HW-5.knit

Module 5

In module 5, we learned about tuning hyperparameters of models. In this homework, we are using L1/L2 penalties and dimensionality reduction using PCA and PLS to control the flexibility of our models and reduce the risk of overfitting. We will apply these techniques to build classification and regression models. Both assignments 1 and 2 use datasets from previous assignments. You can reuse the preprocessing steps from these assignments.

You can download the R Markdown file (https://gedeck.github.io/DS-6030/homework/Module-5.Rmd) and use it to answer the following questions.

If not otherwise stated, use Tidyverse and Tidymodels for the assignments.

As you will find out, the knitting times for the assignment will get longer as you add more code. To speed up the knitting process, use caching and parallel processing. You can find more information about caching here and about parallel processing here.

#Load packages

```
library(tidymodels)
library(tidyverse)
library(discrim)
library(probably)
library(future)
library(doParallel)
library(GGally)
library(glmnet)
library(janitor)
library(patchwork)
plan(multisession, workers = 2)
registerDoParallel(cores = 2)
```

1. Build elasticnet model for predicting airfare prices (L1/L2 regularization)

The `Airfares.csv.gz` dataset was already used in problem 1 of module 2. In that assignment, we built a model to predict the price of an airline ticket FARE using a linear regression model. In this assignment, we will build a model to predict the price of an airline ticket FARE using a linear regression model with both L1 and L2 regularization (tuning parameters `mixture` and `penalty`).

Load the data from
https://gedeck.github.io/DS-6030/datasets/homework/Airfares.csv.gz

(1.1) Load and preprocess the data. Reuse the preprocessing steps you developed in module 2. (1 point - coding)

```
# Load the data

url <-
"https://gedeck.github.io/DS-6030/datasets/homework/Airfares.csv.gz"
airfares <- read_csv(url)

## Rows: 638 Columns: 18
## — Column specification
————————————————————————————————————————————————
## Delimiter: ","
## chr  (8): S_CODE, S_CITY, E_CODE, E_CITY, VACATION, SW, SLOT, GATE
## dbl (10): COUPON, NEW, HI, S_INCOME, E_INCOME, S_POP, E_POP,
DISTANCE, PAX, ...
##
## ℹ Use `spec()` to retrieve the full column specification for this
data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet
this message.

# Convert relevant columns to factors

airfares <- airfares %>%
mutate(
VACATION = as.factor(VACATION),
SW = as.factor(SW),
SLOT = as.factor(SLOT),
GATE = as.factor(GATE)
)

# View structure

glimpse(airfares)

## Rows: 638
## Columns: 18
## $ S_CODE    <chr> "*", "*", "*", "ORD", "MDW", "*", "*", "*", "*",
"*", "*", "*…
## $ S_CITY    <chr> "Dallas/Fort Worth   TX", "Atlanta
GA", "Boston   …
## $ E_CODE    <chr> "*", "*", "*", "*", "*", "*", "*", "*", "*", "*",
"*", "*", "…
## $ E_CITY    <chr> "Amarillo          TX", "Baltimore/Wash Intl
MD", "Baltimor…
## $ COUPON    <dbl> 1.00, 1.06, 1.06, 1.06, 1.06, 1.01, 1.28, 1.15,
1.33, 1.60, 1…
## $ NEW       <dbl> 3, 3, 3, 3, 3, 3, 3, 3, 3, 2, 3, 1, 3, 3, 3, 3, 3,
3, 3, 3, 3…
```

```
## $ VACATION <fct> No, No, No, No, No, No, No, Yes, No, No, Yes, No,
No, No, No,…
## $ SW       <fct> Yes, No, No, Yes, Yes, Yes, No, Yes, Yes, Yes,
Yes, Yes, Yes,…
## $ HI       <dbl> 5291.99, 5419.16, 9185.28, 2657.35, 2657.35,
3408.11, 6754.48…
## $ S_INCOME <dbl> 28637, 26993, 30124, 29260, 29260, 26046, 28637,
26752, 27211…
## $ E_INCOME <dbl> 21112, 29838, 29838, 29838, 29838, 29838, 29838,
29838, 29838…
## $ S_POP    <dbl> 3036732, 3532657, 5787293, 7830332, 7830332,
2230955, 3036732…
## $ E_POP    <dbl> 205711, 7145897, 7145897, 7145897, 7145897,
7145897, 7145897,…
## $ SLOT     <fct> Free, Free, Free, Controlled, Free, Free, Free,
Free, Free, F…
## $ GATE     <fct> Free, Free, Free, Free, Free, Free, Free, Free,
Free, Free, F…
## $ DISTANCE <dbl> 312, 576, 364, 612, 612, 309, 1220, 921, 1249,
964, 2104, 232…
## $ PAX      <dbl> 7864, 8820, 6452, 25144, 25144, 13386, 4625, 5512,
7811, 4657…
## $ FARE     <dbl> 64.11, 174.47, 207.76, 85.47, 85.47, 56.76,
228.00, 116.54, 1…
```

