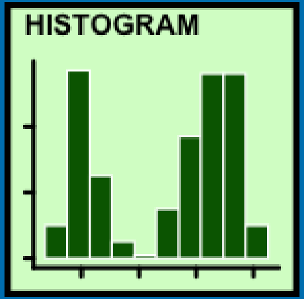
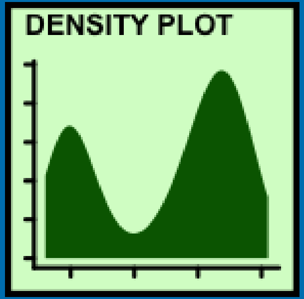
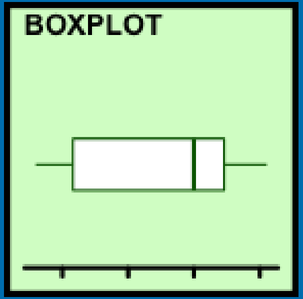
Data Visualisation with R

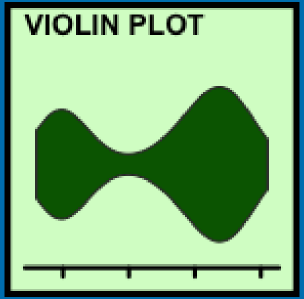
Workshop Part 1

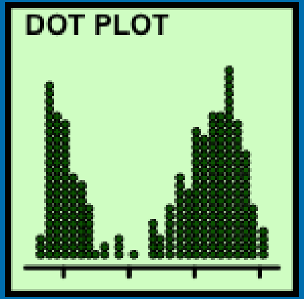
Catalogue

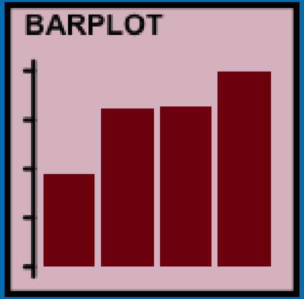

HISTOGRAM

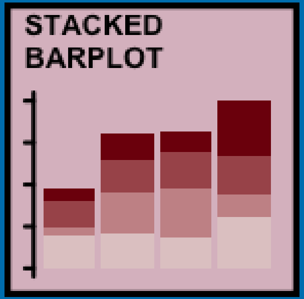

DENSITY PLOT

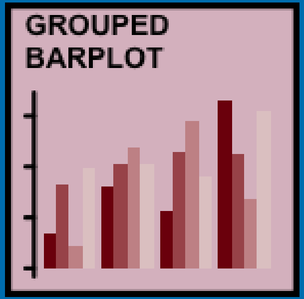

BOXPLOT

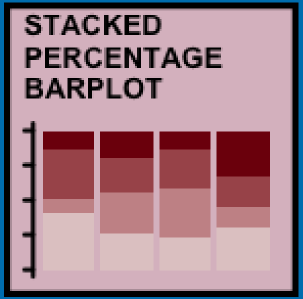

VIOLIN PLOT

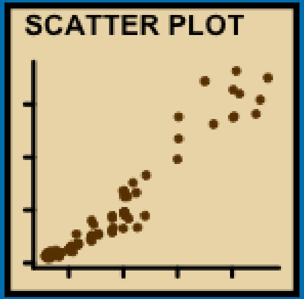

DOT PLOT


BARPLOT

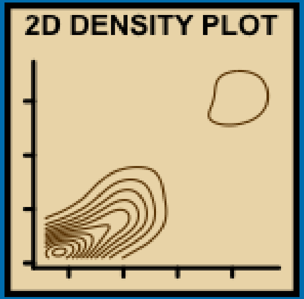

STACKED BARPLOT


GROUPED BARPLOT

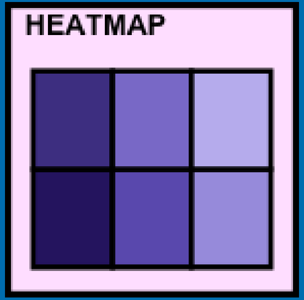

STACKED PERCENTAGE BARPLOT

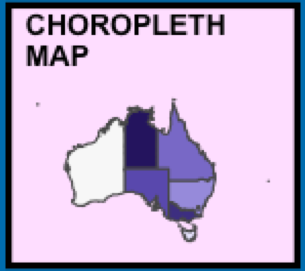

SCATTER PLOT


HEX PLOT


2D DENSITY PLOT


LINE PLOT


HEATMAP


CHOROPLETH MAP

Illustrative data 💰 Wages

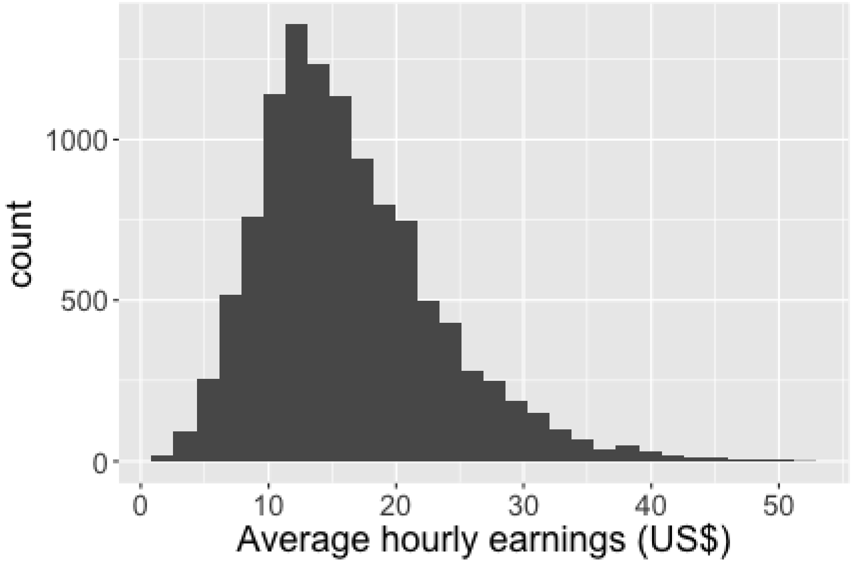
- Let's look at a survey of average hourly earnings in United States where each observation is an individual.

```r
data(CPSch3, package = "Ecdat")
str(CPSch3)
```

```
## 'data.frame':    11130 obs. of  3 variables:
##  $ year: int  1992 1992 1992 1992 1992 1992 1992 1992 199
##  $ ahe : num  13 11.6 17.4 10.1 16.8 ...
##  $ sex : Factor w/ 2 levels "male","female": 1 1 1 2 1 2
```

A histogram with geom_histogram( )

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_histogram() +
  labs(x = "Average hourly earnings (US$)")
```



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Layer data

