Exploring numerical data

EXPLORATORY DATA ANALYSIS IN R

Andrew Bray

Assistant Professor, Reed College

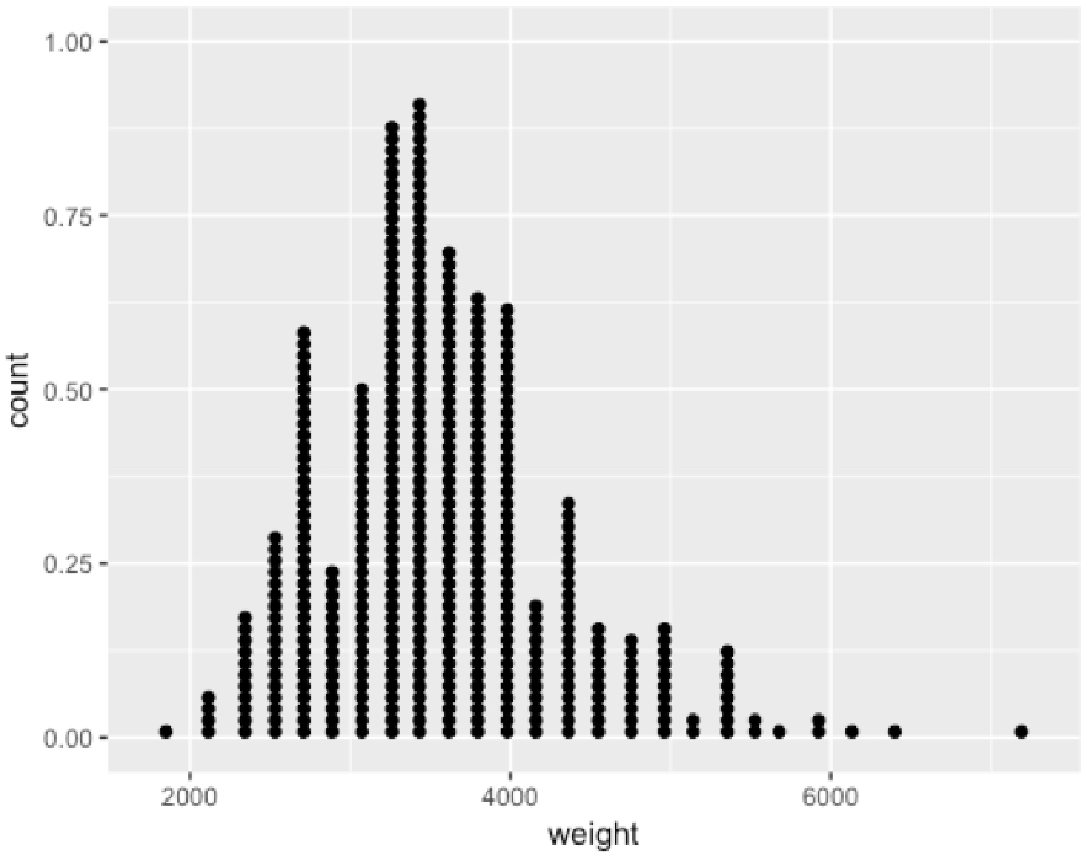
Cars dataset

```
str(cars)
```

```
Classes ‘tbl_df’, ‘tbl’ and 'data.frame':    428 obs. of  19 variables:
$ name       : chr  "Chevrolet Aveo 4dr" "Chevrolet Aveo LS 4dr hatch" ...
$ sports_car : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ suv        : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ wagon      : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ minivan    : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ pickup     : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ all_wheel  : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ rear_wheel : logi  FALSE FALSE FALSE FALSE FALSE FALSE ...
$ msrp       : int  11690 12585 14610 14810 16385 13670 15040 13270 ...
$ dealer_cost: int  10965 11802 13697 13884 15357 12849 14086 12482 ...
$ eng_size   : num  1.6 1.6 2.2 2.2 2.2 2 2 2 2 2 ...
$ ncyl       : int  4 4 4 4 4 4 4 4 4 4 ...
$ horsepwr   : int  103 103 140 140 140 132 132 130 110 130 ...
$ city_mpg   : int  28 28 26 26 26 29 29 26 27 26 ...
$ hwy_mpg    : int  34 34 37 37 37 36 36 33 36 33 ...
$ weight     : int  2370 2348 2617 2676 2617 2581 2626 2612 2606 ...
$ wheel_base : int  98 98 104 104 104 105 105 103 103 103 ...
$ length     : int  167 153 183 183 183 174 174 168 168 168 ...
$ width      : int  66 66 69 68 69 67 67 67 67 67 ...
```

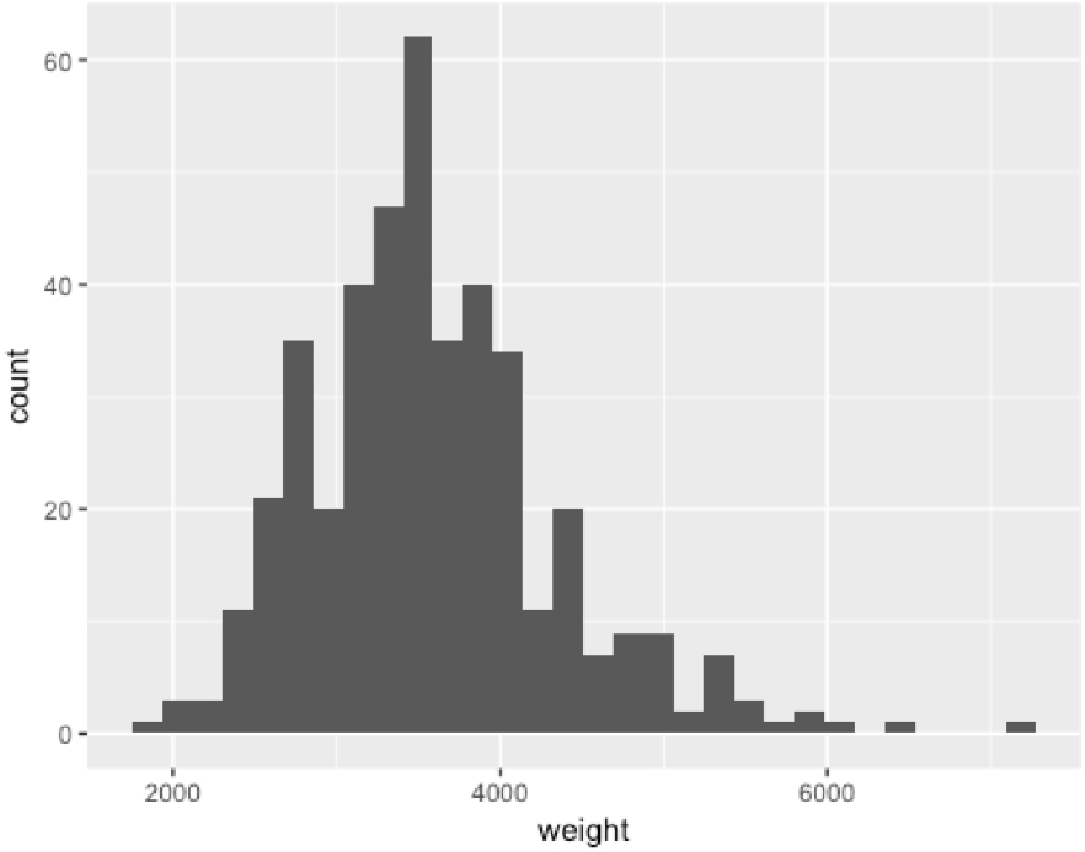
Dotplot

```
ggplot(data, aes(x = weight)) +
  geom_dotplot(dotsize = 0.4)
```



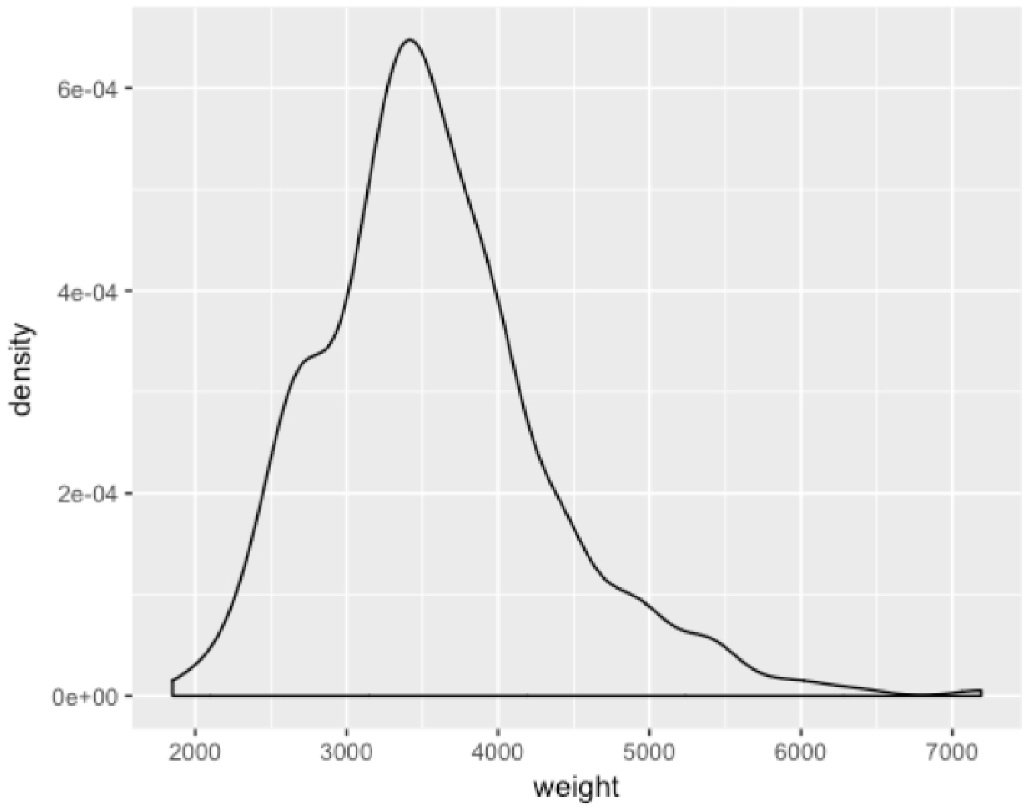
Histogram

```
ggplot(data, aes(x = weight)) +
  geom_histogram()
```



Density plot

```
ggplot(data, aes(x = weight)) +
  geom_density()
```



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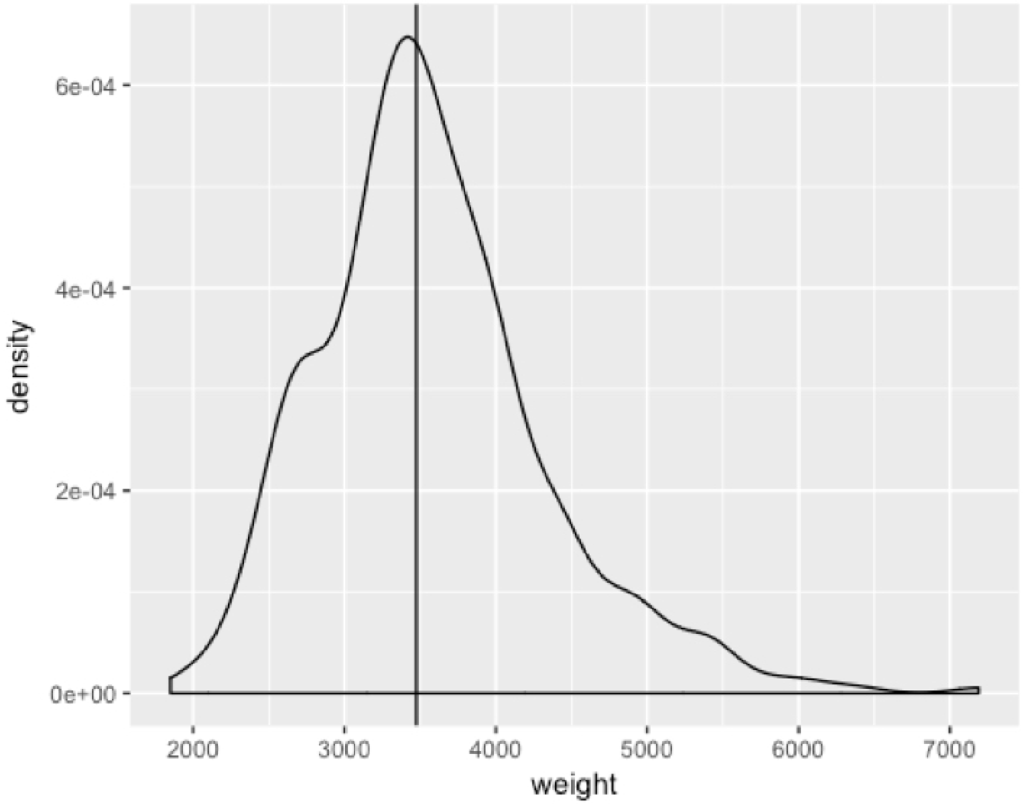

Density plot

```
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  geom_density()
```
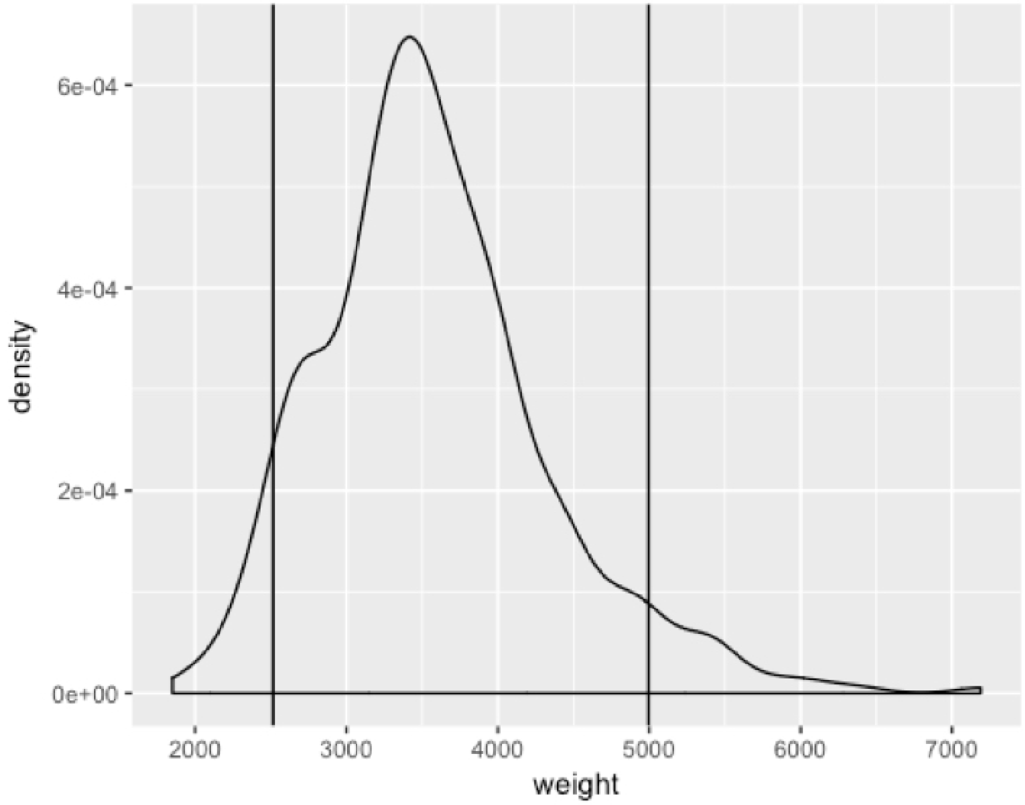
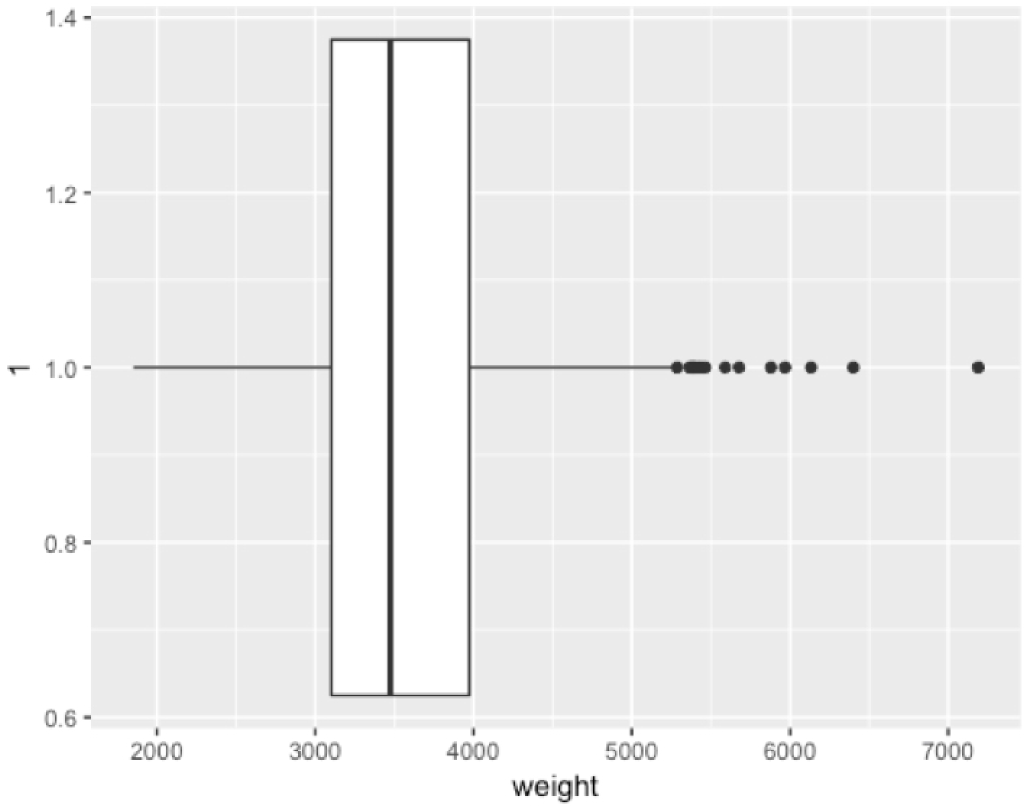



