Data visualization for real-world machine learning

Julia Silge

@juliasilge

data visualization informs how we think, understand, decide

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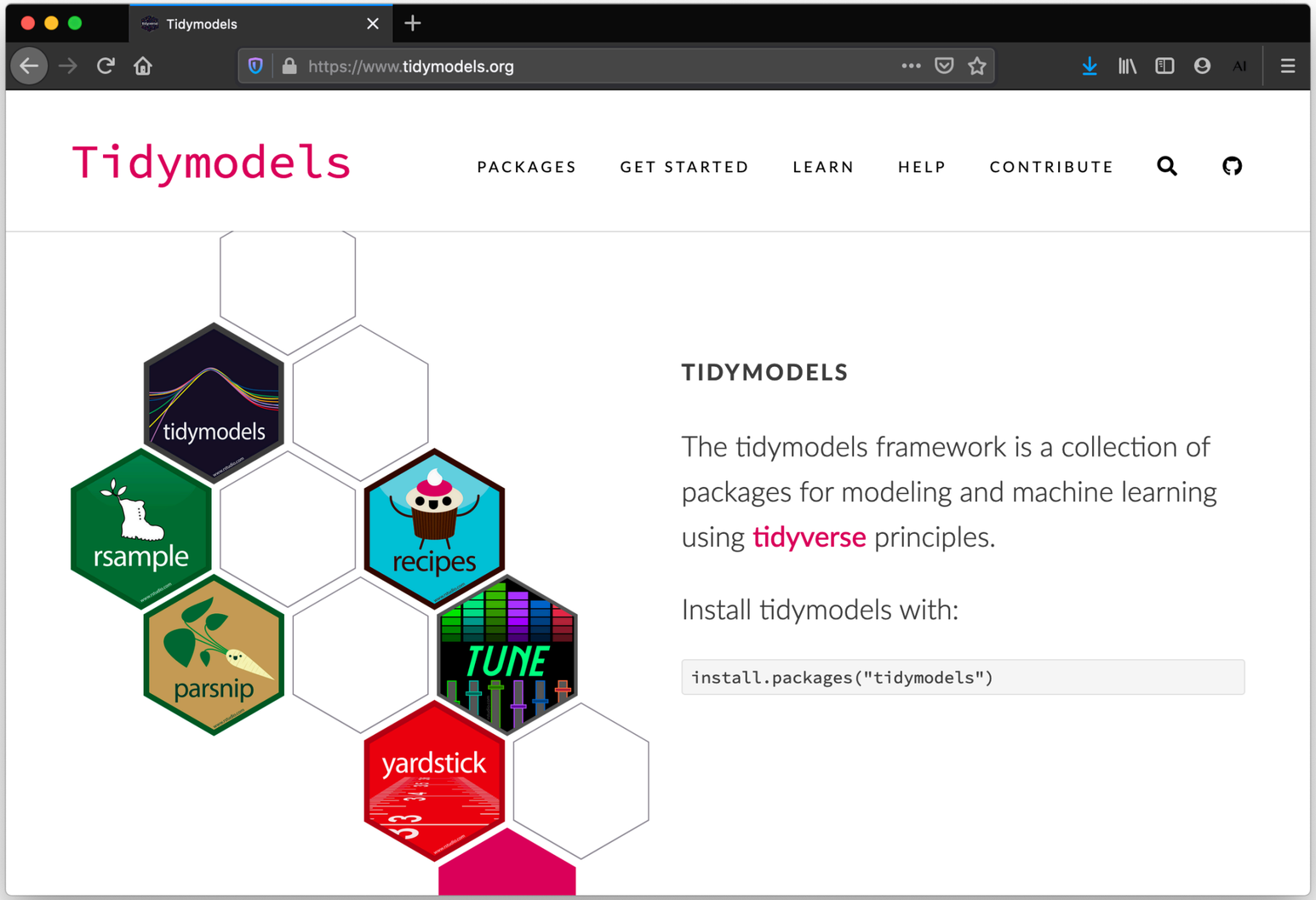
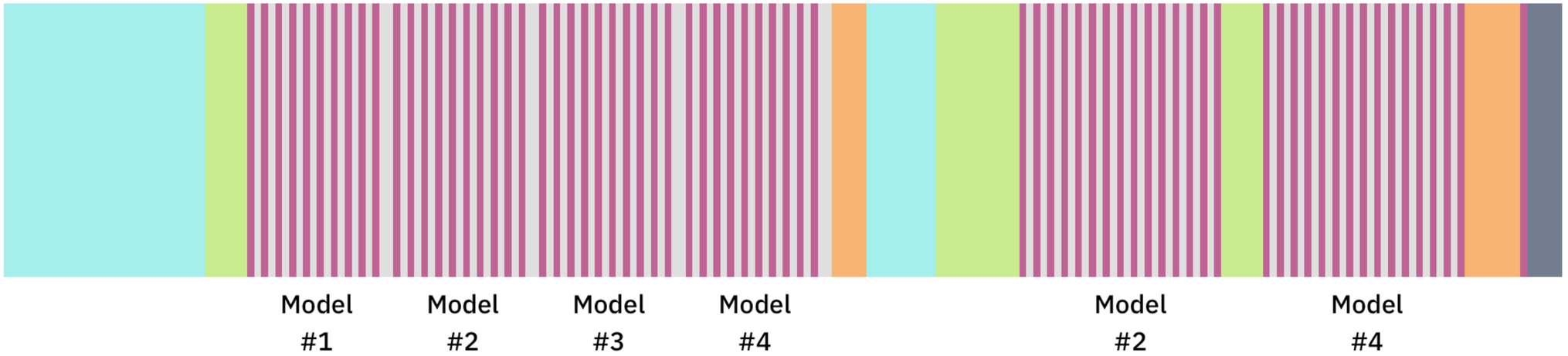
Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.

— Tamara Munzner in *Visualization Analysis & Design*


Tidymodels
https://www.tidymodels.org
Tidymodels
PACKAGES
GET STARTED
LEARN
HELP
CONTRIBUTE
tidymodels
rsample
recipes
parsnip
TUNE
yardstick
TIDYMODELS
The tidymodels framework is a collection of packages for modeling and machine learning using tidyverse principles.
Install tidymodels with:
install.packages("tidymodels")