```r
g <- ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_histogram()

layer_data(g, 1)
```

```
##       y count         x       xmin      xmax      density      ncount    ndensity flipped_aes
## 1    19    19  1.734720  0.8673601  2.602080 0.0009840768 0.014011799 0.014011799       FALSE
## 2    91    91  3.469440  2.6020802  4.336800 0.0047132101 0.067109145 0.067109145       FALSE
## 3   255   255  5.204160  4.3368004  6.071521 0.0132073470 0.188053097 0.188053097       FALSE
## 4   514   514  6.938881  6.0715206  7.806241 0.0266218681 0.379056047 0.379056047       FALSE
## 5   760   760  8.673601  7.8062407  9.540961 0.0393630735 0.560471976 0.560471976       FALSE
## 6  1143  1143 10.408321  9.5409609 11.275681 0.0591999908 0.842920354 0.842920354       FALSE
## 7  1356  1356 12.143041 11.2756811 13.010401 0.0702320101 1.000000000 1.000000000       FALSE
## 8  1232  1232 13.877761 13.0104012 14.745121 0.0638096139 0.908554572 0.908554572       FALSE
## 9  1137  1137 15.612481 14.7451214 16.479842 0.0588892297 0.838495575 0.8384955
## 10  941   941 17.347202 16.4798416 18.214562 0.0487377002 0.693952802 0.6939528
```

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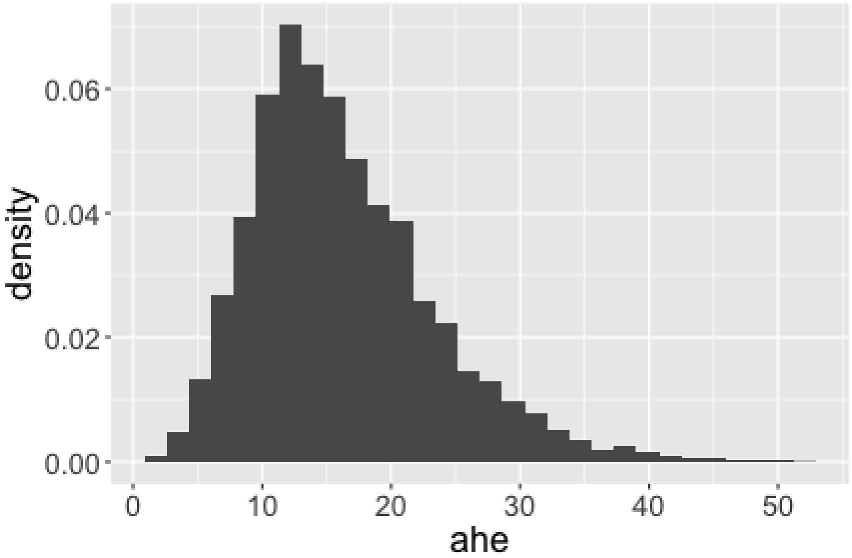
Layer data

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_histogram(aes(y = after_stat(density)))
```



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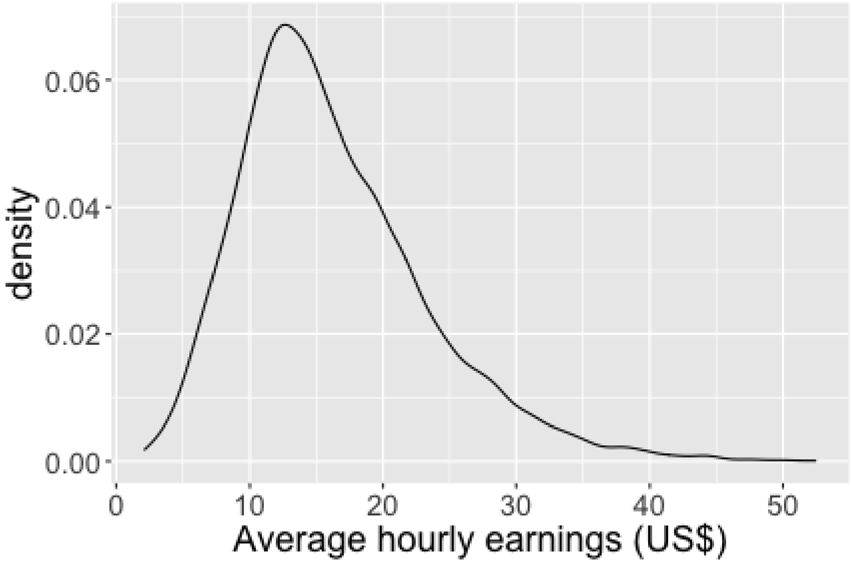
A density plot with geom_density()

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_density() +
  labs(x = "Average hourly earnings (US$)")
```



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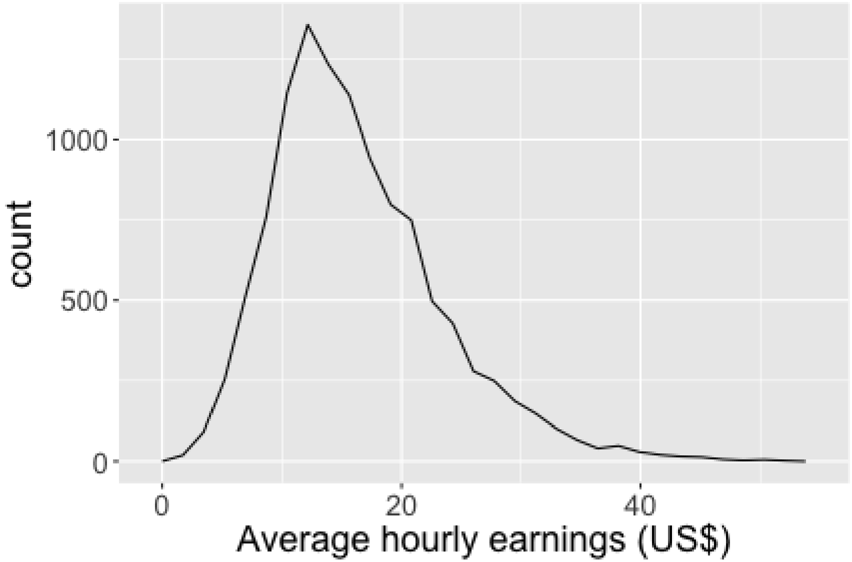
A frequency polygon with geom_freqpoly()

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_freqpoly() +
  labs(x = "Average hourly earnings (US$)")
```



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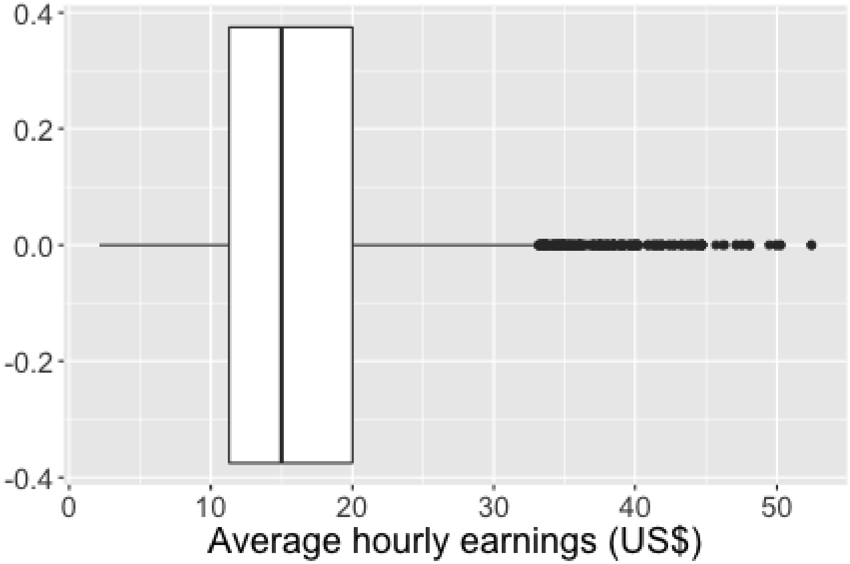
A boxplot with geom_boxplot()

