Package 'Biostatistics'

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Type Package

Title Statistics Tutorials for Biologists

Version 1.0.4

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Description Tutorials for statistics, aimed at biological scientists.
Subjects range from basic descriptive statistics
through to complex linear modelling. The tutorials
include text, videos, interactive coding exercises
and multiple choice quizzes. The package also
includes 19 datasets which are used in the
tutorials.

Encoding UTF-8

LazyData true

Imports learnr

Suggests ggplot2, car, plotrix, knitr, rmarkdown

License GPL-3

VignetteBuilder knitr

RoxygenNote 7.1.1

NeedsCompilation no

Depends R (>= 3.5.0)

Repository CRAN

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Contents

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carnivores	*Brain and body mass for carnivore species*

Description

Data on mean brain and body mass for 199 species from the carnivora.

Usage

```
data("carnivores")
```

Format

A data frame with 199 observations on the following 7 variables.

Binomial binomial species name

order order name

family family name

genus genus name

species species name

Mean_brain_mass_g mean brain mass for that species in g

Mean_body_mass_Kg mean body mass for that species in Kg

Source

Burger, Joseph Robert; George, Menshian Ashaki; Leadbetter, Claire; Shaikh, Farhin (2019), Data from: The allometry of brain size in mammals, Dryad, Dataset, https://doi.org/10.5061/dryad.2r62k7s

References

Burger, J.R., George, M.A., Leadbetter, C. & Shaikh, F. (2019) The allometry of brain size in mammals. Journal of mammalogy, 100, 276-283.

Examples

```
data(carnivores)
str(carnivores)
```

---

cricket_song   *Cricket song dataset*

Description

Data on condition, resource availability (food quality) and sexual signalling (calling song) in the decorated cricket, Gryllodes sigillatus.

Usage

```
data("cricket_song")
```

Format

A data frame with 568 observations on the following 5 variables.

Diet total nutritional content of the diet in percent

Pronotum Pronotum width in mm

Mass0 mass at the start of the experiment in g

Delta_smi change in weight over the first week in g

Song_week1 Total amount of time the animal sang in the first week of the experiment in seconds

Source

Houslay, Thomas M. et al. (2017), Data from: Mating opportunities and energetic constraints drive variation in age-dependent sexual signalling, Dryad, Dataset, https://doi.org/10.5061/dryad.tj693

References

Houslay, T.M., Houslay, K.F., Rapkin, J., Hunt, J. & Bussi??re, L.F. (2017) Mating opportunities and energetic constraints drive variation in age-dependent sexual signalling (ed C Miller). Functional ecology, 31, 728-741.

Examples

```
data(cricket_song)
str(cricket_song)
```

---

finch_colours   *Finch colouration and mitochondrial function*

Description

Data on the hue of the red feathers and a series of measures of mitochondrial function in 36 male house finches Haemorhous mexicanus at a time when they were moulting and therefore actively producing red carotenoids.

Usage

```
data("finch_colours")
```

Format

A data frame with 36 observations on the following 5 variables.

ID ID number for the individual bird

Hue Hue of the red feathers. Lower values are redder

C1RCR "Respiratory Control Ratio", calculated by dividing the maximum respiration rate by the basal rate

C1MMP Mitochondrial Membrane Potential

PGC_1a The level of a protein which activates transcription in mitochondrial biogenesis

Source

Hill, Geoffrey et al. (2019), Data from: Plumage redness signals mitochondrial function in the house finch, Dryad, Dataset, https://doi.org/10.5061/dryad.f0kr74v

References

Hill, G.E., Hood, W.R., Ge, Z., Grinter, R., Greening, C., Johnson, J.D., Park, N.R., Taylor, H.A., Andreasen, V.A., Powers, M.J., Justyn, N.M., Parry, H.A., Kavazis, A.N. & Zhang, Y. (2019) Plumage redness signals mitochondrial function in the house finch. Proceedings of the Royal Sociaty B: Biological sciences, 286, 20191354.

