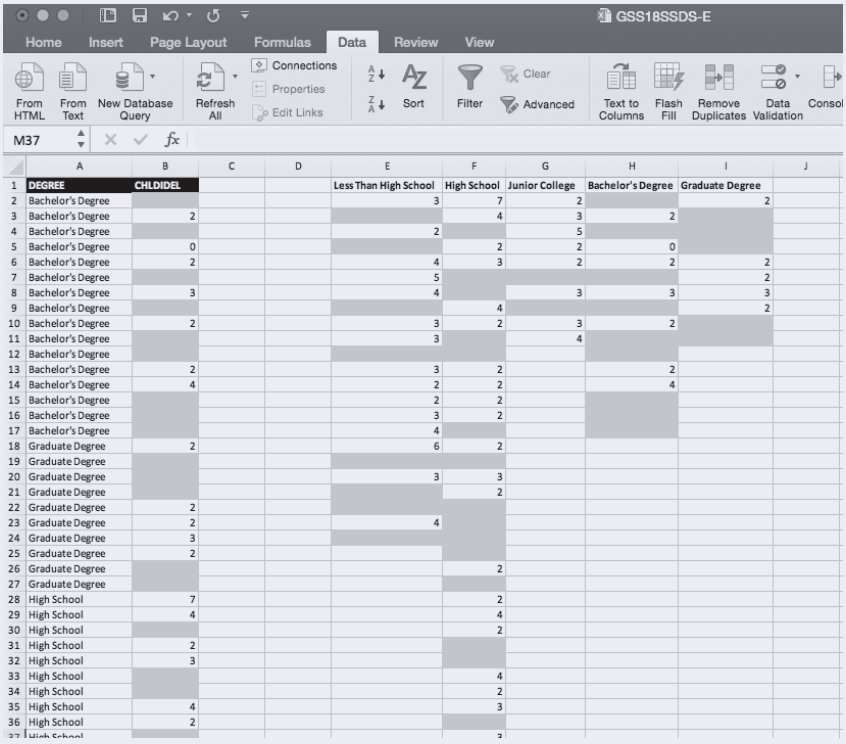



| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DEGREE | CHLDIDEL | | | Less Than High School | High School | Junior College | Bachelor's Degree | Graduate Degree |
| 2 | Bachelor's Degree | | | | | | | | |
| 3 | Bachelor's Degree | 2 | | | | | | | |
| 4 | Bachelor's Degree | | | | | | | | |
| 5 | Bachelor's Degree | 0 | | | | | | | |
| 6 | Bachelor's Degree | 2 | | | | | | | |
| 7 | Bachelor's Degree | | | | | | | | |
| 8 | Bachelor's Degree | 3 | | | | | | | |
| 9 | Bachelor's Degree | | | | | | | | |
| 10 | Bachelor's Degree | 2 | | | | | | | |
| 11 | Bachelor's Degree | | | | | | | | |
| 12 | Bachelor's Degree | | | | | | | | |
| 13 | Bachelor's Degree | 2 | | | | | | | |
| 14 | Bachelor's Degree | 4 | | | | | | | |
| 15 | Bachelor's Degree | | | | | | | | |
| 16 | Bachelor's Degree | | | | | | | | |
| 17 | Bachelor's Degree | | | | | | | | |
| 18 | Graduate Degree | 2 | | | | | | | |
| 19 | Graduate Degree | | | | | | | | |
| 20 | Graduate Degree | | | | | | | | |
| 21 | Graduate Degree | | | | | | | | |
| 22 | Graduate Degree | 2 | | | | | | | |
| 23 | Graduate Degree | 2 | | | | | | | |
| 24 | Graduate Degree | 3 | | | | | | | |
| 25 | Graduate Degree | 2 | | | | | | | |
| 26 | Graduate Degree | | | | | | | | |
| 27 | Graduate Degree | | | | | | | | |
| 28 | High School | 7 | | | | | | | |
| 29 | High School | 4 | | | | | | | |
| 30 | High School | | | | | | | | |
| 31 | High School | 2 | | | | | | | |
| 32 | High School | 3 | | | | | | | |
| 33 | High School | | | | | | | | |

An "Anova: Single Factor" window will appear (see Figure 9.8). Under "Input," click in the empty box next to "Input Range" and then select all of the CHLDIDEL data that we organized into columns by highest degree earned. In the "Input Range" box, you should see $E$1:$I$77. Next to "Grouped By," make sure "Columns" is selected. Also make sure "Labels in first row" is selected. The default alpha is .05—you can change this if necessary. Under "Output options," click in the empty box next to "Output Range" and select any cell in the current Excel sheet where you'd like the ANOVA results to appear. In this demonstration, we've chosen cell K3. Hit *OK*. We are now ready to interpret our findings.

We are interested in the *F* statistic and significance in the ANOVA table (Figure 9.9). Based on the output, *F* is 2.56 with a .045 *p* value. If we set alpha at .05, we can conclude we are observing a significant difference in the mean number of ideal children by highest degree earned. More specifically, the data reveal a negative relationship—the higher one's educational attainment, the fewer number of children he or she feels is ideal. Those with less than a high school diploma reported a higher ideal number of children (3.4 children) than those with a high school diploma (2.64 children), junior college (3 children), bachelor's degree (2.14), or graduate degree (2.2).

