

# talk09 练习与作业

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### 0.1 练习和作业说明

将相关代码填写入以 “{r}” 标志的代码框中，运行并看到正确的结果；

完成后，用工具栏里的”Knit” 按键生成 PDF 文档；

将 PDF 文档改为：姓名-学号-talk09 作业.pdf，并提交到老师指定的平台/钉群。

### 0.2 talk09 内容回顾

- basic plot
- ggplot2

### 0.2.1 layered grammar (图层语法) 的成分

- 图层 ( geom\_XXX )
- scale ( scale\_XXX )
- faceting ( facet\_XXX )
- 坐标系统

### 0.2.2 图象类型

- 点图
- bars
- boxplots

### 0.2.3 其它重要内容 (部分需要自学)

- colours
- theme
- 其它图像类型
- 图例 (legends) 和坐标轴
- 图形注释和其它定制

## 0.3 练习与作业：用户验证

请运行以下命令，验证你的用户名。

如你当前用户名不能体现你的真实姓名，请改为拼音后再运行本作业！

```
Sys.info()[["user"]]
```

```
## [1] "lucas"
```

```
Sys.getenv("HOME")
```

```
## [1] "/Users/lucas"
```

## 0.4 练习与作业 1: 基础做图 & ggplot2

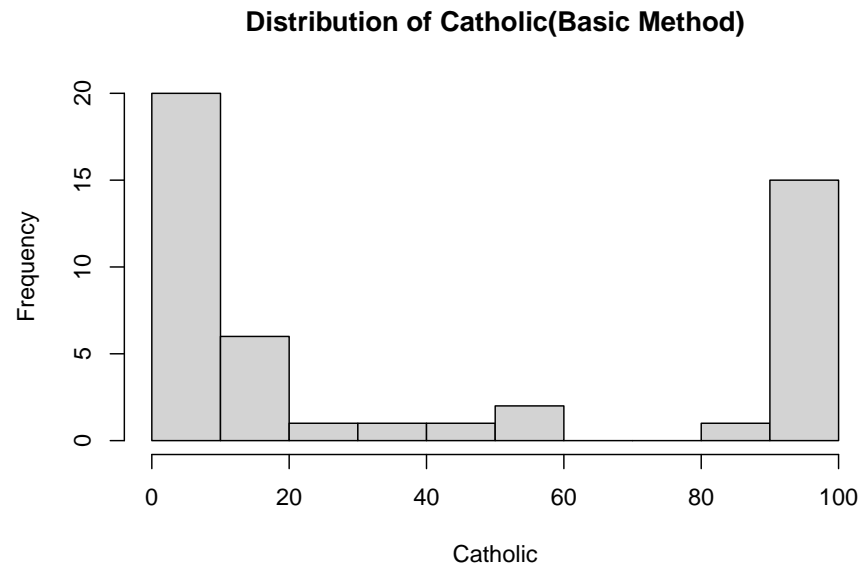
---

### 0.4.1 用 `swiss` 数据做图

1. 用直方图 `histogram` 显示 `Catholic` 列的分布情况;
2. 用散点图显示 `Eduction` 与 `Fertility` 的关系; 将表示两者关系的线性公式、相关系数和 `p` 值画在图的空白处。

注: 每种图提供基础做图函数和 `ggplot2` 两个版本!

```
## 代码写这里, 并运行;  
library(ggplot2)  
data(swiss)  
  
# Basic  
# Task 01  
hist(  
  swiss$Catholic,  
  main="Distribution of Catholic(Basic Method)",  
  xlab="Catholic")
```



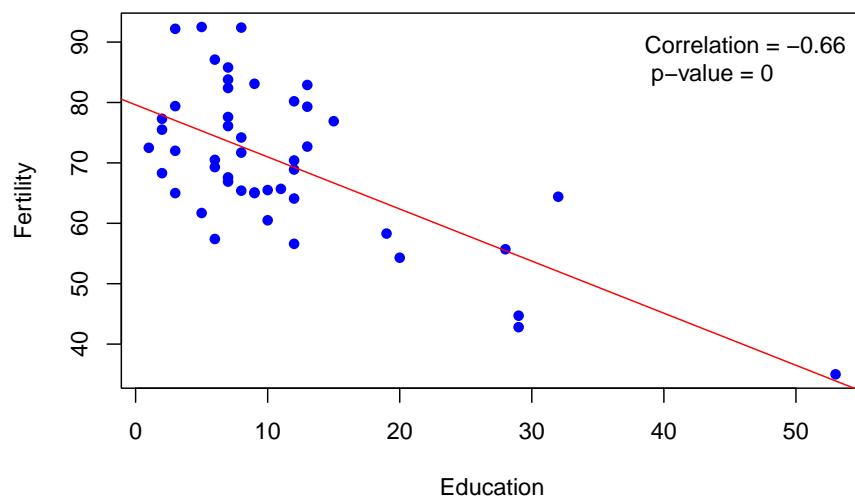
```
# Task 02
# Plotting Scatter Plots
plot(
  swiss$Education,
  swiss$Fertility,
  main = "Education vs Fertility(Basic Method)",
  xlab = "Education",
  ylab = "Fertility",
  pch = 16,
  col = "blue")

# Adding a linear regression line
abline(
  lm(swiss$Fertility ~ swiss$Education),
  col = "red")

# Add correlation coefficients and p-values
cor_val =
```

