# Color scales

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# Uses of color in data visualization

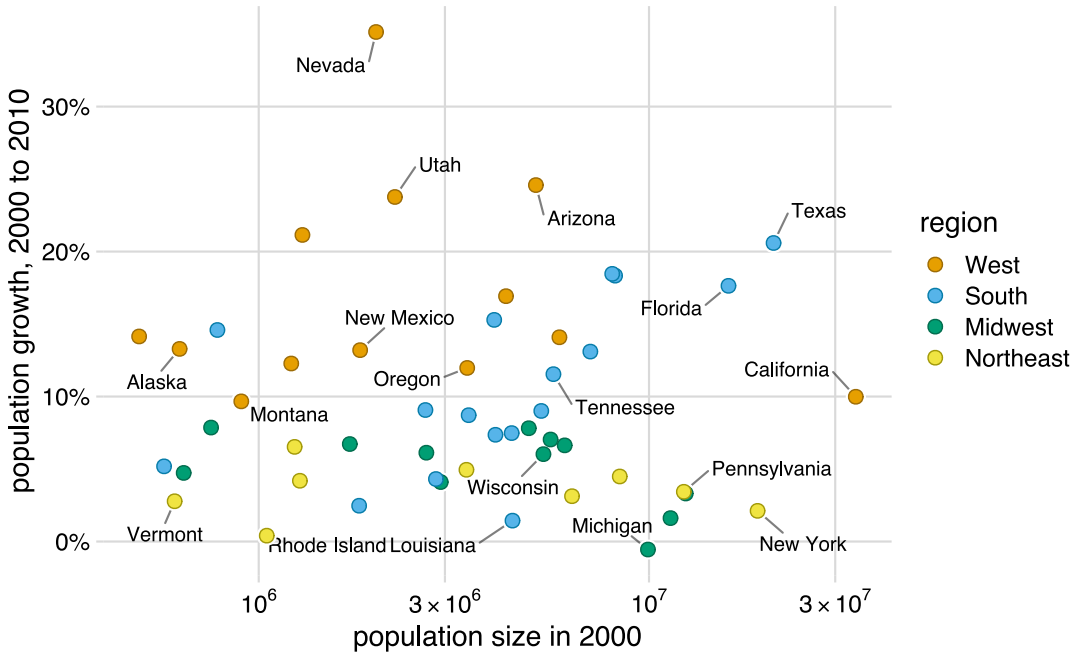
**Color should not create the order.**

1. Distinguish

categories

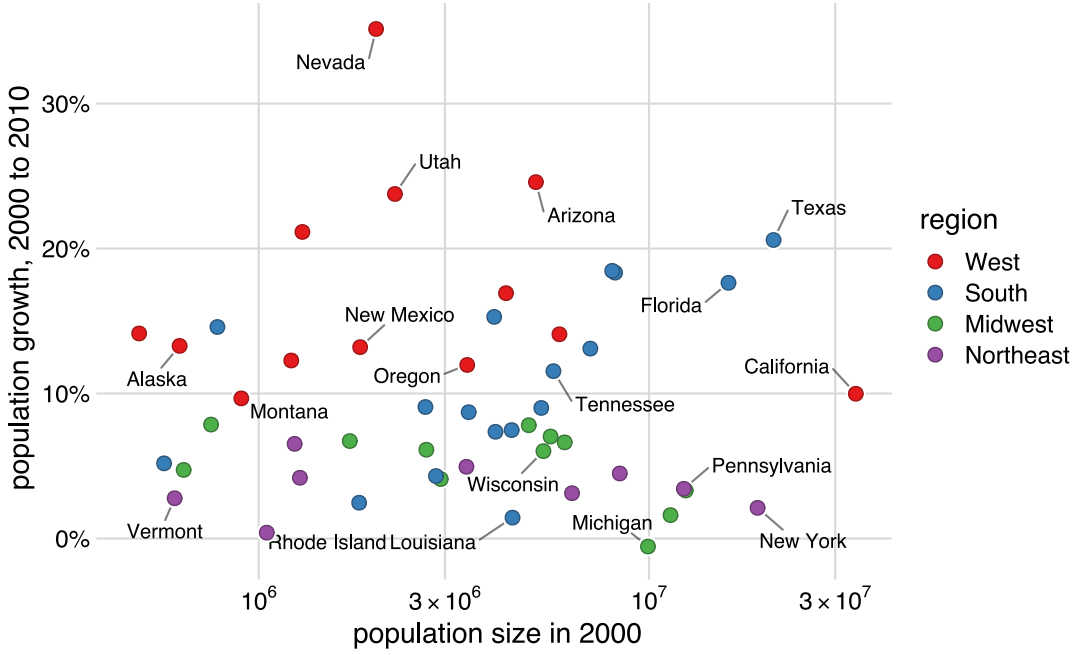
(qualitative)