## Figure 9.7




| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | DEGREE | CHLDIDEL | | | Less Than High School | High School | Junior College | Bachelor's Degree | Graduate Degree | |
| 2 | Bachelor's Degree | | | | 3 | 7 | 2 | | 2 | |
| 3 | Bachelor's Degree | 2 | | | | 4 | 3 | 2 | | |
| 4 | Bachelor's Degree | | | | 2 | | 5 | | | |
| 5 | Bachelor's Degree | 0 | | | | 2 | 2 | 0 | | |
| 6 | Bachelor's Degree | 2 | | | 4 | 3 | 2 | 2 | 2 | |
| 7 | Bachelor's Degree | | | | 5 | | | | 2 | |
| 8 | Bachelor's Degree | 3 | | | 4 | | 3 | 3 | 3 | |
| 9 | Bachelor's Degree | | | | | 4 | | | 2 | |
| 10 | Bachelor's Degree | 2 | | | 3 | 2 | 3 | 2 | | |
| 11 | Bachelor's Degree | | | | 3 | | 4 | | | |
| 12 | Bachelor's Degree | | | | | | | | | |
| 13 | Bachelor's Degree | 2 | | | 3 | 2 | | 2 | | |
| 14 | Bachelor's Degree | 4 | | | 2 | 2 | | 4 | | |
| 15 | Bachelor's Degree | | | | 2 | 2 | | | | |
| 16 | Bachelor's Degree | | | | 3 | 2 | | | | |
| 17 | Bachelor's Degree | | | | 4 | | | | | |
| 18 | Graduate Degree | 2 | | | 6 | 2 | | | | |
| 19 | Graduate Degree | | | | | | | | | |
| 20 | Graduate Degree | | | | 3 | 3 | | | | |
| 21 | Graduate Degree | | | | | 2 | | | | |
| 22 | Graduate Degree | 2 | | | | | | | | |
| 23 | Graduate Degree | 2 | | | 4 | | | | | |
| 24 | Graduate Degree | 3 | | | | | | | | |
| 25 | Graduate Degree | 2 | | | | | | | | |
| 26 | Graduate Degree | | | | | 2 | | | | |
| 27 | Graduate Degree | | | | | | | | | |
| 28 | High School | 7 | | | | 2 | | | | |
| 29 | High School | 4 | | | | 4 | | | | |
| 30 | High School | | | | | 2 | | | | |
| 31 | High School | 2 | | | | | | | | |
| 32 | High School | 3 | | | | | | | | |
| 33 | High School | | | | | 4 | | | | |
| 34 | High School | | | | | 2 | | | | |
| 35 | High School | 4 | | | | 3 | | | | |
| 36 | High School | 2 | | | | | | | | |

## Figure 9.8

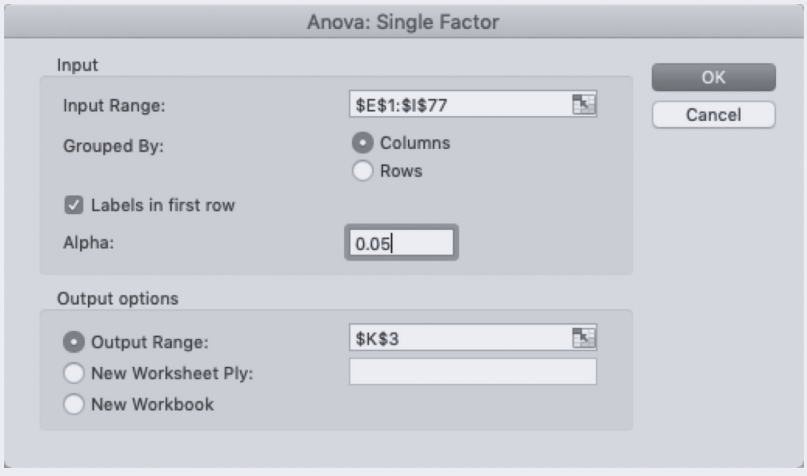


**Figure 9.9**

Anova: Single Factor

SUMMARY

| *Groups* | *Count* | *Sum* | *Average* | *Variance* |
|---|---|---|---|---|
| Less Than High School | 15 | 51 | 3.4 | 1.25714286 |
| High School | 45 | 119 | 2.64444444 | 1.0979798 |
| Junior College | 8 | 24 | 3 | 1.14285714 |
| Bachelor's Degree | 7 | 15 | 2.14285714 | 1.47619048 |
| Graduate Degree | 5 | 11 | 2.2 | 0.2 |

ANOVA

| *Source of Variation* | *SS* | *df* | *MS* | *F* | *P-value* | *F crit* |
|---|---|---|---|---|---|---|
| Between Groups | 11.431746 | 4 | 2.85793651 | 2.56491225 | 0.04500551 | 2.493696 |
| Within Groups | 83.568254 | 75 | 1.11424339 | | | |
| Total | 95 | 79 | | | | |

## EXCEL PROBLEMS [GSS18SSDS-E]

E1. Investigate whether there is a significant difference in the number of ideal children (CHLDIDEL) by marital status (MARITAL).

a. Run an ANOVA test of CHLDIDEL by MARITAL.

b. What is the mean ideal number of children for married respondents? Widowed? Divorced? Separated? Never married?

c. What is the value of the *F* statistic? What *p* value is associated with this *F* statistic?

d. Is there a significant difference in the ideal number of children by marital status? How do you know? Set alpha at .05.

E2. Is there a significant difference in the age at which a respondent's first child was born (AGEKDBRN) among different educational groups (DEGREE)?

a. Run an ANOVA test of AGEKDBRN by DEGREE.

b. What is the value of the *F* statistic? What *p* value is associated with this *F* statistic?

c. Is there a significant difference in the age at which a respondent's first child was born among different educational groups? How do you know? Set alpha at .01.