

# data cleaning principles

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Tidy datasets are all alike,  
but every messy dataset  
is messy in its own way.

— Hadley Wickham

If I clean up [Medicare] data ...  
does any of the knowledge I gain ...  
apply to the processing of RNA-seq data?

– Roger Peng

# Data Mishaps Night

Join us for the first inaugural Data Mishaps Night!  
We will feature a lineup of data mistake stories with  
a focus on the human aspect of data work and  
lessons learned the hard way.



Caitlin Hudon & Laura Ellis  
[dataMishapsNight.com](http://dataMishapsNight.com)

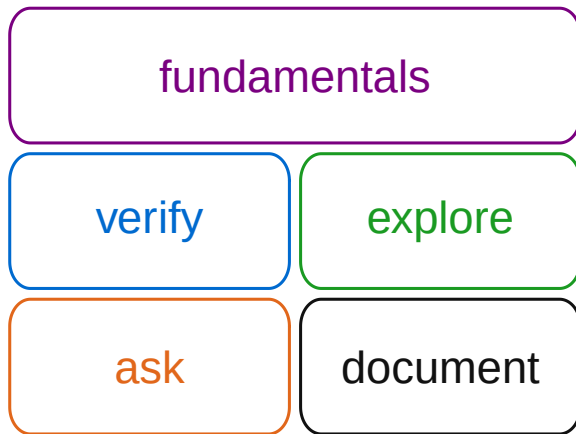
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- ▶ needs context
- ▶ doesn't feel like progress

# Data cleaning

- ▶ tedious
- ▶ embarrassing
- ▶ needs context
- ▶ doesn't feel like progress
- ▶ requires creativity
- ▶ requires coding prowess
- ▶ source of many problems

# Data cleaning principles



## fundamentals

1. Don't clean data when you're tired or hungry.

(paraphrasing Ghazal Gulati)



## fundamentals

2. Don't trust anyone (even yourself)

## fundamentals

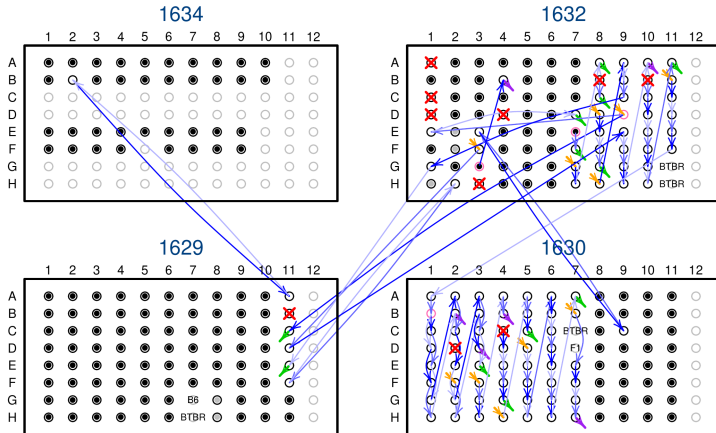
### 2. Don't trust anyone (even yourself)

“my motto is ‘trust no one’  
...except maybe @kwbroman?”

