Scatter plots

INTRODUCTION TO DATA VISUALIZATION WITH GGPLOT2

Rick Scavetta
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48 geometries

geom_*						
abline	contour	dotplot	jitter	pointrange	ribbon	spoke
area	count	errorbar	label	polygon	rug	step
bar	crossbar	errorbarh	line	qq	segment	text
bin2d	curve	freqpoly	linerange	qq_line	sf	tile
blank	density	hex	map	quantile	sf_label	violin
boxplot	density2d	histogram	path	raster	sf_text	vline
col	density_2d	hline	point	rect	smooth	

Common plot types

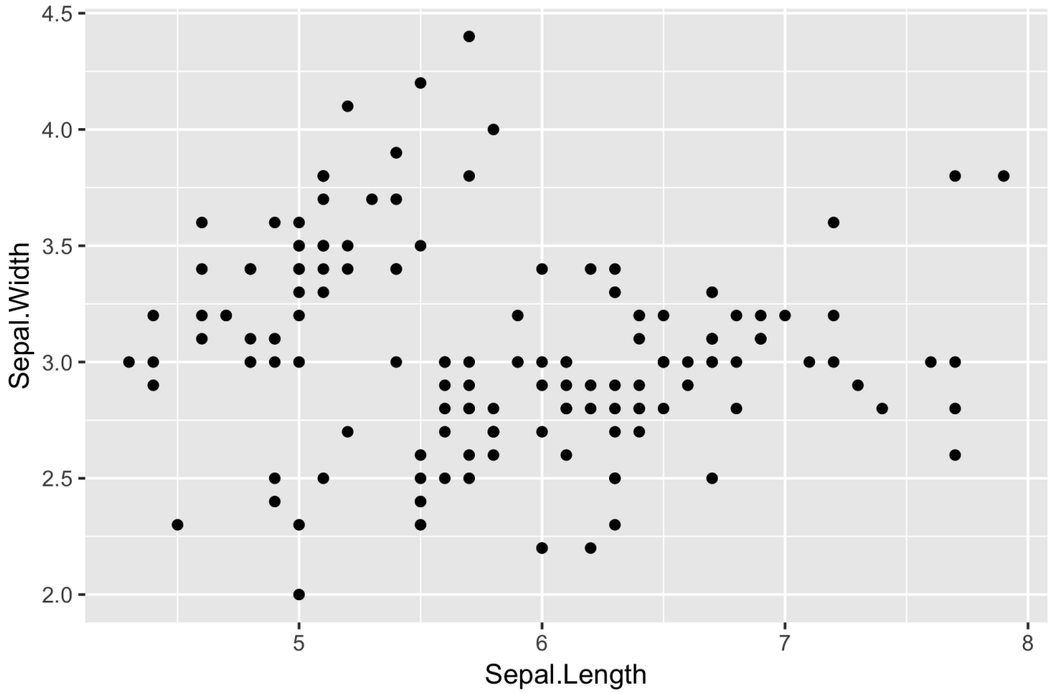
Plot type	Possible Geoms
Scatter plots	points, jitter, abline, smooth, count

Scatter plots

- Each geom can accept specific aesthetic mappings, e.g. geom_point():

Essential
x,y

```
ggplot(iris, aes(x = Sepal.Length,
                 y = Sepal.Width)) +
  geom_point()
```

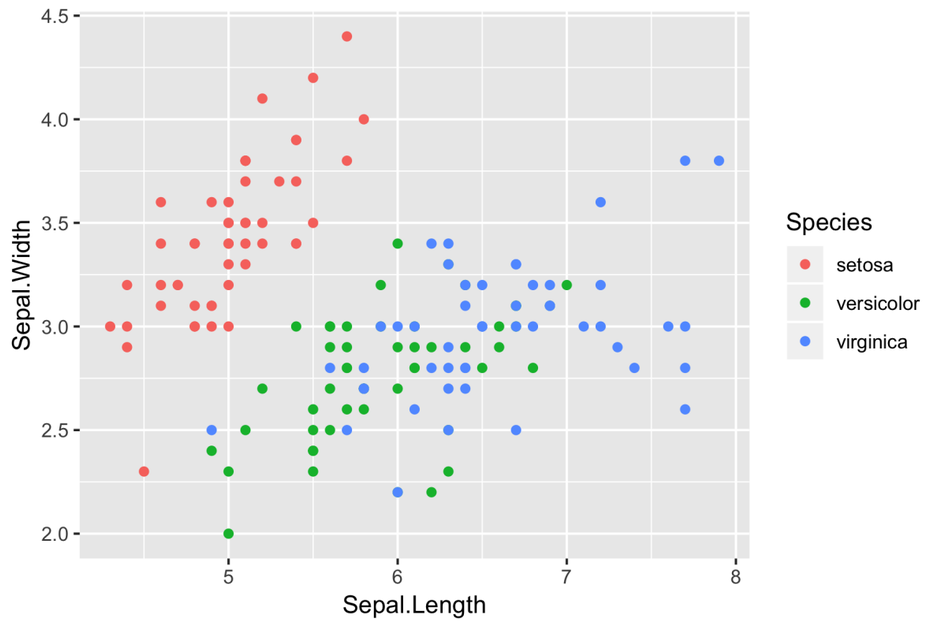


Scatter plots

- Each geom can accept specific aesthetic mappings, e.g. geom_point():

Essential	Optional
x,y	alpha, color, fill, shape, size, stroke

```
ggplot(iris, aes(x = Sepal.Length,
                 y = Sepal.Width,
                 col = Species)) +
  geom_point()
```

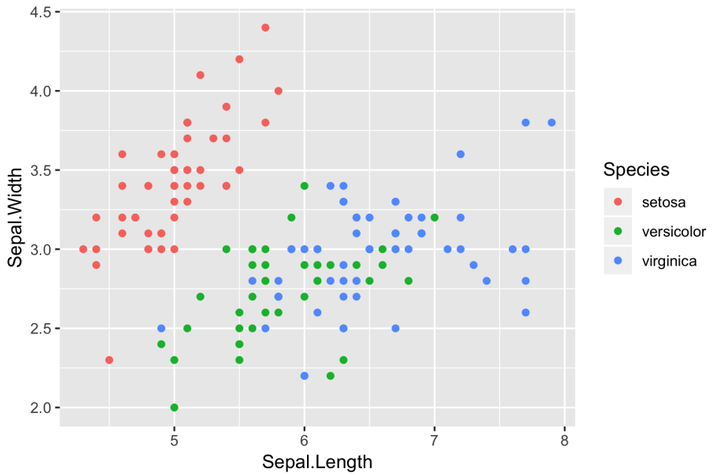


Geom-specific aesthetic mappings

```
# These result in the same plot!
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point()

ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
  geom_point(aes(col = Species))
```

Control aesthetic mappings of each layer independently:



```
head(iris, 3) # Raw data
```

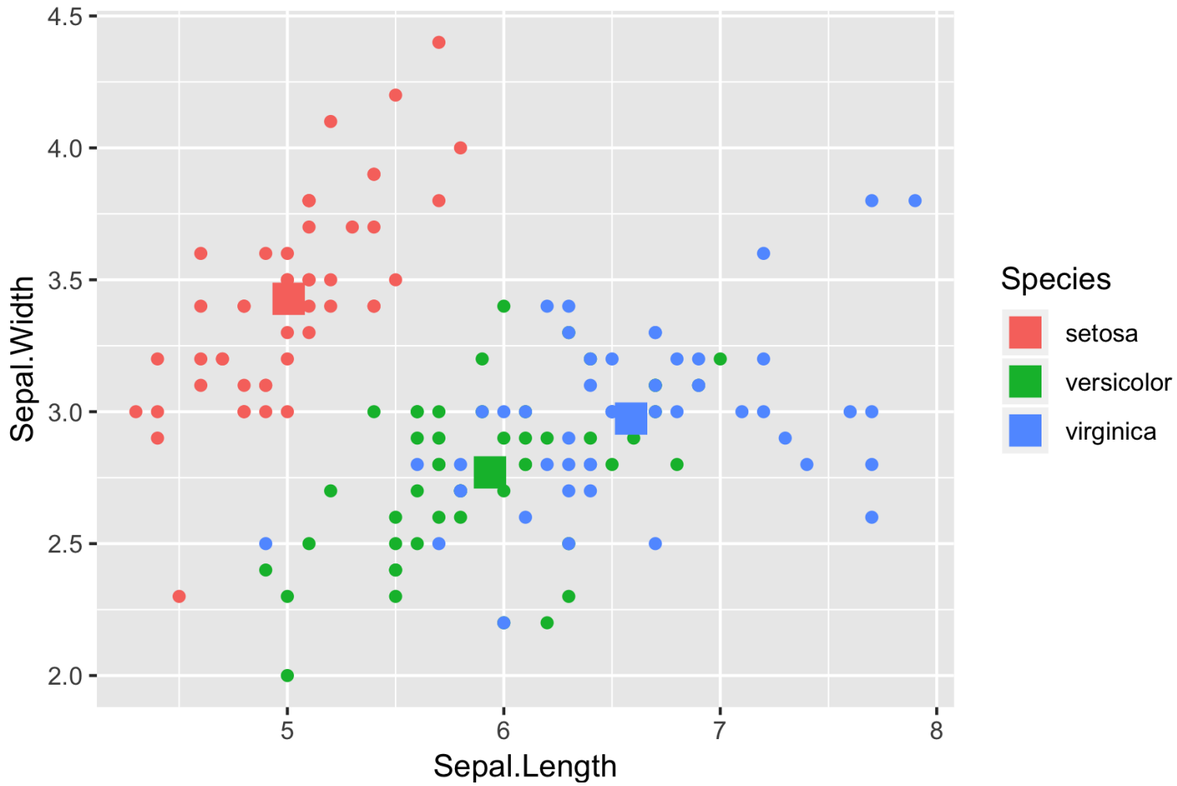
```
Species Sepal.Length Sepal.Width Petal.Length Petal.Width
1  setosa          5.1         3.5          1.4         0.2
2  setosa          4.9         3.0          1.4         0.2
3  setosa          4.7         3.2          1.3         0.2
```

```
iris %>%
  group_by(Species) %>%
  summarise_all(mean) -> iris.summary

iris.summary # Summary statistics
```

```
# A tibble: 3 x 5
  Species    Sepal.Length Sepal.Width Petal.Length Petal.Width
  <fct>             <dbl>       <dbl>        <dbl>       <dbl>
1 setosa             5.01        3.43         1.46       0.246
2 versicolor         5.94        2.77         4.26       1.33
3 virginica          6.59        2.97         5.55       2.03
```

