

# cquadr Stata module: User's Guide

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## The **cquadr** package

**cquadr** collects Stata routines that allow to execute the R package **cquad** inside Stata. This package makes use of the Stata module **rcall** that lets Stata and R to communicate.

The R package performs the estimation, based on conditional maximum likelihood, of the quadratic exponential model proposed by Bartolucci and Nigro (2010) and of a simplified and a modified version of this model. The quadratic exponential model (**cquadextr**) is suitable for the analysis of binary longitudinal data when state dependence (further to the effect of the covariates and a time-fixed individual intercept) has to be taken into account. Therefore, this is an alternative to the dynamic logit model having the advantage of easily allowing conditional inference in order to eliminate the individual intercepts and then getting consistent estimates of the parameters of main interest (for the covariates and the lagged response). The simplified version of this model (**cquadbasicr**) does not distinguish, as the original model does, between the last time occasion and the previous occasions. The modified version (**cquadeqr**) formulates in a different way the interaction terms and it may be used to test in a easy way state dependence as shown in Bartolucci et al. (2018). The package also includes estimation of the dynamic logit model by a pseudo conditional estimator (**cquadpseudor**) based on the quadratic exponential model, as proposed by Bartolucci and Nigro (2012). Further details are provided in Bartolucci and Pigni (2017).

## Preliminaries

### Install R

First of all, users are required to install the software R on their machines. It is a multi-platform free software, available for UNIX, Windows and MacOS. Further details and instructions are available at <https://www.r-project.org/>

### cquad

Once the user has a working version of R, it is possible to install the **cquad** package (<https://cran.r-project.org/package=cquad>). All we need to do is to type in the R console:

```
> install.packages("cquad")
```

At this point, R should be ready. We're halfway there.

### Stata

We have now to install three additional packages in Stata: **github**, **rcall** and clearly **cquadr**.

### github

First we have to install this very useful module for managing Stata packages from GitHub (<https://github.com/haghish/github>). We just need to type in our Stata console:

```
. net install github, from("https://haghish.github.io/github/")
```

### rcall

Once **github** is ready, we install the **rcall** function, which lets R and Stata interact (<https://github.com/haghish/rcall>).

```
. github install haghish/rcall
```

### cquadr

Finally, it is possible to install the **cquadr** package by the ad hoc GitHub repository by:

```
. github install fravale/cquadr
```

This package includes four different functions: `cquadbasicr`, `cquadextr`, `cquadeqr` and `cquadpseudor`. We can obtain the documentation for all the specific functions typing the `help` command, for example:

```
. help cquadbasicr
```

## Usage

This section reports a simple example that shows how to use the `cquadr` package.

## Input

The usage of the functions is very simple. The function command must be followed by the panel identifier `id`, the dependent variable `depvar` and the optional list of explanatory variables `indepvars`.

```
cquadbasicr id depvar [indepvars]
```

Here an example of a standard displayed output.

```
. webuse union
(NLS Women 14-24 in 1968)
```

```
. cquadbasicr idcode union age grade
```

Unbalanced panel data

iteration	lk	lk-lko
1	-3439.91	Inf
2	-3138.46	301.45
3	-3137.59	0.872128
4	-3137.59	1.36272e-05
5	-3137.59	3.18323e-12

Call:

```
cquad_basic(id = A[, 1], yv = A[, ncol(A)],
```

```
X = A[, -c(1, ncol(A))], dyn = TRUE, Ttol = 5)
```

Log-likelihood:

```
-3137.587
```

	est.	s.e.	t-stat	p-value
age	0.02848173	0.00443275	6.4252966	1.316127e-10
grade	-0.03391173	0.04567405	-0.7424726	4.578010e-01
y_lag	1.44912485	0.06095074	23.7753465	0.000000e+00

## Output

The package also provide some interesting quantities. The whole set of objects returned by the function can be displayed by:

```
. return list
```

scalars:

```
r(rc) = 0
```

matrices:

```

r(vcov) : 3 x 3
r(serr) : 3 x 1
r(ser)  : 3 x 1
r(He)   : 3 x 3
r(coefficients) : 3 x 1
```

Specifically, in order to manage a specific object, we need to type:

```
. matrix list r(coefficients)
```

```
r(coefficients)[3,1]
```

```
c1
```

```

age    .02848173
grade  -.03391173
y_lag  1.4491248
```

```
. matrix X = r(coefficients)
```

```
. di X[1,1]  
.02848173
```

Here above, two examples on how to show a specific object and how to store it for other purposes.

## References

- Bartolucci, F. and Nigro, V. (2010). A dynamic model for binary panel data with unobserved heterogeneity admitting a  $\sqrt{n}$ -consistent conditional estimator. *Econometrica*, 78(2):719–733.
- Bartolucci, F. and Nigro, V. (2012). Pseudo conditional maximum likelihood estimation of the dynamic logit model for binary panel data. *Journal of Econometrics*, 170(1):102–116.
- Bartolucci, F., Nigro, V., and Pigni, C. (2018). Testing for state dependence in binary panel data with individual covariates by a modified quadratic exponential model. *Econometric Reviews*, 37(1):61–88.
- Bartolucci, F. and Pigni, C. (2017). cquad: An r and stata package for conditional maximum likelihood estimation of dynamic binary panel data models. *Journal of Statistical Software*, 78.