Examples

```
data(finch_colours)
## maybe str(finch_colours)
```

---

gabon_diversity   *Data on relative animal abundances in Gabon*

Description

Data on the relative abundance (proportion of total observations) of a variety of animal groups as recorded on a network of transects in NE Gabon. A variety of land use variables are also recorded.

Usage

```
data("gabon_diversity")
```

Format

A data frame with 24 observations on the following 14 variables.

TransectID Identifier for each transect

Distance Distance from the nearest village in Km

HuntCat Estimate of the intensity of hunting

LandUse What the land is used for

NumHouseholds Number of households in the nearest village

Veg_Rich Vegetation species richness measured as the number of tree species present in a series of plots along the transect

Veg_Canopy Canopy cover as the percentage of the sky blocked by canpoy in each plot, scored as 1 = 0-25, 2 = 26-50, 3 = 51-75, 4 = 76-100

Veg_Understory Understory cover as the percentage of the ground covered, scored as for canopy cover

RA_Apes Relative abundance of apes

RA_Birds Relative abundance of birds

RA_Elephant Relative abundance of elephants

RA_Monkeys Relative abundance of monkeys

RA_Rodent Relative abundance of rodents

RA_Ungulate Relative abundance of ungulates

Source

Koerner, Sally E. et al. (2017), Data from: Vertebrate community composition and diversity declines along a defaunation gradient radiating from rural villages in Gabon, Dryad, Dataset, https://doi.org/10.5061/dryad.vs97

References

Koerner, S.E., Poulsen, J.R., Blanchard, E.J., Okouyi, J. & Clark, C.J. (2017) Vertebrate community composition and diversity declines along a defaunation gradient radiating from rural villages in Gabon (ed S Cheyne). The Journal of applied ecology, 54, 805-814.

Examples

```
data(gabon_diversity)
## maybe str(gabon_diversity)
```

---

gnatocerus	*Weapon size and insulin-like signalling in the broad-horned flour beetle*

Description

Data from an experiment testing how weapon size in insects is controlled by insulin-like peptides. The weapon in question is the enlarged mandibles of the broad-horned flour beetle Gnatocerus cornutus. Larvae were treated with RNAi to knock out a number of candidate ILPs and adult size (elytron width) and weapon size were measured once they had eclosed.

Usage

```
data("gnatocerus")
```

Format

A data frame with 144 observations on the following 3 variables.

treatment The RNAi knockout treatment used. GFP = control, 1-5 ILP are the 5 insulin-like peptides targetted

EW Eytron width in micrometres

ML Mandible length in micrometres

Source

https://figshare.com/s/609486022a3df39169bf DOI:10.6084/m9.figshare.9734780

References

Okada, Y., Katsuki, M., Okamoto, N., Fujioka, H. & Okada, K. (2019) A specific type of insulin-like peptide regulates the conditional growth of a beetle weapon. PLoS biology, 17, e3000541.

Examples

```
data(gnatocerus)
str(gnatocerus)
```

---

height_immunity	*Data on the relationship between immune system functioning and body height in healthy people.*

Description

Data from a study relating innate (complement & lysozyme activity, neutrophil function) and adaptive (lymphocyte count, IgA, IgG and vaccine responce) to height. The subjects were a group of Polish volunteers.

Usage

```
data("height_immunity")
```

Format

A data frame with 193 observations on the following 16 variables.

sex Subject sex

age Age in years

body.height Height in mm

BMI Body Mass Index

body_fat Percent body fat

testosterone Free testosterone titre

complement Complement activity

lysozyme Lysozyme activity

phagocytic Phagocytic uptake

ROS Reactive Oxygen Species production

IgA Immunoglobulin A levels

IgG Immunoglobulin G levels

CD3 CD3 lymphocytes

CD19 CD19 lymphocytes

flu_post_vaccination_response Antibody response to 'flu vaccination

tetanus_post_vaccination_response Antibody response to tetanus vaccination

Source

Pawlowski, Boguslaw et al. (2017), Data from: Body height and immune efficacy: testing body stature as a signal of biological quality, Dryad, Dataset, https://doi.org/10.5061/dryad.2vn0d

References

Drulis-Kawa, Z. (2017) Body height and immune efficacy: testing body stature as a signal of biological quality. Proceedings. Biological sciences / The Royal Society, 284: 0171372

Examples

```
data(height_immunity)
str(height_immunity)
```

---

latitude_diversity   *Tree diversity data*

Description

Data on tree diversity from 24 forest plots in locations ranging from the tropics to northern Europe and the USA

Usage

```
data("latitude_diversity")
```

Format

A data frame with 24 observations on the following 12 variables.