(1.2) Split the data into a training (75%) and test set (25%). Prepare the resamples for 10-fold cross-validation using the training set. (1 point - coding)

```
set.seed(123)
split_data <- initial_split(airfares, prop = 0.75)
train_data <- training(split_data)
test_data <- testing(split_data)

#10-fold CV

set.seed(345)
cv_folds <- vfold_cv(train_data, v = 10)
```

(1.3) Define workflow and tuneable parameters. In the recipe, include a step to convert the categorical / nominal variables to dummy variables
(step_dummy(all_nominal_predictors())) (1 point - coding)

```
rec <- recipe(FARE ~ ., data = train_data) %>%
  step_dummy(all_nominal_predictors()) %>%
  step_normalize(all_numeric_predictors())

elastic_spec <- linear_reg(
  mode = "regression",
  penalty = tune(),
  mixture = tune()
```

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

wf <- workflow() %>%
  add_recipe(rec) %>%
  add_model(elastic_spec)

params <- extract_parameter_set_dials(wf) %>%
  update(
    penalty = penalty(range = c(-3, 0)),
    mixture = mixture(range = c(0,1))
  )
```

(1.4) Tune the model with 10-fold cross-validation using Bayesian hyperparameter optimization. Make sure that your search space covers a suitable range of values. (see DS-6030: Bayesian Hyperparameter optimization) (2 point - coding)

```r
set.seed(345)
ctrl <- control_bayes(verbose = TRUE, save_pred = TRUE)

tuned_elastic <- tune_bayes(
  wf,
  resamples = cv_folds,
  param_info = params,
  iter = 25,
  metrics = metric_set(rmse, rsq),
  control = ctrl
)
```

```
##

## ❯ Generating a set of 5 initial parameter results

## ! Fold01: preprocessor 1/1, model 1/5 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold01: preprocessor 1/1, model 2/5 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold01: preprocessor 1/1, model 3/5 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.
```

```
## ! Fold01: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold01: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold02: preprocessor 1/1, model 1/5 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold02: preprocessor 1/1, model 2/5 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold02: preprocessor 1/1, model 3/5 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold02: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold02: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold03: preprocessor 1/1, model 1/5 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.
```

```
## ! Fold03: preprocessor 1/1, model 2/5 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold03: preprocessor 1/1, model 3/5 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold03: preprocessor 1/1, model 4/5 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold03: preprocessor 1/1, model 5/5 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold04: preprocessor 1/1, model 1/5 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.
```

```
## ! Fold04: preprocessor 1/1, model 2/5 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold04: preprocessor 1/1, model 3/5 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold04: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold04: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold06: preprocessor 1/1, model 1/5 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold06: preprocessor 1/1, model 2/5 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold06: preprocessor 1/1, model 3/5 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold06: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold06: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold08: preprocessor 1/1, model 1/5 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## ! Fold08: preprocessor 1/1, model 2/5 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold08: preprocessor 1/1, model 3/5 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold08: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold08: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold09: preprocessor 1/1, model 1/5 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold09: preprocessor 1/1, model 2/5 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ! Fold09: preprocessor 1/1, model 3/5 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
```

```
   "Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold09: preprocessor 1/1, model 4/5 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold09: preprocessor 1/1, model 5/5 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold10: preprocessor 1/1, model 1/5 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold10: preprocessor 1/1, model 2/5 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ! Fold10: preprocessor 1/1, model 3/5 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
```

```
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold10: preprocessor 1/1, model 4/5 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ! Fold10: preprocessor 1/1, model 5/5 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ✓ Initialization complete

##

## ℹ Gaussian process model

## ✓ Gaussian process model

## ℹ Generating 5000 candidates

## ℹ Predicted candidates

## ℹ Estimating performance

## ℹ Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##       to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##       to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##       to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##       to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## ℹ Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## ℹ Fold10: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## ℹ Gaussian process model

