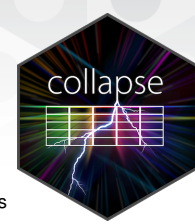


# Advanced and Fast Data Transformation with collapse :: CHEAT SHEET



## Introduction

**collapse** is a C/C++ based package supporting advanced (grouped, weighted, time series, panel data and recursive) statistical operations in R, with very efficient low-level vectorizations across both groups and columns.

It also offers a flexible, class-agnostic, approach to data transformation in R: handling matrix and data frame based objects in a uniform, attribute preserving, way, and ensuring seamless compatibility with *dplyr* / (grouped) *tibble*, *data.table*, *xts*, *sf* and *plm* classes for panel data ('pseries', 'pdata.frame').

**collapse** provides full control to the user for statistical programming - with several ways to reach the same outcome and rich optimization possibilities. Its default is `na.rm = TRUE`, and implemented at very low cost at the algorithm level.

Calling `help("collapse-documentation")` brings up a detailed documentation, which is also available [online](#). See also the *fastverse* package/project for a recommended set of complimentary packages and easy package management.

## Row/Column Arithmetic (by Reference)

Column-wise sweeping out of vectors/matrices/DFs/lists

```
%c%, %c+%, %c-%, %c*%, %c/% e.g. Z = X %c/% rowSums(X)
```

Row-wise sweeping vectors from vectors/matrices/DFs/lists

```
%r%, %r+%, %r-%, %r*%, %r/% e.g. Z = X %r/% colSums(X)
```

Standard (column-wise) math by reference (returns invisibly)

```
%+=%, %-=%, %*=%, %/= % e.g. X %+=% rowSums(X)
```

Same thing, also supports row-wise operations by reference

```
setop(X, "/", rowSums(X))  
setop(X, "/", colSums(X), rowwise = TRUE)
```

## Transform Data by (Grouped) Replacing or Sweeping out Statistics (by Reference)

A generalisation of rowwise operations, that also supports sweeping by groups e.g. aggregate statistics

```
TRA(x, STATS, FUN = "-", g = NULL, set = FALSE)  
setTRA(x, STATS, FUN = "-", g = NULL)
```

`x` vector, matrix, or (grouped) data frame / list

STATS statistics matching (columns of) `x` (i.e. aggregated vector, matrix or data frame / list)

FUN integer/string indicating transformation to perform:

Int.	String	Description
0	"replace_NA"	replace missing values in x
1	"replace_fill"	replace data and missing values in x
2	"replace"	replace data but preserve missing values in x
3	"-"	subtract: x - STATS(g)
4	"-+"	x - STATS(g) + fmean(STATS, w = GRPN)
5	"#"	divide: x / STATS(g)
6	"%#"	compute percentages: x * 100/STATS(g)
7	"#"	add: x + STATS(g)
8	"*"	multiply: x * STATS(g)
9	"%#"	modulus: x %# STATS(g)
10	"-%#"	subtract modulus: x - %# STATS(g)

`g` [optional] (list of) vectors / factors or GRP() object

`set` TRUE transforms `x` by reference. `setTRA` is equivalent to `invisible(TRA(..., set = TRUE))`

## Fast Statistical Functions

Fast functions to perform column-wise grouped and weighted computations on matrix-like objects

```
fmean, fmedian, fmode, fsum, fprod, fsd, fvar  
fmin, fmax, fnth, ffirst, flast, fnobs, fndistinct
```

### Syntax

```
FUN(x, g = NULL, [w = NULL], TRA = NULL,  
[na.rm = TRUE], use.g.names = TRUE,  
[drop = TRUE], [nthreads = 1L])
```

`x` vector, matrix, or (grouped) data frame / list

`g` [optional] (list of) vectors / factors or GRP() object

`w` [optional] vector of (frequency) weights

TRA [optional] operation to transform data with computed statistics (see FUN argument to TRA()) and Examples)