Boxplot

```
ggplot(data, aes(x = 1, y = weight)) +
  geom_boxplot() +
  coord_flip()
```



Boxplot

```
ggplot(data, aes(x = 1, y = weight)) +
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```

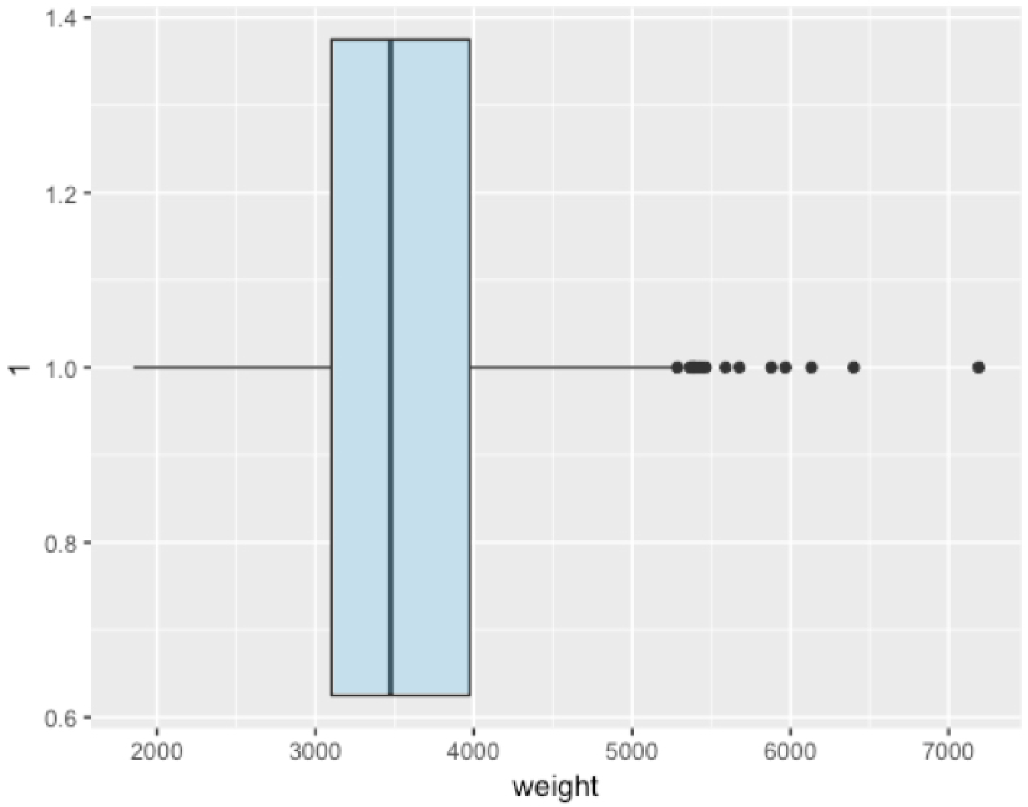

Boxplot

```
ggplot(data, aes(x = 1, y = weight)) +
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```

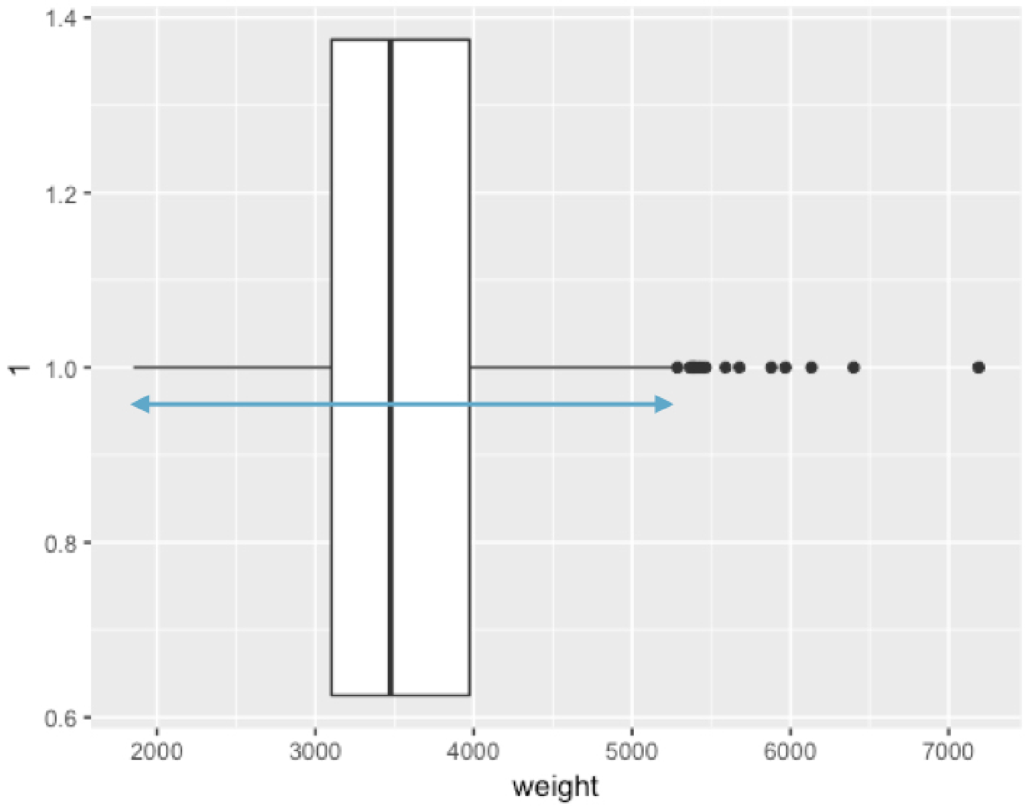

Boxplot

```
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  geom_boxplot() +
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```
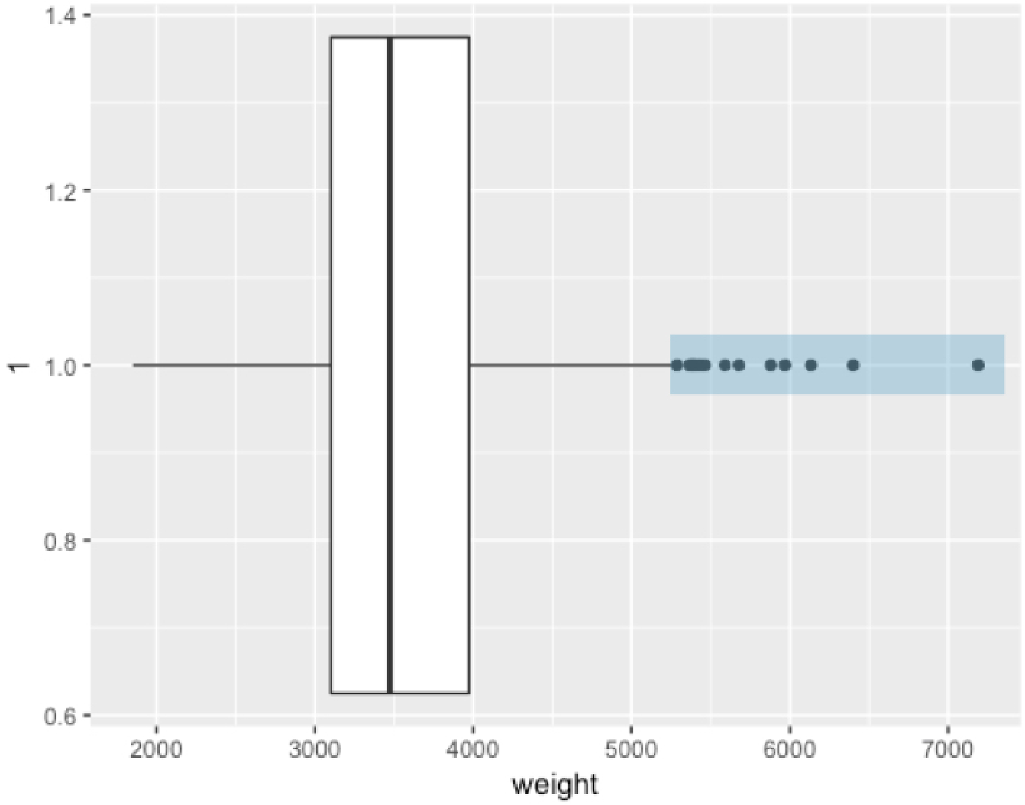
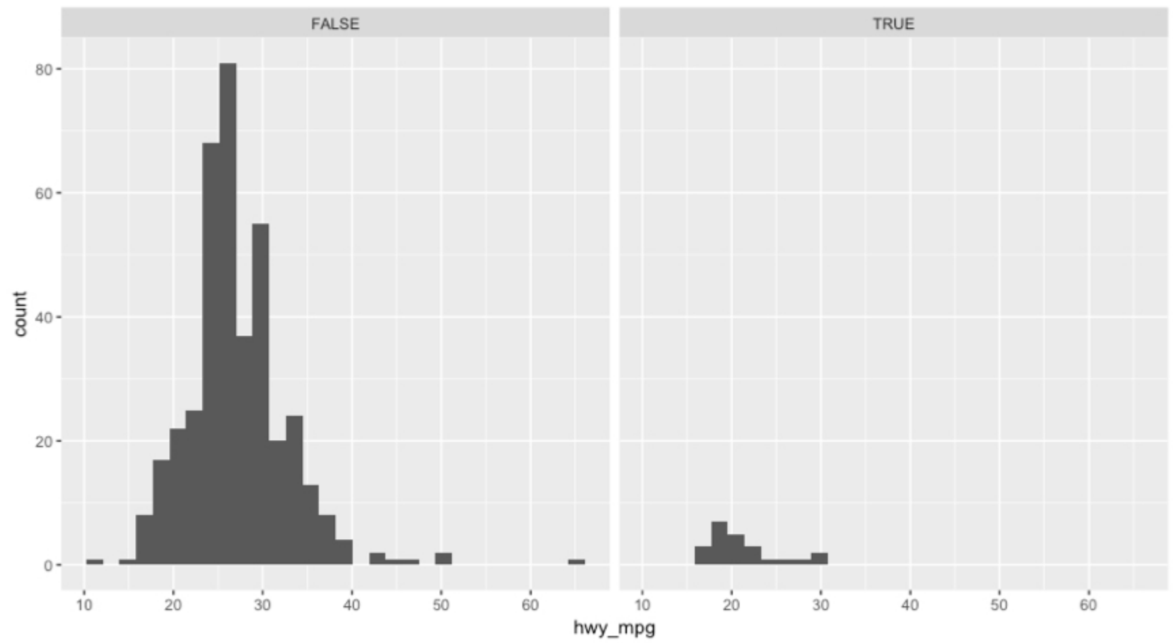



Faceted histogram

```
ggplot(cars, aes(x = hwy_mpg)) +
  geom_histogram() +
  facet_wrap(~pickup)
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
Warning message:
Removed 14 rows containing non-finite values (stat_bin).
```



Faceted histogram

```r
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  geom_histogram() +
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`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
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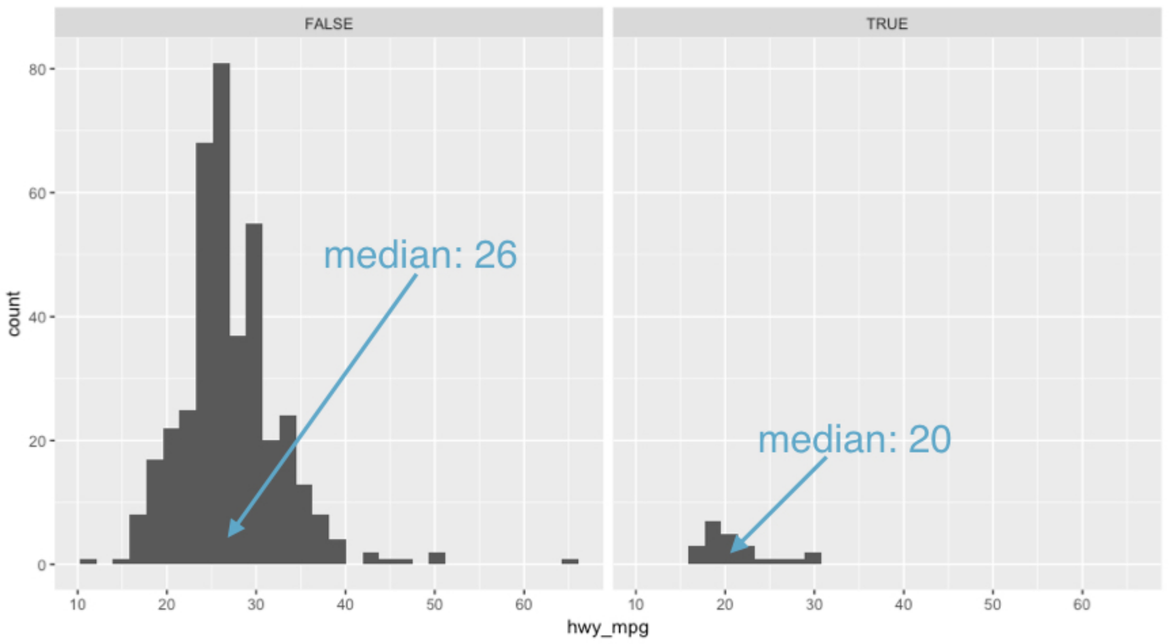