Plot Plot name

Country Country

Latitude Plot latitude

Longitude Plot longitude

Plot_size_Ha Size of the plot in Ha

Total_individuals Total number of trees >1cm DBH

Species_richness Total number of tree species

Rarified_sp_richness Rarified species richness

Shannon_diversity Shannon diversity index

Mean_local_richness Mean richness per 20m quadrat

Mean_local_richness_rarified Rarified richness per 20m quadrat

Mean_local_Shannon Shannon diversity index per 20m quadrat

Source

Table S1 in https://science.sciencemag.org/content/sci/suppl/2017/06/28/356.6345.1389.DC1/aam5678_LaManna_SM.pdf

References

LaManna, J.A., Mangan, S.A., Alonso, A., Bourg, N.A., Brockelman, W.Y., Bunyavejchewin, S., Chang, L.-W., Chiang, J.-M., Chuyong, G.B., Clay, K., Condit, R., Cordell, S., Davies, S.J., Furniss, T.J., Giardina, C.P., Gunatilleke, I.A.U.N., Gunatilleke, C.V.S., He, F., Howe, R.W., Hubbell, S.P., Hsieh, C.-F., Inman-Narahari, F.M., Janik, D., Johnson, D.J., Kenfack, D., Korte, L., Kral, K., Larson, A.J., Lutz, J.A., McMahon, S.M., McShea, W.J., Memiaghe, H.R., Nathalang, A., Novotny, V., Ong, P.S., Orwig, D.A., Ostertag, R., Parker, G.G., Phillips, R.P., Sack, L., Sun, I.-F., Tello, J.S., Thomas, D.W., Turner, B.L., Vela Diaz, D.M., Vrska, T., Weiblen, G.D., Wolf, A., Yap, S. & Myers, J.A. (2017) Plant diversity increases with the strength of negative density dependence at the global scale. Science, 356, 1389-1392.

Examples

```
data(latitude_diversity)
str(latitude_diversity)
```

---

longevity	*Data on maximum lifespan for 909 species of mammal and bird*

Description

A dataset used to explore the ecological correlates of longevity in mammals and birds.

Usage

```
data("longevity")
```

Format

A data frame with 909 observations on the following 9 variables.

species Species name

class Class: mammalia = mammals, aves = birds

order Order

maximum_lifespan_yr Maximum lifespan in years

mass_g Average body weight in g

volancy Does it fly?

fossoriallity Does it live in holes in the ground?

foraging_environment Environment where it forages

daily_activity When is it active?

Source

https://royalsocietypublishing.org/doi/suppl/10.1098/rspb.2014.0298

References

Healy, K., Guillerme, T., Finlay, S., Kane, A., Kelly, S.B.A., McClean, D., Kelly, D.J., Donohue, I., Jackson, A.L. & Cooper, N. (2014) Ecology and mode-of-life explain lifespan variation in birds and mammals. Proceedings. Biological sciences / The Royal Society, 281, 20140298.

Examples

```
data(longevity)
str(longevity)
```

---

malawi_carbon   *Carbon exposure and lung immunity*

Description

Data on two lung immunity measures (oxidative burst activity and phagocytic activity) from people exposed to chronic carbon particulates in their homes in Malawi

Usage

```
data("malawi_carbon")
```

Format

A data frame with 29 observations on the following 4 variables.

