

# Package ‘DATAstudio’

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**Version** 1.2.3

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**Title** The Research Data Warehouse of Miguel de Carvalho

**Description** Pulls together a collection of datasets from Miguel de Carvalho research articles and books. Including, for example:

- de Carvalho (2012) <[doi:10.1016/j.jspi.2011.08.016](https://doi.org/10.1016/j.jspi.2011.08.016)>;
- de Carvalho et al (2012) <[doi:10.1080/03610926.2012.709905](https://doi.org/10.1080/03610926.2012.709905)>;
- de Carvalho et al (2012) <[doi:10.1016/j.econlet.2011.09.007](https://doi.org/10.1016/j.econlet.2011.09.007)>;
- de Carvalho and Davison (2014) <[doi:10.1080/01621459.2013.872651](https://doi.org/10.1080/01621459.2013.872651)>;
- de Carvalho and Rua (2017) <[doi:10.1016/j.ijforecast.2015.09.004](https://doi.org/10.1016/j.ijforecast.2015.09.004)>;
- de Carvalho et al (2023) <[doi:10.1002/sta4.560](https://doi.org/10.1002/sta4.560)>;
- de Carvalho et al (2022) <[doi:10.1007/s13253-021-00469-9](https://doi.org/10.1007/s13253-021-00469-9)>;
- Palacios et al (2025) <[doi:10.1214/24-BA1420](https://doi.org/10.1214/24-BA1420)>.

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**Depends** R (>= 3.5)

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**License** GPL (>= 3)

**Repository** CRAN

**Suggests** extremis, spearmanCI

**Imports** data.table, ggplot2, scales

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## Format

The alps data frame contains the following columns:

date Date of measurements.

min\_montana, min\_zermatt Daily minimum temperature in °C on Montana and Zermatt.

max\_montana, max\_zermatt Daily maximum temperature in °C on Montana and Zermatt.

## Source

MeteoSwiss

## References

Mhalla, L., de Carvalho, M., and Chavez-Demoulin, V. (2019) Regression type models for extremal dependence. *Scandinavian Journal of Statistics*, **46**, 1141-1167.

## Examples

```
## visualizing the data
data(alps)
oldpar <- par(pty = 's', mfrow = c(1, 2))
plot(alps$min_montana, alps$min_zermatt, pch = 20,
      xlab = "Montana", ylab = "Zermatt", main = "Daily Minimum")
plot(alps$max_montana, alps$max_zermatt, pch = 20,
      xlab = "Montana", ylab = "Zermatt", main = "Daily Maximum")
par(oldpar)

oldpar <- par(pty = 's', mfrow = c(1, 2))
plot(alps$min_montana, alps$max_montana, pch = 20,
      xlab = "Minimum", ylab = "Maximum", main = "Montana")
abline(a = 0, b = 1, col = "red", lty = 2)
plot(alps$min_zermatt, alps$max_zermatt, pch = 20,
      xlab = "Minimum", ylab = "Maximum", main = "Zermatt")
abline(a = 0, b = 1, col = "red", lty = 2)
par(oldpar)

## Not run:
## to download the NAO daily index in Mhalla et al (2019) use
## the R package data.table to access NOAA via ftp
link <- "ftp://ftp.cdc.noaa.gov/Public/gbates/teleconn/nao.reanalysis.t10trunc.1948-present.txt"
NAO.daily <- data.table::fread(link)
NAO.daily <- data.frame(NAO.daily)
colnames(NAO.daily) <- c("year", "month", "day", "NAO")

## End(Not run)
```

---

beatenberg

*Beatenberg Forest Temperature Data (In Unit Fréchet Scale)*

---

### Description

Preprocessed pairs of temperatures in unit Fréchet scale from Beatenberg forest, registered under forest cover and in the open field.

### Usage

beatenberg

### Format

The beatenberg data frame has 2839 rows and 2 columns: x (forest cover) and y (open field).

### Details

Preprocessing was conducted as described in Ferrez et al (2011), and for applications of this dataset within the context of extreme value theory see de Carvalho *et al.* (2013), de Carvalho and Davison (2014) as well as Castro and de Carvalho (2017).

### References

- Castro, D. and de Carvalho, M. (2017) Spectral density regression for bivariate extremes. *Stochastic Environmental Research and Risk Assessment*, **31**, 1603-1613.
- de Carvalho, M., Oumow, B., Segers, J., and Warchol, M. (2013) A Euclidean likelihood estimator for bivariate tail dependence. *Communications in Statistics—Theory and Methods*, **42**, 1176-1192.
- de Carvalho, M. and Davison, A. C. (2014) Spectral density ratio models for multivariate extremes. *Journal of the American Statistical Association*, **109**, 764-776.
- Ferrez, J., Davison, A. C., and Rebetez., M. (2011) Extreme temperature analysis under forest cover compared to an open field. *Agricultural and Forest Meteorology*, **151**, 992-1001.

### Examples

```
## de Carvalho et al (2013, Fig. 5)
data(beatenberg)
attach(beatenberg)
plot(x, y, log = "xy", pch = 20, xlab = "Forest Cover", ylab = "Open Field")

## Not run:
## install package extremis if not installed
if (!require("extremis")) install.packages("extremis")

## de Carvalho et al (2013, Fig. 7)
data(beatenberg)
fit <- bev.kernel(beatenberg, tau = 0.98, nu = 163, raw = FALSE)
plot(fit)
```

```
rug(fit$w)
## End(Not run)
```

---

brainwave	<i>Brainwave Data</i>
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---

### Description

The data contains the EEG power of two commonly-recognized types of EEG frequency bands: Y1 for alpha and Y2 for beta, for 30 participants and different covariates/stimulus. Column 3 to 8, represent the stimulus in the set: x1 for "mathematics", x2 for "relaxation", x3 for "music", x4 for "color", x5 for "video", x6 for "think and relax"). Column 9 represents the id of the participant, and column 10 contains the time in seconds.

### Usage

```
brainwave
```

### Format

The brainwave data frame has 7506 rows and 10 columns.

### References

Palacios Ramirez, V., de Carvalho, M., and Gutierrez, L. (2025) Heavy-tailed NGG-mixture models. *Bayesian Analysis*, **20**, 1315-1343.

