

# The Data Frame Reference Manual

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Data frames for Common Lisp, version 1.0.0

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## Copying

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# 1 Systems

The main system appears first, followed by any subsystem dependency.

## 1.1 data-frame

A data manipulation library for statistical computing

### Long Name

Data frames for Common Lisp

**Author** Steve Nunez <steve@symbolics.tech>

### Home Page

<https://lisp-stat.dev/docs/manuals/data-frame>

### Source Control

(GIT <https://github.com/Lisp-Stat/data-frame.git>)

### Bug Tracker

<https://github.com/Lisp-Stat/data-frame/issues>

**License** MS-PL

### Long Description

A data frame is a common way of storing data for statistical analysis. Under the hood, a data frame is a vector of equal-length vectors. Each element of the vector can be thought of as a column and the length of each element of the vector is the number of rows. As a result, data frames can store different classes of objects in each column (i.e. numeric, character, factor). In essence, the easiest way to think of a data frame is as an Excel worksheet that contains columns of different types of data but are all of equal length rows.

From a design perspective, Lisp-Stat's data frame is conceptually most similar to the 'tibble' from the tidyverse, but using Common Lisp idioms, style and syntax.

**Version** 1.0.0

### Dependencies

- alexandria (system).
- alexandria+ (system).
- anaphora (system).
- array-operations (system).
- num-utils (system).
- select (system).
- let-plus (system).
- duologue (system).

**Source** [data-frame.asd], page 5.

### Child Components

- [pkgdcl.lisp], page 5 (file).
- [utils.lisp], page 5 (file).
- [conditions.lisp], page 5 (file).
- [data-frame.lisp], page 6 (file).
- [pprint.lisp], page 8 (file).

- `[formatted-output.lisp]`, page 8 (file).
- `[summary.lisp]`, page 9 (file).
- `[defdf.lisp]`, page 10 (file).
- `[properties.lisp]`, page 11 (file).
- `[missing.lisp]`, page 11 (file).
- `[filter.lisp]`, page 11 (file).



## 2 Files

Files are sorted by type and then listed depth-first from the systems components trees.

### 2.1 Lisp

#### 2.1.1 data-frame/data-frame.asd

**Source** [data-frame.asd], page 5.

**Parent Component**  
[data-frame], page 3 (system).

**ASDF Systems**  
[data-frame], page 3.

#### 2.1.2 data-frame/pkgdcl.lisp

**Source** [data-frame.asd], page 5.

**Parent Component**  
[data-frame], page 3 (system).

**Packages** [data-frame], page 13.

#### 2.1.3 data-frame/utils.lisp

**Dependency**  
[pkgdcl.lisp], page 5 (file).

**Source** [data-frame.asd], page 5.

**Parent Component**  
[data-frame], page 3 (system).

**Public Interface**

- [column-type], page 21 (function).
- [delete-nth], page 21 (function).
- [delete-nth\*], page 20 (macro).

**Internals**

- [get-type], page 38 (function).
- [types-in-column], page 43 (function).

#### 2.1.4 data-frame/conditions.lisp

**Dependency**  
[utils.lisp], page 5 (file).

**Source** [data-frame.asd], page 5.

**Parent Component**  
[data-frame], page 3 (system).

**Public Interface**

- [data-frame], page 26 (reader method).
- [duplicate-key], page 30 (condition).
- [key-not-found], page 30 (condition).

- [large-data], page 31 (condition).

### Internals

- [data-frame-exists], page 45 (condition).
- [data-size], page 45 (reader method).
- [df-exists-p], page 37 (function).
- [invalid-df-name], page 39 (function).
- [missing-data], page 45 (condition).

## 2.1.5 data-frame/data-frame.lisp

### Dependency

[conditions.lisp], page 5 (file).

### Source

[data-frame.asd], page 5.

### Parent Component

[data-frame], page 3 (system).

### Public Interface

- [\*large-data\*], page 19 (special variable).
- [add-column!], page 20 (function).
- [add-columns], page 20 (function).
- [add-columns!], page 20 (function).
- [alist-df], page 20 (function).
- [alist-dv], page 20 (function).
- [as-alist], page 28 (method).
- [as-array], page 28 (method).
- [as-array], page 29 (method).
- [axis-dimension], page 29 (method).
- [canonical-representation], page 29 (method).
- [column], page 20 (function).
- [(setf column)], page 21 (function).
- [column-names], page 21 (function).
- [columns], page 21 (function).
- [copy], page 21 (function).
- [count-rows], page 21 (function).
- [data-frame], page 33 (class).
- [data-type], page 34 (type).
- [data-vector], page 34 (class).
- [describe-object], page 29 (method).
- [df], page 22 (function).
- [df-remove-duplicates], page 22 (function).
- [dims], page 29 (method).
- [dms], page 29 (method).
- [do-rows], page 22 (function).
- [dv], page 22 (function).
- [element-type], page 29 (method).

- `[initialize-instance]`, page 29 (method).
- `[keys]`, page 23 (function).
- `[make-df]`, page 23 (function).
- `[make-dv]`, page 23 (function).
- `[map-columns]`, page 23 (function).
- `[map-df]`, page 24 (function).
- `[map-rows]`, page 24 (function).
- `[mask-rows]`, page 24 (function).
- `[matrix-df]`, page 24 (function).
- `[name]`, page 28 (reader method).
- `[(setf name)]`, page 28 (writer method).
- `[ncol]`, page 29 (method).
- `[nrow]`, page 29 (method).
- `[plist-df]`, page 24 (function).
- `[plist-dv]`, page 24 (function).
- `[print-object]`, page 29 (method).
- `[print-object]`, page 29 (method).
- `[print-object]`, page 30 (method).
- `[remove-column!]`, page 25 (function).
- `[remove-columns]`, page 25 (function).
- `[rename-column!]`, page 28 (method).
- `[replace-column]`, page 25 (function).
- `[replace-column!]`, page 25 (function).
- `[rows]`, page 25 (function).
- `[select]`, page 30 (method).
- `[select]`, page 30 (method).
- `[select]`, page 30 (method).

## Internals

- `[add-key!]`, page 35 (function).
- `[add-keys]`, page 35 (function).
- `[alist-data]`, page 35 (function).
- `[check-column-compatibility]`, page 44 (generic function).
- `[copy-ordered-keys]`, page 36 (function).
- `[data]`, page 47 (class).
- `[define-data-subclass]`, page 35 (macro).
- `[df-env-p]`, page 36 (function).
- `[ensure-arguments-alist]`, page 37 (function).
- `[key-index]`, page 39 (function).
- `[keys-count]`, page 39 (function).
- `[keys-vector]`, page 39 (function).
- `[make-data]`, page 39 (function).
- `[make-ordered-keys]`, page 40 (function).

- [ordered-keys], page 40 (function).
- [ordered-keys], page 46 (structure).
- [ordered-keys-p], page 40 (function).
- [ordered-keys-table], page 40 (reader).
- [plist-data], page 41 (function).
- [remove-columns!], page 42 (function).
- [remove-key!], page 42 (function).

### 2.1.6 data-frame/pprint.lisp

#### Dependency

[data-frame.lisp], page 6 (file).

**Source** [data-frame.asd], page 5.

#### Parent Component

[data-frame], page 3 (system).

#### Public Interface

- [head], page 27 (method).
- [print-array], page 24 (function).
- [print-data], page 24 (function).
- [short-string], page 26 (function).
- [tail], page 28 (method).

#### Internals

- [\*max-digits\*], page 34 (special variable).
- [\*row-numbers-p\*], page 34 (special variable).
- [2d-array-to-list], page 35 (function).
- [column-type-format], page 36 (function).
- [default-column-formats], page 45 (method).
- [max-decimal], page 40 (function).
- [max-width], page 40 (function).
- [printer-status], page 41 (function).
- [reverse-df], page 43 (function).