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe)) +
  geom_boxplot() +
  labs(x = "Average hourly earnings (US$)")
```



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A violin plot with geom_violin()

```
ggplot(data = CPSch3,
       mapping = aes(x = ahe, y = "")) +
  geom_violin() +
  labs(x = "Average hourly earnings (US$)")
```

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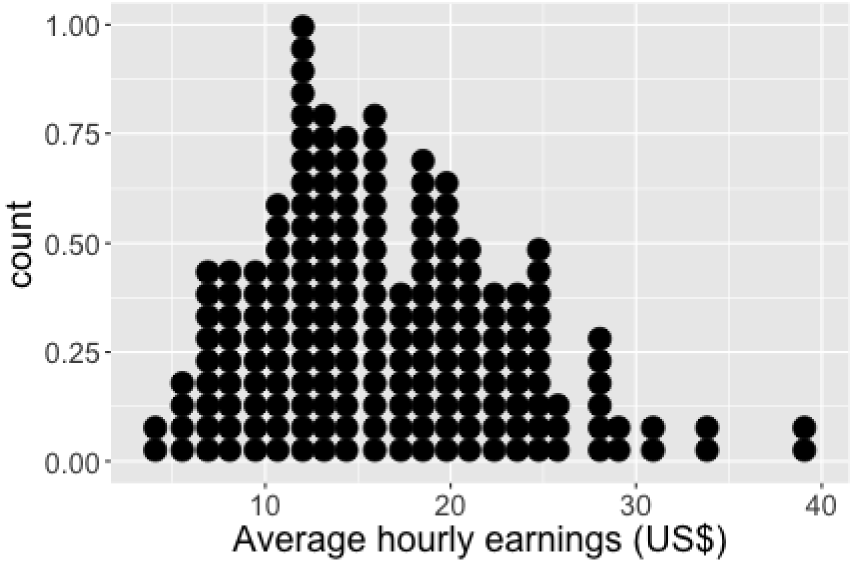
A dotplot with geom_dotplot()

```
ggplot(data = dplyr::sample_n(CPSch3, 200),
       mapping = aes(x = ahe)) +
  geom_dotplot() +
  labs(x = "Average hourly earnings (US$)")
```



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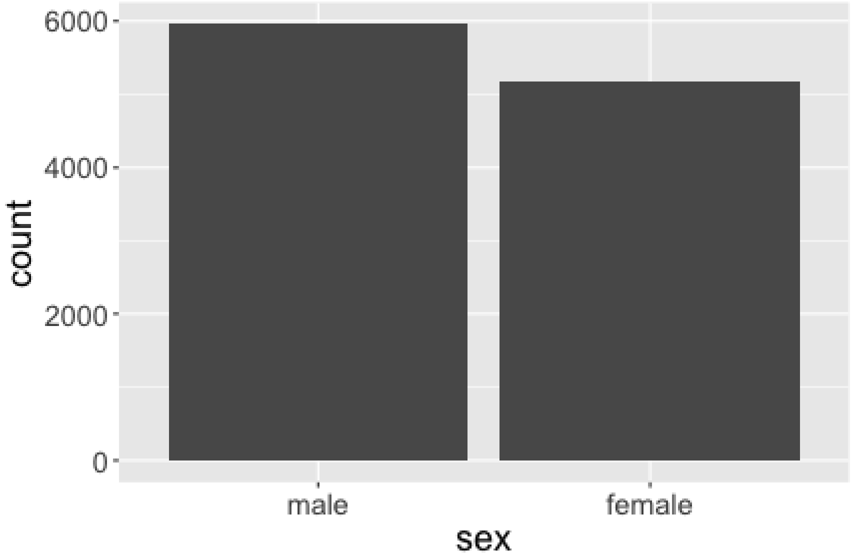
A barplot with `geom_bar()` with categorical variables

```
ggplot(data = CPSch3,
       mapping = aes(x = sex)) +
  geom_bar()
```



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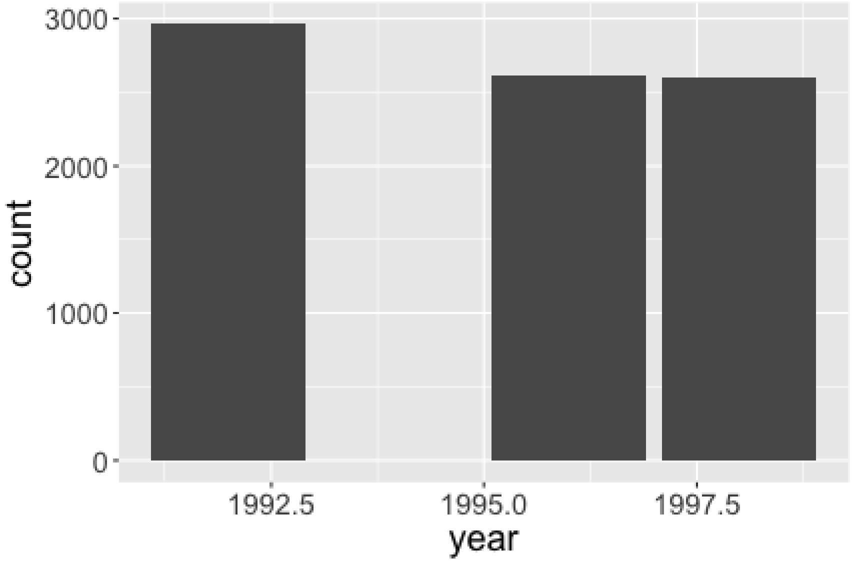
A barplot with geom_bar( ) with discrete variables

```
ggplot(data = filter(CPSch3, year!=1994),
          mapping = aes(x = year)) +
   geom_bar()
```



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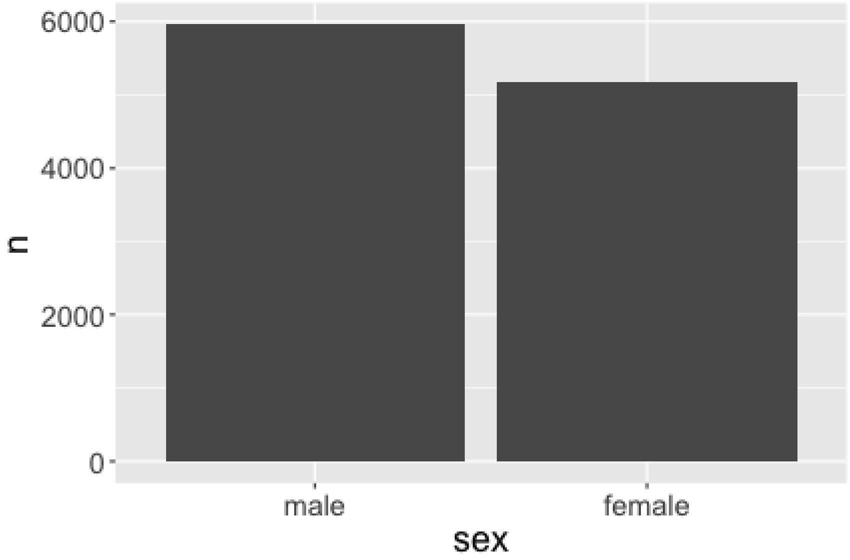
A barplot with geom_col()