---

brexit	<i>Brexit Poll Tracker</i>
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---

### Description

The data consist of 267 polls conducted before the June 23 2016 EU referendum, which took place in the UK.

### Usage

```
brexit
```

### Format

A dataframe with 272 observations on six variables.

leave, stay, undecided Percentage in favor of each option.

date Date on which the poll was conducted.

pollster Institution conducting the poll.

size Number of polled subjects.

**Source**

Financial Times (FT) Brexit poll tracker.

**References**

de Carvalho, M. and Martos, G. (2020). Brexit: Tracking and disentangling the sentiment towards leaving the EU. *International Journal of Forecasting*, **36**, 1128-1137.

**Examples**

```
## Leave-stay plot (de Carvalho and Martos, 2018; Fig. 1)
data(brexit)
attach(brexit)
oldpar <- par(pty = "s")
plot(leave[(leave > stay)], stay[(leave > stay)],
     xlim = c(22, 66), ylim = c(22, 66), pch = 16, col = "red",
     xlab = "Leave", ylab = "Stay")
points(leave[(stay > leave)], stay[(stay > leave)],
       pch = 16, col = "blue")
points(leave[(stay == leave)], stay[(stay == leave)],
       pch = 24)
abline(a = 0, b = 1, lwd = 3)
par(oldpar)
```

---

california

*California Fire Perimeters*

---

**Description**

The `california` data frame has 16577 rows and 2 columns. The first column contains the date, the second column gives the quantity of acres consumed by the flames.

**Format**

This data frame contains the following columns:

**Date** A numeric vector of dates of wildfires.

**Acres** A numeric vector of thousands of acres consumed by the flames.

**Details**

Data are available from GitHub and hence can be gathered using the command `dataset("california")`.

**Source**

California State Geoportal.

## References

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

de Carvalho, M., Palacios, V., Henriques-Rodrigues, L., and Lee, M. W. (2026). Regression Models for Extreme Events. In: *Handbook of Statistics of Extremes*, Chapter 6, pp. 99–120.

---

challenger

*Space Shuttle Challenger Data*

---

## Description

Data on 23 flights of the space shuttle Challenger prior to the 1986 accident, wherein the shuttle blew up during takeoff.

## Usage

```
challenger
```

## Format

A dataframe with 23 observations on two variables, namely O-ring temperature (°F) and oring state (1 = failure; 0 = success).

## References

de Carvalho, M. (2012) A Generalization of the Solis–Wets method. *Journal of Statistical Planning and Inference*, **142**, 633-644.

## Examples

```
## Not run:
data(challenger)
ggplot(challenger, aes(x = as.factor(oring), y = temperature)) +
  geom_boxplot(fill = "steelblue", alpha = 0.3) +
  xlab("Failure") +
  ylab("Temperature (°F)") +
  theme_minimal()

## End(Not run)
```

---

claims                      *Initial Claims of Unemployment*

---

**Description**

Weekly number (in thousands) of unemployment insurance claims in the US from 7 Jan 1967 until 28 Nov 2009.

**Usage**

claims

**Format**

A time series with 515 observations; the object is of class `tis` (time-indexed series).

**Source**

United States Department of Labor—Employment & Training Administration.

**References**

de Carvalho, M., Turkman, K. F. and Rua, A. (2013) Dynamic threshold modelling and the US business cycle. *Journal of the Royal Statistical Society, Ser. C*, **62**, 535-550.

**See Also**

<https://webhomes.maths.ed.ac.uk/~mdecarv/decarvalho2013ash.html>

**Examples**

```
## de Carvalho et al (2013; Fig 1)
data(claims)
plot(time(claims), claims, type = "l",
      xlab = "Time", ylab = "Initial Claims (in Thousands)")
```

---

cortical                      *Brain Shape Data*

---

**Description**

Axial brain slices gathered via magnetic resonance images (MRI) with 500 points on each outline, for 30 schizophrenia patients and 38 healthy controls.

**Usage**

cortical

## Format

The cortical list has the following variables:

age Age, in years.

group Control patient (Con) or schizophrenia patient (Scz).

sex Male (1) or female (2).

symm Symmetry score obtained from raw 3D brain surface.

x and y Coordinates of slice from brain surface that intersects the AC (anterior commissure) and PC (posterior commissure).

cortical\$r 500 radii from angular polar coordinates.

## Details

The data were gathered from a neuroscience study conducted at the University of British Columbia, Canada, and documented in Brignell *et al.* (2010) and Martos and de Carvalho (2018). Each brain was registered into the so-called Talairach space so that brains can be compared on the same three-dimensional referential coordinate space.

## References

Brignell, C.J., Dryden, I.L., Gattone, S.A., Park, B., Leask, S., Browne, W.J., and Flynn, S. (2010) Surface shape analysis, with an application to brain surface asymmetry in schizophrenia. *Biostatistics*, **11**, 609-630.

Martos, G. and de Carvalho, M. (2018) Discrimination surfaces with application to region-specific brain asymmetry analysis. *Statistics in Medicine*, **37**, 1859-1873.

## Examples

```
## Martos and de Carvalho (2018; Fig 1 a)
library(scales)
data(cortical)
m <- 500
n <- 68
plot(cortical$r[,1] * cos(2 * pi * 1:m / m),
     cortical$r[,1] * sin(2 * pi * 1:m / m) , type = "l",
     col = alpha("gray", 1 / n), xlab = "z", ylab = "x")
for(i in 2:n)
lines(cortical$r[, i] * cos(2 * pi * 1:m / m),
     cortical$r[, i] * sin(2 * pi * 1:m / m), type = "l",
     col = alpha("gray", i / n))
```

---

cyclone_sst	<i>Tropical Cyclone and Sea Surface Temperature Data</i>
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**Description**

The cyclone\_sst dataset consists of point process data on tropical cyclone locations (latitude and longitude), together with information on storm intensity, status, and timing.

**Usage**

cyclone\_sst

**Format**

The cyclone\_sst data frame contains the following columns:

latitude Latitude (degrees).

longitude Longitude (degrees).

category Saffir–Simpson hurricane wind scale category (1–5, with 5 the most severe); 0 indicates tropical storms or tropical depressions.

date Date of the tropical cyclone event.

status Storm classification (hurricane, tropical storm, or tropical depression).