## ✓ Gaussian process model

## ℹ Generating 5000 candidates

## ℹ Predicted candidates

## ℹ Estimating performance

## ℹ Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## ℹ Gaussian process model

## ✓ Gaussian process model

## ℹ Generating 5000 candidates

## ℹ Predicted candidates

## ℹ Estimating performance

## ℹ Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ⓘ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ⓘ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ⓘ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ⓘ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ⓘ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ⓘ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ⓘ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ⓘ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ⓘ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ⓘ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ⓘ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##   ⓘ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ⓘ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ⓘ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ⓘ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ⓘ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance

## ℹ Gaussian process model

## ✓ Gaussian process model

## ℹ Generating 5000 candidates

## ℹ Predicted candidates

## ℹ Estimating performance

## ℹ Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##       to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##       "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
## 	to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
## 	ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
## 	! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
## 	"Anchorage AK".
## 	ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
## 	ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "El Paso TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Memphis TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Omaha NE".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
 `step_...
## 	   to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
## 	 ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	   to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
## 	  ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
## 	    "Anchorage AK".
## 	 ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	   to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
## 	 ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
## 	   to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## ℹ Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## ℹ Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## ℹ Fold10: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##    to handle unseen values.

## ✓ Estimating performance

## ℹ Gaussian process model

## ✓ Gaussian process model

## ℹ Generating 5000 candidates

## ℹ Predicted candidates

## ℹ Estimating performance

## ℹ Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## ℹ Fold01: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Lubbock TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Boise ID".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Nashville TN".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##       to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## i Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## i Fold04: preprocessor 1/1, model 1/1 (extracts)

## i Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##      "Anchorage AK".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## i Fold05: preprocessor 1/1, model 1/1
```

```
## ✓ Fold05: preprocessor 1/1, model 1/1

## i Fold05: preprocessor 1/1, model 1/1 (extracts)

## i Fold05: preprocessor 1/1, model 1/1 (predictions)

## i Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## i Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## i Fold06: preprocessor 1/1, model 1/1 (extracts)

## i Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates
```

```
## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## i Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## i Fold02: preprocessor 1/1, model 1/1 (extracts)

## i Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## i Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## i Fold03: preprocessor 1/1, model 1/1 (extracts)

## i Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Cinci...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)

## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## i Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1

## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
```

```
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)

## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance

## i Gaussian process model

## ✓ Gaussian process model

## i Generating 5000 candidates

## i Predicted candidates

## i Estimating performance

## i Fold01: preprocessor 1/1

## ✓ Fold01: preprocessor 1/1

## i Fold01: preprocessor 1/1, model 1/1

## ✓ Fold01: preprocessor 1/1, model 1/1

## i Fold01: preprocessor 1/1, model 1/1 (extracts)

## i Fold01: preprocessor 1/1, model 1/1 (predictions)

## ! Fold01: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Greenville/Sprtnbg SC".
```

```
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##      to handle unseen values.

## ℹ Fold02: preprocessor 1/1

## ✓ Fold02: preprocessor 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1

## ✓ Fold02: preprocessor 1/1, model 1/1

## ℹ Fold02: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold02: preprocessor 1/1, model 1/1 (predictions)

## ! Fold02: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `E_CITY`: "Lubbock TX".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold03: preprocessor 1/1

## ✓ Fold03: preprocessor 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1

## ✓ Fold03: preprocessor 1/1, model 1/1

## ℹ Fold03: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold03: preprocessor 1/1, model 1/1 (predictions)

## ! Fold03: preprocessor 1/1, model 1/1 (predictions):
##    ! There are new levels in `S_CITY`: "Boise ID".
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values., ! There are new levels in `E_CITY`: "Cinci...
##    ℹ Consider using step_novel() (`?recipes::step_novel()`) before `step_...
##       to handle unseen values.