Faceted histogram

```
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  geom_histogram() +
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```

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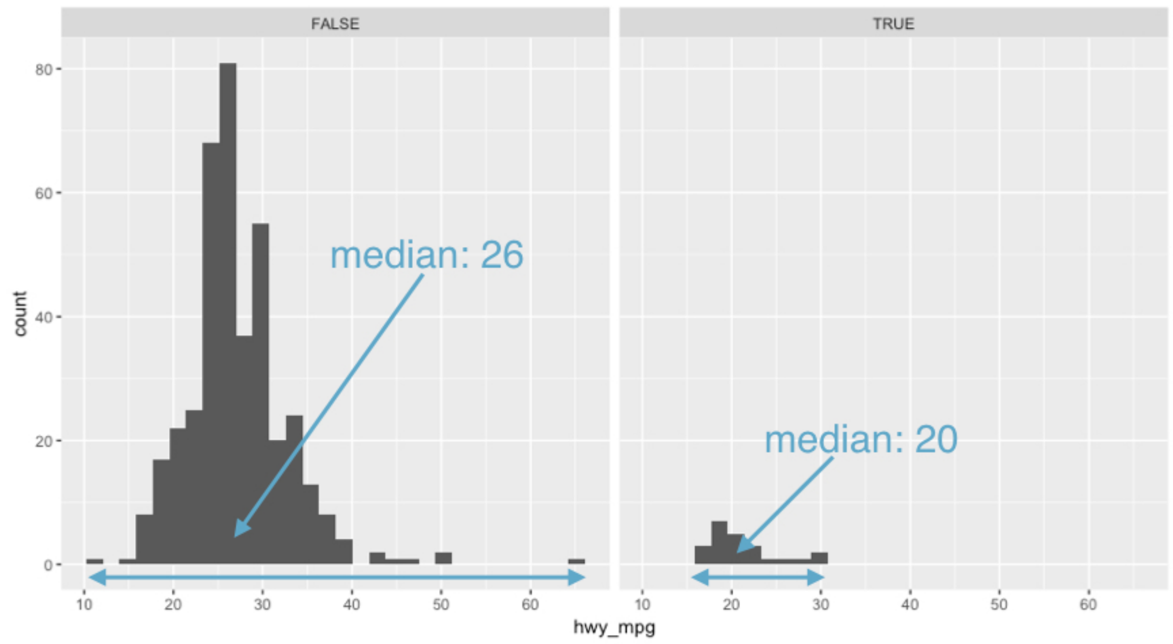

Let's practice!

EXPLORATORY DATA ANALYSIS IN R

Distribution of one variable

EXPLORATORY DATA ANALYSIS IN R

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Assistant Professor, Reed College

Marginal vs. conditional

```
ggplot(cars, aes(x = hwy_mpg)) +
  geom_histogram()
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
Warning message:
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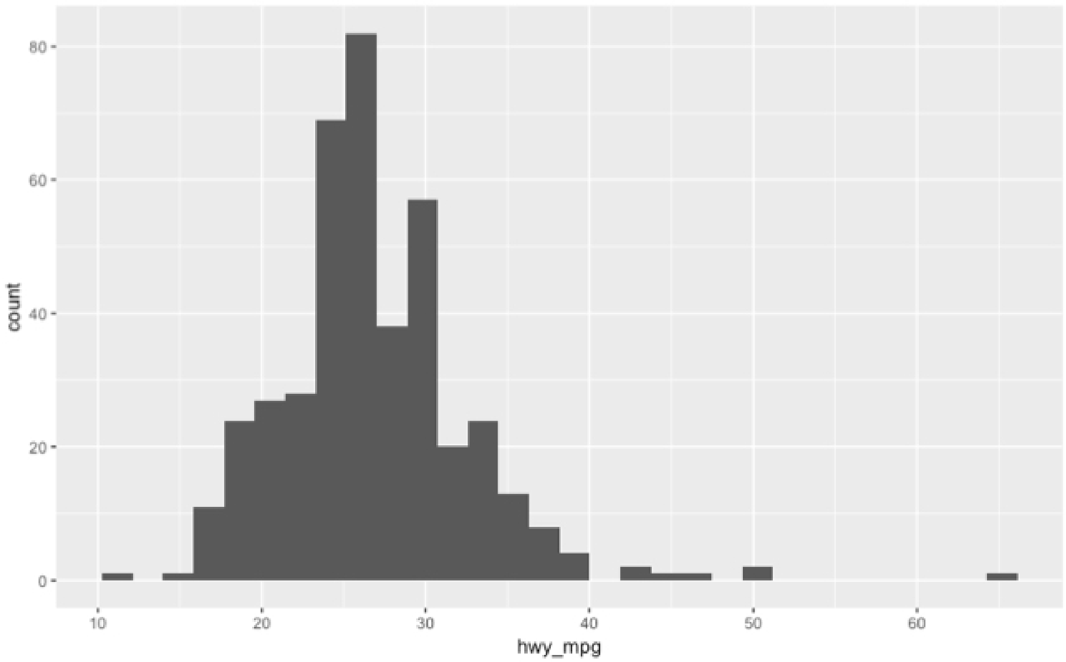
```



Marginal vs. conditional

```
ggplot(cars, aes(x = hwy_mpg)) +
  geom_histogram() +
  facet_wrap(~pickup)
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
Warning message:
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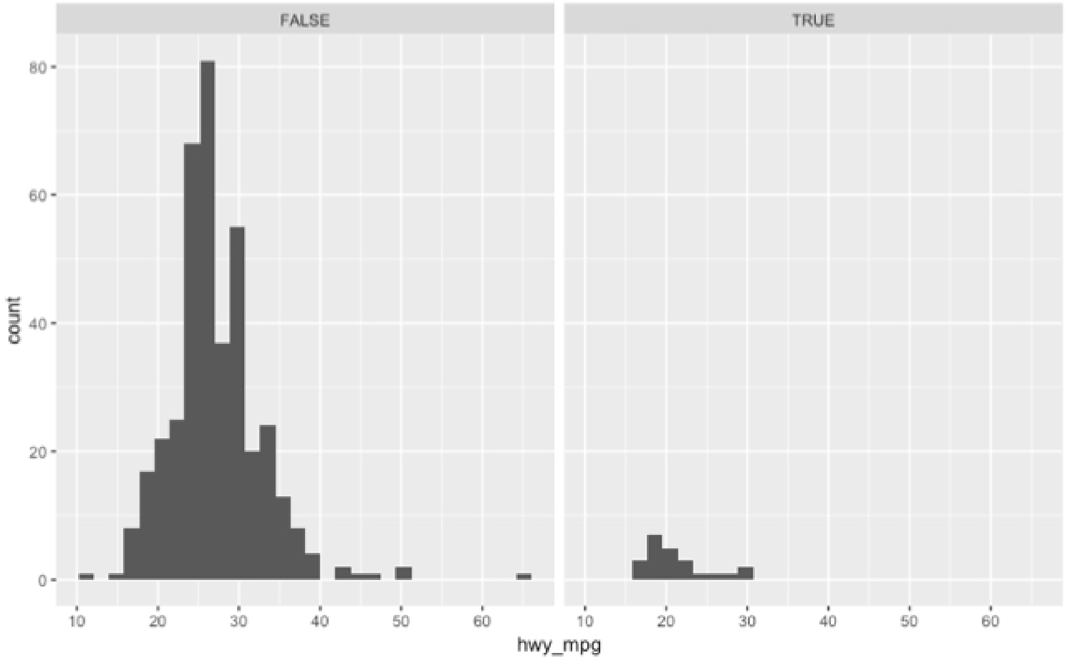
```



Building a data pipeline

```r
cars2 <- cars %>%
  filter(eng_size < 2.0)

ggplot(cars2, aes(x = hwy_mpg)) +
  geom_histogram()
```

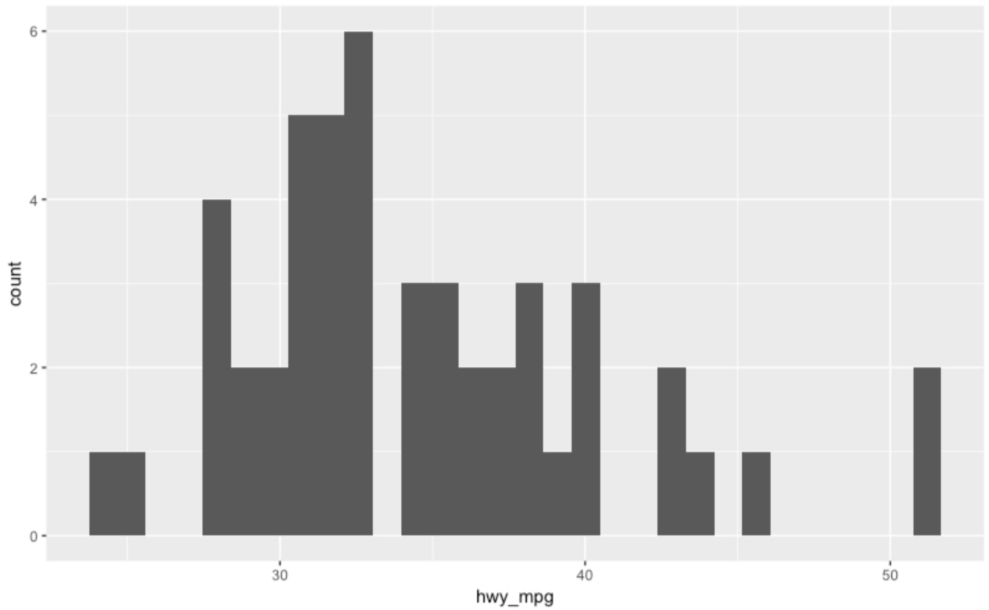
Building a data pipeline

```
cars %>%
  filter(eng_size < 2.0) %>%
  ggplot(aes(x = hwy_mpg)) +
  geom_histogram()
```

Filtered and faceted histogram

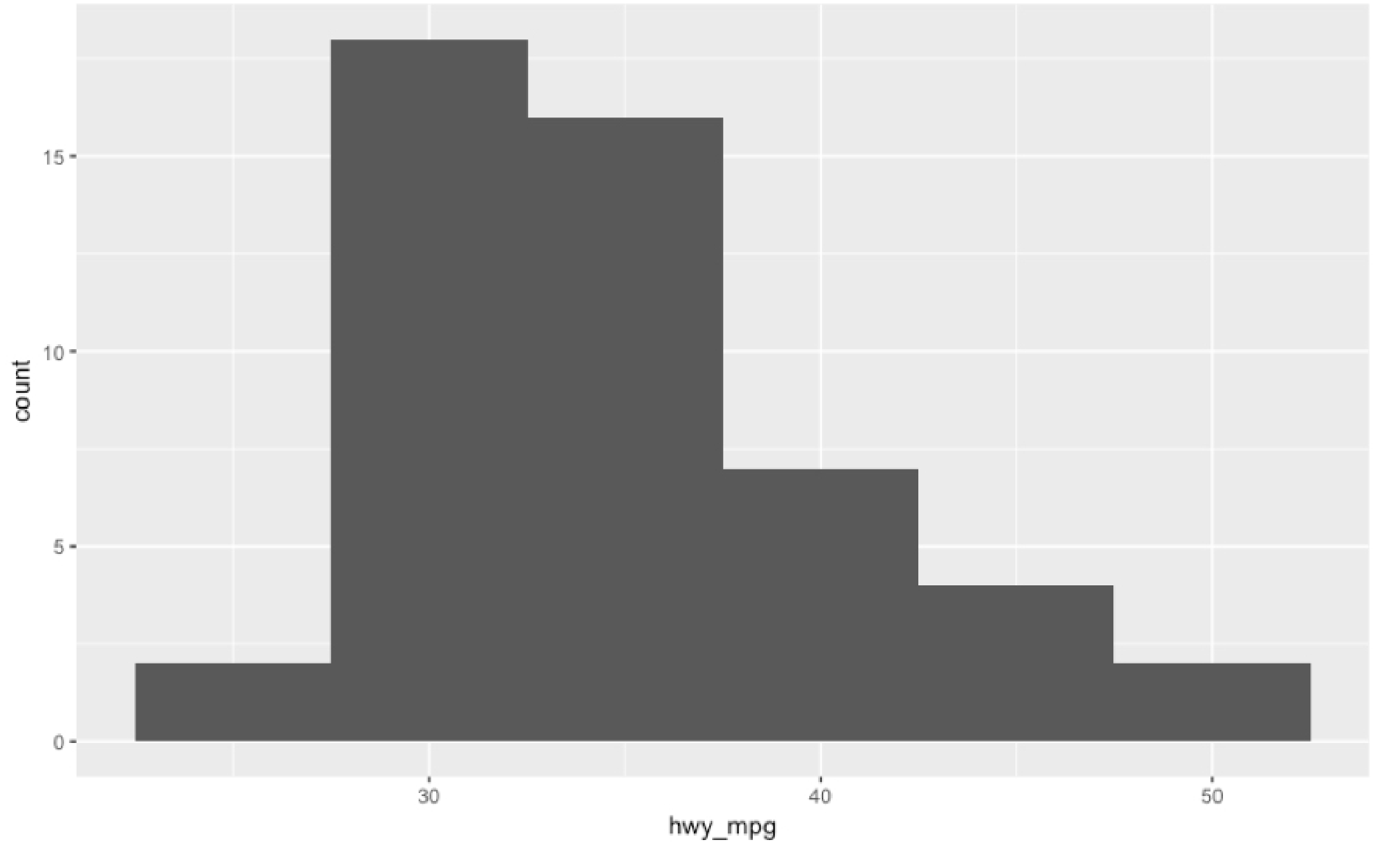
```r
cars %>%
  filter(eng_size < 2.0) %>%
  ggplot(aes(x = hwy_mpg)) +
  geom_histogram()
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



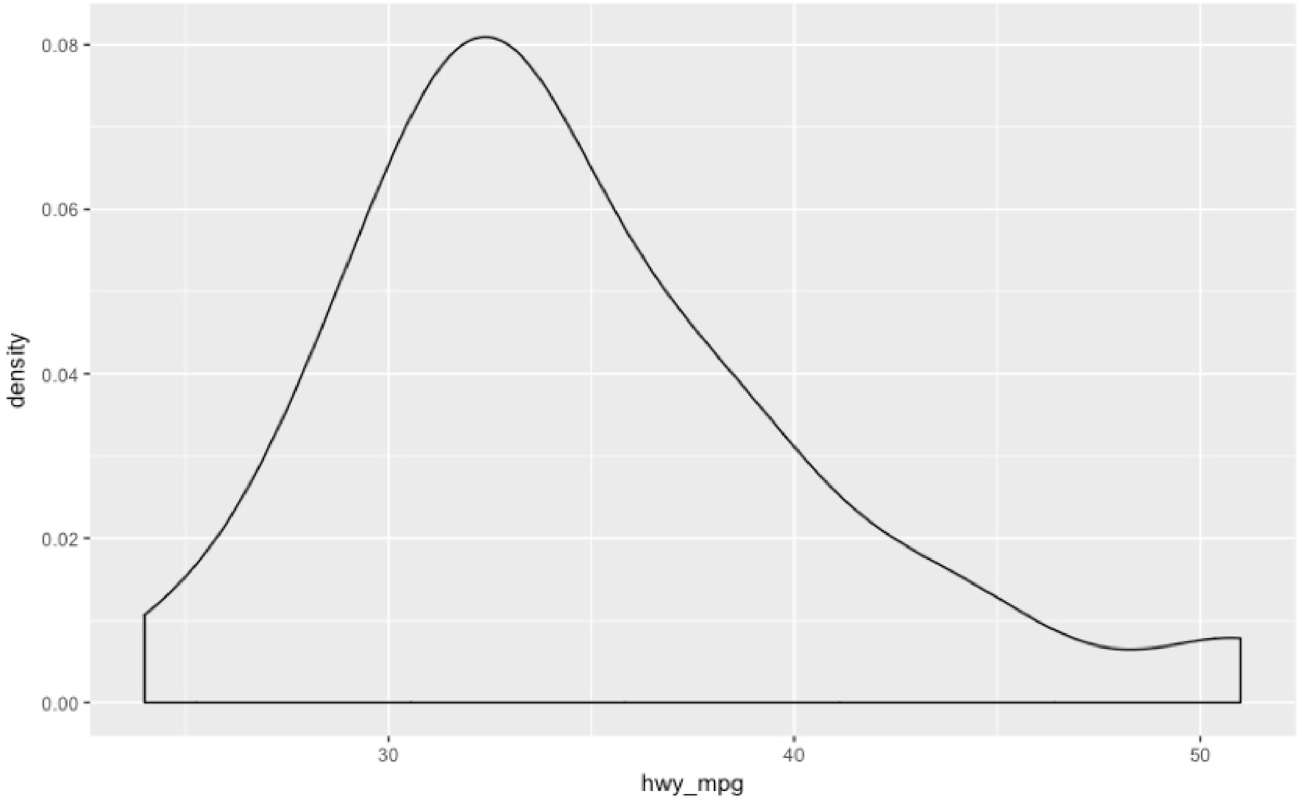
Wide bin width

```
cars %>%
  filter(eng_size < 2.0) %>%
  ggplot(aes(x = hwy_mpg)) +
  geom_histogram(binwidth = 5)
```



