Missing value handling in R

MISSING VALUE HANDLING IN R

Missing value handling in R

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Missing value handling in R

We need data that is:

- Relevant
- Connected
- Accurate
- Enough to work with

Missing value handling in R

Example of missing values dataset

Column 0	age	years_seniority	income	parking_space	attending_party	entree	pets	emergency_contact
Tony	48	27		1	5	shrimp		Pepper
Donald	67	25	86	10	2	beef		Jane
Henry	69	21	95	6	1	chicken	62	Janet
Janet	62	21	110	3	1	beef		Henry
Nick		17		4				
Bruce	37	14	63		1	veggie		NA
Steve	83		77	7	1	chicken		n/a
Clint	27	9	118	9		shrimp	3	None
Wanda	19	7	52	2	2	shrimp		empty
Natasha	26	4	162	5	3			_
Carol		3	127	11	1	veggie	1	""""
Mandy	44	2	68	8	1	chicken		null

Missing value handling in R

Too many missing data == Swiss cheese

Missing value handling in R

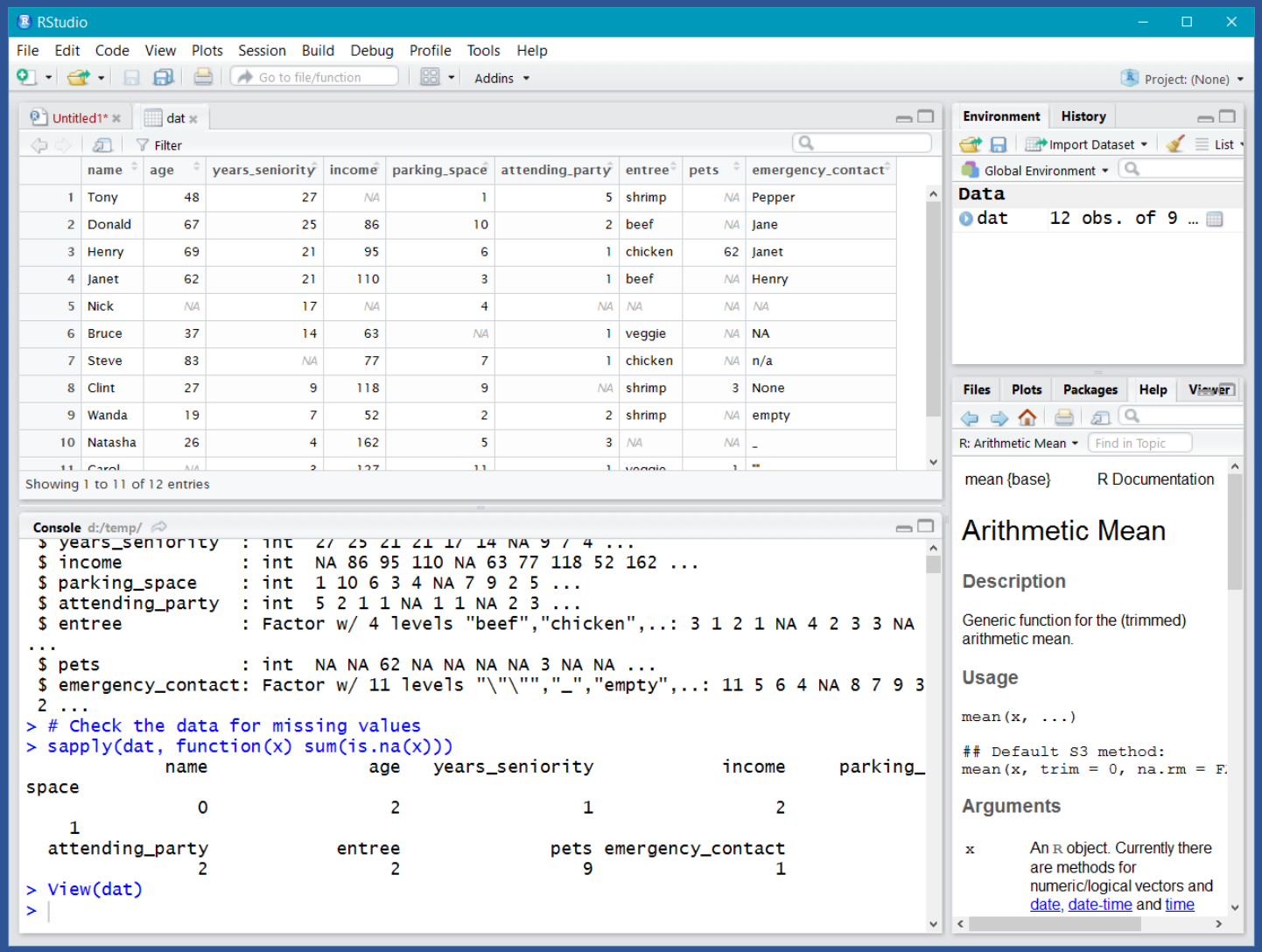
Example of missing values dataset CSV file

