

# Package ‘LSTbook’

January 20, 2025

**Title** Data and Software for “Lessons in Statistical Thinking”

**Version** 0.6

**Description** “Lessons in Statistical Thinking” D.T. Kaplan (2014)  
<<https://dtkaplan.github.io/Lessons-in-statistical-thinking/>>  
is a textbook for a first or second course in statistics that embraces data wrangling, causal reasoning, modeling, statistical adjustment, and simulation. ‘LSTbook’ supports the student-centered, tidy, pipeline-oriented computing style featured in the book.

**Encoding** UTF-8

**Depends** R (>= 3.5.0)

**LazyData** true

**LazyDataCompression** xz

**Imports** rlang, dplyr, ggplot2 (>= 3.4.4), broom, glue, stats, MASS, tibble, stringi

**RoxygenNote** 7.2.1

**Suggests** igraph, mosaicData, moderndive, palmerpenguins, stringdist, rmarkdown, knitr, testthat

**Config/testthat/edition** 3

**VignetteBuilder** knitr

**URL** <https://github.com/dtkaplan/LSTbook>

**BugReports** <https://github.com/dtkaplan/LSTbook/issues>

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**NeedsCompilation** no

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**Repository** CRAN

**Date/Publication** 2024-12-07 13:40:03 UTC

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AAUP	<i>1984 salaries in various professional fields</i>
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### Description

These data were published in the American Association of University Professor's journal, *Academe*. They were compiled by Marcia Bellas drawing on data from the 1984 Carnegie survey of faculty, the US National Science Foundation, the National Research Council, and the US Census Bureau. The motivation for the work was to investigate salary "disparities among faculty whose education and experience are comparable and whose duties are broadly similar," in particular those due to sex. Regrettably, the data do not include measures of the production of workers in the various fields or the numbers of people employed in each field.

### Usage

```
data(AAUP)
```

### Format

28 rows, each of which is a professional discipline:

- subject name of the discipline
- ac: average salary (USD) for academics
- nonacsal median salary (USD) for non-academics
- fem: fraction of the workforce that is female
- unemp: unemployment rate in the discipline
- nonac: fraction of the workforce that is non-academic,
- licensed: Does work in the profession require a license (from George Cobb's paper)

### Source

George Cobb (2011) "Teaching statistics: some important tensions" *Chilean Journal of Statistics* 2(1):31-62 [link](#)

**References**

M Bellas & BF Reskin (1994) "On comparable worth" *Academe* **80**:83-85

---

add_plot_labels	<i>Convenience function for adding labels to point_plot or others without needing the ggplot2 + pipe.</i>
-----------------	---

---

**Description**

Convenience function for adding labels to point\_plot or others without needing the ggplot2 + pipe.

**Usage**

```
add_plot_labels(P, ..., color = NULL)
```

**Arguments**

P	A ggplot2 object, for instance as made with point_plot() or model_plot()
color	Name for color legend (works for point_plot())
...	Label items (e.g. x = "hello") as in ggplot2::labs

**Value**

A ggplot graphics object

**Examples**

```
mtcars |> point_plot(mpg ~ hp + cyl) |>
  add_plot_labels(x = "The X axis", y = "Vertical", color = "# cylinders")
```

---

add_slope_rose	<i>Add a slope "rose" to a plot.</i>
----------------	--------------------------------------

---

**Description**

To guide a reader in quantifying the slope of components of an x-y graph, a "slope rose" is helpful. Several radiating lines are drawn, each marked with a numerical slope. A suitable choice of slopes is made automatically, based on the x- and y- scale of the plot.

**Usage**

```

add_slope_rose(
  P,
  x = NULL,
  y = NULL,
  scale = 1/4,
  color = "red",
  keepers = c("both", "pos", "neg")
)

add_violin_ruler(
  P,
  x = NULL,
  y = NULL,
  width = 1/10,
  ticks = seq(0, 1, by = 0.1),
  ...
)

```

**Arguments**

P	a ggplot2 object made by the ggplot2 or ggformula packages
x	the x-position of the rose. This will be assigned automatically if x isn't specified.
y	the y-position of the rose, just like x.
scale	the size of the rose as a fraction of the plot area covered (default 1/4)
color	text string (e.g. "blue") for the rose
keepers	whether to show "both" positive and negative slopes or just show the "pos" or the "neg"
width	for rulers, the distance between tick marks (in native units, where categories are separated by a distance of 1.)
ticks	Integers, typically 0:5, that label the ticks.
...	additional graphical parameters, e.g. color = "blue"

**Details**

For the ruler, x gives the position of the root of the ruler, with the rest of the ruler moving off to the left. (For vertically oriented rulers, use a negative width.)

**Value**

A ggplot graphics object

**Note**

Use the pipe operator to send a previously made plot to have a rose added. Don't use the {ggplot2} + connector.

**Examples**

```
mtcars |> point_plot(mpg ~ hp, annot="model") |> add_slope_rose()
mtcars |> point_plot(wt ~ hp) |> add_slope_rose(keepers="pos", color="blue", x=100, scale=.5)
```

---

 Anthro\_F

---

*Anthropometric data from college-aged women*


---

**Description**

Percentage of body fat, age, weight, height, body mass index and fourteen circumference measurements are given for 184 college women ages 18-25. Body fat was accurately determined by an underwater weighing technique which requires special equipment and training of the individuals conducting the process. Circumference measurements were made to the nearest 0.1 cm using a cloth tape in complete contact with the skin but without compression of the soft tissues. The measurement process, described somewhat incompletely below, is described in greater detail in Slack (1997) who used the standards recommended by Lohman, Roche and Martrell (1988).

**Usage**

```
data(Anthro_F)
```

**Format**

A data.frame with one row for each of 184 woman

- Weight (kg)
- Height (m)
- BMI: (Body Mass Index) Weight divided by the square of Height
- Age
- Neck: Minimal circumference perpendicular to the long axis of the neck (cm)
- Chest: Horizontal plane measurement at the sixth rib, at the end of a normal expiration (cm)
- Calf: Horizontal maximal calf measurement (cm)
- Biceps: Measurement with arm extended (cm)
- Hips: Horizontal maximal measurement around buttocks (cm)
- Waist: Horizontal minimal measurement, at the end of a normal expiration (cm)
- Forearm: Maximal measurement perpendicular to long axis (cm)
- PThigh: (Proximal Thigh) Horizontal measurement immediately distal to the gluteal furrow (cm)
- MThigh: (Middle Thigh) Measurement midway between the midpoint of the inguinal crease and the proximal border of the patella (cm)
- DThigh: (Distal Thigh) Measurement proximal to the femoral epicondyles (cm)
- Wrist: Measurement perpendicular to the long axis of the forearm (cm)

- Knee: Measurement at the mid-patellar level, with the knee slightly flexed (cm)
- Elbow: A minimal circumference measurement with the elbow extended (cm)
- Ankle: Minimal circumference measurement perpendicular to the long axis of the calf (cm)
- BFat: Amount of body fat expressed as a percentage of total body weight, using Siri's (1956) method

### Source

Roger W. Johnson (2021) "Fitting Percentage of Body Fat to Simple Body Measurements: College Women" *Journal of Statistics and Data Science Education* **29**(3) doi:[10.1080/26939169.2021.1971585](https://doi.org/10.1080/26939169.2021.1971585)

---

Birdkeepers

*Birdkeeping and Lung Cancer*

---

### Description

A 1972–1981 health survey in The Hague, Netherlands, discovered an association between keeping pet birds and increased risk of lung cancer. To investigate birdkeeping as a risk factor, researchers conducted a *case–control* study of patients in 1985 at four hospitals in The Hague (population 450,000). They identified 49 cases of lung cancer among the patients who were registered with a general practice, who were age 65 or younger and who had resided in the city since 1965. They also selected 98 controls from a population of residents having the same general age structure.

### Usage

`data(Birdkeepers)`

### Format

A data frame with 147 observations on the following 7 variables.

- LC Whether subject has lung cancer
- FM Sex of subject
- SS Socioeconomic status, determined by occupation of the household's principal wage earner
- BK Indicator for birdkeeping (caged birds in the home for more than 6 consecutive months from 5 to 14 years before diagnosis (cases) or examination (control))
- AG Age of subject (in years)
- YR Years of smoking prior to diagnosis or examination
- CD Average rate of smoking (in cigarettes per day)

### Details

This dataset is copied and renamed from the Sleuth3 R package, where it is called `case2002`.

