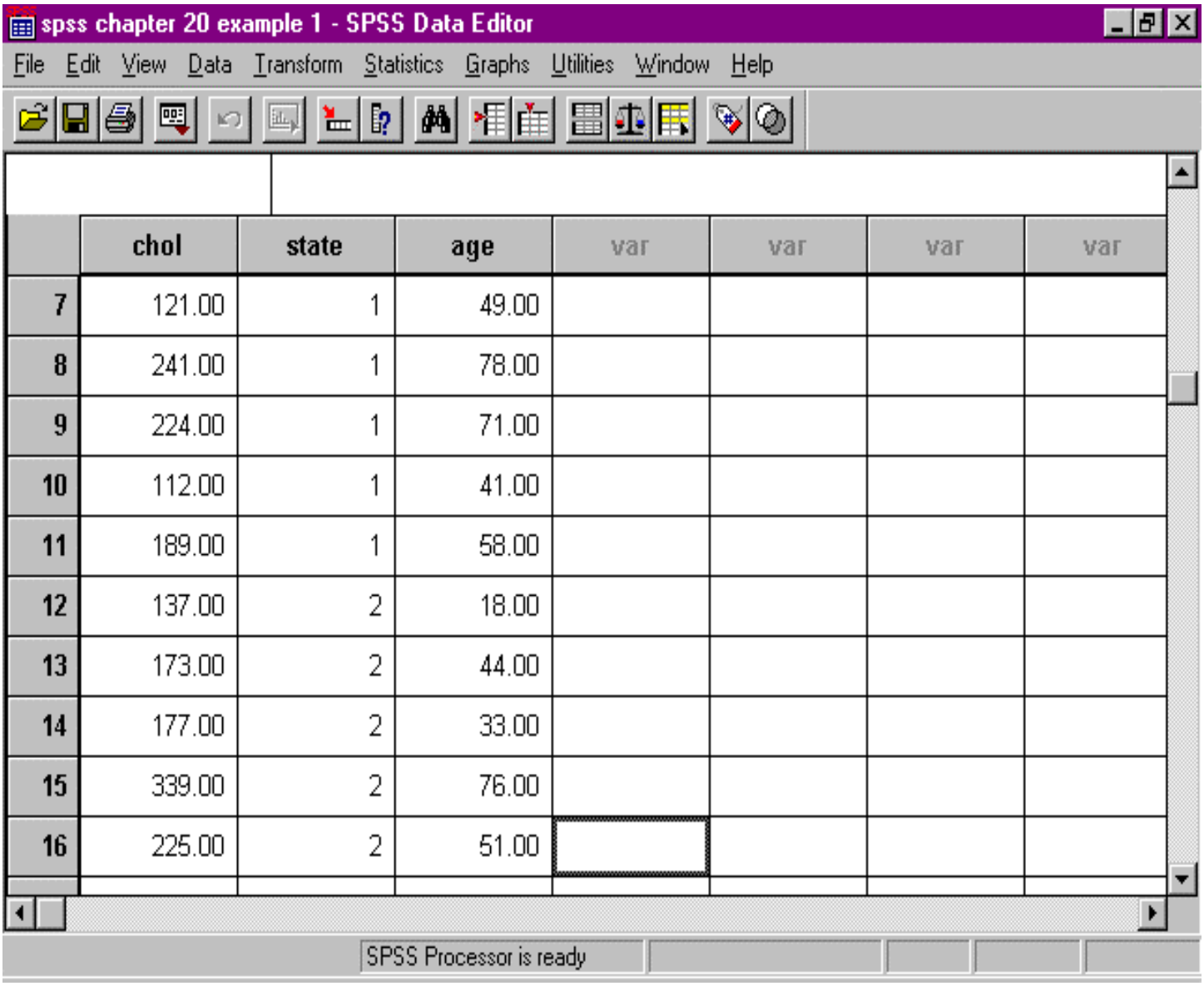
SPSS Chapter 20 Example 1 – Analysis of Covariance

Swanson, P. et al., Journal of Gerontology, 10, 41-47, 1955 as repeated in Cochran, examined how cholesterol concentration varied in women. Two states were considered, Iowa and Nebraska. Age was also recorded since it is known to influence cholesterol. We are interested in comparing the cholesterol concentration of women from Iowa and Nebraska. We are testing:

H_O: $\mu_I = \mu_N$ (the means are equal)

H_A: $\mu_I \neq \mu_N$ (the means are not equal)