missing_values.csv

	A	B	C	D	E	F	G	H	I
1		age	years_seniority	income	parking_space	attending_party	entree	pets	emergency_contact
2	Tony	48	27		1	5	shrimp		Pepper
3	Donald	67	25	86	10	2	beef		Jane
4	Henry	69	21	95	6	1	chicken	62	Janet
5	Janet	62	21	110	3	1	beef		Henry
6	Nick		17		4				
7	Bruce	37	14	63		1	veggie		NA
8	Steve	83		77	7	1	chicken		n/a
9	Clint	27	9	118	9		shrimp	3	None
10	Wanda	19	7	52	2	2	shrimp		empty
11	Natasha	26	4	162	5	3			_
12	Carol		3	127	11	1	veggie	1	""
13	Mandy	44	2	68	8	1	chicken		null

Missing value handling in R

R Studio



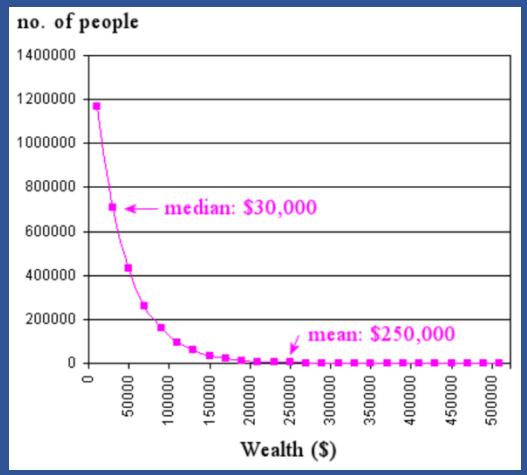
Missing value handling in R

General commands

```
rm(list = ls()) # clear work space
setwd("d:/temp") # set current work directory
sessionInfo() # get session information
installed.packages() # list installed packages
# import data file
dat <- read.csv("missing_values.csv", na.strings = "")
str(dat) # show data frame structure
# Check the data for missing values
sapply(dat, function(x) sum(is.na(x)))
```

Missing value handling in R

Replace missing values with the mean



Sample Mean	Population Mean
$\bar{x} = \frac{\Sigma x}{n}$	$\mu = \frac{\Sigma x}{N}$

where Σx is sum of all data values

N is number of data items in population

n is number of data items in sample

```r
# Replace missing values with the mean
# column = age
# Missing values type = distributed
# Formal name =  Missing Completely at Random (MCAR)
rm(list = ls()) # clear work space
setwd("d:/temp") # set current work directory
# import data file
dat <- read.csv("missing_values.csv", na.strings = "")
dat$age.mean <- ifelse(is.na(dat$age),
                       mean(dat$age, na.rm = TRUE),
                       dat$age)
```

Missing value handling in R

Replace missing values with the median

$$Median = l + \frac{h}{f}\left(\frac{N}{2} - c\right)$$

Where:

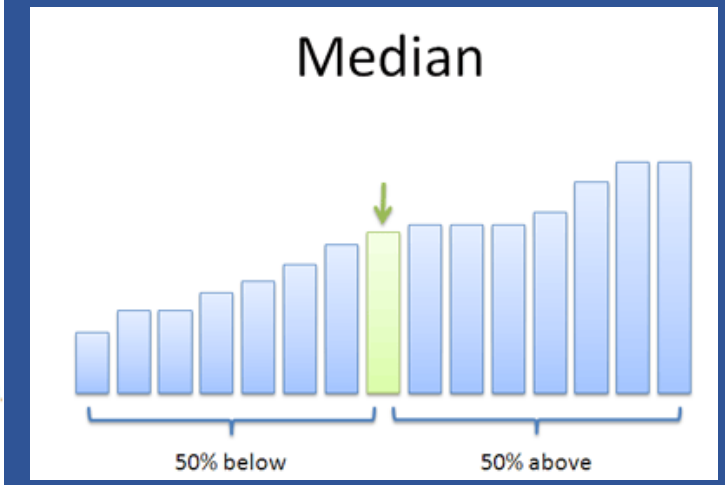
l = lower class boundary of the median class

h = Size of the median class interval

f = Frequency corresponding to the median class

N = Total number of observations i.e. sum of the frequencies

c = Cumulative frequency preceding median class.

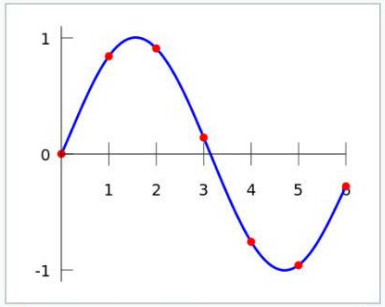



```
# Replace missing values with the median
# column = age
# • Another justifiable way to handle missing-at-random data
rm(list = ls()) # clear work space
setwd("d:/temp") # set current work directory
# import data file
dat <- read.csv("missing_values.csv", na.strings = "")
dat$age.mean <- ifelse(is.na(dat$age),
                       median(dat$age, na.rm = TRUE), dat$age)
```

Missing value handling in R

Replace missing values with an interpolated estimate

```
# Replace missing values with an interpolated estimate
# column = years_seniority
# the values in this column, years seniority, is ordered,
# greatest to least. This structure can be exploited by
# interpolating the missing value. This approach is very effective
# when it is appropriate, usually with time - series data.
rm(list = ls()) # clear work space
setwd("d:/temp") # set current work directory
# import data file
dat <- read.csv("missing_values.csv", na.strings = "")
dat$senior <- ifelse(is.na(dat$years_seniority), 11.5,
                     dat$years_seniority)
```



Plot of the data with polynomial interpolation applied

Missing value handling in R

Replace missing values with a constant

```
# Replace missing values with a constant
# column = income
# Missing values are Missing Not at Random(MNAR)
# Those with very high incomes preferred not to state them
# Make a reasonable guess for what "high" means and fill
# in the blanks. It will still be inaccurate, but better than blank

rm(list = ls()) # clear work space
setwd("d:/temp") # set current work directory
# import data file
dat <- read.csv("missing_values.csv", na.strings = "")
dat$income4 <- ifelse(is.na(dat$income), 250, dat$income)
```

Missing value handling in R

Replace missing values using imputation MICE

```
# Column = years_seniority, age, income
# Method = multivariate imputation by chained equations(MICE)
# MICE is the method of choice for complex incomplete data
# Good for missing data in more than one variable
# powerful when features are somewhat related

rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
# A fast, consistent tool for working with data frame
install.packages("dplyr")
library(dplyr) # attach packages
# Make new dataframe with column years_seniority,
# age, income with column type = numeric
dat <- dat %>% # make new 3 columns with type numberic
        mutate(
            senior1 = as.numeric(years_seniority),
            age1 = as.numeric(age),
            income1 = as.numeric(income)
            )
```