When do practitioners build data visualizations?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Model #3
Model #4
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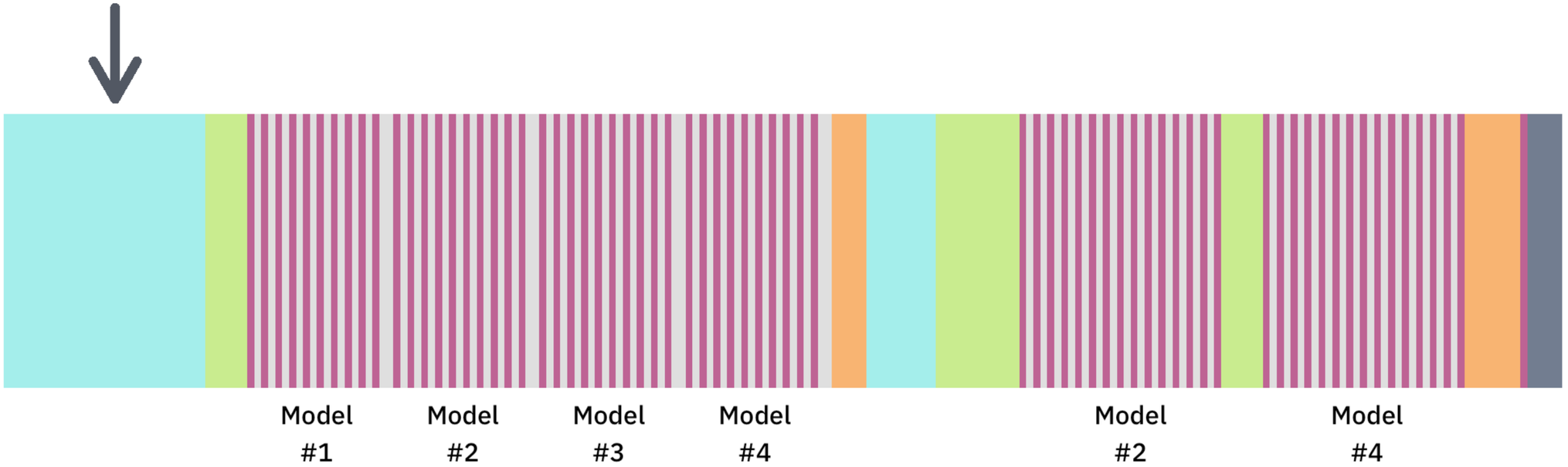
EDA
Feature Engineering
Model Fit
Model Tuning
Model Evaluation
Communication, deployment, etc.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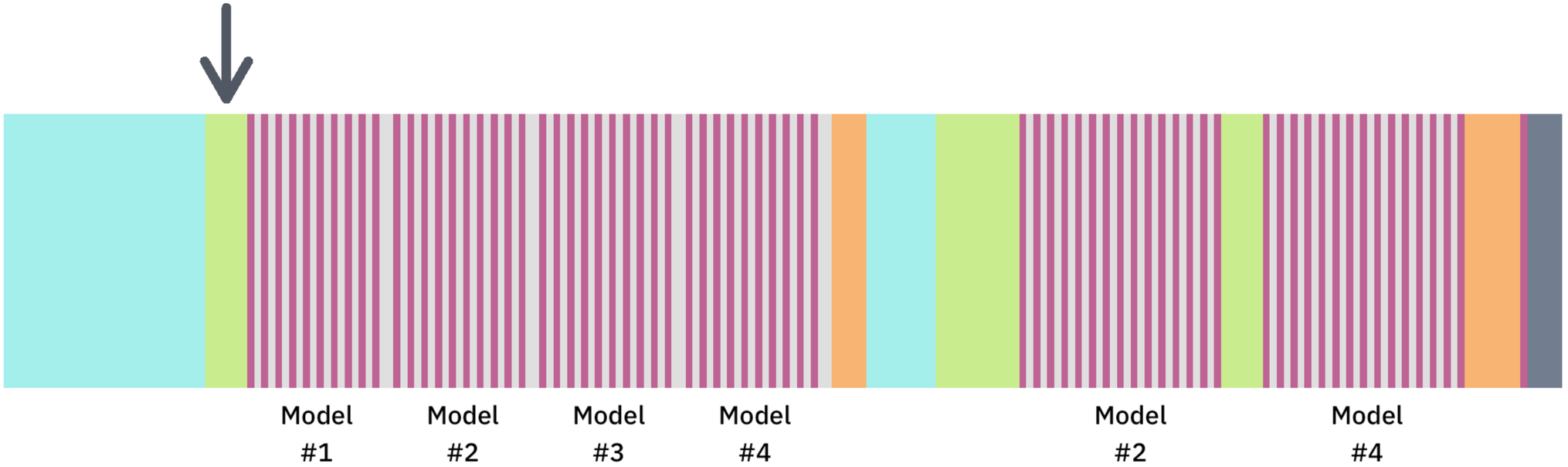
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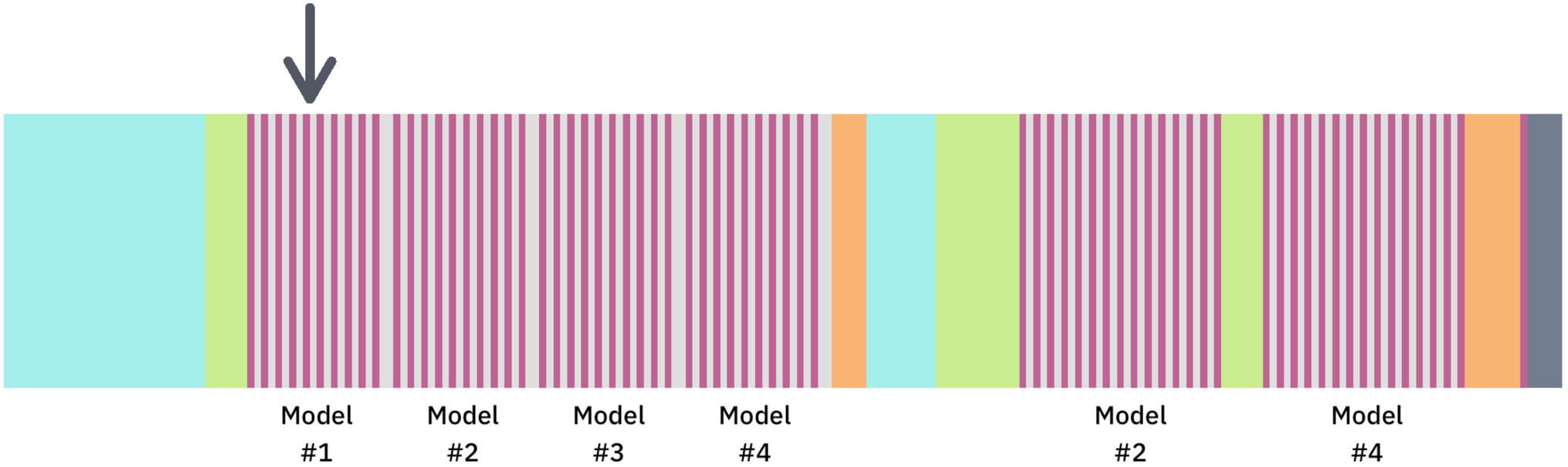
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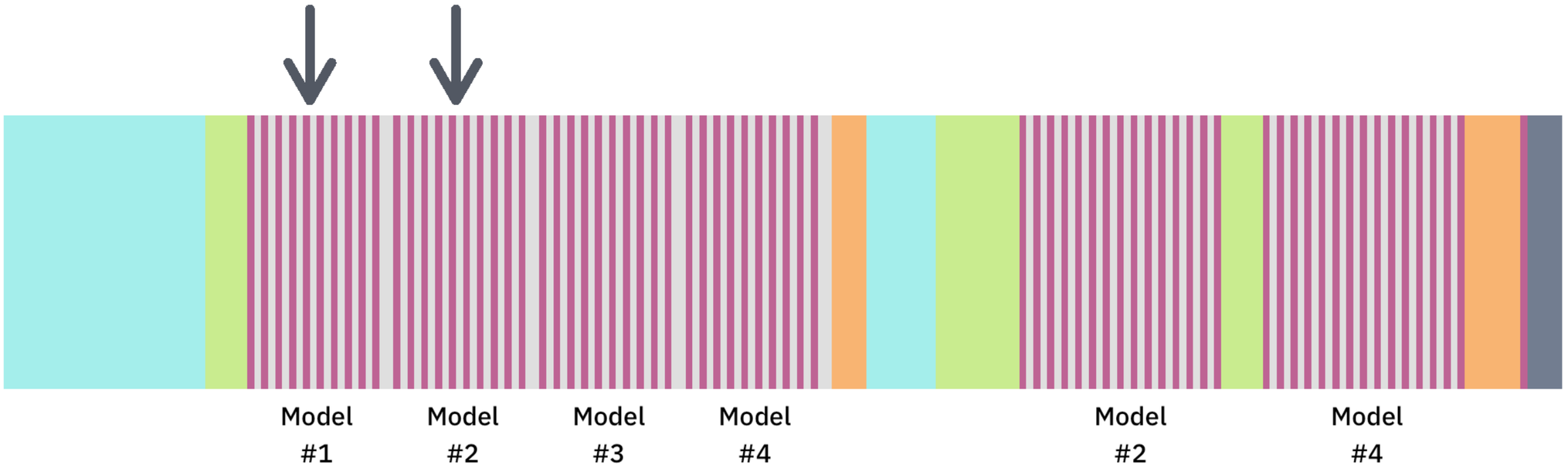
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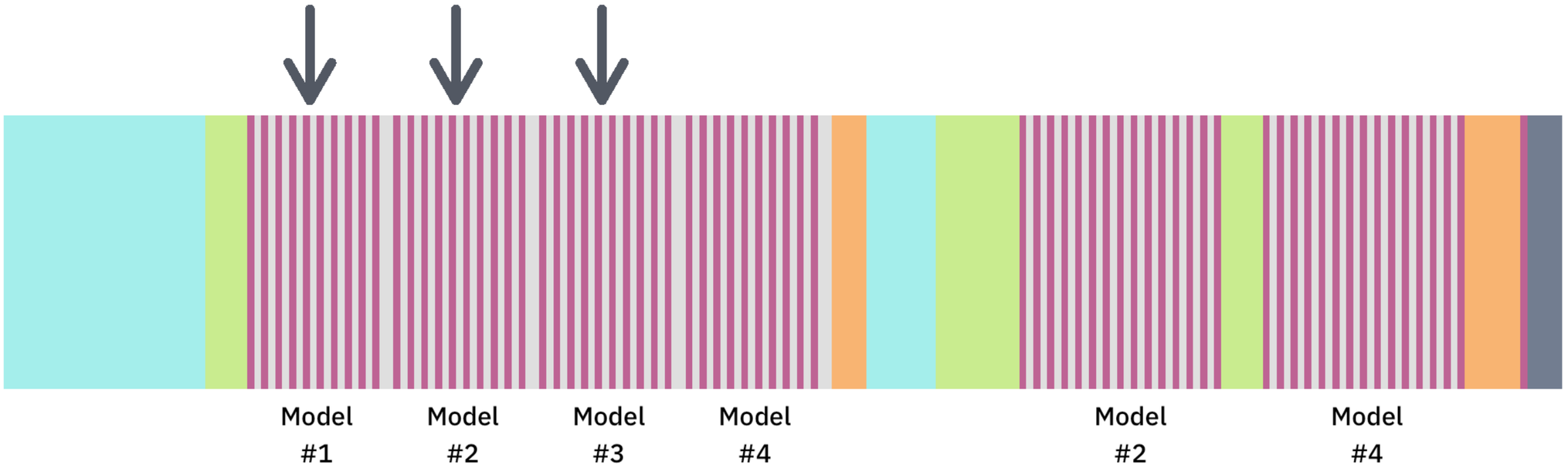
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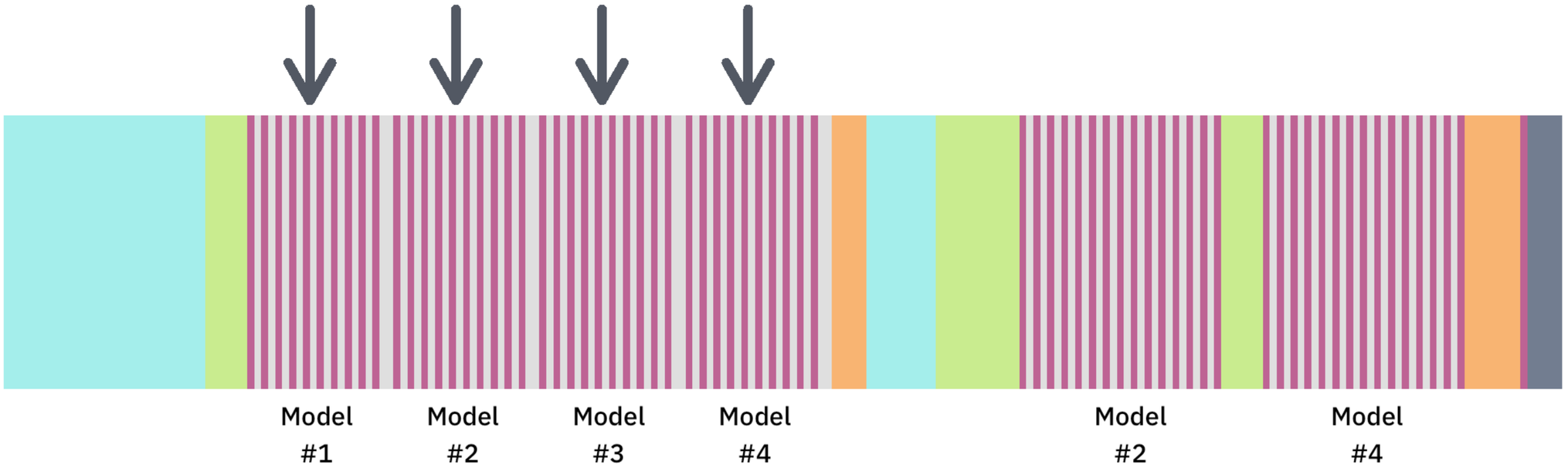
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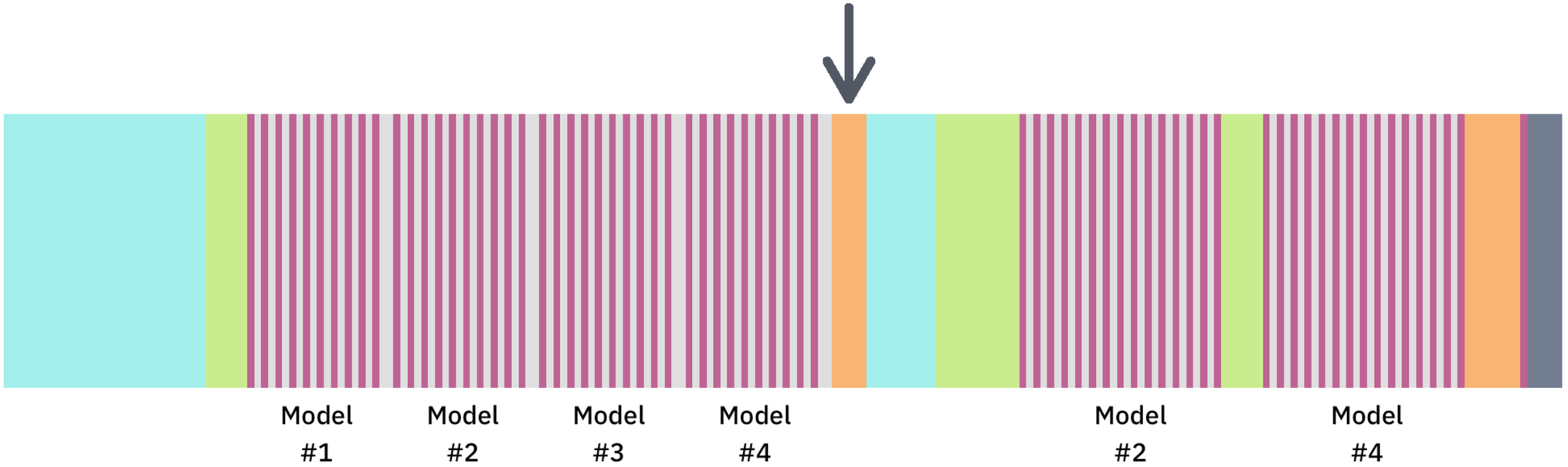
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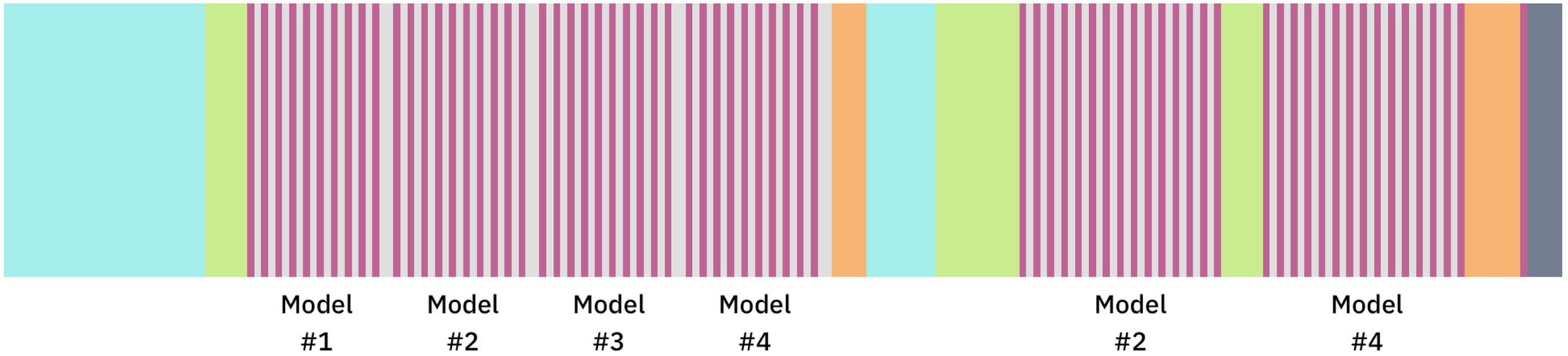
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exploratory data analysis