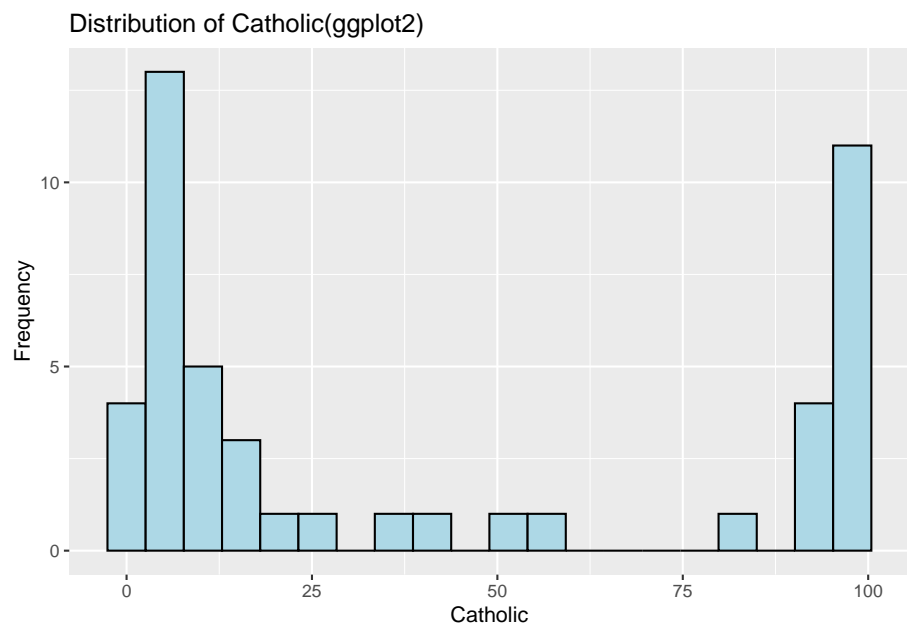
```
cor(swiss$Fertility,
    swiss$Education)
p_val =
  cor.test(swiss$Fertility,
    swiss$Education)$p.value
legend(
  "topright",
  legend = paste("Correlation =",
    round(cor_val, 2),
    "\n", "p-value =",
    round(p_val, 4)),
  bty = "n",
  col = "red")
```

Education vs Fertility(Basic Method)



```
# ggplot2
# Task 01
ggplot(
  swiss,
```

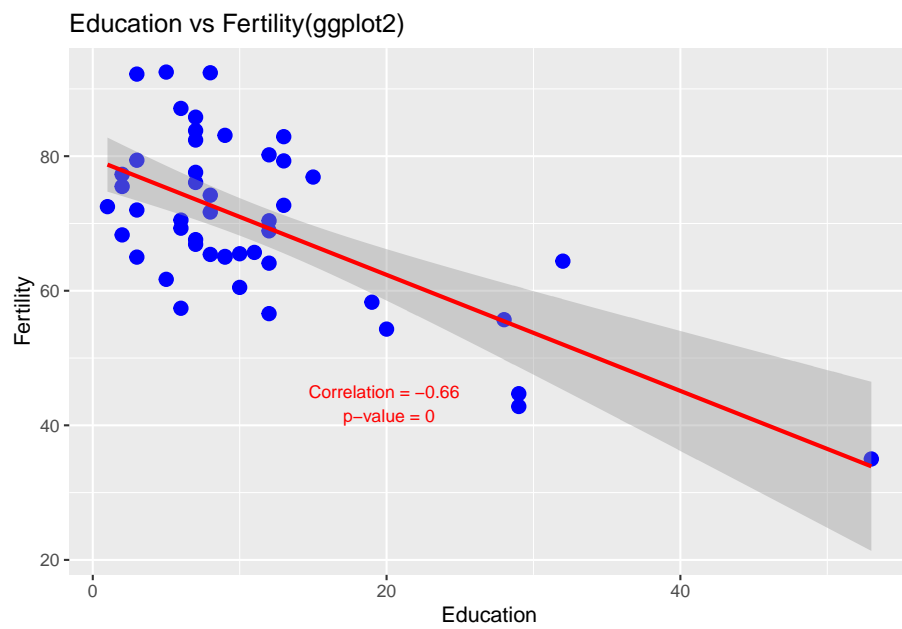
```
aes(x = Catholic)) +  
geom_histogram(  
  fill = "lightblue",  
  color = "black",  
  bins = 20) +  
labs(  
  title = "Distribution of Catholic(ggplot2)",  
  x = "Catholic",  
  y = "Frequency")
```



```
# Task 02  
# Plotting Scatterplots with ggplot2  
ggplot(  
  swiss,  
  aes(x = Education,  
       y = Fertility)) +  
geom_point(  
  color = "blue",
```

```
size = 3) +  
geom_smooth(  
  method = "lm",  
  color = "red") +  
labs(  
  title = "Education vs Fertility(ggplot2)",  
  x = "Education",  
  y = "Fertility") +  
annotate(  
  "text",  
  x = 20,  
  y = 35,  
  label =  
    paste(  
      "Correlation =",  
      round(cor_val, 2),  
      "\n",  
      "p-value =",  
      round(p_val, 4)),  
  color = "red",  
  vjust = -1,  
  size = 3)
```