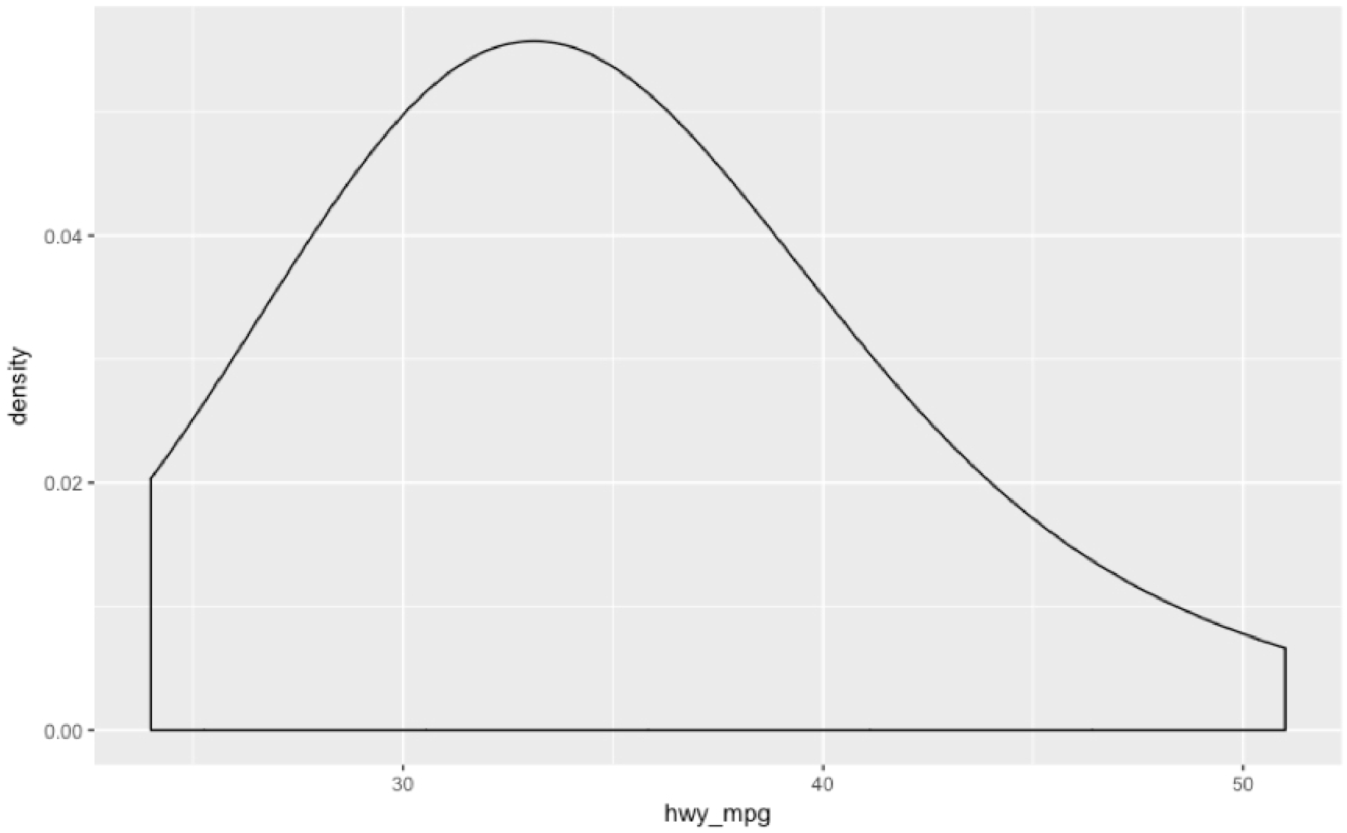
Density plot

```
cars %>%
  filter(eng_size < 2.0) %>%
  ggplot(aes(x = hwy_mpg)) +
  geom_density()
```



Wide bandwidth

```
cars %>%
  filter(eng_size < 2.0) %>%
  ggplot(aes(x = hwy_mpg)) +
  geom_density(bw = 5)
```



Let's practice!

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Box plots

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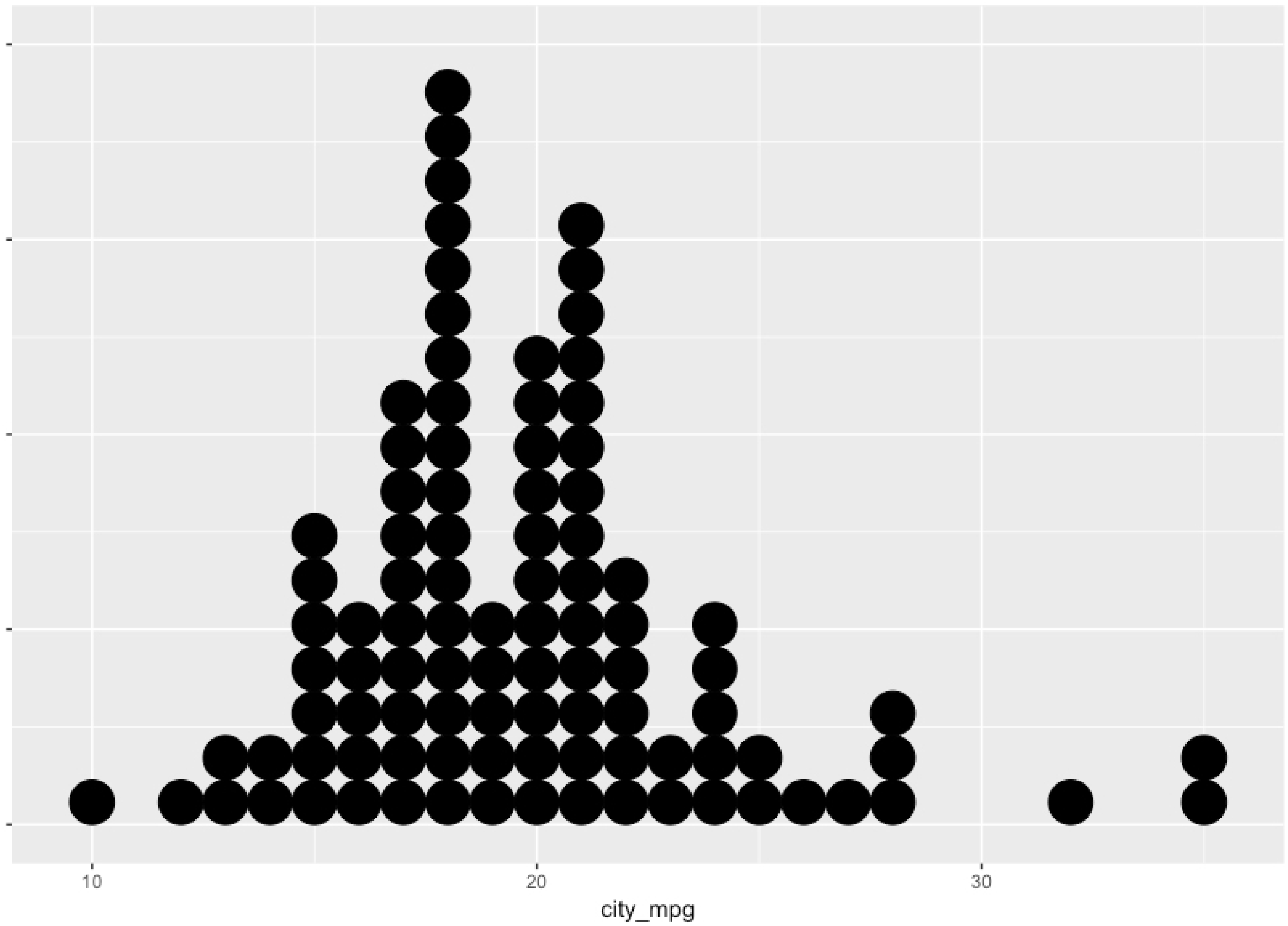
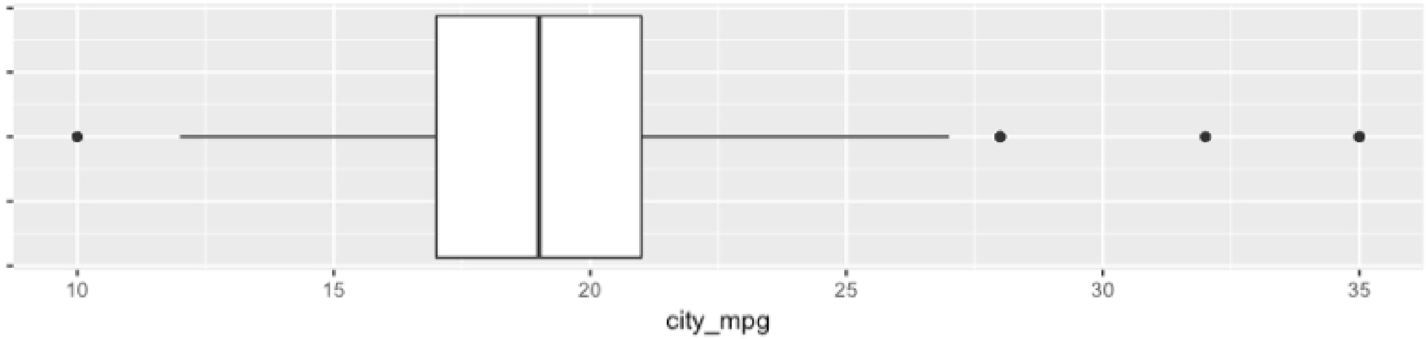
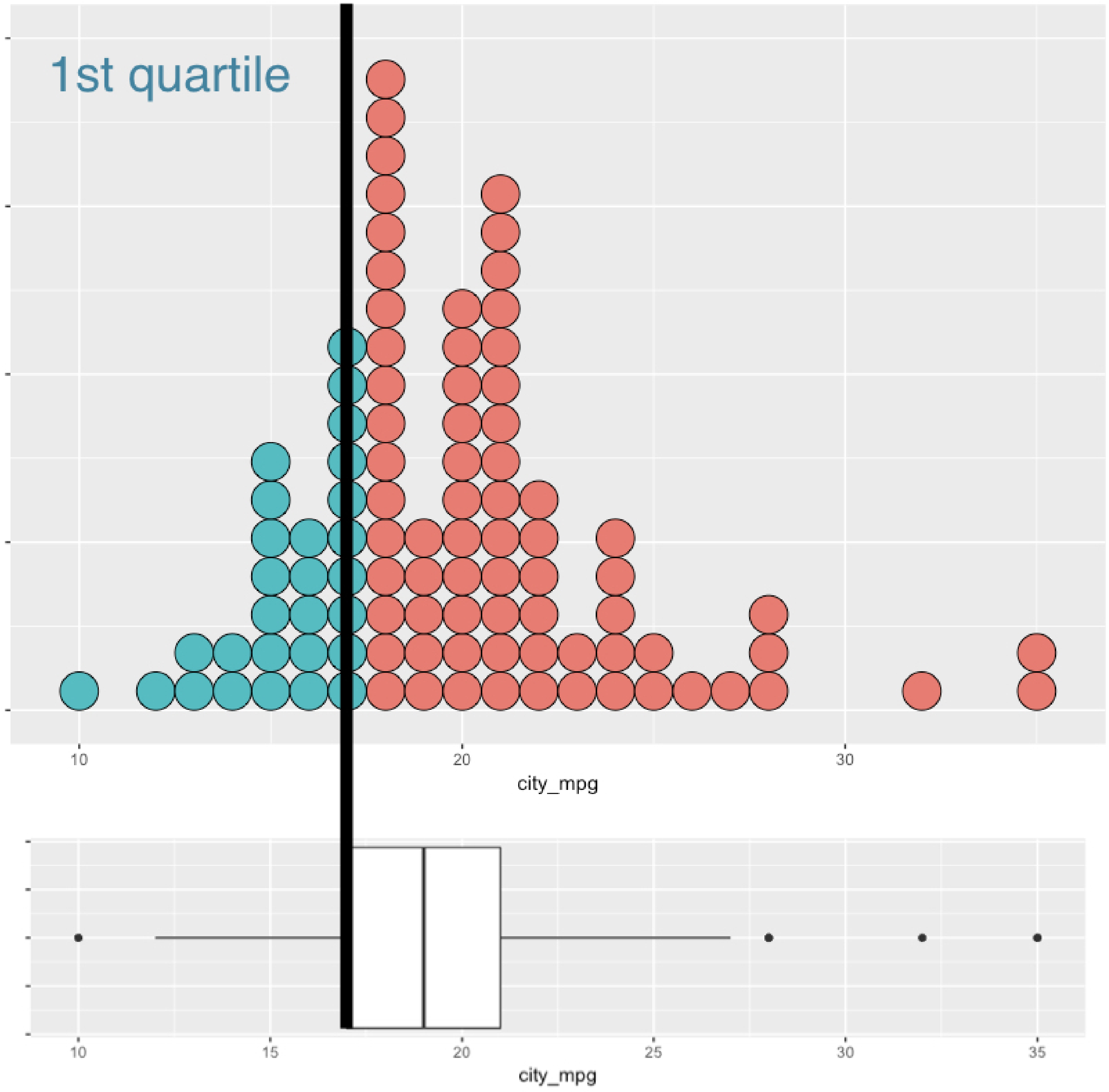
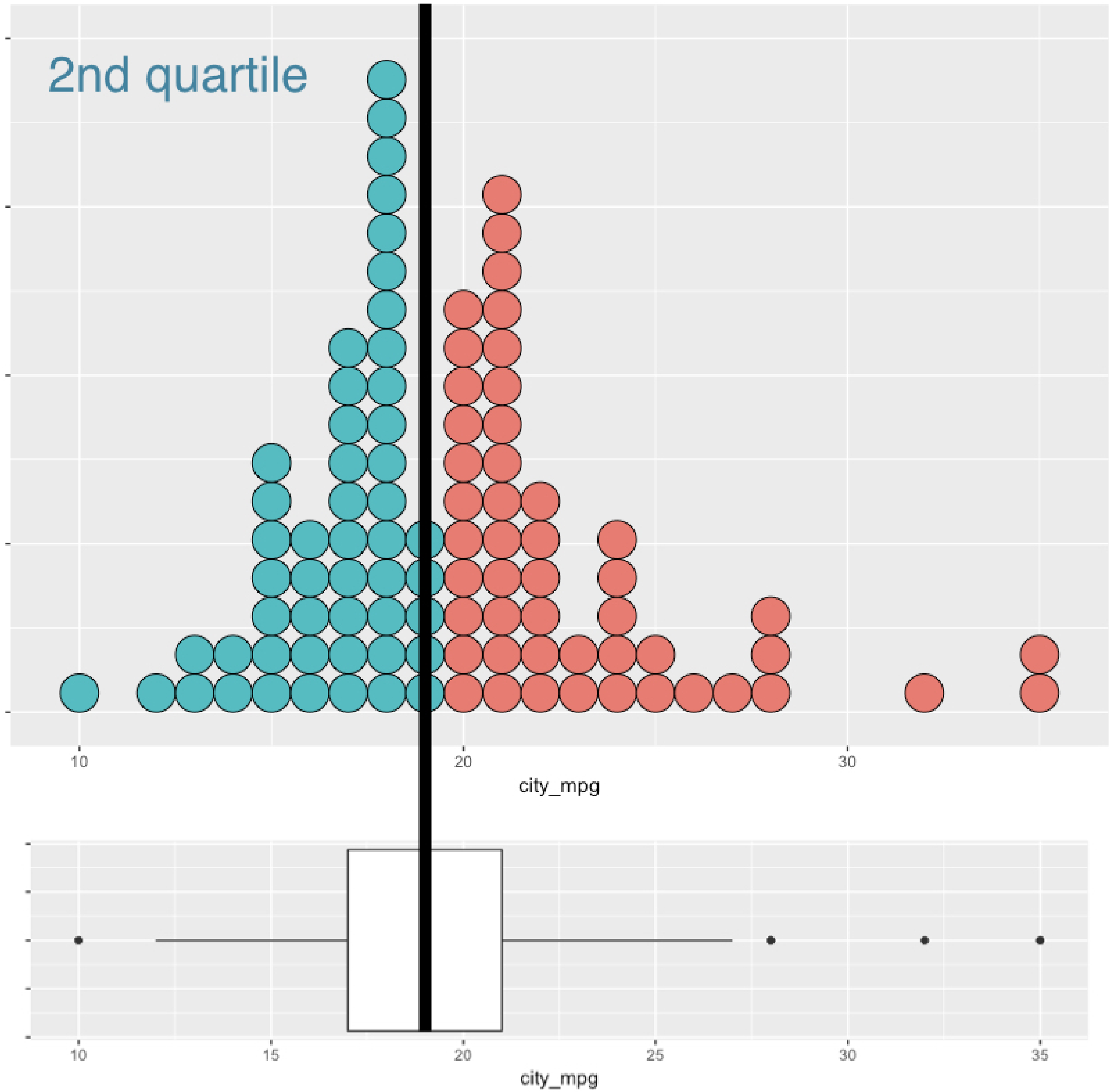
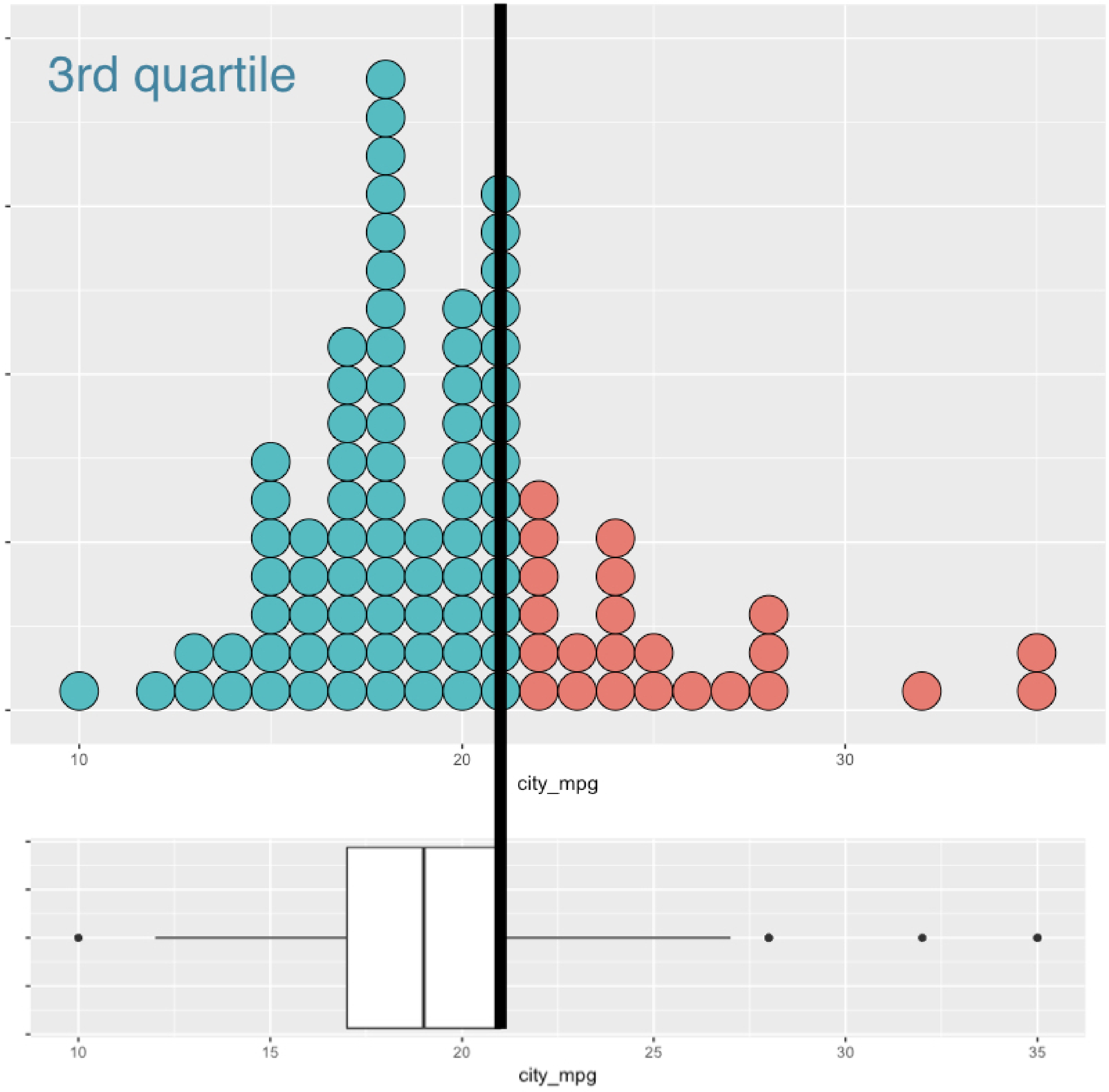
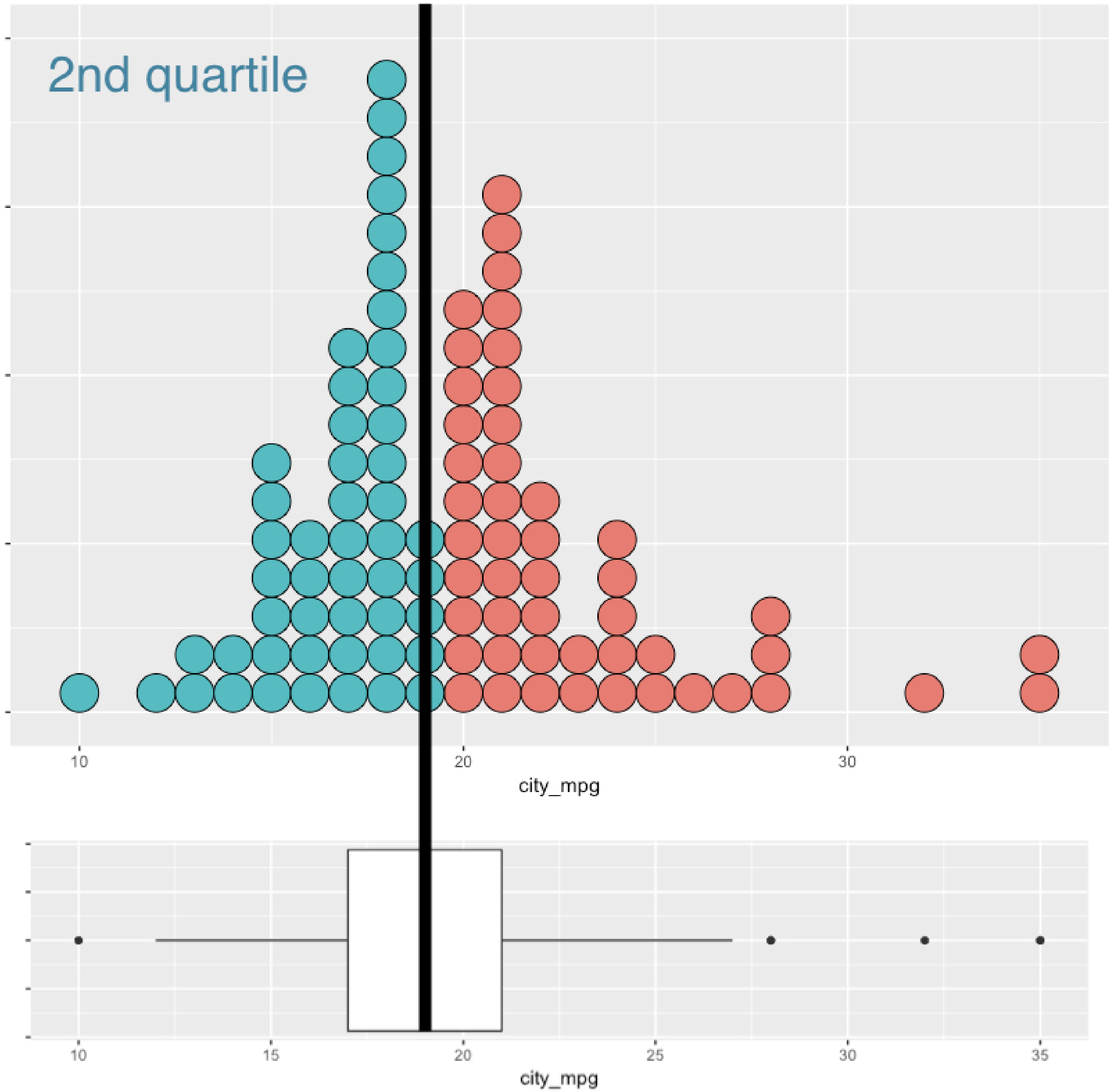

