Grammar of graphics (quick intro)

SI 649 W20: Information visualization

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School of Information
University of Michigan

(slack)

Join here: https://tinyurl.com/uhaxkwy

(laptops)

(waitlist)

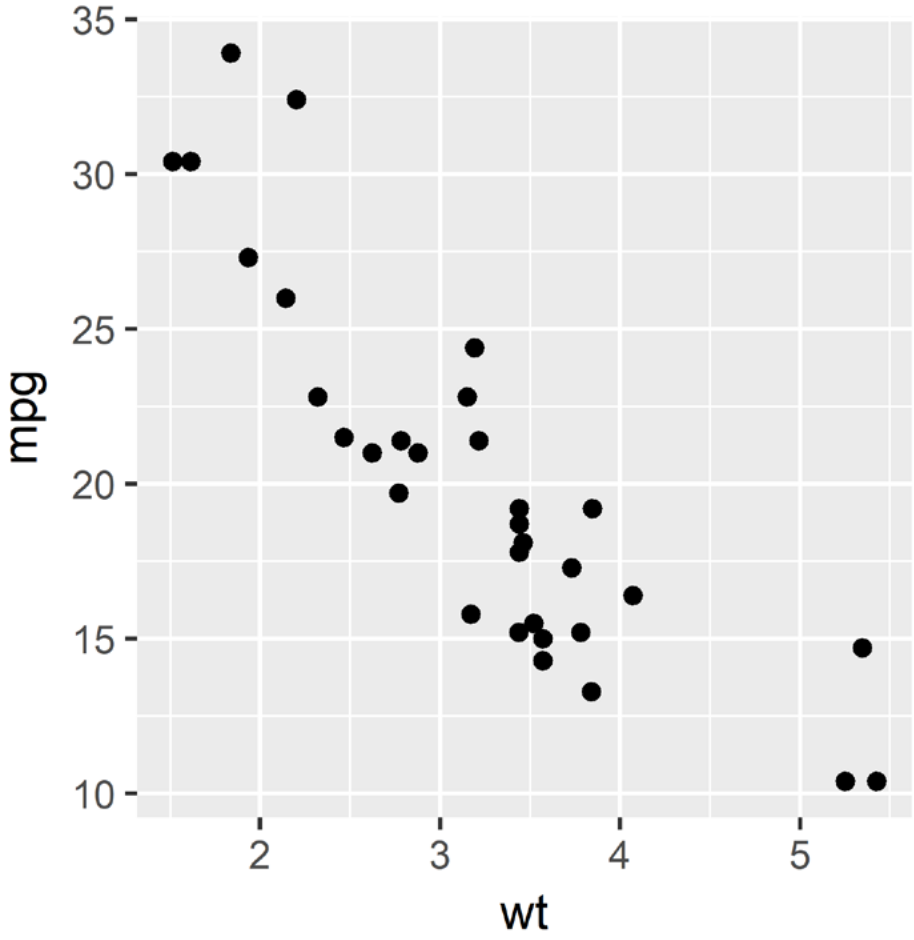
This lab

Quick intro to grammar of graphics

Altair (python library based on grammar of graphics)

How do we turn data into visualizations?

	mpg	cyl	disp	hp	drat	wt	qsec	vs	am
Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1
Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1
Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1
Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0
Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0
Valiant	18.1	6	225.0	105	2.76	3.460	20.22	1	0
Duster 360	14.3	8	360.0	245	3.21	3.570	15.84	0	0
Merc 240D	24.4	4	146.7	62	3.69	3.190	20.00	1	0
Merc 230	22.8	4	140.8	95	3.92	3.150	22.90	1	0
Merc 280	19.2	6	167.6	123	3.92	3.440	18.30	1	0
Merc 280C	17.8	6	167.6	123	3.92	3.440	18.90	1	0
Merc 450SE	16.4	8	275.8	180	3.07	4.070	17.40	0	0
Merc 450SL	17.3	8	275.8	180	3.07	3.730	17.60	0	0
Merc 450SLC	15.2	8	275.8	180	3.07	3.780	18.00	0	0
Cadillac Fleetwood	10.4	8	472.0	205	2.93	5.250	17.98	0	0
Lincoln Continental	10.4	8	460.0	215	3.00	5.424	17.82	0	0
Chrysler Imperial	14.7	8	440.0	230	3.23	5.345	17.42	0	0
Fiat 128	32.4	4	78.7	66	4.08	2.200	19.47	1	1
Honda Civic	30.4	4	75.7	52	4.93	1.615	18.52	1	1
Toyota Corolla	33.9	4	71.1	65	4.22	1.835	19.90	1	1
Toyota Corona	21.5	4	120.1	97	3.70	2.465	20.01	1	0
Dodge Challenger	15.5	8	318.0	150	2.76	3.520	16.87	0	0
AMC Javelin	15.2	8	304.0	150	3.15	3.435	17.30	0	0
Camaro Z28	13.3	8	350.0	245	3.73	3.840	15.41	0	0
Pontiac Firebird	19.2	8	400.0	175	3.08	3.845	17.05	0	0
Fiat X1-9	27.3	4	79.0	66	4.08	1.935	18.90	1	1



Let's systematize "turning data into a vis"

data -> ??? -> marks on the screen (or paper)

Let's systematize "turning data into a vis"

data -> ??? -> marks on the screen (or paper)

??? = some vis API
= some way of thinking about vis systematically

Let's systematize "turning data into a vis"

data -> ??? -> marks on the screen (or paper)

??? = New function for every chart type:

```
scatter_plot(data, ...)
bar_chart(data, ...)
...
```

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```

...

Every new chart is a new adventure!

Too many specs! — Too high level!

Let's systematize "turning data into a vis"

data -> ??? -> marks on the screen (or paper)

