AE 09: Model comparison

Restaurant tips

Oct 19, 2022

> **Important**
>
> The AE is due on GitHub by Saturday, October 22 at 11:59pm.

Packages

```
library(tidyverse)
library(tidymodels)
library(viridis)
library(knitr)
library(patchwork)
```

Load data

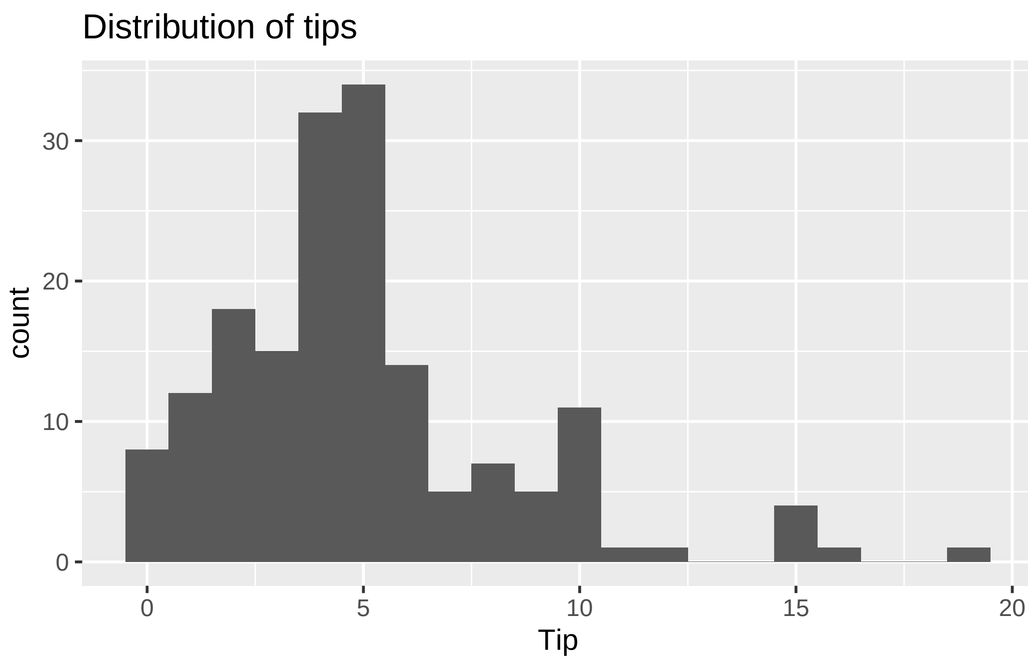
```
tips <- read_csv("data/tip-data.csv") |>
  filter(!is.na(Party))
```

```
# relevel factors
tips <- tips |>
  mutate(
    Meal = fct_relevel(Meal, "Lunch", "Dinner", "Late Night"),
    Age  = fct_relevel(Age, "Yadult", "Middle", "SenCit")
  )
```

Exploratory data analysis

Response variable

```
ggplot(tips, aes(x = Tip)) +
  geom_histogram(binwidth = 1) +
  labs(title = "Distribution of tips")
```



Predictor variables

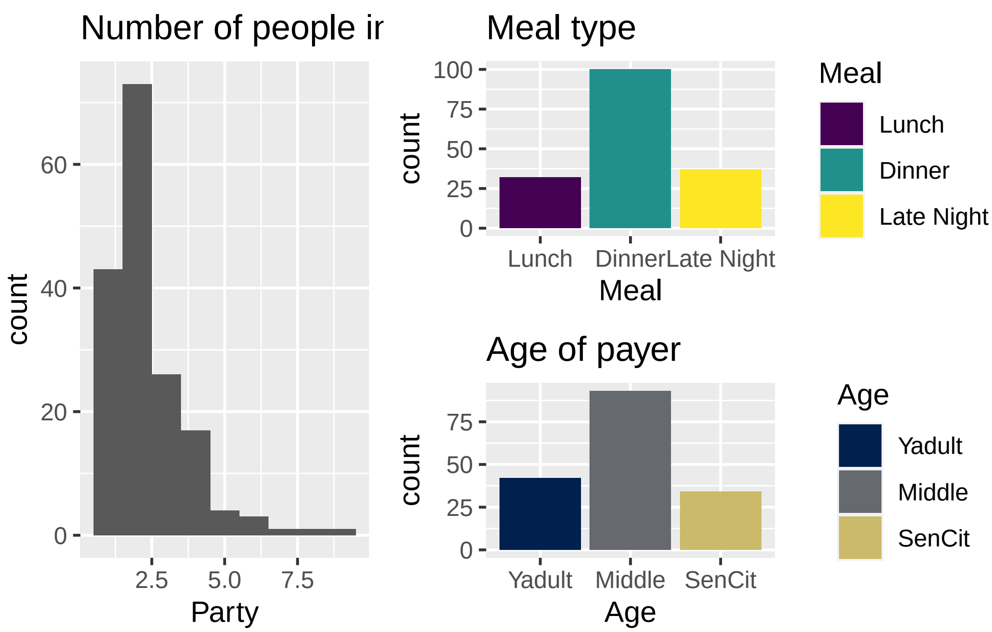
```
p1 <- ggplot(tips, aes(x = Party)) +
  geom_histogram(binwidth = 1) +
  labs(title = "Number of people in party")

p2 <- ggplot(tips, aes(x = Meal, fill = Meal)) +
  geom_bar() +
  labs(title = "Meal type") +
  scale_fill_viridis_d()

p3 <- ggplot(tips, aes(x = Age, fill = Age)) +
```

```r
  geom_bar() +
  labs(title = "Age of payer") +
  scale_fill_viridis_d(option = "E", end = 0.8)

p1 + (p2 / p3)
```