Missing value handling in R

Replace missing values using imputation MICE

```
# Replace missing values using imputation MICE
keep <- c("senior1", "age1", "income1")
#drop all columns but keep 3 col
dat <- dat[, keep, drop = FALSE]
install.packages('mice')        # standard command
library(mice)                   # standard command
init = mice(dat, maxit = 0)     # standard command
meth = init$method              # standard command
predM = init$predictorMatrix
# Bayesian linear regression (การวิเคราะห์ถดถอยเชิงเส้นแบบเบยส์)
meth[c("senior1")] = "norm"
Predictive mean matching
meth[c("age1")] = "pmm" #
meth[c("income1")] = "pmm"
# Replace missing values using imputation MICE
set.seed(103) # seed for pseudo random number generator
imputed = mice(dat, method = meth, predictorMatrix = predM, m = 5)
imputed <- complete(imputed)
```

Missing value handling in R

Replace missing values with a missing rank

```
# Replace missing values with a missing rank
# Column = parking_space
# Our knowledge of how parking spaces are numbered,
# let us make a guess here
# All the space numbers from 1 - 11
# Missing one might be 12
rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$park <- ifelse(is.na(dat$parking_space), 12,
                   dat$parking_space)
```

Missing value handling in R

Replace missing values with a dummy

```
# eplace missing values with a dummy
# Column = parking_space
# Filling in a dummy value
# Clearly different from actual values
# Such as a negative rank
# Used to indicate that the feature is not applicable

rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$park <- ifelse(is.na(dat$parking_space), -99,
                   dat$parking_space)
```

Missing value handling in R

Replace missing values with 0

```
# eplace missing values with 0
# Column = attending_party
# A missing numerical value can mean zero.
# In the case of an RSVP, invitees who are not planning
# to attend sometimes neglect to respond, but guests
# planning to attend are more likely to.
# In this case, filling in missing blanks with a zero is reasonable
rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$party <- ifelse(is.na(dat$attending_party), 0, dat$attending_party)
```

Missing value handling in R

Create an indicator variable for "missing"

```
# Create an indicator variable for "missing"
# Column = pets
# Replacing missing values requires making assumptions.
# Whenever your confidence in those assumptions is low,
# it is safer to also create a true / false feature
# indicating that the value was missing.
# This allows many algorithms to learn to weight those differently.
rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$pet1 <- ifelse(is.na(dat$pet), 0, dat$pets)
dat$pet2 <- complete.cases(dat$pets)
```

Missing value handling in R

Replace missing values with a string

```
# Replace missing values with a string
# Column = emergency_contact
# Replace NA with “no”

rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$emer <- ifelse(is.na(dat$emergency_contact), 'no',
                   dat$emergency_contact)
```

Missing value handling in R

Add an indicator variable showing which strings are considered "missing."

```
# Add an indicator variable showing which strings
# are considered "missing."
# Column = emergency_contact
# There are lots of ways to communicate the concept
# of "missing" in a string
# Replace no, NA, n / a, None, _,"""",empty,null with 0
# Otherwise = 1
rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat$emer <- ifelse(dat[9] == 'NA' |
      is.na(dat[9]) | dat[9] == 'n/a' |
      dat[9] == 'None' | dat[9] == 'empty' |
      dat[9] == '_' | dat[9] == '""' | dat[9] == 'null', 0, 1)
```

Missing value handling in R

Delete columns that are missing too many values to be useful

```
# Column = pets
# Is a feature that missing too many values
# Not enough information available to make reasonable
# assumptions about how to replace the missing values
# Best policy = delete the column entirely.

rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat <- dat[, !(names(dat) %in% 'pets')]
```

Missing value handling in R

Delete rows that are missing critical values

```
# Delete rows that are missing critical values
# Rows that are missing important features can be deleted.
# This is particularly useful when you have the luxury of
# hand - picking high - quality data
# such as when training a model
rm(list = ls())
dat <- read.csv("missing_values.csv", na.strings = "")
dat <- dat[complete.cases(dat),]
```

Missing value handling in R

More information on Missing value handling in R

Bayesian linear regression analysis without tears (R)

https://www.r-bloggers.com/bayesian-linear-regression-analysis-without-tears-r/

Source code

https://github.com/laploy/ML/blob/master/Missing%20R%20Script.zip