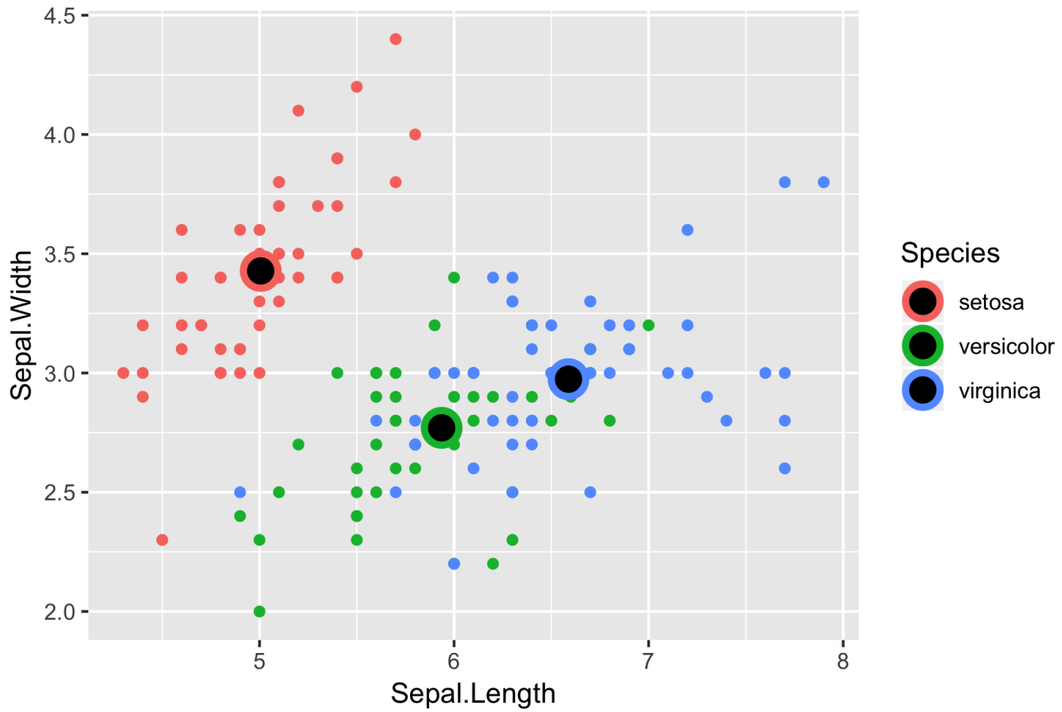
```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  # Inherits both data and aes from ggplot()
  geom_point() +
  # Different data, but inherited aes
  geom_point(data = iris.summary, shape = 15, size = 5)
```



Shape attribute values

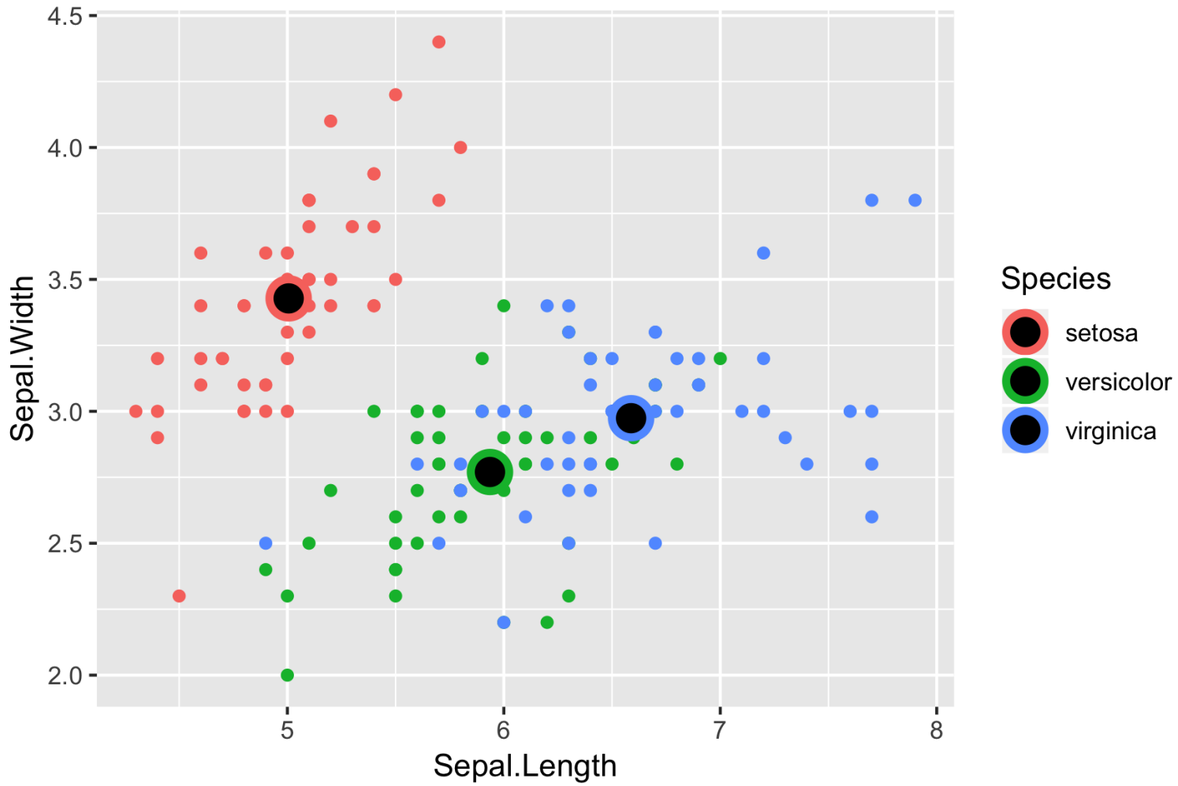
Example

```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point() +
  geom_point(data = iris.summary, shape = 21, size = 5,
             fill = "black", stroke = 2)
```



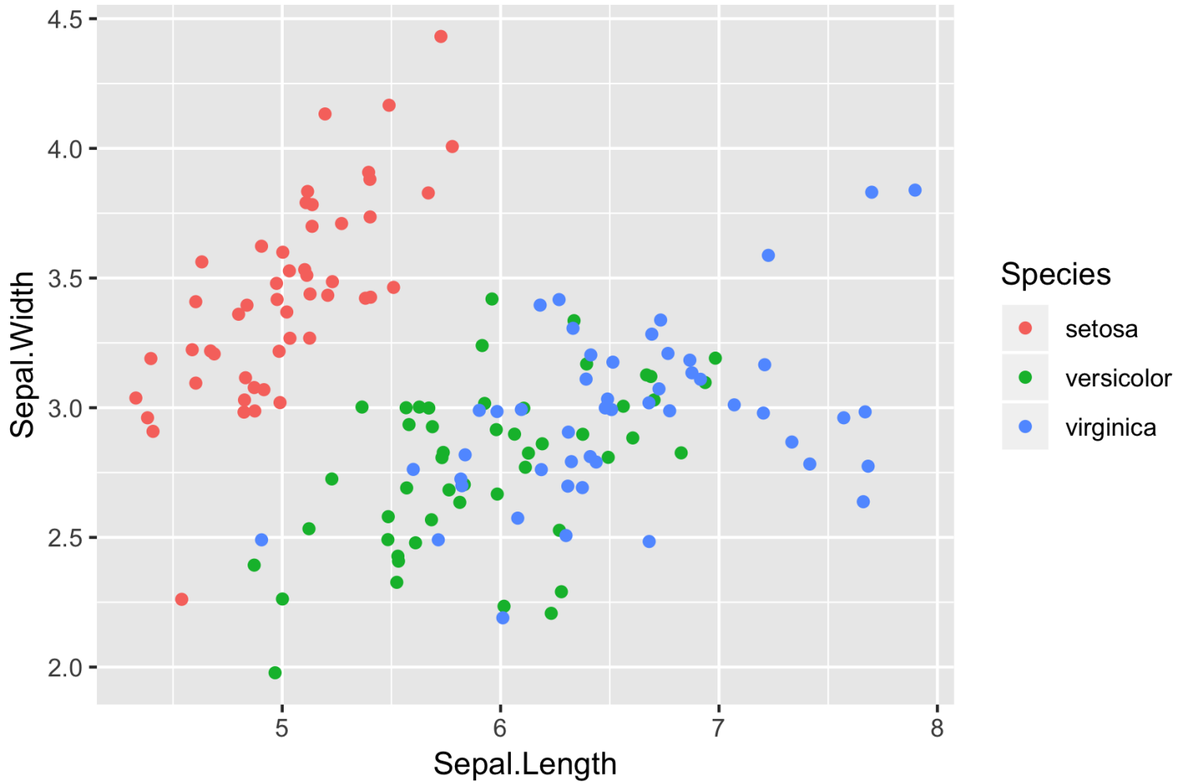
On-the-fly stats by ggplot2

- See the second course for the stats layer.
- Note: Avoid plotting only the mean without a measure of spread, e.g. the standard deviation.