model evaluation

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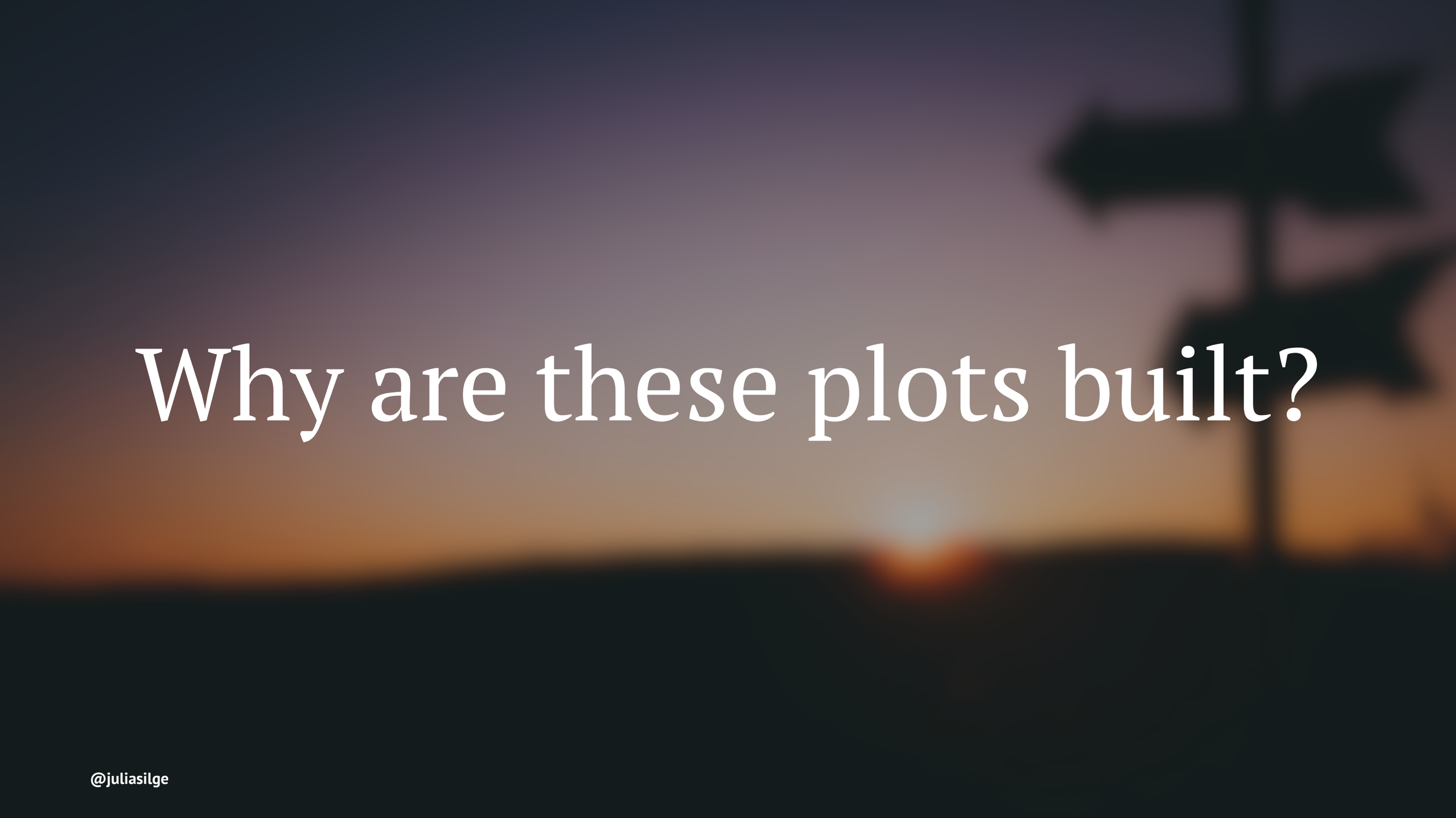
Why are these plots built?
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Visualization for decision making

— What kind of model is appropriate?

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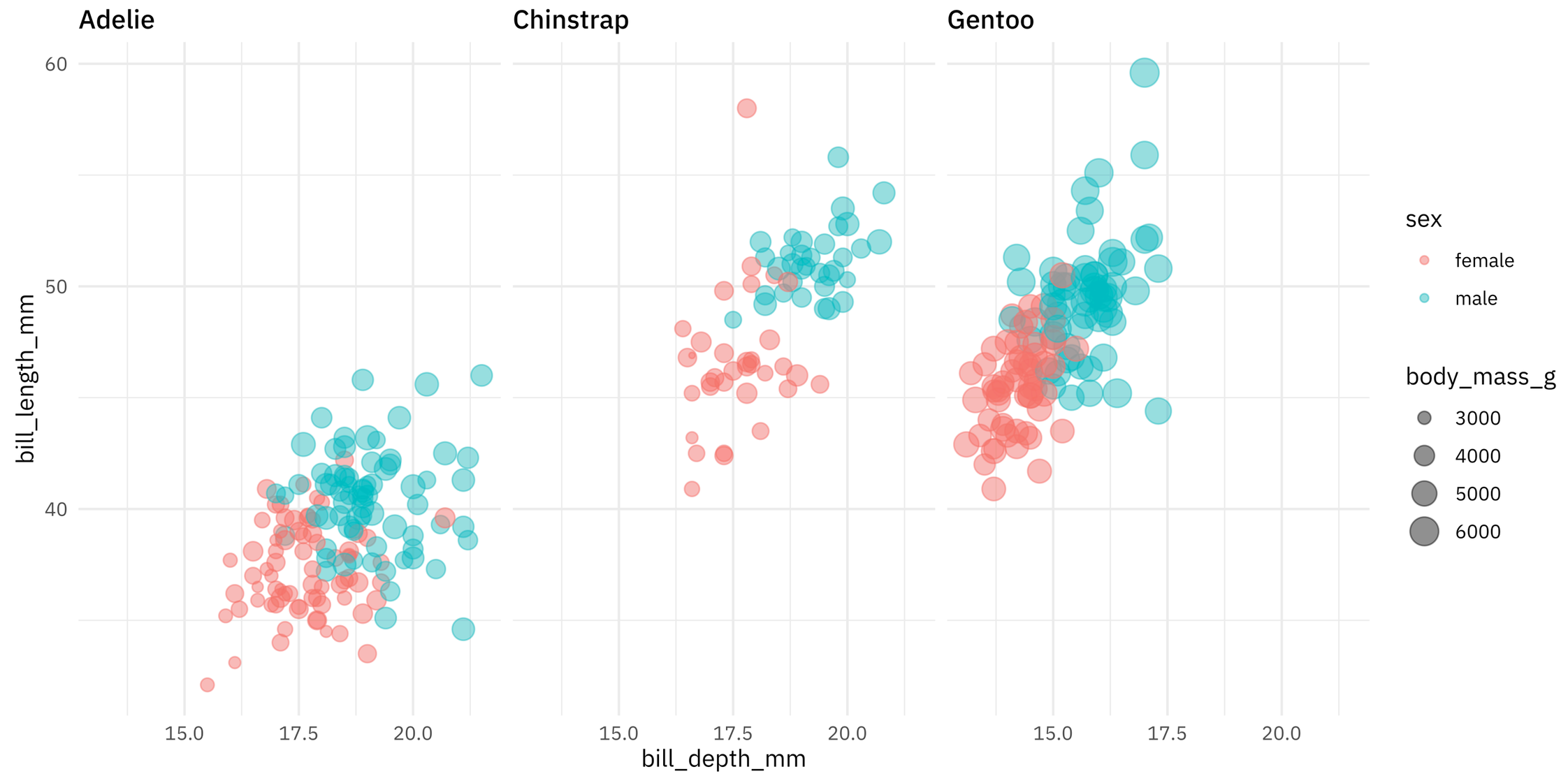
— What kind of preprocessing is needed?

Visualization for decision making

— What kind of model is appropriate?

— What kind of preprocessing is needed?

— Is anything unusual going on with this data?



Palmer penguins

Trees in San Francisco

prioritize efficient iteration for EDA

What kind of model is appropriate?

```
linear_reg() %>%
  set_engine("lm")

## Linear Regression Model Specification (regression)
##
## Computational engine: lm
```

What kind of model is appropriate?

```
linear_reg() %>%
  set_engine("glmnet")

## Linear Regression Model Specification (regression)
##
## Computational engine: glmnet
```

What kind of model is appropriate?

```
rand_forest() %>%
  set_engine("ranger") %>%
  set_mode("regression")

## Random Forest Model Specification (regression)
##
## Computational engine: ranger
```

What kind of model is appropriate?

