

# Package ‘gamair’

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**Title** Data for “GAMs: An Introduction with R”

**Description** Data sets and scripts used in the book “Generalized Additive Models: An Introduction with R”, Wood (2006) CRC.

**Depends** R (>= 1.8.0)

**License** GPL (>= 2)

**Repository** CRAN

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gamair-package      *Data for ‘GAMs: An Introduction with R’*

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## Description

This package contains the data sets used in the book *Generalized Additive Models: An Introduction with R*, which covers linear and generalized linear models, GAMs as implemented in package `mgcv` and mixed model extensions of these.

## Details

Each dataset has its own help page, which describes the dataset, and gives the original source and associated references. All datasets have been reformatted into standard R data frames. Some smaller datasets from the book have not been included. Datasets from other R packages have not been included, with the exception of a distillation of one set from the `NMMAPSdata` package.

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**References**

Wood, S.N. (2006) *Generalized Additive Models: An Introduction with R*, CRC

**See Also**

[mgcv](#)

**Examples**

```
library(help=gamair)
```

---

bird

*Bird distribution data from Portugal*

---

**Description**

Data from the compilation of the Portuguese Atlas of Breeding Birds.

**Usage**

```
data(bird)
```

**Format**

A data frame with 6 columns and 25100 rows. Each row refers to one 2km by 2km square (tetrad). The columns are:

QUADRICULA An identifier for the 10km by 10km square that this tetrad belongs to.

crestlark Were crested lark (or possibly thekla lark!) found (1), not found (0) breeding in this tetrad, or was the tetrad not visited (NA).

linnet As `crestlark`, but for linnet.

x location of tetrad (km east of an origin).

y location of tetrad (km north of an origin).

**Details**

At least 6 tetrads from each 10km square were visited, to establish whether each species was breeding there, or not. Each Tetrad was visited twice for one hour each visit. These data are not definitive: at time of writing the fieldwork was not quite complete.

The data were kindly supplied by Jose Pedro Granadeiro.

**Source**

The Atlas of the Portuguese Breeding Birds.

**References**

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R

**Examples**

```
data(bird)
species <- "crestlark"
op<-par(bg="white",mfrow=c(1,1),mar=c(5,5,1,1))
ind <- bird[[species]]==0&!is.na(bird[[species]])
plot(bird$y[ind]/1000,1000-bird$x[ind]/1000,pch=19,cex=.3,col="white",
      ylab="km west",xlab="km north",cex.lab=1.4,cex.axis=1.3,type="n")
polygon(c(4000,4700,4700,4000),c(250,250,600,600),col="grey",border="black")
points(bird$y[ind]/1000,1000-bird$x[ind]/1000,pch=19,cex=.3,col="white")
ind <- bird[[species]]==1&!is.na(bird[[species]])
with(bird,points(y[ind]/1000,1000-x[ind]/1000,pch=19,cex=.3))
par(op)
```

---

blowfly

*Nicholson's Blowfly data*

---

**Description**

Data on a laboratory population of Blowflies, from the classic ecological studies of Nicholson.

**Usage**

```
data(blowfly)
```

**Format**

A data frame with 2 columns and 180 rows. The columns are:

pop Counts (!) of the population of adult Blowflies in one of the experiments.  
 day Day of experiment.

**Details**

The population counts are actually obtained by counting dead blowflies and back calculating.

**References**

Nicholson, A.J. (1954a) Compensatory reactions of populations to stresses and their evolutionary significance. Australian Journal of Zoology 2, 1-8.

Nicholson, A.J. (1954b) An outline of the dynamics of animal populations. Australian Journal of Zoology 2, 9-65.

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R

**Examples**

```
data(blowfly)
with(blowfly, plot(day, pop, type="l"))
```

---

 brain

*Brain scan data*


---

**Description**

Functional magnetic resonance imaging measurements for a human brain subject to a particular experimental stimulus. One slice of the image is provided, described as a near-axial slice through the dorsal cerebral cortex.

**Usage**

```
data(brain)
```

**Format**

A data frame with 5 columns and 1567 rows. Each row refers to one ‘voxel’ of the image. The columns are:

X voxel position on horizontal axis.

Y voxel position on vertical axis.

medFPQ median of three replicate ‘Fundamental Power Quotient’ values at the voxel: this is the main measurement of brain activity.

region code indicating which of several regions of the brain the voxel belongs to. The regions are defined by the experimenters. 0 is the base region; 1 is the region of interest; 2 is the region activated by the experimental stimulus; NA denotes a voxel with no allocation.

meanTheta mean phase shift at the Voxel, over three measurements.

**Details**

See the source article for fuller details.