`drop` drop matrix / data frame dimensions. default TRUE

### Examples

```
fmean(AirPassengers) # Vector  
## [1] 280.2986  
fmean(AirPassengers, w = cycle(AirPassengers)) # Weighted mean  
## [1] 284.3397  
fmean(EuStockMarkets) # Matrix  
## DAX SMI CAC FTSE  
## 2530.657 3376.224 2227.828 3565.643  
fmean(EuStockMarkets, drop = FALSE) # Don't drop dimensions  
## DAX SMI CAC FTSE  
## [1,] 2530.657 3376.224 2227.828 3565.643  
fmean(airquality) # Data Frame (can also use drop = FALSE)  
## Ozone Solar.R Wind Temp Month Day  
## 42.129310 185.931507 9.957516 77.882353 6.993464 15.803922  
fmean(iris[1:4], g = iris$Species) # Grouped  
## Sepal.Length Sepal.Width Petal.Length Petal.Width  
## setosa 5.006 3.428 1.462 0.246  
## versicolor 5.936 2.770 4.260 1.326  
## virginica 6.588 2.974 5.552 2.026  
X = iris[1:4]; g = iris$Species; w <- abs(rnorm(nrow(X)))  
fmean(X, g, w) # Grouped and weighted (random weights)  
## Sepal.Length Sepal.Width Petal.Length Petal.Width  
## setosa 5.011663 3.467638 1.504067 0.2525002  
## versicolor 5.930365 2.773558 4.238593 1.3136082  
## virginica 6.588903 2.978017 5.552375 2.0221178  
# Transformations: here centering data on the weighted group median  
TRA(X, fmedian(X, g, w), "-", g) |> head(3)  
## Sepal.Length Sepal.Width Petal.Length Petal.Width  
## 1 0.1 0.0 -0.1 0  
## 2 -0.1 -0.5 -0.1 0  
## 3 -0.3 -0.3 -0.2 0  
fmedian(X, g, w, TRA = "-") |> head(3) # Same thing: more compact  
## Sepal.Length Sepal.Width Petal.Length Petal.Width  
## 1 0.1 0.0 -0.1 0  
## 2 -0.1 -0.5 -0.1 0  
## 3 -0.3 -0.3 -0.2 0  
fmedian(X, g, w, "-", set = TRUE) # Modify in-place (same as setTRA())  
head(iris, 3) # Changed iris too, as X = iris[1:4] did a shallow copy
```

## Basic Computing with R Functions

Apply R functions to rows or columns (by groups)

```
dapply(x, FUN, ..., MARGIN = 2) - column/row apply
```

```
BY(x, g, FUN, ...) - split-apply-combine computing
```

## Grouping and Ordering

Optimized functions for grouping, ordering, unique values, splitting & recombining, and dealing with factors

GRP() - create a grouping object (class 'GRP'): pass to `g` arg.

```
g <- GRP(iris, ~ Species) # or GRP(iris$Species) or GRP(iris["Species"])  
fndistinct(iris[1:4], g) # Computation without grouping overhead  
## Sepal.Length Sepal.Width Petal.Length Petal.Width  
## setosa 15 16 9 6  
## versicolor 21 14 19 9  
## virginica 21 13 20 12
```

`fgroup_by()` - attach 'GRP' object to data: a class-agnostic grouped frame supporting fast computations

```
mtcars |> fgroup_by(cyl, vs, am) |> ss(1:2)  
## mpg cyl disp hp drat wt qsec vs am gear carb  
## Mazda RX4 21 6 160 110 3.9 2.620 16.46 0 1 4 4  
## Mazda RX4 Wag 21 6 160 110 3.9 2.875 17.02 0 1 4 4  
##  
## Grouped by: cyl, vs, am [7 | 5 (3.8) 1-12]  
# Group Stats: [N, groups | mean (sd) min-max of group sizes]  
# Fast Functions also have a grouped_df method: here wt-weighted medians  
mtcars |> fgroup_by(cyl, vs, am) |> fmedian(wt) |> head(3)  
## cyl vs am sum.wt mpg disp hp drat qsec gear carb  
## 1 4 0 1 2.140 26.0 120.3 91 4.43 16.70 5 2  
## 2 4 1 0 8.805 22.8 140.8 95 3.70 20.01 4 2  
## 3 4 1 1 14.198 30.4 79.0 66 4.08 18.61 4 1
```

GRPN(), `fgroup_vars()`, `fungroup()` - get group count, grouping columns/variables, and ungroup data

`qF()`, `qG()` - quick `as.factor`, and vector grouping object of class 'qG': a factor-light without levels attribute

`group()` - (multivariate) group id ('qG') in appearance order

`groupid()` - run-length-type group id ('qG')

`seqid()` - group-id from integer-sequences ('qG')

`radixorder[v]()` - (multivariate) radix-based ordering

`finteraction()` - fast factor interactions (or return 'qG')

`fdroplevels()` - fast removal of unused factor levels

`f[n]unique()` - fast unique values / rows (by columns)

`gsplit()` - fast splitting vector based on 'GRP' objects

`greorder()` - efficiently reorder `y = unlist(gsplit(x, g))` such that identical(`greorder(y, g), x`)

**collapse** optimizes grouping using both factors / 'qG' objects and 'GRP' objects. 'GRP' objects contain most information and are thus most efficient for complex computations.

```
X <- iris[1:4]; v <- as.character(iris$Species)  
f <- qF(v, na.exclude = FALSE) # Adds 'na.included' class: no NA checks  
gv <- group(v) # 'qG' object: first appearance order, with 'na.included' microbenchmark(fmode(X, v), fmode(X, f), fmode(X, gv), fmode(X, g))  
## Unit: microseconds  
## expr min lq mean median uq max neval  
## fmode(X, v) 11.890 12.9150 15.17697 13.3455 13.7350 162.073 100  
## fmode(X, f) 9.225 9.8195 11.33035 10.0860 10.4550 92.947 100  
## fmode(X, gv) 8.569 9.3480 10.73667 9.6555 10.1065 73.021 100  
## fmode(X, g) 6.683 7.2980 7.71620 7.5440 7.7490 13.489 100
```

