

# Package ‘fitOU’

November 3, 2023

**Title** The Ornstein–Uhlenbeck Model

**Version** 0.0.0.9000

**Description** Fit the Ornstein–Uhlenbeck model using the 'dynr' package.

**URL** <https://github.com/ijapesigan/fitOU>,  
<https://ijapesigan.github.io/fitOU/>

**BugReports** <https://github.com/ijapesigan/fitOU/issues>

**License** GPL (>= 3)

**Encoding** UTF-8

**LazyData** true

**Roxygen** list(markdown = TRUE)

**VignetteBuilder** knitr

**Depends** R (>= 3.5.0)

**Imports** stats, dynr

**Suggests** knitr, rmarkdown, testthat

**RoxygenNote** 7.2.3

**NeedsCompilation** no

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bivariate_ou	<i>Bivariate Ornstein–Uhlenbeck Model Data</i>
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**Description**

Bivariate Ornstein–Uhlenbeck Model Data

**Usage**

bivariate\_ou

**Format**

A dataframe with 10000 rows and 4 columns (y1, y2, id, and time) generated from the bivariate Ornstein–Uhlenbeck model from Chow et al. (2023).

**References**

Chow, S.-M., Losardo, D., Park, J., & Molenaar, P. C. M. (2023). Continuous-time dynamic models: Connections to structural equation models and other discrete-time models. In R. H. Hoyle (Ed.), Handbook of structural equation modeling (2nd ed.). The Guilford Press.

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DataOU	<i>Preliminary Data Preparation</i>
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**Description**

This function performs the following:

- 1. Insert NA to observed variables for existing time points.
- 2. Iteratively remove rows where any observed variable for the first time point has NA.
- 3. Scale the data by id.

**Usage**

DataOU(data, observed, id, time, center = TRUE, scale = TRUE)

**Arguments**

data	Data frame. A data frame object of data for potentially multiple subjects that contain a column of subject ID numbers (i.e., an ID variable), a column indicating subject-specific measurement occasions (i.e., a TIME variable), at least one column of observed values.
observed	Character vector. A vector of character strings of the names of the observed variables in the data.

id	Character string. A character string of the name of the ID variable in the data.
time	Character string. A character string of the name of the TIME variable in the data.
center	Logical. If center = TRUE, mean center by id.
scale	Logical. If scale = TRUE, standardize by id.

**Author(s)**

Ivan Jacob Agaloos Pesigan

**See Also**

Other Fit Ornstein–Uhlenbeck Model Functions: [FitOU\(\)](#), [ModelOU\(\)](#)

**Examples**

```
DataOU(  
  data = bivariate_ou,  
  observed = c("y1", "y2"),  
  id = "id",  
  time = "time"  
)
```

---

FitOU

*Fit the Ornstein–Uhlenbeck Model*

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**Description**

This is a wrapper function that makes fitting the Ornstein–Uhlenbeck model convenient using the dynr package.

**Usage**

```
FitOU(model, retry = NULL, ...)
```

**Arguments**

model	Output of <a href="#">ModelOU()</a> .
retry	Positive integer. Maximum number of reruns.
...	Additional arguments to pass to <a href="#">dynr::dynr.cook()</a> .

## Details

The measurement model is given by

$$\mathbf{y}_{i,t} = \boldsymbol{\nu} + \boldsymbol{\Lambda}\boldsymbol{\eta}_{i,t} + \boldsymbol{\varepsilon}_{i,t} \quad \text{with} \quad \boldsymbol{\varepsilon}_{i,t} \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Theta})$$

where  $\mathbf{y}_{i,t}$ ,  $\boldsymbol{\eta}_{i,t}$ , and  $\boldsymbol{\varepsilon}_{i,t}$  are random variables and  $\boldsymbol{\nu}$ ,  $\boldsymbol{\Lambda}$ , and  $\boldsymbol{\Theta}$  are model parameters.  $\mathbf{y}_{i,t}$  is a vector of observed random variables at time  $t$  and individual  $i$ ,  $\boldsymbol{\eta}_{i,t}$  is a vector of latent random variables at time  $t$  and individual  $i$ , and  $\boldsymbol{\varepsilon}_{i,t}$  is a vector of random measurement errors at time  $t$  and individual  $i$ , while  $\boldsymbol{\nu}$  is a vector of intercept,  $\boldsymbol{\Lambda}$  is a matrix of factor loadings, and  $\boldsymbol{\Theta}$  is the covariance matrix of  $\boldsymbol{\varepsilon}$ .