**References**

de Carvalho, M., Ferrer, C. and Vallejos, R. (2026). A Kolmogorov–Arnold neural model for cascading extremes. *Extremes*, to appear.

---

danube	<i>Upper Danube Basin Data</i>
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---

**Description**

River discharge data for tributaries of the Danube River.

**Format**

A named list with four components:

data\_clustered A numeric matrix containing preprocessed discharge data for each gauging station.

data\_raw A numeric matrix containing daily discharge observations for each gauging station.

info A data frame containing information on each gauging station and its catchment area.

flow\_edges A two-column numeric matrix; each row gives the indices (in info) of a pair of gauging stations that are directly connected by a river segment.

## Details

The matrix `data_clustered` was obtained by declustering the daily discharge data from the summer months between 1960 and 2010 contained in `data_raw`, yielding between seven and ten observations per year. Each row corresponds to one observation from the declustered time series; the *non-unique row names* indicate the year of observation. Each column corresponds to a gauging station, with column indices in `data_raw` and `data_clustered` matching row indices in `info`. See Asadi et al. (2015) for details on the preprocessing and declustering.

The `info` data frame contains the following variables for each gauging station or its associated catchment area:

`RivNames` Name of the river at the gauging station.

`Lat`, `Long` Geographic coordinates of the gauging station.

`Lat_Center`, `Long_Center` Coordinates of the center of the corresponding catchment area.

`Alt` Mean altitude of the catchment area.

`Area` Area of the catchment.

`Slope` Mean slope of the catchment.

`PlotCoordX`, `PlotCoordY` Coordinates used to arrange gauging stations when plotting a flow graph.

Data are available from GitHub and hence can be gathered using the command `dataset("danube")`.

## Source

Bavarian Environmental Agency, <https://www.gkd.bayern.de> and **graphicalExtremes**.

## References

Asadi, P., Davison, A. C., Engelke, S., and Furrer, R. (2015). Extreme-value modeling of spatially dependent river discharges. *Journal of the American Statistical Association*, 110, 124–136.

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook of Statistics of Extremes*. Chapman & Hall/CRC, Boca Raton, FL.

Wan, P. and Janßen, A. (2026). Clustering Methods for Multivariate Extremes. In: *Handbook of Statistics of Extremes*, Chapter 12, pp. 243–262.

---

dataset

*Load Dataset*

---

## Description

This function loads a dataset that is not included in the package due to space constraints on CRAN, but is available online from GitHub. It works similarly to the R command `data` from the `utils` package, except that it downloads the dataset.

## Usage

`dataset(name)`

**Arguments**

name                    a string containing the link.

**Examples**

```
## Download data
dataset("thefts")
head(thefts)
summary(thefts)
## for details on the dataset type
?thefts
```

---

diabetes	<i>Diabetes Diagnosis Data</i>
----------	--------------------------------

---

**Description**

The diabetes data frame has 286 rows and 3 columns. The data were gathered from a population-based pilot survey of diabetes in Cairo, Egypt, in which postprandial blood glucose measurements were obtained from a fingerstick on 286 subjects. Based on the WHO (World Health Organization) criteria, 88 subjects were classified as diseased and 198 as healthy.

**Usage**

```
diabetes
```

**Format**

The diabetes data frame contains the following columns:

marker Postprandial blood glucose measurements (mg/dl) obtained from a fingerstick.

status Disease status, with 1 identifying subjects diagnosed with diabetes.

age Age in years.

**References**

Inácio de Carvalho, V., de Carvalho, M. and Branscum, A. (2017) Nonparametric Bayesian covariate-adjusted estimation of the Youden index. *Biometrics*, **73**, 1279-1288.

Inácio de Carvalho, V., Jara, A., Hanson, T. E. and de Carvalho, M. (2013) Bayesian nonparametric ROC regression modeling. *Bayesian Analysis*, **8**, 623-646.

**Examples**

```
data(diabetes)
plot(diabetes, pch = 20, main = "Diabetes Data")
```

---

earthquake\_tsunami      *Earthquake-Tsunami Data*

---

### Description

The earthquake\_tsunami dataset consists of point process data on earthquake locations (latitude and longitude) dating back to 2150 B.C., together with an indicator of whether the event was followed by a tsunami.

### Usage

earthquake\_tsunami

### Format

The earthquake\_tsunami data frame contains the following columns:

tsunami Indicator of tsunami occurrence (1 = yes, 0 = no).

latitude Epicentral latitude (°).

longitude Epicentral longitude (°).

magnitude Earthquake magnitude (Richter scale).

focal Focal depth of the earthquake (km).

### References

de Carvalho, M., Ferrer, C. & Vallejos, R. (2026, to appear). A Kolmogorov–Arnold neural model for cascading extremes. *Extremes*.

---

ecg200      *Electrocardiogram Data*

---

### Description

The ecg data frame has 200 rows and 97 columns. The data is the result of monitoring electrical activity recorded during one heartbeat and it consists of 200 ECG signals sampled at 96 time instants, corresponding to 133 normal heartbeats and 67 myocardial infarction signals.

### Usage

ecg200

**Format**

The `ecg200` data frame contains the following columns:

`status` : status of the patient, where 1 identifies subjects with myocardial infarction signals, and 0 identifies subjects with normal heartbeats.

`i1 to i96` measurements at instants `i1 to i96`; to my knowledge the exact unit of time is unknown and is not specified by Olszewski (2001), who gathered the data.

**References**

de Carvalho, M. and Martos, G. (2024). Uncovering sets of maximum dissimilarity on random process data. *Transactions on Machine Learning Research*, **5**, 1-31.

Olszewski, R. T. (2001). Generalized feature extraction for structural pattern recognition in time-series data. Carnegie Mellon University, PhD thesis.