## ℹ Fold04: preprocessor 1/1

## ✓ Fold04: preprocessor 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1

## ✓ Fold04: preprocessor 1/1, model 1/1

## ℹ Fold04: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold04: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold04: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Spokane WA", "Honolulu
(Intl) HI"...
##     "Anchorage AK".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Spoka...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold05: preprocessor 1/1

## ✓ Fold05: preprocessor 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1

## ✓ Fold05: preprocessor 1/1, model 1/1

## ℹ Fold05: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold05: preprocessor 1/1, model 1/1 (predictions)

## ℹ Fold06: preprocessor 1/1

## ✓ Fold06: preprocessor 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1

## ✓ Fold06: preprocessor 1/1, model 1/1

## ℹ Fold06: preprocessor 1/1, model 1/1 (extracts)

## ℹ Fold06: preprocessor 1/1, model 1/1 (predictions)

## ! Fold06: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "El Paso TX".
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Littl...
##   ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## ℹ Fold07: preprocessor 1/1

## ✓ Fold07: preprocessor 1/1

## ℹ Fold07: preprocessor 1/1, model 1/1

## ✓ Fold07: preprocessor 1/1, model 1/1
```

```
## i Fold07: preprocessor 1/1, model 1/1 (extracts)

## i Fold07: preprocessor 1/1, model 1/1 (predictions)

## i Fold08: preprocessor 1/1

## ✓ Fold08: preprocessor 1/1

## i Fold08: preprocessor 1/1, model 1/1

## ✓ Fold08: preprocessor 1/1, model 1/1

## i Fold08: preprocessor 1/1, model 1/1 (extracts)

## i Fold08: preprocessor 1/1, model 1/1 (predictions)

## ! Fold08: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `E_CITY`: "Memphis TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold09: preprocessor 1/1

## ✓ Fold09: preprocessor 1/1

## i Fold09: preprocessor 1/1, model 1/1

## ✓ Fold09: preprocessor 1/1, model 1/1

## i Fold09: preprocessor 1/1, model 1/1 (extracts)

## i Fold09: preprocessor 1/1, model 1/1 (predictions)

## ! Fold09: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Omaha NE".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values., ! There are new levels in `E_CITY`:
"Hartf...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##     to handle unseen values.

## i Fold10: preprocessor 1/1

## ✓ Fold10: preprocessor 1/1

## i Fold10: preprocessor 1/1, model 1/1

## ✓ Fold10: preprocessor 1/1, model 1/1

## i Fold10: preprocessor 1/1, model 1/1 (extracts)

## i Fold10: preprocessor 1/1, model 1/1 (predictions)
```

```
## ! Fold10: preprocessor 1/1, model 1/1 (predictions):
##   ! There are new levels in `S_CITY`: "Nashville TN".
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values., ! There are new levels in `E_CITY`:
"Green...
##   i Consider using step_novel() (`?recipes::step_novel()`) before
`step_...
##      to handle unseen values.

## ✓ Estimating performance
```

```r
autoplot(tuned_elastic)
```

```r
show_best(tuned_elastic, metric = "rmse")
```

```
## # A tibble: 5 × 9
##   penalty mixture .metric .estimator  mean     n
std_err .config .iter
##     <dbl>   <dbl> <chr>   <chr>      <dbl> <int>  <dbl> <chr>
<int>
## 1   0.805    1.00 rmse    standard    31.5    10  0.918 Iter18
18
## 2   0.888   0.909 rmse    standard    31.5    10  0.916 Iter23
23
## 3   0.801   0.990 rmse    standard    31.5    10  0.919 Iter15
15
## 4   0.967   0.848 rmse    standard    31.5    10  0.913 Iter8
8
## 5   0.985   0.834 rmse    standard    31.5    10  0.913 Iter6
6
```

(1.5) Train a final model using the best parameter set. (1 point - coding)

```r
best_params <- select_best(tuned_elastic, metric = "rmse")

final_model <- finalize_workflow(wf, best_params) %>%
  fit(data = train_data)
```

(1.6) Predict the FARE for the test set and calculate the performance metrics on the test set.
(1 point - coding)

```r
test_preds <- predict(final_model, new_data = test_data) %>%
  bind_cols(test_data)
```

```
## Warning: ! There are new levels in `S_CITY`: "Portland OR" and
"Pittsburgh PA".
## i Consider using step_novel() (`?recipes::step_novel()`) before
`step_dummy()`
##   to handle unseen values.
```

```
## Warning: ! There are new levels in `E_CITY`: "Amarillo TX", "Boston
MA", and
##    "Tallahassee FL".
## ℹ Consider using step_novel() (`?recipes::step_novel()`) before
`step_dummy()`
##    to handle unseen values.

metrics <- metric_set(rmse, rsq)
metrics(test_preds, truth = FARE, estimate = .pred)