### 2.1.7 data-frame/formatted-output.lisp

#### Dependency

[pprint.lisp], page 8 (file).

**Source** [data-frame.asd], page 5.

#### Parent Component

[data-frame], page 3 (system).

#### Public Interface

- [df-print], page 22 (function).
- [print-markdown], page 24 (function).

#### Internals

- [aesthetic-string], page 35 (function).
- [print-table], page 41 (function).
- [weave], page 44 (function).

## 2.1.8 data-frame/summary.lisp

### Dependency

[formatted-output.lisp], page 8 (file).

### Source

[data-frame.asd], page 5.

### Parent Component

[data-frame], page 3 (system).

### Public Interface

- [\*distinct-maximum\*], page 19 (special variable).
- [\*distinct-threshold\*], page 19 (special variable).
- [\*quantile-threshold\*], page 19 (special variable).
- [\*summary-minimum-length\*], page 19 (special variable).
- [bit-variable-summary], page 31 (structure).
- [factor-variable-summary], page 31 (structure).
- [generic-variable-summary], page 32 (structure).
- [get-summaries], page 23 (function).
- [print-object], page 29 (method).
- [print-object], page 30 (method).
- [print-object], page 30 (method).
- [print-object], page 30 (method).
- [real-variable-summary], page 32 (structure).
- [summarize-column], page 26 (function).
- [summary], page 26 (function).

### Internals

- [bit-variable-summary-count], page 35 (reader).
- [bit-variable-summary-desc], page 35 (function).
- [bit-variable-summary-length], page 35 (function).
- [bit-variable-summary-missing], page 36 (function).
- [bit-variable-summary-name], page 36 (function).
- [bit-variable-summary-p], page 36 (function).
- [column-length], page 44 (generic function).
- [copy-bit-variable-summary], page 36 (function).
- [copy-factor-variable-summary], page 36 (function).
- [copy-generic-variable-summary], page 36 (function).
- [copy-real-variable-summary], page 36 (function).
- [copy-variable-summary%], page 36 (function).
- [distinct], page 37 (function).
- [ensure-not-ratio], page 37 (function).
- [factor-variable-summary-desc], page 37 (function).
- [factor-variable-summary-element-count-alist], page 37 (reader).
- [factor-variable-summary-length], page 37 (function).
- [factor-variable-summary-missing], page 37 (function).
- [factor-variable-summary-name], page 38 (function).

- [factor-variable-summary-p], page 38 (function).
- [generic-variable-summary-desc], page 38 (function).
- [generic-variable-summary-element-count-alist], page 38 (reader).
- [generic-variable-summary-length], page 38 (function).
- [generic-variable-summary-missing], page 38 (function).
- [generic-variable-summary-name], page 38 (function).
- [generic-variable-summary-p], page 38 (function).
- [generic-variable-summary-quantiles], page 38 (reader).
- [make-bit-variable-summary], page 39 (function).
- [make-factor-variable-summary], page 39 (function).
- [make-generic-variable-summary], page 39 (function).
- [make-real-variable-summary], page 40 (function).
- [make-variable-summary%], page 40 (function).
- [monotonicp], page 40 (function).
- [print-count-and-percentage], page 41 (function).
- [real-variable-summary-desc], page 41 (function).
- [real-variable-summary-length], page 41 (function).
- [real-variable-summary-max], page 41 (reader).
- [real-variable-summary-mean], page 41 (reader).
- [real-variable-summary-min], page 42 (reader).
- [real-variable-summary-missing], page 42 (function).
- [real-variable-summary-name], page 42 (function).
- [real-variable-summary-p], page 42 (function).
- [real-variable-summary-q25], page 42 (reader).
- [real-variable-summary-q50], page 42 (reader).
- [real-variable-summary-q75], page 42 (reader).
- [summarize-factor-variable], page 43 (function).
- [summarize-generic-variable], page 43 (function).
- [summarize-real-variable], page 43 (function).
- [variable-summary%], page 46 (structure).
- [variable-summary%-desc], page 43 (reader).
- [variable-summary%-length], page 44 (reader).
- [variable-summary%-missing], page 44 (reader).
- [variable-summary%-name], page 44 (reader).
- [variable-summary%-p], page 44 (function).

### 2.1.9 data-frame/defdf.lisp

#### Dependency

[summary.lisp], page 9 (file).

#### Source

[data-frame.asd], page 5.

#### Parent Component

[data-frame], page 3 (system).

**Public Interface**

- [`*ask-on-redefine*`], page 19 (special variable).
- [`defdf`], page 20 (macro).
- [`defdf-env`], page 21 (function).
- [`show-data-frames`], page 26 (function).
- [`undef`], page 26 (function).

**Internals**

- [`*data-frames*`], page 34 (special variable).
- [`show-symbols`], page 43 (function).

**2.1.10 data-frame/properties.lisp****Dependency**

[`defdf.lisp`], page 10 (file).

**Source**      [`data-frame.asd`], page 5.

**Parent Component**

[`data-frame`], page 3 (system).

**Public Interface**

- [`get-property`], page 23 (function).
- [`heuristicate-types`], page 23 (function).
- [`set-properties`], page 25 (function).
- [`set-property`], page 26 (function).

**Internals**    [`show-properties`], page 43 (function).

**2.1.11 data-frame/missing.lisp****Dependency**

[`properties.lisp`], page 11 (file).

**Source**      [`data-frame.asd`], page 5.

**Parent Component**

[`data-frame`], page 3 (system).

**Public Interface**

- [`drop-missing`], page 27 (method).
- [`drop-missing`], page 27 (method).
- [`ignore-missing`], page 23 (function).
- [`missingp`], page 27 (generic function).
- [`replace-missing`], page 28 (method).

**Internals**    [`drop-na`], page 37 (function).

**2.1.12 data-frame/filter.lisp****Dependency**

[`missing.lisp`], page 11 (file).

**Source**      [`data-frame.asd`], page 5.

**Parent Component**

[`data-frame`], page 3 (system).

**Public Interface**

[`filter-rows`], page 22 (function).

**Internals**    [`key-list`], page 39 (function).



## 3 Packages

Packages are listed by definition order.

### 3.1 data-frame

**Source** [pkgdcl.lisp], page 5.

**Nickname** df

#### Use List

- alexandria.
- alexandria+.
- anaphora.
- common-lisp.
- let-plus.
- select.
- select-dev.

#### Used By List

- dfio.
- lisp-stat.

#### Public Interface

- [\*ask-on-redefine\*], page 19 (special variable).
- [\*distinct-maximum\*], page 19 (special variable).
- [\*distinct-threshold\*], page 19 (special variable).
- [\*large-data\*], page 19 (special variable).
- [\*quantile-threshold\*], page 19 (special variable).
- [\*summary-minimum-length\*], page 19 (special variable).
- [add-column!], page 20 (function).
- [add-columns], page 20 (function).
- [add-columns!], page 20 (function).
- [alist-df], page 20 (function).
- [alist-dv], page 20 (function).
- [bit-variable-summary], page 31 (structure).
- [column], page 20 (function).
- [(setf column)], page 21 (function).
- [column-names], page 21 (function).
- [column-type], page 21 (function).
- [columns], page 21 (function).
- [copy], page 21 (function).
- [count-rows], page 21 (function).
- [data-frame], page 26 (generic reader).
- [data-frame], page 33 (class).
- [data-type], page 34 (type).
- [data-vector], page 34 (class).