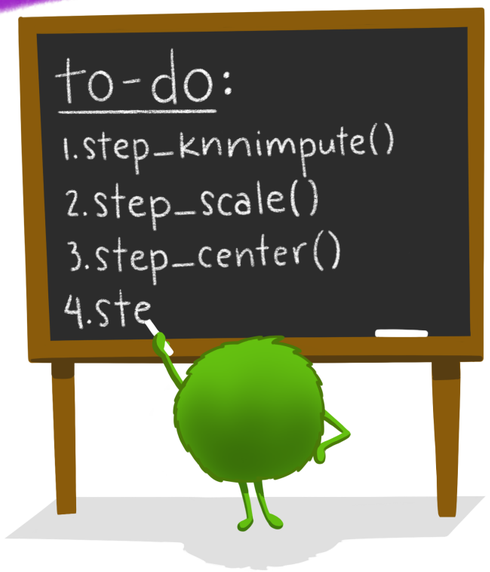
```
rand_forest() %>%
  set_engine("ranger") %>%
  set_mode("classification")

## Random Forest Model Specification (classification)
##
## Computational engine: ranger
```

recipes:

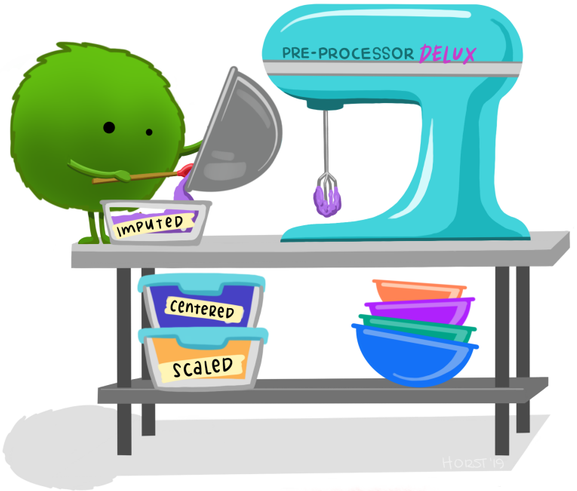
STREAMLINED DATA **PRE-PROCESSING** FOR STATISTICAL + MACHINE LEARNING MODELS

1. SPECIFY VARIABLES
recipe(y ~ a + b + ..., data = pantry)



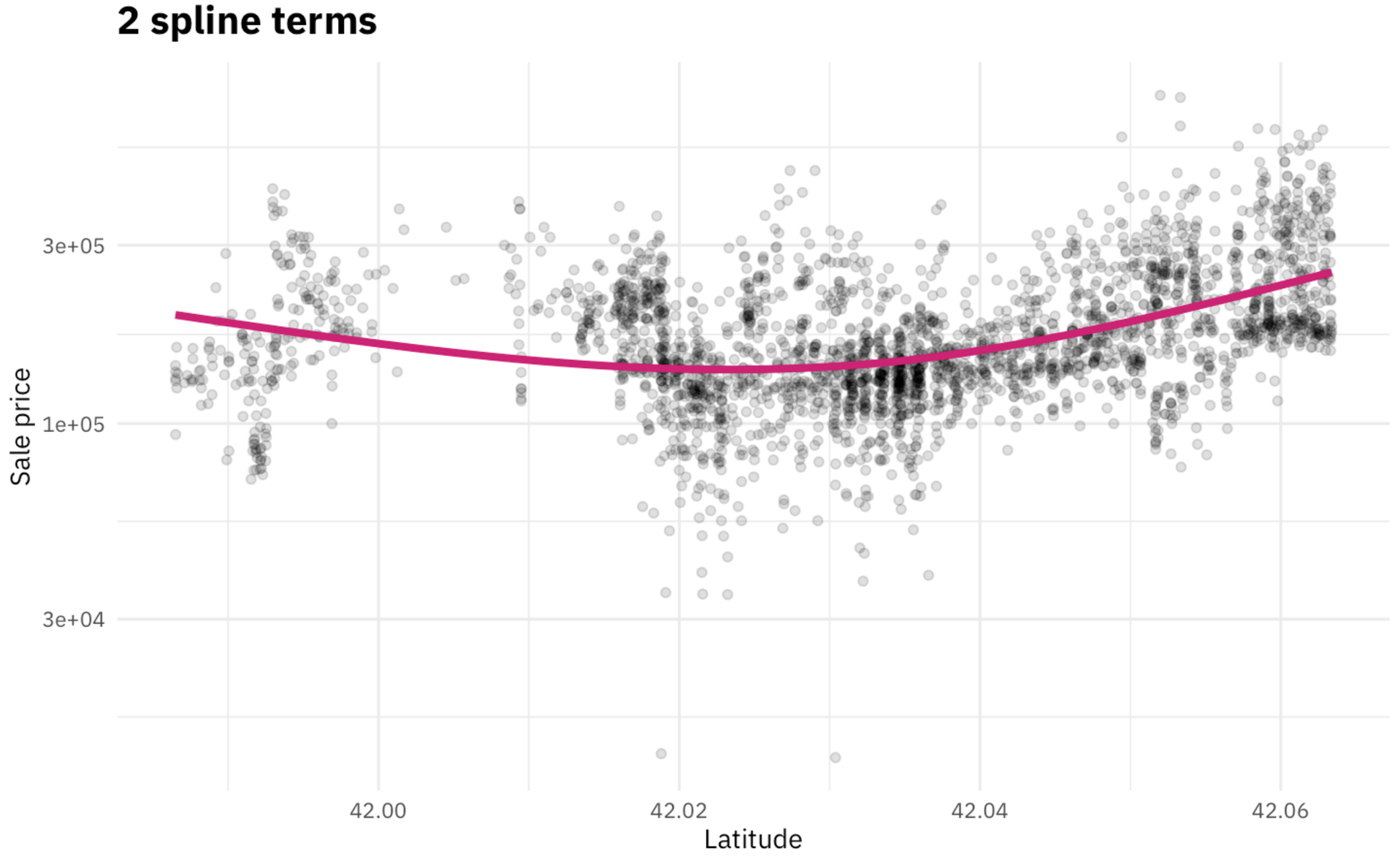
2. DEFINE PRE-PROCESSING STEPS (step_*)

