Chapter 8: Multicollinearity

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Perfect multicollinearity (UE 8.1.1):

EViews is incapable of generating estimates of regression coefficients when the model specification contains two or more variables that are perfectly collinear. When the equation specification contains two or more perfectly collinear (or even some highly collinear) variables, EViews will put out the error message “Near singular matrix.”

The next two sections explain how EViews can be used to detect severe multicollinearity (UE 8.3). The data for the fish/Pope example found in UE, Table 8.1, p. 267, will be used to demonstrate the two methods discussed in UE.

Detecting multicollinearity with simple correlation coefficients (UE 8.3.1):

High simple correlation coefficients between variables is a sign of multicollinearity. Follow these steps to compute the simple correlation coefficient between variables:

Step 1. Open the EViews workfile named Fish8.wk1.
Step 2. Create a group object for the variables found in UE, Equation 8.24, p. 268 (i.e., $F$, $PF$, $PB$, $log(YD)$, $N$, $P$). An easy way to create a group object for a set of variables from a regression model is to select Procs/Make Regressor Group on the equation window menu bar (refer to Chapter 3 to review the usual way of creating a group object).
Step 3. Select View/Correlations on the group object menu bar to reveal the simple correlation coefficients between all of the variables in the group.
Step 4. Select Freeze on the group object menu bar to create a table of the simple correlation coefficients. Select Name on the table object menu bar to name the table.

<table>
<thead>
<tr>
<th></th>
<th>$F$</th>
<th>$PF$</th>
<th>$PB$</th>
<th>$log(YD)$</th>
<th>$N$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F$</td>
<td>1.000000</td>
<td>0.847590</td>
<td>0.818532</td>
<td>0.780012</td>
<td>0.736549</td>
<td>0.585630</td>
</tr>
<tr>
<td>$PF$</td>
<td>0.847590</td>
<td>1.000000</td>
<td>0.958096</td>
<td>0.915320</td>
<td>0.883207</td>
<td>0.734643</td>
</tr>
<tr>
<td>$PB$</td>
<td>0.818532</td>
<td>0.958096</td>
<td>1.000000</td>
<td>0.814890</td>
<td>0.781400</td>
<td>0.663162</td>
</tr>
<tr>
<td>$log(YD)$</td>
<td>0.780012</td>
<td>0.915320</td>
<td>0.814890</td>
<td>1.000000</td>
<td>0.945766</td>
<td>0.744500</td>
</tr>
<tr>
<td>$N$</td>
<td>0.736549</td>
<td>0.883207</td>
<td>0.781400</td>
<td>0.945766</td>
<td>1.000000</td>
<td>0.571129</td>
</tr>
<tr>
<td>$P$</td>
<td>0.585630</td>
<td>0.734643</td>
<td>0.663162</td>
<td>0.744500</td>
<td>0.571129</td>
<td>1.000000</td>
</tr>
</tbody>
</table>

To test whether a particular simple correlation coefficient between variables is significant, refer to Performing the t-test of the simple correlation coefficient (UE 5.3.3).
Calculating Variance Inflation Factors (UE 8.3.2):

The procedure for calculating the Variance Inflation Factors (VIF's) for explanatory variables in a regression model is explained in UE, p. 257. Use the following steps to calculate the VIF for the PF explanatory variable in UE, Equation 8.24, p. 268:

**Step 1.** Open the EViews workfile named *Fish8.wk1*.

**Step 2.** Select Objects/New Object/Equation on the workfile menu bar, enter $PF C PB \log(YD) N P$ in the Equation Specification: window, and click OK. Note the $R^2 = 0.976680$.

**Step 3.** To save this regression, select Name on the equation window menu bar, enter EQPF in the Name to identify object: window, and click OK.

**Step 4.** To calculate the VIF for the variable PF, write the equation: scalar $VIFPF=1/(1-EQPF.@R2)$ in the command window, and press Enter. The status line in the lower left of the screen will display the phrase "VIFPF successfully created." A new variable named VIFPF will appear in the workfile window.

**Step 5.** Double click on the VIFPF icon and the value for the Variance Inflation Factor for the variable named VIFPF = 42.88… will be displayed on the status line (lower left of the screen). The fact that VIFPF is significantly greater than 5 (i.e., the common rule of thumb value stated in UE, p. 258), would suggest that PF exhibits severe multicollinearity.

**Step 6.** Repeat Steps 2-5 to compute the Variance Inflation Factors for the rest of the explanatory variables in UE, Equation 8.24, p. 268.

Transforming multicollinear variables (UE 8.4.3):

Variable transformations can be achieved by creating a new variable or by simply writing the transformation in the Equation Specification: window in EViews. In many ways, the latter is preferred because the equation output labels depict the transformation. Otherwise, it is easy to forget what transformations have been made. The table below lists the most common transformations used to rid a model of multicollinearity, along with the EViews specification (*EViews specification*) to make it happen.

<table>
<thead>
<tr>
<th>Function Name</th>
<th>Description</th>
<th>EViews specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear combination</td>
<td>$Y_t = \beta_0 + \beta_1(X_t + Z_t)$</td>
<td>Y C X+Z*</td>
</tr>
<tr>
<td>First difference</td>
<td>$Y_t = \beta_0 + \beta_1(X_t - X_{t-1})$</td>
<td>Y C d(X)</td>
</tr>
<tr>
<td>First difference of the logarithm</td>
<td>$Y_t = \beta_0 + \beta_1(\ln X_t - \ln X_{t-1})$</td>
<td>Y C dlog(X)</td>
</tr>
<tr>
<td>One-period % change (in decimal)</td>
<td>$Y_t = \beta_0 + \beta_1[(X_t - X_{t-1})/X_t]$</td>
<td>Y C pch(X)</td>
</tr>
</tbody>
</table>

* no spaces in the X+Z variable designation.
Exercises:

8.
   a.
   b. Follow the steps outlined in Detecting multicollinearity with simple correlation coefficients and Calculating Variance Inflation Factors to check for high correlations and high VIF’s in the implied regression model.

13. Follow the steps outlined in Detecting multicollinearity with simple correlation coefficients and Calculating Variance Inflation Factors to check UE, Equation 8.25, p. 269 for high correlations and high VIF’s.

16. 
   f. Run the regressions for this problem using the Mine8.wfl data set.
      a) Refer to Chapter 5 for help with this part.
      b) Refer to Detecting multicollinearity with simple correlation coefficients for help with this part.
      c) Refer to Transforming the multicollinear variables for help with this part.
      d) Refer to Table with EViews specification for functional forms for help with this part.