10
20
30
city_mpg

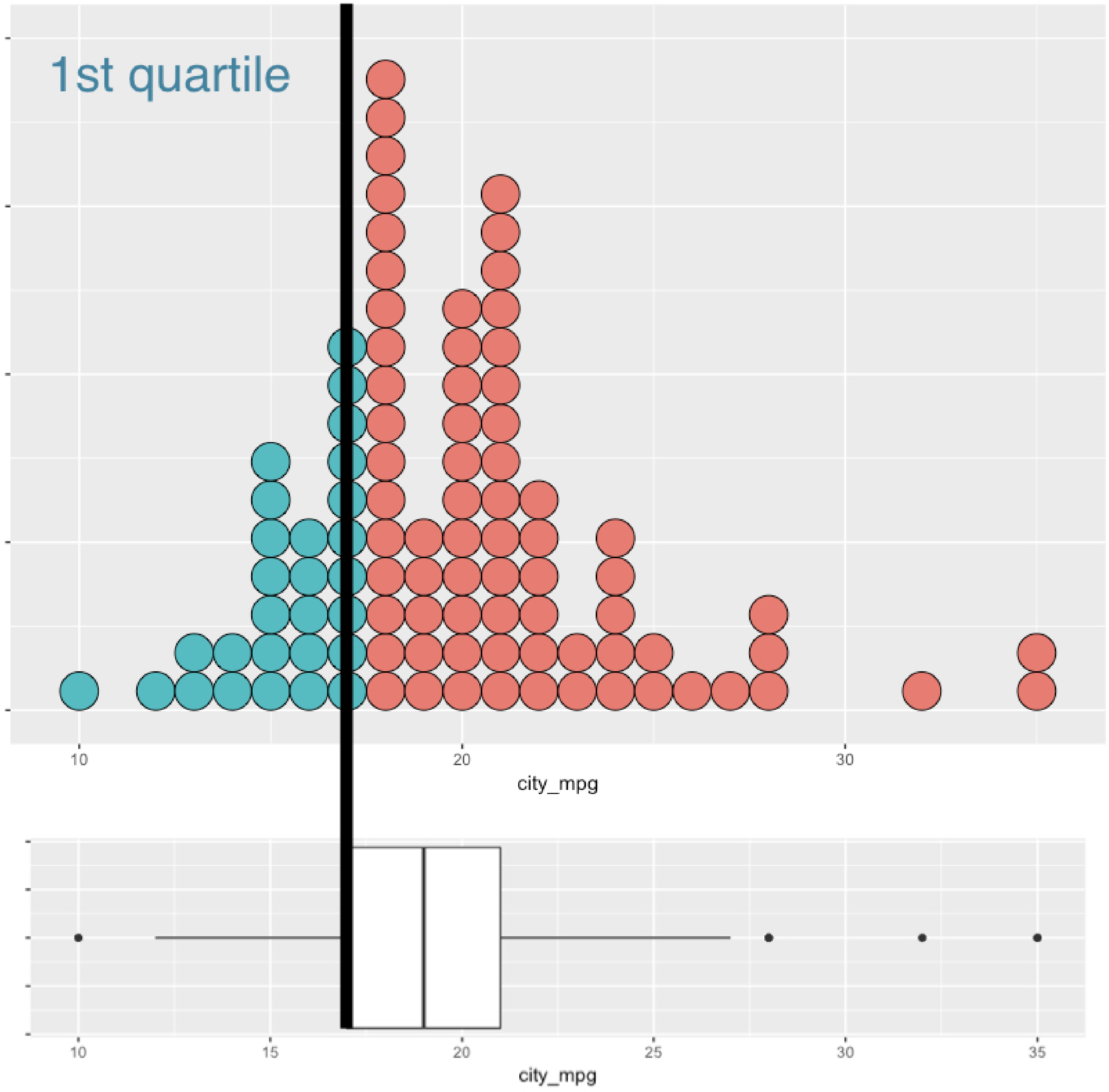

10
15
20
25
30
35
city_mpg

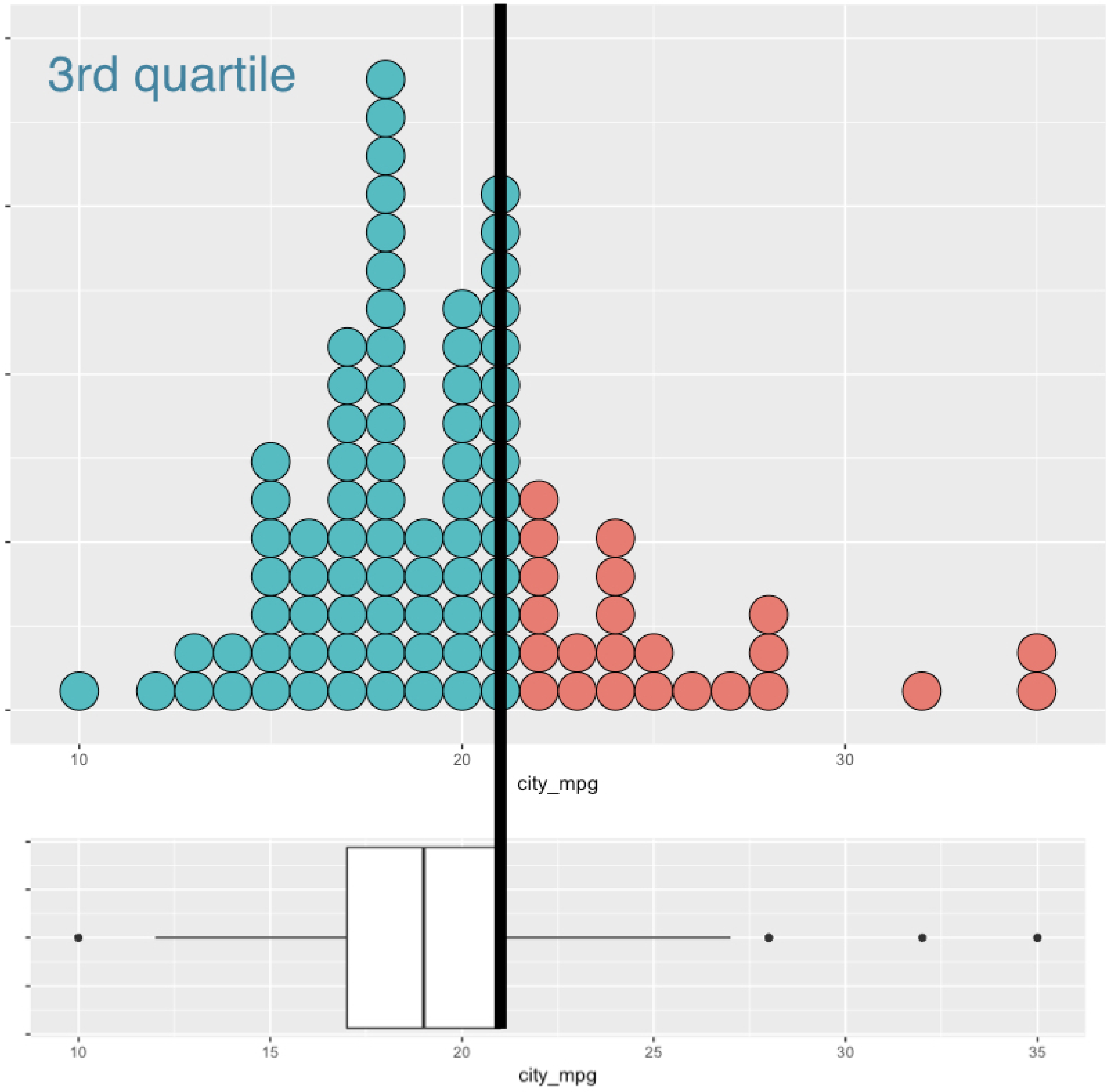

1st quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg

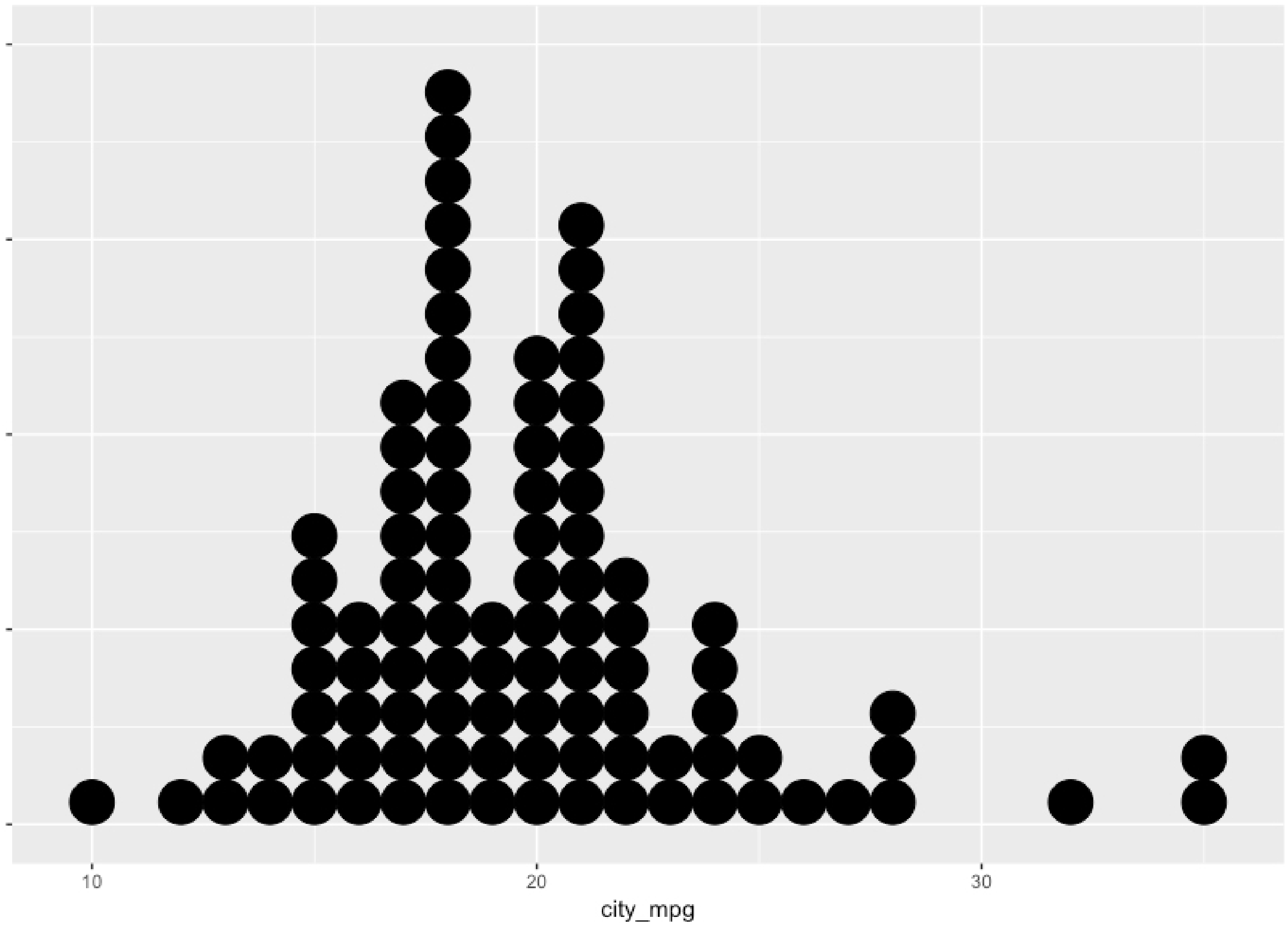

2nd quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg


3rd quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg


2nd quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg


1st quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg


3rd quartile
10
20
30
city_mpg
10
15
20
25
30