**Examples**

```
## Not run:
## de Carvalho and Martos (2024, TMLR; Fig. 4)
if (!require("dplyr")) install.packages("dplyr")
if (!require("ggplot2")) install.packages("ggplot2")
if (!require("tidyr")) install.packages("tidyr")

packages <- c("dplyr", "ggplot2", "tidyr")
sapply(packages, require, character = TRUE)
longECG <- ecg200
  pivot_longer(cols = starts_with("i"), names_to = "instant",
               values_to = "value")
  mutate(instant = as.integer(sub("i", "", instant)))

# create scatter plot of pooled data
ggplot(longECG, aes(x = instant, y = value, color = factor(status))) +
  geom_point(size = 1, alpha = 0.3) +
  labs(color = "Status") +
  scale_color_manual(values = c("0" = "red", "1" = "blue"),
                    labels = c("0" = "Non-diseased", "1" = "Diseased")) +
  xlab("Time") +
  ylab("ECG Signal") +
  theme_minimal()

## End(Not run)
```

---

 epilepsy

*Epilepsy EEG Data*


---

**Description**

Electroencephalogram (EEG) recordings from a patient experiencing a temporal lobe epileptic seizure.

**Format**

A numeric matrix with 50,000 rows and 19 columns, containing EEG recordings from 19 channels sampled at 100~Hz.

**Details**

The data contain EEG recordings from 19 channels of a female patient suffering from a temporal lobe epileptic seizure, monitored by a neurologist at the Epilepsy Center of the University of Michigan. The EEG signals were sampled at 100 Hz (100 observations per second) over a duration of 500 seconds, yielding a total of 50,000 time points. The seizure onset occurs after 350 seconds ( $t = 35\,000$ ).

The data are organized as a matrix of dimension  $50\,000 \times 19$ , where columns correspond to EEG channels and rows correspond to recordings at times  $t = 1, \dots, 50\,000$ .

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). Handbook of Statistics of Extremes. Chapman & Hall/CRC, Boca Raton, FL.

Redondo, P. V., Guerrero, M. B., Huser, R., and Ombao, H. (2026). Statistics of Extremes for Neuroscience. In: Handbook of Statistics of Extremes, Chapter 30, pp. 675–690.

---

faang

*FAANG Data*

---

**Description**

Daily information on FAANG stocks.

**Format**

The `faang` object is a list with five elements, each containing a matrix with columns corresponding to the opening, highest, lowest, and closing prices, as well as trading volume and adjusted closing price.

**Details**

To load the file use the command `dataset("faang")`. FAANG is an acronym for popular tech stocks, namely (Meta's) Facebook, Apple, Amazon, Netflix, and (Alphabet's) Google. The data consist of prices at close for these stocks over 2012-2024. The data were gathered from Yahoo Finance.

**References**

de Carvalho, M. and Palacios Ramirez, K. (2025) Semiparametric Bayesian modeling of nonstationary joint extremes: How do big tech's extreme losses behave? *Journal of the Royal Statistical Society, Ser. C*, **74**, 447-465.

**Examples**

```
## Not run:  
dataset("faang")  
  
## End(Not run)
```

---

fire

*Danish Fire Insurance Claims Database*

---

**Description**

The Danish Fire Insurance Claims Database includes 2167 industrial fire losses gathered from the Copenhagen Reinsurance Company over the period 1980-1990.

**Usage**

```
fire
```

**Format**

A dataframe with 2167 observations on five variables, namely:

```
Positions Date.  
building Loss to buildings.  
content Loss to content.  
profits Loss to profits.  
total Total loss.
```

**References**

de Carvalho, M. and Marques, F. (2012) Jackknife Euclidean likelihood-based inference for Spearman's rho. *North American Actuarial Journal*, **16**, 487-492.

**Examples**

```
data(fire)  
attach(fire)  
plot(building, contents, pch = 20, xlim = c(0, 95), ylim = c(0, 133),  
      xlab = "Loss of Building", ylab = "Loss of Contents",  
      main = "Danish Fire Insurance Claims")  
  
## Not run:  
## Confidence intervals for Spearman rho; install the package  
## spearmanCI, if not installed  
if (!require("spearmanCI")) install.packages("spearmanCI")  
spearmanCI(building, contents)  
  
## End(Not run)
```

---

 flights

*Flight Delay Data*


---

### Description

A dataset containing daily total delays of major U.S.\ airlines. The raw data were obtained from the US\ Bureau of Transportation Statistics and subsequently preprocessed.

### Format

A named list with three components:

`airports` A data frame containing information on US\ airports.

`delays` A numeric array containing daily aggregated delays at the airports in the dataset.

`flightCounts` A numeric array containing yearly numbers of flights between airports in the dataset.

### Details

The component `flightCounts` is a three-dimensional array containing the number of flights between each pair of airports, aggregated on a yearly basis. Each entry gives the total number of flights between a departure airport (row) and a destination airport (column) in a given year (third dimension). This array does not contain any NAs; airports with no flights in a given year are represented by zeros.

The component `delays` is a three-dimensional array containing daily total positive delays (in minutes) of incoming and outgoing flights. Each column corresponds to an airport and each row to a day. The third dimension has length two, with "arrivals" containing delays of incoming flights and "departures" containing delays of outgoing flights. Zeros indicate that flights occurred but none were delayed; NAs indicate that no flights occurred on that day.

The component `airports` is a data frame containing information on US\ airports. Missing entries are indicated by NA.

`IATA` Three-letter IATA airport code.

`Name` Name of the airport.

`City` Primary city served by the airport.

`Country` Country or territory where the airport is located.

`ICAO` Four-letter ICAO airport code.

`Latitude` Latitude of the airport (decimal degrees).

`Longitude` Longitude of the airport (decimal degrees).

`Altitude` Altitude of the airport (feet).

`Timezone` Timezone offset from UTC (hours).

`DST` Daylight saving time used at the airport.

`Timezone2` Name of the timezone of the airport.

Data are available from GitHub and hence can be gathered using the command `dataset("flights")`.

**Source**

Reproduced with permission from the **graphicalExtremes** package.

Raw delay data were obtained from the US\ Bureau of Transportation Statistics.

Airport metadata were obtained from: <https://openflights.org/data>.

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook of Statistics of Extremes*. Chapman & Hall/CRC, Boca Raton, FL.

Engelke, S., Hentschel, M., Lalancette, M., and Röttger, F. (2026). Graphical models for multivariate extremes. In: *Handbook of Statistics of Extremes*, Chapter 13, pp. 263–290.