# Qualitative scale example



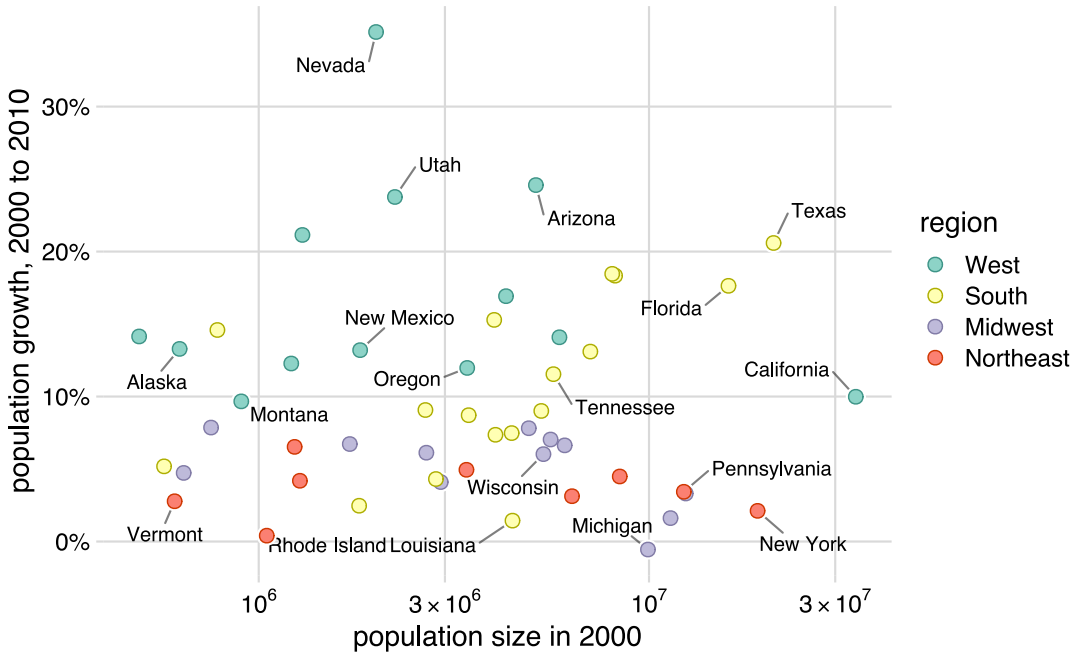

Palette name: Okabe-Ito

# Qualitative scale example




Palette name: ColorBrewer Set1

# Qualitative scale example



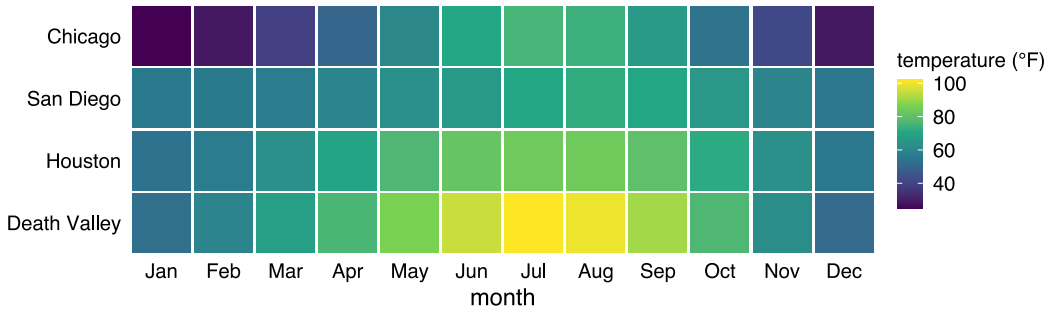

Palette name: ColorBrewer Set3

# Uses of color in data visualization

1. Distinguish categories (qualitative)

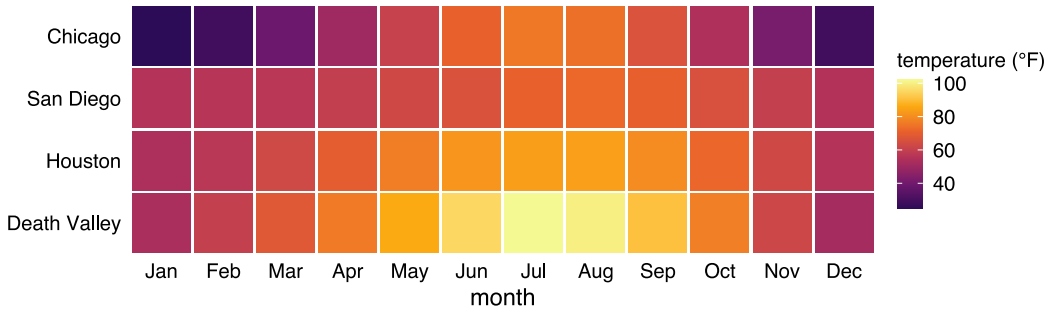
2. Represent numeric values (sequential)

# Sequential scale example



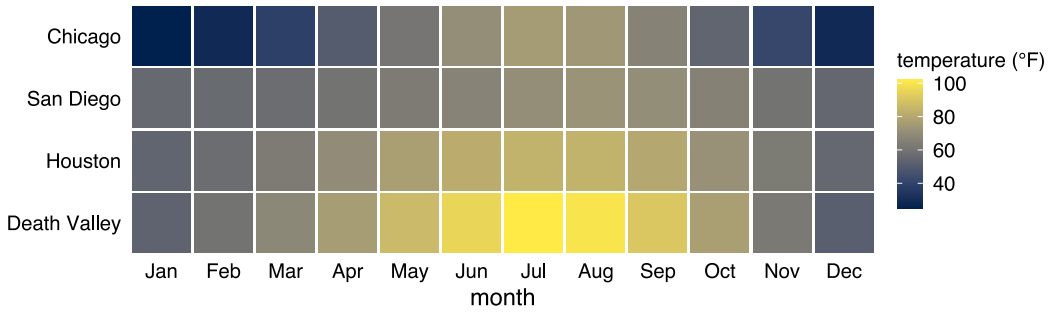

Palette name: Viridis

# Sequential scale example




Palette name: Inferno

# Sequential scale example



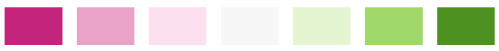

Palette name: Cividis

# Uses of color in data visualization

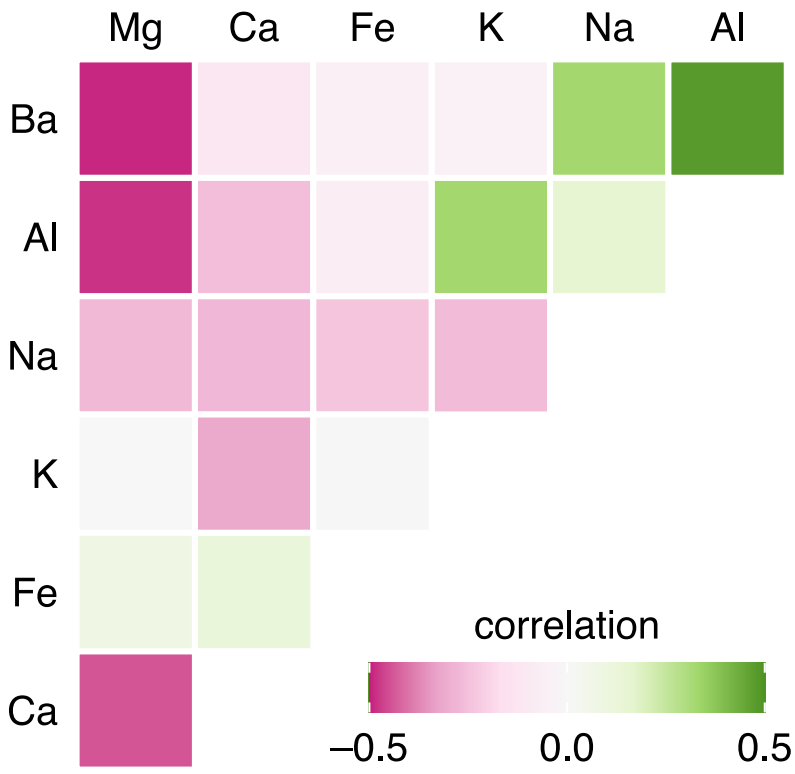
1. Distinguish categories (qualitative)