35
city_mpg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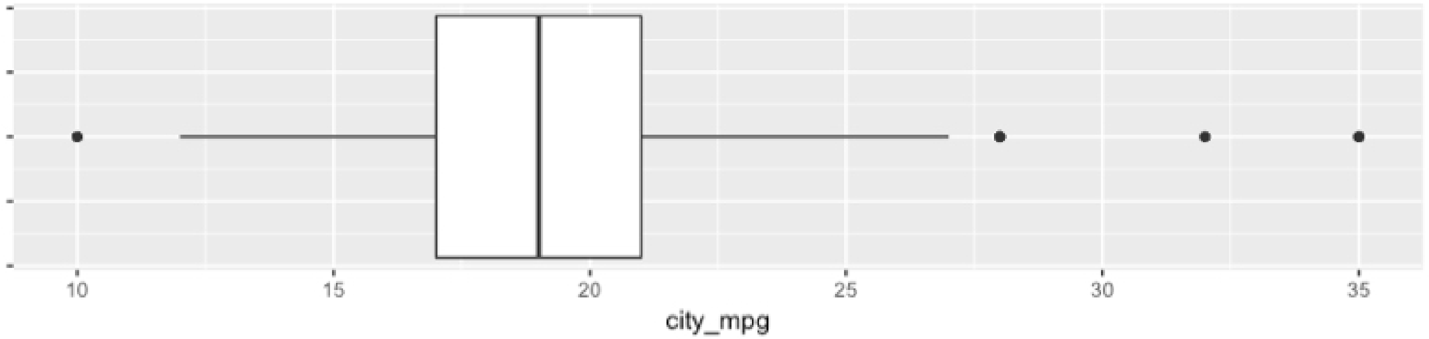
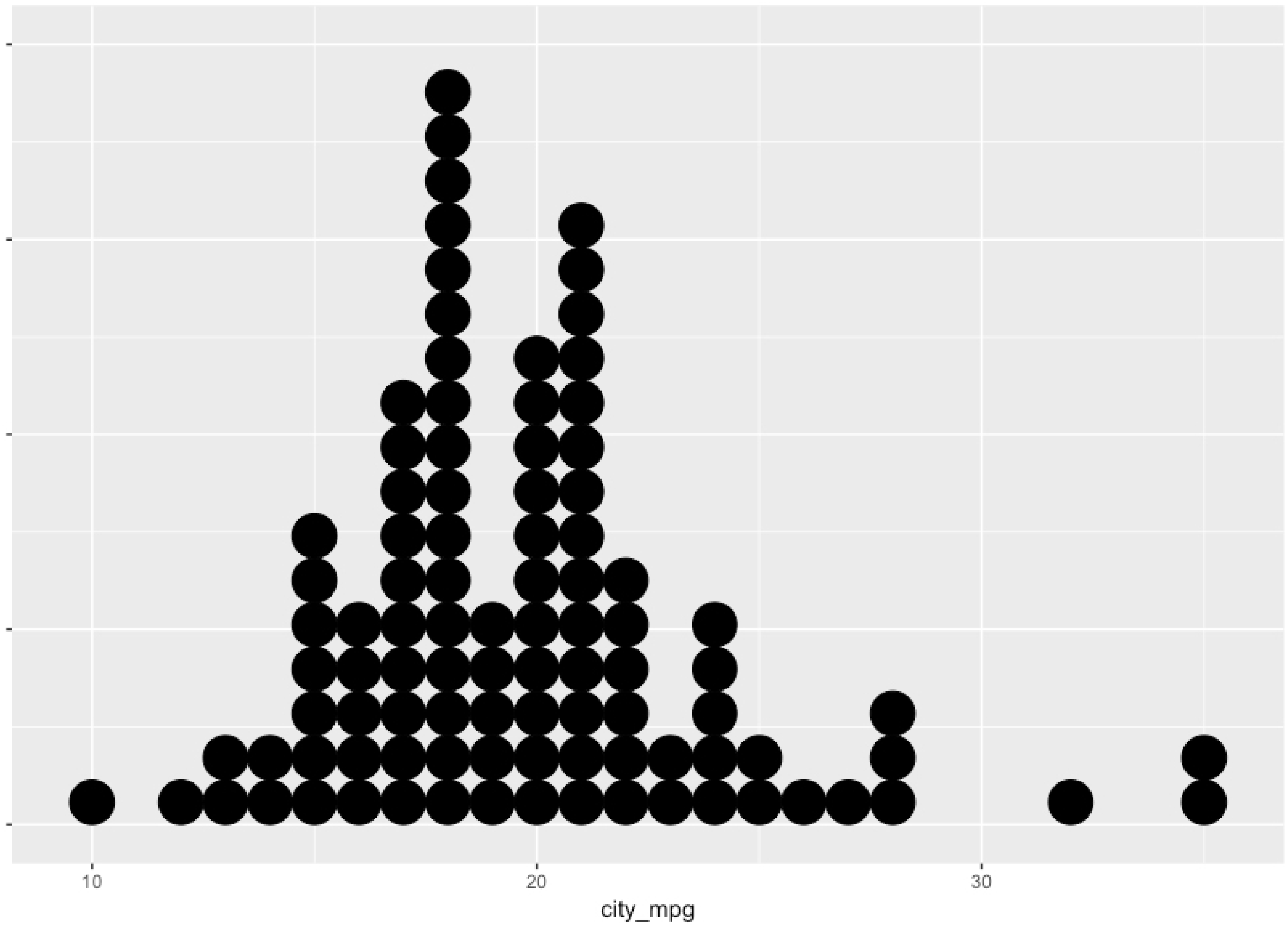
20
30
city_mpg


10
15
20
25
30
35
city_mpg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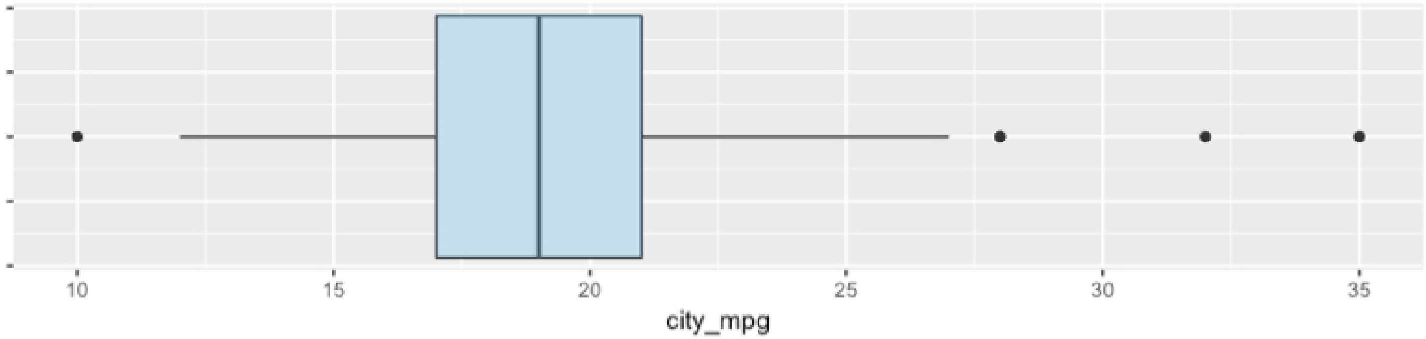
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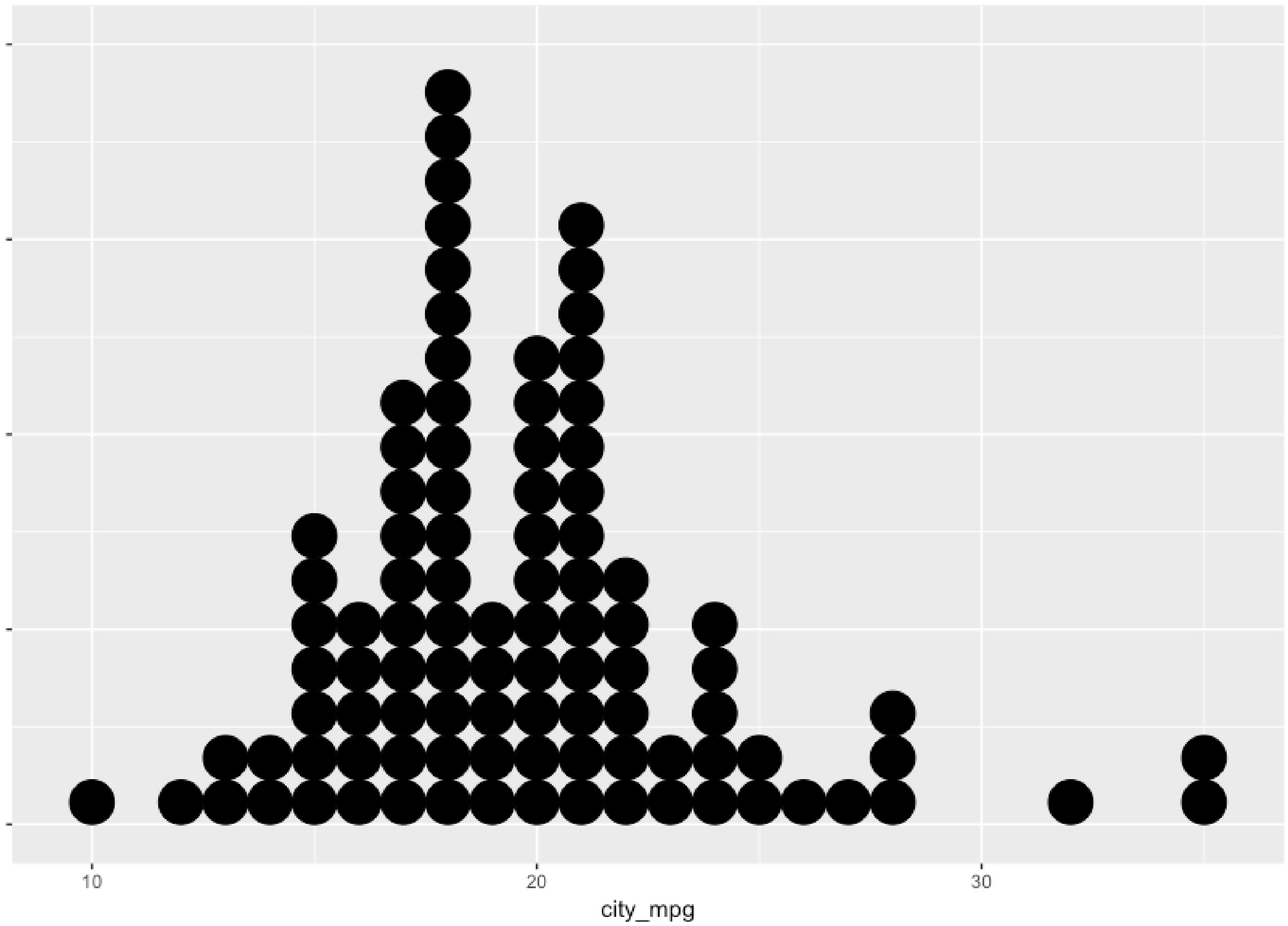
15
20
25
30
35
city_mpg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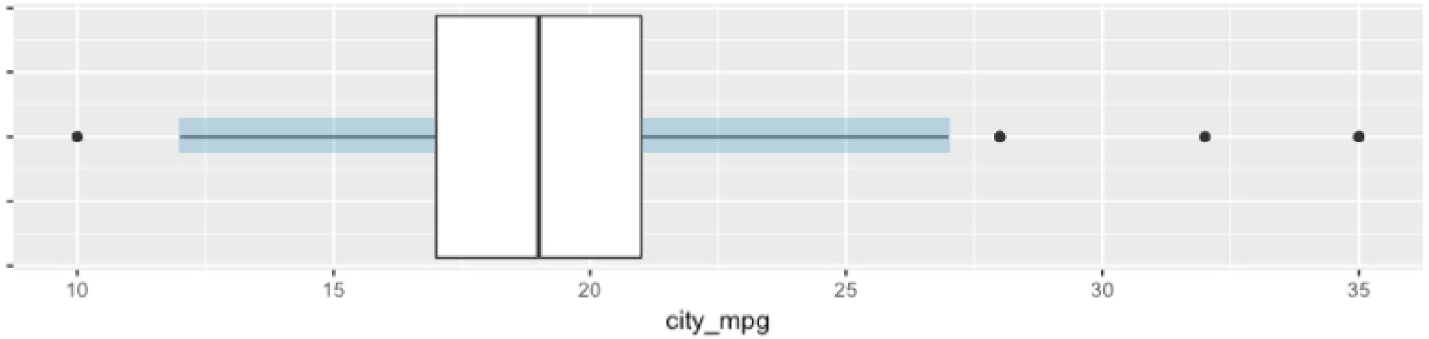
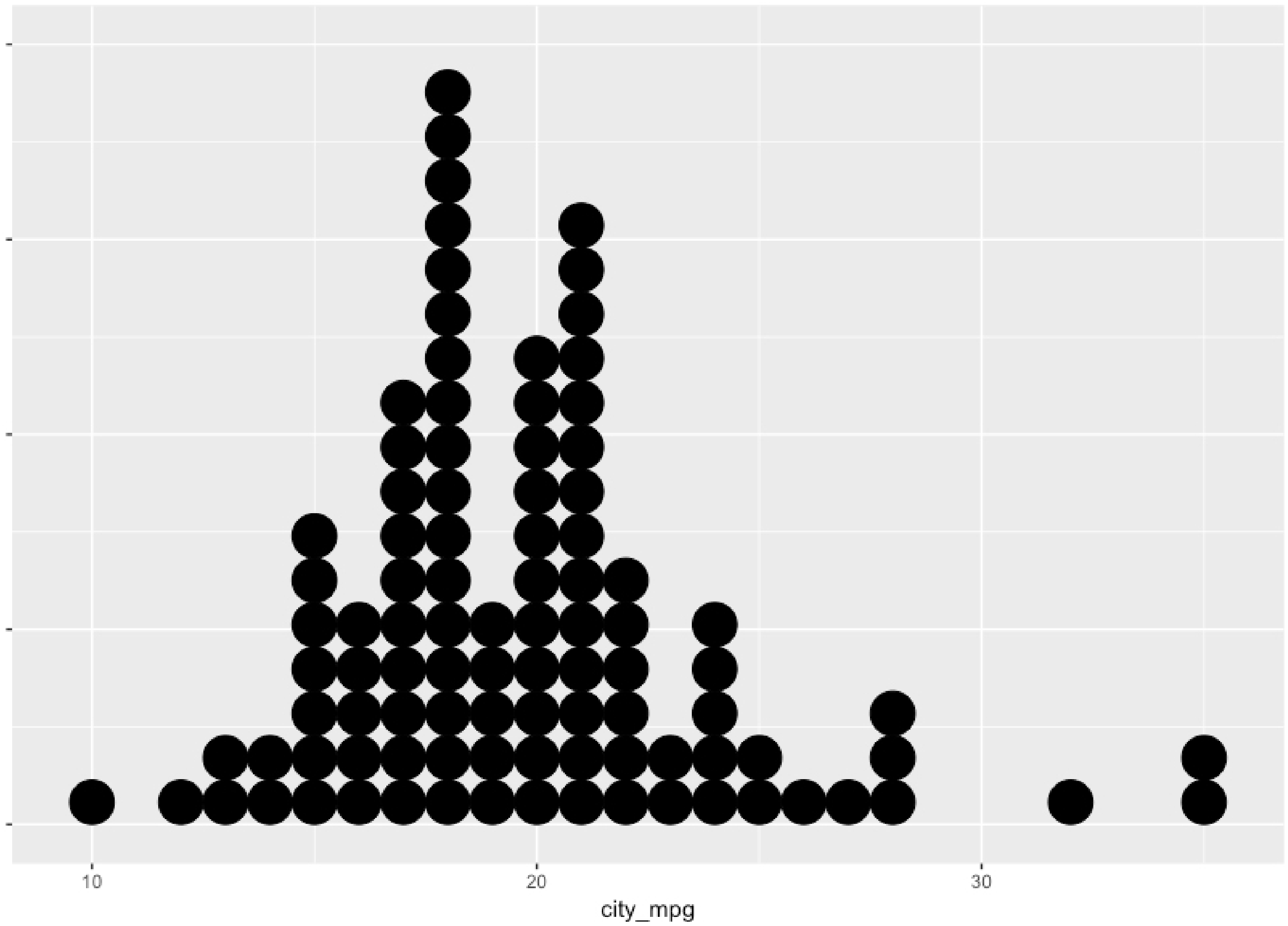