- [defdf], page 20 (macro).
- [defdf-env], page 21 (function).
- [delete-nth], page 21 (function).
- [delete-nth\*], page 20 (macro).
- [df], page 22 (function).
- [df-print], page 22 (function).
- [df-remove-duplicates], page 22 (function).
- [do-rows], page 22 (function).
- [drop-missing], page 27 (generic function).
- [duplicate-key], page 30 (condition).
- [dv], page 22 (function).
- [factor-variable-summary], page 31 (structure).
- [filter-rows], page 22 (function).
- [generic-variable-summary], page 32 (structure).
- [get-property], page 23 (function).
- [get-summaries], page 23 (function).
- [head], page 27 (generic function).
- [heuristicate-types], page 23 (function).
- [ignore-missing], page 23 (function).
- [key-not-found], page 30 (condition).
- [keys], page 23 (function).
- [large-data], page 31 (condition).
- [make-df], page 23 (function).
- [make-dv], page 23 (function).
- [map-columns], page 23 (function).
- [map-df], page 24 (function).
- [map-rows], page 24 (function).
- [mask-rows], page 24 (function).
- [matrix-df], page 24 (function).
- [missingp], page 27 (generic function).
- [name], page 27 (generic reader).
- [(setf name)], page 27 (generic writer).
- [plist-df], page 24 (function).
- [plist-dv], page 24 (function).
- [print-array], page 24 (function).
- [print-data], page 24 (function).
- [print-markdown], page 24 (function).
- [real-variable-summary], page 32 (structure).
- [remove-column!], page 25 (function).
- [remove-columns], page 25 (function).
- [rename-column!], page 28 (generic function).
- [replace-column], page 25 (function).
- [replace-column!], page 25 (function).

- `[replace-missing]`, page 28 (generic function).
- `[rows]`, page 25 (function).
- `[set-properties]`, page 25 (function).
- `[set-property]`, page 26 (function).
- `[short-string]`, page 26 (function).
- `[show-data-frames]`, page 26 (function).
- `[summarize-column]`, page 26 (function).
- `[summary]`, page 26 (function).
- `[tail]`, page 28 (generic function).
- `[undef]`, page 26 (function).

### Internals

- `[*data-frames*]`, page 34 (special variable).
- `[*max-digits*]`, page 34 (special variable).
- `[*row-numbers-p*]`, page 34 (special variable).
- `[2d-array-to-list]`, page 35 (function).
- `[add-key!]`, page 35 (function).
- `[add-keys]`, page 35 (function).
- `[aesthetic-string]`, page 35 (function).
- `[alist-data]`, page 35 (function).
- `[bit-variable-summary-count]`, page 35 (reader).
- `[bit-variable-summary-desc]`, page 35 (function).
- `[bit-variable-summary-length]`, page 35 (function).
- `[bit-variable-summary-missing]`, page 36 (function).
- `[bit-variable-summary-name]`, page 36 (function).
- `[bit-variable-summary-p]`, page 36 (function).
- `[check-column-compatibility]`, page 44 (generic function).
- `[column-length]`, page 44 (generic function).
- `[column-type-format]`, page 36 (function).
- `[copy-bit-variable-summary]`, page 36 (function).
- `[copy-factor-variable-summary]`, page 36 (function).
- `[copy-generic-variable-summary]`, page 36 (function).
- `[copy-ordered-keys]`, page 36 (function).
- `[copy-real-variable-summary]`, page 36 (function).
- `[copy-variable-summary%]`, page 36 (function).
- `[data]`, page 47 (class).
- `[data-frame-exists]`, page 45 (condition).
- `[data-size]`, page 45 (generic reader).
- `[default-column-formats]`, page 45 (generic function).
- `[define-data-subclass]`, page 35 (macro).
- `[df-env-p]`, page 36 (function).
- `[df-exists-p]`, page 37 (function).
- `[distinct]`, page 37 (function).

- [drop-na], page 37 (function).
- [ensure-arguments-alist], page 37 (function).
- [ensure-not-ratio], page 37 (function).
- [factor-variable-summary-desc], page 37 (function).
- [factor-variable-summary-element-count-alist], page 37 (reader).
- [factor-variable-summary-length], page 37 (function).
- [factor-variable-summary-missing], page 37 (function).
- [factor-variable-summary-name], page 38 (function).
- [factor-variable-summary-p], page 38 (function).
- [generic-variable-summary-desc], page 38 (function).
- [generic-variable-summary-element-count-alist], page 38 (reader).
- [generic-variable-summary-length], page 38 (function).
- [generic-variable-summary-missing], page 38 (function).
- [generic-variable-summary-name], page 38 (function).
- [generic-variable-summary-p], page 38 (function).
- [generic-variable-summary-quantiles], page 38 (reader).
- [get-type], page 38 (function).
- [invalid-df-name], page 39 (function).
- [key-index], page 39 (function).
- [key-list], page 39 (function).
- [keys-count], page 39 (function).
- [keys-vector], page 39 (function).
- [make-bit-variable-summary], page 39 (function).
- [make-data], page 39 (function).
- [make-factor-variable-summary], page 39 (function).
- [make-generic-variable-summary], page 39 (function).
- [make-ordered-keys], page 40 (function).
- [make-real-variable-summary], page 40 (function).
- [make-variable-summary%], page 40 (function).
- [max-decimal], page 40 (function).
- [max-width], page 40 (function).
- [missing-data], page 45 (condition).
- [monotonicp], page 40 (function).
- [ordered-keys], page 40 (function).
- [ordered-keys], page 46 (structure).
- [ordered-keys-p], page 40 (function).
- [ordered-keys-table], page 40 (reader).
- [plist-data], page 41 (function).
- [print-count-and-percentage], page 41 (function).
- [print-table], page 41 (function).
- [printer-status], page 41 (function).
- [real-variable-summary-desc], page 41 (function).
- [real-variable-summary-length], page 41 (function).

- `[real-variable-summary-max]`, page 41 (reader).
- `[real-variable-summary-mean]`, page 41 (reader).
- `[real-variable-summary-min]`, page 42 (reader).
- `[real-variable-summary-missing]`, page 42 (function).
- `[real-variable-summary-name]`, page 42 (function).
- `[real-variable-summary-p]`, page 42 (function).
- `[real-variable-summary-q25]`, page 42 (reader).
- `[real-variable-summary-q50]`, page 42 (reader).
- `[real-variable-summary-q75]`, page 42 (reader).
- `[remove-columns!]`, page 42 (function).
- `[remove-key!]`, page 42 (function).
- `[reverse-df]`, page 43 (function).
- `[show-properties]`, page 43 (function).
- `[show-symbols]`, page 43 (function).
- `[summarize-factor-variable]`, page 43 (function).
- `[summarize-generic-variable]`, page 43 (function).
- `[summarize-real-variable]`, page 43 (function).
- `[types-in-column]`, page 43 (function).
- `[variable-summary%]`, page 46 (structure).
- `[variable-summary%-desc]`, page 43 (reader).
- `[variable-summary%-length]`, page 44 (reader).
- `[variable-summary%-missing]`, page 44 (reader).
- `[variable-summary%-name]`, page 44 (reader).
- `[variable-summary%-p]`, page 44 (function).
- `[weave]`, page 44 (function).



## 4 Definitions

Definitions are sorted by export status, category, package, and then by lexicographic order.

### 4.1 Public Interface

#### 4.1.1 Special variables

**\*ask-on-redefine\*** [Special Variable]

If non-nil, the system will ask the user for confirmation before redefining a data frame

**Package** [data-frame], page 13.

**Source** [defdf.lisp], page 10.

**\*distinct-maximum\*** [Special Variable]

If a string/factor variable has > \*distinct-maximum\* values, exclude it

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**\*distinct-threshold\*** [Special Variable]

If an integer variable has <= discrete values, consider it a factor

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**\*large-data\*** [Special Variable]

An indication that the data set is large for a particular use case.

This should be bound by a user to the maximum number of data points they consider to be 'normal'. The function can then signal a large-data warning if it is exceeded.

