

Package ‘SASxport’

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Title Read and Write 'SAS' 'XPORT' Files

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Description Functions for reading, listing the contents of, and writing 'SAS' 'xport' format files. The functions support reading and writing of either individual data frames or sets of data frames. Further, a mechanism has been provided for customizing how variables of different data types are stored.

Author Gregory R. Warnes <greg@warnes.net>

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The files 'src/ieee2ibm.c' and 'src/ibm2ieee.c' were extracted from BRL-CAD file /brlcad/src/libbu/htond.c written by Michael John Muuss, Copyright (c) 2004-2007 United States Government as represented by the U.S. Army Research Laboratory, and is utilized and redistributed under the terms of the GNU Lesser General Public License, version 2.1.

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The file 'R/read.xport.R' is adapted from the 'Hmisc' package created by Frank E. Harrell, Jr. <f.harrell@vanderbilt.edu>, and is utilized and redistributed under the terms of the GNU General Public License, version 2.0 or later.

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The files 'R/xport.R', 'src/SASxport.c', 'src/SASxport.h', and 'src/foreign.h' are copied or adapted from the 'R' 'foreign' package created by Douglas M. Bates <bates@stat.wisc.edu> and Saikat DebRoy <saikat@stat.wisc.edu>, and are utilized and redistributed under the terms of the GNU General Public License, version 2.0 or later.

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SASxport-package	<i>Read and Write SAS Export Files</i>
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Description

This package provides functions to read, list contents of, and write SAS export files.

Details

The `read.xport` function reads SAS xport formatted files, augmenting the functionality of the `read.xport` function provided in the 'foreign' package with additional features, borrowed from `sasxport.get` in Frank Harrell's 'Hmisc' package. Namely, variables are properly coerced into the types specified by the format field. All standard numeric and string SAS formats are supported automatically, while user-defined formats are supported when the user has included the appropriate format data in the xport file via:

```
PROC FORMAT CNTLOUT=format;
```

In addition, labels are supported for variable and data frames, as are dataset 'types'.

The `write.xport` function writes one or more data sets into a SAS xport formatted file. Standard R data types, including date and time objects (e.g. `Date`, and `POSIX.t`) are stored with proper SAS format types. Handling of object formatting is customizable by providing methods for the function `toSAS`. This is accomplished by writing a new method for `toSAS` for the object class of interest. The `toSAS` method is responsible for converting its argument to either a simple floating point or character variable (the only basic types permitted by the xport format) and adding the appropriate SAS format code in the "SASformat" attribute.

The `write.xport` function also allows the user to override the operating system type and SAS version information, as well as object creation and modification times.

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<code>lookup.xport</code>	Lookup Information on a SAS XPORT Format Library
<code>read.xport</code>	Import SAS XPORT files
<code>toSAS.default</code>	Convert R data object for storage in SAS xport file
<code>units</code>	Set or Retrieve the label, SASformat, SASiformat, or units Attribute of a Vector
<code>write.xport</code>	Write data to a SAS XPORT file
<code>makeSASNames</code>	Create valid SAS names from a character vector.

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Author(s)

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The files `'R/AFirst.lib.s'`, `'R/all.is.numeric.R'`, `'R/importConvertDateTime.R'`, `'R/in.operator.R'`, `'R/makeNames.R'`, `'R/read.xport.R'`, and `'R/testDateTime.R'` are copied or adapted from the 'Hmisc' package created by Frank E. Harrell, Jr. <f.harrell@vanderbilt.edu>, and are utilized and redistributed under the terms of the GNU General Public License, version 2.0 or later.

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bRoy <saikat@stat.wisc.edu>, and are utilized and redistributed under the terms of the GNU General Public License, version 2.0 or later.

Alfalfa

Example SAS data set

Description

Alfalfa data from Brian Yandell's book *Practical Data Analysis for Designed Experiments*.

Usage

```
data(Alfalfa)
```

Format

A data frame with 40 observations on the following 6 variables.

POP Population, a factor with levels MAX and min

SAMPLE Sample ID (0:5)

REP Replicate (always 1)

SEEDWT Seed weight

HARV1 Harvest 1 volume

HARV2 Harvest 2 volume

Details

Population "MAX" has slightly higher harvest volumes (HARV1 and HARV2) than population "min". (Surprise! Shock! Awe!)

Source

<http://pages.stat.wisc.edu/~yandell/pda/data/Alfalfa/alfalfa.dat>.

References

Yandell, Brian S. *Practical data analysis for designed experiments*. Vol. 39. Crd Press, 1997.