2. Represent numeric values (sequential)

3. Represent numeric values (diverging)

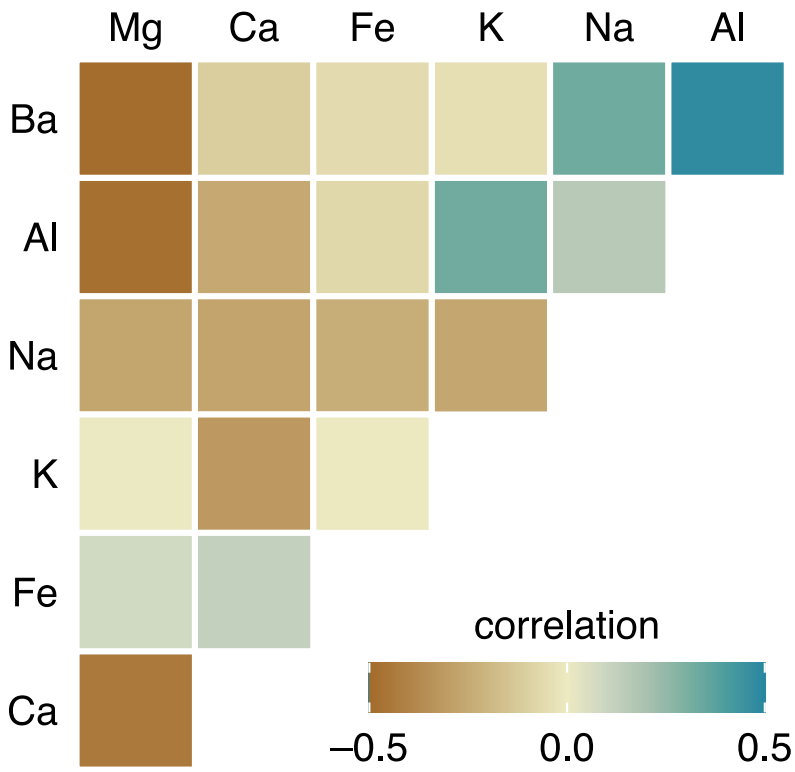


# Diverging scale example



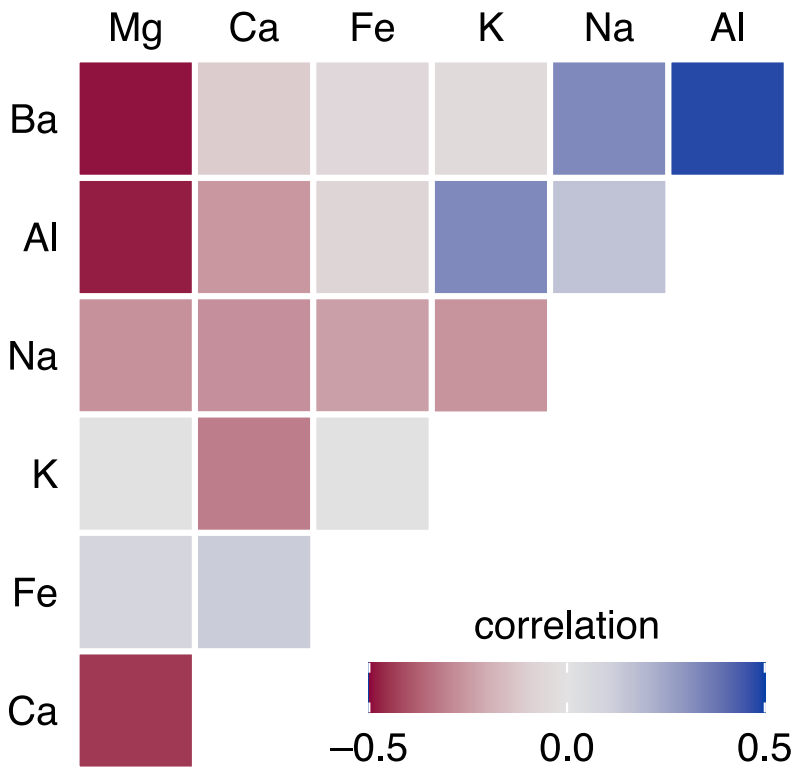

Palette name: ColorBrewer PiYG

# Diverging scale example




Palette name: Carto Earth

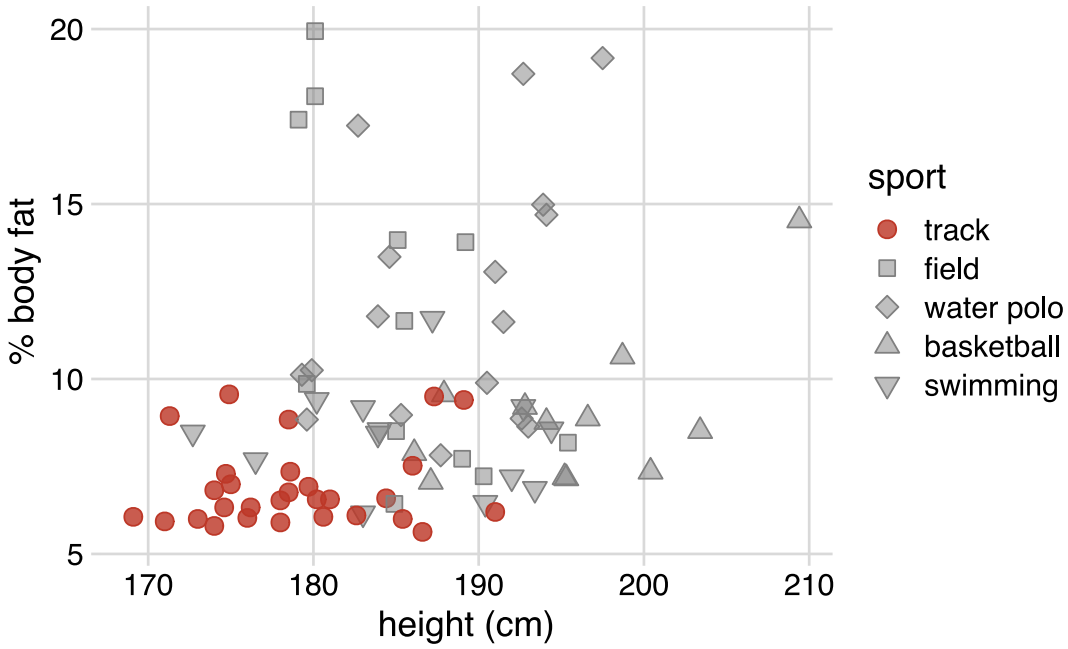
# Diverging scale example




Palette name: Blue-Red

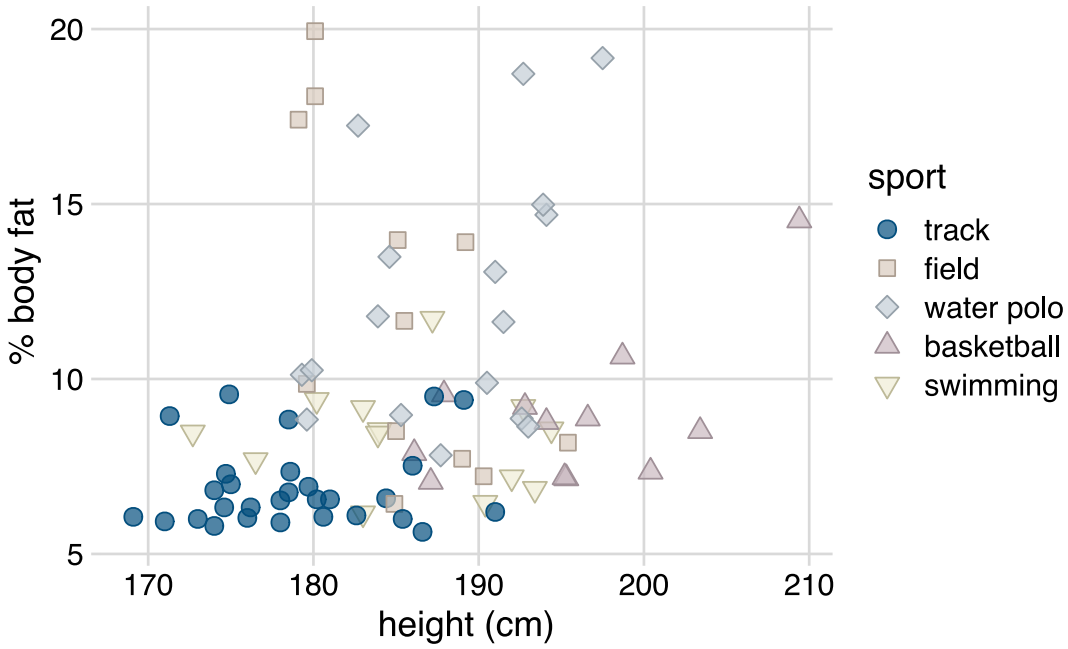
# Uses of color in data visualization

# Highlight example



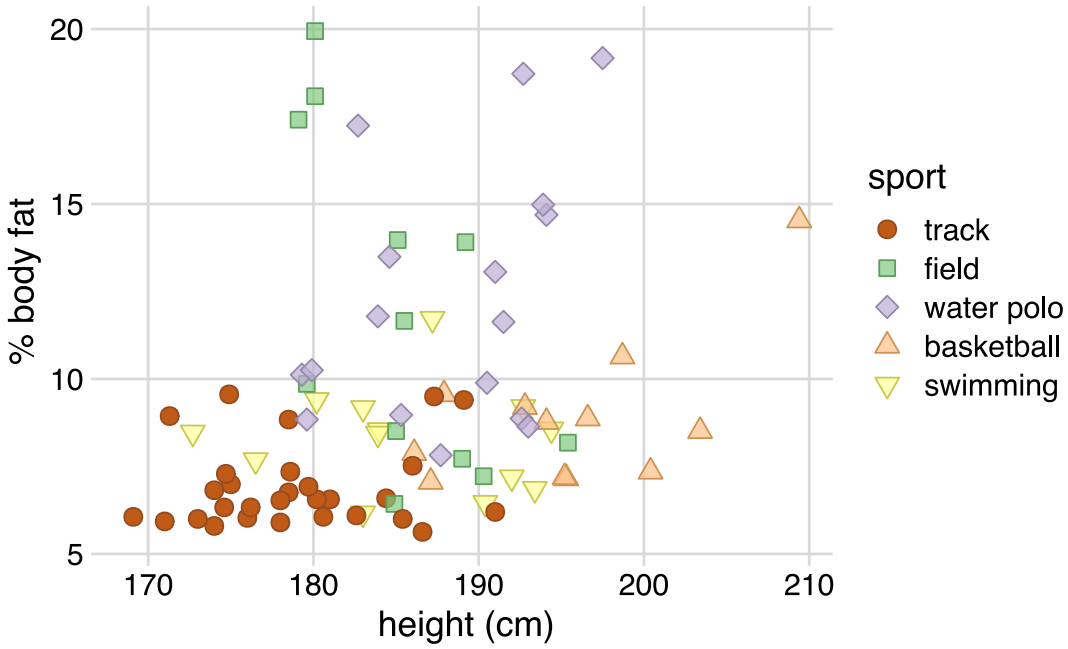

Palette name: Grays with accents

# Highlight example




Palette name: Okabe-Ito accent

# Highlight example




Palette name: ColorBrewer accent

# ggplot2 color scale functions are a bit of a mess

| Scale function | Aesthetic | Data type | Palette type |
|---|---|---|---|
| `scale_color_hue()` | `color` | discrete | qualitative |

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|---|---|---|---|
