finregress capm postestimation — Postestimation tools for finregress capm[+]

[+]Postestimation features after `finregress capm` are part of StataNow.

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Postestimation commands

The following postestimation commands are of special interest after `finregress capm`:

Command	Description
`estat grstest`	Gibbons–Ross–Shanken test

The following standard postestimation commands are also available:

Command	Description
`estat summarize`	summary statistics for the estimation sample
`estat vce`	variance–covariance matrix of the estimators (VCE)
`estimates`	cataloging estimation results
`etable`	table of estimation results
`lincom`	point estimates, standard errors, testing, and inference for linear combinations of parameters
`nlcom`	point estimates, standard errors, testing, and inference for nonlinear combinations of parameters
`predict`	linear predictions and residuals
`predictnl`	point estimates, standard errors, testing, and inference for generalized predictions
`test`	Wald tests of simple and composite linear hypotheses
`testnl`	Wald tests of nonlinear hypotheses

predict

Description for predict

`predict` creates a new variable containing predictions such as linear predictions and residuals.

Menu for predict

Statistics > Postestimation

Syntax for predict

`predict` [*type*] *newvar* [*if*] [*in*] [, *statistic* `equation(`*eqspec*`)`]

statistic	Description
Main	
`xb`	linear prediction; the default
`residuals`	residuals

These statistics are available both in and out of sample; type `predict ... if e(sample) ...` if wanted only for the estimation sample.

Options for predict

Main

`xb`, the default, calculates the linear prediction for the specified equation. Note that the linear prediction for `finregress capm` models is computed in terms of returns, rather than excess returns. That is, $r_t^f + \mathbf{x}_t'\widehat{\mathbf{b}}$, where $\mathbf{x}_t'\widehat{\mathbf{b}}$ is the typical linear prediction of the regression model, and r_t^f is the risk-free rate specified in the `rfrate()` option of `finregress capm`. See *Methods and formulas* for details.

`residuals` calculates the residuals for the specified equation. The residuals for `finregress capm` models are computed, as usual, by subtracting linear predictions from observed values. But keep in mind that the linear prediction for `finregress capm` models is computed in terms of returns, rather than excess returns. That is, $r_t^f + \mathbf{x}_t'\widehat{\mathbf{b}}$, where $\mathbf{x}_t'\widehat{\mathbf{b}}$ is the typical linear prediction of the regression model, and r_t^f is the risk-free rate specified in the `rfrate()` option of `finregress capm`. See *Methods and formulas* for details.

`equation(`*eqspec*`)` specifies to which equation you are referring. *eqspec* can be an equation number or an equation name. For example, if *eqspec* is a number, then `equation(#1)` would mean that the calculation is to be made for the first equation (that is, for the first dependent variable), `equation(#2)` would mean the second, and so on. If *eqspec* is a name, then `equation(return)` would refer to the equation named `return`, and `equation(r_asset)` would refer to the equation named `r_asset`.

If you do not specify `equation()`, the results are the same as if you had specified `equation(#1)`.

estat grstest

Description for estat grstest

`estat grstest` performs a Gibbons–Ross–Shanken test on the intercepts that are estimated simultaneously from a financial regression with multiple assets. The null hypothesis is that those intercepts are jointly zero.

Menu for estat

Statistics > Postestimation

Syntax for estat grstest

```
estat grstest [ , finite ]
```

`collect` is allowed; see **[U] 11.1.10 Prefix commands**.

Option for estat grstest

`finite` performs the test as described in Gibbons, Ross, and Shanken (1989), which assumes normality of the errors and uses a finite-sample F statistic.