The dynamic structure is given by

$$d\boldsymbol{\eta}_{i,t} = \boldsymbol{\Phi}(\boldsymbol{\mu} - \boldsymbol{\eta}_{i,t}) dt + \boldsymbol{\Sigma}^{\frac{1}{2}} d\mathbf{W}_{i,t}$$

where  $\boldsymbol{\mu}$  is the long-term mean or equilibrium level,  $\boldsymbol{\Phi}$  is the rate of mean reversion, determining how quickly the variable returns to its mean,  $\boldsymbol{\Sigma}$  is the matrix of volatility or randomness in the process, and  $d\mathbf{W}$  is a Wiener process or Brownian motion, which represents random fluctuations.

## Author(s)

Ivan Jacob Agaloos Pesigan

## References

- Chow, S.-M., Losardo, D., Park, J., & Molenaar, P. C. M. (2023). Continuous-time dynamic models: Connections to structural equation models and other discrete-time models. In R. H. Hoyle (Ed.), *Handbook of structural equation modeling* (2nd ed.). The Guilford Press.
- Ou, L., Hunter, M. D., & Chow, S.-M. (2019). What's for dynr: A package for linear and nonlinear dynamic modeling in R. *The R Journal*, 11(1), 91. doi:10.32614/rj2019012
- Uhlenbeck, G. E., & Ornstein, L. S. (1930). On the theory of the brownian motion. *Physical Review*, 36(5), 823–841. doi:doi.org/10.1103/physrev.36.823

## See Also

Other Fit Ornstein–Uhlenbeck Model Functions: [DataOU\(\)](#), [ModelOU\(\)](#)

## Examples

```
## Not run:
data <- DataOU(
  data = bivariate_ou,
  observed = c("y1", "y2"),
  id = "id",
  time = "time"
)
model <- ModelOU(
  data = data,
  observed = c("y1", "y2"),
  id = "id",
```

```

    time = "time"
  )
  FitOU(
    model = model,
    verbose = FALSE
  )

## End(Not run)

```

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ModelOU

Specify the Ornstein–Uhlenbeck Model

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### Description

This is a wrapper function that makes specifying the Ornstein–Uhlenbeck model convenient using the dynr package.

### Usage

```

ModelOU(
  data,
  observed,
  id,
  time,
  mu0 = NULL,
  sigma0 = NULL,
  mu_start = NULL,
  phi_start = NULL,
  sigma_start = NULL,
  theta_start = NULL,
  sigma_diag = FALSE,
  outfile = paste0(tempfile(), ".c")
)

```

### Arguments

data	Data frame. A data frame object of data for potentially multiple subjects that contain a column of subject ID numbers (i.e., an ID variable), a column indicating subject-specific measurement occasions (i.e., a TIME variable), at least one column of observed values.
observed	Character vector. A vector of character strings of the names of the observed variables in the data.
id	Character string. A character string of the name of the ID variable in the data.
time	Character string. A character string of the name of the TIME variable in the data.
mu0	Numeric vector. Mean of initial latent variable values ( $\mu_{\eta 0}$ ). If mu0 = NULL, a vector of zeros is used.

<code>sigma0</code>	Numeric matrix. Covariance matrix of initial latent variable values ( $\Sigma_{\eta 0}$ ). If <code>sigma0 = NULL</code> , an identity matrix is used.
<code>mu_start</code>	Numeric vector. Starting values of the <code>mu</code> vector, that is, the long-term mean or equilibrium level. If <code>mu_start = NULL</code> , a vector means of the observed variables is used.
<code>phi_start</code>	Numeric matrix. Starting values of the <code>phi</code> matrix, that is, the rate of mean reversion, determining how quickly the variable returns to its mean. If <code>phi_start = NULL</code> , a matrix of zeros is used.
<code>sigma_start</code>	Numeric matrix. Starting values of the <code>sigma</code> matrix, that is, the matrix of volatility or randomness in the process. If <code>sigma_start = NULL</code> , an identity matrix is used.
<code>theta_start</code>	Numeric matrix. Starting values of the <code>theta</code> matrix, that is, the measurement error covariance matrix ( $\Theta$ ). If <code>theta_start = NULL</code> , an identity matrix is used.
<code>sigma_diag</code>	Logical. If <code>sigma_diag = TRUE</code> , estimate only the diagonals of $\Sigma$ .
<code>outfile</code>	A character string of the name of the output C script of model functions to be compiled for parameter estimation.

**Author(s)**

Ivan Jacob Agaloos Pesigan

**See Also**

Other Fit Ornstein–Uhlenbeck Model Functions: [DataOU\(\)](#), [FitOU\(\)](#)

**Examples**

```
## Not run:
data <- DataOU(
  data = bivariate_ou,
  observed = c("y1", "y2"),
  id = "id",
  time = "time"
)
ModelOU(
  data = data,
  observed = c("y1", "y2"),
  id = "id",
  time = "time"
)

## End(Not run)
```

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