**Source**

Ramsey, F.L. and Schafer, D.W. (2013). *The Statistical Sleuth: A Course in Methods of Data Analysis (3rd ed)*, Cengage Learning.

**References**

Holst, P.A., Kromhout, D. and Brand, R. (1988). "For Debate: Pet Birds as an Independent Risk Factor for Lung Cancer" *British Medical Journal* **297**: 13–21.

---

 Births2022

---

*Records on births in the US in 2022*


---

**Description**

These data come from the Centers for Disease Controls "public use file" recording all 3,699,040 (known) births in the US in 2022. Births2022 is a random sample of size 20,000 from the comprehensive file

**Usage**

Births2022

**Format**

A data frame with 20,000 observations on the following 38 variables. The unit of observation is a birth.

- month: 1-12
- dow: Day of week: Sun, Mon, Tues, ...
- place: hospital, home, clinic, etc.
- paternity: is paternity acknowledged. Y, N, and X. X stands for "not applicable" which is shorthand for the mother is married (consequently the husband is presumed to be the father).
- meduc: mother's educational level. <8 is 8th grade or less, HSG+ means high school plus some college but no degree.
- feduc: father's education. Same coding as meduc.
- married: Is the mother married?
- mage: mother's age
- fage: father's age
- total\_kids: how many total births to mother including this one.
- interval: months since last birth (if applicable).
- prenatal\_start: Which trimester did the mother start prenatal care?
- prenatal\_visits: How many total prenatal care visits.
- mheight: Mother's height in inches



- wt\_pre: Mother's weight in pounds before pregnancy
- wt\_delivery: Mother's weight in pounds at delivery
- diabetes\_pre: Did the mother have diabetes before pregnancy
- diabetes\_gest: Did the mother develop gestational diabetes
- hbp\_pre: Did the mother have high blood pressure before pregnancy
- hbp\_gest: Did the mother develop high blood pressure during pregnancy
- eclampsia: Did the mother develop eclampsia
- induction: Was labor induced?
- augmentation: Was the uterus stimulated to increase frequency, duration, and intensity of contractions.
- anesthesia: Was the mother given anesthesia?
- presentation: Baby's presentation at birth (e.g. cephalic or breech)
- method: method of delivery (vaginal or C-section)
- trial\_at\_labor: For mother's who delivered by C-section, was there an attempt at labor.
- attendant: MD, DO, midwife, other
- payment: How was the bill paid?
- apgar5, apgar10: APGAR scores (0-10) at five and ten minutes after birth.
- plurality: singletons, twins, triplets, quadruplets (as an integer 1-4)
- sex: Baby's sex
- duration: Duration of gestation, in weeks by "obstetric estimate."
- menses: Last normal menses month: 1-12 (Jan-Dec)
- weight: Baby's weight (in grams)
- living: Baby living at time of birth report
- breastfed: Baby breastfed at time of discharge

**Source**

US Centers for Disease Control "Nativity Public Use File", CDC vital stats online

**References**

"User Guide to the 2022 Natality Public Use File"

---

Boston\_marathon

*Winning times in the Boston Marathon*

---

### **Description**

The Boston marathon is the oldest continuing marathon in the US.

### **Usage**

Boston\_marathon

### **Format**

A data frame

- year
- name: the winner's name
- country from which the winner registered
- time: the winning time
- sex: female or male
- minutes: the winning time converted to minutes

### **Source**

[Boston Athletic Association](#)

---

Butterfly

*World records in the 100 & 200 m butterfly swim*

---

### **Description**

World records in the 100 & 200 m butterfly swim

### **Usage**

data(Butterfly)

**Format**

A data.frame object with one row for each world record and variables

- time: the record time in seconds
- swimmer the name of the swimmer
- date a Date object containing the date the record was made
- place string describing the location
- sex: coded as F and M
- lengths: the total distance was divided into lengths of either 25 or 50 meters. lengths gives the number of such lengths in the total distance.
- dist: the total distance (in meters) of the race

**Source**

[Wikipedia](#)

---

Calif\_precip

*Annual precipitation in California locations*

---

**Description**

These data are from an article in the journal *Geography* that illustrates precipitation modeling.

**Usage**

Calif\_precip

**Format**

A data.frame with 30 rows, each a weather station in California

- station: the name of the station
- precip average annual precipitation in inches
- altitude in feet
- latitude the station's north-south location (degrees North)
- distance: distance in miles from the coast
- orientation: related to the rain shadow effect of the mountains. "W" means westward facing (toward the prevailing winds). "L" mean "leeward," that is, facing away from the prevailing winds.

**Source**

P. J. Taylor (1980) "A Pedagogic Application of Multiple Regression Analysis: Precipitation in California" *Geography* **65** (3) 203-212

---

 Callback
 

---

*Resume Experiment Data*


---

### Description

Data from an experimental study in which researchers sent the resumes of fictitious job applicants to potential employers. The first names of the fictitious applicants was set randomly to sound either Black or white.

### Usage

```
data("Callback")
```

```
Names_and_race
```

### Format

: Callback: A data frame with 4870 rows and 4 variables. Each row is one fictitious applicant

- name: first name of the fictitious job applicant
- sex: sex of applicant (female or male)
- callback: whether the potential employer called back to follow up. (1 = yes, 0 = no) Another data frame, Names\_and\_race: which first names are associated with which race.

An object of class grouped\_df (inherits from tbl\_df, tbl, data.frame) with 36 rows and 2 columns.

### References

- Imai, Kosuke. 2017. Quantitative Social Science: An Introduction. Princeton University Press. [URL](#) from whence these data were added to this package. In QSS, the data are called resume.
- Marianne Bertrand and Sendhil Mullainathan (2004) “Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination.” American Economic Review, vol. 94, no. 4, pp. 991–1013. doi: 10.3386/w9873

---

 categorical
 

---

*Helpers for specifying nodes in simulations*


---

### Description

Helpers for specifying nodes in simulations

Mix two variables together. The output will have the specified R-squared with var1 and variance one.

Evaluate an expression separately for each case

**Usage**

```

categorical(n = 5, ..., exact = TRUE)

cat2value(variable, ...)

bernoulli(n = 0, logodds = NULL, prob = 0.5, labels = NULL)

mix_with(signal, noise = NULL, R2 = 0.5, var = 1, exact = FALSE)

each(ex)

block_by(block_var, levels = c("treatment", "control"), show_block = FALSE)

random_levels(n, k = NULL, replace = FALSE)

```

**Arguments**

n	The symbol standing for the number of rows in the data frame to be generated by <code>datasim_run()</code> . Just use <code>n</code> as a symbol; don't assign it a value. (That will be done by <code>datasim_run()</code> .)
exact	if TRUE, make R-squared or the target variance exactly as specified.
variable	a categorical variable
logodds	Numerical vector used to generate bernoulli trials. Can be any real number.
prob	An alternative to <code>logodds</code> . Values must be in $[\emptyset, 1]$ .
labels	Character vector: names for categorical levels, also used to replace 0 and 1 in <code>bernoulli()</code>
signal	The part of the mixture that will be correlated with the output.
noise	The rest of the mixture. This will be <b>uncorrelated</b> with the output only if you specify it as pure noise.
R2	The target R-squared.
var	The target variance.
ex	an expression potentially involving other variables.
block_var	Which variable to use for blocking
levels	Character vector giving names to the blocking levels
show_block	Logical. If TRUE, put the block number in the output.
k	Number of distinct levels
replace	if TRUE, use resampling on the set of <code>k</code> levels
...	assignments of values to the names in <code>variable</code>

**Details**

`datasim_make()` constructs a simulation which can then be run with `datasim_run()`. Each argument to `datasim_make()` specifies one node of the simulation using an assignment-like syntax

such as  $y \leftarrow 3x + 2 + \text{rnorm}(n)$ . The `datasim` helpers documented here are for use on the right-hand side of the specification of a node. They simplify potentially complex operations such as blocking, creation of random categorical methods, translation from categorical to numerical values, etc.

The target R-squared and variance will be achieved only if `exact=TRUE` or the sample size goes to infinity.