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| `scale_color_gradient()` | `color` | continuous | sequen |

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|---|---|---|---|
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| `scale_color_gradient2()` | `color` | continuous | diverg |

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|---|---|---|---|
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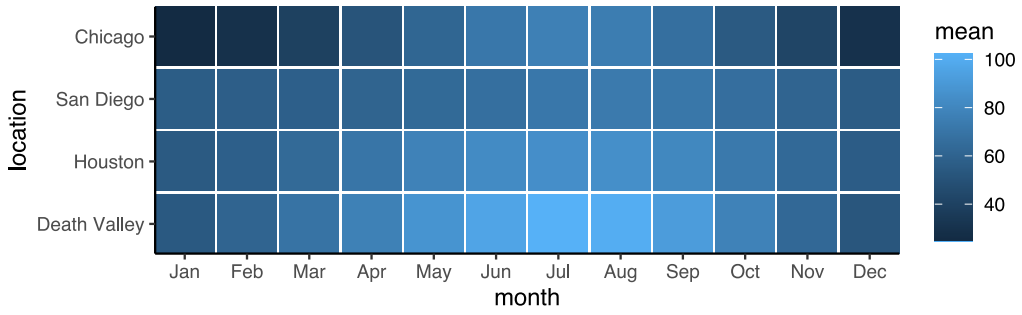
| `scale_color_gradient()` | `color` | continuous | seque |
| `scale_color_gradient2()` | `color` | continuous | diverg |
| `scale_fill_virids_c()` | `color` | continuous | seque |
| `scale_fill_virids_d()` | `fill` | discrete | seque |
| `scale_color_brewer()` | `color` | discrete | qualit seque |
| `scale_fill_brewer()` | `fill` | discrete | qualit seque |
| `scale_color_distiller()` | `color` | continuous | qualit seque |