Remarks and examples

▷ Example 1: The Gibbons–Ross–Shanken test

We continue with example 1 of [FIN] **finregress capm**. We have fit a CAPM for the excess returns of five assets on excess market return.

```
. use https://www.stata-press.com/data/r19/finex
(Fictional stock price data)
. quietly finreturns acme-tyr, log(lnr_) multiply(100)
. quietly finreturns sp500, log(lnr_mkt) multiply(100)
. generate double rf = 100 * log(1 + fedfunds/100)/12
. finregress capm lnr_acme-lnr_tyr = lnr_mkt, rfrate(rf) adjust
Capital asset pricing model
Sample: 1955m2 thru 2019m12                          Number of obs = 779
```

	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
lnr_acme						
lnr_mkt	.1316993	.0102147	12.89	0.000	.111679	.1517197
_cons	.0322367	.0378174	0.85	0.394	-.041884	.1063575
lnr_bat						
lnr_mkt	1.530731	.0114377	133.83	0.000	1.508314	1.553148
_cons	.0760026	.0416309	1.83	0.068	-.0055925	.1575977
lnr_iron						
lnr_mkt	1.871524	.012273	152.49	0.000	1.847469	1.895579
_cons	.0556327	.0454103	1.23	0.221	-.0333698	.1446352
lnr_dune						
lnr_mkt	1.878887	.0123726	151.86	0.000	1.854637	1.903137
_cons	.0895071	.046235	1.94	0.053	-.0011119	.1801261
lnr_tyr						
lnr_mkt	1.087576	.0117232	92.77	0.000	1.064599	1.110553
_cons	.0282078	.0443328	0.64	0.525	-.0586828	.1150984

```
Notes: Dependent variables adjusted for risk-free rate rf.
       Independent variable lnr_mkt adjusted for risk-free rate rf.
```

In many asset-pricing applications, the key test is not for the coefficient on the market return in each time-series regression. Instead, the question of interest is whether the independent variables explain all the variation in the average level of the dependent variables. Statistically, the key implication is that the intercepts of the regressions should be small. An intercept other than zero indicates that there is still some average return that is not explained by the asset's relationship with the independent variables.

It is then natural to test for whether the intercepts are jointly zero. Because this is a multiequation regression estimated simultaneously, the joint test of significance is just a Wald test. We could use the `test` command to perform such tests, but instead let's use the `estat grstest` command after `finregress capm` to more conveniently perform the test.

```
. estat grstest

Gibbons-Ross-Shanken test
H0: All intercept terms are zero

  No. of dependent vars. =      5
No. of independent vars. =      1
     No. of time periods =    779

                 chi2(5) =  6.662
          Prob > chi2    = 0.2470
```

We do not find evidence that the intercepts are jointly different from zero.

Gibbons, Ross, and Shanken (1989) developed a version of the test that assumes normality of the errors and uses a finite-sample F statistic. This statistic can be requested with the `finite` option.

```
. estat grstest, finite

Gibbons-Ross-Shanken test
H0: All intercept terms are zero

  No. of dependent vars. =      5
No. of independent vars. =      1
     No. of time periods =    779

            F(5, 773) =  1.321
              Prob > F = 0.2532
```

Results are similar. We fail to reject the null hypothesis that the intercept is jointly zero for all assets.

◁

Stored results

`estat grstest` stores the following in `r()`:

Scalars

`r(N)`	number of observations
`r(k_dv)`	number of dependent variables
`r(k_indepvars)`	number of independent variables
`r(df)`	degrees of freedom
`r(chi2)`	χ^2
`r(p)`	p-value

`estat grstest` with the `finite` option stores the following in `r()`:

Scalars

`r(N)`	number of observations
`r(k_dv)`	number of dependent variables
`r(k_indepvars)`	number of independent variables
`r(F)`	F statistic
`r(df)`	denominator degrees of freedom
`r(df_r)`	numerator degrees of freedom
`r(p)`	p-value

Methods and formulas

Methods and formulas are presented under the following headings:

predict
estat grstest

predict

`predict` with the `xb` option provides the linear prediction. With the `residuals` option, `predict` calculates the errors of the linear prediction.