E.g. (let ((df:\*large-data\* 50000))

(handler-bind ((large-data ...

(some-data-operation ; this will signal if the data is too large

(restart-bind ...

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**\*quantile-threshold\*** [Special Variable]

If the number of unique reals exceeds this threshold, they will be summarized with quantiles, otherwise print frequency table

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**\*summary-minimum-length\*** [Special Variable]

Columns are only summarised when longer than this, otherwise they are returned as is.

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

### 4.1.2 Macros

**defdf** (*name data &optional documentation*) [Macro]

Define a data-frame and package by the same name.

Also defines symbol-macros for variable access, e.g. `mtcars:mpg`

**Package** [data-frame], page 13.

**Source** [defdf.lisp], page 10.

**delete-nth\*** (*place n*) [Macro]

Destructively modifies N, a SEQUENCE by removing the Nth item. Example:

```
LS-USER> (defparameter *v* #(a b c d))
```

```
*v*
```

```
LS-USER> (delete-nth* *v* 1)
```

```
#(A C D)
```

```
LS-USER> *v*
```

```
#(A C D)
```

**Package** [data-frame], page 13.

**Source** [utils.lisp], page 5.

### 4.1.3 Ordinary functions

**add-column!** (*data key column &optional update-env*) [Function]

Modify DATA (a data-frame or data-vector) by adding COLUMN with KEY. Return DATA.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**add-columns** (*data &rest keys-and-columns*) [Function]

Return a new data-frame or data-vector with keys and columns added. Does not modify DATA.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**add-columns!** (*data &rest keys-and-columns*) [Function]

Modify DATA (a data-frame or data-vector) by adding columns with keys. If a data-frame environment exists, add columns to it as well.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**alist-df** (*alist*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**alist-dv** (*alist*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**column** (*data key*) [Function]

Return column corresponding to key.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.



- (setf column) (data key)** [Function]  
Set column corresponding to key.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- column-names (df)** [Function]  
Return a list of column names in DF, as strings  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- column-type (col)** [Function]  
Return the most specific type found in COL  
**Package** [data-frame], page 13.  
**Source** [utils.lisp], page 5.
- columns (data &optional slice)** [Function]  
Return the columns of DATA as a vector, or a selection if given (keys are resolved).  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- copy (data &key key)** [Function]  
Copy data frame or vector. Keys are copied (and thus can be modified), columns or elements are copied using KEY, making the default give a shallow copy.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- count-rows (data-frame keys predicate)** [Function]  
Count the number of rows for which PREDICATE called on the columns corresponding to KEYS returns non-NIL.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- defdf-env (data-frame old-keys)** [Function]  
Create a package with the same name as DATA-FRAME. Within it, create a symbol-macro for each column that will return the columns value. Can also be used to remove and update the environment as the DATA-FRAME changes in destructive operations  
**Package** [data-frame], page 13.  
**Source** [defdf.lisp], page 10.
- delete-nth (sequence n)** [Function]  
Return SEQUENCE with the Nth item removed.  
Note: DELETE-IF makes no guarantee of being destructive, so you cannot rely on this side-effect. You must SETF the original sequence to the values returned from this function, or use the modify-macro DELETE-NTH\*  
**Package** [data-frame], page 13.  
**Source** [utils.lisp], page 5.

**df** (*&rest plist-or-alist*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**df-print** (*df*) [Function]

Print DF to \*standard-output\* in table format

**Package** [data-frame], page 13.

**Source** [formatted-output.lisp], page 8.

**df-remove-duplicates** (*data*) [Function]

Return a modified copy of DATA from which any element (row, if a DATA-FRAME) that matches another element has been removed

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**do-rows** (*data-frame keys function*) [Function]

Traverse rows from first to last, calling FUNCTION on the columns corresponding to KEYS. Return no values.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**dv** (*&rest plist-or-alist*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**filter-rows** (*data body*) [Function]

Filter DATA by a predicate given in BODY

Example

(data :mtcars) ; load a data set

(head mtcars) ; view first 6 rows

```
;; MODEL MPG CYL DISP HP DRAT WT QSEC VS AM GEAR CARB ;; 0 Mazda RX4
21.0 6 160 110 3.90 2.620 16.46 0 1 4 4 ;; 1 Mazda RX4 Wag 21.0 6 160 110 3.90 2.875 17.02
0 1 4 4 ;; 2 Datsun 710 22.8 4 108 93 3.85 2.320 18.61 1 1 4 1 ;; 3 Hornet 4 Drive 21.4 6 258
110 3.08 3.215 19.44 1 0 3 1 ;; 4 Hornet Sportabout 18.7 8 360 175 3.15 3.440 17.02 0 0 3 2 ;;
5 Valiant 18.1 6 225 105 2.76 3.460 20.22 1 0 3 1
```

(filter-rows mtcars '(< mpg 17))

#<DATA-FRAME (11 observations of 12 variables)>

(head \*) ; view first 6 rows of filtered data frame

```
;; MODEL MPG CYL DISP HP DRAT WT QSEC VS AM GEAR CARB ;; 0 Duster 360
14.3 8 360.0 245 3.21 3.570 15.84 0 0 3 4 ;; 1 Merc 450SE 16.4 8 275.8 180 3.07 4.070 17.40
0 0 3 3 ;; 2 Merc 450SLC 15.2 8 275.8 180 3.07 3.780 18.00 0 0 3 3 ;; 3 Cadillac Fleetwood
10.4 8 472.0 205 2.93 5.250 17.98 0 0 3 4 ;; 4 Lincoln Continental 10.4 8 460.0 215 3.00 5.424
17.82 0 0 3 4 ;; 5 Chrysler Imperial 14.7 8 440.0 230 3.23 5.345 17.42 0 0 3 4
```

**Package** [data-frame], page 13.

**Source** [filter.lisp], page 11.

**get-property** (*variable property*) [Function]  
Return the PROPERTY of data VARIABLE

**Package** [data-frame], page 13.

**Source** [properties.lisp], page 11.

**get-summaries** (*df*) [Function]  
Return a list of summaries of the variables in DF

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**heuristicate-types** (*df*) [Function]  
Coerce each element of the column vectors to the most specific type in the column

Often when reading in a data set, the types will be inconsistent in a variable. For example one observation might be 5.1, and another 5. Whilst mathmatically equivalent, we want our variable vectors to have identical types. The COLUMN-TYPE function returns the most specific numeric type in the column, then coerces all the vector elements to this type

**Package** [data-frame], page 13.

**Source** [properties.lisp], page 11.

**ignore-missing** (*function &key warn-user provide-restart*) [Function]  
Wrap FUNCTION in a closure that removes missing values and applys FUNCTION in case any of the arguments are :MISSING, :NA or NIL to arguments. Intended for functions accepting vectors.

**Package** [data-frame], page 13.

**Source** [missing.lisp], page 11.

**keys** (*data*) [Function]  
Return a vector of keys.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**make-df** (*keys columns*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**make-dv** (*keys columns*) [Function]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**map-columns** (*data function &optional result-class*) [Function]  
Map columns of DATA-FRAME or DATA-VECTOR using FUNCTION. The result is a new DATA-FRAME with the same keys.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

- map-df** (*data-frame keys function result-keys*) [Function]  
 Map DATA-FRAME to another one by rows. Function is called on the columns corresponding to KEYS, and should return a sequence with the same length as RESULT-KEYS, which give the keys of the resulting data frame. RESULT-KETS should be either symbols, or of the format (symbol &optional (element-type t)).  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- map-rows** (*data-frame keys function &key element-type*) [Function]  
 Map rows using FUNCTION, on the columns corresponding to KEYS. Return the result with the given ELEMENT-TYPE.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- mask-rows** (*data-frame keys predicate*) [Function]  
 Return a bit-vector containing the result of calling PREDICATE on rows of the columns corresponding to KEYS (0 for NIL, 1 otherwise).  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- matrix-df** (*keys matrix*) [Function]  
 Convert a matrix to a data-frame with the given keys.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- plist-df** (*plist*) [Function]  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- plist-dv** (*plist*) [Function]  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- print-array** (*arr &optional stream row-numbers-p*) [Function]  
 Print an array to STREAM, defaulting to \*standard-output\*, in a tabular format. If ROW-NUMBERS-P, print row numbers.  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- print-data** (*data-frame &optional stream row-numbers-p max-digits*) [Function]  
 Print DATA-FRAME to STREAM using the pretty printer  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- print-markdown** (*df &key stream row-numbers*) [Function]  
 Print data frame DF, in markdown format, to STREAM  
 If ROW-NUMBERS is true, also print row numbers as the first column  
**Package** [data-frame], page 13.  
**Source** [formatted-output.lisp], page 8.