– Jenny Bryan

# fundamentals

3. Think about what might have gone wrong and how it might be revealed



doi:10/gpfzs8

# fundamentals

## 4. Use care in merging

|    | A      | B          | C          | D          | E          | F          | G         |            |            |
|----|--------|------------|------------|------------|------------|------------|-----------|------------|------------|
| 1  | id     | glucose.0  | glucose.5  | glucose.15 | glucose.30 | insulin.0  | insulin.5 |            |            |
| 2  | DO-221 | 145.742786 | 206.452638 | 216.640608 | 299.55501  | 0.74455    | 2.0264    |            |            |
| 3  | DO-222 |            |            |            |            |            |           |            |            |
| 4  | DO-223 |            | A          | B          | C          | D          | E         | F          | G          |
| 5  | DO-224 | 1          | id         | glucose.0  | insulin.0  | glucose.5  | insulin.5 | glucose.15 | insulin.15 |
| 6  | DO-225 | 2          | DO-321     | 66.839405  | 0.04       | 246.685995 | 0.04      | 305.26214  | 0.04       |
| 7  | DO-226 | 3          | DO-322     | 98.12509   | 0.51185    | 246.25574  | 1.4062    | 301.8201   | 2.828      |
| 8  | DO-227 | 4          | DO-323     | 94.68305   | 1.7812     | 448.1068   | 1.0248    | 521.61894  | 1.02725    |
| 9  | DO-228 | 5          | DO-324     | 121.051535 | 0.0882     | 407.355505 | 0.63475   | 470.541525 | 0.8195     |
| 10 | DO-229 | 6          | DO-325     | 122.95695  | 0.19155    | 298.193665 | 0.6467    | 323.148455 | 0.40515    |
| 11 | DO-230 | 7          | DO-326     | 201.447755 | 0.7454     | 386.51887  | 0.6081    | 654.99799  | 1.07225    |
|    |        | 8          | DO-327     | 130.025425 | 0.0509     | 477.302675 | 0.166     | 610.49733  | 0.4842     |
|    |        | 9          | DO-328     | 143.60919  | 0.23435    | 438.88705  | 0.70505   | 406.249135 | 0.2498     |
|    |        | 10         | DO-329     | 125.29262  | 0.04       | 543.74634  | 1.7366    | 520.205245 | 0.8498     |
|    |        | 11         | DO-330     | 135.61874  | 0.91275    | 393.03416  | 3.73095   | 454.62209  | 1.7325     |

## fundamentals

### 5. Dates & categories suck

Principle:

a fundamental truth that guides our thinking

# fundamentals

## 5. Dates & categories suck

verify

## 6. Check that distinct things are distinct

|    | A             | B    | C      | D      | E        | F        | G      |
|----|---------------|------|--------|--------|----------|----------|--------|
| 1  | WiscID        | ID   | NEOID  | Fem_CA | Fem_Imax | Fem_Imin | Fem_J  |
| 2  | F2.C1W.F.1248 | 1248 | NEO183 | 0.7524 | 0.1427   | 0.1006   | 0.2433 |
| 3  | F2.C1W.M.1250 | 1250 | NEO184 | 0.7669 | 0.1556   | 0.09652  | 0.2521 |
| 4  | F2.C1W.F.1251 | 1251 | NEO185 | 0.7613 | 0.1549   | 0.09659  | 0.2515 |
| 5  | F2.C1W.F.1254 | 1254 | NEO186 | 0.7475 | 0.1503   | 0.08603  | 0.2363 |
| 6  | F2.C1W.M.1257 | 1257 | NEO187 | 0.8197 | 0.1849   | 0.1056   | 0.2905 |
| 7  | F2.___.F.715  | 715  | NEO764 | 0.6017 | 0.09662  | 0.05969  | 0.1563 |
| 8  | F2.___.F.751  | 751  | NEO765 | 0.7273 | 0.1304   | 0.08735  | 0.2178 |
| 9  | F2.___.F.1251 | 1251 | NEO766 | 0.6675 | 0.1157   | 0.07814  | 0.1938 |
| 10 | F2.___.M.1340 | 1340 | NEO768 | 0.6656 | 0.1387   | 0.08122  | 0.2199 |
| 11 | F2.C1W.M.739  | 739  | NEO779 | 0.9336 | 0.2828   | 0.1628   | 0.4456 |