```
dfsum <- CPSch3 %>%
  group_by(sex) %>%
  tally()
dfsum
```

```
## # A tibble: 2 × 2
##   sex        n
##   <fct>  <int>
## 1 male    5956
## 2 female  5174
```

```
ggplot(data = dfsum,
       mapping = aes(x = sex,
                     y = n)) +
  geom_col()
```



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Illusrative data 🚢 ship accidents

```r
data(Accident, package = "Ecdat")
str(Accident)
```

```
## 'data.frame':    40 obs. of  5 variables:
##  $ type    : Factor w/ 5 levels "A","B","C","D",..: 1 1 1
##  $ constr  : Factor w/ 4 levels "C6064","C6569",..: 1 1 2
##  $ operate: Factor w/ 2 levels "O6074","O7579": 1 2 1 2
##  $ months  : int  127 63 1095 1095 1512 3353 NA 2244 44882
##  $ acc     : int  0 0 3 4 6 18 NA 11 39 29 ...
```

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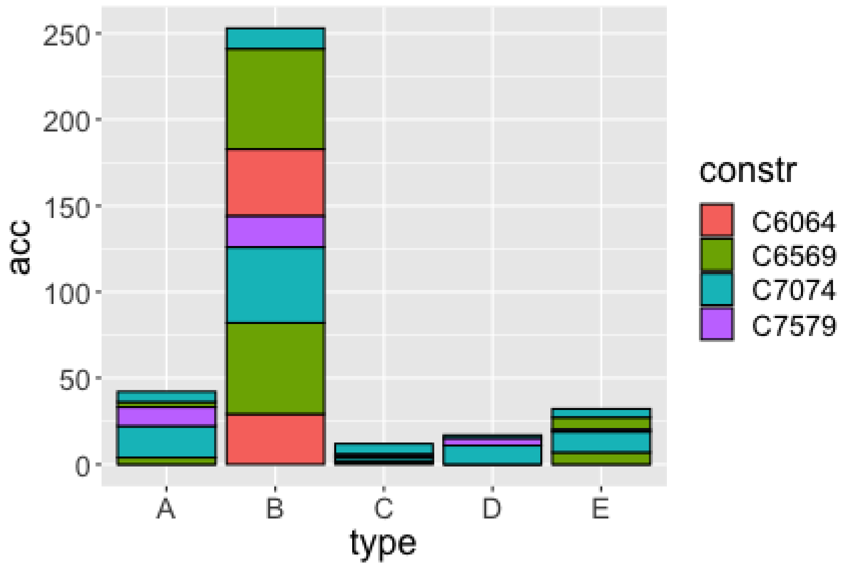
A stacked barplot with geom_col()

```
ggplot(Accident, aes(type, acc, fill = constr, group = opera
  geom_col(color = "black", position = "stack")
```



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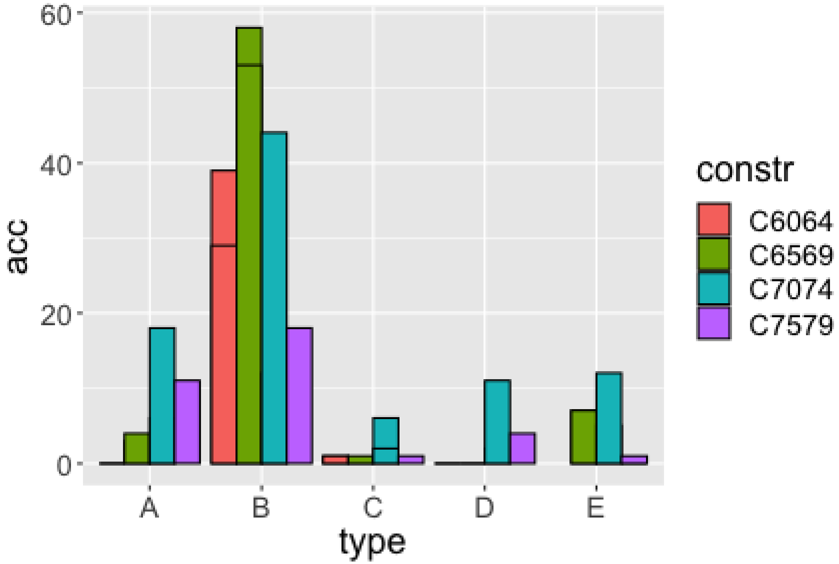
A grouped barplot with geom_col()

```
ggplot(Accident, aes(type, acc, fill = constr)) +
  geom_col(color = "black", position = "dodge")
```



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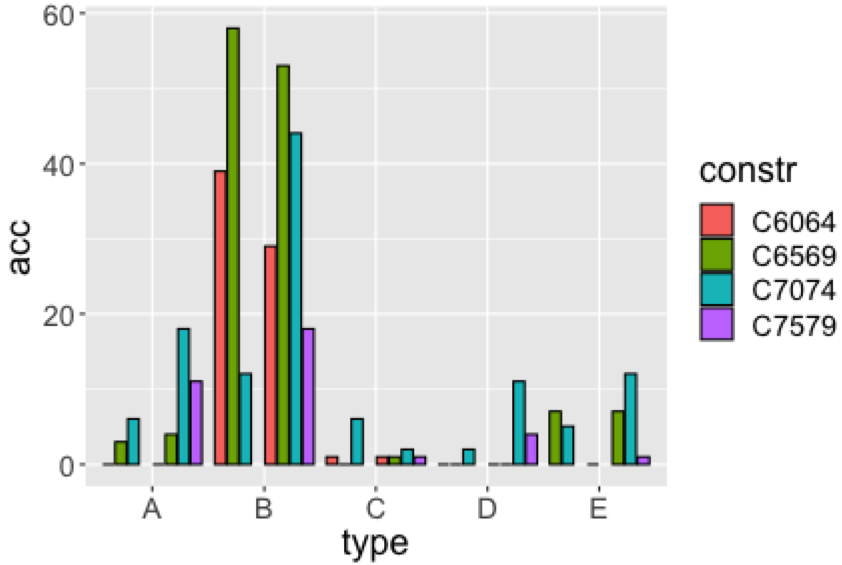
Another grouped barplot with geom_col()

```
ggplot(Accident, aes(type, acc, fill = constr, group = opera
  geom_col(color = "black", position = "dodge2")
```



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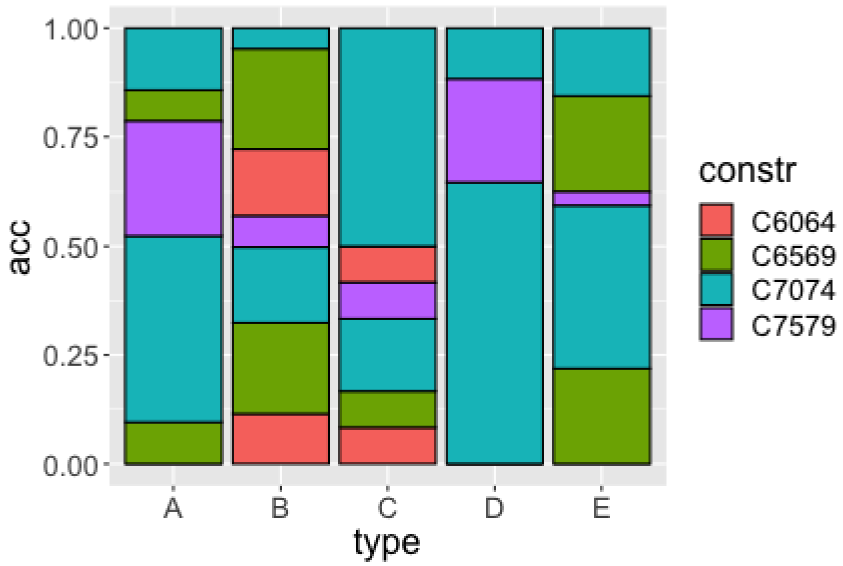
Stacked percentage barplot with geom_col()