... and there are many many more

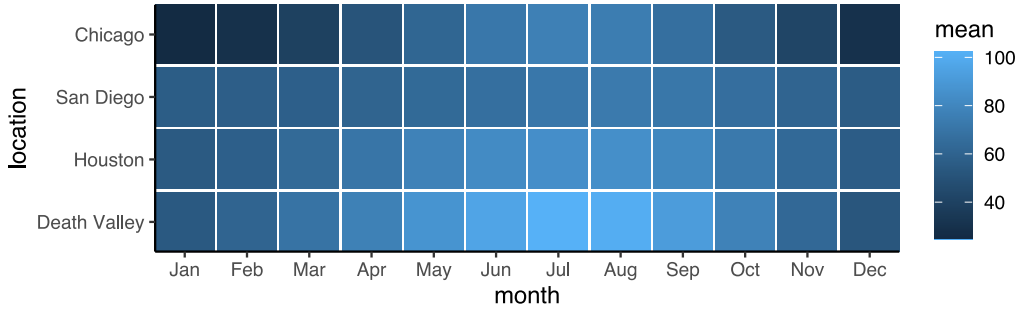
# Examples

```
ggplot(temps_months, aes(x = month, y
  geom_tile(width = 0.95, height = 0.9
  coord_fixed(expand = FALSE) +
  theme_classic()
  # no fill scale defined, default is
```



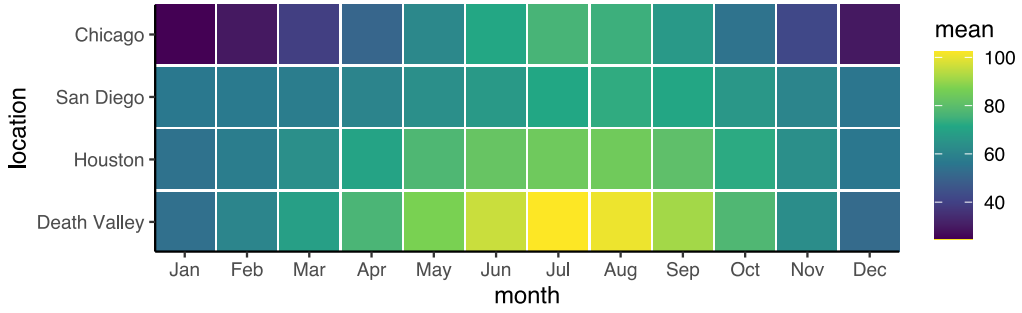
# Examples

```
ggplot(temps_months, aes(x = month, y
  geom_tile(width = 0.95, height = 0.9
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_gradient()
```



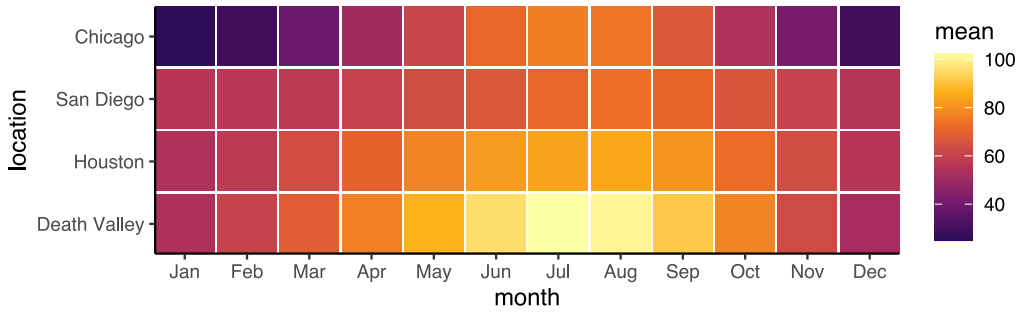
# Examples

```
ggplot(temps_months, aes(x = month, y
  geom_tile(width = 0.95, height = 0.9
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_viridis_c()
```



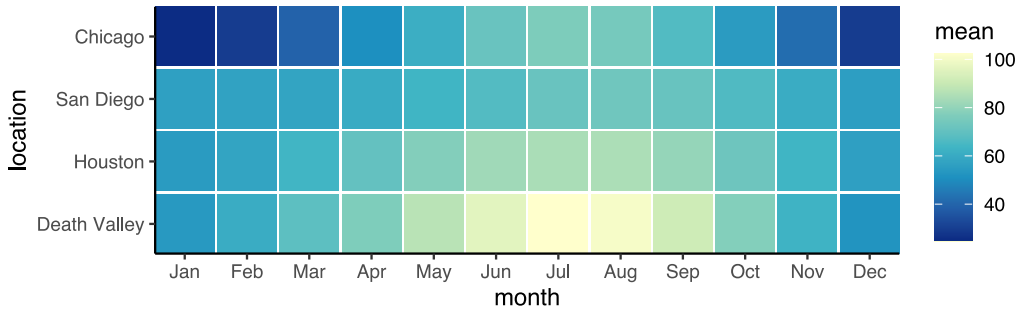
# Examples

```
ggplot(temps_months, aes(x = month, y
  geom_tile(width = 0.95, height = 0.9
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_viridis_c(option = "B", b
```



# Examples

```
ggplot(temps_months, aes(x = month, y
  geom_tile(width = 0.95, height = 0.9
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_distiller(palette = "YlGn
```



# The colorspace package creates some order

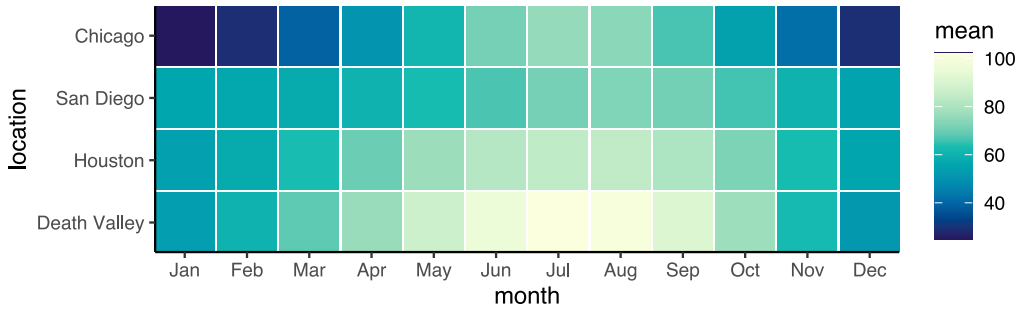
Scale name: `scale_<aesthetic>_<datatype>_<colorscale>()`

- `<aesthetic>`: name of the aesthetic (`fill`, `color`, `colour`)
- `<datatype>`: type of variable plotted (`discrete`, `continuous`, `binned`)
- `colorscale`: type of the color scale (`qualitative`, `sequential`, `diverging`, `divergingx`

| Scale function | Aesthetic | Dat |
|---|---|---|
| `scale_color_discrete_qualitative()` | `color` | disc |
| `scale_fill_continuous_sequential()` | `fill` | con |
| `scale_colour_continous_divergingx()` | `colour` | con |