### Value

A numerical or categorical vector which will be assembled into a data frame by `datasim_run()`

### Examples

```
Demo <- datasim_make(
  g <- categorical(n, a=2, b=1, c=0.5),
  x <- cat2value(g, a=-1.7, b=0.1, c=1.2),
  y <- bernoulli(logodds = x, labels=c("no", "yes")),
  z <- random_levels(n, k=4),
  w <- mix_with(x, noise=rnorm(n), R2=0.75, var=1),
  treatment <- block_by(w),
  dice <- each(rnorm(1, sd = abs(w)))
)
```

---

College\_grades

*Grades at a small college*

---

### Description

These are the actual grades for 400+ individual students in the courses they took at a small, liberal-arts college in the midwest US. All the students graduated in 2006. Each row corresponds to a single student in a single course. The data have been de-identified by translating the student ID, the instructor ID, and the name of the department. Typically a graduating student has taken about 32 courses. As another form of de-identification, only half of the courses each student, selected randomly, are included. Only courses with 10 or more students enrolled were included.

### Usage

```
data(College_grades)
```

### Format

A data frame with 6146 Grades for 443 students.

- grade The letter grade for the student in this course: A is the highest.
- sessionID An identifier for the course taken. Courses offered multiple times in one semester or across semesters have individual IDs.
- sid The student ID

-dept The department in which the course was offered. 100 is entry-level, 200 sophomore-level, 300 junior-level, 400 senior-level.

-enroll Student enrollment in the course. This includes students who are not part of this sample.

-iid Instructor ID

-gradepoint A translation of the letter grade into a numerical scale. 4 is high. Some letter grades are not counted in a student's gradepoint average. These have `{NA}` for the gradepoint.

### Source

The data were helpfully provided by the registrar of the college with the proviso that the de-identification steps outlined above be performed.

---

conf_interval	<i>Summaries of regression models</i>
---------------	---------------------------------------

---

### Description

The summaries are always in the form of a data frame

- `conf_interval()` — displays coefficients and their confidence intervals
- `R2()` — R-squared of a model together with related measures such as F, adjusted R-squared, the p-value, and degrees of freedom used in calculating the p-value.
- `regression_summary()` – A regression report in data-frame format.
- `anova_summary()` — An ANOVA report in data-frame format. If only one model is passed as an argument, the data frame will have one line per model term. If multiple models are given as arguments, the ANOVA report will show the increments from one model to the next.

### Usage

```
conf_interval(model, level = 0.95, show_p = FALSE)
```

```
R2(model)
```

```
regression_summary(model)
```

```
anova_summary(...)
```

### Arguments

model	A model as produced by <code>model_train()</code> , <code>lm()</code> , <code>glm()</code> , and so on
level	Confidence level to use in <code>conf_interval()</code> (default: 0.95)
show_p	For <code>conf_interval()</code> , append the p-value to the report.
...	One or more models (for ANOVA)

## Details

Many of these are wrappers around `broom::tidy()` used to emphasize to students that the results are a summary in the form of a regression report, similar to the summaries produced by `stats::confint()`, `stats::coef()`, etc.

## Value

a data frame

## Examples

```
Model <- CRDS |> model_train(FEV ~ age + smoker)
Model |> conf_interval()
Model |> R2()
Model |> anova_summary()
```

---

CRDS

*Smoking and lung function among youths*

---

## Description

Data from the Childhood Respiratory Disease Study collected in the late 1970s to examine the effects of smoking and exposure to second-hand smoke. on pulmonary functions in youths.

## Usage

```
data(CRDS)
```

## Format

A data.frame with one row for each of 645 youngsters.

- age in years
- FEV (forced expiratory lung volume) in liters
- height in inches
- sex
- smoker whether or not the youngster smokes

## Source

Cummiskey, et al. (2020) "Causal Inference in Introductory Statistics Courses" *Journal of Statistics Education* **28**(1) doi:[10.1080/10691898.2020.1713936](https://doi.org/10.1080/10691898.2020.1713936)



---

dag_draw	<i>Draw a DAG</i>
----------	-------------------

---

**Description**

Make a simple drawing of a Directed Acyclic Graph as constructed by `datasim_make`.

**Usage**

```
dag_draw(DAG, ..., report_hidden = FALSE)
```

**Arguments**

DAG	The DAG to draw
report_hidden	logical. If TRUE, show the hidden nodes.
...	Additional arguments to <code>plot.igraph()</code>

**Details**

See the `igraph` package for more details.

By default, edges are not drawn to hidden nodes, that is, those whose names begin with a dot. To show the hidden nodes, use the argument `show_hidden=TRUE`.

**Value**

No return value. Called for graphics side-effects.

**Examples**

```
dag_draw(sim_03)
```

---

datasim_make	<i>Construct and modify data simulations</i>
--------------	--

---

**Description**

Construct and modify data simulations

**Usage**

```
datasim_make(...)  
  
datasim_to_igraph(sim, report_hidden = FALSE)  
  
datasim_intervene(sim, ...)
```

**Arguments**

<code>sim</code>	The data simulation object to be modified.
<code>report_hidden</code>	If TRUE, show the hidden nodes (nodes whose names begin with a dot.)
<code>...</code>	Descriptions of the nodes in the simulation, written in assignment form. See details.

**Details**

Simulations in LSTbook are first specified by providing the code for each node (which can be written in terms of the values of other nodes). Once constructed, data can be extracted from the simulation using `datasim_run(n)` or the generic `take_sample(n)`.

Each argument defines one node in the simulation. The argument syntax is unusual, using *assignment*. For instance, an argument `y <- 3*x + rnorm(n)` defines a node named `y`. The R code on the RHS of the assignment operator (that is, `3*x + rnorm(n)` in the example) will be used by `datasim_run()` to generate the `y` variable when the simulation is run. Nodes defined by previous arguments can be used in the code for later arguments.

Helper functions such as `mix_with()`, `categorical()`, and several others can be used within the node to perform complex operations.

Remember to use *commas* to separate the arguments in the normal way.

**Value**

an object of class "datasim". Internally, this is a list of the R assignment expressions used when running the simulation.

**Examples**

```
Simple_sim <- datasim_make(x <- rnorm(n, sd=2), y <- 3*x + rnorm(n))
Simple_sim |> datasim_run(n = 5)
```

---

`datasim_run`

*Run a datasim simulation, producing a data frame*

---

**Description**

Run a `datasim` simulation, producing a data frame

**Usage**

```
datasim_run(sim, n = 5, seed = NULL, report_hidden = FALSE)
```

**Arguments**

sim	A simulation object, as produced by <code>datasim_make()</code> .
n	The size of the data sample pulled from the simulation.
seed	An integer random number seed, for reproducibility. (Or, use <code>set.seed()</code> before running <code>sim_run()</code> .)
report_hidden	logical. If TRUE, show the values of hidden variables (that is, variables whose name begins with a dot)

**Value**

a data frame with a column for each node in the `datasim` object.

---

Econ_outlook_poll	<i>SIMULATED data from an economic outlook poll</i>
-------------------	---

---

**Description**

SIMULATED data from an economic outlook poll

**Usage**

```
Econ_outlook_poll
```

**Format**

10,000 rows with three variables: age, income, pessimism

Data from a simple SIMULATION of people's pessimism about the economic state based on age group and income group. Nothing about the real world should be inferred from these data; they are merely to illustrate adjusting for covariates.

**Source**

The simulation is from "Statistical Modeling: A Fresh Approach" (2/e). Code for it is in the file `system.file("SM2-simulations.R", package="LSTbook")`

---

explanatory_vars	<i>Utilities</i>
------------------	------------------

---

**Description**

Functions for pulling various components from model objects. These work mainly for lm and glm objects. It's a future project to add facilities for other object types.