```
ggplot(Accident, aes(type, acc, fill = constr, group = opera
  geom_col(color = "black", position = "fill")
```



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Illustrative data 💎 diamonds

- Let's have a look at the `diamonds` data which contains information about different attributes of diamonds

```
data(diamonds, package = "ggplot2")
diamonds
```

```
## # A tibble: 53,940 × 10
##    carat cut       color clarity depth table price     x
##    <dbl> <ord>     <ord> <ord>   <dbl> <dbl> <int> <dbl>
##  1  0.23 Ideal     E     SI2      61.5    55   326  3.95
##  2  0.21 Premium   E     SI1      59.8    61   326  3.89
##  3  0.23 Good      E     VS1      56.9    65   327  4.05
##  4  0.29 Premium   I     VS2      62.4    58
```

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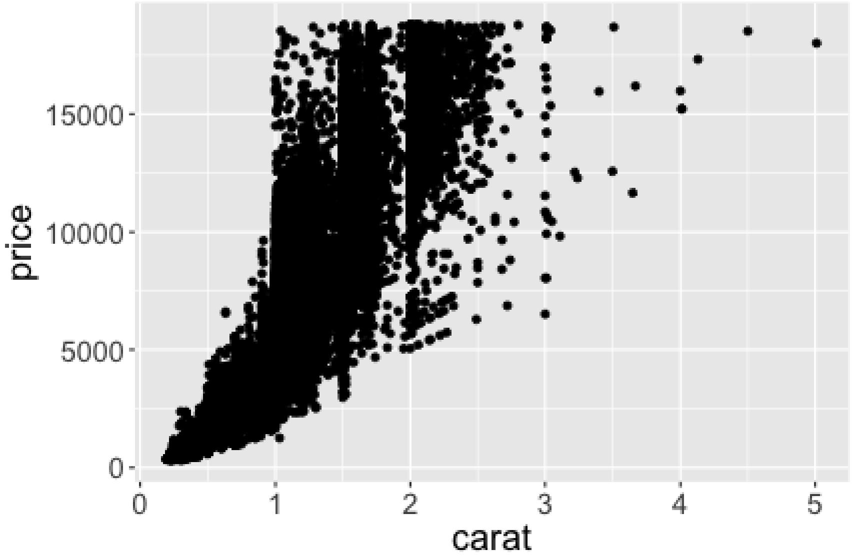
A scatterplot with geom_point()

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_point()
```



- Scatter plot of price vs carat of diamonds
- Each point correponds to a dimaond

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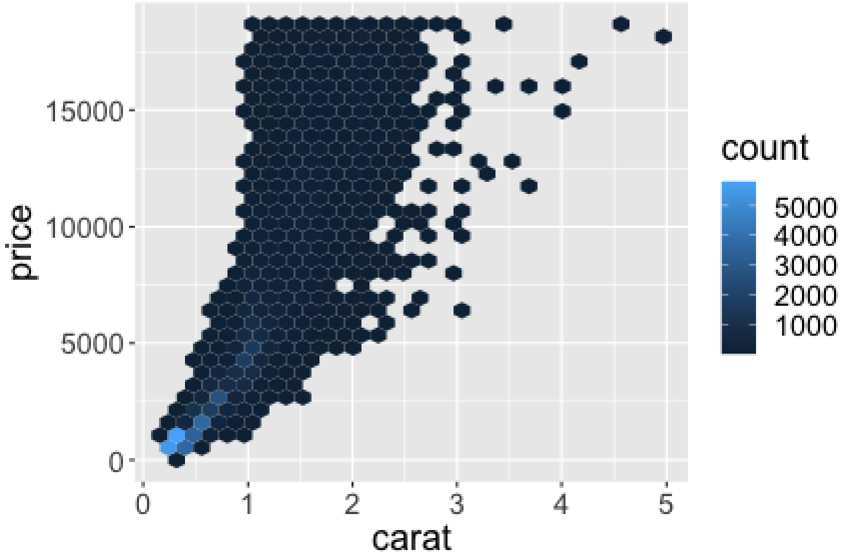
A hexagonal 2D heatmap with geom_hex()

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_hex()
```



- A hexagon shows the count of observations within the region.

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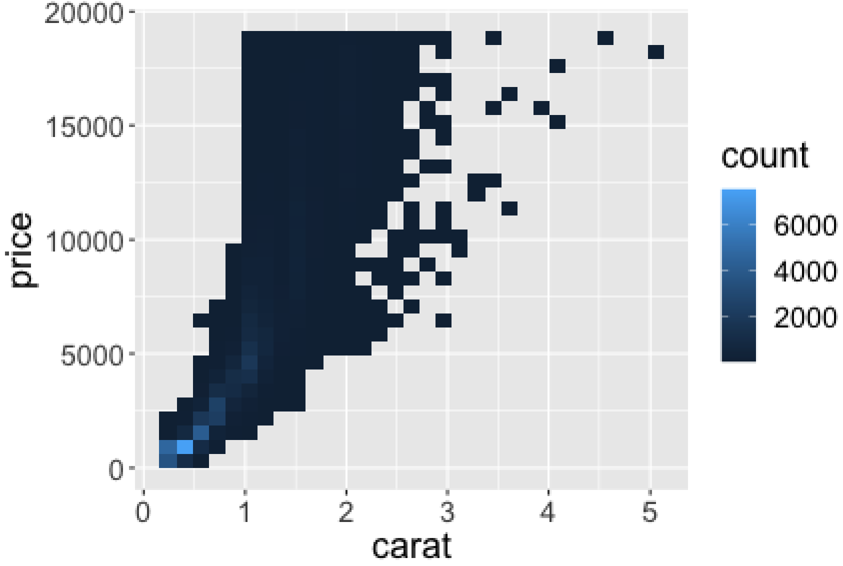
A rectangular 2D heatmap with geom_bin_2d()

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_bin_2d()
```



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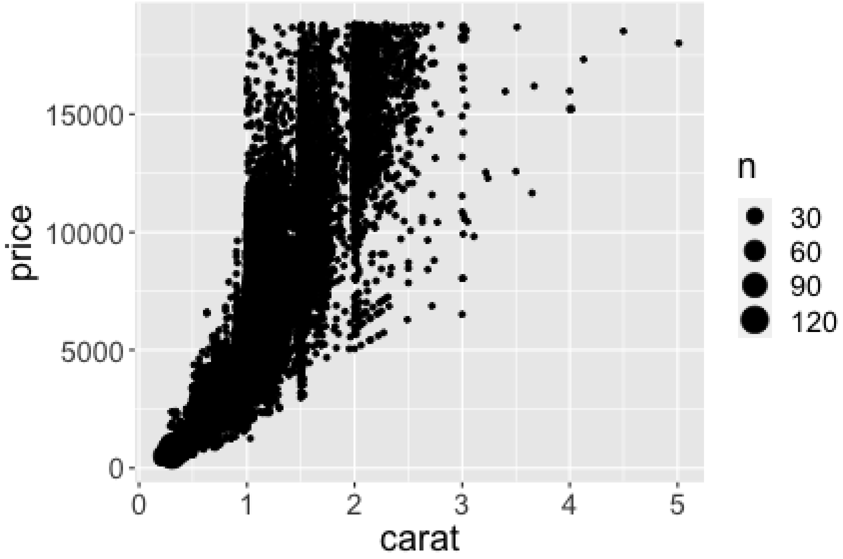
Count of overlapping points with `geom_count()`