## Quick Conversions

Fast and exact conversion of common data objects

`qM()`, `qDF()`, `qDT()`, `qTBL()` - convert vectors, arrays, data.frames or lists to matrix, data.frame, data.table or tibble

`m[r|c]t1()` - matrix rows/cols to list, data.frame or data.table

`qF()`, `as.numeric.factor()`, `as.character.factor()` - convert to/from factors or all factors in a list / data.frame

## Fast Data Manipulation

Minimal overhead implementations

`fselect[<-]()` - select/replace columns

`fsubset()` - subset data (rows and columns)

`ss()` - fast alternative to `[],` particularly for data frames

`[row|col]order[v]()` - reorder (sort) rows and columns

`fmutate()`, `fsummarise()` - *dplyr*-like, incl. `across()` feature

`[f|set]transform[v][<-]()` - transform cols (by reference)

`fcompute[v]()` - compute new cols dropping existing ones

`[f|set]rename()` - rename (any object with 'names' attribute)

`[set]relabel()` - assign/change variable labels ('label' attr.)

`get_vars[<-]()` - select/replace columns (standard eval.)

`[num|cat|char|fact|logi|date].vars[<-]()` - select/replace columns by data type or retrieve names/indices

`add_vars[<-]()` - add or column-bind columns

### Examples

```
mtcars |> fsubset(mpg > fnth(mpg, 0.95), disp:wt, cylinders = cyl)  
## disp hp drat wt cylinders  
## Fiat 128 78.7 66 4.08 2.200 4  
## Toyota Corolla 71.1 65 4.22 1.835 4  
mtcars |> colorder(cyl, vs, am, pos = 'after') |> head(2)  
## mpg cyl vs am disp hp drat wt qsec gear carb  
## Mazda RX4 21 6 0 1 160 110 3.9 2.620 16.46 4 4  
## Mazda RX4 Wag 21 6 0 1 160 110 3.9 2.875 17.02 4 4  
i <- base::invisible # These are equivalent, the second option is faster:  
mtcars |> fmutate_by(cyl, vs, am) |> fmutate(sum_mpg = fsum(mpg)) |> i()  
mtcars |> fmutate(sum_mpg = fsum(mpg, list(cyl, vs, am), TRA = 1)) |> i()  
# These are also equivalent (weighted means), again the second is faster  
mtcars |> fgroup_by(cyl) |> fmutate(across(disp:drat, fmean, wt)) |> i()  
mtcars |> ftransform(disp:drat, fmean, cyl, wt, 1, apply = FALSE) |> i()  
# ftransform()/fcompute() support list input and ignore attached groupings  
mtcars %>% fgroup_by(cyl) %>% ftransform(fselect(, hp:qsec) %>%  
fmedian(TRA = 1) %>% fungroup() %>% fsum(TRA = "/")) |> i()  
# Again a faster equivalent: note the use of 'set' to avoid a deep copy  
mtcars %>% ftransform(fselect(, hp:qsec) %>% fmedian(cyl, TRA = 1) %>%  
fsum(TRA = "/", set = TRUE)) %>% i()  
# Aggregation: weighted standard deviations  
mtcars |> fgroup_by(vs) |> fsummarise(across(disp:drat, fsd, w = wt))  
## vs disp hp drat  
## 1 0 101.80094 54.79388 0.4294947  
## 2 1 56.30073 23.17952 0.4915166  
# Grouped linear models: .apply = FALSE applies functions to DF subset  
qTBL(mtcars) |> fgroup_by(vs) |> fsummarise(across(disp:drat,  
function(x) list(models = list(lm(disp ~ ., x))), .apply = FALSE))  
## # A tibble: 2 x 2  
## vs models  
## <dbl> <list>  
## 1 0 <lm>  
## 2 1 <lm>  
# Adding some columns. Use ftransform()- to also replace existing ones  
add_vars(iris) <- num_vars(iris) |> fsum(TRA = 'X') |> add_stub("perc. %")
```

## Multi-Type Aggregation

Convenient interface to complex multi-type aggregations

```
collap(data, by, FUN = fmean, catFUN = fmode,  
cols = NULL, w = NULL, wFUN = fsum,  
custom = NULL, keep.col.order = TRUE, ...)
```

```
# Population weighted mean (PCGDP, LIFEEX) & mode (country), and sum(POP)  
collap(wlddev, country + PCGDP + LIFEEX ~ income, w = ~ POP)  
## country income PCGDP LIFEEX POP  
## 1 United States High income 31284.7366 75.69257 58840387058  
## 2 Ethiopia Low income 557.1427 53.50608 20949161394  
## 3 India Lower middle income 1238.8280 60.58651 113837684528  
## 4 China Upper middle income 4145.6844 68.26984 119606023798
```