position = "jitter"

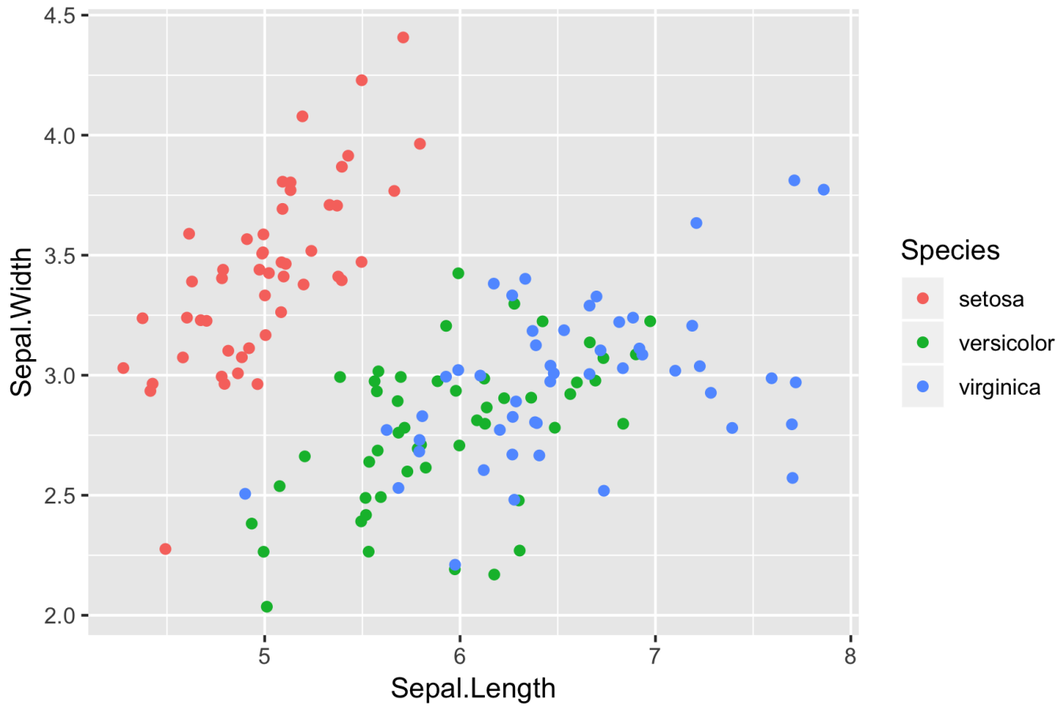
```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter")
```



geom_jitter()

A short-cut to `geom_point(position = "jitter")`

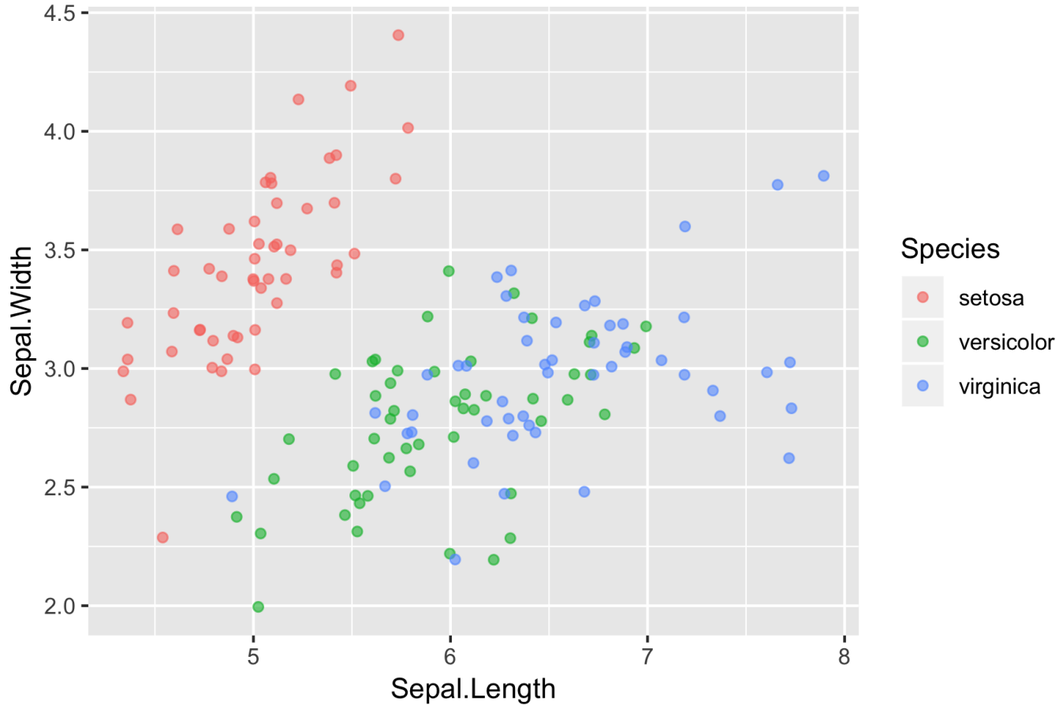
```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_jitter()
```



Don't forget to adjust alpha

- Combine jittering with alpha-blending if necessary

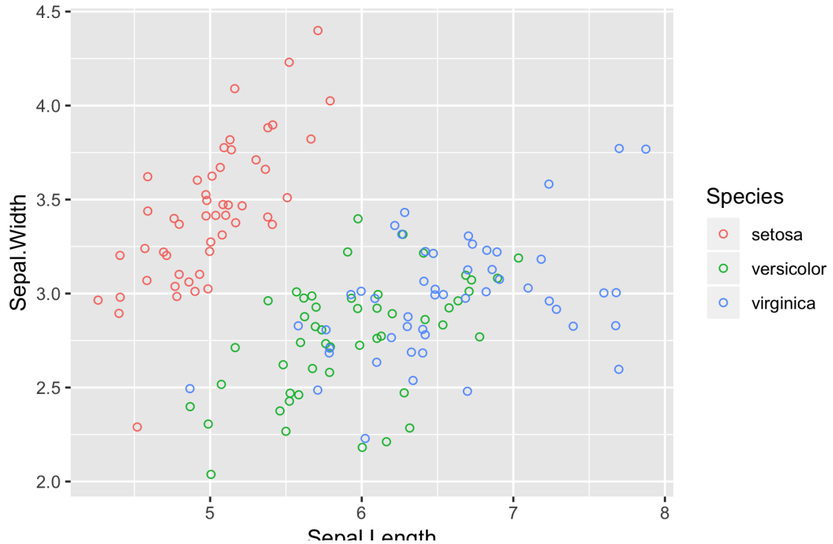
```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_jitter(alpha = 0.6)
```



Hollow circles also help

- `shape = 1` is a. hollow circle.
- Not necessary to also use alpha-blending.

```
ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_jitter(shape = 1)
```



Let's practice!