**Source**

S. Landau et al (2003) ‘Tests for a difference in timing of physiological response between two brain regions measured by using functional magnetic resonance imaging’. *Journal of the Royal Statistical Society, Series C, Applied Statistics*, 53(1):63-82

---

cairo *Daily temperature data for Cairo*

---

### Description

The average air temperature (F) in Cairo from Jan 1st 1995.

### Usage

```
data(cairo)
```

### Format

A data frame with 6 columns and 3780 rows. The columns are:

month month of year from 1 to 12.  
day.of.month day of month, from 1 to 31.  
year Year, starting 1995.  
temp Average temperature (F).  
day.of.year Day of year from 1 to 366.  
time Number of days since 1st Jan 1995.

### Source

<http://www.engr.udayton.edu/weather/citylistWorld.htm>

### References

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R

### Examples

```
data(cairo)  
with(cairo, plot(time, temp, type="l"))
```

---

`chicago`*Chicago air pollution and death rate data*

---

**Description**

Daily air pollution and death rate data for Chicago.

**Usage**

```
data(chicago)
```

**Format**

A data frame with 7 columns and 5114 rows. Each row refers to one day. The columns are:

`death` total deaths (per day).

`pm10median` median particles in 2.5-10 per cubic m

`pm25median` median particles < 2.5 mg per cubic m (more dangerous).

`o3median` Ozone in parts per billion

`so2median` Median Sulphur dioxide measurement

`time` time in days

`tmpd` temperature in fahrenheit

**Details**

See the `NMMAPSdata` package for fuller details. Note that there are missing values in some fields.

**Source**

Roger D. Peng, Leah J. Welty and Aiden McDermott. R package `NMMAPSdata`.

**References**

Peng, R.D. and Welty, L.J. (2004) The `NMMAPSdata` package. *R News* 4(2).

Wood, S.N. (2006) *Generalized Additive Models: An Introduction with R*

<http://www.ihapss.jhsph.edu/data/NMMAPS/R/>

---

`chl`*Chlorophyll data*

---

**Description**

Data relating to the calibration of remote sensed satellite data. The SeaWifs satellite provides estimates of chlorophyll concentration at the ocean surface from measurements of ocean surface colour. It is of interest to attempt to use these data to predict direct bottle measurements of chl. conc.

**Usage**

```
data(chl)
```

**Format**

A data frame with 6 columns and 13840 rows. The columns are:

lon longitude

lat latitude

jul.day Julian day (i.e. day of year starting at Jan 1st.)

bath Ocean depth in metres.

chl direct chlorophyll concentration measured at given location from a bottle sample.

chl.sw chl. conc. as measured by Seawifs Satellite

**Source**

<http://seawifs.gsfc.nasa.gov/SEAWIFS>

and the World Ocean Database.

**References**

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R. CRC

**Examples**

```
data(chl)
with(chl, plot(chl, chl.sw))
```

---

`co2s`*Atmospheric CO2 at South Pole*

---

**Description**

Monthly CO2 concentration in parts per million at the South Pole.

**Usage**

```
data(co2s)
```

**Format**

A data frame with 3 columns and 507 rows. The columns are:

```
co2 atmospheric CO2 concentration in parts per million
c.month cumulative number of months since Jan 1957
month month of year
```

**Source**

<http://cdiac.esd.ornl.gov/trends/co2/sio-spl.htm>

**References**

Keeling C.P. and T.P Whorf (2000) Atmospheric CO2 records from sites in the SIO air sampling network. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge Tenn., USA

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R. CRC

**Examples**

```
data(co2s)
with(co2s, plot(c.month, co2, type="l", ylab=
expression(paste(CO[2], " in ppm.")), xlab="Month since Jan. 1957"))
```

---

`coast`*European coastline from -11 to 0 East and from 43 to 59 North*

---

**Description**

The data are longitudes (degrees E) and latitudes (degrees N) defining points that can be joined up to get the European coastline in the rectangle (-11E,43N)-(0E,59N). Discontinuous sections of coast are separated by NA's.

**Usage**

```
data(coast)
```

**Format**

A data frame with 2 columns.

lon Longitude in degrees East for points used to define the coast.

lat Latitude in degrees North for points used to define the coast.

**Details**

lon, lat together define the co-ordinates of points that can be joined up in order to plot the coastline. The original data come from the NOAA www site given below, but have been substantially thinned, to a much lower resolution than the source.

**Author(s)**

Simon Wood.