verify

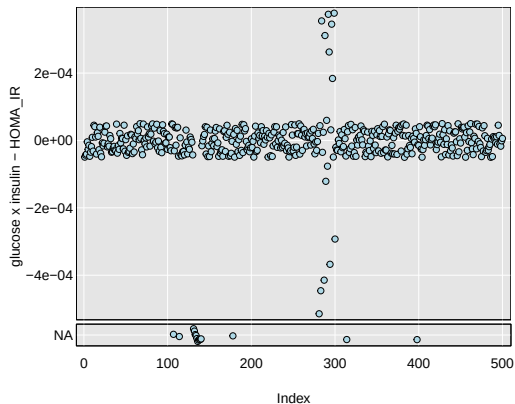
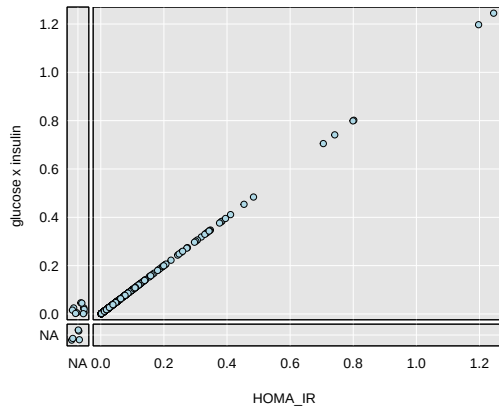
## 7. Check that matching things match

|    | A             | B   | C     | D        |
|----|---------------|-----|-------|----------|
| 1  | id            | sex | n_gen | age_days |
| 2  | F20.25        | M   | 20    | 75       |
| 3  | F21.30        | M   | 21    | 75       |
| 4  | F21.68        | M   | 21    | 71       |
| 5  | F22.52        | M   | 22    | 73       |
| 6  | F21.71        | F   | 22    | 63       |
| 7  | F22.116       | F   | 22    | 57       |
| 8  | F21.F20.9.M5  | M   | 20    | 82       |
| 9  | F21.F20.18.M5 | M   | 20    | 77       |
| 10 | F20.26        | M   | 20    | 75       |
| 11 | F21.62        | M   | 21    | 72       |

|    | A       | B   | C             | D     |
|----|---------|-----|---------------|-------|
| 1  | id      | sex | age_at_dosing | n_gen |
| 2  | F22.69  | F   | 67            | 22    |
| 3  | F22.106 | F   | 69            | 22    |
| 4  | F22.70  | F   | 67            | 22    |
| 5  | F22.107 | F   | 69            | 22    |
| 6  | F21.71  | F   | 65            | 21    |
| 7  | F22.116 | F   | 62            | 22    |
| 8  | F22.73  | F   | 65            | 22    |
| 9  | F22.117 | F   | 62            | 22    |
| 10 | F21.108 | F   | 62            | 21    |
| 11 | F22.118 | F   | 59            | 22    |

