Choose one of the following alternatives to estimate an asset pricing model where the stochastic discount factor is a linear function of consumption growth:

\[ m_{t+1} = b_0 + b_1 \cdot \Delta c_{t+1} \]

- as a dependent variable, use the excess return of our ten test assets (subtract \textit{avustret} from each of the ten asset returns \textit{decile1} to \textit{decile10})
- for each of the alternatives, use the variable \textit{cnsq differenz} as a factor

1. **Alternative 1:** Use standard GMM techniques in an EViews System environment to estimate the model. Write down the classical moment conditions according to the basic pricing equation

\[ E(mR^{ei}) = 0 \]

Proceed as in the 5th assignment sheet!

2. **Alternative 2:** Use the two stage regression approach discussed in Cochrane, chapter 12.2. Therefore, you have to conduct time series regression first to estimate the \( \beta_i \) (see assignment sheet 6 for details). Then, compute the average excess return of your test assets \( E_T(R^{ei}) \) and regress them on the estimated \( \beta_i \) in order to get an OLS estimate for \( \lambda \). Compute the standard error for \( \hat{\lambda} \) as follows:

\[
Var(\hat{\lambda}) = \frac{1}{T} \left[ (\hat{\beta}'\hat{\beta})^{-1} \hat{\beta}' \hat{\Sigma} \hat{\beta}(\hat{\beta}'\hat{\beta})^{-1}(1 + \hat{\lambda}' \hat{\Sigma}_f^{-1} \hat{\lambda}) + \hat{\Sigma}_f \right]
\]

where

- \( \hat{\beta} = (\hat{\beta}_1, \ldots, \hat{\beta}_N)' \)
- \( \hat{\lambda} = (\hat{\lambda}_1, \ldots, \hat{\lambda}_K)' \)
- \( \hat{\Sigma} \) = VC-matrix of the first stage regression residuals
- \( \hat{\Sigma}_f \) = VC-matrix of the factors

(Note: differs slightly from the lecture)

Hints, how to proceed: First, conduct a time series regression in a Pool object. Save your \( \hat{\beta}_i \) coefficients in a vector. Collect the average excess return of each asset \( i \) in a vector. Estimate \( \lambda \) by computing the OLS estimator in matrix notation:

\[
\hat{\lambda} = (\hat{\beta}'\hat{\beta})^{-1} \hat{\beta}' E_T(R^e)
\]

Having saved the residuals of the first stage time series regression and computed their VC-matrix as well as the VC-matrix of the factors (here, in the one factor case this is just a variance) you have all the ingredients to calculate the variance of \( \hat{\lambda} \). In order to test if all the pricing errors \( \hat{\alpha} \) are zero, compute the test statistic

\[
\hat{\alpha}' \text{cov}(\hat{\alpha})^{-1} \hat{\alpha} \sim \chi^2_{N-1}
\]

where

\[
\text{cov}(\hat{\alpha}) = \frac{1}{T}(I_N - \hat{\beta}(\hat{\beta}'\hat{\beta})^{-1} \hat{\beta}') \hat{\Sigma}(I_N - \hat{\beta}(\hat{\beta}'\hat{\beta})^{-1} \hat{\beta}') \times (1 + \hat{\lambda}' \hat{\Sigma}_f^{-1} \hat{\lambda})
\]

and

\[
\hat{\alpha} = (\hat{\alpha}_1, \ldots, \hat{\alpha}_N) \text{ with } \hat{\alpha}_i = R^{ei} - \hat{\beta}_i \hat{\lambda}
\]
3. Alternative 3: Estimate simultaneously all the $\beta_i$ and $\lambda$ in a GMM framework using the System object and formulating the moment conditions as follows:

$$g_T(\beta, \lambda) = \begin{bmatrix}
E_T[R_{e1} - a - \beta_1 f_t] \\
E_T[(R_{e1} - a - \beta_1 f_t) f_t] \\
\vdots \\
E_T[R_{eN} - a - \beta_N f_t] \\
E_T[(R_{eN} - a - \beta_N f_t) f_t] \\
E_T[R_{e1} - \lambda \beta_1] \\
\vdots \\
E_T[R_{eN} - \lambda \beta_N]
\end{bmatrix}$$

Now, in order to test if $\lambda$ is equal to zero you can refer to the usual GMM test statistics delivered by EViews. The same is true for testing if the model is correctly specified. A usual $J$-test is applicable here.