**remove-column!** (*data key*) [Function]  
 Modify DATA (a data-frame or data-vector) by removing COLUMN with KEY. Return DATA.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**remove-columns** (*data keys*) [Function]  
 Return a new data-frame or data-vector with keys and columns removed. Does not modify DATA. ARGS: DATA data frame  
 KEYS list of keys (variables) to be removed

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**replace-column** (*data key function-or-column &key element-type*) [Function]  
 Create a new data frame with new column KEY from data-frame DATA by replacing it either with the given column, or applying the function to the current values (ELEMENT-TYPE is used.)

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**replace-column!** (*data key function-or-column &key element-type*) [Function]  
 Modify column KEY of data-frame DATA by replacing it either with the given column, or applying the function to the current values (ELEMENT-TYPE is used.)

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**rows** (*data*) [Function]  
 Return the rows of DATA as a vector

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**set-properties** (*df property prop-values*) [Function]  
 Set the PROPERTY of each variable in DF to a value. The value is specified in the plist PROP-VALUES. Example:

To give the variables in the mtcars dataset a unit, use:

```
(set-properties mtcars :unit '(:mpg m/g
```

```
:cyl :NA
```

```
:disp in3
```

```
:hp hp
```

```
:drat :NA
```

```
:wt lb
```

```
:qsec s
```

```
:vs :NA
```

```
:am :NA
```

```
:gear :NA
```

```
:carb :NA))
```

**Package** [data-frame], page 13.

**Source** [properties.lisp], page 11.

**set-property** (*symbol value property*) [Function]  
 Set the PROPERTY of SYMBOL to VALUE

**Package** [data-frame], page 13.

**Source** [properties.lisp], page 11.

**short-string** (*str*) [Function]  
 Return up to the first newline  
 This is useful when docstrings are multi-line. By convention, the first line is the title.

**Package** [data-frame], page 13.

**Source** [pprint.lisp], page 8.

**show-data-frames** (**&key** *head stream*) [Function]  
 Print all data frames in the current environment in reverse order of creation, i.e. most recently created first. If HEAD is not NIL, print the first six rows, similar to the (head) function

**Package** [data-frame], page 13.

**Source** [defdf.lisp], page 10.

**summarize-column** (*column &optional name*) [Function]  
 Return a summary struct for COLUMN

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**summary** (*df &optional stream*) [Function]  
 Print a summary of DF to STREAM, using heuristics for better formatting

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**undef** (**&rest** *params*) [Function]  
 Remove one or more data frames from the environment  
 PARAMS: a list of DATA-FRAMEs

Essentially reverses what DEFDF does. Returns the data frames that were removed. Don't use this if you have a data frame bound via DEFPARAMETER. Examples:  
 (undef mtcars vlcars)

**Package** [data-frame], page 13.

**Source** [defdf.lisp], page 10.

#### 4.1.4 Generic functions

**data-frame** (*condition*) [Generic Reader]  
**Package** [data-frame], page 13.  
**Methods**

**data-frame** ((*condition* [*data-frame-exists*],  
*page 45*)) [Reader Method]

**Source** [conditions.lisp], page 5.

**Target Slot**  
 [data-frame], page 45.

**drop-missing** (*df* &**optional** *predicate*) [Generic Function]

**Package** [data-frame], page 13.

#### Methods

**drop-missing** ((*var vector*) &**optional** *predicate*) [Method]

Remove all values from VAR that are missing according to PREDICATE.

Returns values:

1. the vector with missing values removed
2. the number of elements removed

**Source** [missing.lisp], page 11.

**drop-missing** ((*df* [data-frame], page 33) &**optional** *predicate*) [Method]

Remove all rows from DF that are missing values according to PREDICATE

**Source** [missing.lisp], page 11.

**head** (*df* &**optional** *n*) [Generic Function]

**Package** [data-frame], page 13.

#### Methods

**head** ((*df* [data-frame], page 33) &**optional** *n*) [Method]

Return the first N rows of DF; N defaults to 6

**Source** [pprint.lisp], page 8.

**missingp** (*data*) [Generic Function]

Return a vector indicating the position of any missing value indicators. They currently are :na and :missing

**Package** [data-frame], page 13.

**Source** [missing.lisp], page 11.

#### Methods

**missingp** (*data*) [Method]

**missingp** ((*data* (eql :na))) [Method]

**missingp** ((*data* (eql :missing))) [Method]

**missingp** ((*data* string)) [Method]

**missingp** ((*data* sequence)) [Method]

**missingp** ((*data* array)) [Method]

**missingp** ((*data* [data-frame], page 33)) [Method]

**name** (*object*) [Generic Reader]

(**setf** *name*) (*object*) [Generic Writer]

**Package** [data-frame], page 13.

#### Methods

`name ((data [data], page 47))` [Reader Method]

`(setf name) ((data [data], page 47))` [Writer Method]

The name of the data frame. MUST be the same as the symbol whose value cell points to this data frame. This slot essentially allows us to go 'backwards' and get the symbol that names the data frame.

**Source** [data-frame.lisp], page 6.

**Target Slot**  
[name], page 47.

`rename-column! (data new old)` [Generic Function]

**Package** [data-frame], page 13.

**Methods**

`rename-column! (data new old)` [Method]

Substitute NEW, a SYMBOL, for OLD in DF

Useful when reading data files that have an empty or generated column name.

Example: `(rename-column! cars 'name :|)` will replace an empty symbol with 'name

**Source** [data-frame.lisp], page 6.

`replace-missing (df map-alist)` [Generic Function]

**Package** [data-frame], page 13.

**Methods**

`replace-missing ((df [data-frame], page 33) map-alist)` [Method]

Replace missing values with the values specified

The alist consists of a column name in the CAR and the replacement value in the CDR Example: `(replace-missing mtcarsm '((mpg . foo)))`

**Source** [missing.lisp], page 11.

`tail (df &optional n)` [Generic Function]

**Package** [data-frame], page 13.

**Methods**

`tail ((df [data-frame], page 33) &optional n)` [Method]

Return the last N rows of DF; N defaults to 6

**Source** [pprint.lisp], page 8.

#### 4.1.5 Standalone methods

`as-alist ((data [data], page 47))` [Method]

Key-column pairs as an alist.