verify

## 8. Check calculations

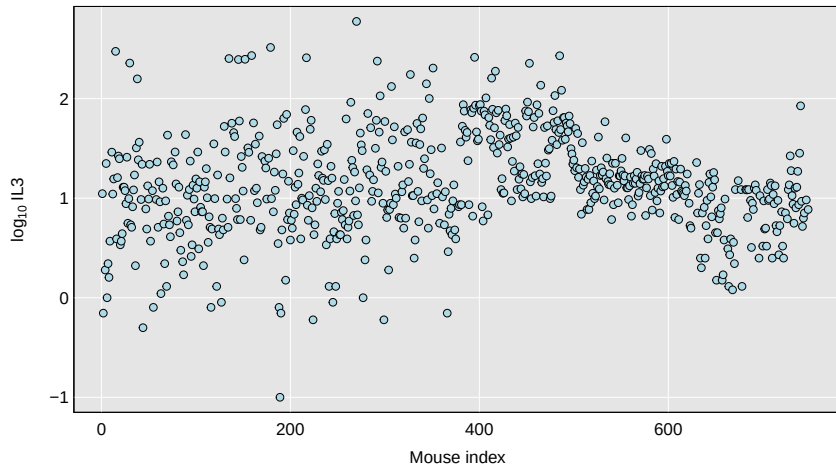


verify

9. Look for other instances of a problem

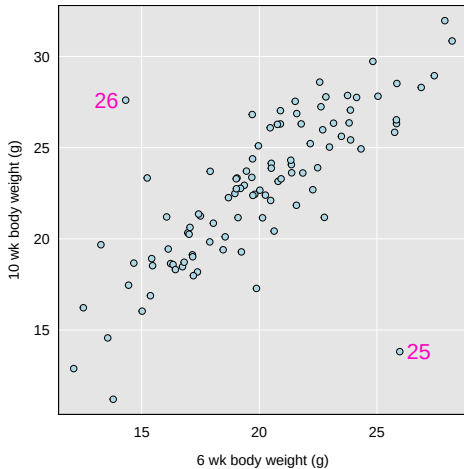
explore

## 10. Make lots of plots



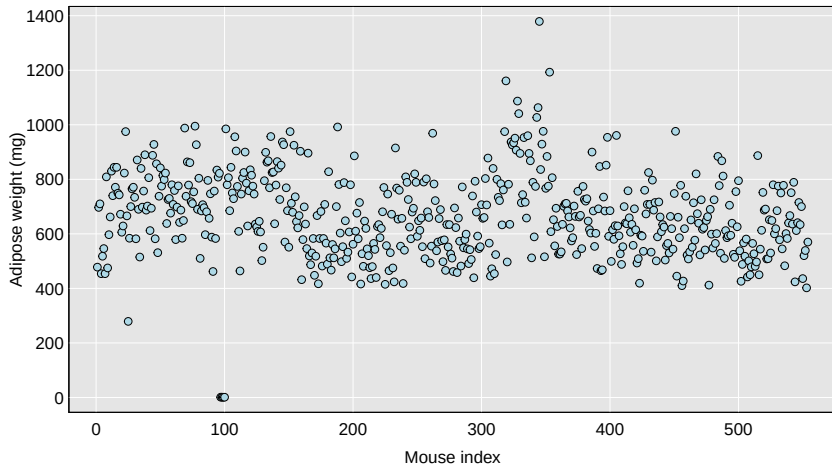
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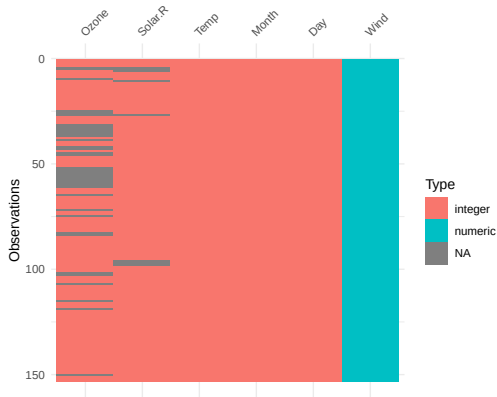
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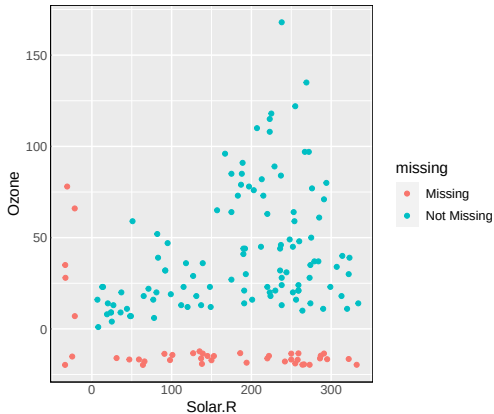
# explore