INTRODUCTION TO DATA VISUALIZATION WITH GGPLOT2

Histograms

INTRODUCTION TO DATA VISUALIZATION WITH GGPLOT2

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Common plot types

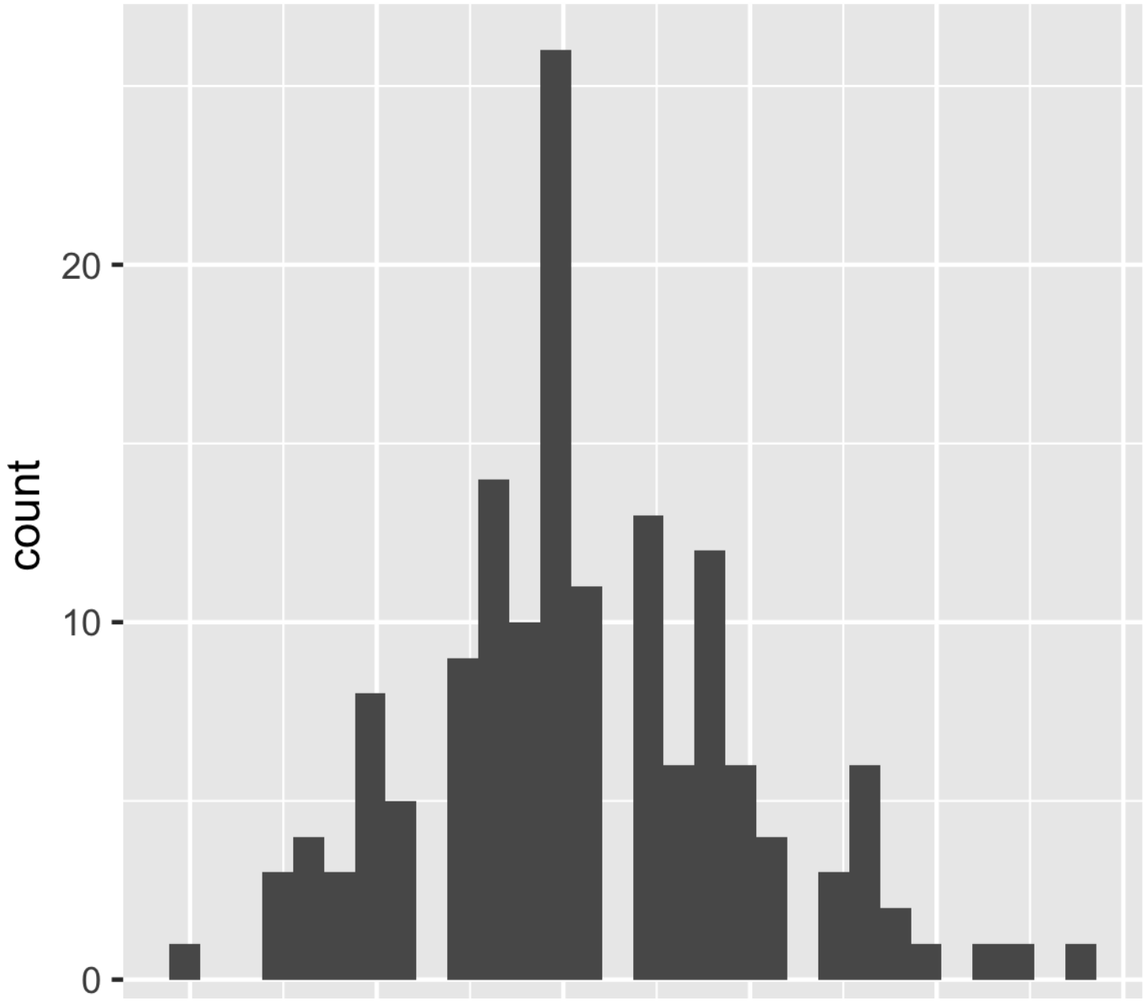
Plot type	Possible Geoms
Scatter plots	points, jitter, abline, smooth, count
Bar plots	**histogram, bar, col, errorbar**
Line plots	line, path

Histograms

```
ggplot(iris, aes(x = Sepal.Width)) +
  geom_histogram()
```

- A plot of binned values
  - i.e. a statistical function

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



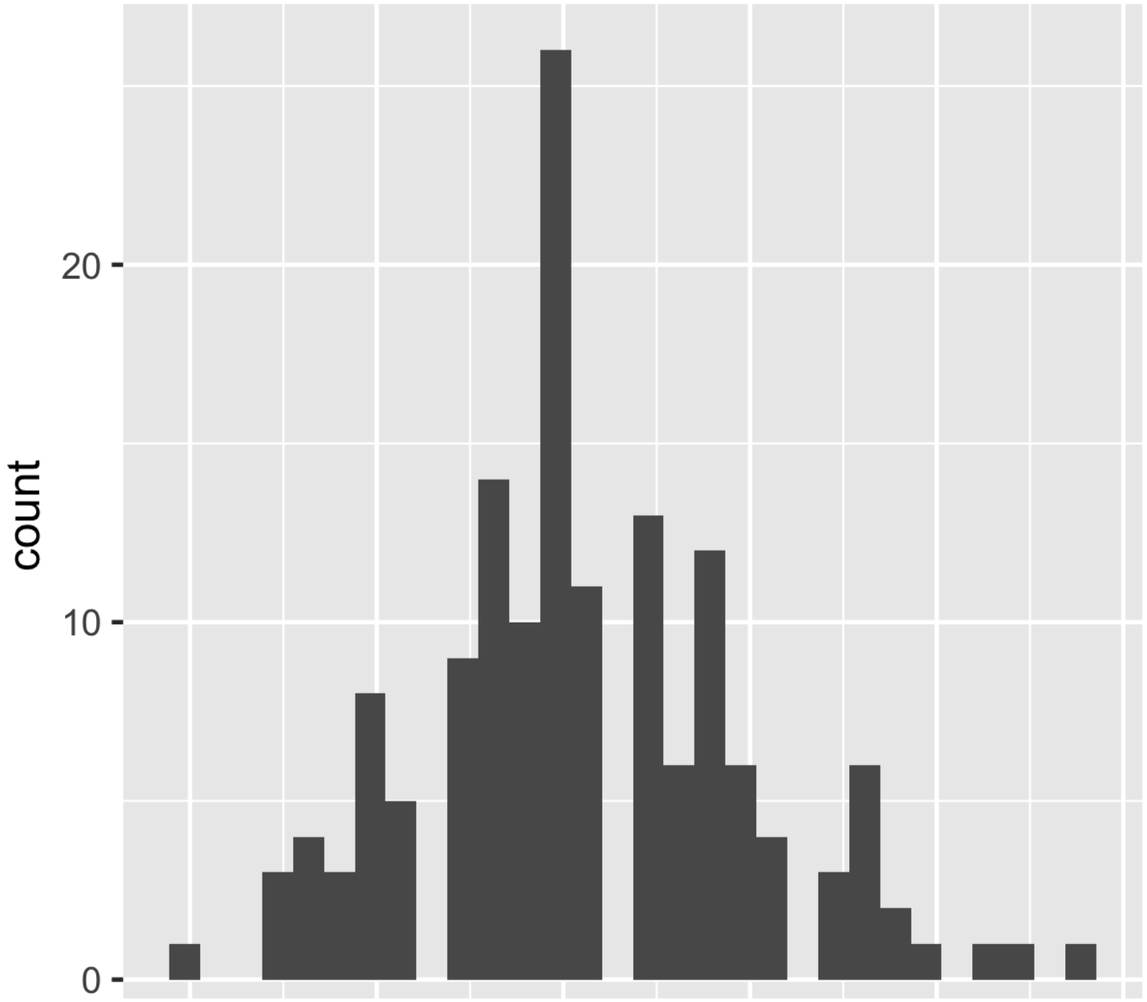
Default of 30 even bins

```
ggplot(iris, aes(x = Sepal.Width)) +
  geom_histogram()
```

- A plot of binned values
  - i.e. a statistical function

```
# Default bin width:
diff(range(iris$Sepal.Width))/30
```

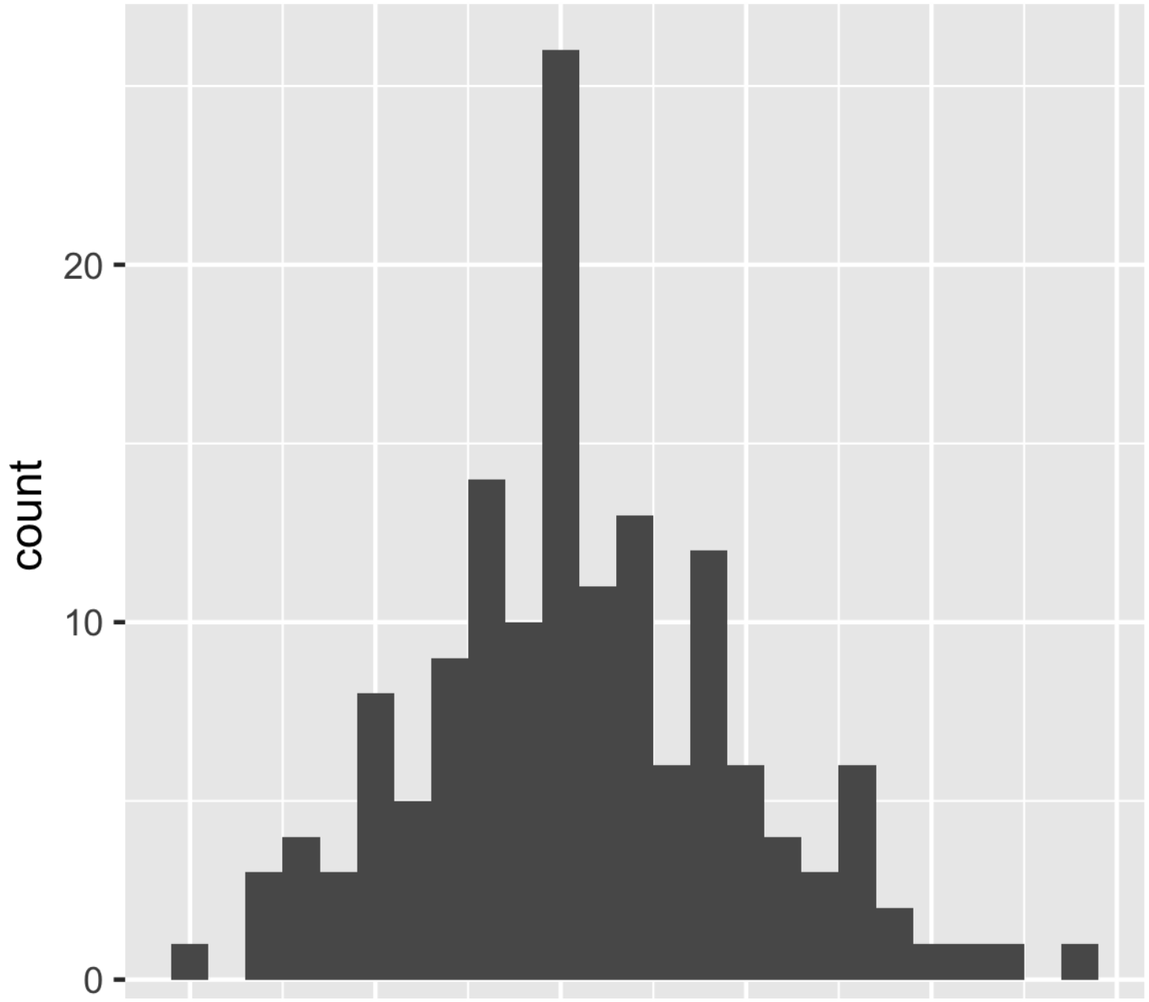
```
[1] 0.08
```



Intuitive and meaningful bin widths

```
ggplot(iris, aes(x = Sepal.Width)) +
  geom_histogram(binwidth = 0.1)
```