## # A tibble: 2 × 3
##    .metric .estimator .estimate
##    <chr>   <chr>           <dbl>
## 1 rmse    standard       31.4
## 2 rsq     standard        0.833
```

2. NASA: Asteroid classification - classification with dimensionality reduction

The dataset `nasa.csv` contains information about asteroids and if they are considered to be hazardous or not.

    A.   Data loading and preprocessing

(2.1) Load the data from https://gedeck.github.io/DS-6030/datasets/nasa.csv and preprocess the data. You can find the necessary preprocessing steps in module 3. (1 point - coding)

```
# Load the dataset

url <- "https://gedeck.github.io/DS-6030/datasets/nasa.csv"
nasa <- read_csv(url)

## Rows: 4687 Columns: 40
## ── Column specification ─────────────────────────────────────────
## Delimiter: ","
## chr   (2): Orbiting Body, Equinox
## dbl  (35): Neo Reference ID, Name, Absolute Magnitude, Est Dia in
KM(min), E...
## lgl   (1): Hazardous
## dttm  (1): Orbit Determination Date
## date  (1): Close Approach Date
##
## ℹ Use `spec()` to retrieve the full column specification for this
data.
## ℹ Specify the column types or set `show_col_types = FALSE` to quiet
this message.

# Convert Hazardous to factor

nasa <- nasa %>%
```

```
    mutate(Hazardous = factor(Hazardous, levels = c(TRUE, FALSE), labels
= c("Yes", "No")))
```

(2.2) Split the dataset into a training and test set. Use 80% of the data for training and 20% for testing. Use stratified sampling to ensure that the training and test set have the same proportion of hazardous asteroids. (1 point - coding)

    B.   Model building

```
set.seed(456)
split_data <- initial_split(nasa, prop = 0.8, strata = Hazardous)

nasa_train <- training(split_data)
nasa_test <- testing(split_data)
```

(2.3) Build a logistic regression classification model using principal components (step_pca) as predictors. Use cross-validation to determine the optimal number of components. (see DS-6030: Specifying tunable parameters) (3 points - coding)

- Use step_normalize and step_pca to preprocess the data in a recipe.
- Use the tune function to find the best number of components (num_comp) in the range 1 to 14 using AUC as the selection criterium. Check **all** possible numbers of components from 1 to 14.
- Use the autoplot function on the cross-validation results to visualize the results. Describe your observations.
- Report the best number of components and the associated regression metrics.
- Using the best parameter set, train a final model using the full training set and determine the performance metrics on the test set.

```
# PCA recipe

pca_rec <- recipe(Hazardous ~ ., data = nasa_train) %>%
  update_role(`Close Approach Date`, `Orbit Determination Date`,
new_role = "id variable") %>%
  step_zv(all_predictors()) %>%
  step_normalize(all_numeric_predictors()) %>%
  step_pca(all_numeric_predictors(), num_comp = tune())

# Model spec

log_reg_spec <- logistic_reg(mode = "classification") %>%
  set_engine("glm")

# Workflow

pca_wf <- workflow() %>%
  add_recipe(pca_rec) %>%
  add_model(log_reg_spec)

# 10-fold CV
```

```r
set.seed(456)
cv_folds <- vfold_cv(nasa_train, v = 10, strata = Hazardous)

# Grid

pca_grid <- grid_regular(num_comp(range = c(1, 14)), levels = 14)

# Tune

res_pca <- tune_grid(
  pca_wf,
  resamples = cv_folds,
  grid = pca_grid,
  metrics = metric_set(roc_auc, accuracy),
  control = control_grid(save_pred = TRUE)
)
```

```
## ! Fold01: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```r
# Results

autoplot(res_pca)
```

```r
# Best PCA result

best_pca <- select_best(res_pca, metric = "roc_auc")
print(best_pca)

## # A tibble: 1 × 2
##   num_comp .config
##      <int> <chr>
## 1       14 Preprocessor14_Model1

# Final workflow

final_pca_wf <- finalize_workflow(pca_wf, best_pca)
final_pca_fit <- fit(final_pca_wf, data = nasa_train)

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

# Predictions on test set

pca_preds <- predict(final_pca_fit, nasa_test, type = "prob") %>%
  bind_cols(predict(final_pca_fit, nasa_test)) %>%
  bind_cols(nasa_test)

# Test metrics

class_metrics <- metric_set(accuracy, roc_auc, sensitivity,
specificity)

pca_metrics <- class_metrics(
  pca_preds,
  truth = Hazardous,
  estimate = .pred_class,
  .pred_Yes
)

print(pca_metrics)