Examples

```
data(Alfalfa)

# go were the data is...
here <- getwd()
setwd(system.file("extdata", package="SASxport"))

# Description of the file contents
lookup.xport("Alfalfa.xpt")
```

```

# Load the file contents
Alfalfa <- read.xport("Alfalfa.xpt")
head(Alfalfa)

# return home
setwd(here)

# Just for fun, plot the data
par(mfrow=c(1,2))
plot( HARV1 ~ POP, data=Alfalfa)
plot( HARV2 ~ POP, data=Alfalfa)

```

lookup.xport

Describe the Contents of an SAS XPORT File

Description

Describe the contents of an SAS XPORT file.

Usage

```

lookup.xport(file)
## S3 method for class 'lookup.xport'
print(x, ...)
## S3 method for class 'lookup.xport'
summary(object, ...)
## S3 method for class 'summary.lookup.xport'
print(x, ...)

```

Arguments

file	Character string specifying the name or URL of a SAS XPORT file.
x, object	Object to be printed or summarized
...	Optional arguments

Details

The `lookup.xport` function is a simple wrapper for the `lookup.xport` function provided by the `foreign` library. The wrapper adds the ability to handle URL's, and returns an object of class `lookup.xport` for which appropriate `print`, and `summary` functions are provided.

Value

`lookup.xport` returns a list with one component for each dataset in the XPORT format library.

`summary.lookup.xport` returns a single data frame containing:

dataset	Dataset name,
---------	---------------

name	Variable name,
type	Type of variable (one of 'character' or 'numeric'),
format	SAS format,
width	SAS format width,
label	Variable label,
nobs	Number of observations.

See Also

For complete documentation of `lookup.xport` see the manual page for [lookup.xport](#).

Examples

```
## Get information about a local file
alfFile <- system.file('extdata', 'Alfalfa.xpt', package='SASxport')
lookup.xport(alfFile)

## Read a copy of test2.xpt available on the web:
## Not run:
url <- 'http://biostat.mc.vanderbilt.edu/wiki/pub/Main/Hmisc/test2.xpt'
w <- lookup.xport(url)

## End(Not run)
## Or use the local copy...
testFile <- system.file('extdata', 'test2.xpt', package="SASxport")
w <- lookup.xport(testFile)

# display the information (calls 'print.lookup.xport')
w

# names of data sets
names(w)

# names of variables within data sets
w$Z$name

# use summary
wS <- summary(w)
wS # same display

# variable names within all data sets
wS$name
```

makeSASNames	<i>Create valid and unique SAS names from a character vector.</i>
--------------	---

Description

Create valid and unique SAS names from a character vector.

Usage

```
makeSASNames(names, nchar = 8, maxPasses = 10, quiet=FALSE)
```

Arguments

names	character vector of candidate names
nchar	maximum number of characters
maxPasses	maximum number of iterations to resolve truncation-related name duplication.
quiet	Logical indicating whether to generate warning messages when names are truncated or made unique.

Details

This function creates valid SAS names from a list of R object or column names, properly handling case conversion (all converted to upper-case), length restrictions (8 characters), and making duplicate names unique. This is not as obvious as it appears, since the process of shortening names can cause duplicates, and adding digits to the end of names to make them unique can make them too long, so a few iterations may be required to ensure valid and unique names.

Value

character vector of unique names valid in SAS.

Author(s)

Gregory R. Warnes <greg@warnes.net>

See Also

[make.names](#)

Examples

```
## Simple example: no duplicates or more than 8 characters
makeSASNames( c("height","weight","age","gender"))

## Resolve duplicates
makeSASNames( c("a","a","b","b","b","c") )

## Truncate long names
```

```

makeSASNames( c("alphabetic", "numeric", "alphanumeric", "whitespace"))

## Truncate and make unique
makeSASNames( rep( c("aaaaaaaaaa", "bbbbbbbbbb"), each=3) )

## Now do it quietly!
makeSASNames( rep( c("aaaaaaaaaa", "bbbbbbbbbb"), each=3), quiet=TRUE)

```

read.xport

Import a SAS XPORT File

Description

Read a SAS XPORT format file and return the contained dataset(s).