X Row number

log_carbon Log carbon particulate exposure

oxidative_burst Lung oxidative burst activity

phagocytosis Phagocytic activity in the lung

Source

Rylance, Jamie et al. (2016), Data from: Chronic household air pollution exposure is associated with impaired alveolar macrophage function in Malawian non-smokers, Dryad, Dataset, https://doi.org/10.5061/dryad.89nj3

References

Rylance, J., Chimpini, C., Semple, S., Russell, D.G., Jackson, M.J., Heyderman, R.S. & Gordon, S.B. (2015) Chronic Household Air Pollution Exposure Is Associated with Impaired Alveolar Macrophage Function in Malawian Non-Smokers. PloS one, 10, e0138762.

Examples

```
data(malawi_carbon)
str(malawi_carbon)
```

---

mammal_longevity   *Data on maximum lifespan for 375 species of mammal*

Description

A subset of a dataset used to explore the ecological correlates of longevity in mammals and birds, with only the mammals represented.

Usage

```
data("longevity")
```

Format

A data frame with 375 observations on the following 10 variables.

X Row number

species Species name

class Class: mammalia = mammals, aves = birds

order Order

maximum_lifespan_yr Maximum lifespan in years

mass_g Average body weight in g

volancy Does it fly?

fossoriallity Does it live in holes in the ground?

foraging_environment Environment where it forages

daily_activity When is it active?

Source

https://royalsocietypublishing.org/doi/suppl/10.1098/rspb.2014.0298

References

Healy, K., Guillerme, T., Finlay, S., Kane, A., Kelly, S.B.A., McClean, D., Kelly, D.J., Donohue, I., Jackson, A.L. & Cooper, N. (2014) Ecology and mode-of-life explain lifespan variation in birds and mammals. Proceedings. Biological sciences / The Royal Society, 281, 20140298.

Examples

```
data(mammal_longevity)
str(mammal_longevity)
```

---

mhc   *MHC promiscuity and pathogen diversity data*

Description

Data relating the breadth of the MHC response for the HLA-DRB1 MHC gene from a number of populations worldwide, and an estimate of the diversity of intracellular and extracellular pathogens that the population is exposed to

Usage

```
data("mhc")
```

Format

A data frame with 28 observations on the following 4 variables.

Population Population identifier

Extracellular Diversity of extracellular pathogens

Intracellular Diversity of intracellular pathogens

Promiscuity_in_vitro Estimated range of epitopes that the MHC can bind to

Source

https://doi.org/10.1371/journal.pbio.3000131.s017

References

Manczinger, M., Boross, G., Kemeny, L., Muller, V., Lenz, T.L., Papp, B. & Pal, C. (2019) Pathogen diversity drives the evolution of generalist MHC-II alleles in human populations. PLoS biology, 17, e3000131.

Examples

```
data(mhc)
str(mhc)
```

| mouse_activity | *Locomotor activity in offspring of mice exposed to nicotine* |

Description

Data on the spontaneous locomotor activity of the F1 offspring of nicotine exposed or control males mated with unexposed females over a 12 hour period.

Usage

```
data("mouse_activity")
```

Format

A data frame with 54 observations on the following 3 variables.

Treatment Parental treatment

Sex Sex of the animal in question

SLA Spontaneous locomotor activity (the count of all the recorded times an infra-red beam was broken during the 12-hour period)

Source

https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2006497

References

McCarthy, D.M., Morgan, T.J., Jr, Lowe, S.E., Williamson, M.J., Spencer, T.J., Biederman, J. & Bhide, P.G. (2018) Nicotine exposure of male mice produces behavioral impairment in multiple generations of descendants. PLoS biology, 16, e2006497.

Examples

```
data(mouse_activity)
str(mouse_activity)
```

---

parrots2   *Parrot lifespan data*

Description

A dataset on maximum lifespan for 69 species of parrot. A subset of the larger longevity dataset with further information on family and subfamily added.

Usage

```
data("parrots2")
```

Format

A data frame with 69 observations on the following 11 variables.

species Species name

class Class: aves = birds

order Order

family Family

subfamily Subfamily

maximum_lifespan_yr Maximum lifespan in years

mass_g Average body weight in g

volancy Does it fly?

fossoriallity Does it live in holes in the ground?

foraging_environment Environment where it forages

daily_activity When is it active?