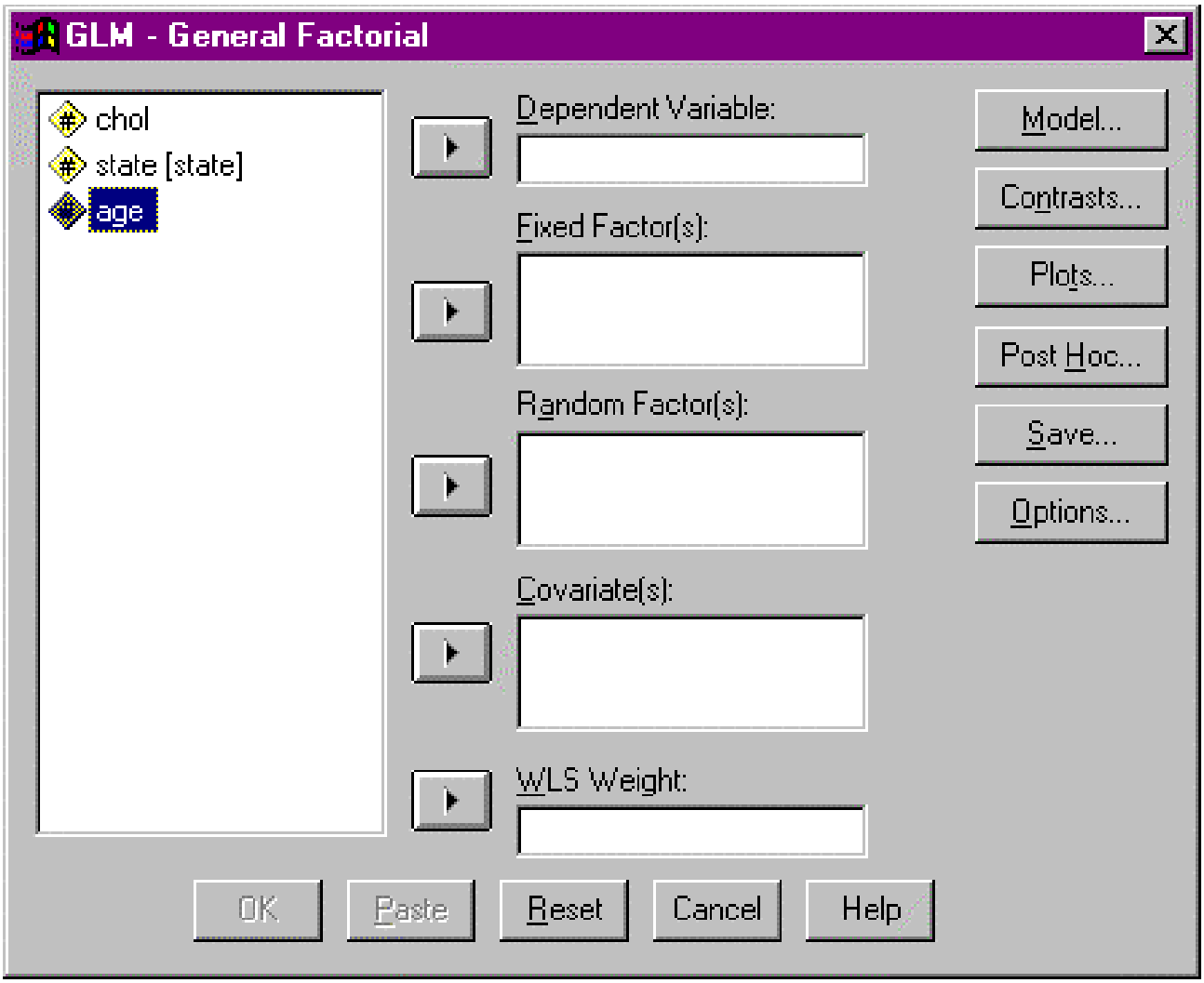
After opening the file, the data appear in the SPSS Data Editor window just like the following (please note that for the variable entitled state, Iowa = 1 and Nebraska = 2.



	chol	state	age	var	var	var	var
7	121.00	1	49.00				
8	241.00	1	78.00				
9	224.00	1	71.00				
10	112.00	1	41.00				
11	189.00	1	58.00				
12	137.00	2	18.00				
13	173.00	2	44.00				
14	177.00	2	33.00				
15	339.00	2	76.00				
16	225.00	2	51.00				

Follow these steps to perform an Analysis of Covariance:

1. Click **Analyze** and **General Linear Model-Univariate**. The following window will appear.

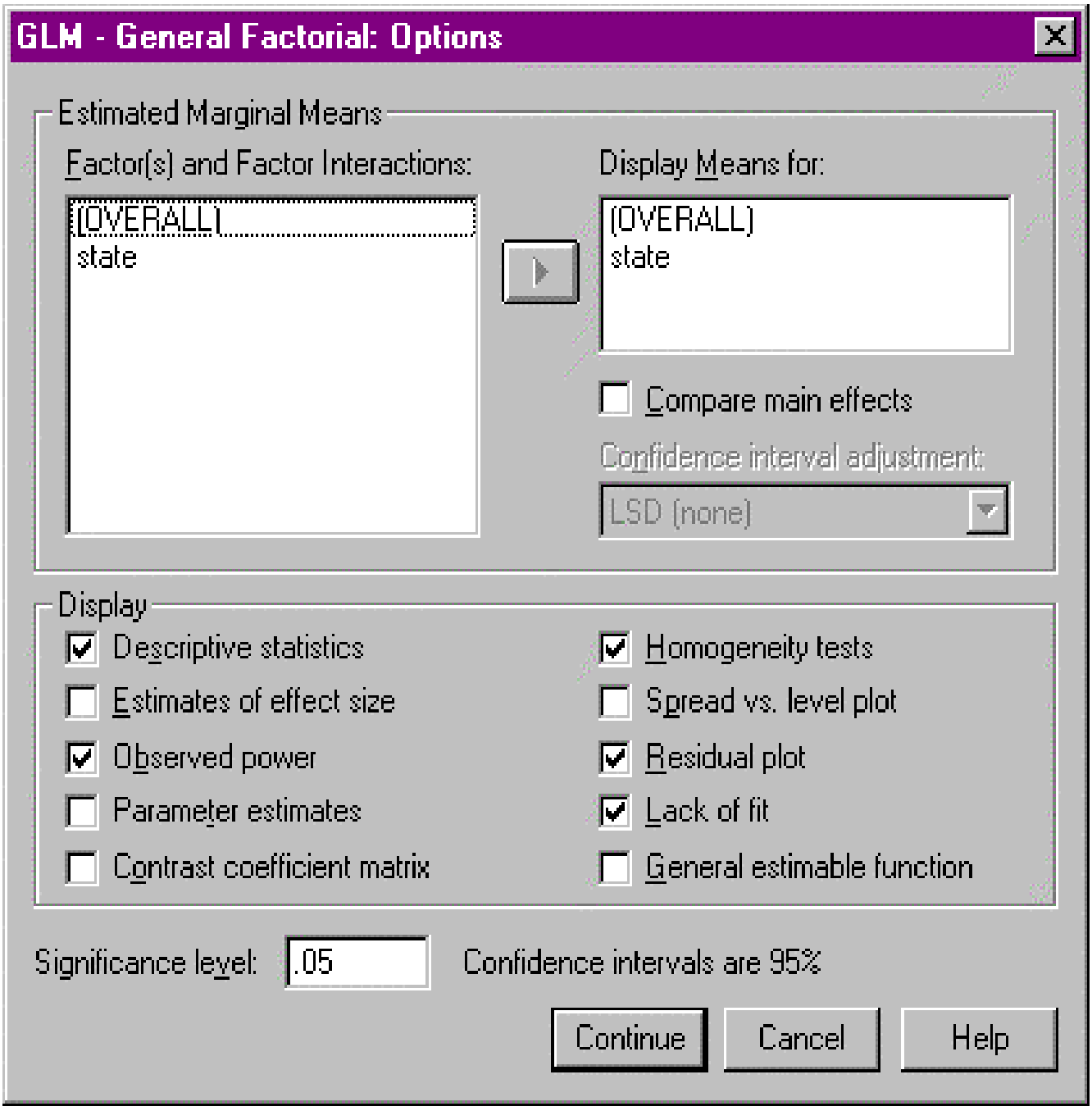


2. Click **"chol"** and click the arrow to move **"chol"** into the box entitled **Dependent Variable**.

3. Click **"state"** and click the arrow to move **"state"** into the box entitled **Fixed Factor**.

4. Click **"age"** and click the arrow to move **"age"** into the box entitled **Covariate**.

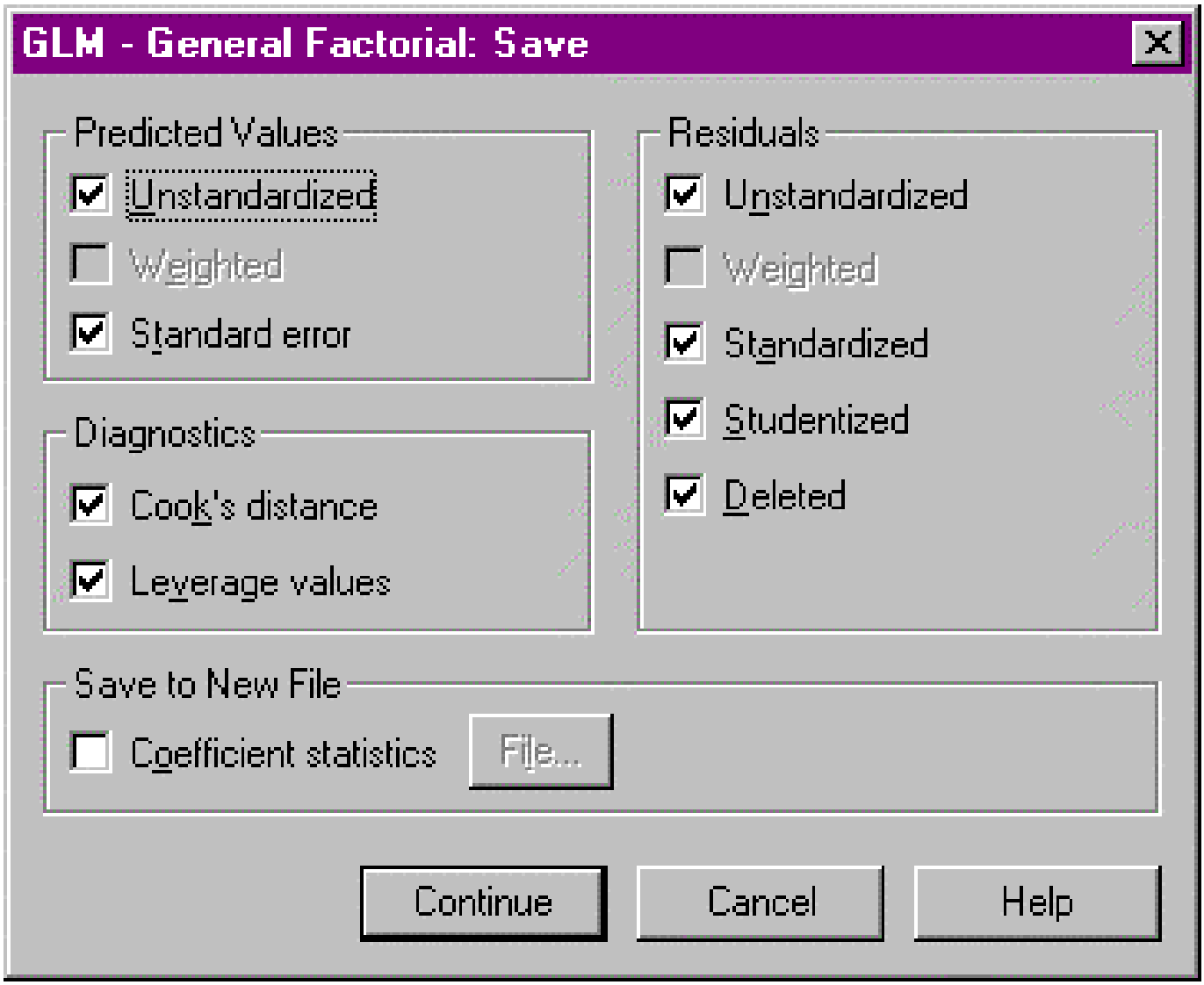
5. Click the **Options** button to choose summary statistics and other helpful information. The following window will appear:



6. Click **"overall"** and **"state"** and click the arrow to move each into the box entitled **Display means for:**

7. Click **descriptive statistics**, **observed power**, **homogeneity tests**, **residual plot** and **lack of fit**. Click **Continue**.

8. Click on **Save** and choose **Cook's distance**, **Leverage values**, etc. as shown in the following box:



9. Click **Continue**. Click **OK**.

The SPSS output for this example of an Analysis of Covariance is the following:

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
state	1	Iowa	11
	2	Nebraska	11

Descriptive Statistics

Dependent Variable: CHOL

state	Mean	Std. Deviation	N
Iowa	198.8182	48.6823	11
Nebraska	223.7273	64.7643	11
Total	211.2727	57.3446	22

Levene's Test of Equality of Error Variances [a]

