DEALING WITH MISSING DATA IN R

Searching for and replacing missing values

Nicholas Tierney
Statistician

What we are going to cover

- How to look for hidden missing values
- Replacing missing value labels with `NA`
- Checking your assumptions on missingness

Searching for and replacing missing values

- Ideal = `NA`
- Missing values can be coded incorrectly: e.g. "missing", "Not Available", "N/A"
- Assuming that missing values are coded as `NA`. This is a mistake.

Understanding Chaos

score	grade	place
3	N/A	-99
-99	E	97
4	missing	95
-99	na	92
7	n/a	-98
10		missing
12	.	88
16		.
9	N/a	86

Searching for missing values

```
miss_scan_count()
```

```
chaos %>%
  miss_scan_count(search = list("N/A"))
```

```
# A tibble: 3 x 2
  Variable     n
  <chr>    <int>
1 score        0
2 grade        1
3 place        0
```

Searching for missing values

```
chaos %>%
  miss_scan_count(search = list("N/A",
                                "N/a"))
```

```
# A tibble: 3 x 2
  Variable     n
  <chr>    <int>
1 score        0
2 grade        2
3 place        0
```

Replacing missing values

```
chaos %>%
  replace_with_na(replace = list(grade = c("N/A", "N/a")))
```

```
# A tibble: 9 x 3
  score grade   place
  <dbl> <chr>   <chr>
1     3 NA      -99
2   -99 E       97
3     4 missing 95
4   -99 na      92
5     7 n/a     -98
6    10 " "     missing
7    12 .       88
8    16 ""      .
9     9 NA      86
```

"scoped variants" of replace_with_na

- `replace_with_na` can be repetitive:
  - Use it across many different variables and values
  - Complex cases, replacing values less than -1, only affect character columns.
- `replace_with_na_all()` All variables.
- `replace_with_na_at()` A subset of selected variables.
- `replace_with_na_if()` A subset of variables that fulfill some condition (numeric, character).

Using scoped variants of replace_with_na

```
chaos %>%
replace_with_na_all(condition = ~.x == -99)

# A tibble: 9 x 3
  score grade   place
  <dbl> <chr>   <chr>
1     3 N/A     NA
2    NA E       97
3     4 missing 95
4    NA na      92
5     7 n/a     -98
6    10 " "     missing
7    12 .       88
8    16 ""      .
9     9 N/a     86
```

Using scoped variants of replace_with_na

```
chaos %>%
replace_with_na_all(condition = ~.x %in% c("N/A", "missing", "na"))
```

```
# A tibble: 9 x 3
  score grade place
  <dbl> <chr> <chr>
1     3 NA    -99
2   -99 E     97
3     4 NA    95
4   -99 NA    92
5     7 n/a   -98
6    10 " "   NA
7    12 .     88
8    16 ""    .
9     9 N/a   86
```

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Let's practice!

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Missing, missing data

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Another perspective on missing data

name	time	value
robin	morning	358
robin	afternoon	534
robin	evening	100
sam	morning	139
sam	afternoon	177
blair	morning	963
blair	afternoon	962
blair	evening	929

name	afternoon	evening	morning
blair	962	929	963
robin	534	100	358
sam	177	NA	139

Explicit and Implicit missing values

- **explicitly**: They are missing with `NA`
- **implicitly**: Not shown in the data, but implied

Making implicit missings explicit

```
tetris %>%
  tidyr::complete(name, time)
```

```
# A tibble: 9 x 3
  name  time      value
  <fct> <fct>     <dbl>
1 blair afternoon   962
2 blair evening     929
3 blair morning     963
4 robin afternoon   534
5 robin evening     100
6 robin morning     358
7 sam   afternoon   177
8 sam   evening      NA
9 sam   morning     139
```