**Usage**

```
explanatory_vars(model, ...)
response_var(model, ...)
response_values(model, ...)
formula_from_mod(model, ...)
get_training_data(model, ...)
```

**Arguments**

model	the model in question
...	(not used)

---

FARS	<i>Annual summaries concerning motor-vehicle related fatalities in the US#'</i>
------	---

---

**Description**

Annual summaries concerning motor-vehicle related fatalities in the US#'

**Usage**

```
data(FARS)
```

**Format**

A data.frame object with one row per year from 1994 to 2016

- year: The year covered by the summary
- crashes the number of incidents in that year
- drivers the number of drivers killed in those incidents
- passengers the number of passengers killed in those incidents

- unknown\_vehicle\_occupants killed whose status as driver or passenger is unknown
- motorcyclists the number of motorcyclists killed in those incidents
- pedestrians the number of pedestrians killed in those incidents
- pedalcyclists the number of non-motorized cyclist deaths
- other\_nonvehicle the number of other deaths in those incidents
- vehicle\_miles the number of miles driven by all vehicles, whether they were involved in an incident or not. (billions of miles)
- population the population of the US (thousands of people)
- registered\_vehicles the number of motor vehicles registered in the US (thousands)
- licensed\_drivers the number of licenced drivers in the US (thousands)

### Source

From the Fatality Analysis Reporting System of the US Department of Transportation (DOT). The data have been put into a tidy form from the untidy version published by the DOT, removing columns calculated from other columns and so on.

---

Framingham

*Data from the Framingham heart study*

---

### Description

When it launched in 1948 the original goal of The Framingham Heart Study (FHS) launched in 1948 with the goal of identifying risk factors for cardiovascular disease. FHS had over 14,000 people from three generations, including the original participants, their children, and their grandchildren. These data represent 4238 Framingham subjects and were published by Kaggle for a machine-learning competition. The goal of the competition was to predict TenYearCHD from the other factors.

### Usage

```
data(Framingham)
```

### Format

4238 rows, each of which is a FHS subject. There are 16 variables:

- sex
- age of the patient
- education highest level achieved: some HS, HS grad/GED, some college/vocational school, college graduate
- currentSmoker: whether or not the patient is a current smoker
- cigsPerDay: the number of cigarettes that the person smoked on average in one day.
- BPMeds: whether or not the patient was on blood pressure medication

- prevalentStroke: whether or not the patient had previously had a stroke
- prevalentHyp: whether or not the patient was hypertensive
- diabetes: whether or not the patient had diabetes
- totChol: total cholesterol level
- sysBP: systolic blood pressure
- diaBP: diastolic blood pressure
- BMI: Body Mass Index
- heartRate: heart rate
- glucose: glucose level
- TenYearCHD: Did the patient develop congestive heart disease during a 10 year follow-up? (1=Yes)

### Source

[Kaggle](#) and [Github repository](#)

### References

Description of [FHS by the National Heart, Lung, and Blood Institute](#)

---

Germany1933vote

*Voting patterns in the 1933 German national election*

---

### Description

1933 was the year that Hitler and the Nazi party came to power. The initial basis for this was a national election in which the Nazis secured a substantial fraction of the vote. (Immediately after the election, the Nazis burned the Reichstag (the German parliament) and started repressing their political opposition through a campaign of imprisonment and murder.)

### Usage

```
data("Germany1933vote")
```

### Format

A data frame with 681 rows and 7 variables. Each row is a German precinct.

- self: share of potential voters who are self-employed
- blue: share of potential voters who are blue-collar workers
- white: share of potential voters who are white-collar workers
- domestic: share of potential voters who are employed domestically
- unemployed: share of potential voters who are un-employed
- nvoter: number of eligible voters (not clear if this include people who didn't vote)
- nazivote: number of votes for the Nazis

## References

- Imai, Kosuke. 2017. Quantitative Social Science: An Introduction. Princeton University Press. [URL](#) from whence these data were added to this package. In QSS, the data are called `nazis`.
- G. King, O. Rosen, M. Tanner, A.F. Wagner (2008) “Ordinary economic voting behavior in the extraordinary election of Adolf Hitler.” *Journal of Economic History*, vol. 68, pp. 951–996.#’

---

Gilbert

*Data from the trial of serial killer Kristen Gilbert*

---

## Description

Intensive care unit nurse **Kristen Gilbert** worked for several years in the 1990s at a Veterans Administration Hospital. Her co-workers became suspicious. The co-workers observed that unexpected patient deaths occurred more frequently on her shifts than on other shifts. They also noticed a shortage of supplies of the cardiac stimulant epinephrine, which can be fatal when administered in large enough doses through an IV drip. The hospital investigators went through all the shifts during the years Gilbert worked at the hospital, noting whether Gilbert was on duty during that shift and whether there was a death during the shift.

## Usage

```
data(Gilbert)
```

## Format

A data frame with one row for each shift at the VA hospital.

- `death` Whether a patient death occurred during the shift.
- `gilbert` Whether nurse Kristen Gilbert was on duty during the shift.
- `time`: the winning time in seconds
- `race` the name of the race. Many races are repeated over successive years.
- `year` the year the race was run
- `name` the name of the winning runner
- `sex`: the runner’s sex, coded as F and M
- `distance`: the total distance of the race in km
- `climb`: the total vertical climb of the race in meters

## Details

Only tabular summaries of the shift/death information are public. This data frame was reconstructed from those summaries.

---

`Go_vote`*Get out the vote experiment*

---

## Description

An experiment about ways to encourage voting in primary elections. During the 2006 primary election in Michigan, registered voters were randomly assigned to different treatments, each in the form of a postcard mailed to them before the primary. The most high-pressure message("Neighbors") listed the voters neighbors and whether they voted in the previous primary elections. The card promised to send out the same information after the 2006 primary, so that "you and your neighbors will all know who voted and who did not." (From the Gerber et al. reference, below.) In another treatment, "Civic Duty," the postcard said, "On August 8, remember your rights and responsibilities as a citizen. Remember to vote. DO YOUR CIVIC DUTY—VOTE!" Yet another treatment, "Hawthorne" simply told the voter that "YOU ARE BEING STUDIED!" as part of research on why people do or do not vote. There was also a control group that did not receive a postcard.

## Usage

```
data(Go_vote)
```

## Format

A data frame with 305866 rows and 6 variables:

- sex of the voter (female or male)
- yearofbirth: year of birth of the voter
- primary2004: whether the voter voted in the 2004 primary election (voted, abstained)
- messages: Get-out-the-vote message the voter received (Civic Duty, Control, Neighbors, Hawthorne)
- primary2006: whether the voter turned out in the 2006 primary election (voted, abstained)
- hhsize: household size of the voter

## References

- Imai, Kosuke. 2017. *Quantitative Social Science: An Introduction*. Princeton University Press. URL.
- Alan S. Gerber, Donald P. Green, and Christopher W. Larimer (2008) "Social pressure and voter turnout: Evidence from a large-scale field experiment." *American Political Science Review*, vol. 102, no. 1, pp. 33–48. doi: 10.1017/S000305540808009X



---

Hill\_racing

*Winning times in Scottish Hill races, 2005-2017*

---

**Description**

Winning times in Scottish Hill races, 2005-2017

**Usage**

```
data(Hill_racing)
```

**Format**

A data.frame object with one row for each race winner. Most races have both a male and female winner.

"year" "sex" "name" "time" "race" "distance" "climb"

- time: the winning time in seconds
- race the name of the race. Many races are repeated over successive years.
- year the year the race was run
- name the name of the winning runner
- sex: the runner's sex, coded as F and M
- distance: the total distance of the race in km
- climb: the total vertical climb of the race in meters

**Source**

The data were scraped from the [Scottish Hill Racing site](#).

---

McClave\_Sincich

*Data from McClave-Sincich Statistics 11/e*

---

**Description**

These are relatively small data frames used for exercises

**Usage**

Clock\_auction

Geography\_journals

PGA\_index

Dowsing

**Format**

Clock\_auction: Prices for grandfather clocks sold in auction

- Sales price for the clock
- Age of the clock
- Number of bidders for the clock

Geography\_journals: Prices for geography journals, c. 2005

- journal name of journal
- cost for a one-year subscription
- jif journal impact factor
- cites number of citations of the journal in the past five years
- rpi relative price index

PGA\_index: Driving distance, accuracy, and a derived index from the PGA tour

- player name of the player
- dist driving distance in yards
- accuracy percent of drives that land in the fairway
- index an index score for ranking players.