??? = ~~New function for every chart type~~
= Low-level drawing functions

```
draw_point(...)
draw_rectangle(...)
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Too low level!

Let's systematize "turning data into a vis"

data -> ??? -> marks on the screen (or paper)

??? = ~~New function for every chart type~~
= ~~Low-level drawing functions~~
= Grammar of graphics

Encode data with visual channels
Display encodings with marks

Grammar of graphics

Codifies data types, encodings/channels, marks

Maps data -> channels -> marks

Makes visualization specification straightforward

Undergirds ggplot, Tableau, Vega-Lite, Altair
(terms may vary)

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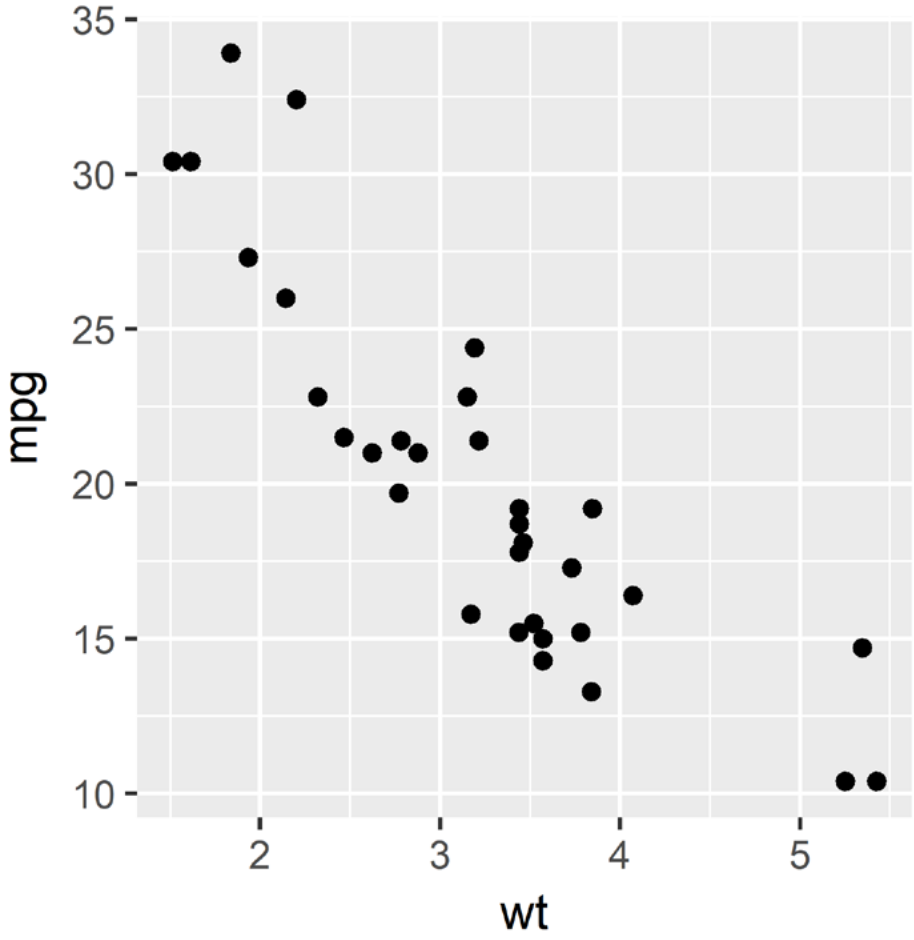
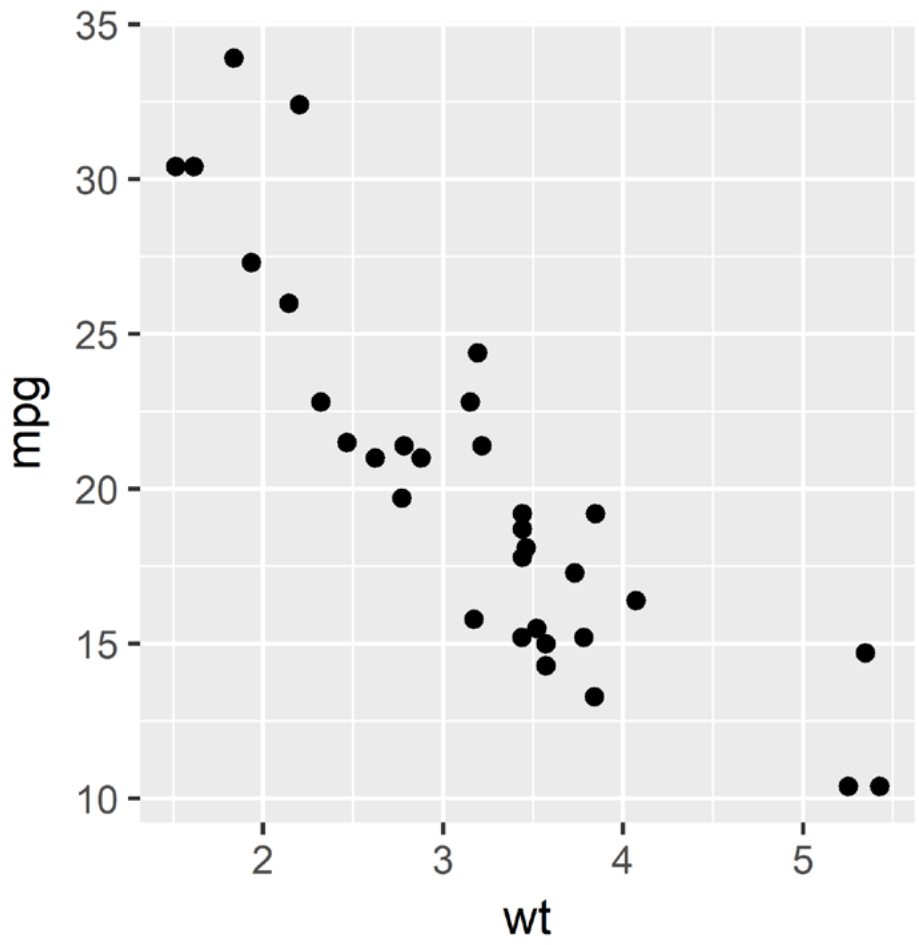


Grammar of graphics

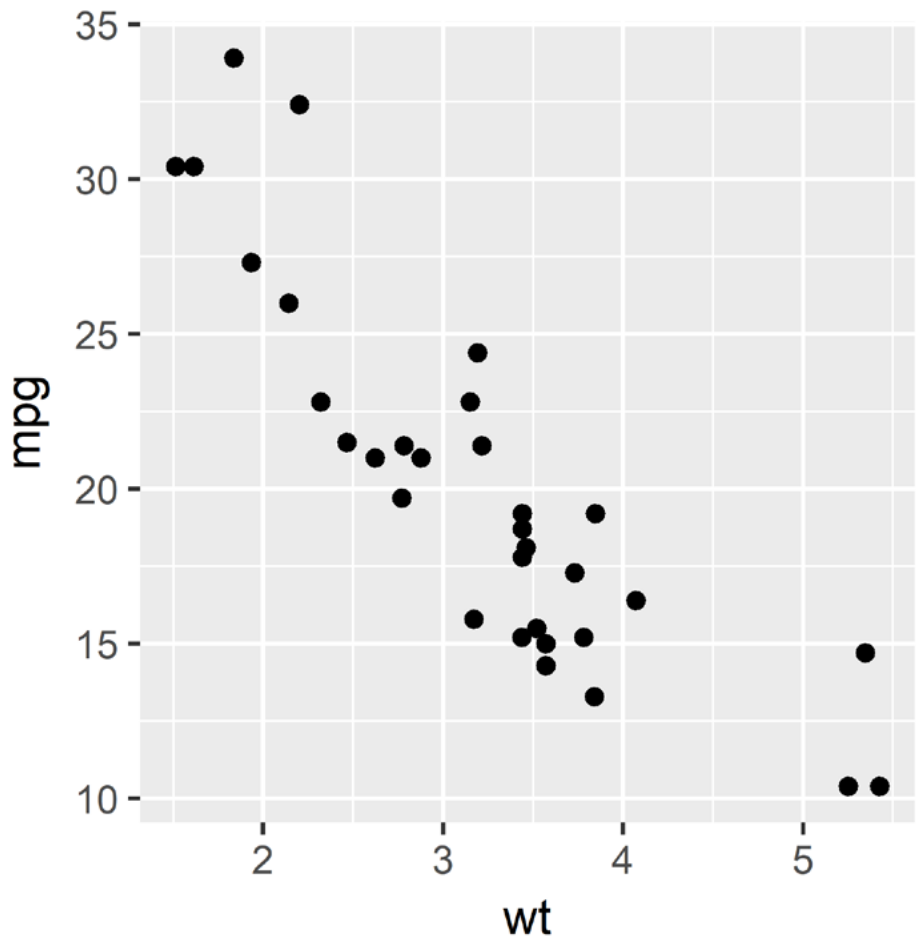
data types, channels, marks



Grammar of graphics

data types, channels, marks

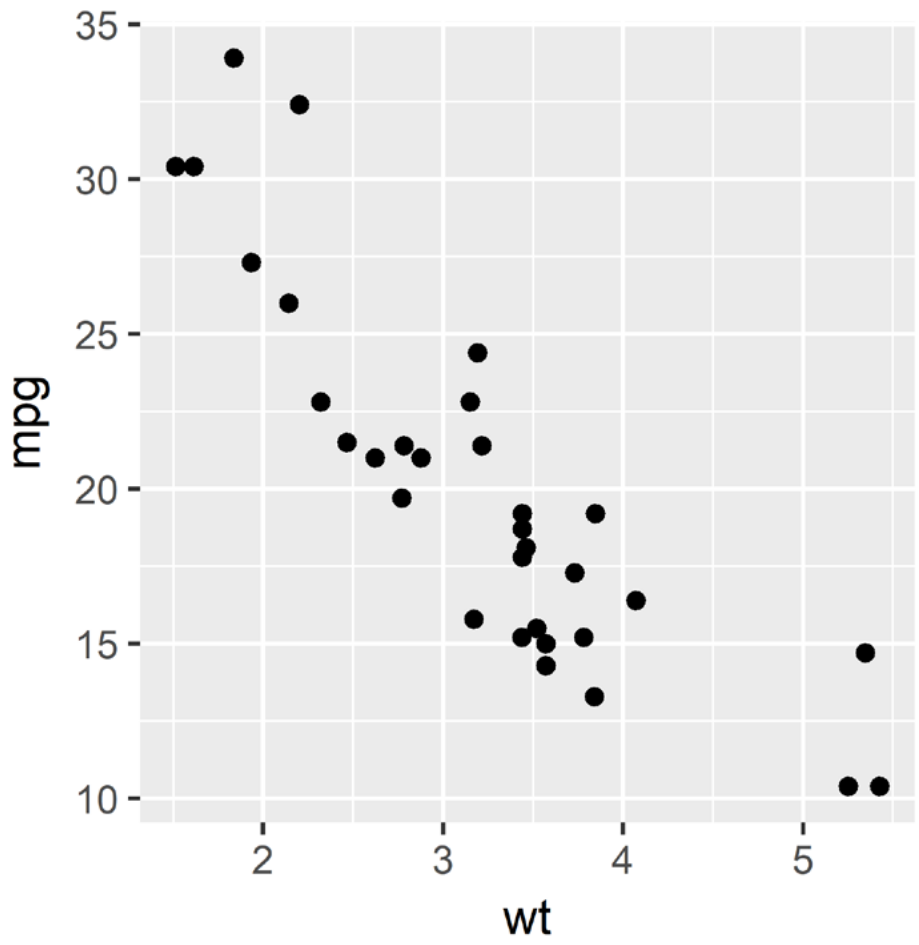