Usage

```

read.xport(file,
           force.integer=TRUE,
           formats=NULL,
           name.chars=NULL,
           names.to.lower=FALSE,
           keep=NULL,
           drop=NULL,
           as.is=0.95,
           verbose=FALSE,
           as.list=FALSE,
           include.formats=FALSE
          )

```

Arguments

<code>file</code>	Character string specifying the name or URL of a SAS XPORT file.
<code>force.integer</code>	Logical flag indicating whether integer-valued variables should be returned as integers (TRUE) or doubles (FALSE). Variables outside the supported integer range (<code>.Machine\$integer.max</code>) will always be converted to doubles.
<code>formats</code>	a data frame or list (like that created by <code>foreign::read.xport</code>) containing PROC FORMAT output, if such output is not stored in the main transport file.
<code>name.chars</code>	Vector of additional characters permissible in variable names. By default, only the alpha and numeric characters (<code>[A-Za-z0-9]</code>) and periods (<code>'.'</code>) are permitted. All other characters are converted into periods (<code>'.'</code>).
<code>names.to.lower</code>	Logical indicating whether variable and dataset names should be converted to lowercase (TRUE) or left uppercase (FALSE)
<code>keep</code>	a vector of names of SAS datasets to process. This list must include PROC FORMAT dataset if it is present for datasets to use any of its value label formats.
<code>drop</code>	a vector of names of SAS datasets to ignore (original SAS upper case names)

<code>as.is</code>	<p>Either a logical flag indicating whether SAS character variables should be preserved as character objects (TRUE) or factor objects (FALSE), or a fractional cutoff between 0 and 1.</p> <p>When a fractional cutoff is provided, character variables containing a more than this fraction of unique values will be stored as a character variables. This is done in order to preserve space, since factors must store both the integer factor codes and the character factor labels.</p>
<code>verbose</code>	Logical indicating whether progress should be printed during the data loading and conversion process.
<code>as.list</code>	Logical indicating whether to return a list even if the SAS xport file contains only one dataset.
<code>include.formats</code>	Logical indicating whether to include SAS format information (if present) in the returned list

Details

- SAS date, time, and date/time variables are converted respectively to Date, POSIX, or chron objects
- SAS labels are stored in "label" attributes on each variable, and are accessible using the [label](#) function.
- SAS formats are stored in "SASformat" attributes on each variable, and are accessible using [SASformat](#)
- SAS iformats are stored in "SASiformat" attributes on each variable, and are accessible using [SASiformat](#)
- SAS integer variables are stored as integers unless `force.integer` is FALSE

If the file includes the output of PROC FORMAT CNTLOUT=, variables having customized label formats will be converted to factor objects with appropriate labels.

If a datasets in the original file has a label or type, these will be stored in the corresponding 'label' and 'SAStype' attributes, which can be accessed by the [label](#) and [SAStype](#) functions.

Value

If only a single dataset is present (after removing PROC FORMAT data when `include.formats=FALSE`), the return value is a single dataframe object. Otherwise the return is a list of dataframe objects.

Note that if `include.formats=TRUE`, the returned list will contain a dataframe named "FORMATS" containing any available 'PROC FORMAT' information.

Note

This code provides a subset of the functionality of the `sasxport.get` function in the Hmisc library.

Author(s)

Gregory R. Warnes <greg@warnes.net> based on `Hmisc::sasxport.get` by Frank E. Harrell, Jr.

See Also

[read.xport](#), [label](#), [sas.get](#), [sasxport.get](#), [Dates](#), [DateTimeClasses](#), [chron](#), [lookup.xport](#), [contents](#), [describe](#), [label](#), [SASformat](#), [SASifformat](#), and [SAStype](#)

Examples

```
## -----
## SAS code to generate test dataset:
## -----
## libname y SASV5XPT "test2.xpt";
##
## PROC FORMAT; VALUE race 1=green 2=blue 3=purple; RUN;
## PROC FORMAT CNTLOUT=format;RUN; * Name, e.g. 'format', unimportant;
## data test;
## LENGTH race 3 age 4;
## age=30; label age="Age at Beginning of Study";
## race=2;
## d1='3mar2002'd ;
## dt1='3mar2002 9:31:02'dt;
## t1='11:13:45't;
## output;
##
## age=31;
## race=4;
## d1='3jun2002'd ;
## dt1='3jun2002 9:42:07'dt;
## t1='11:14:13't;
## output;
## format d1 mmdyy10. dt1 datetime. t1 time. race race.;
## run;
## data z; LENGTH x3 3 x4 4 x5 5 x6 6 x7 7 x8 8;
## DO i=1 TO 100;
##     x3=ranuni(3);
##     x4=ranuni(5);
##     x5=ranuni(7);
##     x6=ranuni(9);
##     x7=ranuni(11);
##     x8=ranuni(13);
##     output;
##     END;
## DROP i;
## RUN;
## PROC MEANS; RUN;
## PROC COPY IN=work OUT=y;SELECT test format z;RUN; *Creates test2.xpt;
## -----

## Read this dataset from a local file:
testFile <- system.file('extdata', 'test2.xpt', package="SASxport")
w <- read.xport(testFile)
class(w)
sapply(w, head)
```

```
## Not run:
## Or read a copy of test2.xpt available on the web:
url <- 'http://biostat.mc.vanderbilt.edu/wiki/pub/Main/Hmisc/test2.xpt'
w <- read.xport(url)

## End(Not run)

## We can also get the dataset wrapped in a list
w <- read.xport(testFile, as.list=TRUE)
class(w)
sapply(w, head)

## And we can ask for the format information to be included as well.
w <- read.xport(testFile, as.list=TRUE, include.formats=TRUE)
class(w)
sapply(w, head)

#### The Hmisc library provides many useful functions for interacting with
#### data imported from SAS via read.xport()
library(Hmisc)

describe(w$TEST) # see labels, format names for dataset test
lapply(w, describe, "")# see descriptive stats in more detail for each variable

contents(w$TEST) # another way to see variable attributes
lapply(w, contents)# show contents of individual items in more detail

options(digits=7) # compare the following matrix with PROC MEANS output
t(sapply(w$Z, function(x)
  c(Mean=mean(x),SD=sqrt(var(x)),Min=min(x),Max=max(x))))
```