Handling explicitly missing values

name	time	value
robin	morning	936
NA	afternoon	635
NA	evening	438
sam	morning	208
NA	afternoon	92
NA	evening	79
blair	morning	969
NA	afternoon	918
NA	evening	954

name	time	value
robin	morning	936
robin	afternoon	635
robin	evening	438
sam	morning	208
sam	afternoon	92
sam	evening	79
blair	morning	969
blair	afternoon	918
blair	evening	954

Handling explicitly missing values

name	time	value
robin	morning	936
NA	afternoon	635
NA	evening	438
sam	morning	208
NA	afternoon	92
NA	evening	79
blair	morning	969
NA	afternoon	918
NA	evening	954

```
tetris %>%
  tidyr::fill(name)
```

```
# A tibble: 9 x 3
  name  time      value
  <chr> <chr>     <dbl>
1 robin morning     936
2 robin afternoon   635
3 robin evening     438
4 sam   morning     208
5 sam   afternoon    92
6 sam   evening      79
7 blair morning     969
8 blair afternoon   918
9 blair evening     954
```

A Warning

```
tetris %>%
  tidyr::fill(name)
```

```
# A tibble: 9 x 3
  name  time      value
  <chr> <chr>     <dbl>
1 robin morning     936
2 robin afternoon   635
3 robin evening     438
4 sam   morning     208
5 sam   afternoon    92
6 sam   evening      79
7 blair morning     969
8 blair afternoon   918
9 blair evening     954
```

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Missing Data dependence

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Statistician

Outline

- **MCAR** Missing Completely at Random
- **MAR** Missing At Random
- **MNAR** Missing Not At Random

MCAR: What is it?

Missingness has no association with any data you have observed, or not observed.

test	vacation
NA	TRUE
11.533340	FALSE
10.126115	TRUE
NA	FALSE
NA	TRUE
8.551881	FALSE
NA	FALSE
NA	TRUE
10.608264	TRUE
8.611877	TRUE

MCAR: What are the implications

Implications

- Imputation is advisable
- Deleting observations may reduce sample size, limiting inference, but will not bias
- You should be imputing data

MAR: What is it?

Missingness depends on data observed, but not data observed

Implications:

- Impute
- Deleting observations not ideal, may lead to bias

test	vacation	depression
NA	TRUE	87.93109
11.533340	FALSE	40.02708
10.126115	TRUE	48.62883
NA	FALSE	88.21743
NA	TRUE	90.29282
8.551881	FALSE	44.77343
NA	FALSE	89.48865
NA	TRUE	89.99209
10.608264	TRUE	45.56832
8.611877	TRUE	42.41686

MNAR: What is it?

Missingness of the response is related to an unobserved value relevant to the assessment of interest.