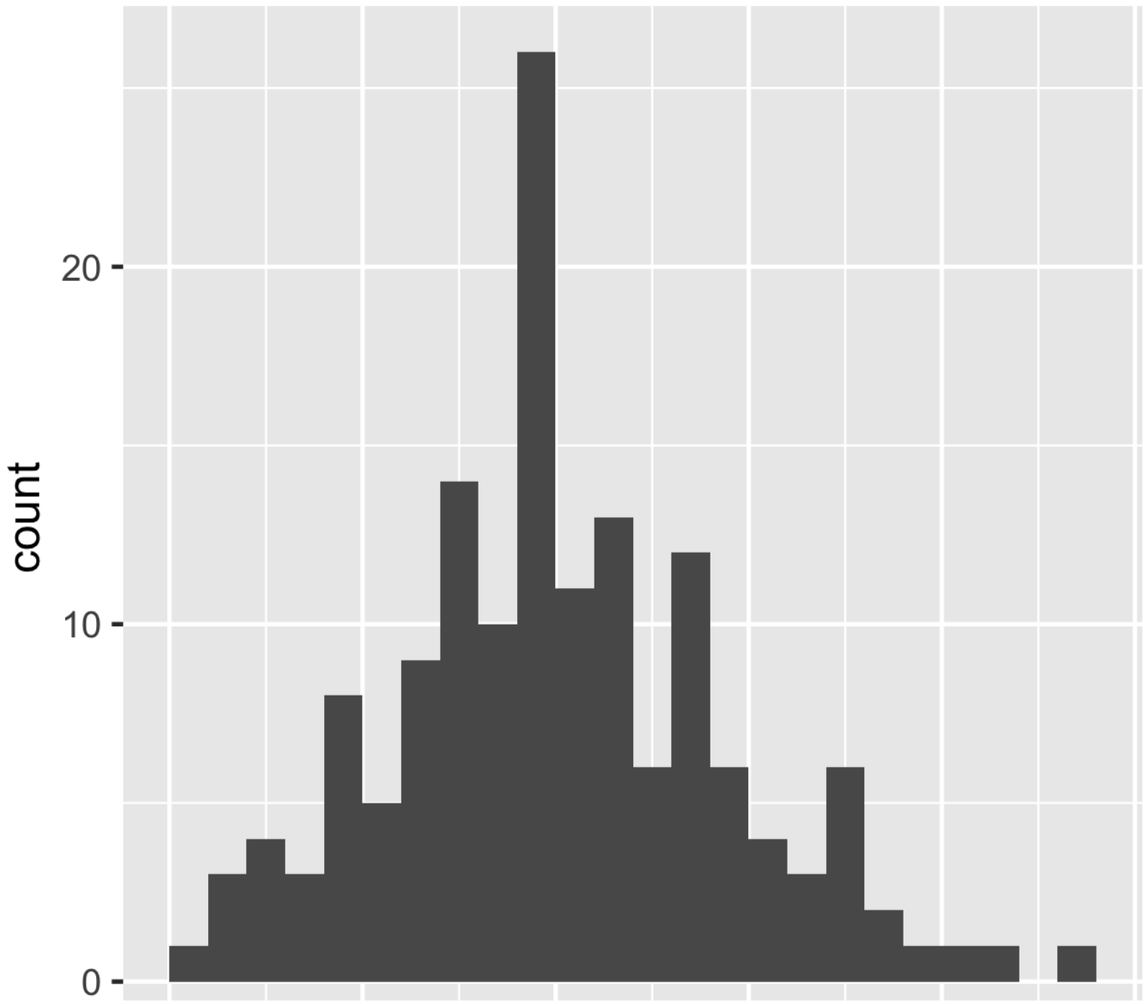
- Always set a meaningful bin widths for your data.
- No spaces between bars.



Re-position tick marks

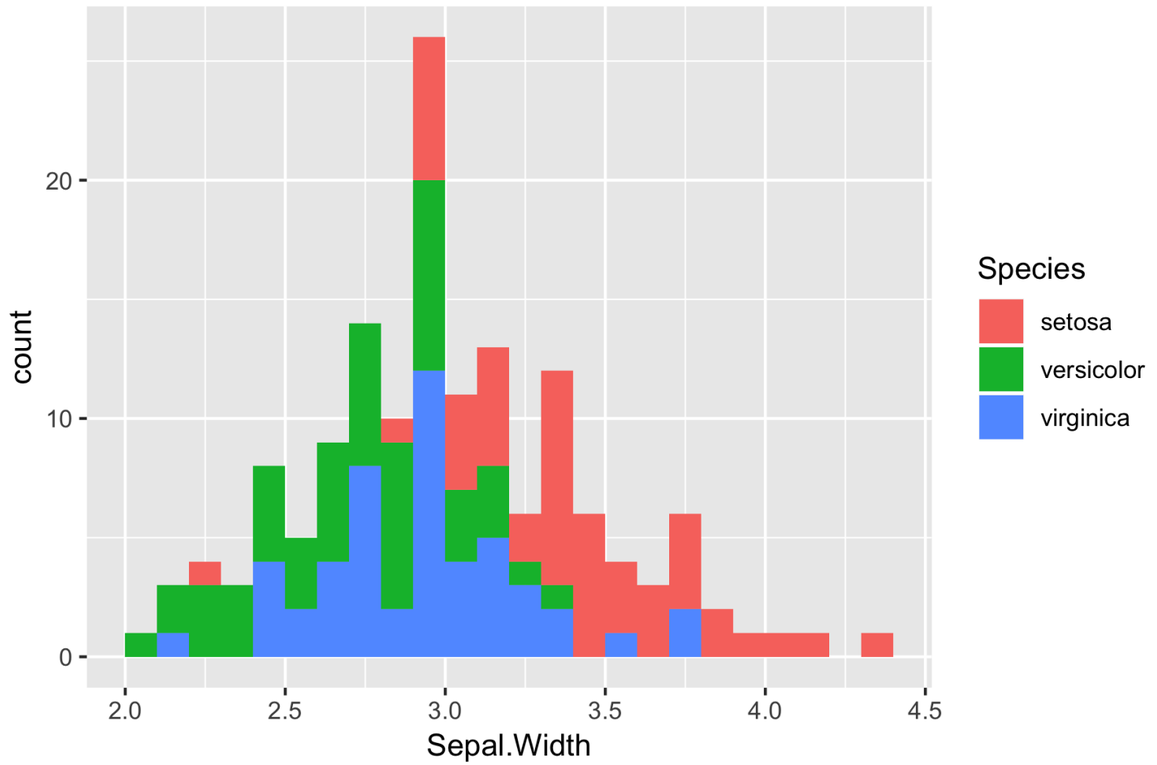
```
ggplot(iris, aes(x = Sepal.Width)) +
  geom_histogram(binwidth = 0.1,
                 center = 0.05)
```

- Always set a meaningful bin widths for your data.
- No spaces between bars.
- X axis labels are between bars.



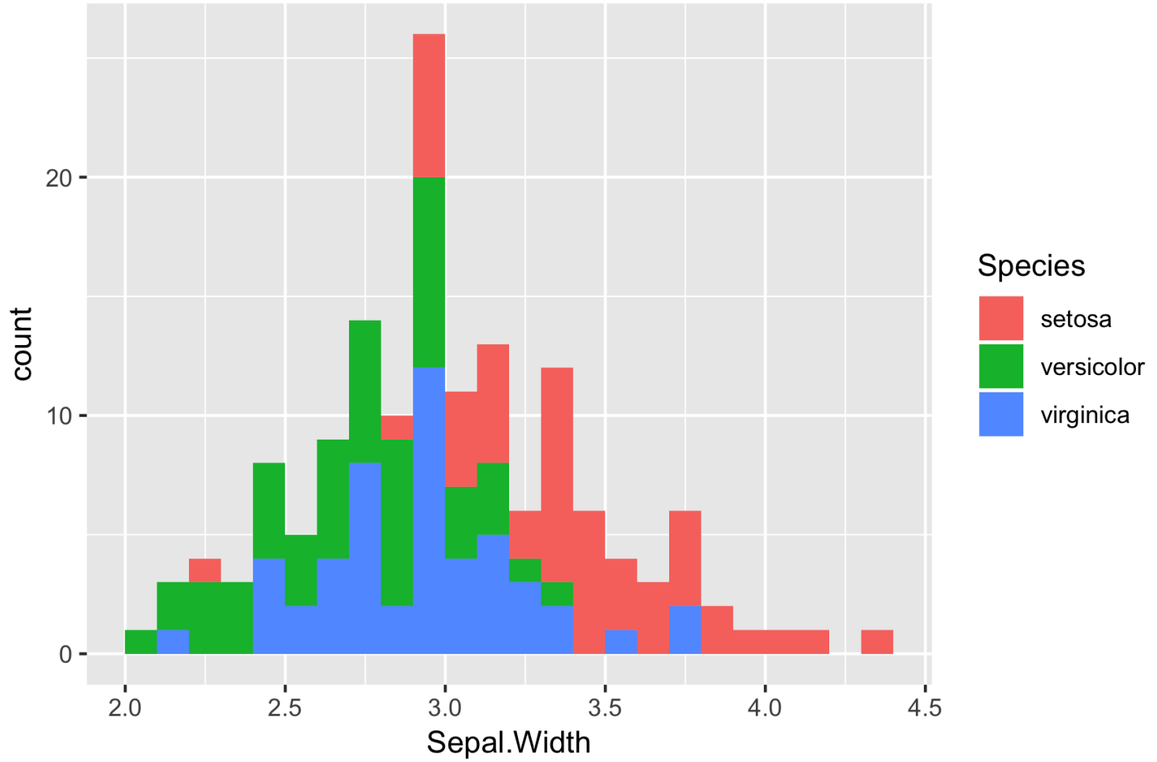
Different Species

```
ggplot(iris, aes(x = Sepal.Width,
                 fill = Species)) +
  geom_histogram(binwidth = .1,
                 center = 0.05)
```