**Package** num-utils.utilities.

**Source** [data-frame.lisp], page 6.

`as-array ((data-vector [data-vector], page 34))` [Method]

**Package** array-operations/generic.

**Source** [data-frame.lisp], page 6.



<code>as-array</code> (( <i>data-frame</i> [ <i>data-frame</i> ], page 33))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>axis-dimension</code> (( <i>axis</i> [ <i>ordered-keys</i> ], page 46))	[Method]
Package select-dev.	
Source [data-frame.lisp], page 6.	
<code>canonical-representation</code> (( <i>axis</i> [ <i>ordered-keys</i> ], page 46) ( <i>slice</i> symbol))	[Method]
Package select-dev.	
Source [data-frame.lisp], page 6.	
<code>describe-object</code> (( <i>df</i> [ <i>data-frame</i> ], page 33) <i>stream</i> )	[Method]
Source [data-frame.lisp], page 6.	
<code>dims</code> (( <i>data-vector</i> [ <i>data-vector</i> ], page 34))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>dims</code> (( <i>data-frame</i> [ <i>data-frame</i> ], page 33))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>element-type</code> (( <i>data</i> [ <i>data</i> ], page 47))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>initialize-instance</code> :after (( <i>data-frame</i> [ <i>data-frame</i> ], page 33) &rest <i>initargs</i> )	[Method]
Source [data-frame.lisp], page 6.	
<code>ncol</code> (( <i>data-frame</i> [ <i>data-frame</i> ], page 33))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>nrow</code> (( <i>data-frame</i> [ <i>data-frame</i> ], page 33))	[Method]
Package array-operations/generic.	
Source [data-frame.lisp], page 6.	
<code>print-object</code> (( <i>data-vector</i> [ <i>data-vector</i> ], page 34) <i>stream</i> )	[Method]
Source [data-frame.lisp], page 6.	
<code>print-object</code> (( <i>df</i> [ <i>data-frame</i> ], page 33) <i>stream</i> )	[Method]
Print DATA-FRAME dimensions and type	
After defining this method it is permanently associated with data-frame objects	
Source [data-frame.lisp], page 6.	
<code>print-object</code> (( <i>object</i> [ <i>generic-variable-summary</i> ], page 32) <i>stream</i> )	[Method]
Source [summary.lisp], page 9.	

<code>print-object ((object [factor-variable-summary], page 31) stream)</code>	[Method]
Source [summary.lisp], page 9.	
<code>print-object ((object [bit-variable-summary], page 31) stream)</code>	[Method]
Source [summary.lisp], page 9.	
<code>print-object ((object [real-variable-summary], page 32) stream)</code>	[Method]
Source [summary.lisp], page 9.	
<code>print-object ((ordered-keys [ordered-keys], page 46) stream)</code>	[Method]
Source [data-frame.lisp], page 6.	
<code>select ((data-vector [data-vector], page 34) &amp;rest slices)</code>	[Method]
Package select.	
Source [data-frame.lisp], page 6.	
<code>select ((data-frame [data-frame], page 33) &amp;rest slices)</code>	[Method]
Package select.	
Source [data-frame.lisp], page 6.	
<code>select ((ordered-keys [ordered-keys], page 46) &amp;rest selections)</code>	[Method]
Package select.	
Source [data-frame.lisp], page 6.	

#### 4.1.6 Conditions

<code>duplicate-key</code>	[Condition]
An operation attempted to use a key that already exists in ORDERED-KEYS	
Package [data-frame], page 13.	
Source [conditions.lisp], page 5.	
Direct superclasses error.	
Direct slots key	[Slot]
Initargs :key	
<code>key-not-found</code>	[Condition]
An operation was attempted on a non-existent key.	
Package [data-frame], page 13.	
Source [conditions.lisp], page 5.	
Direct superclasses error.	
Direct slots key	[Slot]
Initargs :key	

**keys** [Slot]

**Initargs** :keys

**large-data** [Condition]

A operation was requested on a data set large enough to potentially cause problems.

**Package** [data-frame], page 13.

**Source** [conditions.lisp], page 5.

**Direct superclasses**  
warning.

**Direct methods**  
[data-size], page 45.

**Direct slots**

**data-size** [Slot]

**Initargs** :data-size

**Readers** [data-size], page 45.

**Writers** *This slot is read-only.*

#### 4.1.7 Structures

**bit-variable-summary** [Structure]

Summary of a bit vector.

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Direct superclasses**  
[variable-summary%], page 46.

**Direct methods**  
[print-object], page 30.

**Direct slots**

**count** [Slot]

**Package** common-lisp.

**Type** alexandria:array-index

**Initform** 0

**Readers** [bit-variable-summary-count], page 35.

**Writers** *This slot is read-only.*

**factor-variable-summary** [Structure]

Summary for factor variables

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Direct superclasses**  
[variable-summary%], page 46.

**Direct methods**  
[print-object], page 30.

**Direct slots**

**element-count-alist** [Slot]

**Type** list

**Readers** [factor-variable-summary-element-count-alist], page 37.

**Writers** *This slot is read-only.*

**generic-variable-summary** [Structure]

Summary for generic variables, i.e. those with mixed types.

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Direct superclasses**

[variable-summary%], page 46.

**Direct methods**

[print-object], page 29.

**Direct slots**

**quantiles** [Slot]

**Type** (or null data-frame:real-variable-summary)

**Readers** [generic-variable-summary-quantiles], page 38.

**Writers** *This slot is read-only.*

**element-count-alist** [Slot]

**Type** list

**Readers** [generic-variable-summary-element-count-alist], page 38.

**Writers** *This slot is read-only.*

**real-variable-summary** [Structure]

Summary of a real elements (using quantiles).

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Direct superclasses**

[variable-summary%], page 46.

**Direct methods**

[print-object], page 30.

**Direct slots**

**min** [Slot]

**Package** common-lisp.

**Type** real

**Initform** 0

**Readers** [real-variable-summary-min], page 42.

**Writers** *This slot is read-only.*

q25		[Slot]
<b>Type</b>	real	
<b>Initform</b>	0	
<b>Readers</b>	[real-variable-summary-q25], page 42.	
<b>Writers</b>	<i>This slot is read-only.</i>	
q50		[Slot]
<b>Type</b>	real	
<b>Initform</b>	0	
<b>Readers</b>	[real-variable-summary-q50], page 42.	
<b>Writers</b>	<i>This slot is read-only.</i>	
mean		[Slot]
<b>Package</b>	alexandria.	
<b>Type</b>	real	
<b>Initform</b>	0	
<b>Readers</b>	[real-variable-summary-mean], page 41.	
<b>Writers</b>	<i>This slot is read-only.</i>	
q75		[Slot]
<b>Type</b>	real	
<b>Initform</b>	0	
<b>Readers</b>	[real-variable-summary-q75], page 42.	
<b>Writers</b>	<i>This slot is read-only.</i>	
max		[Slot]
<b>Package</b>	common-lisp.	
<b>Type</b>	real	
<b>Initform</b>	0	
<b>Readers</b>	[real-variable-summary-max], page 41.	
<b>Writers</b>	<i>This slot is read-only.</i>	

#### 4.1.8 Classes

data-frame		[Class]
<b>Package</b>	[data-frame], page 13.	
<b>Source</b>	[data-frame.lisp], page 6.	
<b>Direct superclasses</b>	[data], page 47.	
<b>Direct methods</b>	<ul style="list-style-type: none"> <li>• [as-array], page 29.</li> <li>• [check-column-compatibility], page 44.</li> <li>• [describe-object], page 29.</li> </ul>	

- [dims], page 29.
- [drop-missing], page 27.
- [head], page 27.
- [initialize-instance], page 29.
- [missingp], page 27.
- [ncol], page 29.
- [nrow], page 29.
- [print-object], page 29.
- [replace-missing], page 28.
- [select], page 30.
- [tail], page 28.

**data-vector** [Class]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**Direct superclasses**  
[data], page 47.

**Direct methods**

- [as-array], page 28.
- [dims], page 29.
- [print-object], page 29.
- [select], page 30.