Dependent Variable: CHOL

F	df1	df2	Sig.
1.637	1	20	.215

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+AGE+STATE

Tests of Between-Subjects Effects

Dependent Variable: CHOL

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Corrected Mod	41316.017[b]	2	20658.009	14.149	.000	28.298	.995
Intercept	11009.441	1	11009.441	7.541	.013	7.541	.741
AGE	37903.472	1	37903.472	25.961	.000	25.961	.998
STATE	12072.324	1	12072.324	8.269	.010	8.269	.779
Error	27740.346	19	1460.018				
Total	1051052.000	22					
Corrected Tota	69056.364	21					

a. Computed using alpha = .05

b. R Squared = .598 (Adjusted R Squared = .556)

The ANOVA table indicates the covariate age was significant, F(1,19) = 25.96, p < .001. The differences between states was also significant, F(1,19) = 8.27, p < .001. The covariate significantly reduced error. The treatment effects were significant. Clearly the treatment effect would not have been significant without the use of the covariate in the model.

Lack of Fit Tests

Dependent Variable: CHOL

Source	Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Lack of Fit	27595.846	18	1533.103	10.610	.238	190.975	.171
Pure Error	144.500	1	144.500				

a. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Dependent Variable: CHOL

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
211.273[a]	8.146	194.222	228.323

a. Evaluated at covariates appeared in the model: AGE = 48.9545.

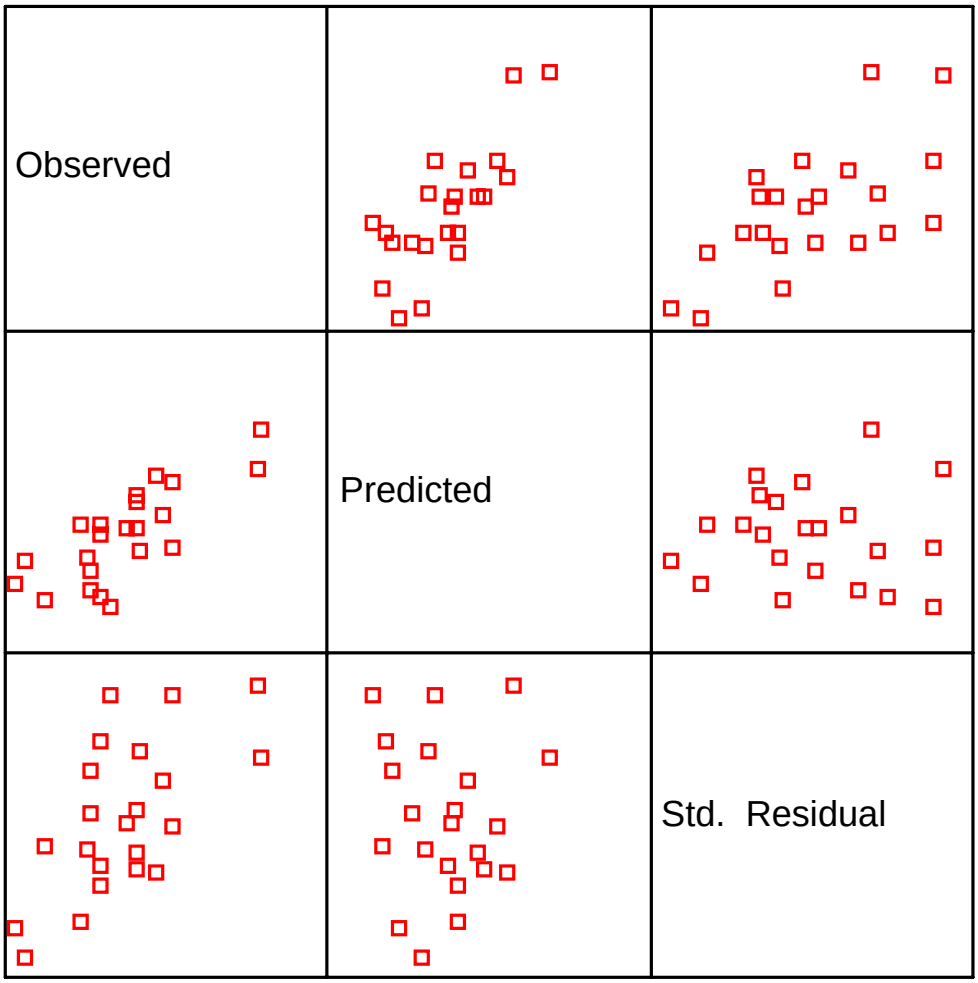
2. state

Dependent Variable: CHOL

state	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Iowa	186.901[a]	11.756	162.296	211.506
Nebraska	235.644[a]	11.756	211.039	260.250

a. Evaluated at covariates appeared in the model: AGE = 48.9545.

Dependent Variable: CHOL



Model: Intercept + AGE + STATE