**References**

<http://rimmer.ngdc.noaa.gov/coast/>

**Examples**

```
data(coast)
# plot the entire coast .....
plot(coast$lon,coast$lat,type="l")
# or draw it clipped to whatever the current plot is....
lines(coast$lon,coast$lat,col="blue")
```

---

engine	<i>Engine wear versus size data</i>
--------	-------------------------------------

---

**Description**

Data on engine wear against engine size for 19 Volvo car engines.

**Usage**

```
data(engine)
```

**Format**

A data frame with 2 columns and 19 rows. Each row refers to one engine model. The columns are:

wear an index of engine wear rate.

size cylinder capacity in litres.

**Details**

See the source for further details.

**Source**

[http://www3.bc.sympatico.ca/Volvo\\_Books/engine3.html](http://www3.bc.sympatico.ca/Volvo_Books/engine3.html)

---

harrier	<i>Hen Harriers Eating Grouse</i>
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---

**Description**

Data on the rate at which Hen Harriers consume Grouse as a function of Grouse density.

**Usage**

```
data(harrier)
```

**Format**

A data frame with 2 columns and 37 rows. The columns are:

Grouse.Density Density of Grouse per square kilometre.

Consumption.Rate Number of Grouse consumed per Hen Harrier per day.

**Details**

Data have been read from Figure 1 of Asseburg et al. (2005)

**Source**

Asseburg, C., S. Smout, J. Matthiopoulos, C. Fernandez, S. Redpath, S. Thirgood and J. Harwood (2005) The functional response of a generalist predator. Web preprint

**References**

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R. CRC

**Examples**

```
data(harrier)
with(harrier, plot(Grouse.Density, Consumption.Rate))
```

---

hubble

*Hubble Space Telescope Data*

---

**Description**

Data on distances and velocities of 24 galaxies containing Cepheid stars, from the Hubble space telescope key project to measure the Hubble constant.

**Usage**

```
data(hubble)
```

**Format**

A data frame with 3 columns and 24 rows. The columns are:

Galaxy A (factor) label identifying the galaxy.

y The galaxy's relative velocity in kilometres per second.

x The galaxy's distance in Mega parsecs. 1 parsec is 3.09e13 km.

**Details**

Cepheids are variable stars which have a known relationship between brightness and period. Hence the distance to galaxies containing these stars can be estimated from the observed brightness of the Cepheid, relative to its absolute brightness as predicted by its period. The velocity of the galaxy can be estimated from its mean red-shift.

The data can be used to get a reasonably good idea of the age of the universe A data free alternative estimate of 6000 years is given in the reference (not the source!).

**Source**

Tables 4 and 5 of Freedman et al. 2001. The Astrophysical Journal 553:47-72

**References**

Freedman et al. (2001) Final results from the Hubble space telescope key project to measure the Hubble constant. *The Astrophysical Journal* (553), 47-72.

<http://www.icr.org/pubs/imp/imp-352.htm>

NUCLEAR DECAY: EVIDENCE FOR A YOUNG WORLD - IMPACT No. 352 October 2002 by D. Russell Humphreys, Ph.D.

Wood, S.N. (2006) *Generalized Additive Models: An Introduction with R*. CRC

---

ipo

*Initial Public Offering Data*

---

**Description**

Data on the relationship between the number of initial public offerings (of shares in a company) and other potentially important variables. It is probably necessary to lag some of the explanatory variables.

**Usage**

`data(ipo)`

**Format**

A data frame with 6 columns and 156 rows. The columns are:

`n.ipo` number of initial public offerings each month.

`ir` the average initial return (volume weighted): this is the percentage difference between the offer price of shares and the price after the first day of trading.

`dp` the average percentage difference between middle of the price range proposed at first filing of the IPO, and the eventual offer price.

`reg.t` the average time between filing and offer.

`t` time, in months.

`n.ipo` month of the year (1 = January).

**Source**

<http://schwert.ssb.rochester.edu>

**References**

Lowry, M. and G.W. Schwert (2002) IPO market cycles: Bubbles or sequential learning? *The Journal of Finance* 67(3), 1171-1198

Wood, S.N. (2006) *Generalized Additive Models: An Introduction with R*. CRC

**Examples**

```
data(ipo)
pairs(ipo)
```

---

 mack

---

*Egg data from 1992 mackerel survey*


---

**Description**

The data relate to the distribution of mackerel eggs and were collected as part of the 1992 mackerel survey aimed at assessing the mackerel spawning stock biomass using the daily egg production method.

**Usage**

```
data(mack)
```

**Format**

A data frame with 16 columns. Each row corresponds to one sample of eggs.