mpg: numeric
wt: numeric



Grammar of graphics

data types, channels, marks

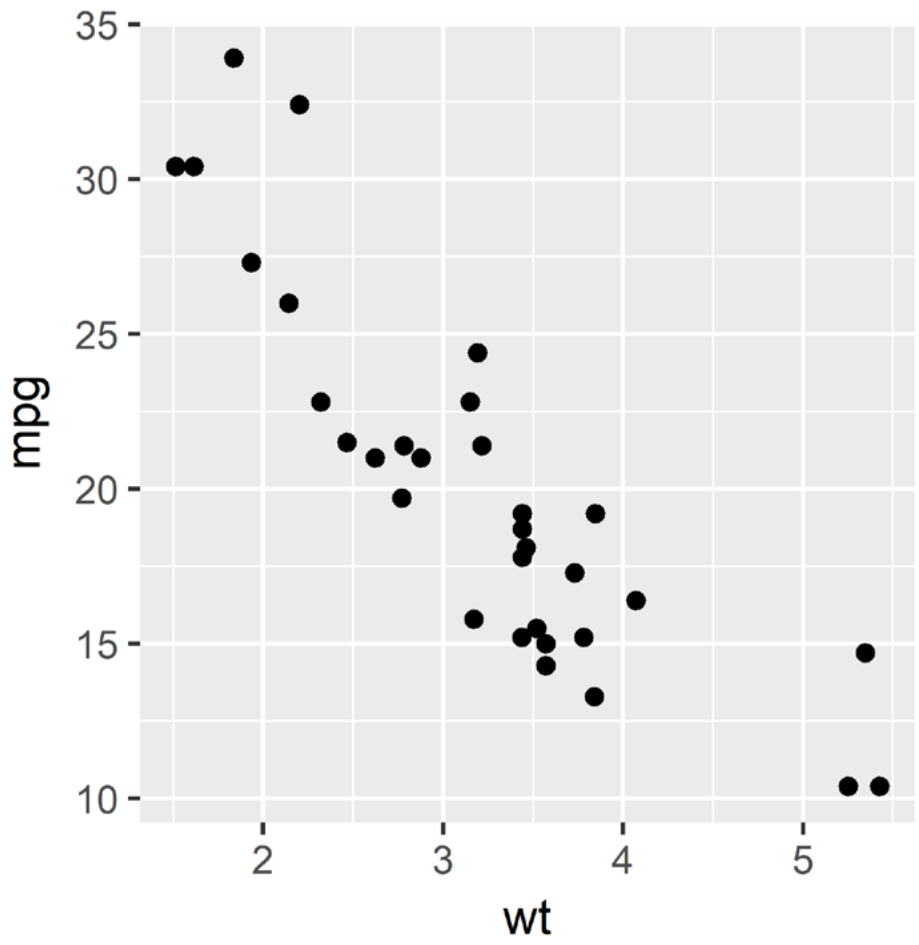
mpg: numeric
wt: numeric
wt -> x position
mpg -> y position



Grammar of graphics

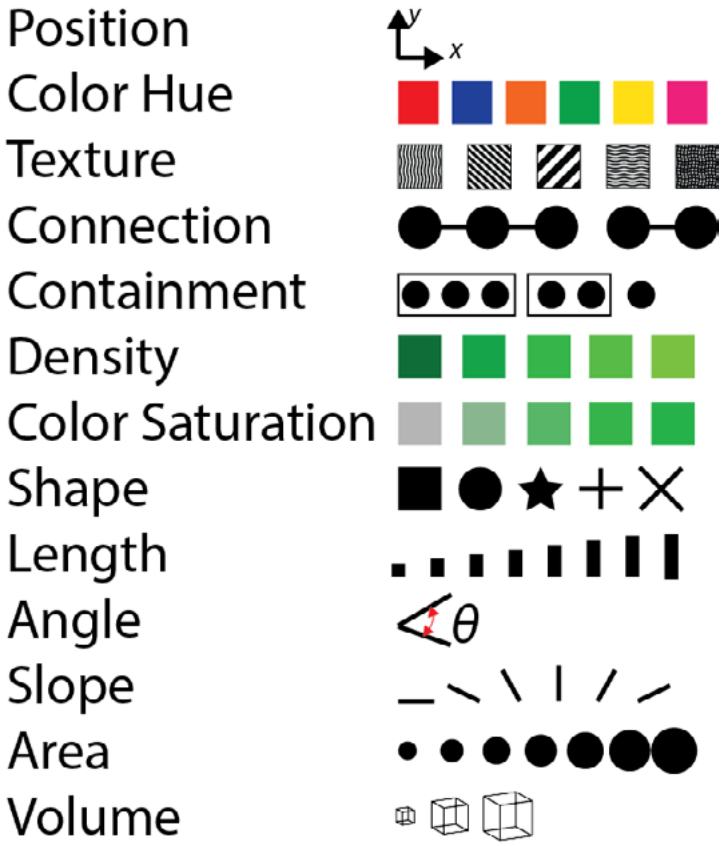
data types, channels, marks

mpg: numeric
wt: numeric
wt -> x position
mpg -> y position
mark: point



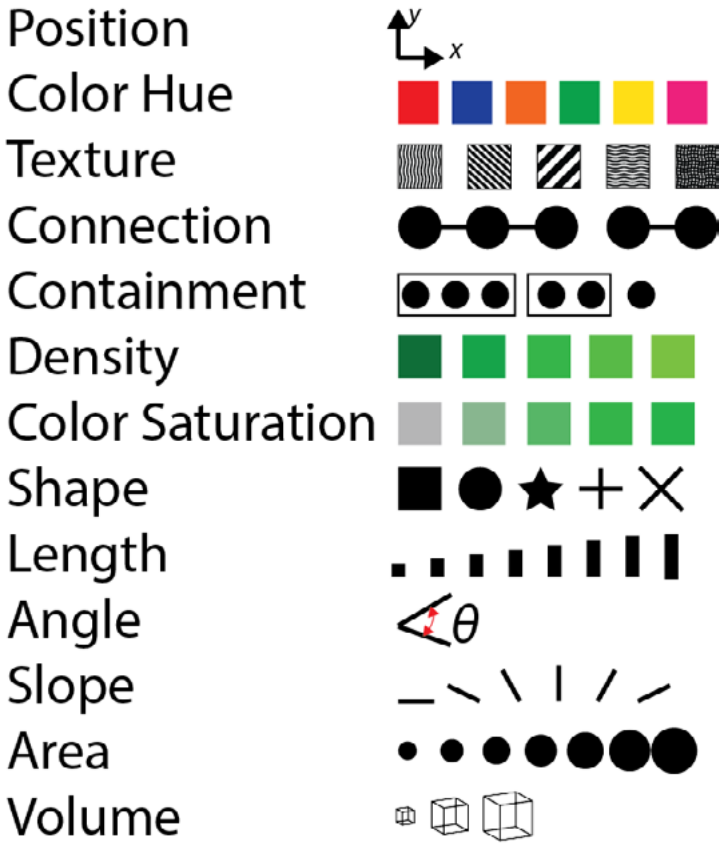
Channels / encodings

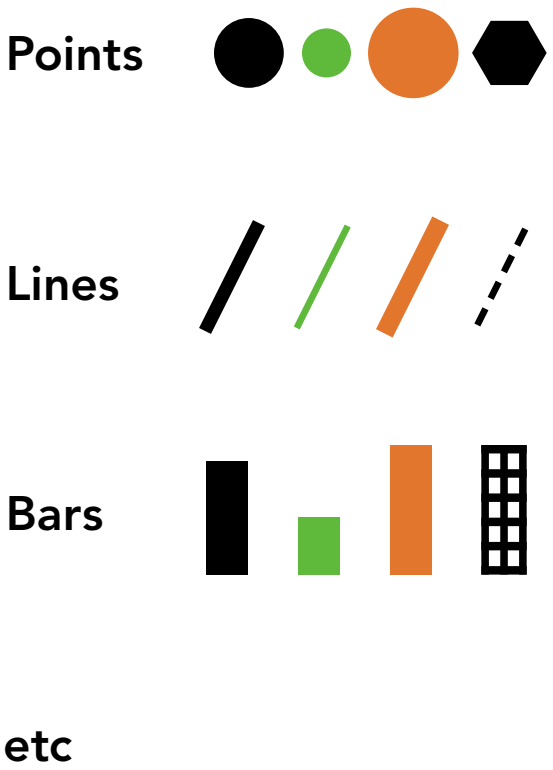
("aesthetics" in ggplot)



Channels / encodings -> Marks

("aesthetics" in ggplot) ("geometries" in ggplot)



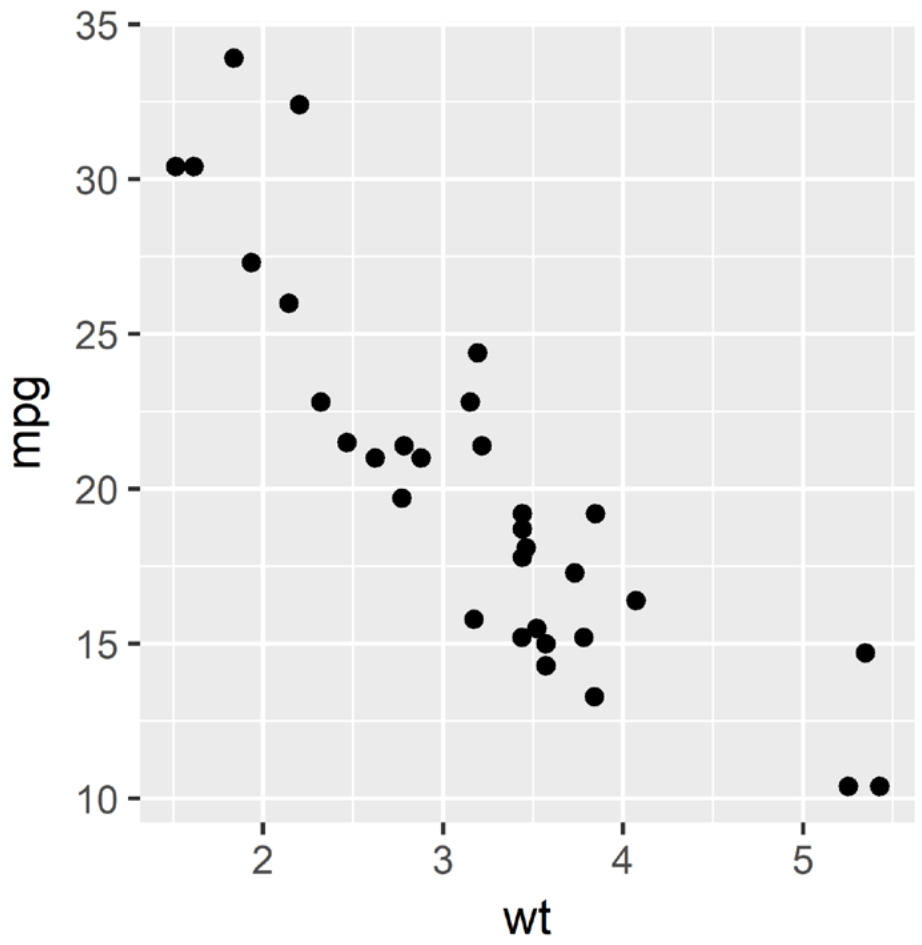


Grammar of graphics

mpg: numeric
wt: numeric

wt -> x position
mpg -> y position

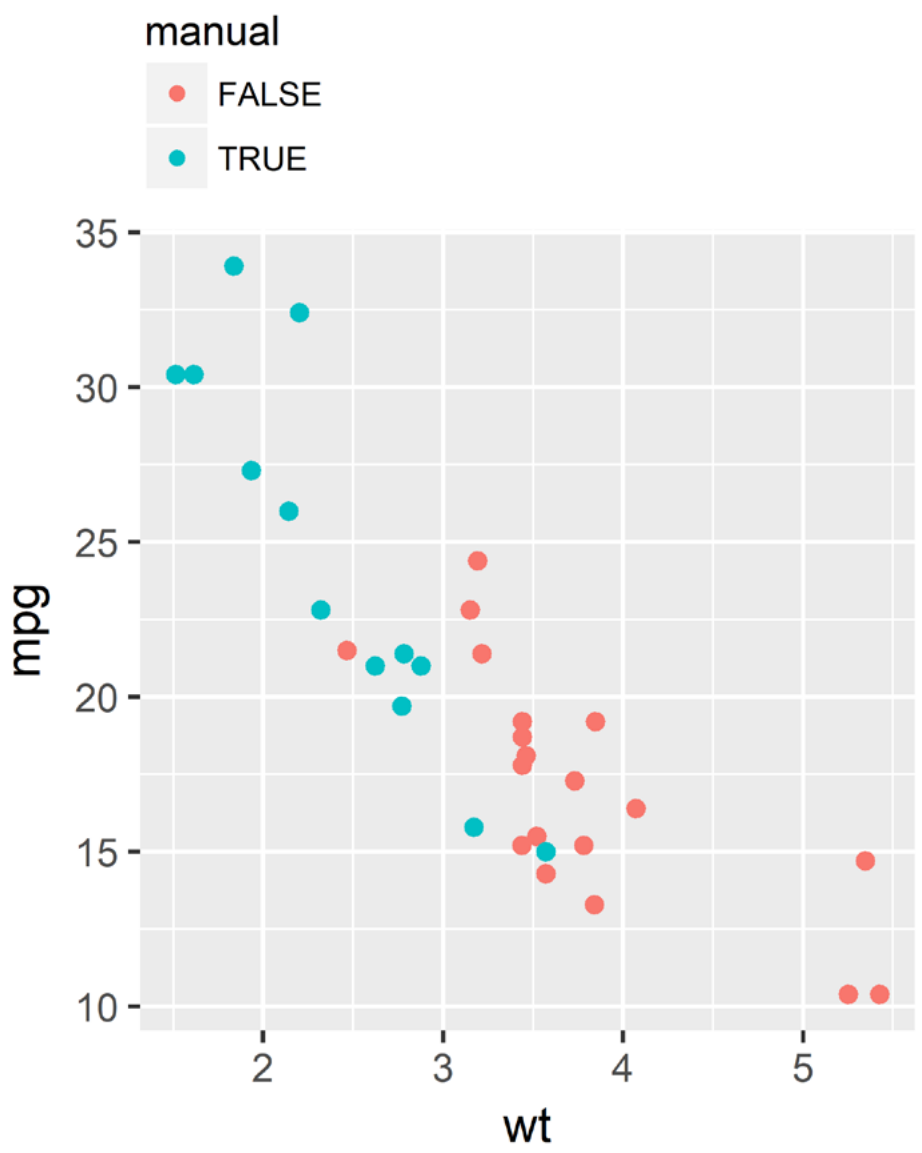
mark: point



Grammar of graphics

mpg: numeric
wt: numeric
→ manual: nominal
wt -> x position
mpg -> y position
→ manual -> color

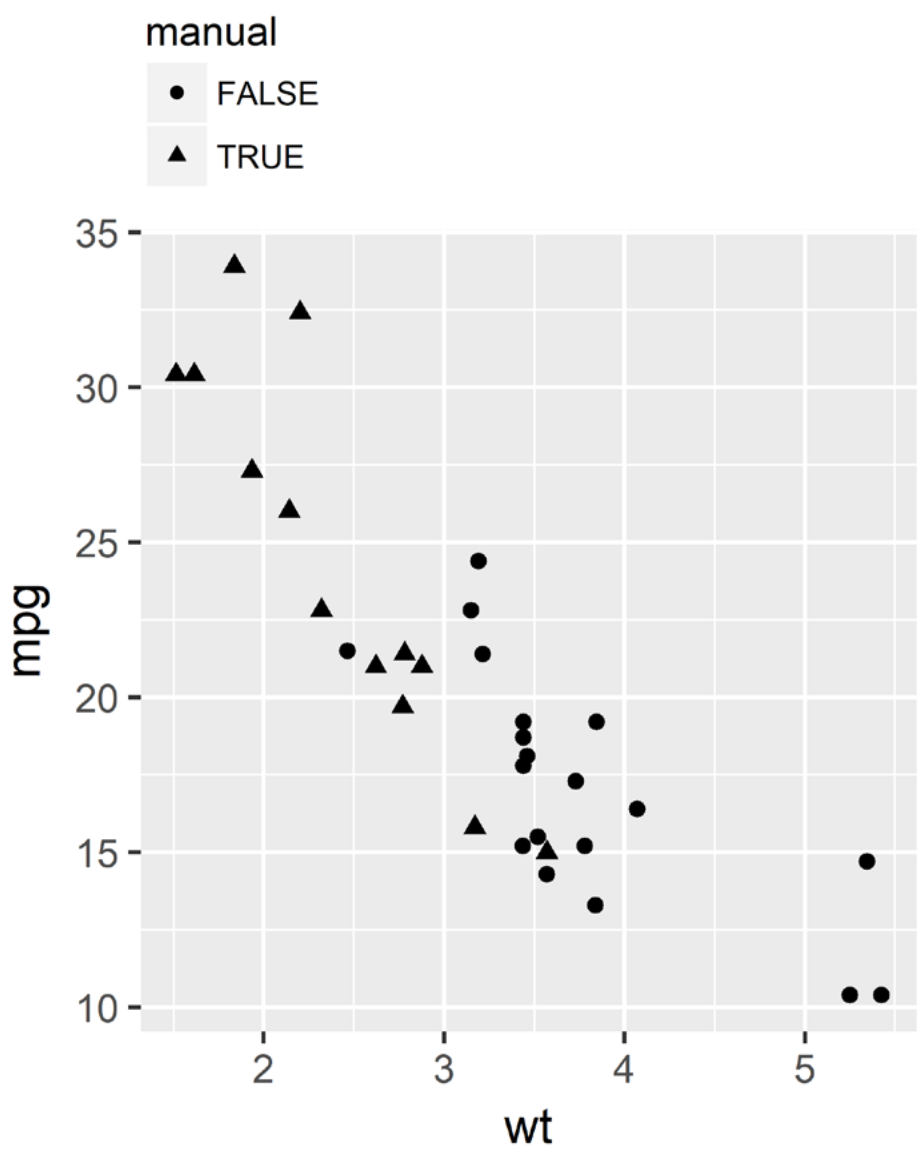
mark: point



Grammar of graphics

mpg: numeric
wt: numeric
manual: nominal