Source

https://royalsocietypublishing.org/doi/suppl/10.1098/rspb.2014.0298

References

Healy, K., Guillerme, T., Finlay, S., Kane, A., Kelly, S.B.A., McClean, D., Kelly, D.J., Donohue, I., Jackson, A.L. & Cooper, N. (2014) Ecology and mode-of-life explain lifespan variation in birds and mammals. Proceedings. Biological sciences / The Royal Society, 281, 20140298.

Examples

```
data(longevity)
str(longevity)
```

---

pinniped	*Pinniped brain sizes and mating system*

Description

A data set of body and brain mass for 33 species of pinniped (seals, sea lions and walruses) along with the type of mating system for that species.

Usage

```
data("pinniped")
```

Format

A data frame with 33 observations on the following 6 variables.

Species Binomial species name

Male_brain_g Brain mass for males in g

Female_brain_g Brain mass for females in g

Male_mass_Kg Body mass for males in Kg

Female_mass_Kg Body mass for females in Kg

Mate_type Mating system: mono = monogynous, poly = polygynous

Source

https://onlinelibrary.wiley.com/doi/10.1111/j.1420-9101.2012.02520.x

References

Fitzpatrick, J.L., Almbro, M., Gonzalez-Voyer, A., Hamada, S., Pennington, C., Scanlan, J. & Kolm, N. (2012) Sexual selection uncouples the evolution of brain and body size in pinnipeds. Journal of evolutionary biology, 25, 1321-1330.

Examples

```
data(pinniped)
str(pinniped)
```

---

quolls   *Data on physical performance in Northern Quolls*

Description

Data from a study of physical performance and morphology in Northern Quolls, Dasyurus hallucatus. These data were collected to test hypotheses about trade-offs between different types of physical activity. NB all physical measurements are standardised to a mean of 0 and an SD of 1.

Usage

```
data("quolls")
```

Format

A data frame with 63 observations on the following 23 variables.

name Number of the individual

sex Sex

mass mass in g

bodylength length in mm

taillength tail length in mm

taildiameter tail diamter in mm

headwidth head width in mm

headlength head length in mm

meanforearm mean forearm length in mm

meanhindlimb mean hind limb length in mm

meanfootlength mean length of feet in mm

bodysize_PC1 PC1 of body size measurements

acceleration Acceleration

sprint sprint speed

jump jump speed

grasp grasping strength

bite bite force

motorcontrol A measure of motor control

maneuverability manauverability

Max_O2_consump Maximum oxygen consumption

Performance_PC1 Principal component 1 from a PCA of performance variables

Performance_PC2 Principal component 2 from a PCA of performance variables

Performance_PC3 Principal component 3 from a PCA of performance variables

Source

Charters, Jordan E. et al. (2019), Data from: Multidimensional analyses of physical performance reveal a size dependent trade-off between suites of traits, Dryad, Dataset, https://doi.org/10.5061/dryad.k0v636g

References

Charters, J.E., Heiniger, J., Clemente, C.J., Cameron, S.F., Amir Abdul Nasir, A.F., Niehaus, A.C. & Wilson, R.S. (2018) Multidimensional analyses of physical performance reveal a size-dependent trade-off between suites of traits. Functional ecology, 32, 1541-1553.

Examples

```
data(quolls)
str(quolls)
```

---

ragwort	*Data on how plant-soil feedback affects growth of ragwort*

Description

Data from an experiment looking at how the removal of soil biota affects plant-soil feedback and hence the growth of ragwort, Jacobaea vulgaris.

Usage

```
data("ragwort")
```

Format

A data frame with 45 observations on the following 3 variables.

inoculum Mesh size of the filter used to process water from soil used to inoculate otherwise sterile soil. Smaller mesh = less microbiota

root_mass plant root mass in g (dry weight)

leaf_mass plant leaf mass in g (dry weight)

Source

Wang, M., Ruan, W., Kostenko, O., Carvalho, S., Hannula, S.E., Mulder, P.P.J., Bu, F., van der Putten, W.H. & Bezemer, T.M. (2019) Removal of soil biota alters soil feedback effects on plant growth and defense chemistry. The New Phytologist, 221, 1478-1491.