- egg.count The number of stage I eggs in this sample.
- egg.dens The number of stage I eggs per square metre of sea surface, produced per day. This is calculated from `egg.count` and other information about sampling net size, and egg stage duration.
- b.depth The sea bed depth at the sampling location.
- c.dist The distance from the sample location to the 200m contour measured in degrees as if degrees latitude equalled degrees longitude, which actually they don't.
- lon The longitude of the sample station in degrees east.
- lat The latitude of the sample station in degrees north.
- time The time of day (in hours) at which the sample was taken.
- salinity The salinity (saltiness) of the water at the sampling location.
- flow Reading from the flow meter attached to the sampling net - used for calibration.
- s.depth The depth that the sampling net started sampling from (the net is dropped to this depth and then hauled up to the surface, filtering eggs etc out of the water as it goes).
- temp.surf The temperature at the sea surface at the sampling location.
- temp.20m The temperature 20m down at the sampling location.
- net.area The area of the sampling net in square metres.
- country A code identifying the country responsible for the boat that took this sample.
- vessel A code identifying the boat that took this sample.
- vessel.haul A code uniquely identifying this sample, given that the vessel is known.

## Details

At each of a number of stations located as defined in `lon` and `lat`, mackerel eggs were sampled by hauling a fine net up from deep below the sea surface to the sea surface. The egg count data are obtained from the resulting samples, and these have been converted to (stage I) eggs produced per metre squared per day - the egg density data. Other possibly useful predictor variable information has been recorded, along with identification information, and some information that is probably useless!

## Source

The data are effectively a combination of datasets `mackerel` and `smacker` from the `sm` library. They were originally analyzed using GAMs by:

Borchers, D.L., S.T. Buckland, I.G. Priede and S. Ahmadi (1997) "Improving the precision of the daily egg production method using generalized additive models". *Can. J. Fish. Aquat. Sci.* 54:2727-2742.

## Examples

```
data(mack)
# plot the egg densities against location
plot(mack$lon,mack$lat,cex=0.2+mack$egg.dens/150,col="red")
```

---

mackp

*Prediction grid data for 1992 mackerel egg model*

---

## Description

This data frame provides a regular grid of values of some predictor variables useful for modelling mackerel egg abundances. Its main purpose is to enable mackerel egg densities to be predicted over a regular spatial grid within the area covered by the 1992 mackerel egg survey (see `mack`), using a fitted generalised additive model.

## Usage

```
data(mackp)
```

## Format

A data frame with 5 columns. Each row corresponds to one spatial location within the survey area. The columns are as follows:

`lon` Longitude of the gridpoint in degrees east

`lat` Latitude of the gridpoint in degrees north.

`b.depth` The sea bed depth at the gridpoint.

`c.dist` The distance from the gridpoint to the 200m sea bed depth contour.

`salinity` Salinity interpolated onto the grid (from `mack` measurements).

temp.surf Surface temperature interpolated onto grid (from `mack` data).  
temp.20m Temperature at 20m interpolated from `mack` data.  
area.index An indexing vector that enables straightforward copying of the other variables into a matrix suitable for plotting against longitude and latitude using `image()`. See the example below.

### Details

The grid is defined on a series of 1/4 degree lon-lat squares.

### References

Borchers, D.L., S.T. Buckland, I.G. Priede and S. Ahmadi (1997) "Improving the precision of the daily egg production method using generalized additive models". *Can. J. Fish. Aquat. Sci.* 54:2727-2742.

### Examples

```
## example of how to use `area.index' to paste gridded info.
## into a square grid (of NA's) for plotting
data(mackp)
lon<-seq(-15,-1,1/4);lat<-seq(44,58,1/4)
zz<-array(NA,57*57)
zz[mackp$area.index]<-mackp$b.depth
image(lon,lat,matrix(zz,57,57))
```

---

sole

*Sole Eggs in the Bristol Channel*

---

### Description

Data on Sole Egg densities in the Bristol Channel (West Coast of England, UK.) The data are from 5 research cruises undertaken for the purpose of measuring Sole egg densities. Samples were taken at each of a number of sampling stations, by hauling a net vertically through the water column. Sole eggs were counted and assigned to one of four developmental stages.

### Usage

```
data(sole)
```

### Format

A data frame with 7 columns and 1575 rows. The columns are:

la latitude of sampling station

lo longitude of sampling station

t time of sampling station: actually time of midpoint of the cruise on which this sample was taken. Measured in Julian days (days since January 1st).

eggs egg density per square metre of sea surface.

stage to which of 4 stages the sample relates.

a.0 lower age limit for the stage (i.e. age of youngest possible egg in this sample).

a.1 upper age limit of this stage (i.e. age of oldest possible egg in sample).