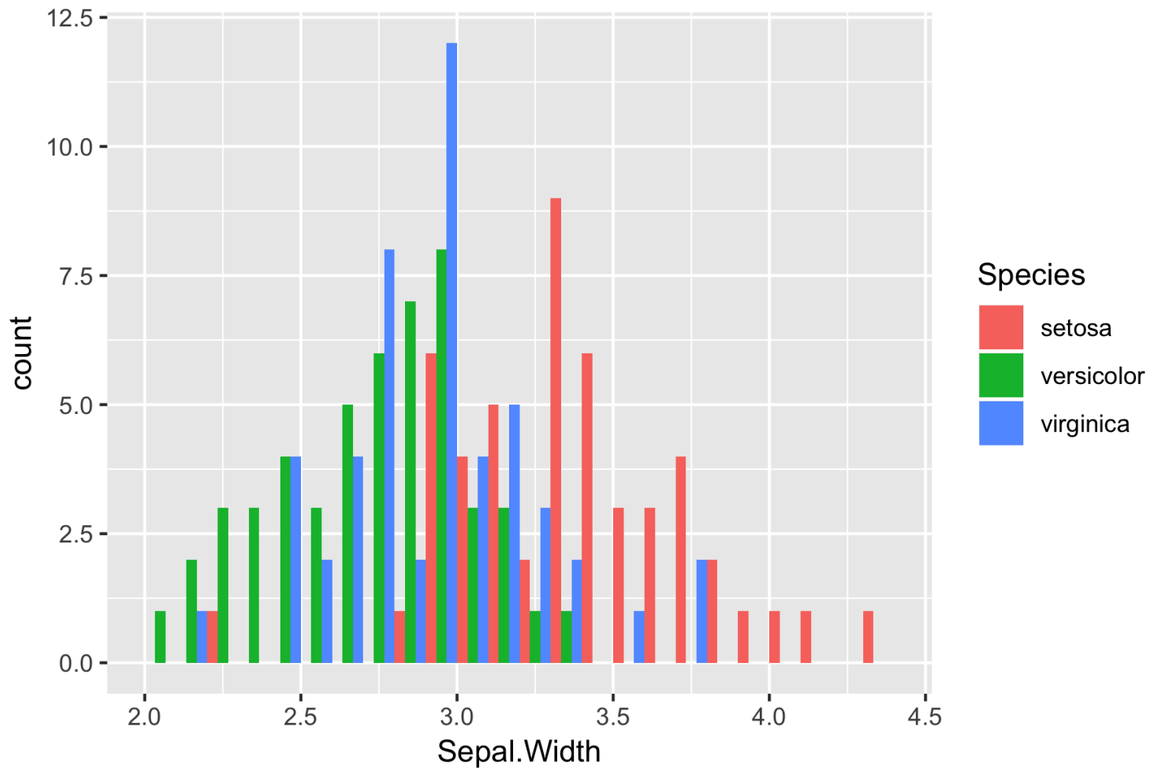
Default position is "stack"

```
ggplot(iris, aes(x = Sepal.Width,
                 fill = Species)) +
  geom_histogram(binwidth = .1,
                 center = 0.05,
                 position = "stack")
```



position = "dodge"

```
ggplot(iris, aes(x = Sepal.Width,
                 fill = Species)) +
  geom_histogram(binwidth = .1,
                 center = 0.05,
                 position = "dodge")
```



position = "fill"

```
ggplot(iris, aes(x = Sepal.Width, fill = S
  geom_histogram(binwidth = .1, center = 0
```

Final Slide

INTRODUCTION TO DATA VISUALIZATION WITH GGPLOT2

Bar plots

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Bar Plots, with a categorical X-axis

- Use geom_bar() or geom_col()

Geom	Stat	Action
`geom_bar()`	"count"	Counts the number of cases at each x position
`geom_col()`	"identity"	Plot actual values

  - All positions from before are available
  - Two types
    - Absolute counts
    - Distributions

Bar Plots, with a categorical X-axis

- Use geom_bar() or geom_col()

Geom	Stat	Action
`geom_bar()`	"count"	Counts the number of cases at each x position
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Bar Plots, with a categorical X-axis

- Use geom_bar() or geom_col()

Geom	Stat	Action
`geom_bar()`	"count"	Counts the number of cases at each x position
`geom_col()`	"identity"	Plot actual values

  - All positions from before are available
  - Two types
    - Absolute counts
    - Distributions

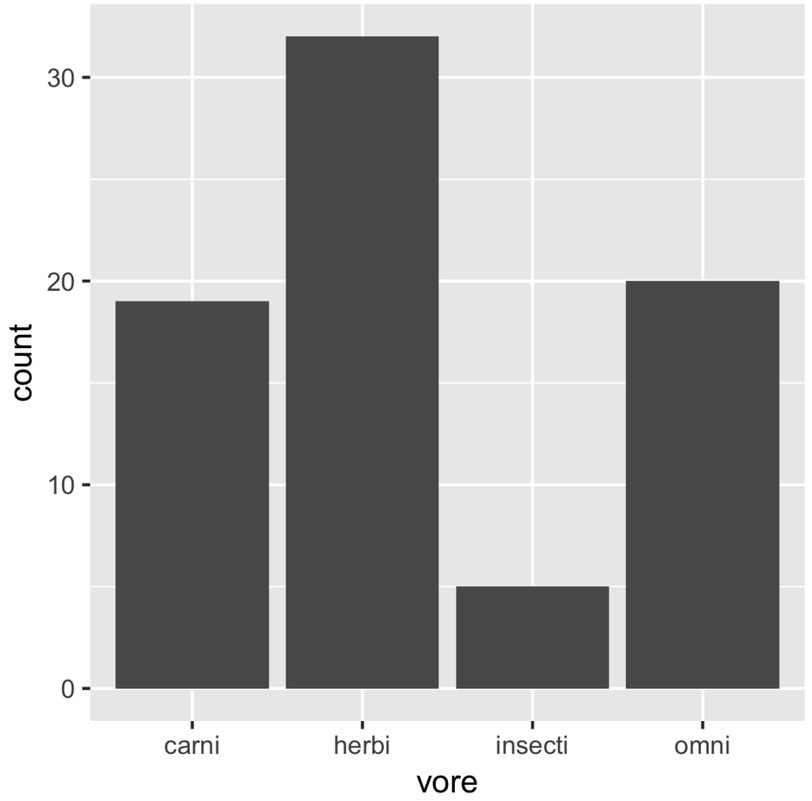
Habits of mammals

```
str(sleep)
```

```
'data.frame':    76 obs. of  3 variables:
 $ vore : Factor w/ 4 levels "carni","herbi",..: 1 4 2 4 2 2 1 1 2 2 ...
 $ total: num  12.1 17 14.4 14.9 4 14.4 8.7 10.1 3 5.3 ...
 $ rem  : num  NA 1.8 2.4 2.3 0.7 2.2 1.4 2.9 NA 0.6 ...
```

Bar plot

```
ggplot(sleep, aes(vore)) +
  geom_bar()
```



Plotting distributions instead of absolute counts

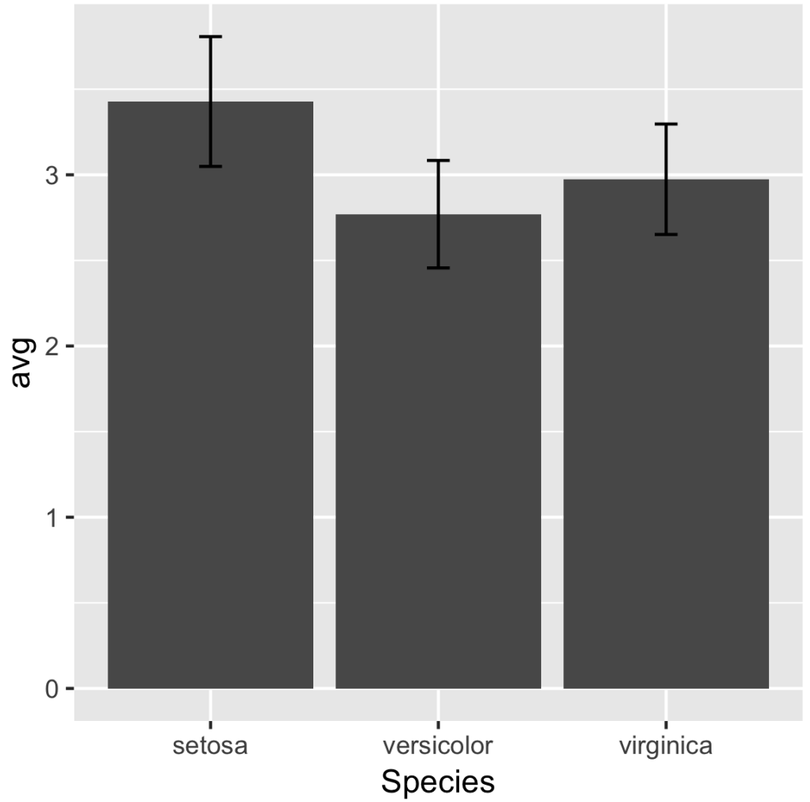
```
# Calculate Descriptive Statistics:
iris %>%
  select(Species, Sepal.Width) %>%
  gather(key, value, -Species) %>%
  group_by(Species) %>%
  summarise(avg = mean(value),
            stdev = sd(value))
   -> iris_summ_long
```

```
iris_summ_long
```