10
15
20
25
30
35
city_mpg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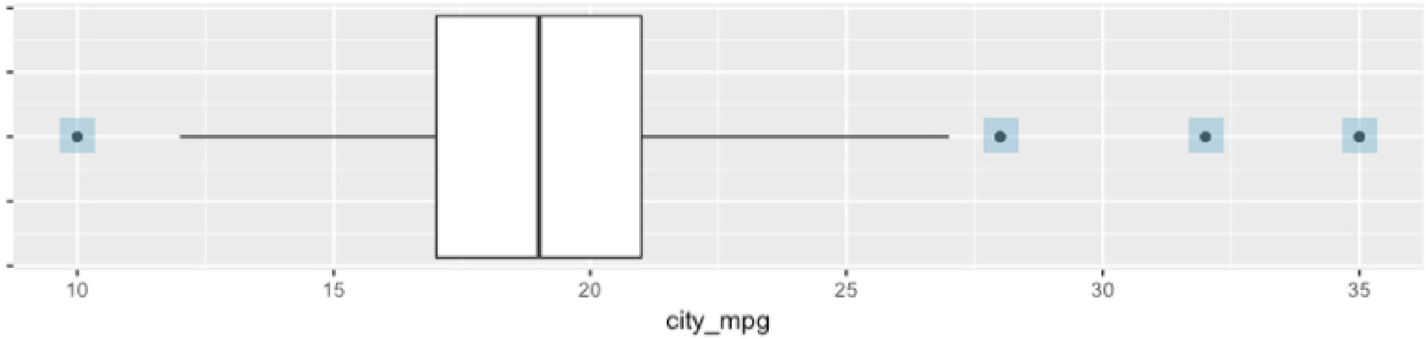
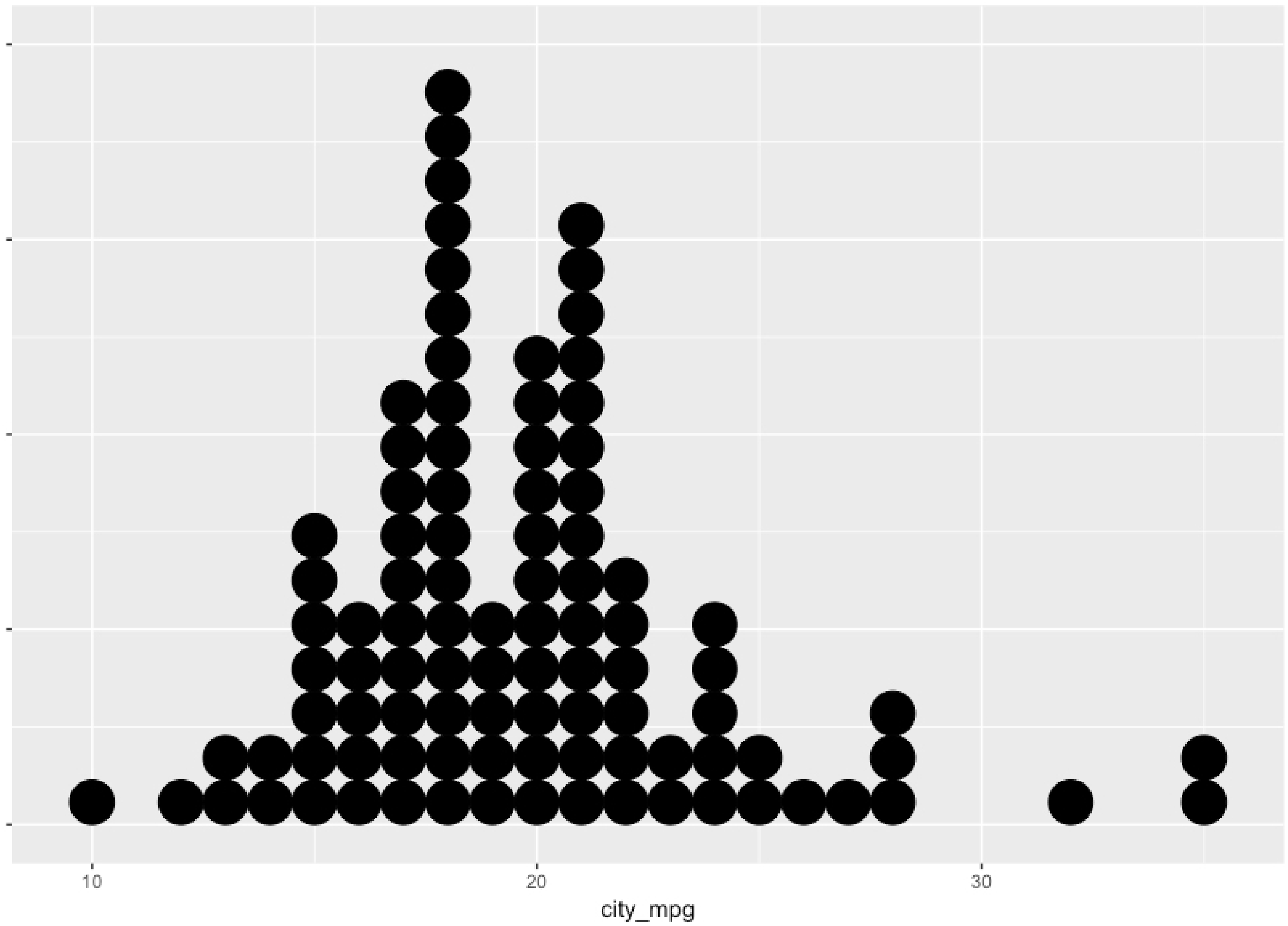

10
15
20
25
30
35
city_mpg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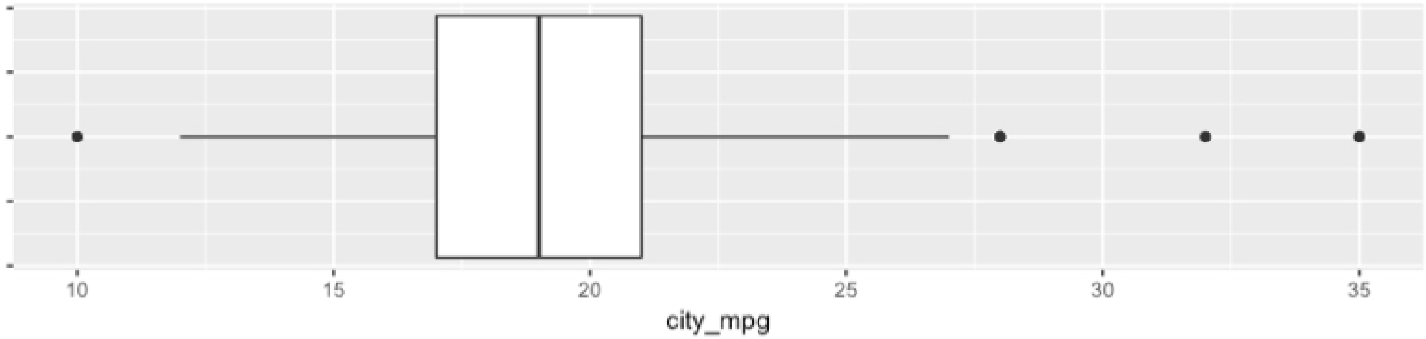
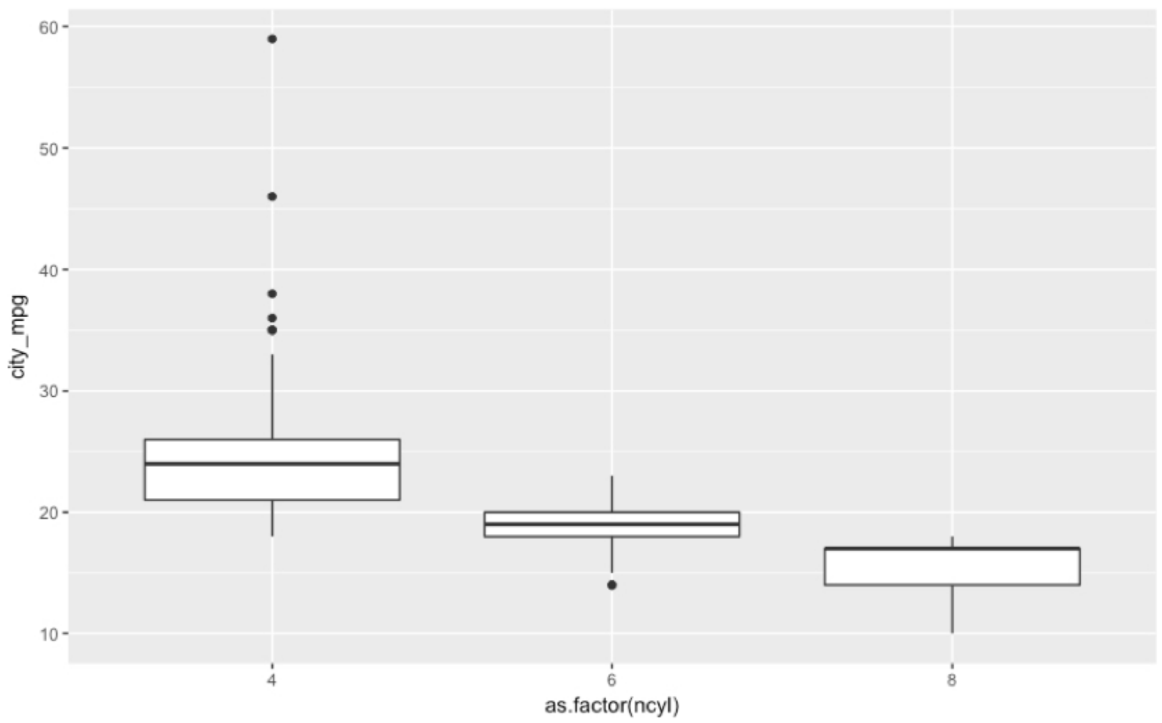
20
30
city_mpg


10
15
20
25
30
35
city_mpg

Side-by-side box plots

```
ggplot(common_cyl, aes(x = as.factor(ncyl), y = city_mpg)) +
  geom_boxplot()
```

```
Warning message:
Removed 11 rows containing non-finite values (stat_boxplot).
```



Side-by-side box plots

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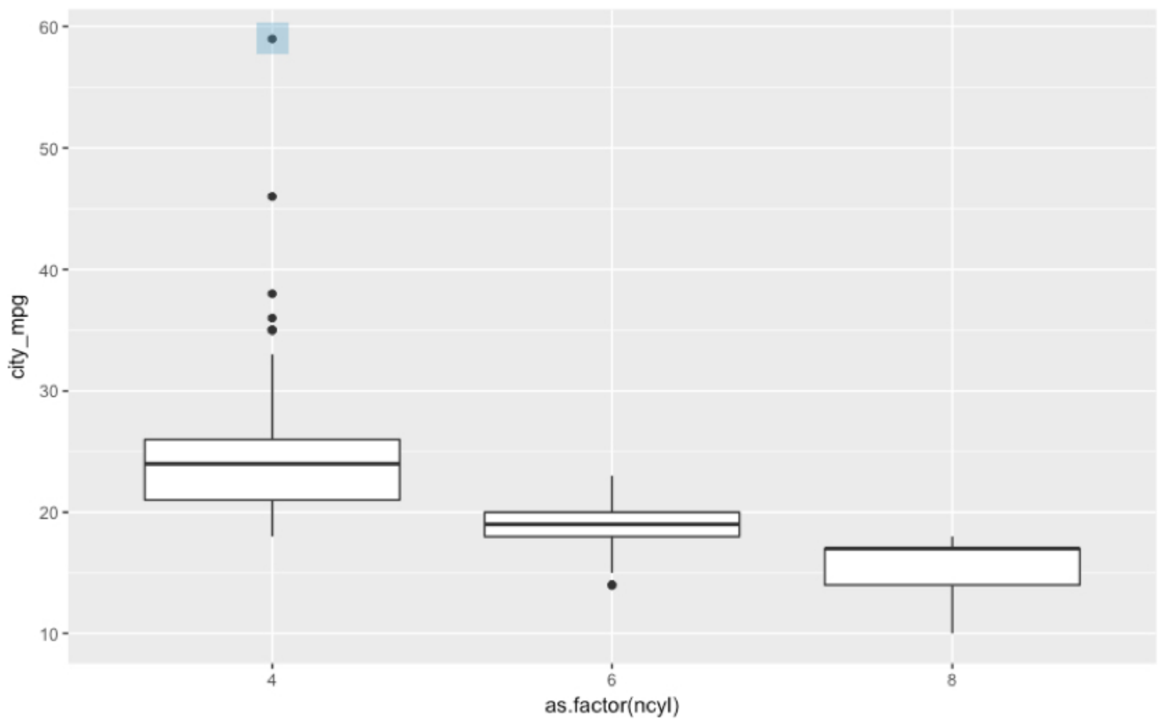