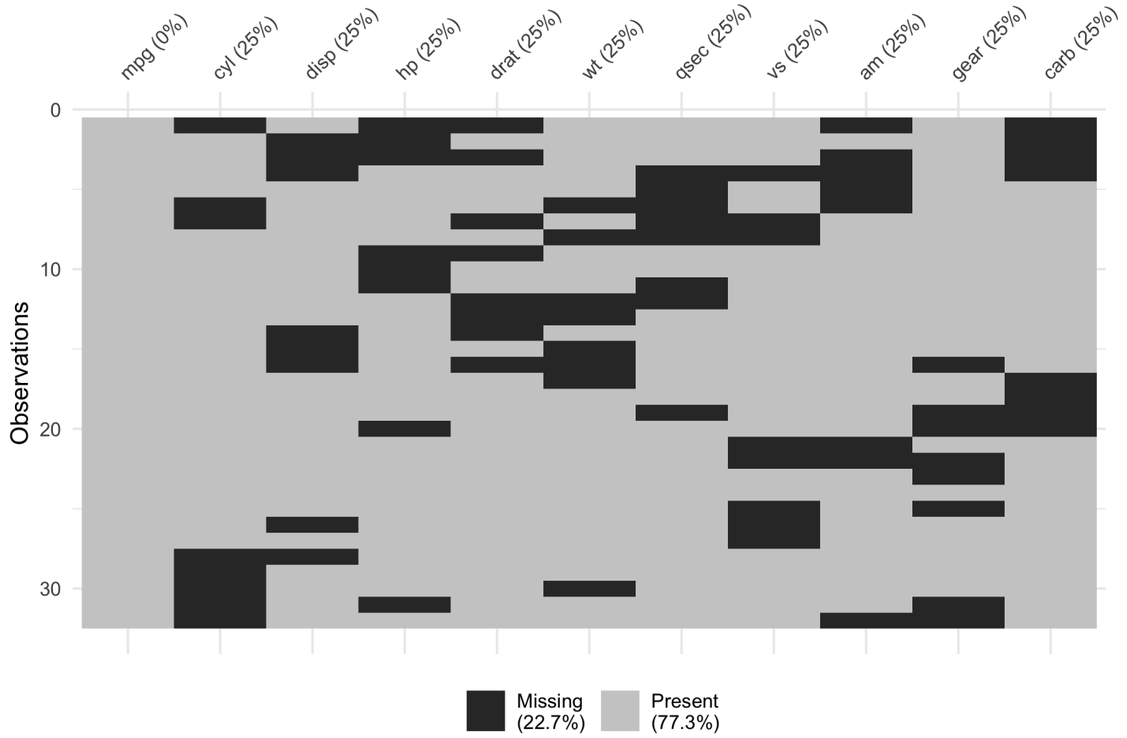
Implications:

- Data will be biased from deletion and imputation
- Inference can be limited, proceed with caution.

test	vacation	depression
NA	TRUE	NA
11.533340	FALSE	11.533340
10.126115	TRUE	10.126115
NA	FALSE	NA
NA	TRUE	NA
8.551881	FALSE	8.551881
NA	FALSE	NA
NA	TRUE	NA
10.608264	TRUE	10.608264
8.611877	TRUE	8.611877

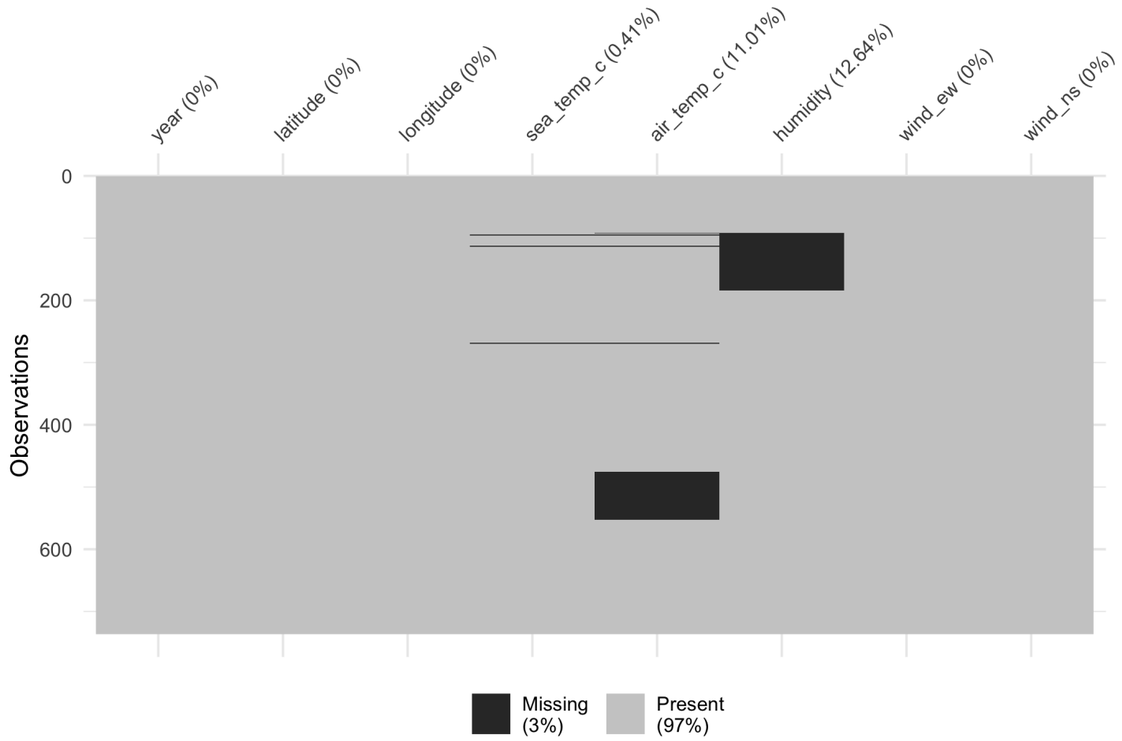
Example: MCAR

```
vis_miss(mt_cars, cluster = TRUE)
```