Species	avg	stdev
setosa	3.43	0.38
versicolor	2.77	0.31
virginica	2.97	0.32

Plotting distributions

```
ggplot(iris_summ_long, aes(x = Species,
                           y = avg)) +
  geom_col() +
  geom_errorbar(aes(ymin = avg - stdev,
                    ymax = avg + stdev),
                width = 0.1)
```



Let's practice!

INTRODUCTION TO DATA VISUALIZATION WITH GGPLOT2

Line plots

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Common plot types

Plot type	Possible Geoms
Scatter plots	points, jitter, abline, smooth, count
Bar plots	histogram, bar, col, errorbar
Line plots	**line, path**

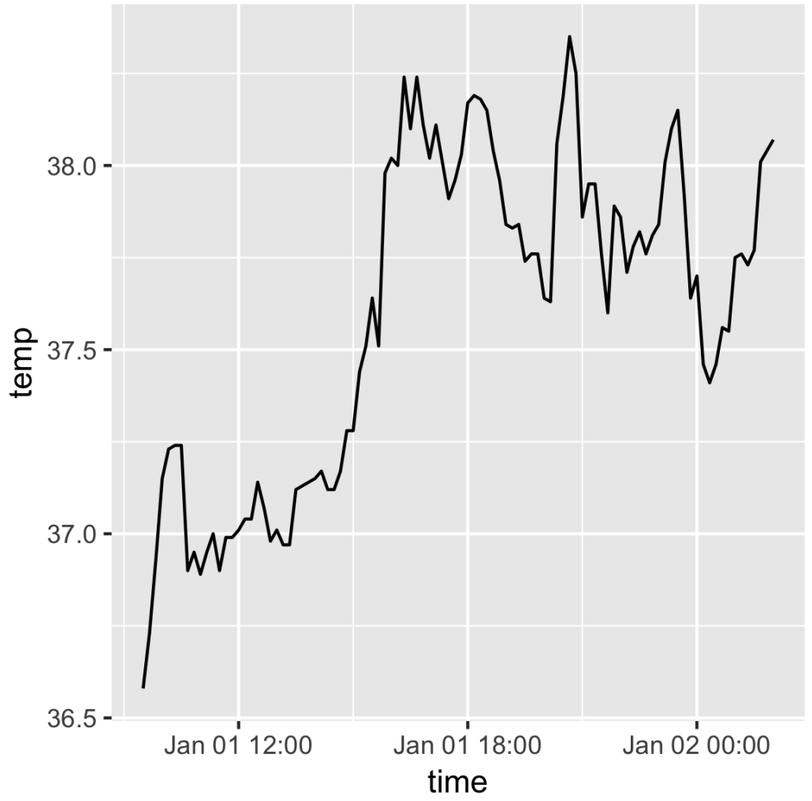
Beaver

```
str(beaver)
```

```
'data.frame':    101 obs. of  3 variables:
 $ time  : POSIXct, format: "2000-01-01 09:30:00" "2000-01-01 09:40:00" "2000-01-01 09:5
 $ temp  : num  36.6 36.7 36.9 37.1 37.2 ...
 $ active: Factor w/ 2 levels "0","1": 1 1 1 1 1 1 1 1 1 1 ...
```

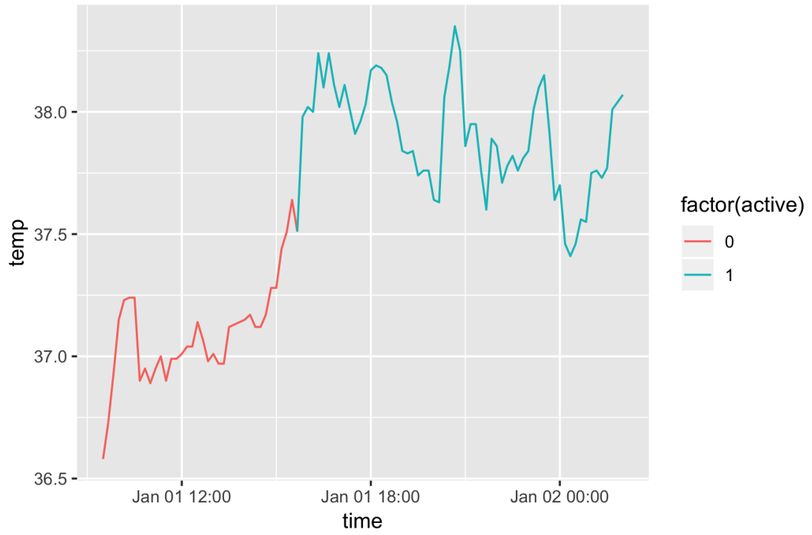
Beaver

```
ggplot(beaver, aes(x = time, y = temp)) +
  geom_line()
```



Beaver

```
ggplot(beaver, aes(x = time, y = temp,
                   color = factor(active))
                   ) +
  geom_line()
```



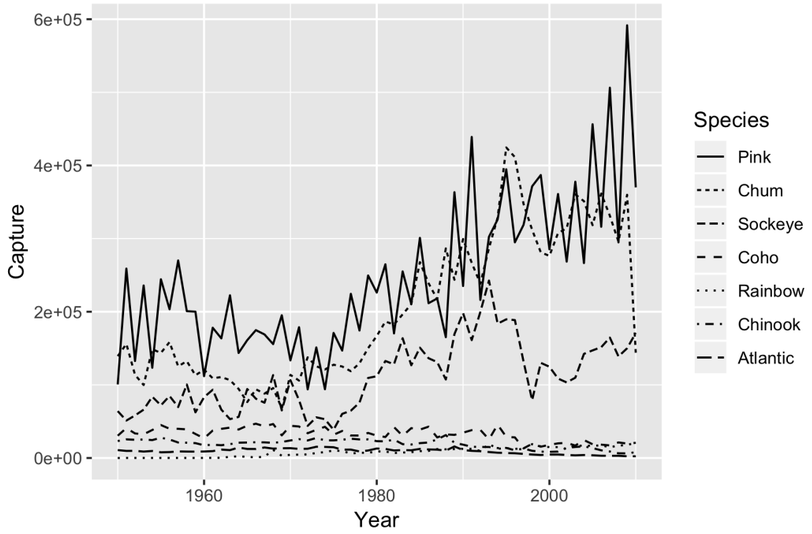
The fish catch dataset

```
str(fish)
```

```
'data.frame':    427 obs. of  3 variables:
 $ Species: Factor w/ 7 levels "Pink","Chum",..: 1 2 3 4 5 6 7 1 2 3 ...
 $ Year   : int  1950 1950 1950 1950 1950 1950 1950 1951 1951 1951 ...
 $ Capture: int  100600 139300 64100 30500 0 23200 10800 259000 155900 51200 ...
```