Henzi, A., Engelke, S., and Reich, B. J. (2022). Graphical modeling for extremes. *Journal of the American Statistical Association*, **117**, 116–131.

**Examples**

```
require(DATAstudio)
dataset("flights")
# Total number of flights in the dataset:
totalFlightCounts <- apply(flights$flightCounts, c(1, 2), sum)

# Number of flights in selected years:
flightCounts_10_11 <- apply(flights$flightCounts[, , c("2010", "2011")], c(1, 2), sum)
```

---

GDP

*GDP of the US Economy*


---

**Description**

US GDP (Gross Domestic Product) ranging from from 1950 (Q1) to 2009 (Q4).

**Usage**

GDP

**Format**

A time series with 268 observations on two variables. The object is of class `ts`.

**Source**

de Carvalho, M., Rodrigues, P. and Rua, A. (2012) Tracking the US business cycle with a singular spectrum analysis. *Economics Letters*, **114**, 32-35.

**References**

de Carvalho, M. and Rua, A. (2017) Real-time nowcasting the US output gap: Singular spectrum analysis at work. *International Journal of Forecasting*, **33**, 185-198.

**See Also**

<https://webhomes.maths.ed.ac.uk/~mdecarv/decarvalho2012dsh.html>

**Examples**

```
data(GDP)
plot(GDP, ylab = "Gross Domestic Product")

## Not run:
if (!require("ASSA")) install.packages("ASSA")
data(GDP)
fit <- bssa(log(GDP[, 1]))
plot(fit)
print(fit)

## End(Not run)
```

---

GDPIP

*A Real-time Vintage of GDP and IP for the US Economy*

---

**Description**

US GDP (Gross Domestic Product) and IP (Industrial Production) ranging from from 1947 (Q1) to 2013 (Q4); the data correspond to a real-time vintage.

**Usage**

GDPIP

**Format**

A bivariate time series with 268 observations on two variables: GDP and IP. The object is of class `mts`.

**Source**

Federal Reserve Bank of Philadelphia.

**References**

de Carvalho, M. and Rua, A. (2017). Real-time nowcasting the US output gap: Singular spectrum analysis at work. *International Journal of Forecasting*, **33**, 185-198.

**See Also**

<https://webhomes.maths.ed.ac.uk/~mdecarv/decarvalho2017sh.html>

**Examples**

```

data(GDPIP)
plot(GDPIP)

## Plotting GDP against IP (de Carvalho and Rua, 2017; Fig. 4)
data(GDPIP)
oldpar <- par(mar = c(5, 4, 4, 5) + .1)
plot(GDPIP[, 1], type = "l",
      xlab = "Time", ylab = "Gross Domestic Product (GDP)",
      lwd = 3, col = "red", cex.lab = 1.4, cex.axis = 1.4)
par(new = TRUE)
plot(GDPIP[, 2], type = "l", xaxt = "n", yaxt = "n",
      xlab = "", ylab = "", lwd = 3, col = "blue", cex.axis = 1.4)
axis(4)
mtext("Industrial Production (IP)", side = 4, line = 3, cex = 1.4)
legend("topleft", col = c("red", "blue"),
      lty = 1, lwd = 3, legend = c("GDP", "IP"))
par(oldpar)

## Not run:
## Tracking the US Business Cycle (de Carvalho et al, 2017; Fig. 6)
## Install the package ASSA, if not installed
if (!require("ASSA")) install.packages("ASSA")
data(GDPIP)
fit <- bmssa(log(GDPIP))
plot(fit)
print(fit)

## End(Not run)

```

---

hongkong

*Daily Maximum Temperature in Hong Kong*


---

**Description**

Daily Maximum Temperature Data from Hong Kong International Airport, Hong Kong, from January 1884 to October 2023.

**Format**

The hongkong data frame has 48517 observations and 2 columns:

date Year-month-day.

value Daily maximum temperature (in degrees Celsius).

**Details**

Data on daily maximum temperatures with no missing values, with a total of 48517 observations. Data are available from GitHub and hence can be gathered using the command `dataset("hongkong")`.

**References**

Carcaiso, V., De Carvalho, M., Prosdocimi, I. and Antoniano-Villalobos, I. (2026). Bayesian mixture models for heterogeneous extremes. arXiv:2509.15359.

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

---

hurricane

*Hurricane Tracking Data*

---

**Description**

Geographical coordinates, wind speed, and atmospheric pressure information for hurricanes from 1970 to 2011.

**Usage**

```
data(hurricane)
```

**Format**

The hurricane data frame has 43122 rows and 8 columns:

Year : Hurricane's year (ranging from 1971 to 2011).

Number : Year-specific hurricane identifier.

Name : Official name of the hurricane.

ISO\_Time : Recorded observation time.

Latitude : Recorded latitude of the measurement.

Longitude : Recorded longitude of the measurement.

Wind : Wind speed (in knots)

Pressure : Atmospheric pressure (millibars).

**Source**

National Hurricane Center and Brian A. Fannin.

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

---

 landslide

*Earthquake-Induced Landslide Dataset*


---

### Description

The landslide dataset contains data related with multiple-landslides following the May 2008 Wenchuan earthquake in Sichuan, China.