wt -> x position
mpg -> y position
manual -> shape ←

mark: point



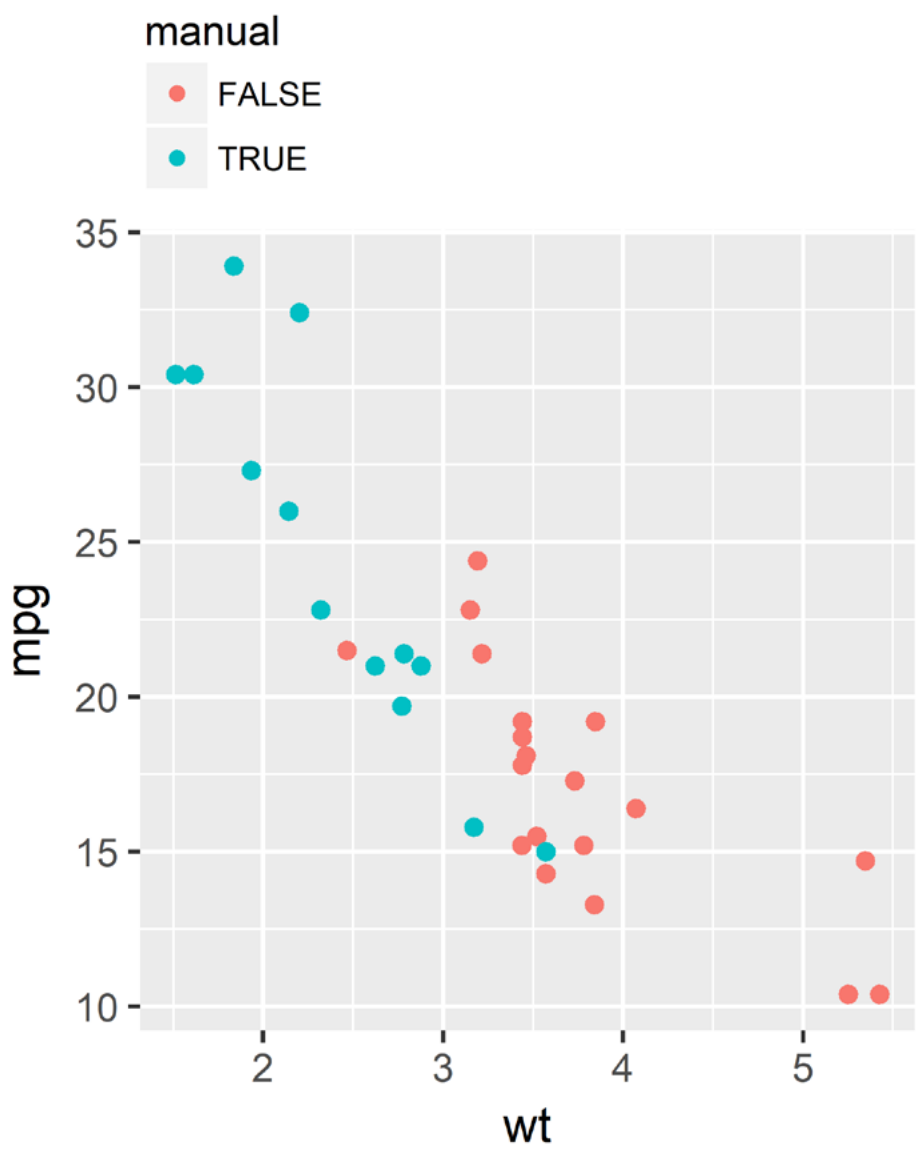
Grammar of graphics

mpg: numeric
wt: numeric
manual: nominal
wt -> x position
mpg -> y position
manual -> color ←
manual -> shape ←
mark: point

Grammar of graphics

mpg: numeric
wt: numeric
manual: nominal
wt -> x position
mpg -> y position
manual -> color

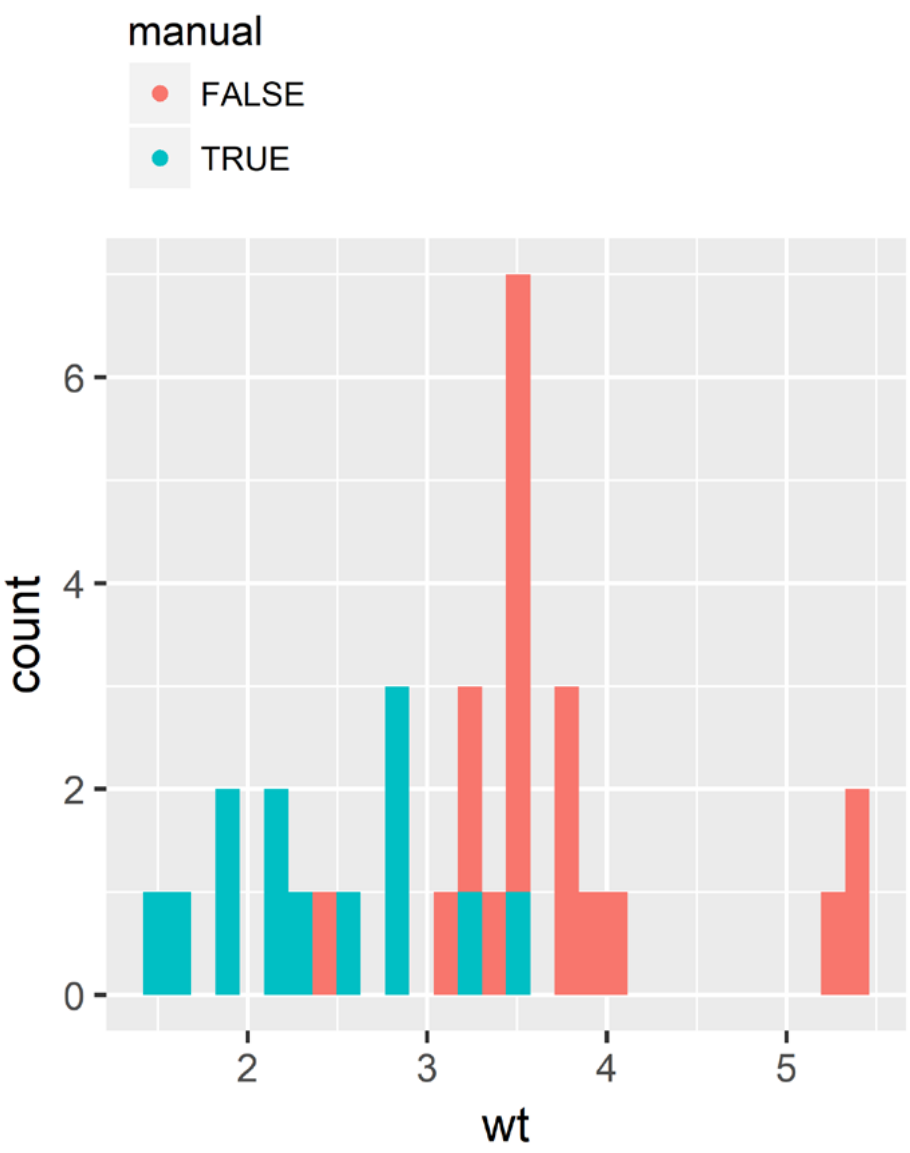
mark: point



Grammar of graphics

wt: numeric
manual: nominal
→ bin(wt) -> x position
→ count(wt)-> length ←
manual -> color

mark: bar ←

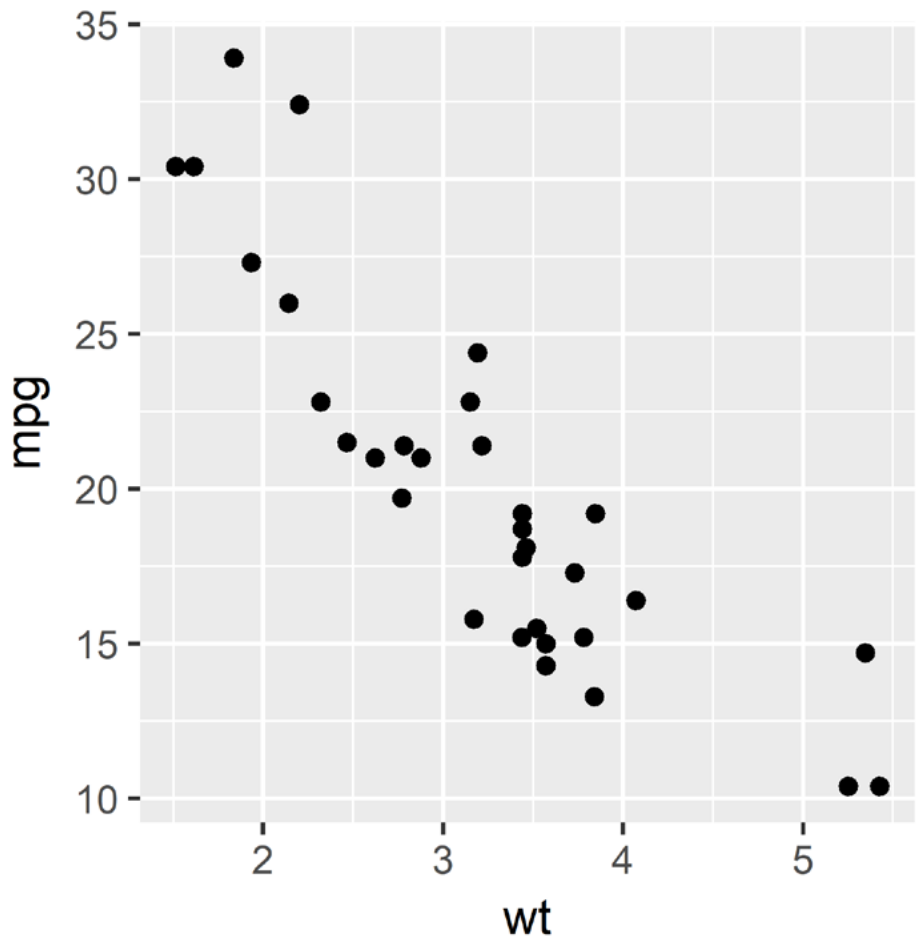


Easier to specify many charts, combinations

mpg: numeric
wt: numeric

wt -> x position
mpg -> y position

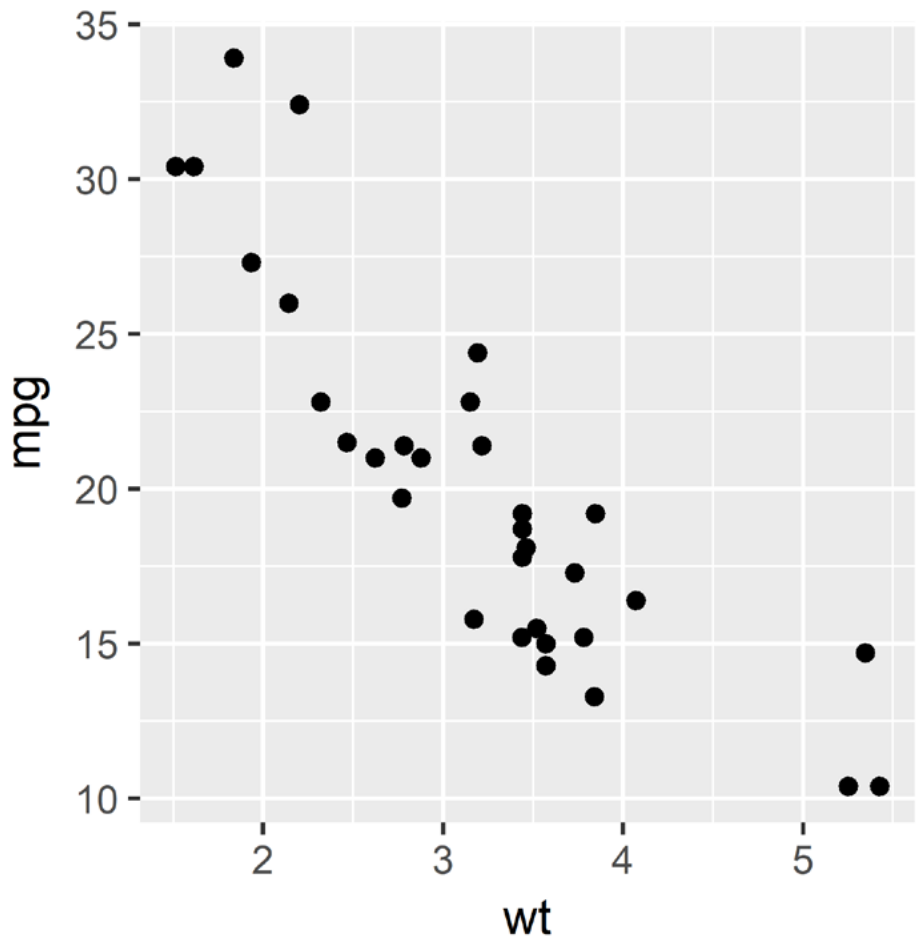
mark: point



Easier to specify many charts, combinations

Not:

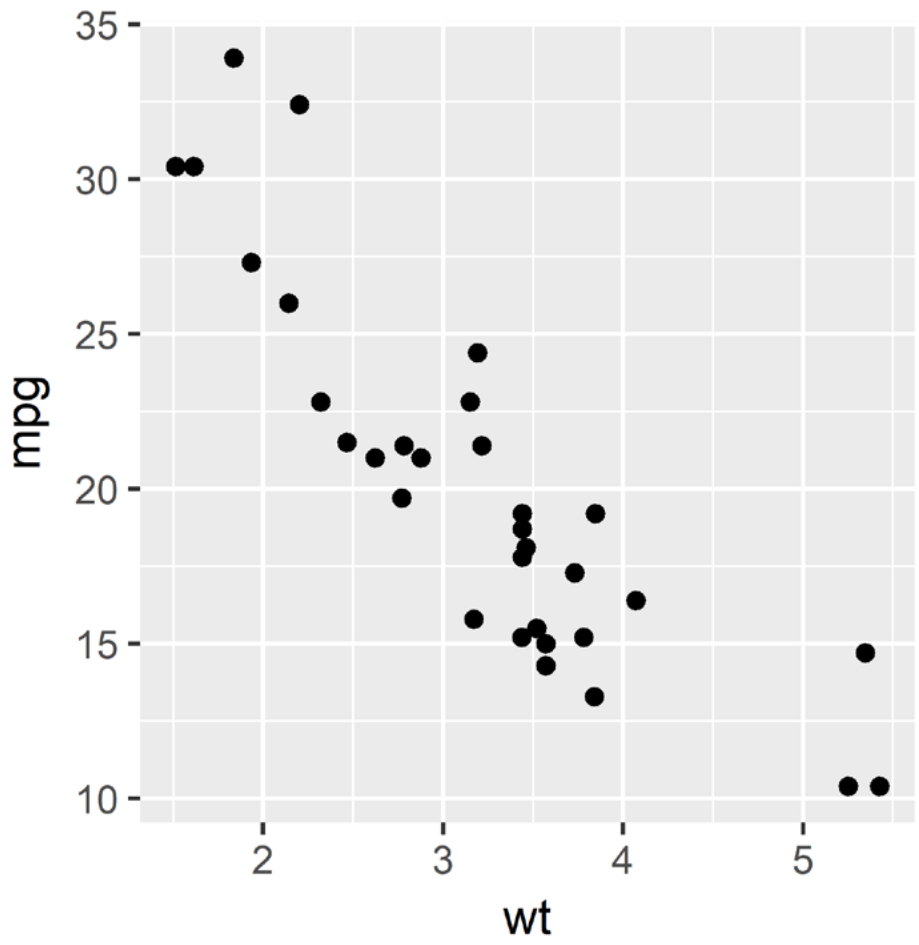
```
some_big_function_to_make_scatterplots(
    my_data,
    a_bunch_of_options
)
```



Easier to specify many charts, combinations

Not:

```
some_function_to_draw_grid()
some_function_to_draw_axes()
for (row in data) {
   draw_point(data[i]["x"], ...)
}
 ...
```

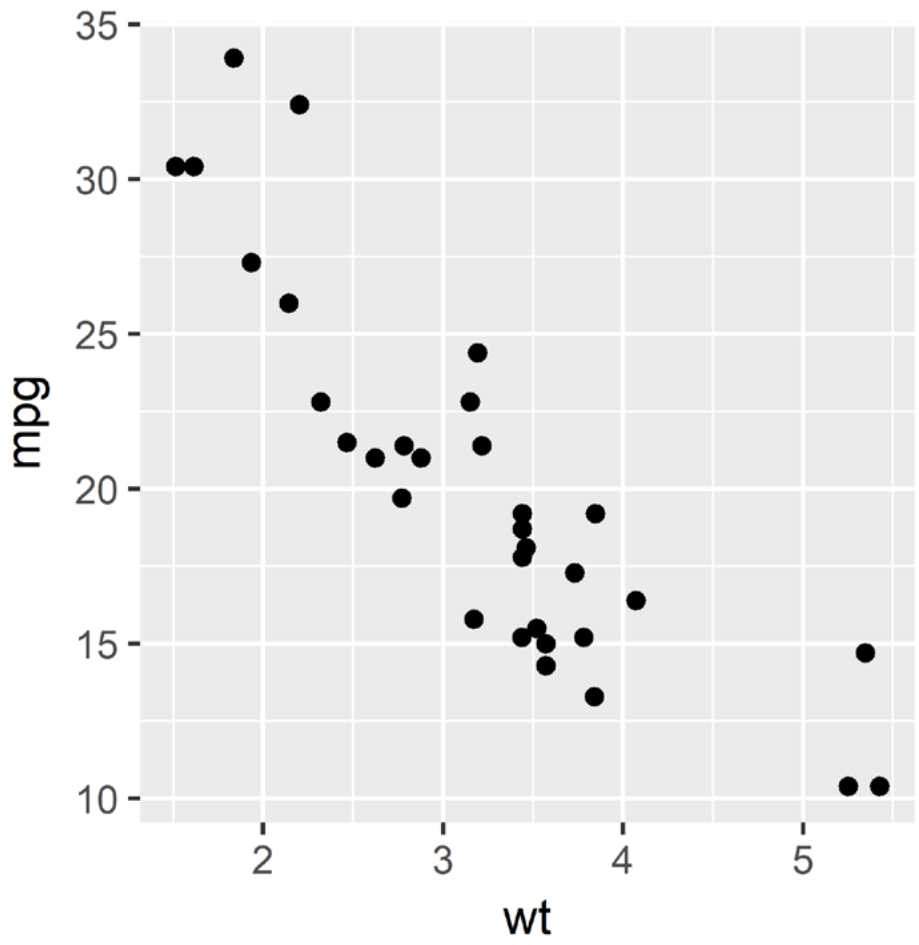


Easier to specify many charts, combinations

e.g., in ggplot:

(data, channels, marks)