### Source

Dixon (2003)

### References

Dixon, C.E. (2003) Multi-dimensional modelling of physiologically and temporally structured populations. PhD thesis. University of St Andrews

Horwood, J. (1993) The Bristol Channel Sole (*solea solea* (L.)): A fisheries case study. *Advances in Marine Biology* 29, 215-367

Horwood, J. and M. Greer Walker (1990) Determinacy of fecundity in Sole (*solea solea*) from the Bristol Channel. *Journal of the Marine Biology Association of the United Kingdom*. 70, 803-813.

Wood (2006) *Generalized Additive Models: An Introduction with R*. CRC

### Examples

```
data(sole)
data(coast)
par(mfrow=c(2,3))
sample.t <- unique(sole$t)
stage <- 1
for (i in 1:5)
{ egg<-sole[sole$stage==stage&sole$t==sample.t[i],]
  plot(egg$lo,egg$la,xlab="lo",ylab="la",main=paste("day",sample.t[i]),cex=egg$eggs/4,
        xlim=range(sole$lo),ylim=range(sole$la),cex.axis=1.5,cex.lab=1.5,cex.main=1.5)
  points(egg$lo,egg$la,pch=".",col=2)
  lines(coast)
}
```

---

sperm.comp1

*Sperm competition data I*

---

### Description

Data relating sperm count to time since last inter-pair copulation and proportion of that time spent together for 15 couples living in Manchester UK.

### Usage

data(sperm.comp1)

**Format**

A data frame with 4 columns and 15 rows. The columns are:

- subject An identifier for the subject/couple.
- time.ipc Time since last inter-pair copulation, in hours.
- prop.partner Proportion of `time.ipc` that the couple had spent together.
- count Sperm count in millions.

**Details**

The sperm counts reported are total counts in ejaculate from a single copulation, for each of 15 couples. Also recorded are the time since the couple's previous copulation, and the proportion of that time that the couple had spent together. The data are from volunteers from Manchester University and were gathered to test theories about human sperm competition. See the source article for further details.

**Source**

Baker, RR and Bellis M.A. (1993) 'Human sperm competition: ejaculate adjustment by males and the function of masturbation'. *Animal behaviour* 46:861-885

---

sperm.comp2

*Sperm competition data II*

---

**Description**

Data relating average number of sperm ejaculated per copulation to physical characteristics of partners involved, for 24 heterosexual couples from Manchester, UK.

**Usage**

```
data(sperm.comp2)
```

**Format**

A data frame with 10 columns and 24 rows. The columns are:

- pair an identifier for the couple. These labels correspond to those given in [sperm.comp1](#).
- n the number of copulations over which the average sperm count has been calculated.
- count the average sperm count in millions, per copulation.
- f.age age of the female, in years.
- f.height height of the female, in cm.
- f.weight weight of the female, in kg.
- m.age age of the male, in years.
- m.height height of the male, in cm.
- m.weight weight of the male, in kg.
- m.vol volume of one male teste in cubic cm.

**Details**

In the source article, these data are used to argue that males invest more reproductive effort in heavier females, on the basis of regression modelling. It is worth checking for outliers.

**Source**

Baker, RR and Bellis M.A. (1993) 'Human sperm competition: ejaculate adjustment by males and the function of masturbation'. *Animal behaviour* 46:861-885

---

stomata

*Stomatal area and CO2*

---

**Description**

Fake data on average stomatal area for 6 trees grown under one of two CO2 concentrations

**Usage**

```
data(stomata)
```

**Format**

A data frame with 3 columns and 24 rows. The columns are:

area mean stomatal area.

CO2 label for which CO2 treatment the measurement relates to.

tree label for individual tree.

**Details**

The context for these simulated data is given in section 6.1 of the source book.

**Source**

The reference.

**References**

Wood, S.N. (2006) *Generalized Additive Models: An Introduction with R*. CRC

---

wine

*Bordeaux Wines*

---

**Description**

Data on prices and growing characteristics of 25 Bordeaux wines from 1952 to 1998.

**Usage**

```
data(wine)
```

**Format**

A data frame with 7 columns and 47 rows. The columns are:

year year of production

price average price of the wines as a percentage of the 1961 price.

h.rain mm of rain in the harvest month.

s.temp Average temperature (C) over the summer preceding harvest.

w.rain mm of rain in the winter preceding harvest.

h.temp average temperature (C) at harvest.

parker a rating of the wine quality (see source for details).

**Source**

<http://schwert.ssb.rochester.edu/a425/a425.htm>

**References**

Wood, S.N. (2006) Generalized Additive Models: An Introduction with R. CRC

**Examples**

```
data(wine)
pairs(wine[, -7])
```

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