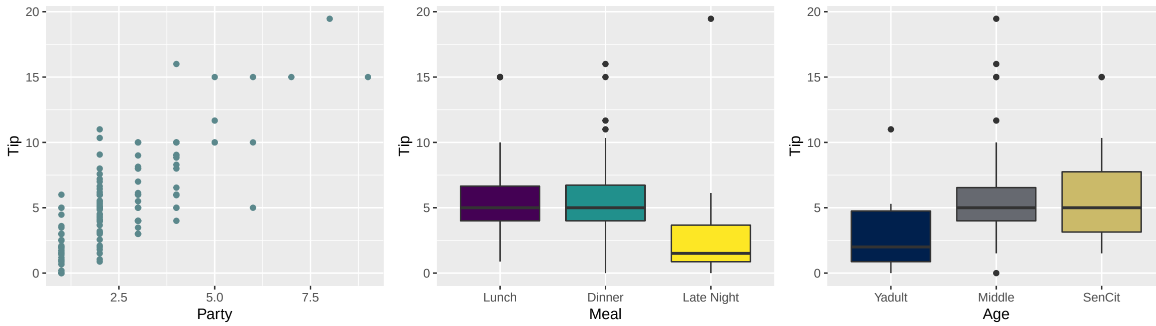
Response vs. predictors

```r
p4 <- ggplot(tips, aes(x = Party, y = Tip)) +
  geom_point(color = "#5B888C")

p5 <- ggplot(tips, aes(x = Meal, y = Tip, fill = Meal)) +
  geom_boxplot(show.legend = FALSE) +
  scale_fill_viridis_d()

p6 <- ggplot(tips, aes(x = Age, y = Tip, fill = Age)) +
  geom_boxplot(show.legend = FALSE) +
  scale_fill_viridis_d(option = "E", end = 0.8)

p4 + p5 + p6
```



Models

Model 1: Tips vs. Age & Party

```
tip_fit <- linear_reg() |>
  set_engine("lm") |>
  fit(Tip ~ Party + Age, data = tips)

tidy(tip_fit) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value
(Intercept)	-0.170	0.366	-0.465	0.643
Party	1.837	0.124	14.758	0.000
AgeMiddle	1.009	0.408	2.475	0.014
AgeSenCit	1.388	0.485	2.862	0.005

Model 2: Tips vs. Age, Party, Meal, & Day

```
tip_fit_2 <- linear_reg() |>
  set_engine("lm") |>
  fit(Tip ~ Party +  Age + Meal +  Day,
      data = tips)

tidy(tip_fit_2) |>
  kable(digits = 3)
```

term	estimate	std.error	statistic	p.value
(Intercept)	-0.354	0.968	-0.365	0.715
Party	1.792	0.126	14.179	0.000
AgeMiddle	0.506	0.427	1.185	0.238
AgeSenCit	1.017	0.494	2.058	0.041
MealDinner	0.636	0.457	1.390	0.167
MealLate Night	-0.729	0.754	-0.967	0.335
DaySaturday	0.812	0.783	1.038	0.301
DaySunday	0.097	0.877	0.111	0.912
DayThursday	0.069	0.897	0.077	0.939
DayTuesday	0.414	0.670	0.618	0.537
DayWednesday	0.936	1.098	0.853	0.395

> Why did we not use the full `recipe()` workflow to fit Model 1 or Model 2?

We didn't actually do anything to the data, so there's no real reason to do a recipe workflow when a simple linear regression will do.

R^2 and Adjusted R^2

Fill in the code below to calculate R^2 and Adjusted R^2 for Model 1. Put `eval: true` once the code is updated.

```
glance(tip_fit) |>
  select(r.squared, adj.r.squared)
```

```
# A tibble: 1 x 2
  r.squared adj.r.squared
      <dbl>         <dbl>
1     0.641         0.635
```

Calculate R^2 and Adjusted R^2 for Model 2.

```
glance(tip_fit_2) %>%
  select(r.squared, adj.r.squared)
```

```
# A tibble: 1 x 2
  r.squared adj.r.squared
```

```
      <dbl>         <dbl>
1     0.683         0.662
```

We would like to choose the model that better fits the data.

- Which model would we choose based on R^2?

The second model.

- Which model would we choose based on Adjusted R^2?

Also the second model.

- Which statistic should we use to choose the final model - R^2 or Adjusted R^2? Why?

Adjusted R^2 - it is a better comparison across models, because it penalizes models that use too many predictors.

Added response above.

AIC & BIC

Use the `glance()` function to calculate AIC and BIC for Models 1 and 2.

```r
glance(tip_fit) %>%
  select(AIC, BIC)
```

```
# A tibble: 1 x 2
    AIC   BIC
  <dbl> <dbl>
1  726.  742.
```

```r
glance(tip_fit_2) %>%
  select(AIC, BIC)
```

```
# A tibble: 1 x 2
    AIC   BIC
  <dbl> <dbl>
1  720.  757.
```

We would like to choose the model that better fits the data.

- Which model would we choose based on AIC?
- Which model would we choose based on BIC?

On the basis of AIC, we should choose the second model, as it has a lower value. However, on the basis of BIC, we should choose the first model instead.

Evaluating analysis process

We fit and evaluated these models using the entire data set. What is a limitation to using the entire data set to fit and evaluate models?

We don't have any test data that the model was not trained on, so we don't know exactly how well our models perform on additional data (i.e., their predictive value).

Submission

! Important

To submit the AE:

- Render the document to produce the PDF with all of your work from today's class.
- Push all your work to your `ae-09-` repo on GitHub. (You do not submit AEs on Gradescope).