Dowsing: Locations identified by dowsers in an experiment

- trial just the row number
- subject identifying number assigned to the subject
- pipe location of the flowing-water pipe along a 10-meter line (decimeters)
- guess the dowser's guess of the location of the pipe in that trial (decimeters)

**Source**

StatCrunch

---

McCredie\_Kurtz

*"Big Five" personality ratings for college first-year students*

---

**Description**

Abstract from the research paper: Five-factor personality ratings were provided by undergraduate freshmen, their parents, and their college peers as predictors of cumulative GPA upon graduation. Conscientiousness ratings were significant predictors of GPA by all three raters; peer ratings of Conscientiousness were the only significant predictor of GPA when self-, parent-, and peer-ratings of Conscientiousness were examined simultaneously. College major was a moderator of this relationship, with self- and parent-ratings of Conscientiousness correlating more strongly with GPA among Social Science majors and parent-ratings of Conscientiousness correlating less strongly with GPA among Science majors. These findings replicate existing research regarding the validity of informant ratings as predictors of behavioral outcomes such as academic performance, while emphasizing the importance of including multiple informants from various life contexts.

**Usage**

```
data(McCredie_Kurtz)
```

**Format**

For simplicity, only the mother's and father's ratings for the student are given. The variable name indicates whose rating and on what scale, e.g. m\_extra is the mothers rating on the extraversion scale. Other variables are:

- subjid: Unique ID for the student
- age: The student's age when the ratings were collected
- GPA: The student's eventual 4-year grade-point average
- sex: The student's sex
- field: What field the student ended up studying

**Details**

The five personality factors are:

1. extraversion: sociability
2. neuroticism: sadness or emotional instability
3. openness to experience
4. agreeableness: kindness
5. conscientiousness: thoughtfulness

**Source**

McCredie\_Kurtz\_Open\_Data.sav comes from <https://data.mendeley.com/datasets/rn2bpp6f37/1>

**References**

Morgan N. McCredie and John E. Kurtz (2020) "Prospective prediction of academic performance in college using self- and informant-rated personality traits" *Journal of Research in Personality* **85**

---

model\_eval

*Evaluate a model on inputs*

---

**Description**

Evaluate a model on inputs

**Usage**

```

model_eval(
  mod,
  data = NULL,
  ...,
  skeleton = FALSE,
  ncont = 3,
  interval = c("prediction", "confidence", "none"),
  level = 0.95,
  type = c("response", "link")
)

```

**Arguments**

mod	A model as from <code>model_train()</code> , <code>lm()</code> or <code>glm()</code>
data	A data frame of inputs. If missing, the inputs will be assembled from ... or from the training data, or an skeleton will be constructed.
skeleton	Logical flag. If TRUE, a skeleton on inputs will be created. See <a href="#">model_skeleton()</a> .
ncont	Only relevant to skeleton. The number of levels at which to evaluate continuous variables. See <a href="#">model_skeleton()</a> .
interval	One of "prediction" (default), "confidence", or "none".
level	The level at which to construct the interval (default: 0.95)
type	Either "response" (default) or "link". Relevant only to glm models. The format of the <code>.output</code>
...	Optional vectors specifying the inputs. See examples.

**Value**

A data frame. There is one row for each row of the input values (see `data` parameter). The columns include

- the explanatory variables
- `.output` — the output of the model that corresponds to the explanatory value
- the `.lwr` and `.upr` bounds of the prediction or confidence interval
- if training data is used as the input, then it's possible to calculate the residual. This will be called `.resid`.

**Examples**

```

mod <- mtcars |> model_train(mpg ~ hp + wt)
model_eval(mod, hp=100, wt=c(2,3))
model_eval(mod) # training data
model_eval(mod, skeleton=TRUE)

```

---

model_eval_fun	<i>Helper functions to evaluate models</i>
----------------	--

---

**Description**

Only used internally in {LSTbook}. These were originally arranged as S3 methods, but now the dispatch is done "by hand" in order to eliminate any exported S3 methods.

**Usage**

```
model_eval_fun(model, data = NULL, interval = "none", level = 0.95, ...)
```

**Arguments**

model	A model object of the classes permitted
data	Usually, a data table specifying the inputs to the model. But if not specified, the training data will be used.
interval	One of "none", "confidence", or "prediction". Not all model types support "prediction" or even "confidence".
level	(default 0.95) confidence or prediction level. Must be in $[\emptyset, 1]$
...	additional arguments

**Value**

a data frame

---

model_family	<i>Check model type against model specification and data</i>
--------------	--

---

**Description**

This can be used to automatically determine a model type or to determine if the specified model type is consistent with the specification/data

**Usage**

```
model_family(
  .data,
  .tilde,
  family = c("auto", "lm", "linear", "binomial", "poisson", "svm", "gaussian", "rlm")
)
```

**Arguments**

.data	A data frame or equivalent
.tilde	A model specification as a tilde expression
family	Requested model type, if any.

---

model_plot	<i>Graph a model function</i>
------------	-------------------------------

---

**Description**

Every model has an implicit function whose output is the response variable and which has one or more explanatory variables. (Exceptionally, there might be no explanatory variables as in response ~ 1.) One of the explanatory variables can be mapped to the horizontal axis; this can be either quantitative or categorical. The remaining explanatory variables will be mapped to color, facet-horizontal, and facet-vertical. For visual clarity, any quantitative variables among these remaining variables must be coerced to categorical, corresponding to a discrete set of colors and a discrete set of facets.

**Usage**

```
model_plot(
  mod,
  nlevels = 3,
  interval = c("confidence", "prediction", "none"),
  level = 0.95,
  palette = LETTERS[1:8],
  model_ink = 0.7
)
```

**Arguments**

mod	A model object, made with <code>model_train()</code> , <code>lm()</code> , or <code>glm()</code>
nlevels	Integer. When quantitative variables need to be converted to factors for color or faceting, how many levels in those factors.
interval	The type of interval to draw (default: confidence)
level	The confidence or prediction level for the interval
palette	One of "A" through "F" giving some control for people who don't like or can't see the default palette
model_ink	The density of ink used to draw the model. ("alpha" for those in the know.)

**Value**

A ggplot graphics object

---

model_skeleton	<i>Convert a model to a skeleton</i>
----------------	--------------------------------------

---

**Description**

A "skeleton" is a data frame containing "nicely spaced" values for the explanatory variables in a model.

**Usage**

```
model_skeleton(mod, data = NULL, ncont = 3, nfirstcont = 50)
```

**Arguments**

mod	A fitted model <b>or</b> a tilde expression describing a model structure, e.g. <code>outcome ~ vara+varb</code> .
data	a data frame. Relevant only when mod is a tilde expression
ncont	minimum number of levels at which to represent continuous variables. (More levels may be added to "prettify" the choices. See <a href="#">pretty()</a> .)
nfirstcont	Like ncont, but for the first explanatory variable if it is categorical. This variable is mapped to the horizontal axis and so should have many levels to produce a smooth graph. (Default: 50)

**Value**

a data frame

**Examples**

```
Model <- CRDS |> model_train(FEV ~ sex + age + height)
Model |> model_skeleton()
```

---

model_train	<i>train a model, easily</i>
-------------	------------------------------

---

**Description**

An interface to several of the most often used model-fitting routines designed to make it easy to construct.

**Usage**

```
model_train(
  data,
  tilde,
  family = c("auto", "lm", "linear", "binomial", "poisson", "rlm")
)
```

**Arguments**

data	Data frame to use as training data
tilde	Formula for the model
family	Character string: the family of model to fit, e.g. "lm", "binomial", "poisson", "rlm", ...

**Details**

Since data may be piped into this function, the training data frame will be called simply "data", the name of the first argument to this function. In order to be able to access the training data in such cases, the training data is assigned to an attribute of the resulting model, "training\_data".

**Value**

An object of class "model\_object". This is much the same as an "lm" or "glm" object but with the additional attribute of the training data and a printing method that encourages the use of the regression summary methods `conf_interval()`, `R2()`, or `anova_summary()`

---

model_values	<i>Construct a model and return the model values</i>
--------------	--

---

**Description**

One-stop shopping to fit a model and return the model output on the training data.

**Usage**

```
model_values(data, tilde, family = c("linear", "prob", "counts"))
```

**Arguments**

data	A data frame containing the training data. When used with <code>mutate()</code> , data will hold the model specification, instead of <code>tilde</code> .
tilde	A model specification in the form of a tilde expression
family	The type of model architecture: "linear", "prob", or "counts"

**Details**

This is intended to be used ONLY WITHIN `mutate()`

**Value**

A **vector** (not a data frame) of the model evaluated on the training data. This is intended mainly for use within `mutate()`, so that a general model can be used in the place of simple reduction verbs like `mean()`, `median()`



**Examples**

```
mtcars |> mutate(mpg_mod = model_values(mpg ~ hp + wt)) |> select(hp, wt, mpg_mod) |> head()
```

---

Monocacy_river	<i>Data on run-off from the Monocacy river at Jug Bridge, Maryland.</i>
----------------	---

---

**Description**

When it rains, some of the water is absorbed into the ground or quickly evaporates. Some of the water runs off (the "runoff") and is collected by streams and rivers. These data, from a 1964 reference on water resource management, were measured after 25 storms in the basin of the Monocacy River at Jug Bridge, Maryland, US.