### Format

The landslide dataset contains the following columns:

**presence** Binary indicator of landslide occurrence within the grid cell (1 = landslide present, 0 = no landslide).

**area\_grid** Total area of the spatial grid cell.

**area\_slide** Total area of landslide material mapped within the grid cell.

**count** Number of individual landslide events recorded within the grid cell.

**slope\_avg** Mean slope angle within the grid cell.

**slope\_stddev** Standard deviation of slope within the grid cell, representing local terrain variability.

**relief** Local terrain relief, defined as the elevation difference within the grid cell.

**TWI\_avg** Mean topographic wetness index (TWI) within the grid cell, indicating potential soil moisture accumulation.

**TWI\_stddev** Standard deviation of the topographic wetness index within the grid cell.

**VRM\_avg** Mean vector ruggedness measure (VRM), quantifying surface roughness and terrain complexity.

**VRM\_stddev** Standard deviation of the vector ruggedness measure within the grid cell.

**planCurv\_a** Mean plan curvature, describing horizontal curvature of the terrain surface.

**planCurv\_s** Standard deviation of plan curvature within the grid cell.

**pga\_avg** Mean peak ground acceleration, representing average seismic shaking intensity.

**pga\_stddev** Standard deviation of peak ground acceleration within the grid cell.

**distStream** Mean distance from the grid cell to the nearest stream or drainage network.

**distStre\_s** Standard deviation of distance to streams within the grid cell.

**POINT\_X** x-coordinate of the centroid of the grid cell (longitude or easting, depending on the coordinate system).

**POINT\_Y** Y-coordinate of the centroid of the grid cell (latitude or northing, depending on the coordinate system).

**liitho** Lithological classification indicating the dominant rock or soil type within the grid cell.

**profCurv\_a** Mean profile curvature, describing vertical curvature of the terrain along the slope direction.

**profCurv\_s** Standard deviation of profile curvature within the grid cell.

Data are available from GitHub and hence can be gathered using the command `dataset("landslide")`.

**Details**

Data are available from GitHub and hence can be gathered using the command `dataset("landslide")`.

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

Yadav, R., Lombardo, L., and Huser, R. (2026). Statistics of Extremes for Landslides and Earthquakes. In: *Handbook of Statistics of Extremes*, Chapter 27, pp. 611–632.

---

lisbon

*Rainfall Data from Lisbon, Portugal*

---

**Description**

Daily rainfall data from Lisbon, Portugal, from December 1863 to June 2018.

**Format**

The `lisbon` data frame has 56503 observations and 2 columns:

`yearmonth` : year-month-day.

`prec` : total precipitation (mm).

**Details**

Prior to 1941, precipitation was measured for the 0-24 hour period; from 1941 onwards, precipitation was recorded from 9am to 9am the following day. Data are available from GitHub and hence can be gathered using the command `dataset("lisbon")`.

**Source**

IPMA (Instituto Português do Mar e da Atmosfera).

**References**

Carcaiso, V., De Carvalho, M., Prosdocimi, I. and Antoniano-Villalobos, I. (2026). Bayesian mixture models for heterogeneous extremes. [arXiv:2509.15359](https://arxiv.org/abs/2509.15359).

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

---

loss	<i>Loss and ALAE Insurance Data</i>
------	-------------------------------------

---

**Description**

Insurance indemnity payments and allocated loss adjustment expenses from an insurance company.

**Format**

The loss data frame contains the following variables:

loss Indemnity payment amount.

alae Allocated loss adjustment expense.

limit Policy limit.

censored Indicator of right-censoring due to the policy limit.

**Details**

The data were collected from Frees and Valdez (1998). Data are gathered using the command `dataset("landslide")`.

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). Handbook of Statistics of Extremes. Chapman & Hall/CRC, Boca Raton, FL.

Frees, E. and Valdez, E. (1998). Understanding relationships using copulas. North American Actuarial Journal, 2, 1–25.

Albrecher, H. and Beirlant, J. (2026). Statistics of Extremes for the Insurance Industry. In: Handbook of Statistics of Extremes, Chapter 29, pp.~655–673.

Belzile, L. R. and Nešlehová, J. G. (2026). Statistics of Extremes for Incomplete Data, with Application to Lifetime and Liability Claim Modeling. In: Handbook of Statistics of Extremes, Chapter 31, pp.~691–708.

---

lse	<i>Selected Stocks from the London Stock Exchange</i>
-----	---

---

**Description**

Prices at close from 26 selected stocks from the London stock exchange from 1989 to 2016.

**Usage**

lse

**Format**

The lse data frame has 6894 rows and 27 columns.

**References**

de Carvalho, M., Rubio, R., and Huser (2023). Similarity-based clustering for patterns of extreme values. *Stat*, **12**, e560.

---

lungcancer

*Lung Cancer Diagnosis*

---

**Description**

The lungcancer data frame has 241 rows and 3 columns. The data were gathered gathered from a case-control study, conducted at the Mayo Clinic in Rochester (Minnesota), which included 140 controls and 101 lung cancer cases; only woman have been enrolled in the study.

**Usage**

lungcancer

**Format**

This data frame contains the following columns:

marker : square root of sEGFR levels (soluble isoform of the epidermal growth factor receptor).

status : disease status, with 1 identifying lung cancer cases and 0 identifying controls.

pre : premenopausal indicator, with 1 identifying premenopausal women.

age : age in years.

**References**

Inácio de Carvalho, V., Jara, A. and de Carvalho, M. (2015) Bayesian nonparametric approaches for ROC curve inference. In: *Nonparametric Bayesian Methods in Biostatistics and Bioinformatics*. Eds R. Mitra and P. Mueller. Cham: Springer.

---

madeira

*Rainfall Data from Madeira, Portugal*

---

### **Description**

Rainfall data from Madeira, Portugal, from January 1973 to June 2018.

### **Usage**

madeira

### **Format**

The madeira data frame has 544 observations and 8 columns:

yearmonth Year and month.

prec Total monthly precipitation (0.01 inches).

amo Atlantic multi-decadal oscillation.

nino34 El Niño–Southern Oscillation (ENSO), expressed by the NINO3.4 index.

np North Pacific Index (NPI).

pdo Pacific Decadal Oscillation (PDO).

soi Southern Oscillation Index (SOI).

nao North Atlantic Oscillation (NAO).

### **Details**

After eliminating the dry events (i.e., zero precipitation) and the missing precipitation data (two observations) one is left with a total of 532 observations, and that is the version of the data analyzed in de Carvalho et al (2022).

### **Source**

National Oceanic and Atmospheric Administration.

### **References**

de Carvalho, M., Pereira, S., Pereira, S., and de Zea Bermudez, P. (2022). An extreme value Bayesian lasso for the conditional left and right tails. *Journal of Agricultural, Biological and Environmental Statistics*, **27**, 222–239.

marketsUS

*NASDAQ and NYSE Indices***Description**

Daily quotations at close of the NASDAQ and NYSE stock market indices from February 1971 till November 2021.

**Usage**

```
marketsUS
```

**Format**

The marketsUS data frame has 12562 rows and 3 columns: date and quotation at close of the nasdaq and nyse indices.