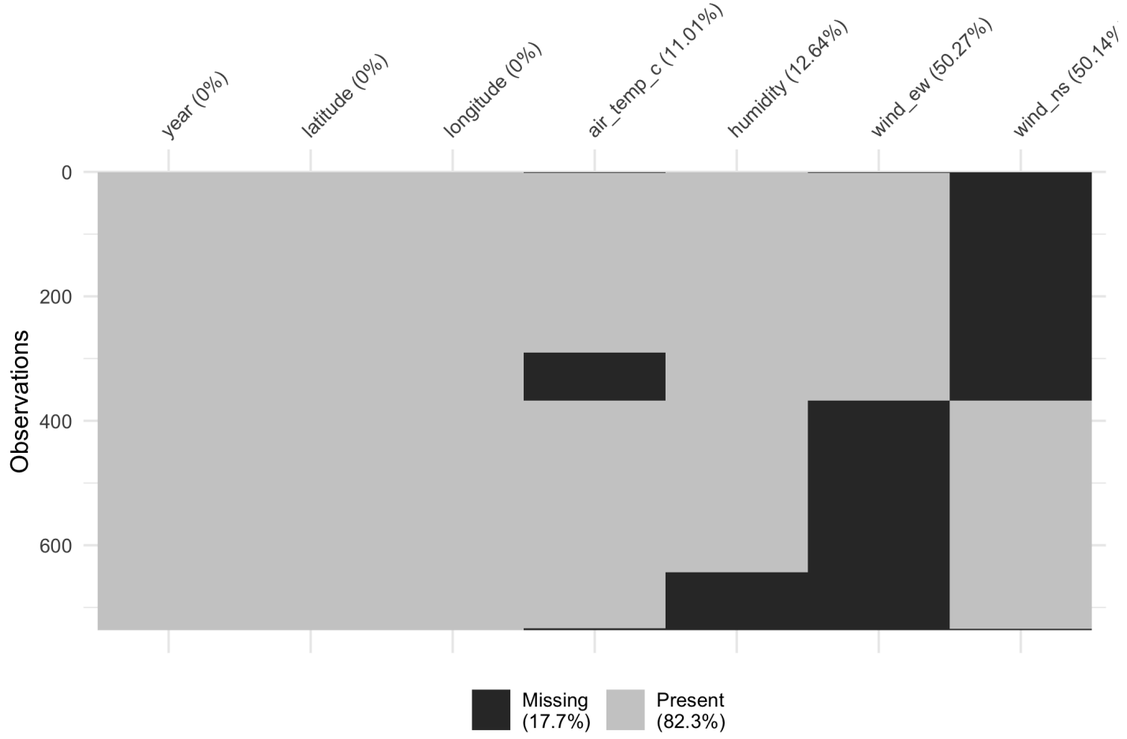
Example: MAR

```
oceanbuoys %>% arrange(year) %>% vis_miss()
```



Example: MNAR

```
vis_miss(ocean, cluster = TRUE)
```



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