SASformat

Set or Retrieve the 'label', 'SASformat', 'SASiformat', or 'SASStype' attribute of a vector or (components of) a data frame

Description

Sets or retrieves the "SASformat", "SASiformat", or SASStype attribute of an object.

More comprehensive support for object labels, and SASformat, are available in Frank Harrell's Hmisc package.

Note that SASStype enforces the SAS 8-character naming convention.

Usage

```
SASformat(x, default)
SASformat(x) <- value
```

```
SASiformat(x, default)
SASiformat(x) <- value
```

```
SAStype(x, default)
SAStype(x) <- value
```

Arguments

x	any object
value	new value for the "label", "SASformat", "SASiformat", or SAStype attribute of an object.
default	value to return when no appropriate attribute is found. The usual return value is NULL.

Value

the contents of the "label", "SASformat", "SASiformat", "SAStype" attribute of x, if any; otherwise, the value provided by default.

Author(s)

Gregory R. Warnes <greg@warnes.net> based on code from the Hmisc library by Frank E. Harrell, Jr.]

Examples

```
## Examples for vectors

fail.time <- c(10,20)

# set attributes
SASformat(fail.time) <- 'Numeric2'
SASiformat(fail.time) <- 'Numeric2'

# display individual attributes
SASformat(fail.time)
SASiformat(fail.time)

# display all attributes
attributes(fail.time)

## SAStype only applies to data frames
df <- data.frame( fail.time, day=c("Mon","Tue") )
SAStype(df) <- "USER"
```

```

SAStype(df)

## Example showing specification of default return value
a <- 70
label(a, default="no label")

```

toSAS.default

Convert R Data Object for Storage in a SAS XPORT File

Description

The toSAS methods control how R objects and data types are represented when stored into a SAS xport format file using write.xport.

Usage

```

toSAS(x, format, format.info=NULL)
## Default S3 method:
toSAS(x, format=SASformat(x), format.info=NULL)
## S3 method for class 'numeric'
toSAS(x, format=SASformat(x), format.info=NULL)
## S3 method for class 'logical'
toSAS(x, format=SASformat(x), format.info=NULL)
## S3 method for class 'character'
toSAS(x, format=SASformat(x), format.info=NULL)
## S3 method for class 'factor'
toSAS(x, format=SASformat(x), format.info=NULL)
## S3 method for class 'POSIXt'
toSAS(x, format="DATETIME16.", format.info=NULL)
## S3 method for class 'Date'
toSAS(x, format="DATE9.", format.info=NULL)

```

Arguments

x	Object to be converted
format	SAS format name
format.info	Table of SAS format information

Details

To add support for a new object type, create an appropriate toSAS method. This method must convert the object data to either an object of type "numeric" (double-precision floating point) or type "character", the only basic types permitted by the xport format, and should add an attribute named "SASformat" to the object providing an appropriate SAS format string or "" (indicating the default SAS format).

Value

A vector of type "character" or of type "numeric", with an attribute named "label" containing the SAS format specification.