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_count()
```



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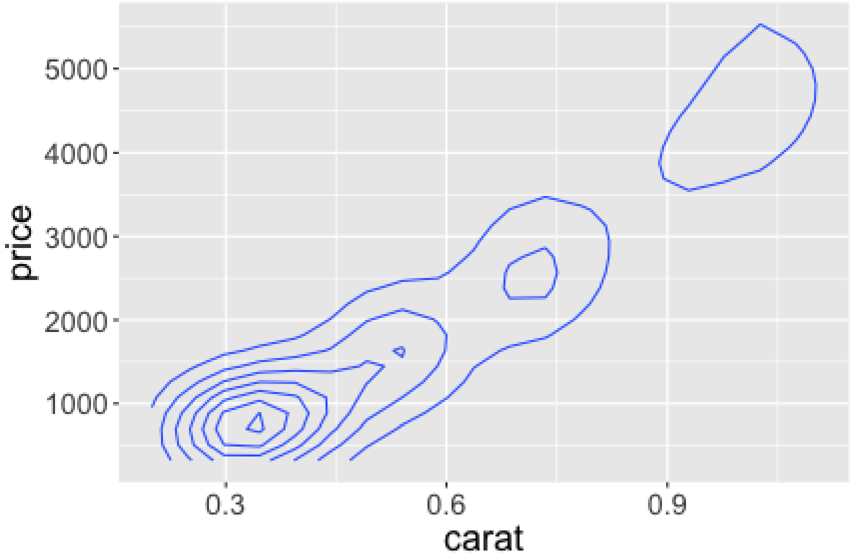
Contour of a 2D density with `geom_density_2d()`

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_density_2d()
```



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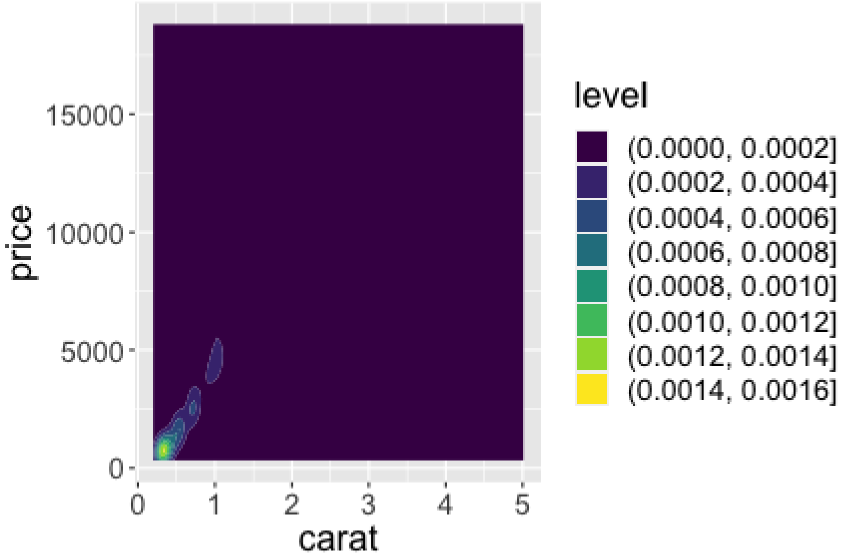
Contour of a 2D density with `geom_density_2d_filled()`

```
ggplot(data = diamonds,
       mapping = aes(x = carat, y = price)) +
  geom_density_2d_filled()
```



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Illustrative data ⛰️ volcano

- The data contains topographic information on Auckland's Maunga Whau Volcano

```
volcanod <- data.frame(row = as.vector(row(volcano)),
                       col = as.vector(col(volcano)),
                       value = as.vector(volcano))

volcanod
```

```
##       row col value
## 1       1   1   100
## 2       2   1   101
## 3       3   1   102
```

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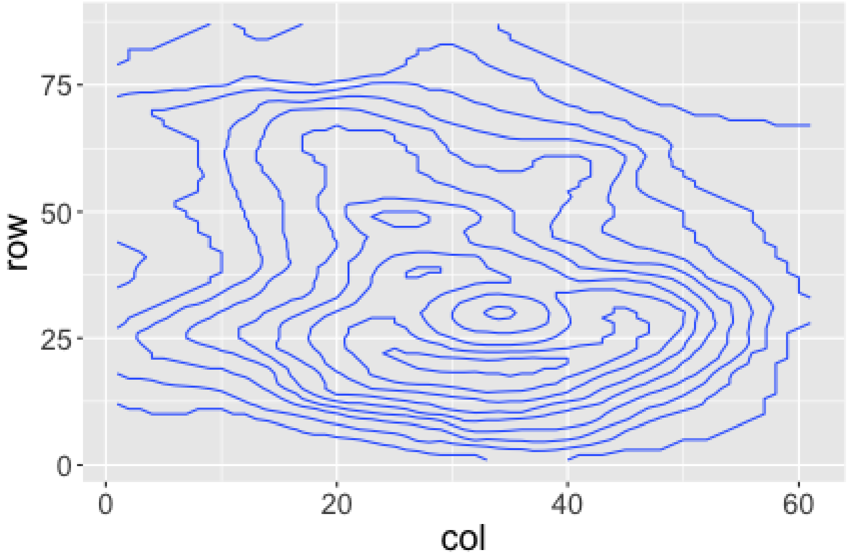
A 2D contour plot with geom_contour()

```
ggplot(data = volcanod,
       mapping = aes(x = col, y = row, z = value)) +
  geom_contour()
```



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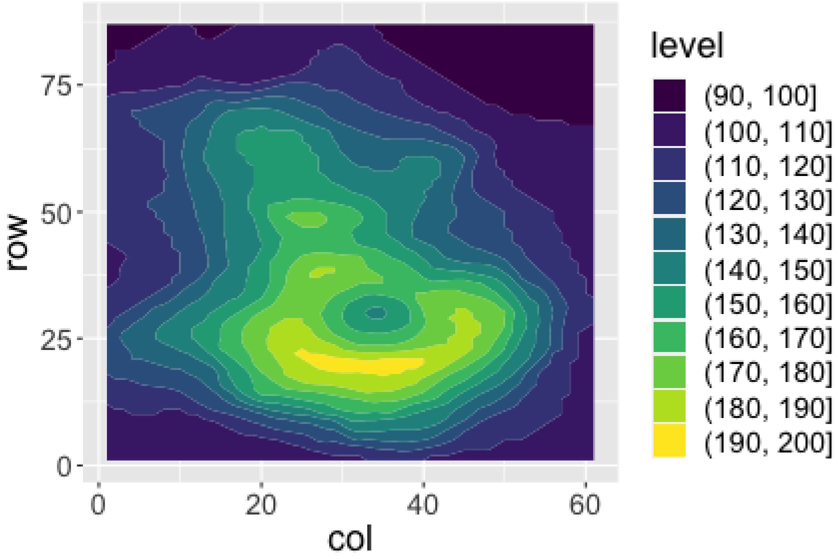
A 2D contour plot with `geom_contour_filled()`

```
ggplot(data = volcanod,
       mapping = aes(x = col, y = row, z = value)) +
  geom_contour_filled()
```