**Usage**

```
Monocacy_river
```

**Format**

A data.frame with 25 observations on the following 2 variables'

- precipitation: amount of rain in inches
- runoff runoff in inches

**Details**

YOU WERER HERE, COPYING from the Rd file in man/

**Source**

"Probability Concepts in Engineering" A H-S Ang and W H Tang, 2007, John Wiley based on R.K. Linsley and J.B. Franzini (1964) *Water Resources Engineering* McGraw-Hill, p.68

---

mosaic_cull_for_do	<i>Cull objects used with do()</i>
--------------------	------------------------------------

---

**Description**

The do() function facilitates easy replication for randomization tests and bootstrapping (among other things). Part of what makes this particularly useful is the ability to cull from the objects produced those elements that are useful for subsequent analysis. cull\_for\_do does this culling. It is generic, and users can add new methods to either change behavior or to handle additional classes of objects.

**Usage**

```
mosaic_cull_for_do(object, ...)
```

**Arguments**

```
object      an object to be culled
...         additional arguments (currently ignored)
```

**Details**

When `do(n) * expression` is evaluated, `expression` is evaluated `n` times to produce a list of `n` result objects. `cull_for_do` is then applied to each element of this list to extract from it the information that should be stored. For example, when applied to a object of class `"lm"`, the default `cull_for_do` extracts the coefficients, coefficient of determinism, an the estimate for the variance, etc.

**Examples**

```
Clock_auction |> model_train(price ~ resample(bidders)) |>
  R2() |> trials(times=10)
```

---

 MPG

---

*Fuel economy measurements on US car models*


---

**Description**

Fuel economy measurements on US car models

**Usage**

```
data(MPG)
```

**Format**

A `data.frame` object with one row year for each model or configuration of automobile or light truck sold in the US.

- `manufacturer`: name of company making the vehicle
- `division`: name of the company division making the vehicle
- `model`: vehicle model name
- `fuel_year`: fuel consumed in 10,000 miles (roughly 1 year.)
- `CO2_year`: Carbon dioxide produced per year, in kilograms. 10,000 miles of driving is taken to represent a year. Note, Carbon-per-year (without the oxygen) is roughly one-quarter the mass of CO2-per-year.
- `hybrid`: whether the car is a hybrid
- `class`: the type of vehicle, e.g. midsize, compact, large, SUV

- vol\_passenger: volume for passengers (cubic feet)
- vol\_luggage: volume for luggage (cubic feet)
- doors: number of passenger doors
- mpg\_city: Estimated fuel consumption in city driving (miles per gallon)
- mpg\_hwy: like mpg\_city but for highway driving
- mpg\_comb: like mpg\_city but for a standard combination of city and highway driving
- EPA\_fuel\_cost: Annual fuel cost using a standard price for gas and a standard miles per year of driving.
- valves\_exhaust: how many exhaust valves per cylinder
- valves\_intake: how many air intake valves per cylinder
- CO2city: estimate of carbon-dioxide (grams/mile) production per mile in city driving.
- CO2hwy: like CO2city but for highway driving
- CO2combined: like CO2city but for a standard mixture of city and highway driving
- hatchback: is there a hatchback rear door
- start\_stop: does the vehicle have a system to stop the engine when idling
- cyl\_deact: are cylinders in the engine deactivated when power demand warrants
- fuel: the kind of fuel used.
  - G = regular unleaded gasoline,
  - GM = mid-grade recommended,
  - GP = premium unleaded recommended,
  - GPR = premium unleaded required,
  - DU = diesel (ultra low sulfur)
- drive: type of drive, e.g. front-wheel, 4-wheel, ...
- regen: wheels with regenerative braking (for hybrids)
- n\_gears: number of transmission gears
- n\_cyl: number of engine cylinders
- displacement: engine displacement (liters)
- transmission: transmission type
  - A = automatic,
  - M = manual,
  - AM = automated manual,
  - AM = automated manual (paddles),
  - CVT = continuously variable,
  - SCV = continuously variable with selection paddles,
  - SA = semi-automatic
- lockup\_torque\_converter:
- air\_aspiration:
- model\_year:

**Source**

Data from the US Environmental Protection Agency (EPA) available at <https://www.fueleconomy.gov/feg/download.shtml>. The file for 2019 model-year vehicles is <https://www.fueleconomy.gov/feg/epadata/19data.zip>

---

Nats	<i>Short, simple data frames for textbook examples</i>
------	--

---

**Description**

These small data frames are for illustration purposes only.

- Nats made up demographic and economic data, by country and year
- Big a simplified form of the PalmerPenguin data
- Tiny an 8-row subset of Big

**Usage**

Nats

**Format**

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 8 rows and 4 columns.

---

ntiles	<i>Create vector based on roughly equally sized groups</i>
--------	--

---

**Description**

Create vector based on roughly equally sized groups

**Usage**

```
ntiles(
  x,
  n = 3,
  format = c("rank", "interval", "mean", "median", "center", "left", "right"),
  digits = 3
)
```

**Arguments**

<code>x</code>	a numeric vector
<code>n</code>	(approximate) number of quantiles
<code>format</code>	a specification of desired output format. One of "center", "interval", "left", "right", "mean", or "median."
<code>digits</code>	desired number of digits for labeling of factors.

**Details**

This is a functional clone of `mosaic::ntiles` in order to avoid the dependency. It should be removed in the future, when there is no need to avoid such dependency, e.g. when `{mosaic}` is available on WASM.

**Value**

a vector. The type of vector will depend on format.

**Examples**

```
CRDS |> head(20) |> mutate(group = ntiles(height, 3, format="center"))
CRDS |> head(20) |> mutate(group = ntiles(height, 3, format="interval"))
```

---

 Offspring

*Relative sizes offspring/parent for many species*


---

**Description**

Body mass of adult of numerous vertebrate species and newly hatched or born offspring.

**Usage**

```
data("Offspring")
```

**Format**

A data.frame with 3971 rows, each for a different species

- species
- class (phylogenetic class)
- group (phylogenetic group)
- adult Mass of the adult (female) in grams.
- hatchling Mass of the offspring, in grams. This applies as well to species where the offspring is born rather than hatched.

**Source**

Shai Meiri, "Endothermy, offspring size and evolution of parental provisioning in vertebrates", *Biological Journal of the Linnean Society*, **128**:4, pp. 1052-6 (See Appendix S1.)

---

Orings

*Space Shuttle O-Ring Failures*

---

### Description

On January 27, 1986, the night before the space shuttle *Challenger* exploded, an engineer recommended to the National Aeronautics and Space Administration (NASA) that the shuttle not be launched in the cold weather. The forecasted temperature for the *Challenger* launch was 31 degrees Fahrenheit—the coldest launch ever. After an intense 3-hour telephone conference, officials decided to proceed with the launch. This data frame contains the launch temperatures and the number of O-ring problems in 24 shuttle launches prior to the *Challenger*. (This documentation comes from the Sleuth3 package, where the dataset is called ex2223.)

### Usage

```
data(Orings)
```

### Format

A data frame with 24 observations on the following 2 variables.

- temp Launch temperatures (in degrees Fahrenheit)
- incidents Numbers of O-ring incidents

### Source

Ramsey, F.L. and Schafer, D.W. (2013). *The Statistical Sleuth: A Course in Methods of Data Analysis (3rd ed)*, Cengage Learning.

---

Penguins

*Body measurements on penguins*

---

### Description

This is the palmerpenguins::penguins data frame with slightly simplified variable names.

### Usage

```
Penguins
```

### Format

An object of class tbl\_df (inherits from tbl, data.frame) with 333 rows and 8 columns.