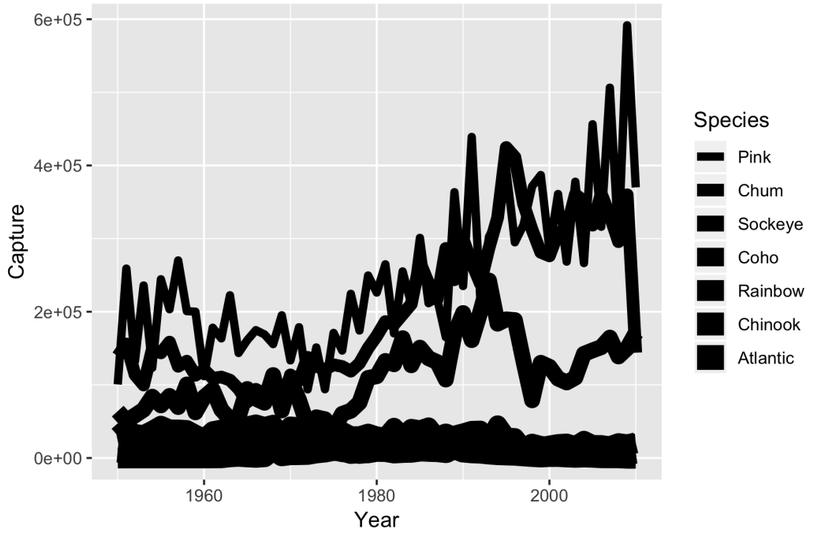
Linetype aesthetic

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 linetype = Species)) +
  geom_line()
```



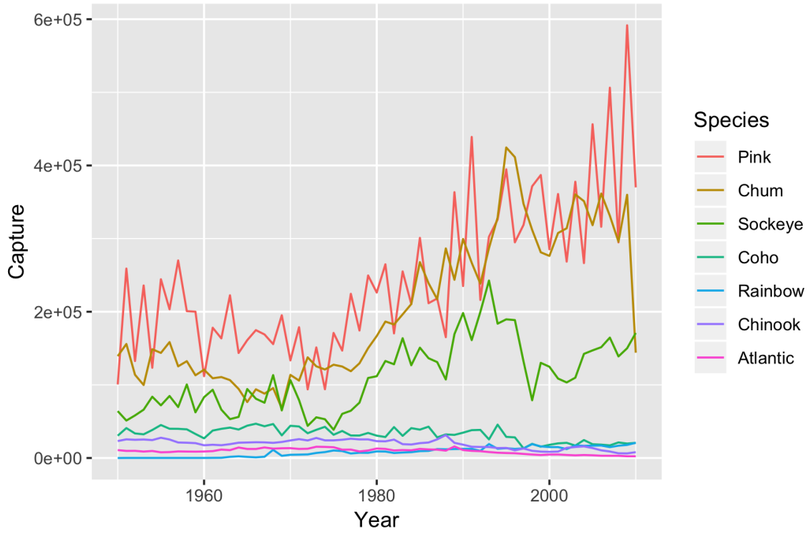
Size aesthetic

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 size = Species)) +
  geom_line()
```

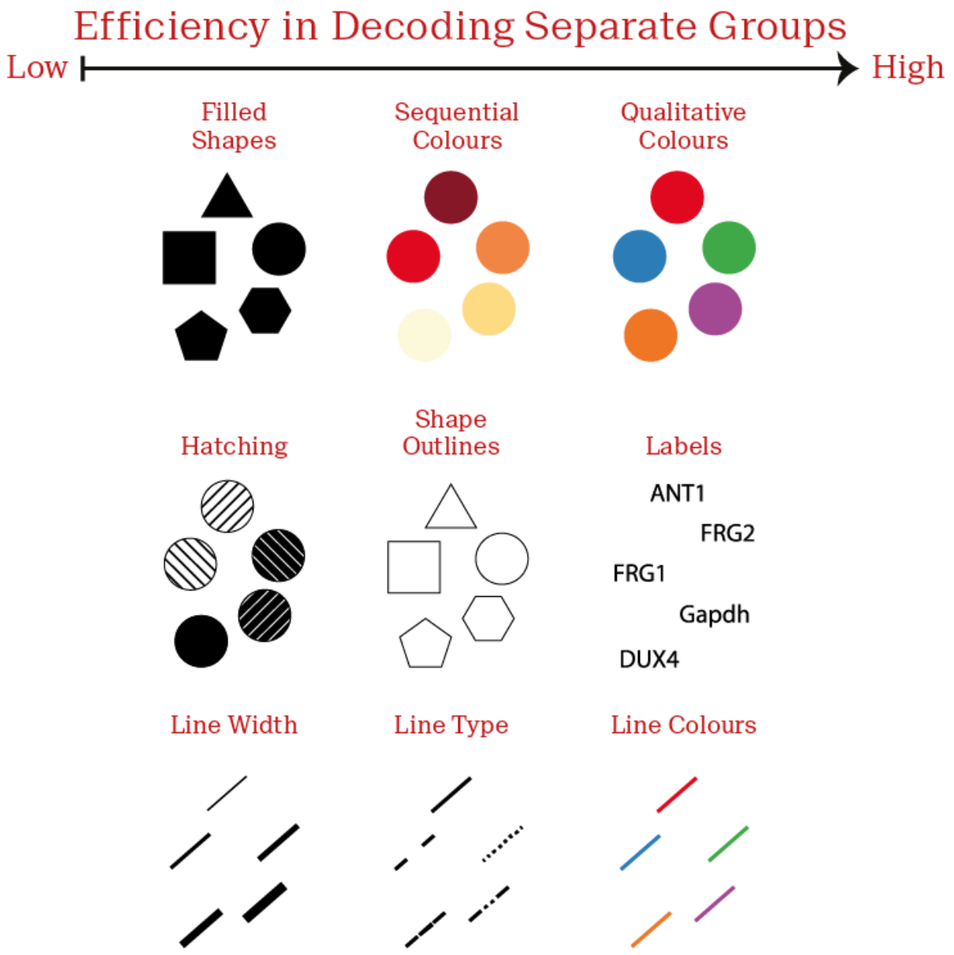


Color aesthetic

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 color = Species)) +
  geom_line()
```

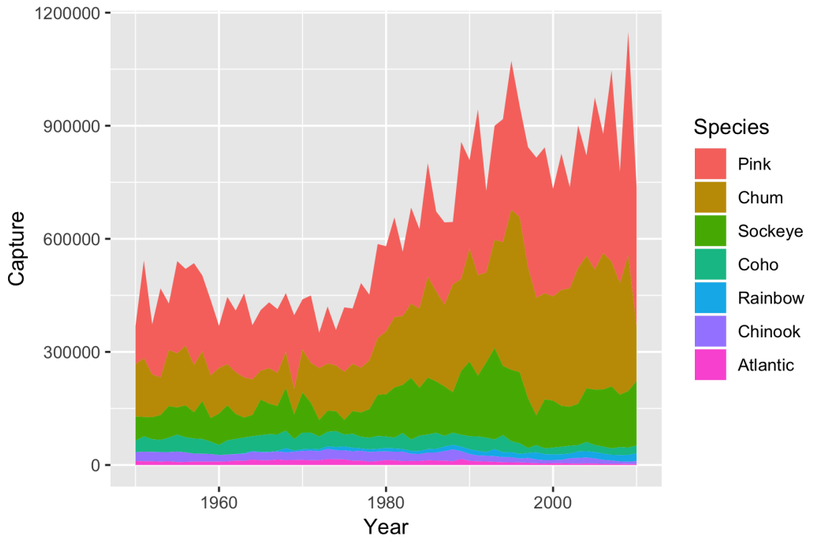


Aesthetics for categorical variables



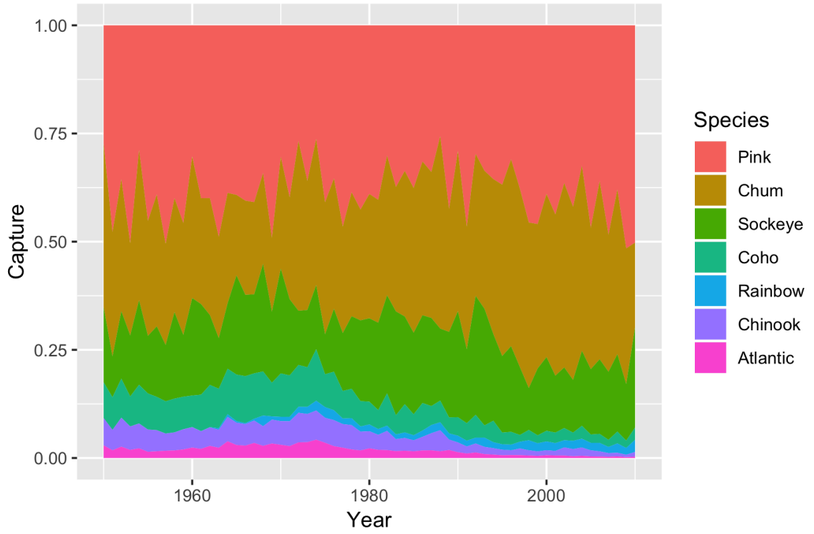
Fill aesthetic with geom_area()

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 fill = Species)) +
  geom_area()
```



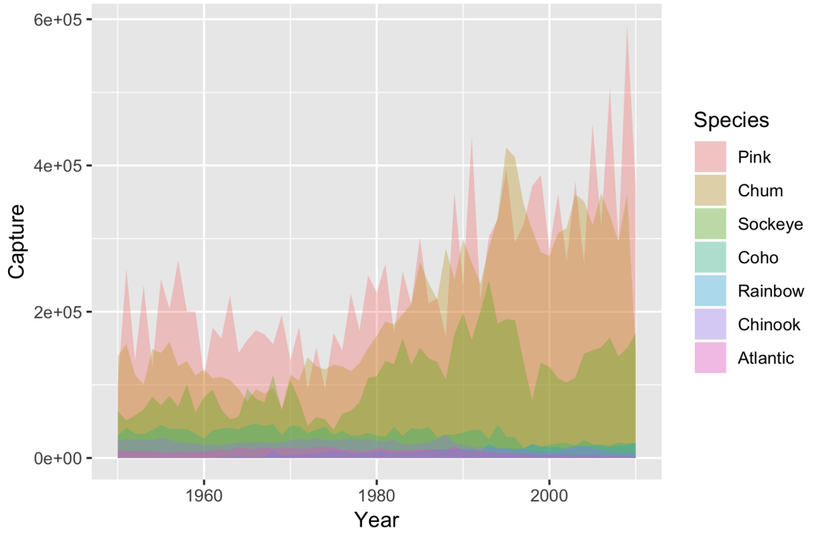
Using position = "fill"

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 fill = Species)) +
  geom_area(position = "fill")
```



geom_ribbon()

```
ggplot(fish, aes(x = Year,
                 y = Capture,
                 fill = Species)) +
  geom_ribbon(aes(ymax = Capture,
                  ymin = 0),
              alpha = 0.3)
```



Let's practice!

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