When the `rfrate()` option is specified in the `finregress capm` command, `predict` with the `xb` option produces the linear prediction plus the risk-free rate specified in `rfrate()`. If the asset return is r_{it} and the risk-free rate is r_t^f, then the prediction is

$$\hat{r}_{it} = r_t^f + \mathbf{x}_t'\hat{\mathbf{b}}$$

The linear prediction is therefore in terms of returns, rather than excess returns, because `predict` automatically adds back the risk-free rate.

When some independent variables are also adjusted for the risk-free rate, say, the first l of the M independent variables, then the linear prediction is

$$\hat{r}_{it} = r_t^f + (x_{1t} - r_t^f)\hat{b}_1 + \cdots + (x_{lt} - r_t^f)\hat{b}_l + x_{l+1,t}\hat{b}_{l+1} + \cdots + x_{Mt}\hat{b}_M$$

Notice that the risk-free rate will also affect the residual series we obtain with the `residuals` option of `predict`, because the residuals are simply the observed outcomes minus the linear prediction we defined above.

estat grstest

`estat grstest` performs a test of all intercepts being jointly zero. By default, this is a standard Wald test.

`estat grstest` with the `finite` option implements the Gibbons, Ross, and Shanken (1989, 1167) procedure. Let r_{it} be a collection of K dependent variables (asset returns), and let $\mathbf{x}_t$ be a collection of M independent variables (factors). Observations are over T periods, $t = 1, \ldots, T$. The test for mean-variance efficiency of the independent variables is that in a regression

$$r_{it} = a_i + \mathbf{x}_t'\mathbf{b}_i + \eta_t \qquad \forall i = 1, \ldots, K$$

all the intercepts will be zero, that is,

$$H_0\colon a_i = 0 \qquad \forall i = 1, \ldots, K$$

Let $\mathbf{r}_t$ be the $K \times 1$ vector of returns in period t, let $\hat{\mathbf{a}}$ be the $K \times 1$ vector of estimated intercept terms, and let $\widehat{\mathbf{B}}$ be the $K \times M$ matrix of estimated coefficients on the M independent variables $\mathbf{x}_t$. Then the required pieces for a Wald test are

$$\hat{\boldsymbol{\eta}} = \mathbf{r}_t - \hat{\mathbf{a}} - \widehat{\mathbf{B}}\mathbf{x}_t \qquad (K \times 1)$$

$$\bar{\mathbf{x}} = \frac{1}{T}\sum_{t=1}^{T}\mathbf{x}_t \qquad (M \times 1)$$

$$\boldsymbol{\Omega} = \frac{1}{T}\sum_{t=1}^{T}(\mathbf{x}_t - \bar{\mathbf{x}})(\mathbf{x}_t - \bar{\mathbf{x}})' \qquad (M \times M)$$

$$\widehat{\boldsymbol{\Sigma}} = \frac{1}{T-K-1}\sum_{t=1}^{T}\hat{\boldsymbol{\eta}}_t\hat{\boldsymbol{\eta}}_t' \qquad (K \times K)$$

The test statistic formed is

$$\widehat{W} = \frac{T(T-K-M)}{K(T-M-1)}\left(1 + \bar{\mathbf{x}}'\boldsymbol{\Omega}^{-1}\bar{\mathbf{x}}\right)^{-1}\left(\hat{\mathbf{a}}'\widehat{\boldsymbol{\Sigma}}^{-1}\hat{\mathbf{a}}\right)$$

When the residuals are distributed normally with covariance matrix $\boldsymbol{\Sigma}$, Kamstra and Shi (2021) show that the test statistic $\widehat{W} \sim F(K, T-K-M)$.

References

Gibbons, M. R., S. A. Ross, and J. Shanken. 1989. A test of the efficiency of a given portfolio. *Econometrica* 57: 1121–1152. https://doi.org/10.2307/1913625.

Kamstra, M. J., and R. Shi. 2021. A note on the GRS test. Working Paper 202111, Department of Economics, University of Californa, Riverside. https://economics.ucr.edu/repec/ucr/wpaper/202111.pdf.

Also see

[FIN] **finregress capm** — Capital asset pricing model (CAPM)+

[U] 20 Estimation and postestimation commands