```
ggplot(mtcars,
  aes(
    x = wt,
    y = mpg
  )) +
  geom_point()
```

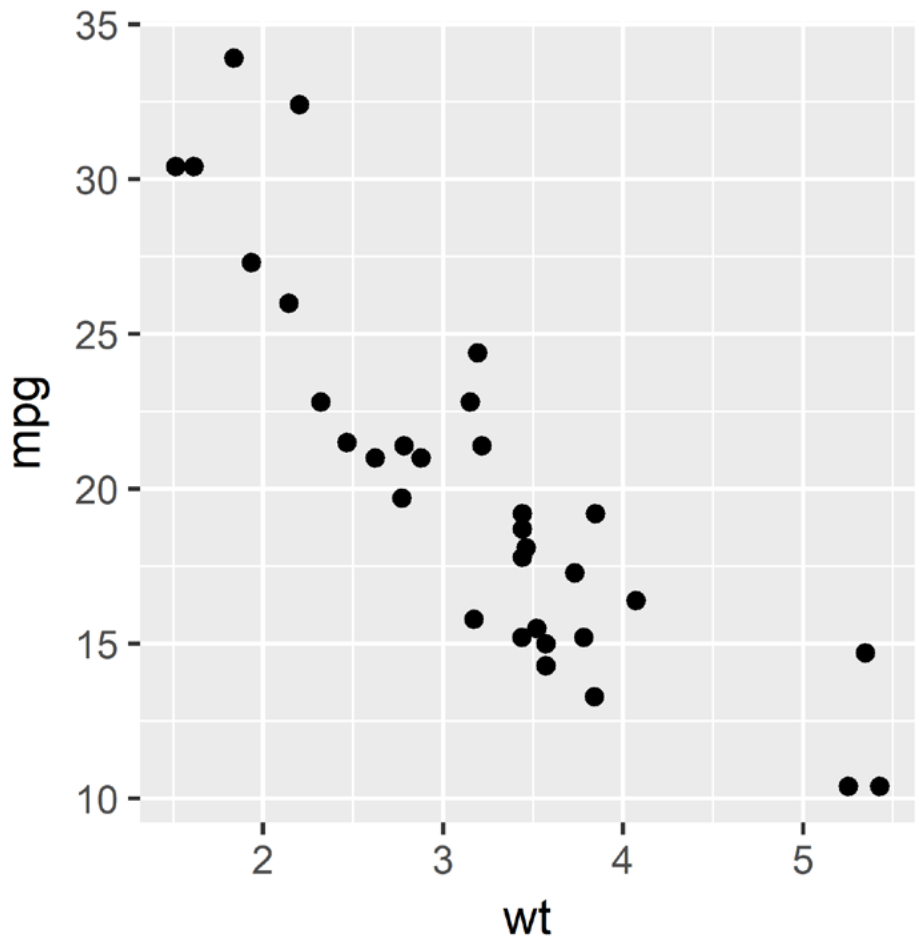


Easier to specify many charts, combinations

e.g., in Vega-Lite:

(data, channels, marks)