3. PROVIDE DATASET(S) FOR RECIPE STEPS
prep()

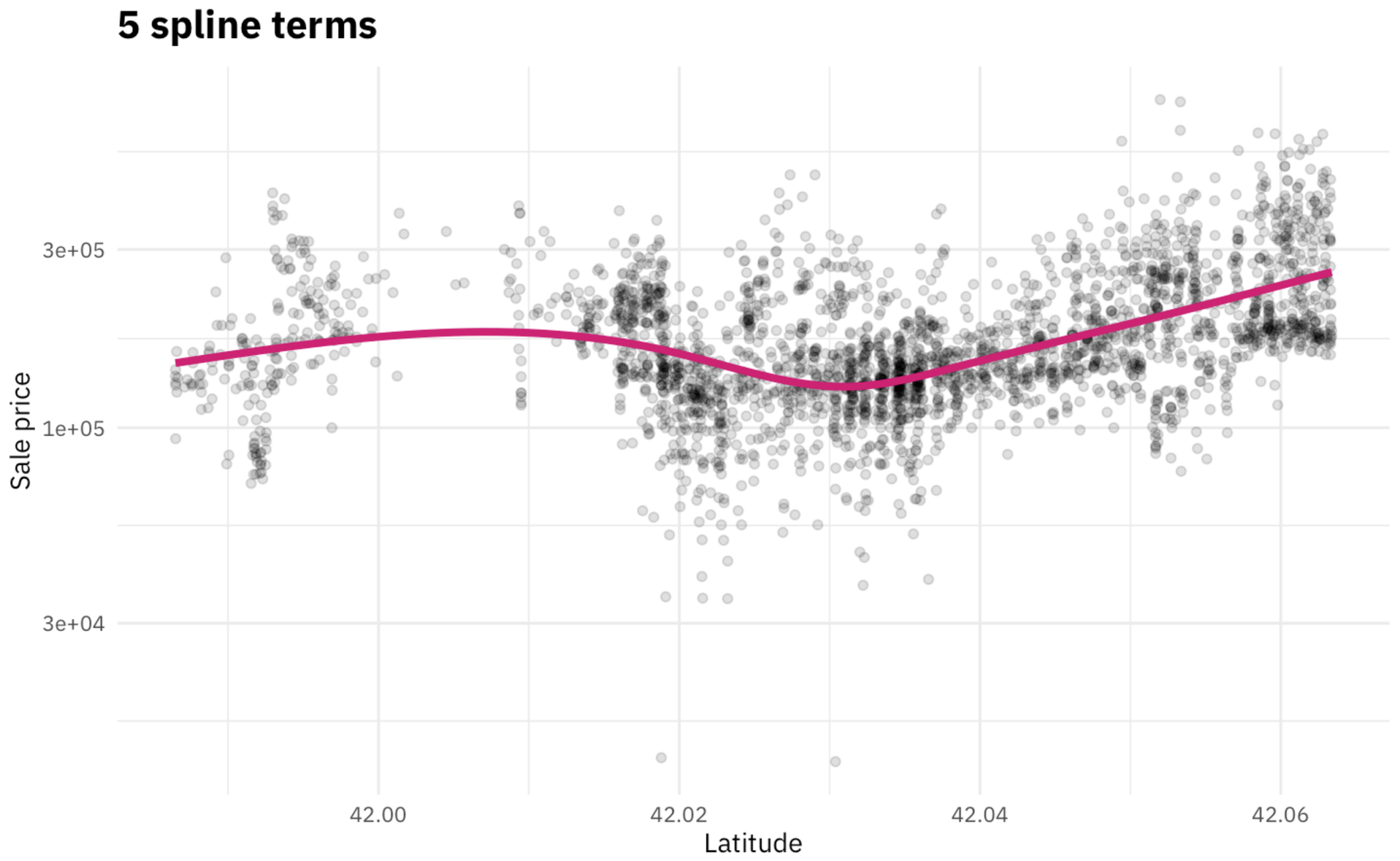


4. APPLY PRE-PROCESSING!
bake()

Illustration by Allison Horst



Houses in Ames, IA



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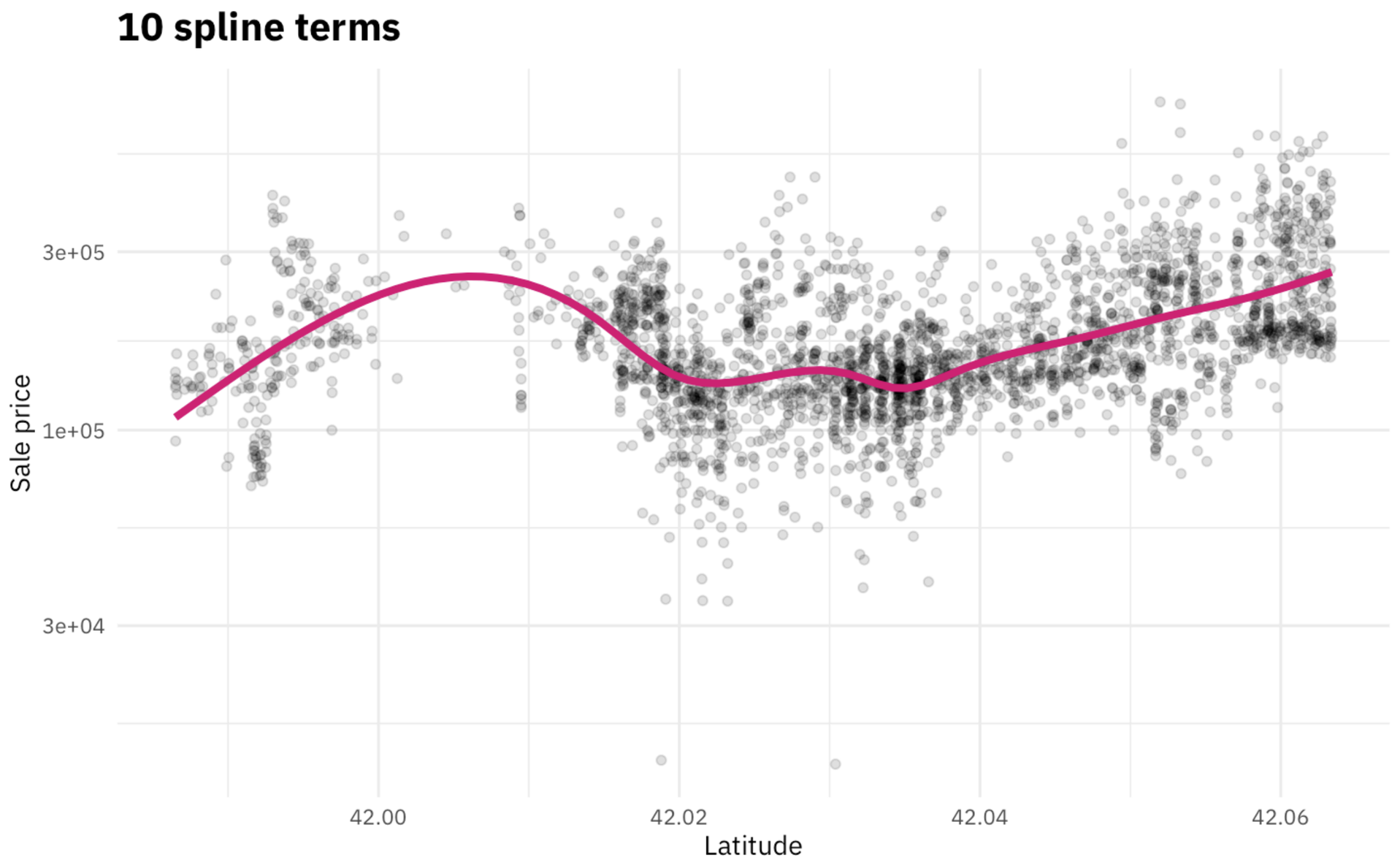

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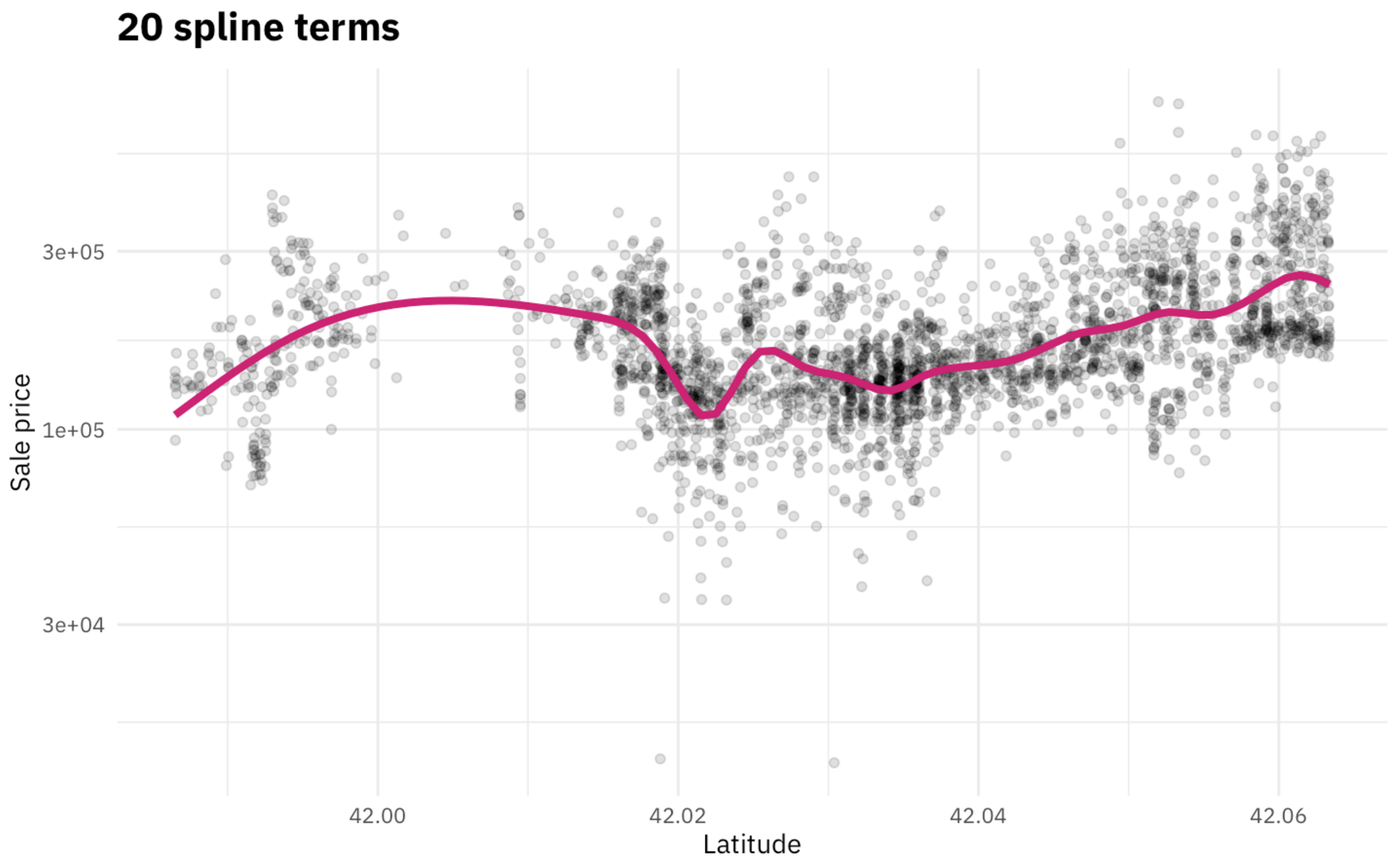

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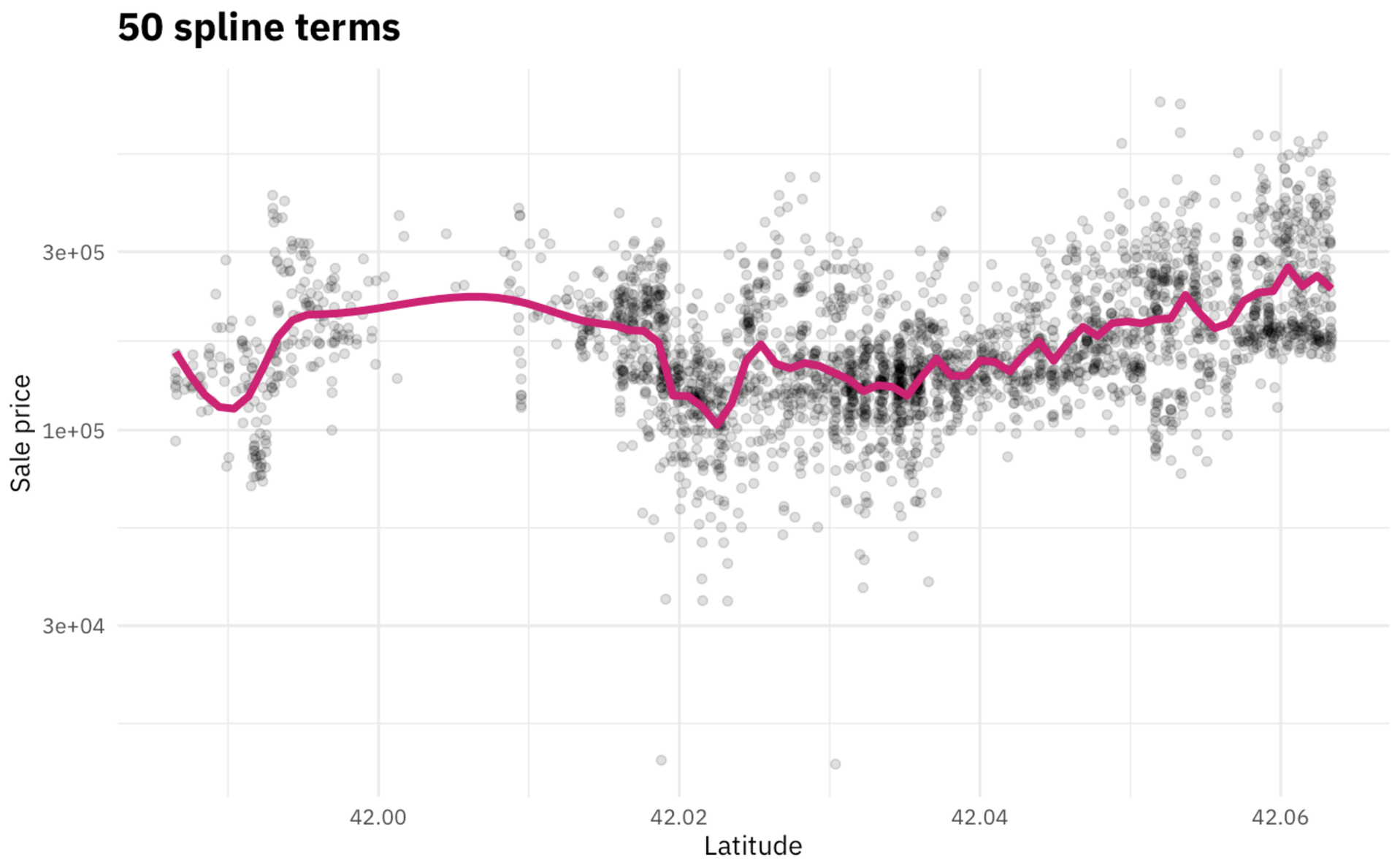