Examples

```
data(ragwort)
str(ragwort)
```

---

weaver   *Oxidative stress and group size in social weaver birds*

Description

Data from an experiment looking at the oxidative stress brought on by reproduction in white-browed sparrow weavers Plocepasser mahali. The birds live in groups but only one pair reproduces. Either eggs were left alone or some eggs were removed to reduce the stress caused by reproduction. Two measures of oxidative stress were made.

Usage

```
data("weaver")
```

Format

A data frame with 34 observations on the following 6 variables.

Bird_ID Individual bird identifier

Treatment either control (eggs left) or some eggs removed to reduce the cost of reproduction

GrpSize Size of the social group

SOD_final Superoxide dismutase activity

MDA_final Malondialdehyde concentration

mass_final mass of the bird in g

Source

Cram, Dominic L.; Blount, Jonathan D.; Young, Andrew J. (2015), Data from: The oxidative costs of reproduction are group-size dependent in a wild cooperative breeder, Dryad, Dataset, https://doi.org/10.5061/dryad.j1305

References

Cram, D.L., Blount, J.D. & Young, A.J. (2015) The oxidative costs of reproduction are group-size dependent in a wild cooperative breeder. Proceedings. Biological sciences / The Royal Society, 282, 20152031.

Examples

```
data(weaver)
str(weaver)
```

---

worldbank   *Data comparing 186 countries originally published by the World Bank*

Description

A variety of geographical, economic, environmental and social measures for 186 countried from the year 2014. Compiled from data published by the World Bank.

Usage

```
data("worldbank")
```

Format

A data frame with 186 observations on the following 25 variables.

Climate_region a factor with levels Temperate or Polar Tropical

Income_binary a factor with levels High Low

Country_Name Name of the country

Country_Code Three letter code for the country

Region Geographic region

Income_group Divides countries into one of four income groups

Population Population size

Land_area Area of the country in km^2

Forest_area Area forested as percent of land area

Precipitation Annual precipitation in mm

Population_density People per km^2

Capital_lat Latutude of the capital

GNP_per_Cap Gross National Product per capita in US$

Population_growth Annual population growth in percent

Cereal_yield Cereal yield in Kg per Ha

Female_life_expectancy Average life expectancy of women in years

Under_5_mortality Deaths of children under 5 per 100000

Renewables. Renewable energy consumption (percent of total final energy consumption)

CO2 CO2 production in tonnes per capita

PM25 PM2.5 air pollution, mean annual exposure (micrograms per cubic meter)

Women_in_parliament Percent of seats held by women in national parliaments

GINI_index Gini index of wealth inequality

Govt_spend_education Government expenditure on education, total (percent of GDP)

Secondary_school_enrolment School enrollment, secondary (percent net)

School_gender_parity Index of gender parity for school enrollment

Source

https://data.worldbank.org/indicator

Examples

```
data(worldbank)
str(worldbank)
```

---

zebra_bacteria   *Data on bacterial adaptation to host gut environments.*

Description

Data from a study on bacterial adaptation to host gut environments. These data are measures of the competitive ability a bacterium called Aeromonas veronii after either 4 or 18 passages through the gut of an otherwise germ-free larval zebrafish.

Usage

```
data("zebra_bacteria")
```

Format

A data frame with 208 observations on the following 4 variables.

Line Which of three lines

Host Wild type (WT) or an immunodeficient myd88- mutant

Passage Number of passages

CI Competitive index

Source

https://figshare.com/articles/dataset/Experimental_bacterial_adaptation_to_the_zebrafish_gut_reveals_a_primary_role_for_i

References

Robinson, C.D., Klein, H.S., Murphy, K.D., Parthasarathy, R., Guillemin, K. & Bohannan, B.J.M. (2018) Experimental bacterial adaptation to the zebrafish gut reveals a primary role for immigration. PLoS biology, 16, e2006893.

Examples

```
data(zebra_bacteria)
str(zebra_bacteria)
```

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