## 4.1.9 Types

**data-type ()** [Type]

A statistical type for a data variable. All data columns must be one of these types if they are to be interpreted properly by Lisp-Stat

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

## 4.2 Internals

### 4.2.1 Special variables

**\*data-frames\*** [Special Variable]

Global list of all data frames

**Package** [data-frame], page 13.

**Source** [defdf.lisp], page 10.

**\*max-digits\*** [Special Variable]

**Package** [data-frame], page 13.

**Source** [pprint.lisp], page 8.

**\*row-numbers-p\*** [Special Variable]

**Package** [data-frame], page 13.

**Source** [pprint.lisp], page 8.

### 4.2.2 Macros

`define-data-subclass` (*class abbreviation*) [Macro]

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

### 4.2.3 Ordinary functions

`2d-array-to-list` (*array*) [Function]

Convert an array to a list of lists

**Package** [data-frame], page 13.

**Source** [pprint.lisp], page 8.

`add-key!` (*ordered-keys key*) [Function]

Modify ORDERED-KEYS by adding KEY.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

`add-keys` (*ordered-keys &rest keys*) [Function]

Add KEYS to ORDERED-KEYS

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

`aesthetic-string` (*thing*) [Function]

Return the string used to represent ‘thing’ when printing aesthetically.

**Package** [data-frame], page 13.

**Source** [formatted-output.lisp], page 8.

`alist-data` (*class alist*) [Function]

Create an object of CLASS (subclass of DATA) from ALIST which contains key-column pairs.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

`bit-variable-summary-count` (*instance*) [Reader]

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Target Slot**  
[count], page 31.

`bit-variable-summary-desc` (*instance*) [Function]

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

`bit-variable-summary-length` (*instance*) [Function]

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

- bit-variable-summary-missing** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- bit-variable-summary-name** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- bit-variable-summary-p** (*object*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- column-type-format** (*sequence*) [Function]  
 Return a format string for the most specific type found in sequence Use this for sequences of type T to determine how to format the column.  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- copy-bit-variable-summary** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- copy-factor-variable-summary** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- copy-generic-variable-summary** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- copy-ordered-keys** (*ordered-keys*) [Function]  
 Return a copy of ORDERED-KEYS  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- copy-real-variable-summary** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- copy-variable-summary%** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- df-env-p** (*df*) [Function]  
 Returns T if there is environment set-up for the data frame, or NIL if there isn't one.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.



- df-exists-p** (*s*) [Function]  
**Package** [data-frame], page 13.  
**Source** [conditions.lisp], page 5.
- distinct** (*column*) [Function]  
Returns the number of distinct elements in COLUMN, a symbol naming a variable. Useful for formatting columns for human output  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- drop-na** (*df*) [Function]  
Remove all rows from DF that are missing values. Convenience R-like function.  
**Package** [data-frame], page 13.  
**Source** [missing.lisp], page 11.
- ensure-arguments-alist** (*rest*) [Function]  
Recognizes the following and converts them to an alist:  
plist  
alist  
(plist)  
(alist)  
(data-frame)  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- ensure-not-ratio** (*real*) [Function]  
When REAL is a RATIO, convert it to a float, otherwise return as is. Used for printing.  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- factor-variable-summary-desc** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- factor-variable-summary-element-count-alist** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
[element-count-alist], page 32.
- factor-variable-summary-length** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- factor-variable-summary-missing** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.

<code>factor-variable-summary-name</code> ( <i>instance</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>factor-variable-summary-p</code> ( <i>object</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-desc</code> ( <i>instance</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-element-count-alist</code> ( <i>instance</i> )	[Reader]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<b>Target Slot</b> [element-count-alist], page 32.	
<code>generic-variable-summary-length</code> ( <i>instance</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-missing</code> ( <i>instance</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-name</code> ( <i>instance</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-p</code> ( <i>object</i> )	[Function]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<code>generic-variable-summary-quantiles</code> ( <i>instance</i> )	[Reader]
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [summary.lisp], page 9.	
<b>Target Slot</b> [quantiles], page 32.	
<code>get-type</code> ( <i>x</i> )	[Function]
Return the most specific type symbol for <i>x</i>	
<b>Package</b> [data-frame], page 13.	
<b>Source</b> [utils.lisp], page 5.	

- invalid-df-name** (*s*) [Function]  
 A user prompt, using DUOLOGUE, to select a valid data frame name.  
**Package** [data-frame], page 13.  
**Source** [conditions.lisp], page 5.
- key-index** (*ordered-keys key*) [Function]  
 Return the index for KEY.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- key-list** (*data form*) [Function]  
 Return a list of keys used in REST, a form  
**Package** [data-frame], page 13.  
**Source** [filter.lisp], page 11.
- keys-count** (*ordered-keys*) [Function]  
 Number of keys.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- keys-vector** (*ordered-keys*) [Function]  
 Vector of all keys.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- make-bit-variable-summary** (**&key** *length missing name desc count*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- make-data** (*class keys columns*) [Function]  
 Create a DATA object from KEYS and COLUMNS. FOR INTERNAL USE. Always creates a copy of COLUMNS in order to ensure that it is an adjustable array with a fill pointer. KEYS are converted to ORDERED-KEYS if necessary.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- make-factor-variable-summary** (**&key** *length missing name desc element-count-alist*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- make-generic-variable-summary** (**&key** *length missing name desc quantiles element-count-alist*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.

- make-ordered-keys** (*&key table*) [Function]  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- make-real-variable-summary** (*&key length missing name desc min q25 q50 mean q75 max*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- make-variable-summary%** (*&key length missing name desc*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- max-decimal** (*sequence &optional max-digits*) [Function]  
 Return the maximum number of digits to the right of the decimal point in the numbers of SEQUENCE, equal to or less than MAX-DIGITS  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- max-width** (*sequence &optional max-width*) [Function]  
 Return the largest printed string size of the elements of SEQUENCE, equal to or less than MAX-WIDTH  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- monotonicp** (*column*) [Function]  
 Returns t if all elements of COLUMN, a SYMBOL, are increasing monotonically Useful for detecting row numbers in imported data  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- ordered-keys** (*keys*) [Function]  
 Create an ORDERED-KEYS object from KEYS (a sequence).  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- ordered-keys-p** (*object*) [Function]  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- ordered-keys-table** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.  
**Target Slot** [table], page 46.

- plist-data** (*class plist*) [Function]  
 Create an object of CLASS (subclass of DATA) from PLIST which contains keys and columns, interleaved.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- print-count-and-percentage** (*stream count length*) [Function]  
 Print COUNT as is and also as a rounded percentage  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- print-table** (*rows &optional stream*) [Function]  
 Print ROWS as a nicely-formatted table.  
 Each row should have the same number of columns.  
 Columns will be justified properly to fit the longest item in each one. Example:  
 (print-table '((1 :red something)  
 (2 :green more)))  
 =>  
 1 | RED | SOMETHING  
 2 | GREEN | MORE  
  
**Package** [data-frame], page 13.  
**Source** [formatted-output.lisp], page 8.
- printer-status** () [Function]  
 Print values of all the printer variables  
**Package** [data-frame], page 13.  
**Source** [pprint.lisp], page 8.
- real-variable-summary-desc** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- real-variable-summary-length** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- real-variable-summary-max** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
 [max], page 33.
- real-variable-summary-mean** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
 [mean], page 33.

- real-variable-summary-min** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot** [min], page 32.
- real-variable-summary-missing** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- real-variable-summary-name** (*instance*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- real-variable-summary-p** (*object*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- real-variable-summary-q25** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot** [q25], page 33.
- real-variable-summary-q50** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot** [q50], page 33.
- real-variable-summary-q75** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot** [q75], page 33.
- remove-columns!** (*data &rest keys*) [Function]  
 Modify DATA (a data-frame or data-vector) by removing columns with keys. If a data-frame environment exists, add columns to it as well.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.
- remove-key!** (*ordered-keys key*) [Function]  
 Modify ORDERED-KEYS by removing KEY.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.