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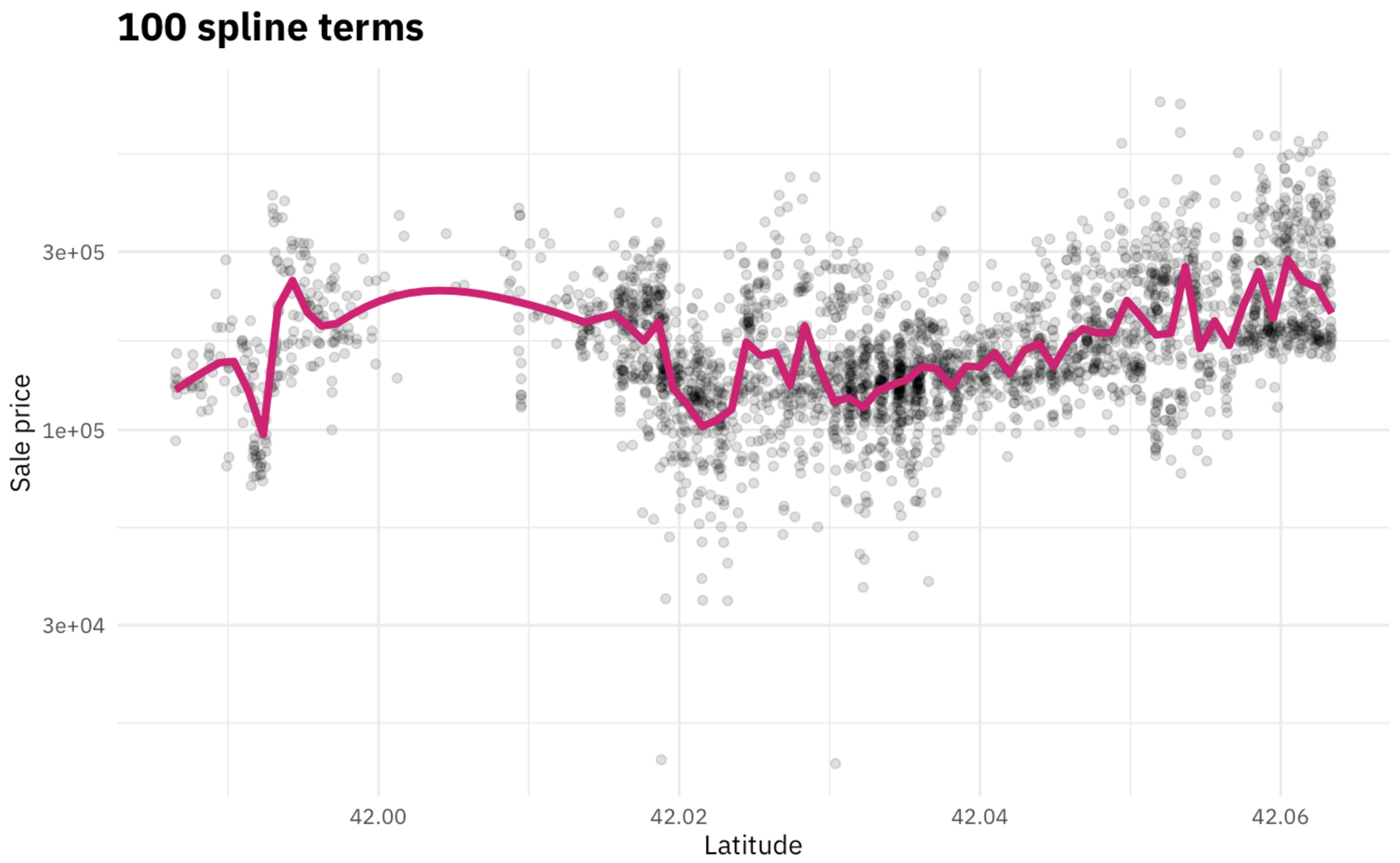


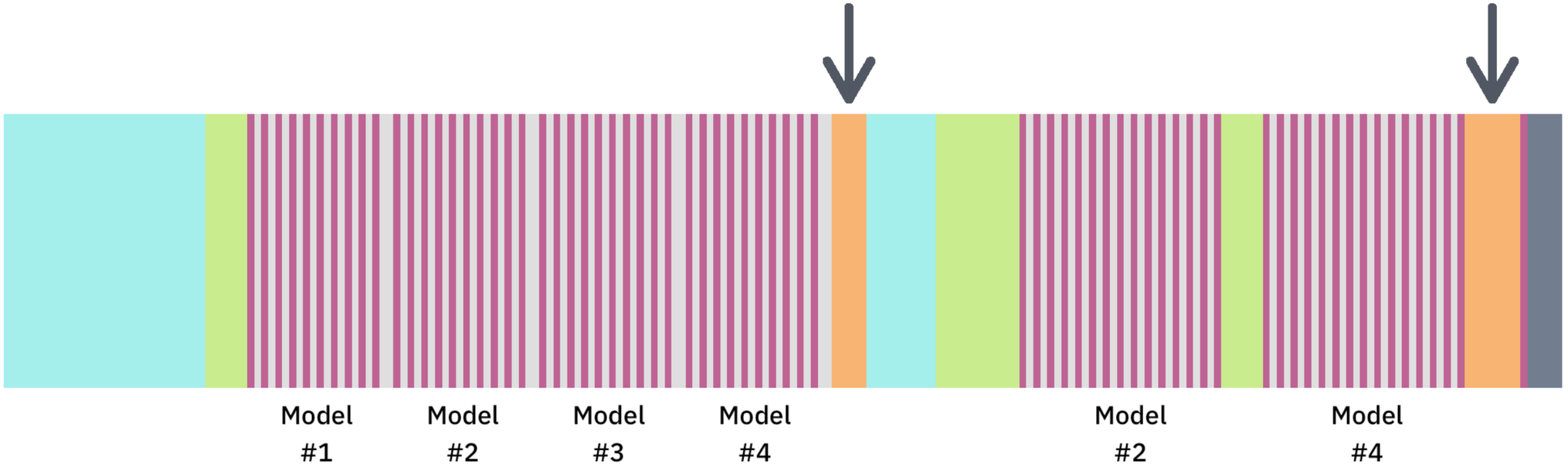
Houses in Ames, IA

```
recipe(Sale_Price ~ Neighborhood + Gr_Liv_Area + Year_Built +
         Bldg_Type + Latitude + Longitude,
       data = ames_train) %>%
  step_log(Gr_Liv_Area, base = 10) %>%
  step_other(Neighborhood, threshold = 0.01) %>%
  step_dummy(all_nominal()) %>%
  step_ns(Latitude, Longitude, deg_free = 10)
```

```
## Data Recipe
##
## Inputs:
##
##       role #variables
##    outcome          1
##  predictor          6
##
## Operations:
##
## Log transformation on Gr_Liv_Area
## Collapsing factor levels for Neighborhood
## Dummy variables from all_nominal()
## Natural Splines on Latitude, Longitude
```

Practitioners use data visualization during EDA to inform modeling choices


Pinboard
@Pinboard
Machine learning is like a deep-fat fryer. First time you try it you think "Amazing, I bet this will work on anything!" And it kind of does
10:16 PM · Jul 6, 2016 · YoruFukurou
321 Retweets and comments
501 Likes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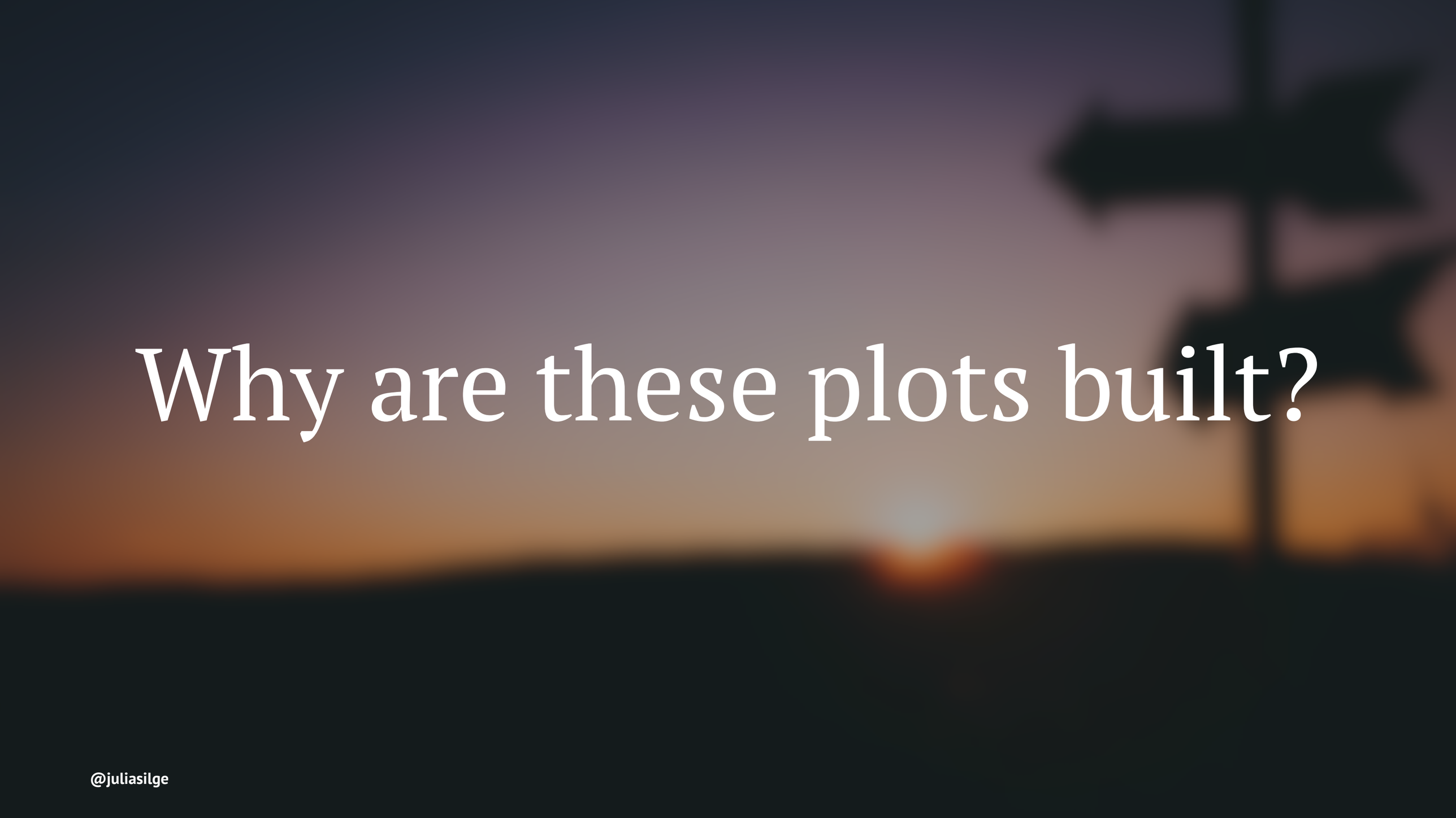
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Visualization as validation tool

— Did this model "work"?