**References**

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

de Carvalho, M., Kumukova, A., and dos Reis, G. (2022) Regression-type analysis for multivariate extreme values. *Extremes*, **25**, 595-622.

**Examples**

```
## Not run:
## de Carvalho et al (2022; Fig 5.1)
data(marketsUS)
packages <- c("ggplot2", "scales")
sapply(packages, require, character.only = TRUE)
ggplot(data = marketsUS, aes(x = date, y = value, color = Indices)) +
  geom_line(aes(y = nasdaq, col = "NASDAQ"), alpha = 0.5,
            position = position_dodge(0.8), size = 1.1) +
  geom_line(aes(y = nyse, col = "NYSE"), alpha = 0.5,
            position = position_dodge(0.8), size = 1.1) +
  scale_y_continuous(breaks = seq(2000, 14000, by = 2000)) +
  scale_x_date(labels = date_format("%Y"),
              breaks = as.Date(c("1971-01-01", "1978-01-01",
                                "1985-01-01", "1992-01-01",
                                "1999-01-01", "2006-01-01",
                                "2013-01-01", "2020-01-01"))) +
  scale_color_manual(values = c("red", "blue")) +
  labs(y = "Value (in USD)", x = "Time (in Years)") +
  theme_minimal()

## End(Not run)
```

---

merval	<i>MERVAL Stock Market Data</i>
--------	---------------------------------

---

**Description**

Raw interval data series corresponding to weekly minimum and maximum values of the MERVAL index (Argentina stock market) ranging from January 1 2016 to September 30 2020 (along with prices at open and prices at close).

**Usage**

```
merval
```

**Format**

A dataframe with 353 observations and 5 columns: dates, low, high, open, and close.

**Source**

Yahoo Finance.

**References**

de Carvalho, M. and Martos, G. (2022). Modeling interval trendlines: Symbolic singular spectrum analysis for interval time series. *Journal of Forecasting*, **41**, 167-180.

**Examples**

```
data(merval)
attach(merval)
head(merval, 3)
oldpar <- par(pty = 's')
plot(low, high, pch = 20)
abline(a = 0, b = 1, lty = 2, col = "gray")
par(oldpar)
```

---

metsynd	<i>Metabolic Syndrome Data</i>
---------	--------------------------------

---

**Description**

The metsynd data includes Gamma-Glutamyl Transferase (GGT) levels and curves of arterial oxygen saturation, for samples of women suffering from metabolic syndrome and women without metabolic syndrome; the data were gathered from a population-based survey conducted in Galicia (NW Spain), and it includes 35 women suffering from metabolic syndrome and 80 women without metabolic syndrome.

**Usage**

metsynd

**Format**

The data consist of a list with the following elements:

$y_0$  GGT levels for women without metabolic syndrome.

$y_1$  GGT levels for women suffering from metabolic syndrome.

$X_0$  Curves of arterial oxygen saturation (%) for women without metabolic syndrome ( $X_0\$data$ ,  $X_0\$time$ ).

$X_1$  Curves of arterial oxygen saturation (%) for women suffering from metabolic syndrome ( $X_1\$data$ ,  $X_1\$time$ ).

**Details**

The curves of arterial oxygen saturation are included in the matrices  $X_0\$data$  and  $X_1\$data$ , with each row representing a patient, and with columns representing ordered measurements over time. Here  $X_0\$time$  and  $X_1\$time$  represents the time (in hours) at which measurements were made, i.e., every 20 seconds during three hours of sleep. Further details on these data can be found in the references below.

**References**

Inácio de Carvalho, V., de Carvalho, M., Alonzo, T. A., González-Manteiga, W. (2016) Functional covariate-adjusted partial area under the specificity-ROC curve regression with an application to metabolic syndrome case study. *Annals of Applied Statistics*, **10**, 1472-1495

**Examples**

```
data(metsynd)
library(scales)
attach(metsynd)

## Inacio de Carvalho et al (2016; Fig 1)
oldpar <- par(mfrow = c(1,2))
n0 <- length(y0)
n1 <- length(y1)
t <- X1$time
plot(t, X1$data[1, ], type = "l", lwd = 3, ylim = c(70, 100),
     xlab = "Time (in hours)", ylab = "Arterial oxygen saturation (%)",
     main = "Metabolic syndrome")
for (i in 2:n1)
  lines(t, X1$data[i, ], type = "l", lwd = 3, col = alpha("black", i / n1))
plot(t, X0$data[1, ], type = "l", lwd = 3, col = "gray", ylim = c(70, 100),
     xlab = "Time (in hours)", ylab = "Arterial oxygen saturation (%)",
     main = "No metabolic syndrome")
for (i in 1:n0)
  lines(t, X0$data[i, ], type = "l", lwd = 3, col = alpha("gray", i / n0))
par(oldpar)
```

---

passengers	<i>International Airline Traffic Data</i>
------------	---

---

**Description**

Monthly number of passengers (in thousands) in a group of several international airline companies from January 1949-December 1960.

**Usage**

passengers

**Format**

A time series with 144 observations; the object is of class ts.

**References**

Brown, R.G. (1963) *Smoothing, Forecasting and Prediction of Discrete Time Series*. New Jersey: Prentice-Hall.

Rodrigues, P. C. and de Carvalho, M. (2013) Spectral modeling of time series with missing data. *Applied Mathematical Modelling*, **37**, 4676-4684.

---

psa	<i>Prostate Cancer Diagnosis Data</i>
-----	---------------------------------------

---

**Description**

Longitudinal measurements of two Prostate Specific Antigen (PSA)-based biomarkers for 71 prostate cancer cases and 70 controls.

**Usage**

psa

**Format**

The psa data frame has 683 rows and 6 columns:

id patient id.

marker1 total PSA.

marker2 ratio of free total PSA.

status disease status of each subject, with 1 identifying subjects diagnosed with prostate cancer.

age age in years.

t time prior to diagnosis.

**Details**

The data were gathered from the Beta-Carotene and Retinol Efficacy Trial (CARET)—a lung cancer prevention trial, conducted at the Fred Hutchison Cancer Research Center. Further details on this study can be found in de Carvalho *et al.* (2020).