- reverse-df** (*df*) [Function]  
Return DF with columns in reverse order
- Package** [data-frame], page 13.
- Source** [pprint.lisp], page 8.
- show-properties** (*df*) [Function]  
Show the standard properties of the variables of the data frame DF Standard properties are 'label', 'type' and 'unit'
- Package** [data-frame], page 13.
- Source** [properties.lisp], page 11.
- show-symbols** (*pkg*) [Function]  
Print all symbols in PKG Example: (show-symbols 'mtcars)
- Package** [data-frame], page 13.
- Source** [defdf.lisp], page 10.
- summarize-factor-variable** (*column*) [Function]  
Return an alist of factor/count pairs
- Package** [data-frame], page 13.
- Source** [summary.lisp], page 9.
- summarize-generic-variable** (*column &optional name*) [Function]  
Return an object that summarizes COLUMN of a DATA-FRAME. Primarily intended for printing, not analysis, returned values should print nicely. This function can be used on any type of column, even one with mixed types
- Package** [data-frame], page 13.
- Source** [summary.lisp], page 9.
- summarize-real-variable** (*column*) [Function]  
Return a summary for a float variable
- Package** [data-frame], page 13.
- Source** [summary.lisp], page 9.
- types-in-column** (*seq*) [Function]  
Return a list of the types found in SEQ
- Package** [data-frame], page 13.
- Source** [utils.lisp], page 5.
- variable-summary%-desc** (*instance*) [Reader]  
**Package** [data-frame], page 13.
- Source** [summary.lisp], page 9.
- Target Slot**  
[desc], page 47.

- variable-summary%-length** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
[length], page 46.
- variable-summary%-missing** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
[missing], page 47.
- variable-summary%-name** (*instance*) [Reader]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Target Slot**  
[name], page 47.
- variable-summary%-p** (*object*) [Function]  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.
- weave** (&rest *lists*) [Function]  
Return a list whose elements alternate between each of the lists ‘lists’. Weaving stops when any of the lists has been exhausted.  
**Package** [data-frame], page 13.  
**Source** [formatted-output.lisp], page 8.

#### 4.2.4 Generic functions

- check-column-compatibility** (*data column*) [Generic Function]  
Check if COLUMN is compatible with DATA.  
**Package** [data-frame], page 13.  
**Source** [data-frame.lisp], page 6.  
**Methods**
- check-column-compatibility** ((*data* [data-frame],  
page 33) *column*) [Method]
- check-column-compatibility** ((*data* [data], page 47)  
*column*) [Method]
- column-length** (*column*) [Generic Function]  
Return the length of column.  
**Package** [data-frame], page 13.  
**Source** [summary.lisp], page 9.  
**Methods**



<code>column-length</code>	<code>((column vector))</code>	[Method]	
<code>data-size</code>	<code>(condition)</code>	[Generic Reader]	
<b>Package</b>	[data-frame], page 13.		
<b>Methods</b>			
	<code>data-size</code>	<code>((condition [large-data], page 31))</code>	[Reader Method]
	<b>Source</b>	[conditions.lisp], page 5.	
	<b>Target Slot</b>		
		[data-size], page 31.	
<code>default-column-formats</code>	<code>(array)</code>	[Generic Function]	
<b>Package</b>	[data-frame], page 13.		
<b>Methods</b>			
	<code>default-column-formats</code>	<code>((array simple-array))</code>	[Method]
	Return a list of formatting strings for ARRAY		
	The method returns a set of default formatting strings using heuristics.		
	<b>Source</b>	[pprint.lisp], page 8.	

### 4.2.5 Conditions

data-frame-exists				[Condition]
An attempt to redefine an existing data frame. Triggered if either the symbol is bound or the package exists.				
Package	[data-frame], page 13.			
Source	[conditions.lisp], page 5.			
Direct superclasses	error.			
Direct methods	[data-frame], page 26.			
Direct slots				
	data-frame	[Slot]		
	Initargs	:data-frame		
	Readers	[data-frame], page 26.		
	Writers	This slot is read-only.		
missing-data				[Condition]
A variable has missing data, e.g. :na, nil				
Package	[data-frame], page 13.			
Source	[conditions.lisp], page 5.			
Direct superclasses	error.			
Direct slots				
	name	[Slot]		
	Initargs	:name		
	data	[Slot]		
	Initargs	:data		

## 4.2.6 Structures

**ordered-keys** [Structure]

Representation of ordered keys

Ordered keys provide a mapping from column keys (symbols) to nonnegative integers. They are used internally and the corresponding interface is NOT EXPORTED.

TABLE maps keys to indexes, starting from zero.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

**Direct superclasses**

structure-object.

**Direct methods**

- [axis-dimension], page 29.
- [canonical-representation], page 29.
- [print-object], page 30.
- [select], page 30.

**Direct slots**

<b>table</b>	[Slot]
<b>Type</b>	hash-table
<b>Initform</b>	(make-hash-table :test (function eq))
<b>Readers</b>	[ordered-keys-table], page 40.
<b>Writers</b>	<i>This slot is read-only.</i>

**variable-summary%** [Structure]

Base class for summarizing variables. Summary functions take SYMBOLS, rather than values, because the symbol property lists naming the variables have meta-data, e.g. type, label, that we want to print. Not exported.

**Package** [data-frame], page 13.

**Source** [summary.lisp], page 9.

**Direct superclasses**

structure-object.

**Direct subclasses**

- [bit-variable-summary], page 31.
- [factor-variable-summary], page 31.
- [generic-variable-summary], page 32.
- [real-variable-summary], page 32.

**Direct slots**

<b>length</b>	[Slot]
<b>Package</b>	common-lisp.
<b>Type</b>	alexandria:array-index
<b>Initform</b>	0
<b>Readers</b>	[variable-summary%-length], page 44.
<b>Writers</b>	<i>This slot is read-only.</i>

<b>missing</b>		[Slot]
<b>Type</b>	fixnum	
<b>Initform</b>	0	
<b>Readers</b>	[variable-summary%-missing], page 44.	
<b>Writers</b>	<i>This slot is read-only.</i>	
<b>name</b>		[Slot]
<b>Type</b>	string	
<b>Initform</b>	""	
<b>Readers</b>	[variable-summary%-name], page 44.	
<b>Writers</b>	<i>This slot is read-only.</i>	
<b>desc</b>		[Slot]
<b>Type</b>	string	
<b>Initform</b>	""	
<b>Readers</b>	[variable-summary%-desc], page 43.	
<b>Writers</b>	<i>This slot is read-only.</i>	

### 4.2.7 Classes

**data** [Class]  
 This class is used for implementing both data-vector and data-frame, and represents an ordered collection of key-column pairs. Columns are not assumed to have any specific attributes. This class is not exported.

**Package** [data-frame], page 13.

**Source** [data-frame.lisp], page 6.

#### Direct subclasses

- [data-frame], page 33.
- [data-vector], page 34.

#### Direct methods

- [as-alist], page 28.
- [check-column-compatibility], page 44.
- [element-type], page 29.
- [(setf name)], page 28.
- [name], page 28.

#### Direct slots

<b>name</b>		[Slot]
The name of the data frame. MUST be the same as the symbol whose value cell points to this data frame. This slot essentially allows us to go 'backwards' and get the symbol that names the data frame.		
<b>Type</b>	string	
<b>Initargs</b>	nil	
<b>Readers</b>	[name], page 28.	
<b>Writers</b>	[(setf name)], page 28.	

<code>ordered-keys</code>		[Slot]
<b>Type</b>	<code>data-frame::ordered-keys</code>	
<b>Initargs</b>	<code>:ordered-keys</code>	
<code>columns</code>		[Slot]
<b>Type</b>	<code>vector</code>	
<b>Initargs</b>	<code>:columns</code>	

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