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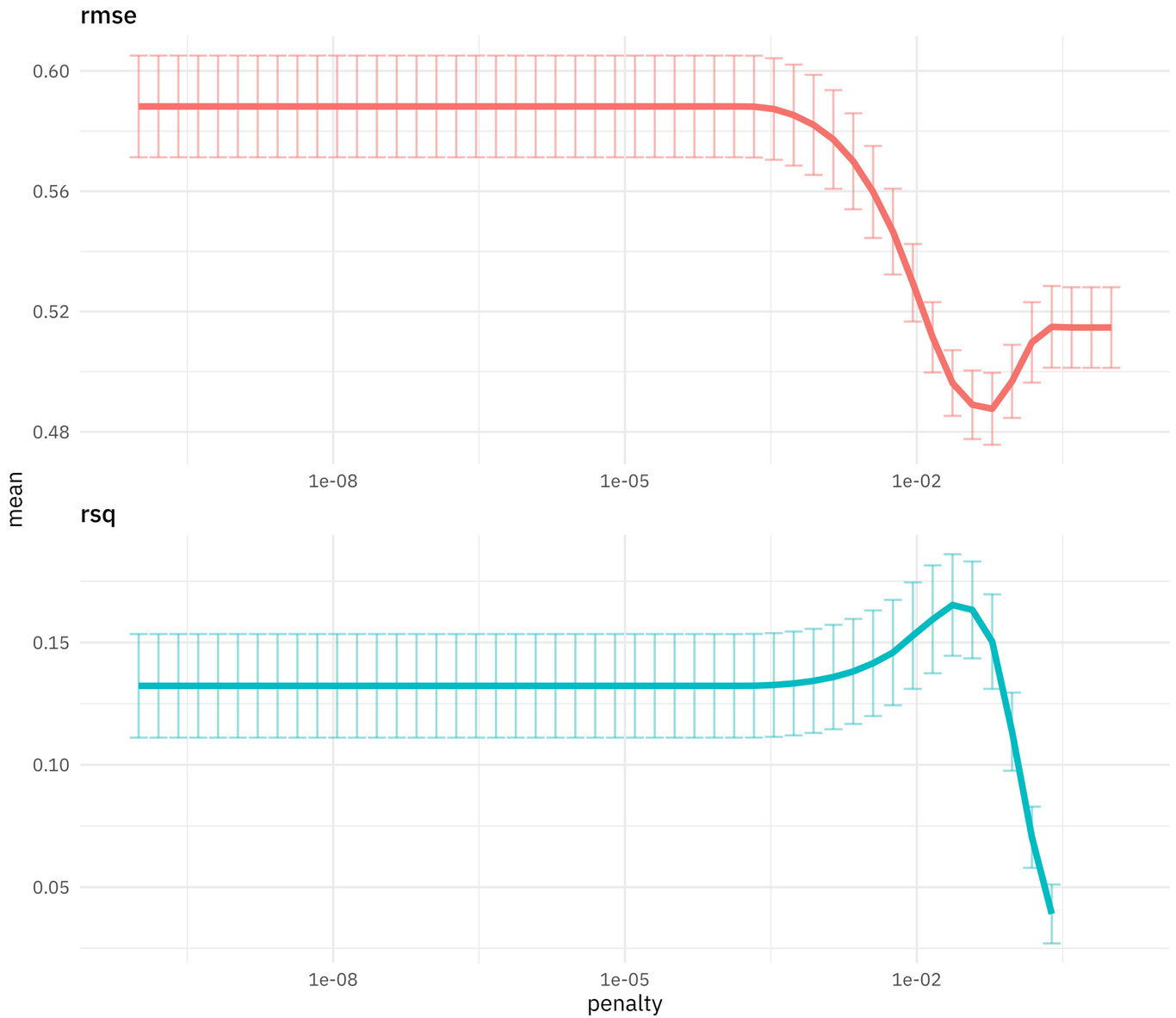
Visualization as validation tool

— Did this model "work"?

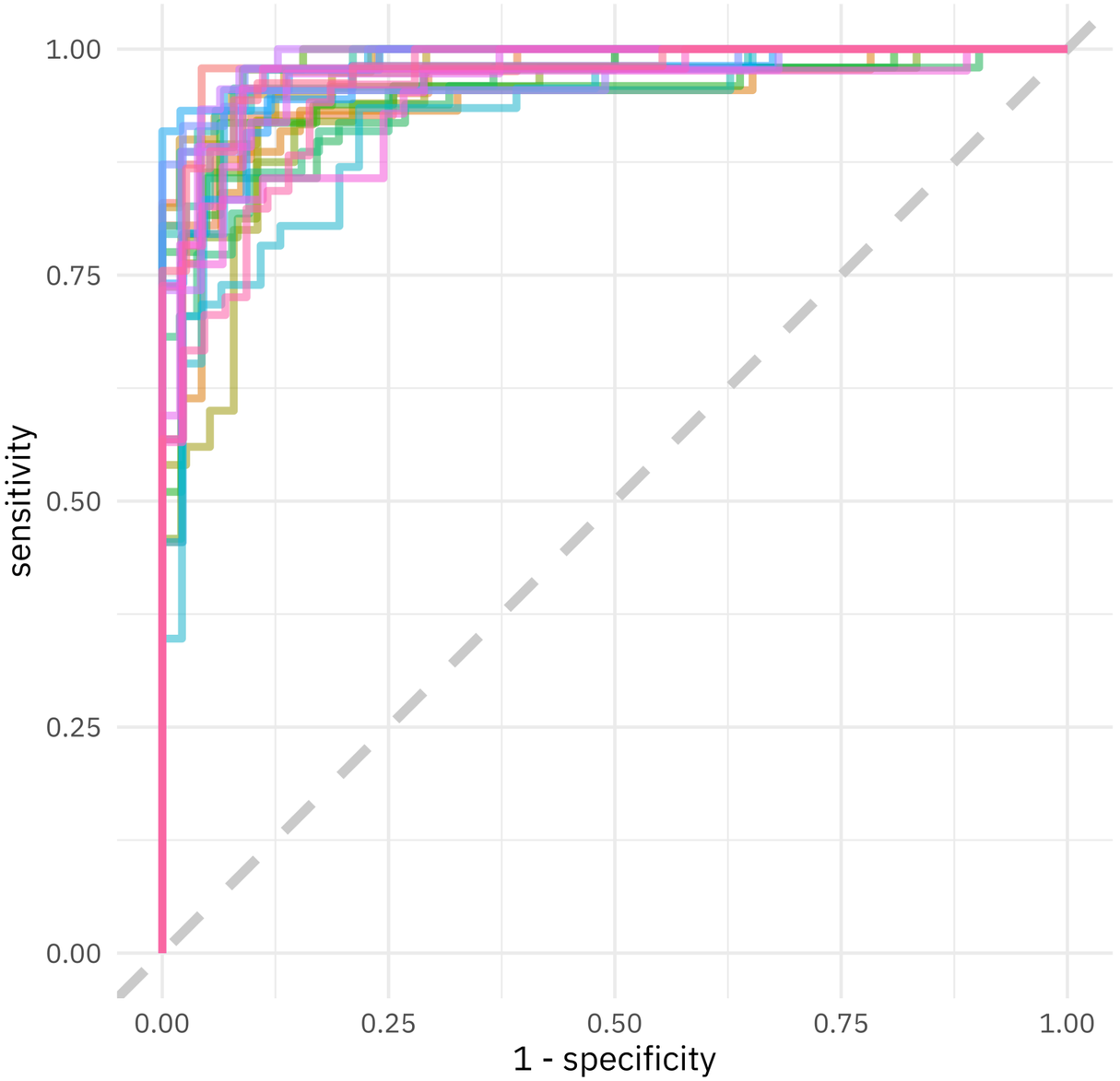
— Which model performed best?

— For which kind of observations?

— Which model features are important?



Episodes of *The Office*



Palmer penguins

automatic plotting methods

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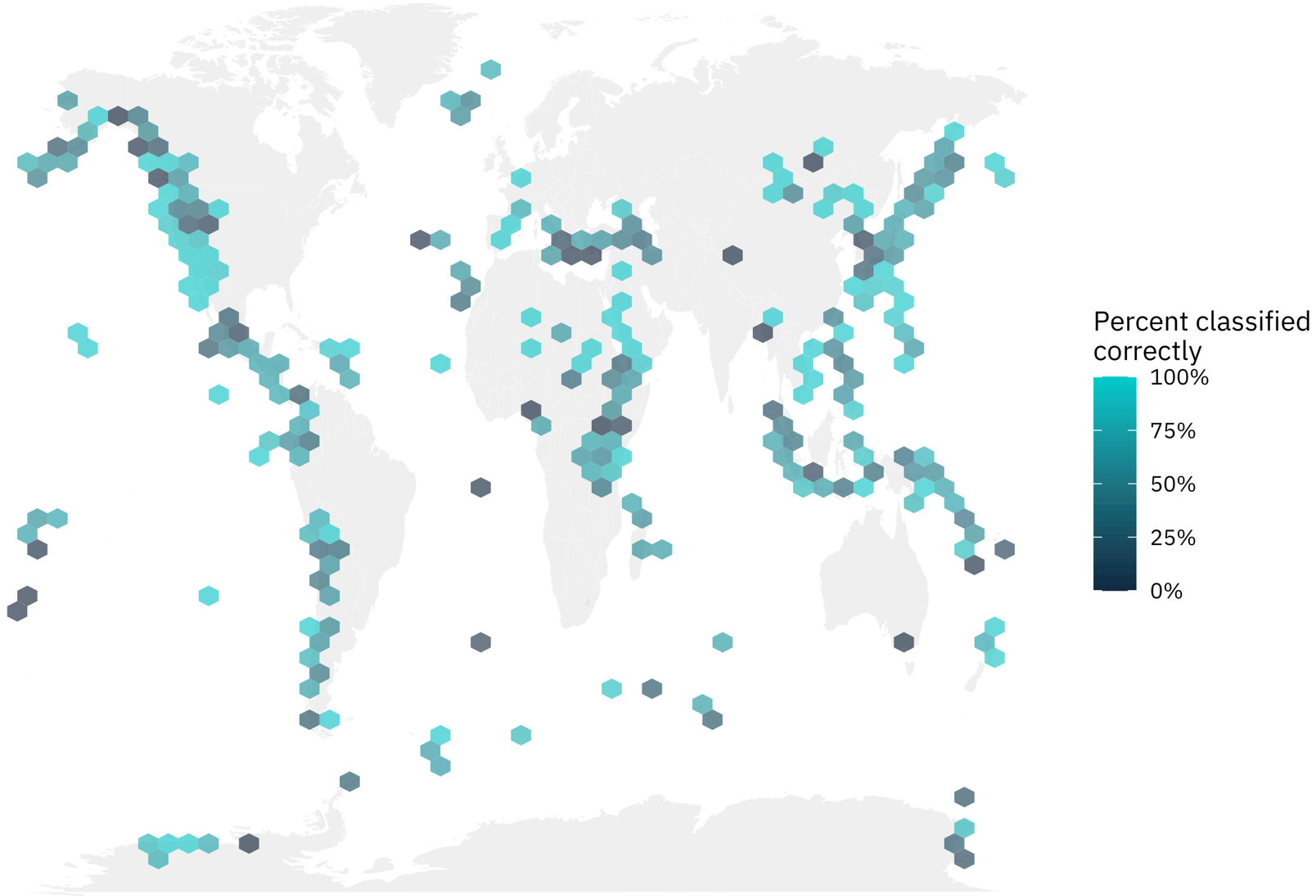