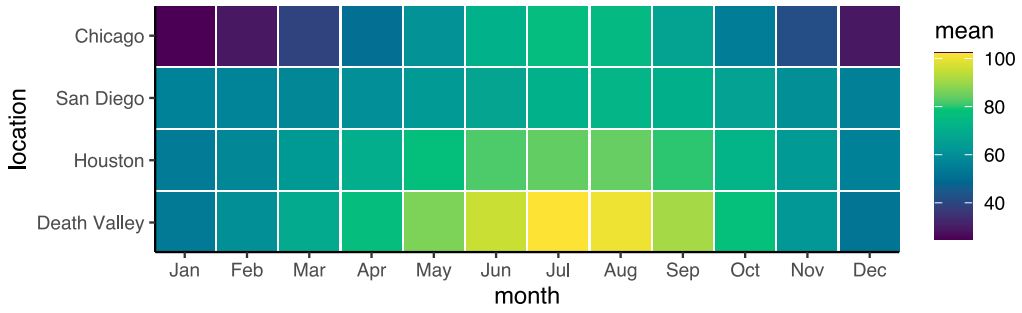
# Examples

```
ggplot(temps_months, aes(x = month, y = location,
  geom_tile(width = 0.95, height = 0.95) +
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_continuous_sequential(palette = "YlGr
```



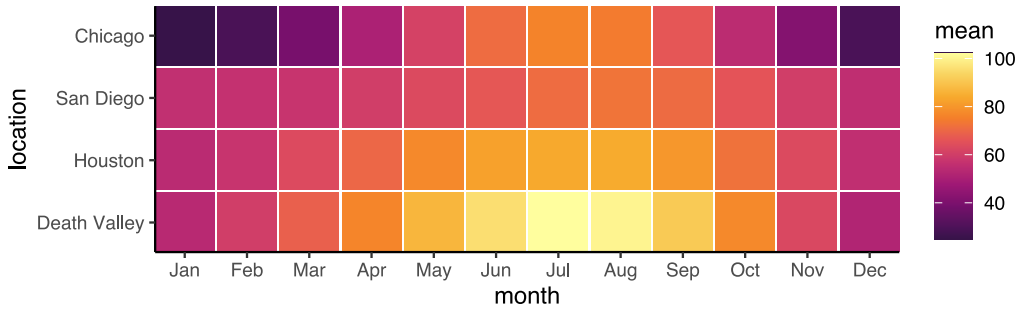
# Examples

```
ggplot(temps_months, aes(x = month, y = location,
  geom_tile(width = 0.95, height = 0.95) +
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_continuous_sequential(palette = "Vir
```



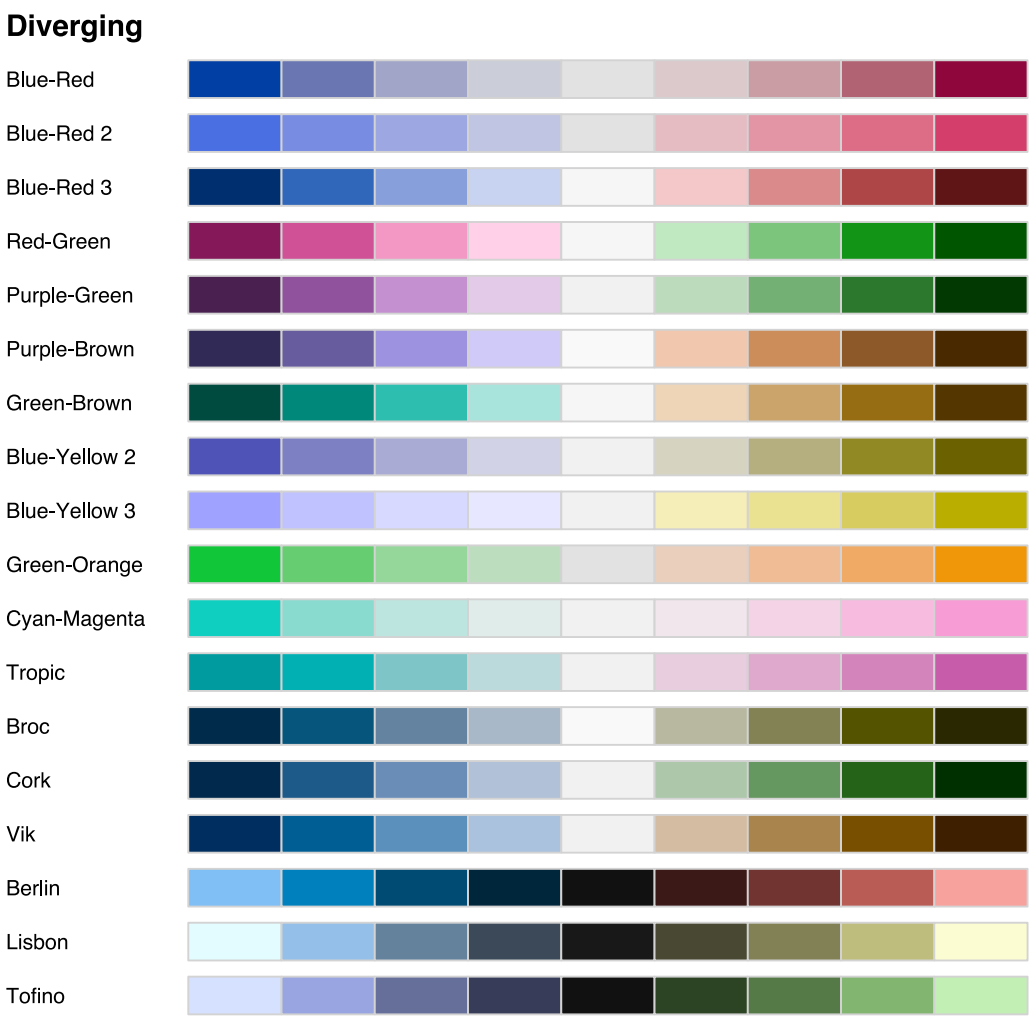
# Examples

```
ggplot(temps_months, aes(x = month, y = location,
  geom_tile(width = 0.95, height = 0.95) +
  coord_fixed(expand = FALSE) +
  theme_classic() +
  scale_fill_continuous_sequential(palette = "Infe
```