**Description**

"The population for this study was the Pima Indian population near Phoenix, Arizona. That population has been under continuous study since 1965 by the National Institute of Diabetes and Digestive and Kidney Diseases because of its high incidence rate of diabetes. Each community resident over 5 years of age was asked to undergo a standardized examination every two years, which included an oral glucose tolerance test. Diabetes was diagnosed according to World Health Organization Criteria; that is, if the 2 hour post-load plasma glucose was at least 200 mg/dl (11.1 mmol/l) at any survey examination or if the Indian Health Service Hospital serving the community found a glucose concentration of at least 200 mg/dl during the course of routine medical care." — quoted from the reference below. The data were published by Kaggle for a machine-learning competition whose goal was to develop a prediction function for diabetes.

**Usage**

```
data(PIDD)
```

**Format**

768 rows, each of which is a woman 21 years or older. There are 9 variables:

- age of the woman
- pregnancies: number of previous pregnancies
- glucose: glucose level
- BP: systolic blood pressure
- skin\_thickness:
- insulin:
- bmi: Body mass index
- pedigree: "Diabetes Pedigree Function"
- diabetes: Did the patient develop diabetes during a 5-year follow-up?

**Source**

[Kaggle](#)

**References**

Smith, J.W., Everhart, J.E., Dickson, W.C., Knowler, W.C., & Johannes, R.S. (1988) "Using the ADAP learning algorithm to forecast the onset of diabetes mellitus" *Proceedings of the Symposium on Computer Applications and Medical Care*

point\_plot

*One-step data graphics***Description**

point\_plot() makes it easy to construct an informative basic graph of a data frame. "Making it easy" means that the user only needs to specify two things: 1) the data frame to be used and 2) a tilde expression with the response variable on the left and up to three explanatory variables on the right. The response variable is mapped to the vertical axis while the first explanatory variable defines the horizontal axis. The second explanatory variable (if any) maps to color, the third (if any) defines facets. Quantitative variables used for color or faceting are cut into categorical variables, so color and facets will always be discrete.

**Usage**

```
point_plot(
  D,
  tilde,
  ...,
  seed = 101,
  annot = c("none", "violin", "model", "bw"),
  jitter = c("default", "none", "all", "x", "y"),
  interval = c("confidence", "none", "prediction"),
  point_ink = 0.5,
  model_ink = 0.4,
  palette = LETTERS[1:8],
  bw = NULL,
  level = 0.95,
  nx = 50,
  model_family = NULL
)
```

**Arguments**

D	a data frame
tilde	tilde expression specifying $y \sim x$ or $y \sim x + \text{color}$
seed	(optional) random seed for jittering
annot	Statistical annotation (one of "none", "violin", "model", "bw")
jitter	Options for turning on jitter: one of "default", "both", "none", "x", "y". By default, By default, categorical variables are jittered.
interval	the type of interval: default "confidence". Others: "none" or "prediction"
point_ink	Opacity of ink for the data points
model_ink	Opacity of ink for the model annotation
palette	Depending on taste and visual capabilities, some people might prefer to alter the color scheme. There are 8 palettes available: "A" through "H".



bw	bandwidth for violin plot
level	confidence level to use (0.95)
nx	Number of places to evaluate any x-axis quantitative vars. Default 50. Use higher if graph isn't smooth enough.
model_family	Override the default model type. See model_train()
...	Graphical options for the data points, labels, e.g. size

### Details

When an x- or y- variables is categorical, jittering is automatically applied.

Using `annot = "model"` will annotate the data with the graph of a model — shown as confidence intervals/bands — corresponding to the tilde expression. `annot = "violin"` will annotate with a violin plot.

If you want to use the same explanatory variable for color and faceting (this might have pedagogical purposes) merely repeat the name of the color variable in the faceting position, e.g. `mpg ~ hp + cyl + cyl`.

### Value

A ggplot graphics object

### See Also

`add_plot_labels` to add labels to the plot (without needing the `ggplot2 + pipe`)

### Examples

```
mosaicData::Galton |> point_plot(height ~ mother + sex + father, annot="model", model_ink=1)
mtcars |> point_plot(mpg ~ wt + cyl)
mtcars |> point_plot(mpg ~ wt + cyl + hp, annot="model")
```

---

print.datasim                      *Nice printing of some internal objects*

---

### Description

Nice printing of some internal objects

### Usage

```
## S3 method for class 'datasim'
print(x, ..., report_hidden = FALSE)
```

### Arguments

x	A data simulation as made by <code>datasim_make()</code>
report_hidden	Show the hidden nodes (nodes whose name begins with <code>.</code> )
...	for compatibility with generic <code>print()</code>

---

`print.model_object`      *A printing method for model objects*

---

**Description**

A printing method for model objects

**Usage**

```
## S3 method for class 'model_object'
print(x, ...)
```

**Arguments**

<code>x</code>	The object to print
<code>...</code>	Not used, but here for consistency with generic <code>print()</code>

---

`random_terms`      *Create columns with random numbers for modeling*

---

**Description**

For demonstration purposes, add the specified number of random columns to a model matrix. This is intended to be used in modeling functions, e.g. `model_train()`, `lm()`, and so on to explore the extent to which random columns "explain" the response variable.

**Usage**

```
random_terms(df = 1, rdist = rnorm, args = list(), n, seed = NULL)
```

**Arguments**

<code>df</code>	How many columns to add
<code>rdist</code>	Function to generate each column's numbers (default: <code>rnorm</code> )
<code>args</code>	A list holding the parameters (if any) to be used for the <code>rdist</code> argument
<code>n</code>	OPTIONALLY, dictate the number of rows in the output
<code>seed</code>	Integer seed for the random-number generator

**Details**

`random_terms()` will try to guess a suitable value for `n` based on the calling function.

**Examples**

```
mtcars |> model_train(mpg ~ wt + random_terms(4)) |> conf_interval()
mtcars |> model_train(mpg ~ wt + random_terms(4)) |> anova_summary()
head(mtcars) |> select(wt, mpg) |> mutate(r = random_terms(3))
```

---

Registrar

*Sample from a college registrar's database*

---

**Description**

Grade data from students at a liberal arts college. IDs of students, professors, and departments have been dis-identified.

**Usage**

Sessions

Grades

Gradepoint

**Format**

Three data frames

- Sessions: ID for a class session, that is, a course in a semester
  - sessionID: Unique identifier for the session
  - iid: Unique identifier for the instructor
  - enroll: Total enrollment in the session (note: includes students who didn't make it into the sample in Grades)
  - dept: Unique identifier for the department
  - level: Instruction evel of the course 100, 200, 300, 400. Roughly: first-year, sophomore, junior, senior
  - sem: The semester in which the session was held.
- Grades: A 50% random sample of student-by-student grades in those Sessions
  - sid: Unique identifier or the student.
  - grade: Letter grade: A, A-, B+ and so on,
  - sessionID: The course session for the grade, as in the Sessions data frame
- Gradepoint: Letter to numerical conversion (per college policy)
  - grade: Letter grade: A, A-, and so on
  - gradepoint: Numerical equivalent

An object of class `data.frame` with 6124 rows and 3 columns.

An object of class `grouped_df` (inherits from `tbl_df`, `tbl`, `data.frame`) with 14 rows and 2 columns.

**Source**

Used with permission by the college's registrar.

---

Shipping_losses	<i>Shipping losses in 1941 in the Atlantic</i>
-----------------	--

---

**Description**

A major theater of action in World War II was the Atlantic ocean. Germany attempted through submarine and aerial attacks to sink shipping supplying Britain through the war. This table summarizes the losses in 1941.

**Usage**

```
data(Shipping_losses)
```

**Format**

12 rows, one for each month of 1941

- month
- nships number of ships sunk
- tons gross tonnage of the ships sunk. This includes both the ship and the cargo.
- country whether the ships were British, or belonged to Allied or Neutral countries.

**Source**

From W.S. Churchill (1952) *The Grand Alliance* a history of the Second World War. Houghton Mifflin Co. Boston. p. 782

---

sim_objects	<i>Simulations for use in Lessons in Statistical Thinking</i>
-------------	---

---

**Description**

These datasim objects are provided.

**Usage**

```
sim_00
```

```
sim_01
```

```
sim_02
```

```
sim_03
```

```
sim_04
```

*sim\_05*

*sim\_06*

*sim\_07*

*sim\_08*

*sim\_09*

*sim\_10*

*sim\_11*

*sim\_12*

*sim\_flights*

*sim\_medical\_observations*

*sim\_prob\_21.1*

*sim\_satgpa*

*sim\_school1*

*sim\_school2*

*sim\_vaccine*

**Format**

An object of class *list* (inherits from *datasim*) of length 2.