**References**

de Carvalho, M., Barney, B. and Page, G. L. (2020) Affinity-based measures of biomarker performance evaluation. *Statistical Methods in Medical Research*, **20**, 837-853.

---

santiago

*Santiago Temperature Data*

---

**Description**

The data consist of average daily air temperatures, measured in degrees Fahrenheit and rounded to the nearest integer, recorded in Santiago (Chile) from April 1990 to March 2017.

**Usage**

santiago

**Format**

A dataframe with 10126 observations on one variable.

**Source**

NOAA's National Centers for Environmental Information (NCEI).

**References**

Galasso, B., Zemel, Y., and de Carvalho, M. (2022). Bayesian semiparametric modelling of phase-varying point processes. *Electronic Journal of Statistics*, **16**, 2518-2549.

---

sp500	<i>Standard &amp; Poor's 500</i>
-------	----------------------------------

---

**Description**

Daily S&P 500 index at close from 1988 till 2007.

**Usage**

sp500

**Format**

The sp500 data frame has 5043 rows and 2 columns: date and price at close.

**References**

de Carvalho, M. (2016) Statistics of extremes: Challenges and opportunities. In: *Handbook of EVT and its Applications to Finance and Insurance*. Eds F. Longin. Hoboken: Wiley.

---

sydney	<i>Monthly Sea Levels for Fort Denison (Sydney)</i>
--------	---

---

**Description**

The sydney data frame contains monthly sea level measurements for Fort Denison (Sydney) from 1914 to 2023.

**Format**

This data frame contains has 1317 rows and 8 columns:

**Mth** Month of observation (1–12).

**Year** Year of observation.

**Gaps** Number of missing observations.

**Good** Number of valid observations.

**Minimum** Minimum sea level (m).

**Maximum** Maximum sea level (m).

**Mean** Mean sea level (m).

**St.Devn** Standard deviation of sea level (m).

**Source**

Australina Government, Bureau of Meteorology.

## References

de Carvalho, M., Huser, R., Naveau, P., and Reich, B. J. (2026). *Handbook on Statistics of Extremes*. Chapman & Hall/CRC. Boca Raton, FL.

---

thefts	<i>Thefts in Buenos Aires</i>
--------	-------------------------------

---

## Description

To load the file use the command `dataset("thefts")`. The data consist of locations (latitude and longitude) of thefts in Buenos Aires from September 2019 to December 2020. For further details see de Carvalho and Martos (2024).

## References

de Carvalho, M. and Martos, G. (2024). Uncovering sets of maximum dissimilarity on random process data. *Transactions on Machine Learning Research*, **5**, 1-31.

## Examples

```
dataset("thefts")
summary(thefts)
head(thefts)
```

---

tmt	<i>Trail Making Test</i>
-----	--------------------------

---

## Description

Completion times in seconds for TMT (Trail Making Test), part A, for 245 patients with Parkinson's disease, along with corresponding diagnostic on cognitive impairment.

## Usage

```
tmt
```

## Format

The `tmt` data frame has 245 rows and 2 columns:

`marker` completion times (in seconds)

`status` disease status of each subject, with 1, 2, and 3 respectively denoting patients diagnosed as unimpaired, mild cognitive impairment, and dementia.

## References

Inácio de Carvalho, V., de Carvalho, M., and Branscum, A. (2018) Bayesian bootstrap inference for the ROC surface. *Stat*, **7**, e211.

---

unemployment	<i>US Unemployment Rate</i>
--------------	-----------------------------

---

**Description**

US monthly unemployment rate from January 1967 to November 2009; the 515 monthly observations are seasonally adjusted.

**Usage**

unemployment

**Format**

A time series with 515 observations; the object is of class `ts`.

**Source**

Bureau of Labor Statistics.

**References**

de Carvalho, M., Turkman, K. F. and Rua, A. (2013) Dynamic threshold modelling and the US business cycle. *Journal of the Royal Statistical Society, Ser. C*, **62**, 535-550.

**See Also**

<https://webhomes.maths.ed.ac.uk/~mdecarv/decarvalho2013ash.html>

**Examples**

```
## de Carvalho et al (2013; Fig. 1)
data(unemployment)
plot(unemployment, xlab = "Time", ylab = "Unemployment Rate")
```

---

wildfire	<i>Portugal Wildfire Data</i>
----------	-------------------------------

---

**Description**

The wildfire data from Portugal contains daily burnt area (in hectares) for wildfires in Portugal, and Canadian Forest Fire Weather Index System indices between 1980 to 2019.

**Usage**

wildfire

## Format

wildfire is a data frame with 14609 occurrences (rows) and 11 variables (columns).

The wildfire data frame contains the following columns:

Burnt\_Area : daily burnt area in hectares.

DSR : Daily Severity Rating (DSR), a numeric rating of the difficulty of controlling fires.

FWI : Fire Weather Index (FWI), a numeric rating of fire intensity.

BUI : Buildup Index (BUI), a numeric rating of the total amount of fuel available for combustion.

ISI : Initial Spread Index (ISI), a numeric rating of the expected rate of fire spread.

FFMC : Fine Fuel Moisture Code (FFMC), a numeric rating of the moisture content of litter and other cured fine fuels.

DMC : Duff Moisture Code (DMC), a numeric rating of the average moisture content of loosely compacted organic layers of moderate depth.

DC : Drought Code (DC), a rating of the average moisture content of deep, compact organic layers.

day, month, year : timestamp to date for each datapoints.

## Source

Instituto Dom Luiz

## References

Lee, M. W., de Carvalho, M., Paulin, D., Pereira, S., Trigo, R., and da Camara, C. (2026). BLAST: A Bayesian lasso tail index regression model with an application to extreme wildfires. *Submitted*.

## Examples

```
## preview of the data
data(wildfire)
head(wildfire, 10)
summary(wildfire)

## Not run:
require(ggplot2)
## visualizing the data by month
ggplot(wildfire, aes(x = month, y = Burnt_Area, color = month)) +
  geom_point(size = 3) +
  xlab("Month") +
  ylab("Burnt Area (ha)") +
  theme_minimal()

## End(Not run)
```

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