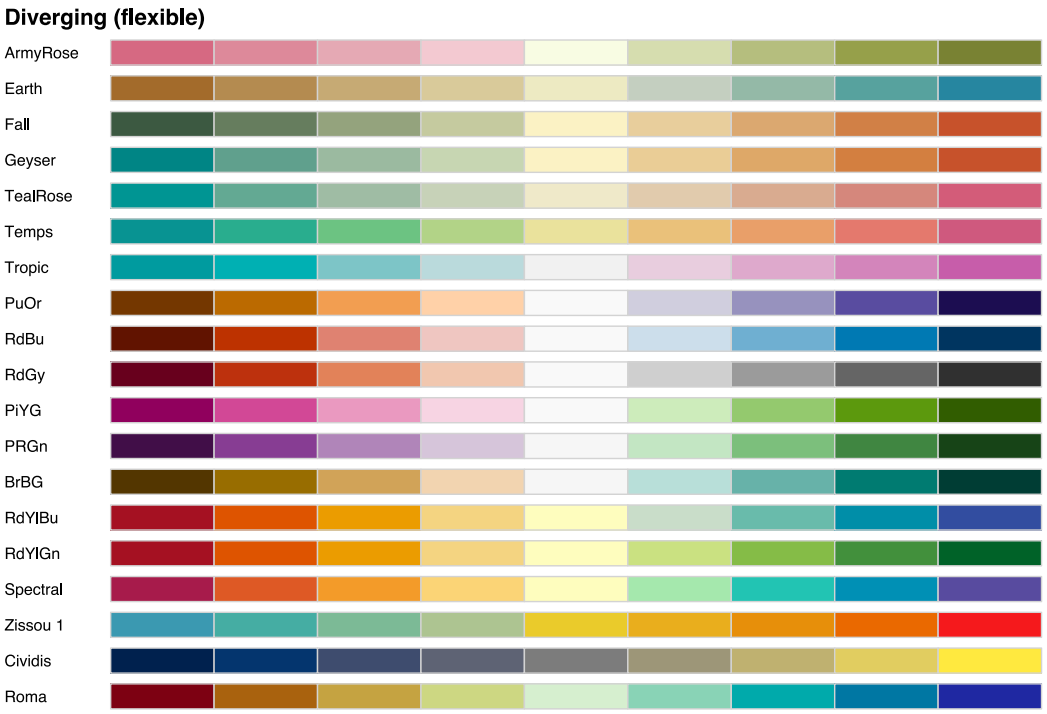


```
colorspace::hcl_palettes(type = "sequential", plot
```

```
colorspace::hcl_palettes(type = "diverging", plot
```

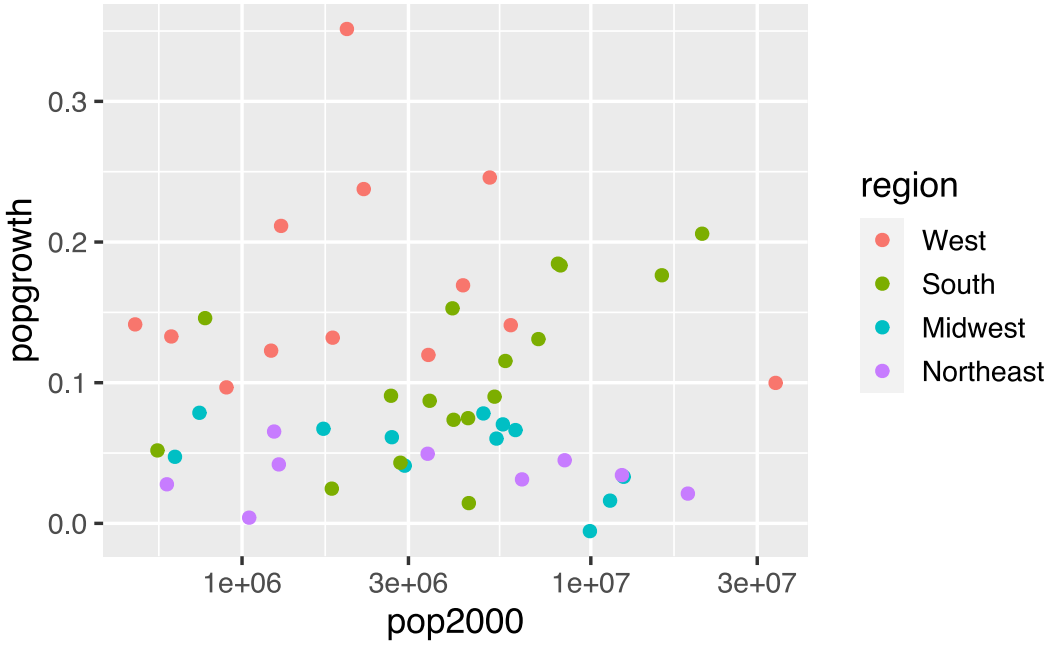


```
colorspace::divergingx_palettes(plot = TRUE, n = 9
```



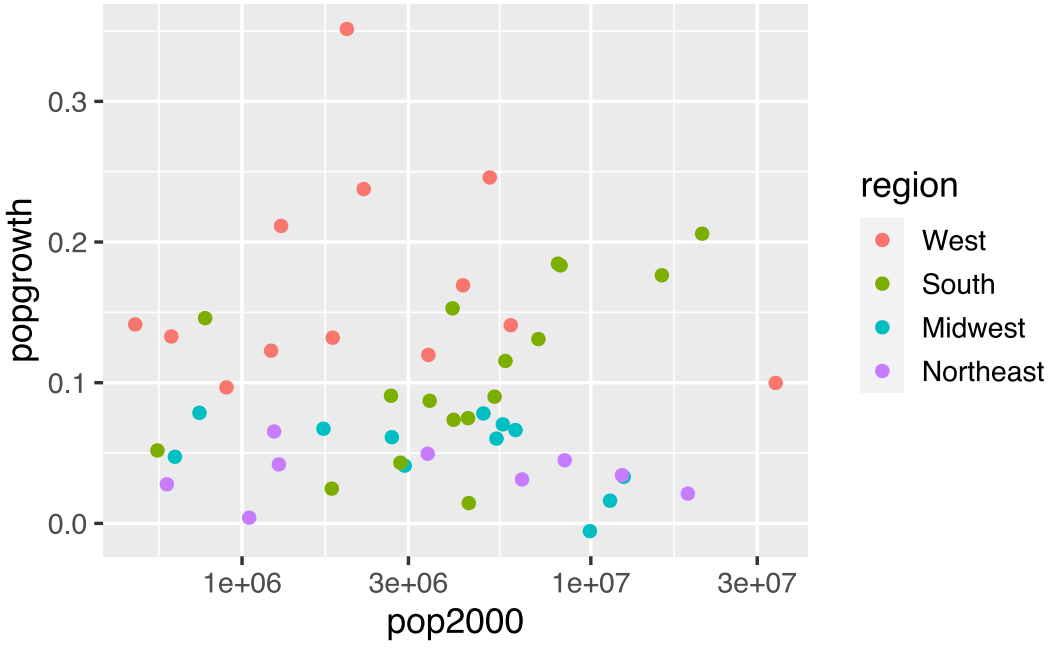
# Discrete, qualitative scales are best set manually

```
ggplot(popgrowth, aes(x = pop2000, y = popgrowth,
  geom_point() +
  scale_x_log10()
  # no color scale defined, default is scale_colo
```