Side-by-side box plots

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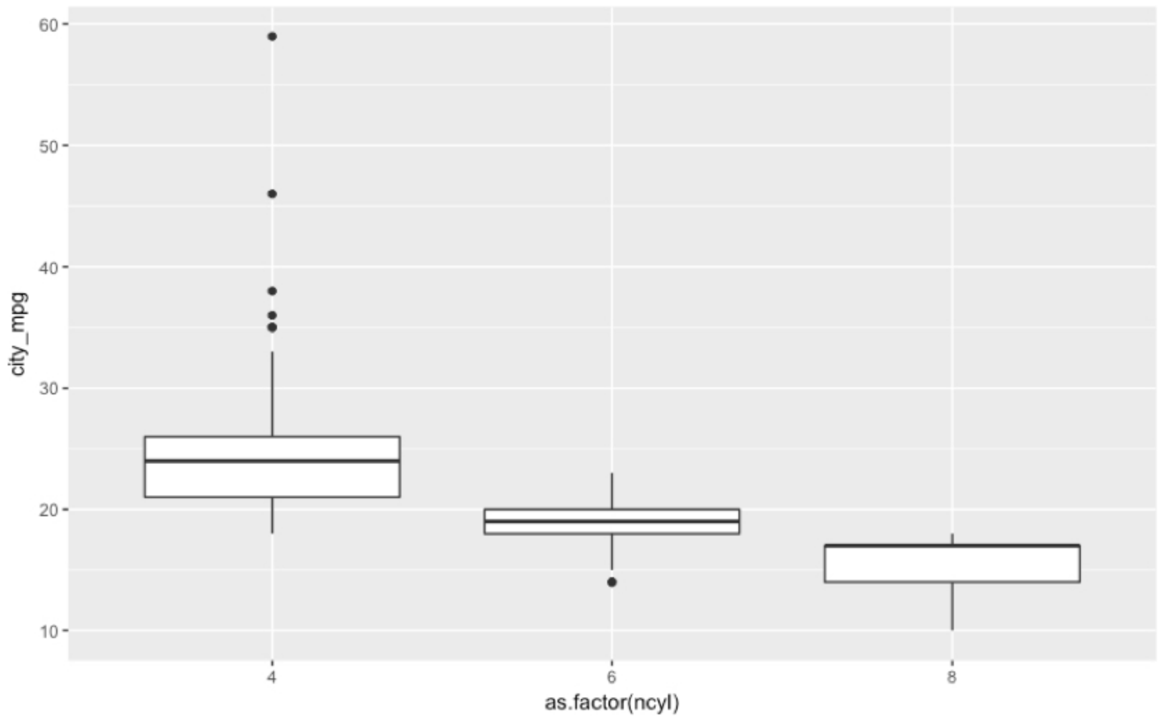
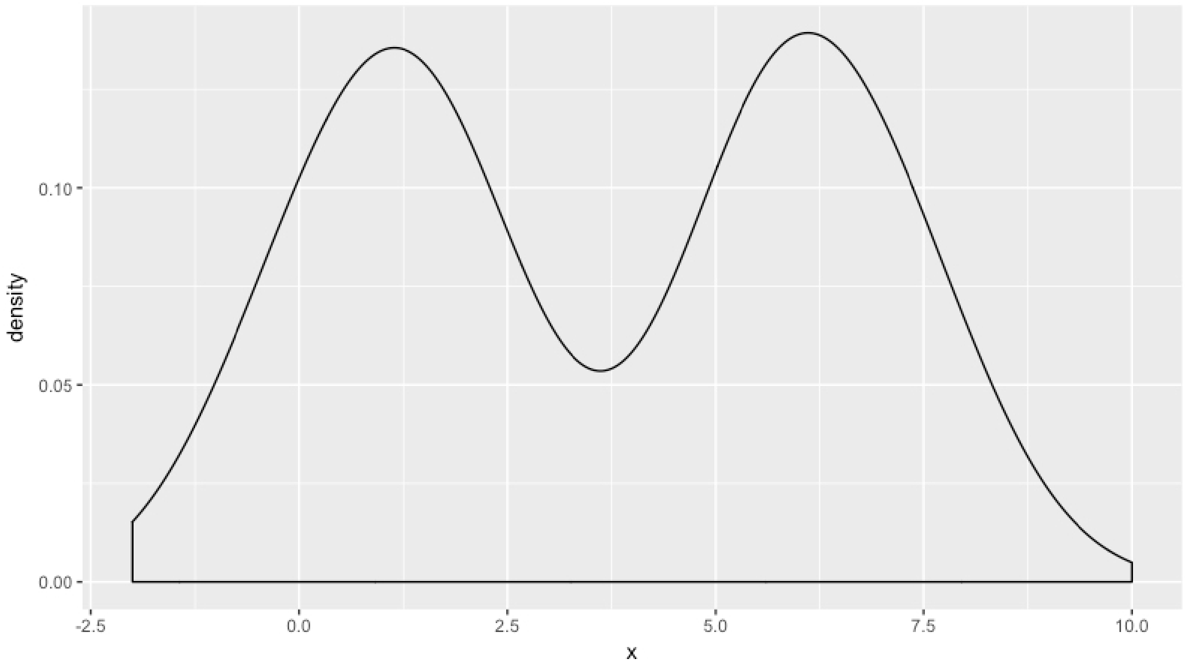
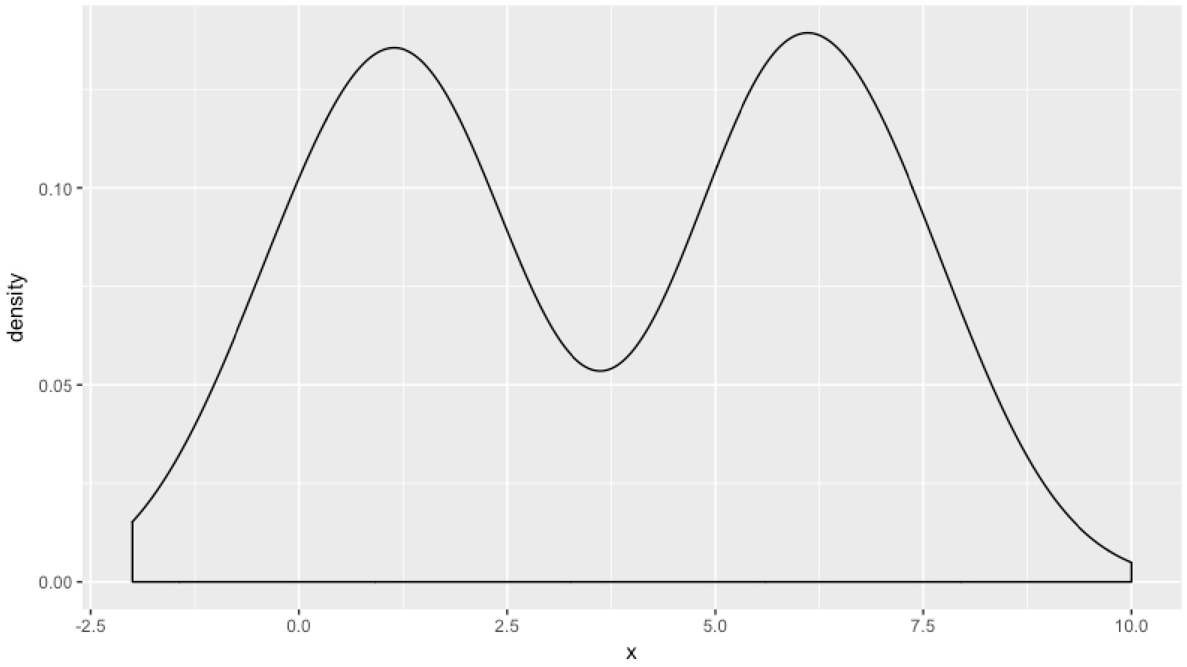
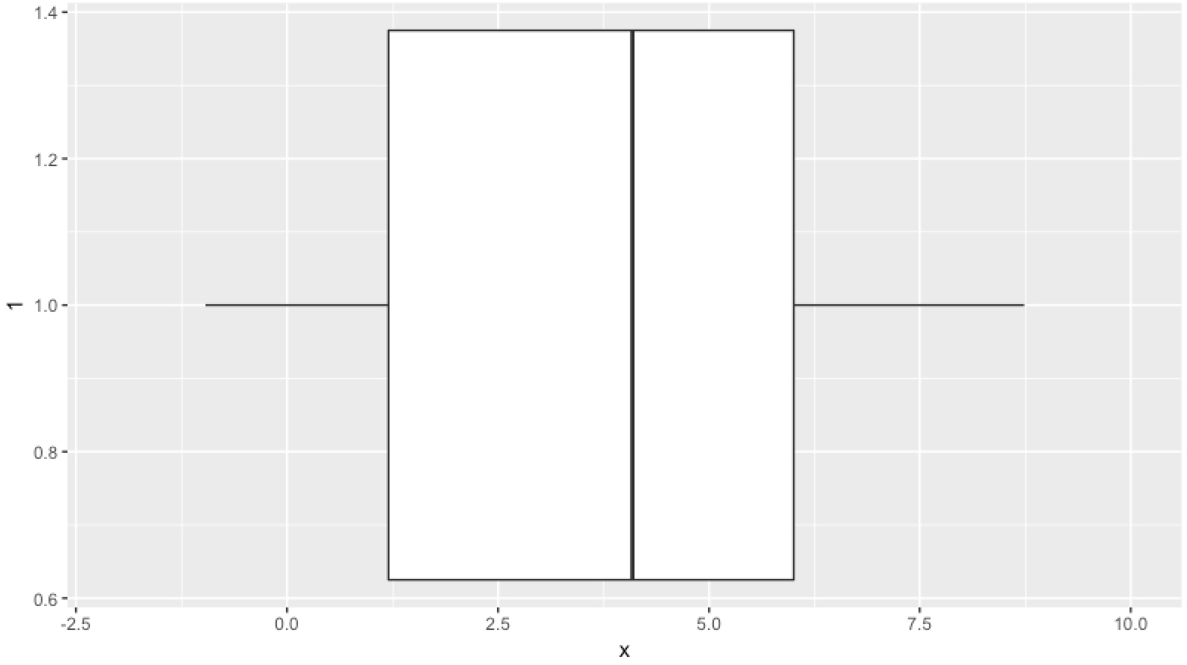



0.10
0.05
0.00
density
-2.5
0.0
2.5
5.0
7.5
10.0
x



density
0.10
0.05
0.00
-2.5
0.0
2.5
5.0
7.5
10.0
x



1
1.4
1.2
1.0
0.8
0.6
-2.5
0.0
2.5
5.0
7.5
10.0
x

Let's practice!

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Visualization in higher dimensions

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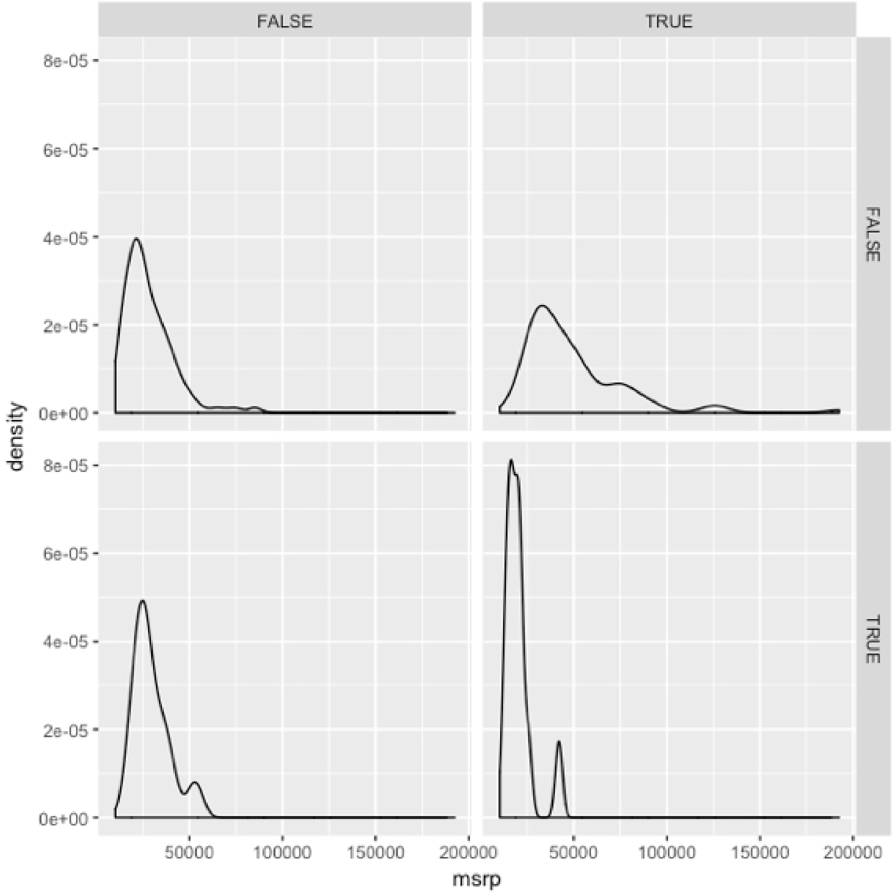
Assistant Professor, Reed College

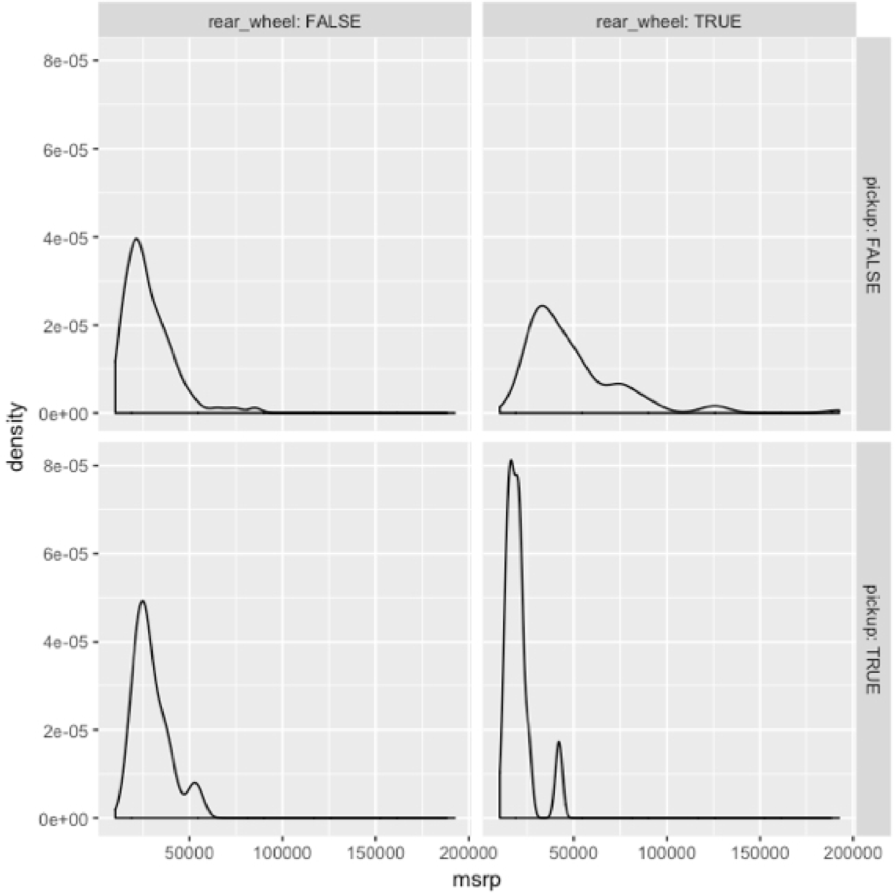
Plots for 3 variables

```
ggplot(cars, aes(x = msrp)) +
  geom_density() +
  facet_grid(pickup ~ rear_wheel)
```



Plots for 3 variables

```
ggplot(cars, aes(x = msrp)) +
  geom_density() +
  facet_grid(pickup ~ rear_wheel, labeller = label_both)
```



Plots for 3 variables

```
ggplot(cars, aes(x = msrp)) +
  geom_density() +
  facet_grid(pickup ~ rear_wheel, labeller = label_both)
table(cars$rear_wheel, cars$pickup)
```

```
      FALSE TRUE
FALSE   306   12
TRUE     98   12
```

Higher dimensional plots

- Shape
- Size
- Color
- Pattern
- Movement
- x-coordinate
- y-coordinate

Let's practice!

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