## # A tibble: 4 × 3
##   .metric     .estimator .estimate
##   <chr>       <chr>          <dbl>
## 1 accuracy    binary         0.925
## 2 sensitivity binary         0.689
## 3 specificity binary         0.971
## 4 roc_auc     binary         0.955
```

Based on the final metrics, it seems as though there is strong predictive performance, particularly in separating Hazardous asteroids from non-Hazardous asteroids.

(2.4) Repeat **(2.3)** using PLS (`step_pls`) in the preprocessing steps of the predictors. The model is still classification using logistic regression (see DS-6030: Partial least squares regression on how to install the required packages) (3 points - coding)

- Use `step_normalize` and `step_pls` to preprocess the data in a recipe.
- Use the `tune` function to find the best number of components (`num_comp`) in the range 1 to 14 using AUC as the selection criterium. Check **all** possible numbers of components from 1 to 14.
- Use the `autoplot` function on the cross-validation results to visualize the results. Describe your observations.
- Report the best number of components and the associated classification metrics.
- Using the best parameter set, train a final model using the full training set and determine the performance metrics on the test set.

```r
library(plsmod)

pls(mode="regression") %>%
    set_engine("mixOmics")

## PLS Model Specification (regression)
##
## Computational engine: mixOmics

# PLS recipe

pls_rec <- recipe(Hazardous ~ ., data = nasa_train) %>%
  update_role(`Close Approach Date`, `Orbit Determination Date`,
new_role = "id variable") %>%
  step_zv(all_predictors()) %>%
  step_normalize(all_numeric_predictors()) %>%
  step_pls(all_numeric_predictors(), outcome = "Hazardous", num_comp =
tune())

# Workflow

pls_wf <- workflow() %>%
  add_recipe(pls_rec) %>%
  add_model(log_reg_spec)

# Tune

res_pls <- tune_grid(
  pls_wf,
  resamples = cv_folds,
  grid = pca_grid,
  metrics = metric_set(roc_auc, accuracy),
  control = control_grid(save_pred = TRUE)
)
```

```
## ! Fold01: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold01: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold02: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold02: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold03: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold03: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold04: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold05: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold05: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold06: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold06: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold07: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold08: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold08: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred
```

```
## ! Fold09: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold09: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 2/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 3/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 4/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 5/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 6/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 7/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 8/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 9/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 10/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 11/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 12/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 13/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

## ! Fold10: preprocessor 14/14, model 1/1: glm.fit: fitted
probabilities numerically 0 or 1 occurred

# Results

autoplot(res_pls)
```

```r
# Best PLS result

best_pls <- select_best(res_pls, metric = "roc_auc")
print(best_pls)

## # A tibble: 1 × 2
##   num_comp .config
##      <int> <chr>
## 1       14 Preprocessor14_Model1

# Final model

final_pls_wf <- finalize_workflow(pls_wf, best_pls)
final_pls_fit <- fit(final_pls_wf, data = nasa_train)

## Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

# Predictions

pls_preds <- predict(final_pls_fit, nasa_test, type = "prob") %>%
  bind_cols(predict(final_pls_fit, nasa_test)) %>%
  bind_cols(nasa_test)

# Test metrics

class_metrics <- metric_set(accuracy, roc_auc, sensitivity, specificity)

pls_metrics <- class_metrics(
  pls_preds,
  truth = Hazardous,
  estimate = .pred_class,
  .pred_Yes
)

print(pls_metrics)

## # A tibble: 4 × 3
##   .metric     .estimator .estimate
##   <chr>       <chr>          <dbl>
## 1 accuracy    binary         0.954
## 2 sensitivity binary         0.874
## 3 specificity binary         0.970
## 4 roc_auc     binary         0.987
```

(2.5) Compare the tuning results in **(2.3)** and **(2.4)** and comment on the differences. Do you see different behavior in the autoplot graphs? What do you think is going on? Could you reduce the number of components further from what is suggested by CV? (2 points - discussion)

I do see different behavior in the autoplot graphs. The graphs in 2.4 seem to give a better fit than those of 2.3. The sensitivity coefficient also seems to be stronger. You could reduce the number of components based on how the AUC curve has been flattened.

Sources:

"Janitor Package - RDocumentation." Rdocumentation.org, 2020,
www.rdocumentation.org/packages/janitor/versions/2.2.1.