**estat df** — Calculate degrees of freedom for fixed effects



## Description

`estat df` is for use after estimation with `mixed`.

`estat df` calculates and displays the degrees of freedom (DF) for each fixed effect using the specified methods. This allows for a comparison of different DF methods. `estat df` can also be used to continue with postestimation using a different DF method without rerunning the model.

## Menu for estat

Statistics > Postestimation

## Syntax

`estat df` [ `,` `method(`*df_methods*`)` `post`[ `(`*df_method*`)` ] `eim` `oim` ]

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

## Options

`method(`*df_methods*`)` specifies a list of methods to compute DF. The supported methods are `residual`, `repeated`, `anova`, `satterthwaite`, and `kroger`; more than one method may be specified. Methods `satterthwaite` and `kroger` are only available with REML estimation. If option `dfmethod()` was not specified in the most recently fit `mixed` model, then option `method()` is required. See *Small-sample inference for fixed effects* under *Remarks and examples* in [ME] **mixed** for more details.

`post` causes `estat df` to behave like a Stata estimation command. When `post` is specified, `estat df` will post the DF for each fixed effect as well as everything related to the DF computation to `e()` for the method specified in `method()`. Thus, after posting, you could continue to use this DF for other postestimation commands. For example, you could use `test, small` to perform Wald $F$ tests on linear combination of the fixed effects.

`post` may also be specified using the syntax `post(`*df_method*`)`. You must use this syntax if you specify multiple *df_methods* in option `method()`. With this syntax, `estat df` computes the DF using the method specified in `post()` and stores the results in `e()`. Only one computation method may be specified using the syntax `post()`.

The *df_method* specified in `post()` must be one of the DF methods specified in option `method()`. If only one method is specified in option `method()`, then one can simply use `post` to make this DF method active for postestimation and for `mixed` replay.

`eim` specifies that the expected information matrix be used in the DF computation. It can be used only when `method()` contains `kroger` or `satterthwaite`. `eim` is the default.

`oim` specifies that the observed information matrix be used in the DF computation. It can be used only when `method()` contains `kroger` or `satterthwaite`.

# Remarks and examples

## ▷ Example 1: Changing the degrees of freedom method

To illustrate the use of `estat df`, we refit the dental veneer data from example 14 of [ME] **mixed** using the Kenward–Roger method (option `dfmethod(kroger)`) to compute the DF for fixed effects.

```
. use https://www.stata-press.com/data/r19/veneer
(Dental veneer data)
. mixed gcf followup base_gcf cda age || patient: followup,
> covariance(unstructured) || tooth:, reml nolog dfmethod(kroger)
Mixed-effects REML regression                   Number of obs =    110
        Grouping information
------------------------------------------------------------------------------
 Group variable |     No. of       Observations per group
                |     groups    Minimum    Average    Maximum
----------------+-------------------------------------------------------------
        patient |         12          2        9.2         12
          tooth |         55          2        2.0          2
------------------------------------------------------------------------------
DF method: Kenward-Roger                        DF:       min =  10.41
                                                          avg =  28.96
                                                          max =  50.71
                                                F(4, 27.96)   =   1.47
Log restricted-likelihood = -420.92761          Prob > F      = 0.2370
------------------------------------------------------------------------------
         gcf | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    followup |   .3009815   1.938641     0.16   0.879    -3.96767    4.569633
    base_gcf |  -.0183127   .1466261    -0.12   0.901    -.3132419    .2766164
         cda |   -.329303   .5533506    -0.60   0.554    -1.440355    .7817493
         age |  -.5773932   .2350491    -2.46   0.033    -1.098324   -.056462
       _cons |   45.73862   13.21824     3.46   0.002     18.53866    72.93858
------------------------------------------------------------------------------

------------------------------------------------------------------------------
  Random-effects parameters |   Estimate   Std. err.      [95% conf. interval]
----------------------------+-------------------------------------------------
patient: Unstructured       |
                var(followup) |   41.88772   18.79997      17.38009    100.9535
                   var(_cons) |   524.9851   253.0205      204.1287    1350.175
          cov(followup,_cons) |  -140.4229   66.57623     -270.9099   -9.935904
----------------------------+-------------------------------------------------
tooth: Identity             |
                   var(_cons) |   47.45738   16.63034       23.8792     94.3165
----------------------------+-------------------------------------------------
                var(Residual) |   48.86704   10.50523      32.06479    74.47382
------------------------------------------------------------------------------
LR test vs. linear model: chi2(4) = 91.12                 Prob > chi2 = 0.0000
Note: LR test is conservative and provided only for reference.
```

Rather than specifying option dftable(pvalue) or dftable(ci) at estimation, we can display the covariate-specific DFs during postestimation by typing

```
. estat df
Degrees of freedom
```

| | Kenward-Roger |
|---|---|
| gcf | |
| followup | 10.96355 |
| base_gcf | 47.2708 |
| cda | 50.70932 |
| age | 10.41127 |
| _cons | 25.43377 |

estat df can also compare different DF methods using the method() option. For example, we can compare the Kenward–Roger method with the Satterthwaite method by typing

```
. estat df, method(kroger satterthwaite)
Degrees of freedom
```

| | Kenward-Roger | Satterthwaite |
|---|---|---|
| gcf | | |
| followup | 10.96355 | 10.96355 |
| base_gcf | 47.2708 | 47.2708 |
| cda | 50.70932 | 50.70932 |
| age | 10.41127 | 10.41127 |
| _cons | 25.43377 | 25.43377 |

The two methods produce the same estimates of DFs for single-hypothesis tests, but the results differ for multiple-hypotheses tests; see example 4 of [ME] **mixed postestimation** for details.

Suppose that we decide to proceed with the Satterthwaite method in subsequent analysis. Rather than retyping our mixed command with the dfmethod(satterthwaite) option, we can post the Satterthwaite DFs using the post option of estat df.

```
. estat df, method(satterthwaite) post
Degrees of freedom
```

| | Satterthwaite |
|---|---|
| gcf | |
| followup | 10.96355 |
| base_gcf | 47.2708 |
| cda | 50.70932 |
| age | 10.41127 |
| _cons | 25.43377 |

The returned values associated with dfmethod(kroger) from the mixed command will be replaced with those of dfmethod(satterthwaite).

◁

# Stored results

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

Macros
- `r(dfmethods)` — DF methods

Matrices
- `r(df)` — parameter-specific DFs for each method specified in `method()`
- `r(V_df)` — variance–covariance matrix of the estimators when `kroger` method is specified

If `post()` is specified, `estat df` also stores the following in `e()`:

Scalars
- `e(F)` — overall $F$ test statistic for the method specified in `post()`
- `e(ddf_m)` — model DDF for the method specified in `post()`
- `e(df_max)` — maximum DF for the method specified in `post()`
- `e(df_avg)` — average DF for the method specified in `post()`
- `e(df_min)` — minimum DF for the method specified in `post()`

Macros
- `e(dfmethod)` — DF method specified in `post()`
- `e(dftitle)` — title for DF method

Matrices
- `e(df)` — parameter-specific DFs for the method specified in `post()`
- `e(V_df)` — variance–covariance matrix of the estimators when `kroger` method is posted

# Also see

[ME] **mixed** — Multilevel mixed-effects linear regression

**[U] 20 Estimation and postestimation commands**