```
{
  "data": {"url": "mtcars.json"},
  "encoding": {
    "x": {"field": "wt"},
    "y": {"field": "mpg"}
  },
  "mark": "point"
}
```

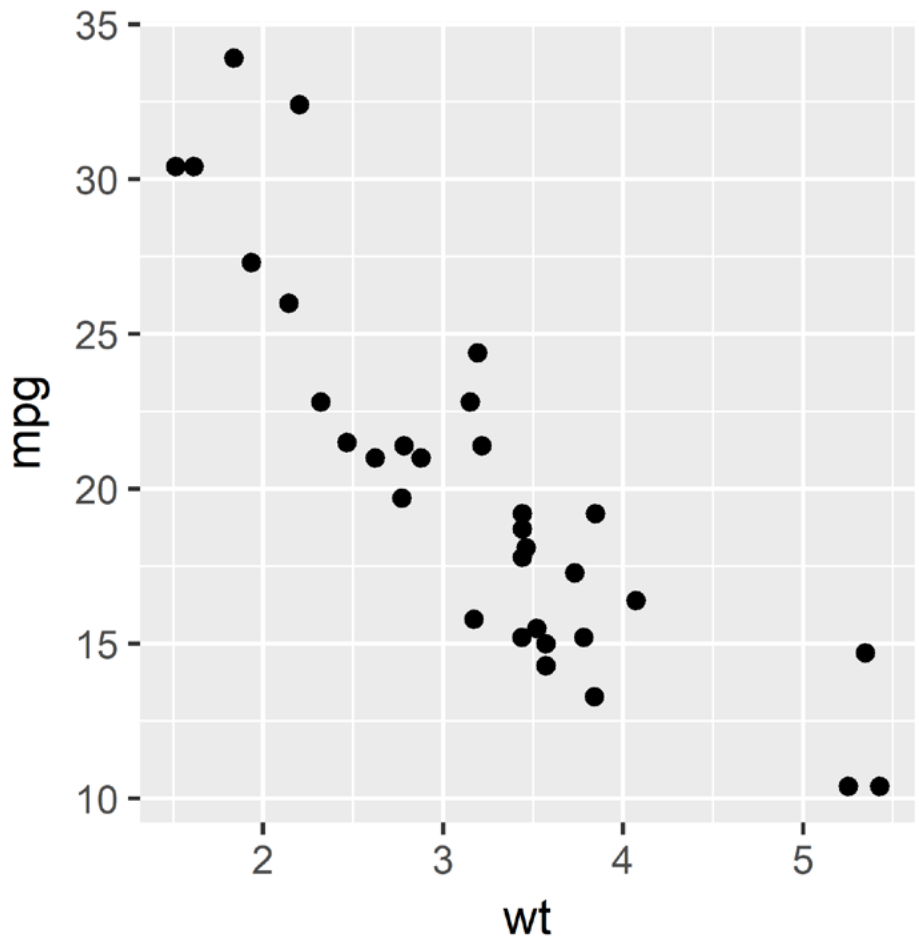


Easier to specify many charts, combinations

e.g., in Altair:

(data, channels, marks)