## 11. Look at missing value patterns

{visdat}

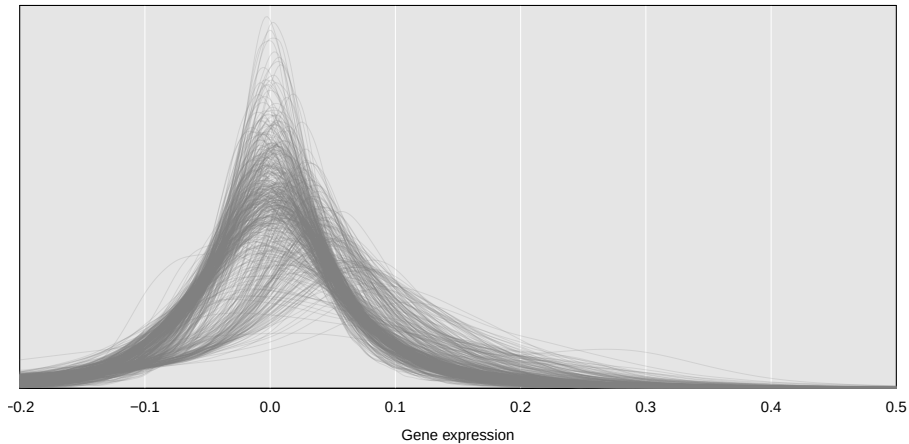


{naniar}



explore

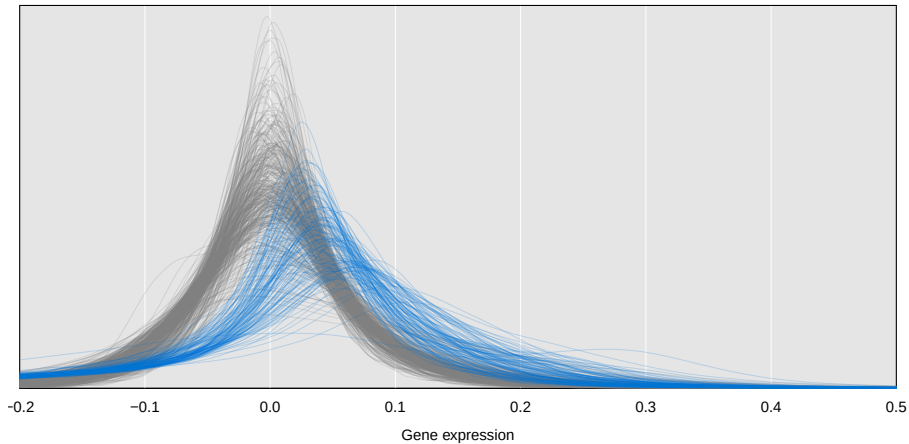
12. With massive data,  
make more plots not fewer





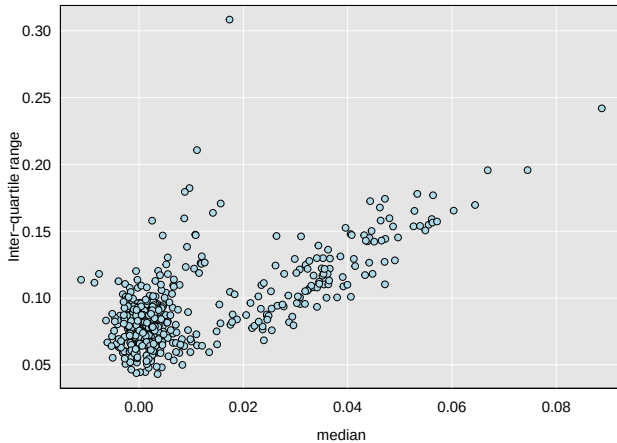
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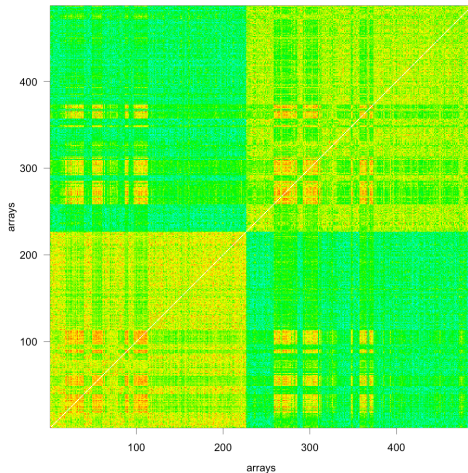
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make more plots not fewer



explore

### 13. Follow up all artifacts



ask

- 14. Ask questions
- 15. Ask for the primary data
- 16. Ask for metadata
- 17. Ask why data are missing

# document

- 18. Create checklists & pipelines
- 19. Document not just what but why
- 20. Expect to recheck

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5. Dates & categories suck

## verify

6. Verify that distinct things are distinct
7. Verify that matching things match
8. Check calculations
9. Look for other instances of problems

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12. With big data make more plots
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I will let the data speak for itself  
when it cleans itself.

— Allison Reichel

Slides: [kbroman.org/Talk\\_DataCleaning](http://kbroman.org/Talk_DataCleaning)



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