Author(s)

Gregory R. Warnes <greg@warnes.net>

See Also

[write.xport](#), [read.xport](#), [lookup.xport](#)

Examples

```
####
## See how an R date/time object will be stored in a SAS xport file:
####

# Date and time
dateTimeObj <- ISOdate(2007,08,01,10,14,37)
class(dateTimeObj)
dateTimeObj

sasDateTimeObj <- toSAS(dateTimeObj)
sasDateTimeObj

# Now just the date portion
dateObj <- as.Date(dateTimeObj)
dateObj

sasDateObj <- toSAS(dateObj)
sasDateObj

####
## Create a new R object class based on factor to hold color names
####
colorFactor <- function(x) # constructor
{
  retval <- factor(x, levels=c("Red","Green","Blue") )
  class(retval) <- c("colorFactor","factor")
  retval
}

## create one and look at it
cf <- colorFactor( c("Red","Red","Blue",NA) )
cf

## See how it will be represented in a SAS xport file
toSAS(cf)

## Create a new conversion function to store as a RGB hex value
```

```

toSAS.colorFactor <- function(x, format="")
{
  retval <- ifelse(x=="Red", "#FF0000",
                  ifelse(x=="Green", "#00FF00", "#0000FF") )
  attr(retval, "SASformat") <- format
  retval
}

## see it in action
toSAS(cf)

```

write.xport

Write Data to a SAS XPORT File

Description

This function writes one or more data frames into a SAS XPORT format library file.

Usage

```

write.xport(...,
            list=base::list(),
            file = stop("'file' must be specified"),
            verbose=FALSE,
            sasVer="7.00",
            osType,
            cDate=Sys.time(),
            formats=NULL,
            autogen.formats=TRUE
)

```

Arguments

...	One or more data frames to be stored
list	A list containing data frames to be stored.
file	File name or connection object. Use "" to view the raw data
verbose	Logical flag controlling whether status is reported during processing
sasVer	SAS version string
osType	Opererating system, defaults to "R X.Y.Z" for appropriate values of X, Y, and Z
cDate	Date object specifying dataset creation date
formats	Optional data frame containing SAS format information.
autogen.formats	Logical indiciating whether SAS formats should be auto-generated for factor variables.

Details

The function creates a SAS XPORT data file (see reference) from one or more data frames. This file format imposes a number of constraints:

- Data set and variable names are truncated to 8 characters and converted to upper case. All characters outside of the set A-Z, 0-9, and '_' are converted to '_'.
- Character variables are stored as characters.
- If `autogen.formats=TRUE` (the default), factor variables are stored as numeric with an appropriate SAS format specification. If `autogen.formats=FALSE`, factor variables are stored as characters.
- All numeric variables are stored as double-precision floating point values utilizing the IBM mainframe double precision floating point format (see the reference).
- Date and time variables are either converted to number of days since 1960-01-01 (date only), or number of seconds since 1960-01-01:00:00:00 GMT (date-time variables).
- Missing values are converted to the standard SAS missing value '.'

The SAS XPORT format allows each dataset to have a label and a type (set via the `label` and `SAS$type` functions). In addition, each variable may have a corresponding label, display format, and input format. To set these values, add the attribute 'label', 'SASformat', or 'SASiformat' to individual data frame. These attributes may be set using the `label`, `SASformat`, and `SASiformat` functions. (See examples provided below.)

The actual translation of R objects to objects appropriate for SAS is handled by the `toSAS` generic and associated methods, which can be (re)defined by the user to provide fine-grained control.

Value

No return value

Note

This package was created with partial funding by Metrum Institute <http://metruminstitute.org>.

Author(s)

Gregory R. Warnes <greg@warnes.net>

References

SAS Technical Support document TS-140: "The Record Layout of a Data Set in SAS Transport (XPORT) Format" available at <https://support.sas.com/techsup/technote/ts140.pdf>

See Also

[toSAS](#), [lookup.xport](#), [read.xport](#), [label](#), [SAS\\$type](#), [SASformat](#), and [SASiformat](#)

Examples

```
#####
## R version of the example given in TS-140
#####

## manually create a data set
abc <- data.frame( x=c(1, 2, NA, NA ), y=c('a', 'B', NA, '*' ) )

## look at it
abc

## add a format specifier (not used by R)
SASformat(abc$x) <- 'date7.'

## add a variable label (not used by R)
label(abc$y) <- 'character variable'

## add a dataset label and type
label(abc) <- 'Simple example'
SAStype(abc) <- 'MYTYPE'

## verify the additions
str(abc)

# create a SAS XPORT file
tmp <- tempfile(fileext = ".dat")
write.xport( abc, file = tmp )

# list the contents of the file
lookup.xport(tmp)

## reload the data
xxx.abc <- read.xport(tmp)

## and look at it
xxx.abc

## Check the label and type
label(xxx.abc)
SAStype(xxx.abc)

## Note that the variable names and SAS dataset type have been converted
## to uppercase
```

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