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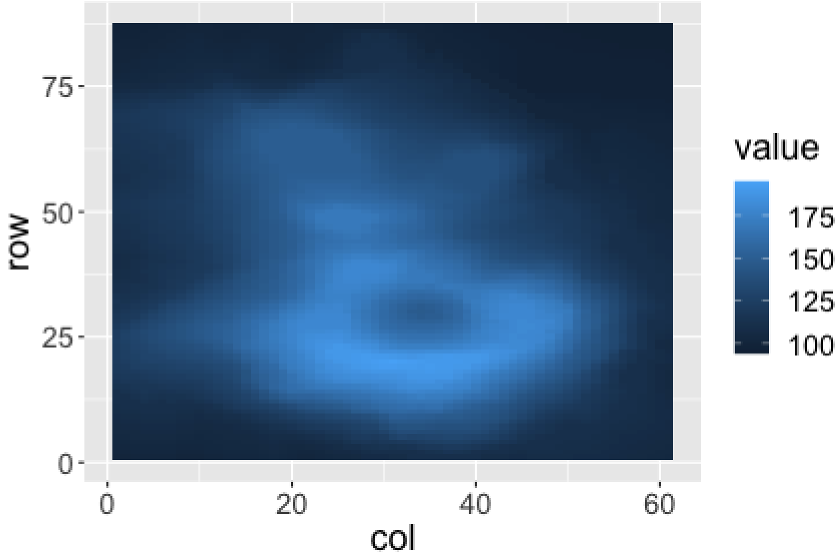
Tile plots with geom_tile()

```
ggplot(volcanod, aes(col, row, fill = value)) +
 geom_tile()
```



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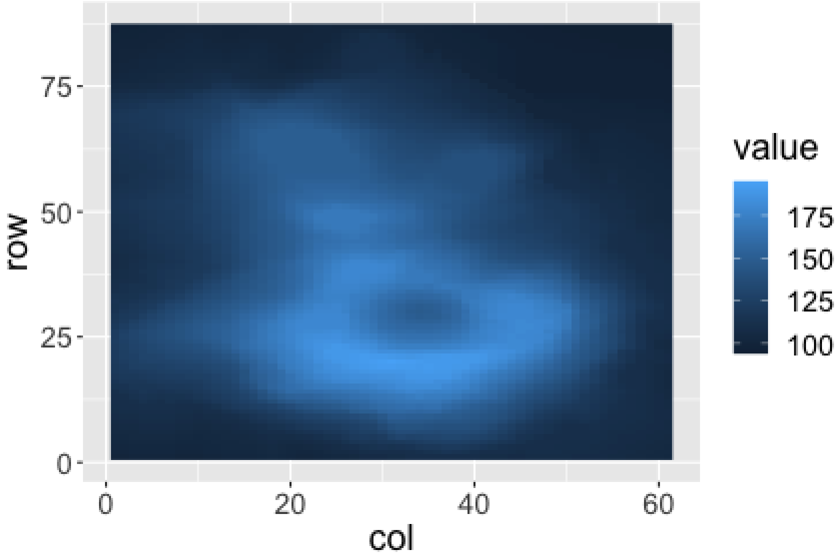
Raster plots with `geom_raster()`

```
ggplot(volcanod, aes(col, row, fill = value)) +
 geom_raster()
```



- A high performance special case of `geom_tile()` for when the tiles are the same size

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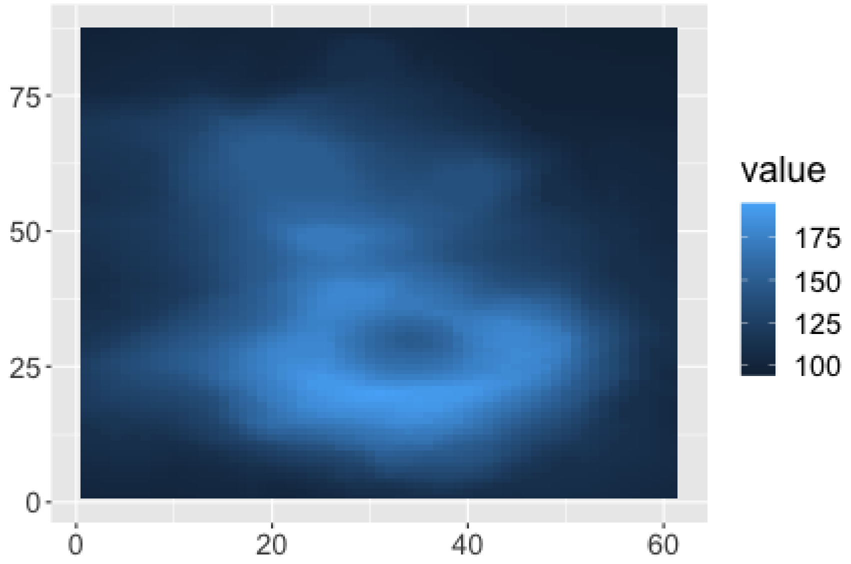
Rectangular plots with geom_rect()

```
ggplot(volcanod, aes(xmin = col - 0.5, xmax = col + 0.5,
                     ymin = row - 0.5, ymax = row + 0.5, fil
 geom_rect()
```



- A reparameterised version of `geom_tile()`

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Illustrative data 📈 economics

```
data(economics, package = "ggplot2")
economics

## # A tibble: 574 × 6
##    date          pce    pop psavert uempmed unemploy
##    <date>      <dbl>  <dbl>   <dbl>   <dbl>    <dbl>
##  1 1967-07-01   507. 198712    12.6     4.5     2944
##  2 1967-08-01   510. 198911    12.6     4.7     2945
##  3 1967-09-01   516. 199113    11.9     4.6     2958
##  4 1967-10-01   512. 199311    12.9     4.9     3143
##  5 1967-11-01   517. 199498    12.8     4.7     3066
##  6 1967-12-01   525. 199657    11.8     4.8
```

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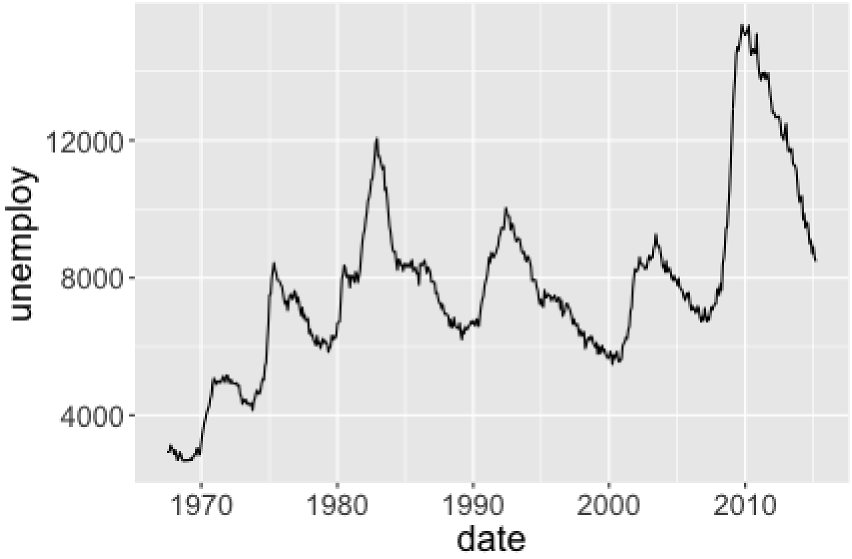
Line plot with geom_line()

```
ggplot(economics, aes(date, unemploy)) +
  geom_line()
```