# Discrete, qualitative scales are best set manually

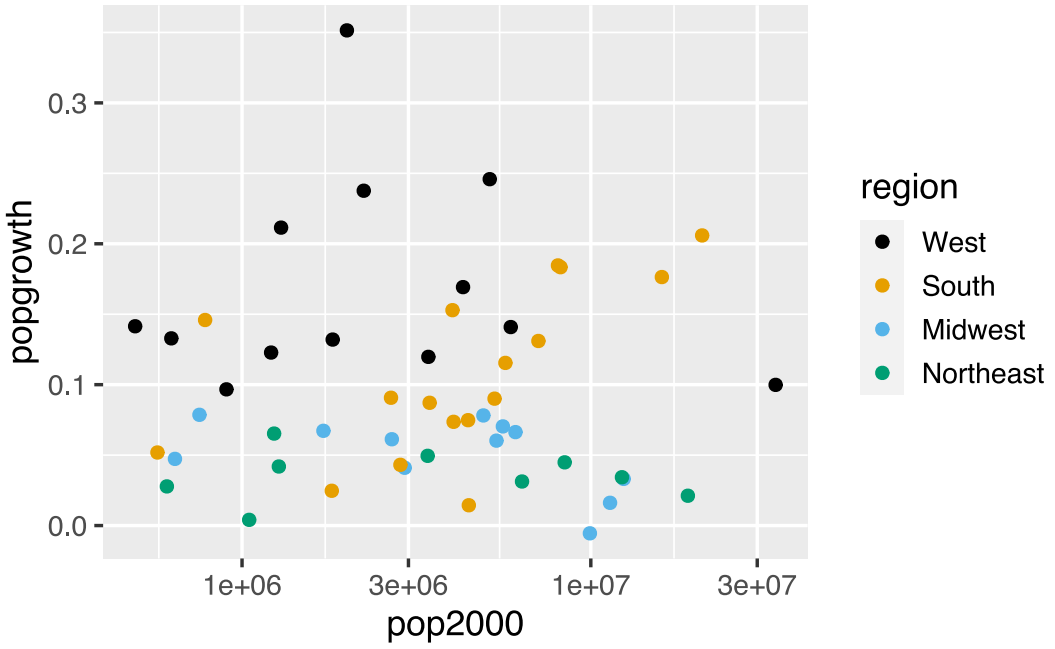
```
ggplot(popgrowth, aes(x = pop2000, y = popgrowth,
  geom_point() +
  scale_x_log10() +
  scale_color_hue()
```



# Discrete, qualitative scales are best set manually

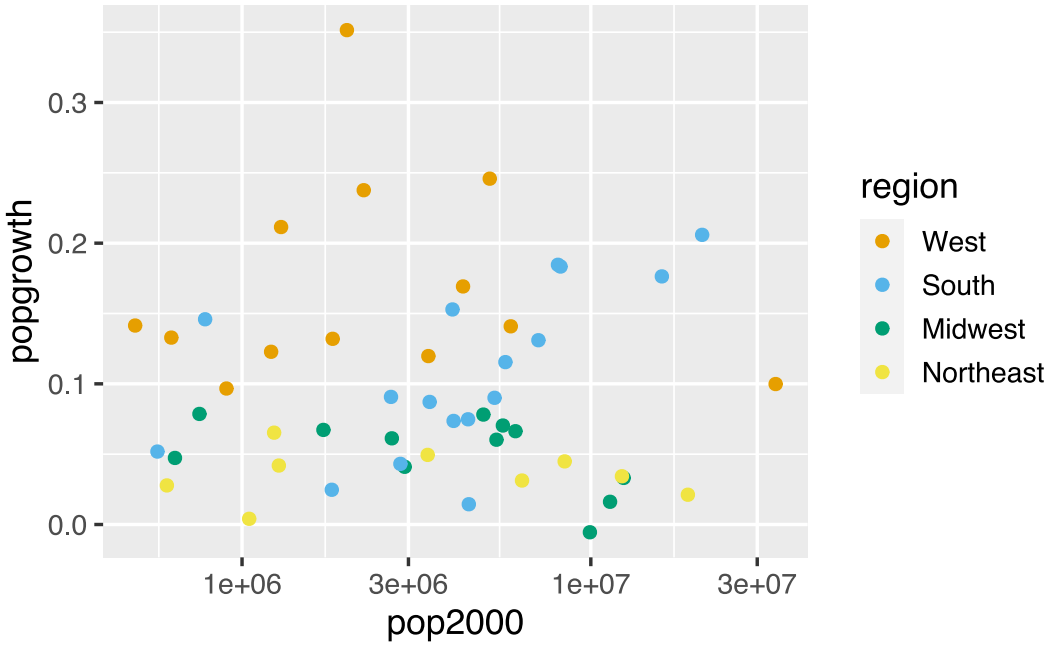
```
library(ggthemes)  # for scale_color_colorblind()

ggplot(popgrowth, aes(x = pop2000, y = popgrowth,
  geom_point() +
  scale_x_log10() +
  scale_color_colorblind()  # uses Okabe-Ito colo
```



# Discrete, qualitative scales are best set manually

```
ggplot(popgrowth, aes(x = pop2000, y = popgrowth,
  geom_point() +
  scale_x_log10() +
  scale_color_manual(
    values = c(West = "#E69F00", South = "#56B4E9"
  )
```



# Okabe-Ito RGB codes


| Name | Hex code | R, G, B (0-255) |
|---|---|---|
| orange | #E69F00 | 230, 159, 0 |
| sky blue | #56B4E9 | 86, 180, 233 |
| bluish green | #009E73 | 0, 158, 115 |
| yellow | #F0E442 | 240, 228, 66 |
| blue | #0072B2 | 0, 114, 178 |
| vermilion | #D55E00 | 213, 94, 0 |
| reddish purple | #CC79A7 | 204, 121, 167 |
| black | #000000 | 0, 0, 0 |

# Further reading

- Fundamentals of Data Visualization: Chapter 4: Color scales
- Fundamentals of Data Visualization: Figure 19.10: Okabe-Ito color palette
- **ggplot2** book: Colour scales and legends
- **ggplot2** reference documentation: Scales
- **colorspace** package: HCL-Based Color Scales for ggplot2