```
alt.Chart(mtcars)\
   .encode(
      x = 'wt',
      y = 'mpg'
   )\
   .mark_point()
```



Easier to specify many charts, combinations

e.g., in Altair:

(data, channels, marks)

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alt.Chart(mtcars)\
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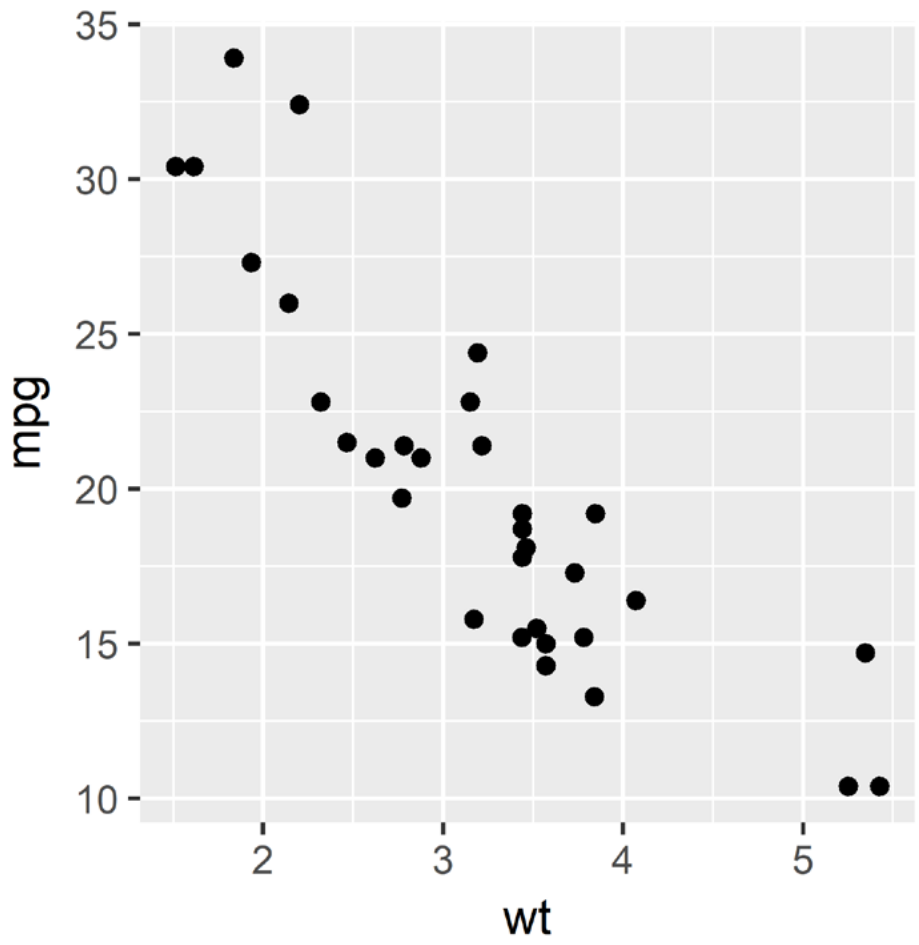
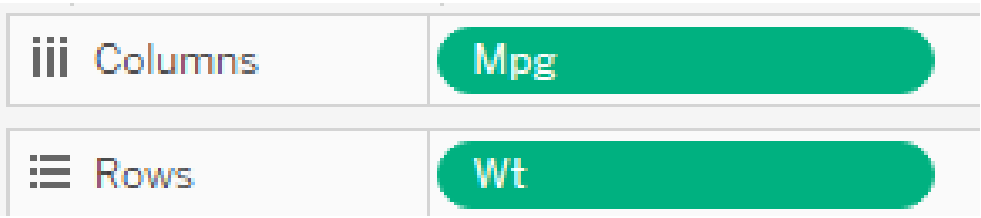
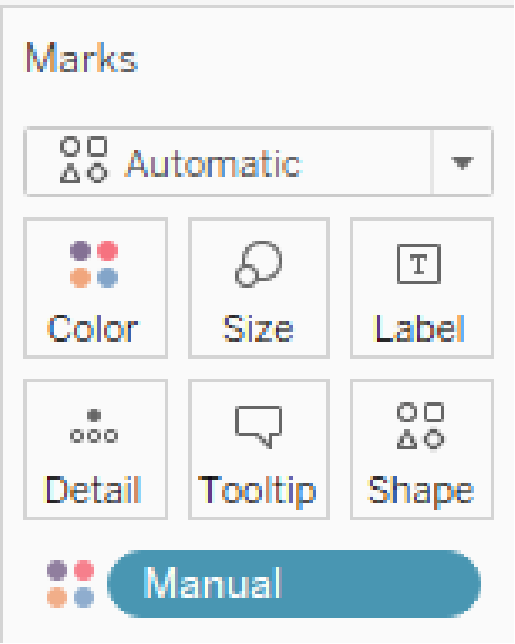
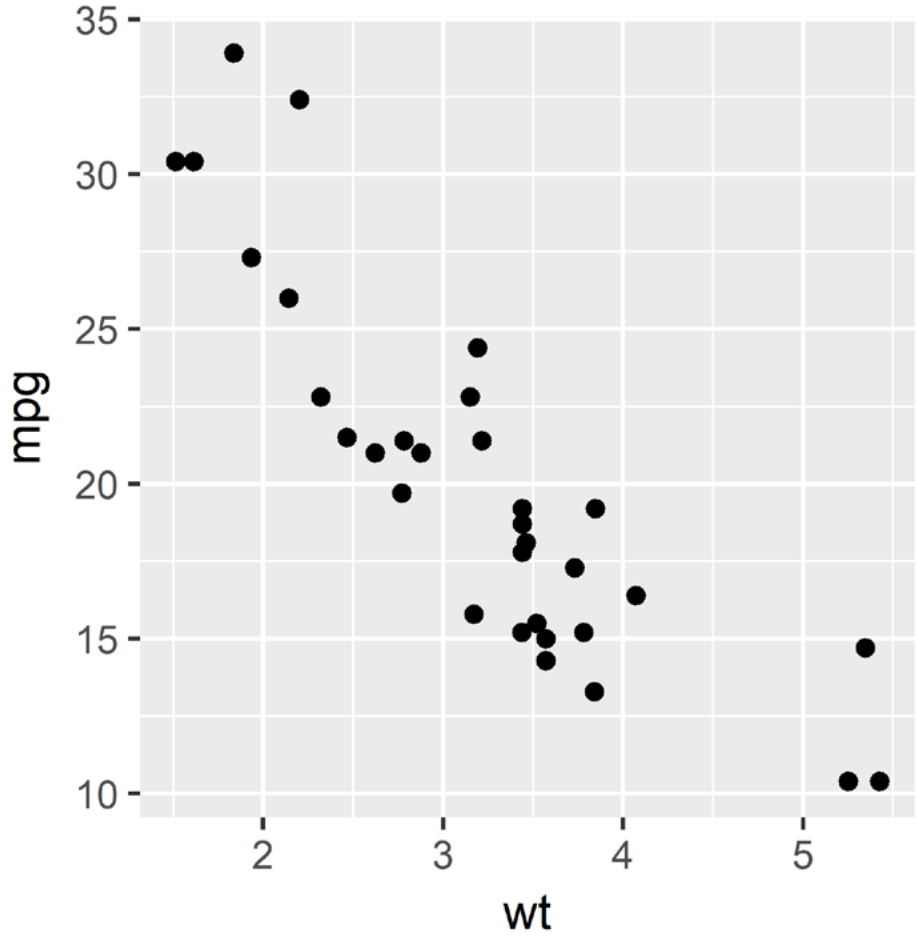


Easier to specify many charts, combinations

e.g., in Tableau:







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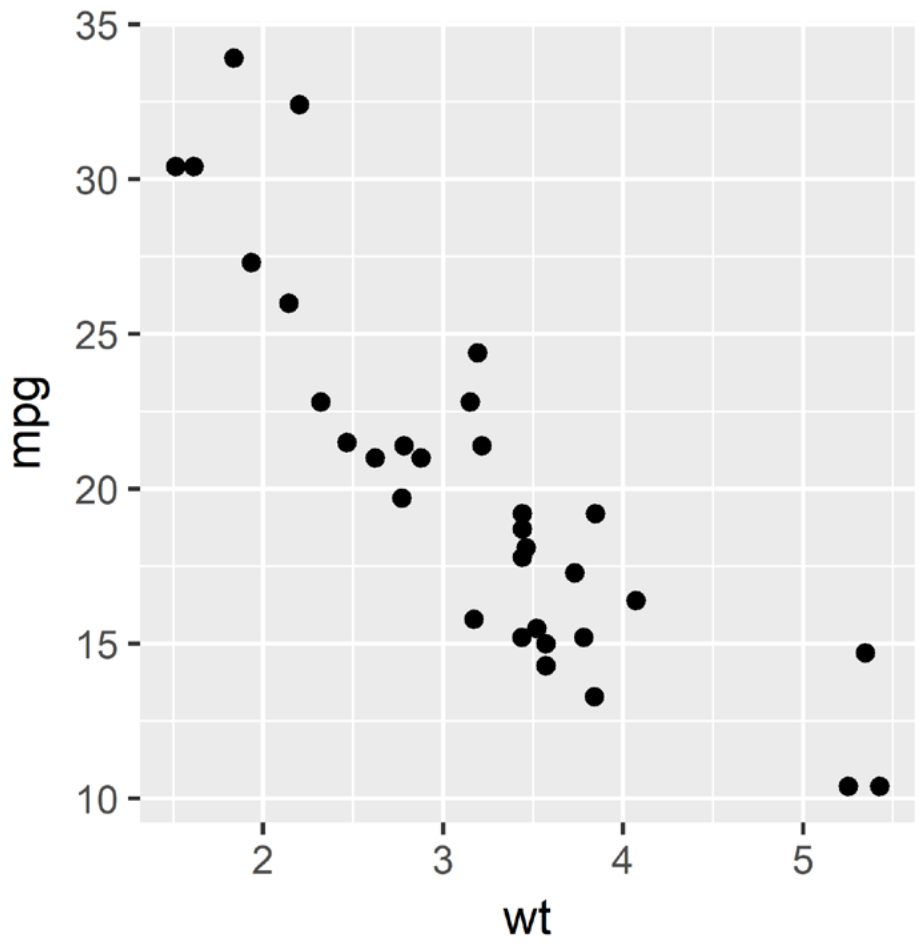

Grammar of graphics

Easier to specify many charts, combinations

Helps you evaluate charts systematically (Monday)