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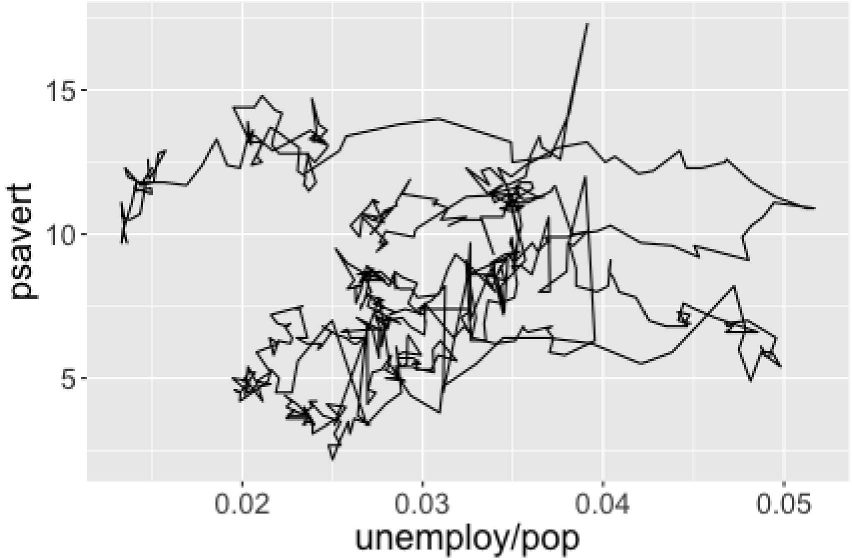
geom_path()

```
ggplot(economics, aes(unemploy/pop, psavert)) +
  geom_path()
```



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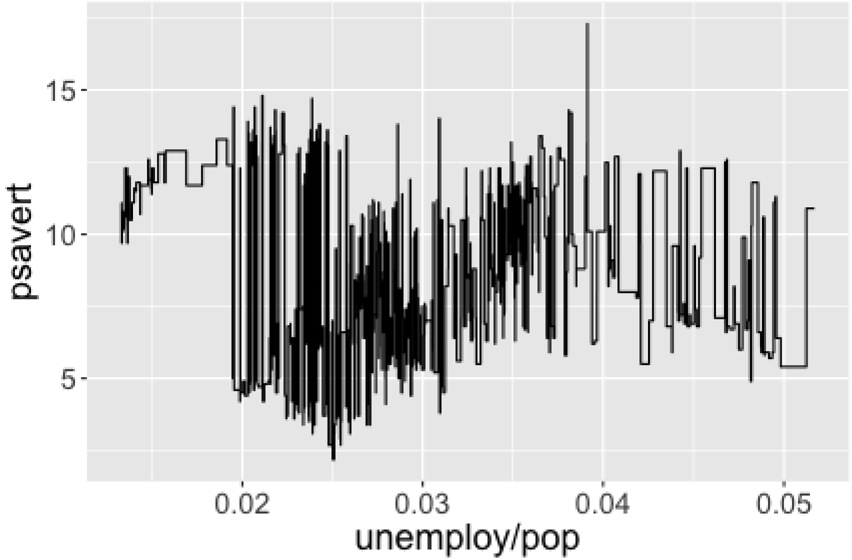
geom_step()

```
ggplot(economics, aes(unemploy/pop, psavert)) +
  geom_step()
```



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Drawing maps

- Drawing maps require the map data

```
world <- map_data("world")
world
```

```
##          long      lat group order  region subregion
## 1   -69.89912 12.45200     1     1   Aruba      <NA>
## 2   -69.89571 12.42300     1     2   Aruba      <NA>
## 3   -69.94219 12.43853     1     3   Aruba      <NA>
## 4   -70.00415 12.50049     1     4   Aruba      <NA>
## 5   -70.06612 12.54697     1     5   Aruba      <NA>
## 6   -70.05088 12.59707     1     6   Aruba      <NA>
## 7   -70.03511 12.61411     1     7   Aruba
```

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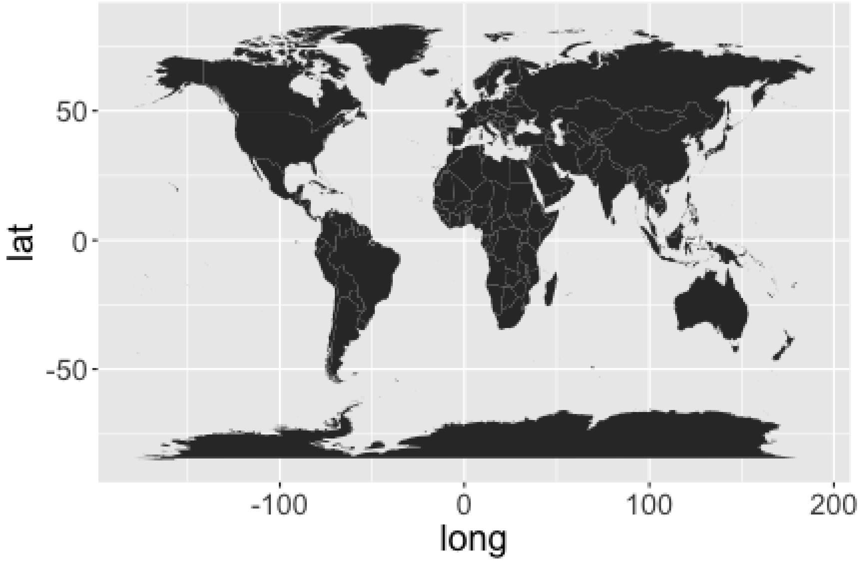
Drawing world map with geom_polygon()

```
world <- map_data("world")
ggplot(world, aes(long, lat, group = group)) +
  geom_polygon()
```



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Other layers

- There are more layers in `ggplot`!
- There are layers also beginning with `stat_`.
- There are also many extension packages to draw more plots: https://exts.ggplot2.tidyverse.org/gallery/
- It is normal to google and copy-and-paste code that you find on the web.
- `ggplot2` is also continually updated so some new features may be added in the future.

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Session Information

```r
devtools::session_info()
```

```
## ─ Session info  3️⃣  🧛🏻  👨🏾  ──────────────────────────────────────────
##  hash: keycap: 3, vampire: light skin tone, man: medium-dark skin tone
##
##  setting  value
##  version  R version 4.1.2 (2021-11-01)
##  os       macOS Big Sur 11.6.2
##  system   x86_64, darwin17.0
##  ui       RStudio
##  language (EN)
##  collate  en_AU.UTF-8
##  ctype    en_AU.UTF-8
##  tz       Australia/Melbourne
##  date     2022-02-20
```

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