An object of class *list* (inherits from *datasim*) of length 2.

An object of class *list* (inherits from *datasim*) of length 2.

An object of class *list* (inherits from *datasim*) of length 2.

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An object of class *list* (inherits from *datasim*) of length 2.

An object of class *list* (inherits from *datasim*) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

An object of class `list` (inherits from `datasim`) of length 2.

### Details

They are defined in the `sim_library.R` file in `inst/`

---

<code>split_tilde</code>	<i>Evaluate a tilde expression on a data frame</i>
--------------------------	--

---

### Description

Evaluate a tilde expression on a data frame

### Usage

```
split_tilde(tilde)
```

### Arguments

<code>tilde</code>	A two-sided tilde expression used for model specification
--------------------	---

---

STAR	<i>STAR Project Data</i>
------	--------------------------

---

### Description

Data from the STAR (Student–Teacher Achievement Ratio) Project, a four-year longitudinal study examining the effect of class size in early grade levels on educational performance and personal development

### Usage

```
data("STAR")
```

**Format**

A data frame with 6325 rows and 6 variables:

- race: black or white
- classtype: kindergarten class type: small, regular, regular with aid
- yearssmall: number of years (0 to 4) in small classes
- hsgrad: high-school graduation (graduated or not). NOTE: There are many NAs
- g4math: total scaled score for the math portion of the fourth-grade standardized test
- g4reading: total scaled score for the reading portion of the fourth-grade standardized test

**References**

- Imai, Kosuke. 2017. Quantitative Social Science: An Introduction. Princeton University Press. [URL](#) from whence these data were added to this package.
- Mosteller, Frederick. 1997. "The Tennessee Study of Class Size in the Early School Grades." Bulletin of the American Academy of Arts and Sciences 50(7): 14-25. doi = 10.2307/3824562

---

take\_sample

*Samples from various kinds of objects*

---

**Description**

A set of methods to generate random samples from data frames and data simulations. For data frames, individual rows are sampled. For vectors, elements are sampled.

**Usage**

```
take_sample(x, n, replace = FALSE, ...)
```

```
## Default S3 method:
```

```
take_sample(  
  x,  
  n = length(x),  
  replace = FALSE,  
  prob = NULL,  
  .by = NULL,  
  groups = .by,  
  orig.ids = FALSE,  
  ...  
)
```

```
resample(..., replace = TRUE)
```

**Arguments**

x	The object from which to sample
n	Size of the sample.
replace	Logical flag: whether to sample with replacement. (default: FALSE)
prob	Probabilities to use for sampling, one for each element of x
.by	Variables to use to define groups for sampling, as in {dplyr}. The sample size applies to each group.
groups	Variable indicating blocks to sample within
orig.ids	Logical. If TRUE, append a column named "orig.ids" with the row from the original x that the same came from.
...	Arguments to pass along to specific sample methods.

**Details**

These are based in spirit on the sample functions in the {mosaic} package, but are redefined here to 1) avoid a dependency on {mosaic} and 2) bring the arguments in line with the .by = features of {dplyr}.

**Value**

A vector or a data frame depending on the nature of the x argument.

**Examples**

```
take_sample(sim_03, n=5) # run a simulation
take_sample(Clock_auction, n = 3) # from a data frame
take_sample(1:6, n = 6) # sample from a vector
```

---

trials

---

*Run the left side of the pipeline multiple times.*


---

**Description**

Write a pipeline to perform some calculation whose result can be coerced into one line of a data frame. Add `trials(times=3)` to the end of the pipeline in order to repeat the calculation multiple times. Typically, each trial involves some random component, but another (or an additional) capability is to parameterize the pipeline expression by including some unbound variable in it, e.g. `lambda`. Then call `trials(lambda=c(10,20))` to repeat the calculation for each of the elements of the named parameter.

**Usage**

```
trials(.ex, times = 1, ...)
```



**Arguments**

<code>.ex</code>	(Not user-facing.) The left side of the pipeline.
<code>times</code>	The number of times to run the trial.
<code>...</code>	Values for any unbound parameter in the left side of the pipeline. If a vector of length $> 1$ , the trials will be run separately for each element of the vector.

**Details**

This is intended as a pipeline friendly replacement for `mosaic::do()`.

**Value**

a dataframe with one row for each trial. (But see the `...` argument.)

**Examples**

```
mean(rnorm(10)) |> trials(times=3)
mean(rnorm(lambda)) |> trials(lambda=c(1, 100, 10000))
mean(rnorm(lambda)) |> trials(times=5, lambda=c(1, 100, 10000))
take_sample(mtcars, n=lambda, replace=TRUE) |> select(mpg, hp) |>
  model_train(mpg ~ resample(hp)) |>
  regression_summary() |> trials(times=3, lambda=c(10, 20, 40)) |>
  filter(term == "resample(hp)")
```

---

 UCB\_applicants

*Roster of applicants to six major departments at UC Berkeley*


---

**Description**

Roster of applicants to six major departments at UC Berkeley

**Usage**

```
data(UCB_applicants)
```

**Format**

A data.frame object with 4236 rows, one for each of the applicants to graduate school at UC Berkeley for the Fall 1973 quarter.

- `admit`: Whether the applicant was admitted.
- `gender`: male or female
- `dept`: The graduate department applied to. Rather than identifying the actual departments involved, the data released by Berkeley used letter codes.

**Details**

In 1973, officials at the University of California Berkeley noticed disturbing trends in graduate admissions rates. The data, with department names redacted, was presented and interpreted in a famous paper in *Science*, Bickel et al. 1975. In that paper, summary tables were presented. UCB\_applicants was reverse engineered from datasets::UCBAdmissions into a data table where the unit of observation is an individual applicant. The origin of datasets::UCBAdmissions is not clear; those data are not explicitly provided in Bickel et al.

**Source**

The UCBAApplicants summary table in the datasets R package.

**References**

Bickel, P. J., Hammel, E. A., and O'Connell, J. W. (1975). Sex bias in graduate admissions: Data from Berkeley. *Science*, 187, 398–403.

---

US\_wildfires

*Monthly tallies of wildfires in the US from 2000 to 2022*

---

**Description**

Records for each month of wildfires in the US.

**Usage**

data(AAUP)

**Format**

275 rows, each of which is a month

- date The year and month in a format that can be easily plotted
- area: total area burned by the wildfires in that month (acres)
- number: the number of wildfires in that month
- month: for convenience, the month (Jan, Feb, ..., Dec) as an ordered factor.

**Source**

USGS

---

Wheat	<i>Experimental data on the yield of winter wheat</i>
-------	---

---

**Description**

In the experiment, eight different varieties of winter wheat were planted in each of 7 calendar years (1996-2002). Each genotype was assigned randomly to a plot within a block.

**Usage**

```
data("Wheat")
```

**Format**

A data.frame with 240 rows

- genotype The type of wheat.
- yield of the wheat from this plot
- block Major region of the field
- plot Subdivision of block in which the wheat was planted
- year of the planting and measurement

**Source**

Andrea Onofri "[Repeated measures with perennial crops](#)"

---

zero_one	<i>Zero-one transformation for categorical variable</i>
----------	---

---

**Description**

A convenience function for handling categorical response variables. Ordinarily, ggplot2 maps categorical levels to numerical values 1, 2, .... Such numerical mapping is inappropriate for logistic modeling, where we want the levels to be on a probability scale.

**Usage**

```
zero_one(x, one)
```

```
label_zero_one(P)
```

**Arguments**

- |     |   |
|-----|---|
| x   | a categorical variable  |
| one | character string specifying the level that gets mapped to 1.                    |
| P   | A ggplot2 object made by <code>model_plot()</code> or <code>point_plot()</code> |

**Value**

A numerical vector of 0s and 1s.

**Examples**

```
Birdkeepers |>  
  point_plot(zero_one(LC, one="LungCancer") ~ AG + BK, annot = "model")
```

```
Birdkeepers |>  
  mutate(Condition = zero_one(LC, one = "LungCancer")) |>  
  point_plot(Condition ~ AG + BK, annot = "model") |>  
  label_zero_one() |>  
  add_plot_labels(x="age", color = "Birdkeeper?")
```

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