Volcano classification

explaining models

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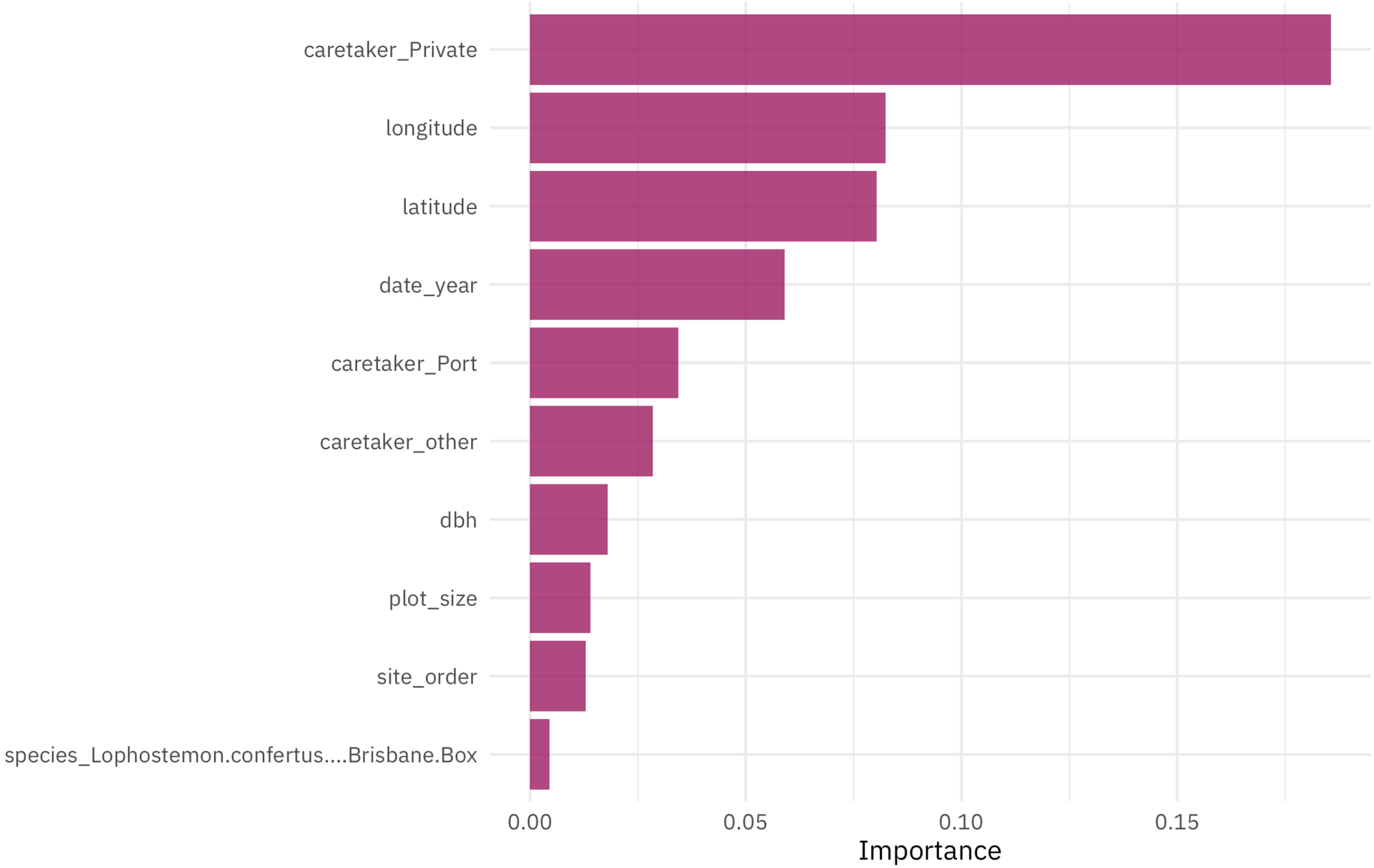
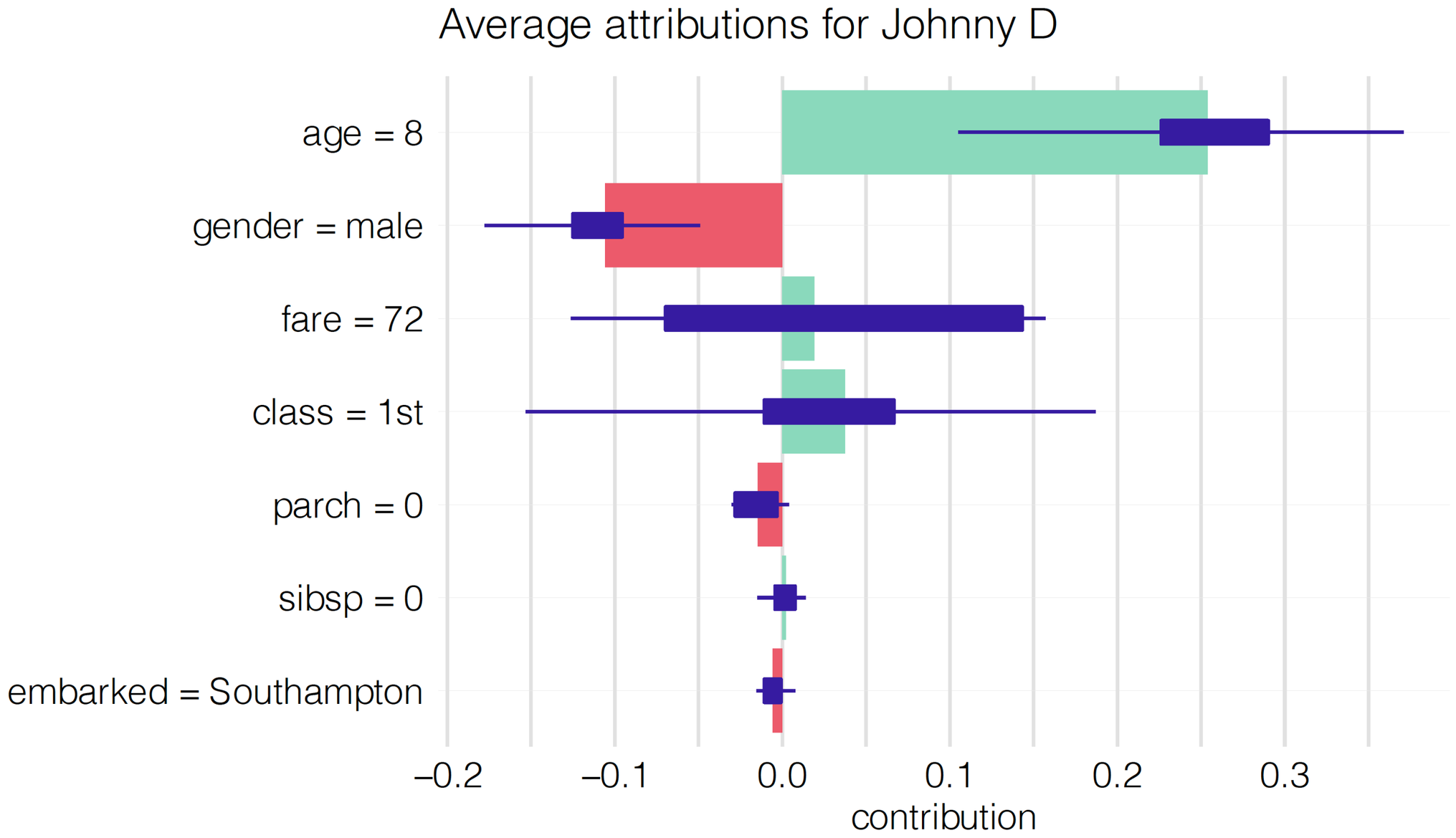
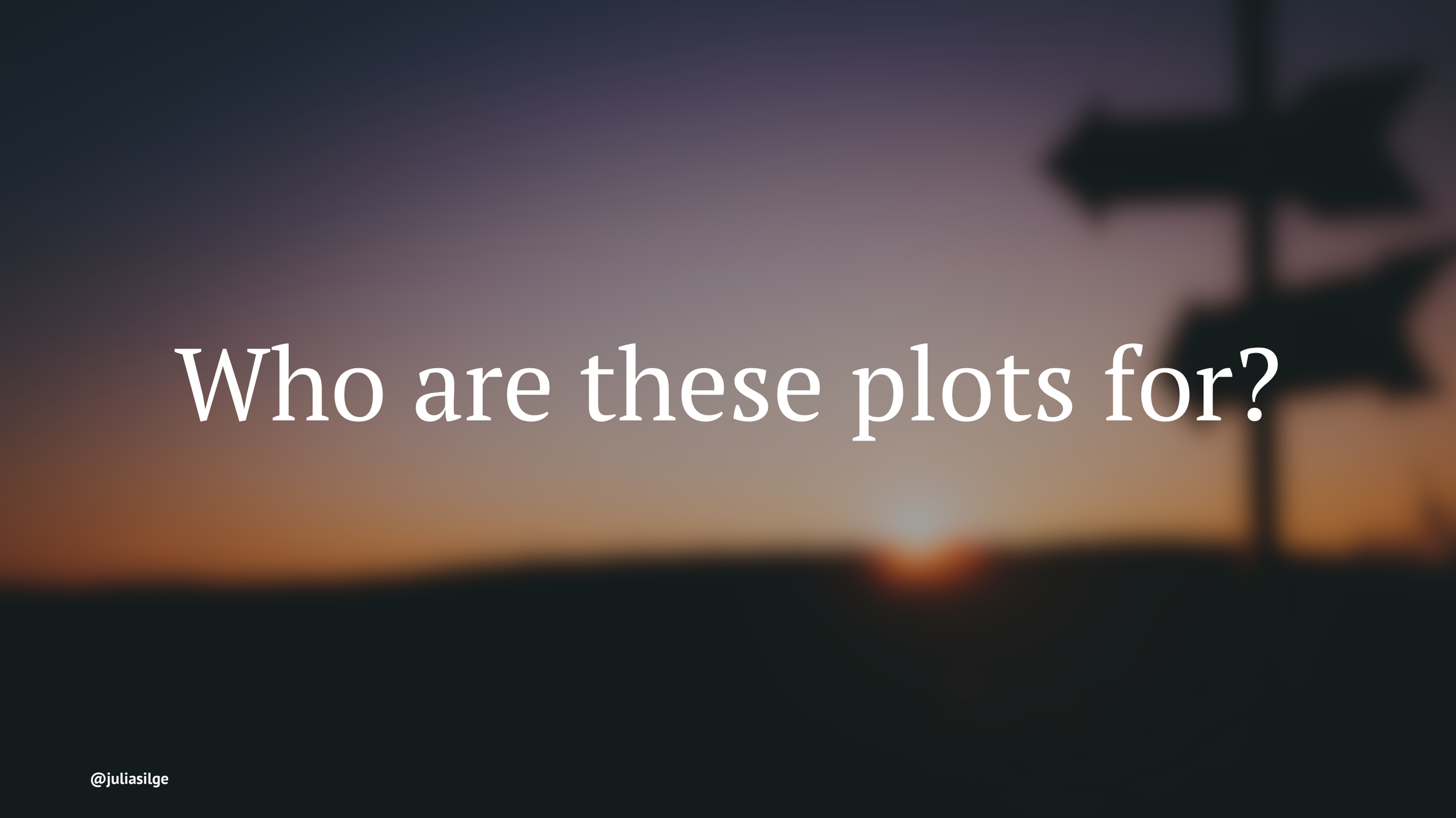


Trees in San Francisco



from *Explanatory Model Analysis* by Przemyslaw Biecek and Tomasz Burzykowski


Who are these plots for?
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understand

data

@juliasilge

understand models

Thank you!

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Photo by Raul Petri on Unsplash