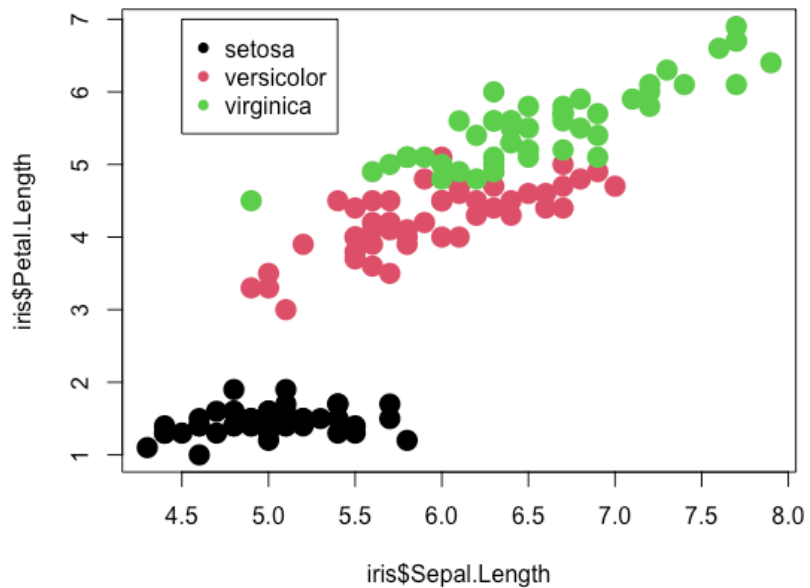
```
## `geom_smooth()` using formula = 'y ~ x'
```



#### 0.4.2 用 iris 作图

1. 用散点图显示 Sepal.Length 和 Petal.Length 之间的关系; 按 species 为散点确定颜色, 并画出 legend 以显示 species 对应的颜色;





如下图所示：

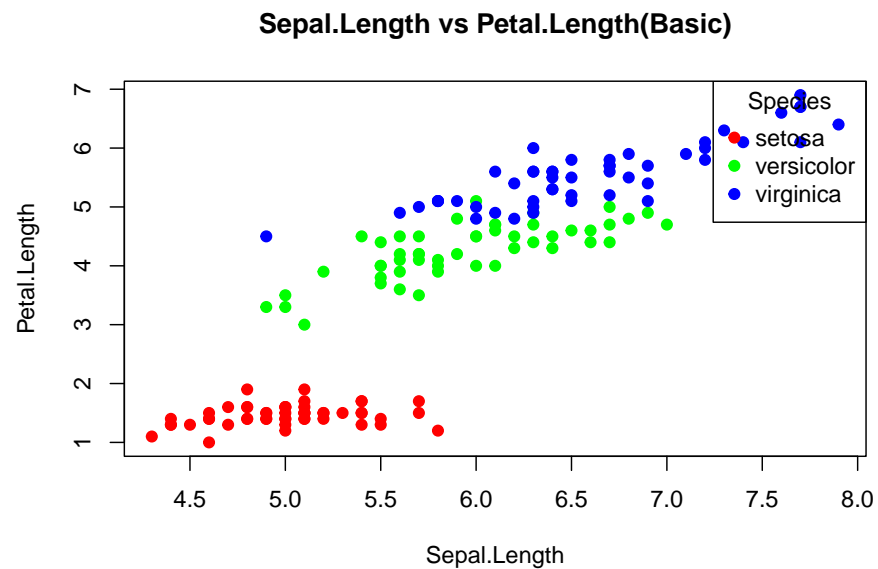
2. 用 boxplot 显示 species 之间 Sepal.Length 的分布情况；

注：每种图提供基础做图函数和 **ggplot2** 两个版本！

```
## 代码写这里，并运行；
data(iris)
library(ggplot2)

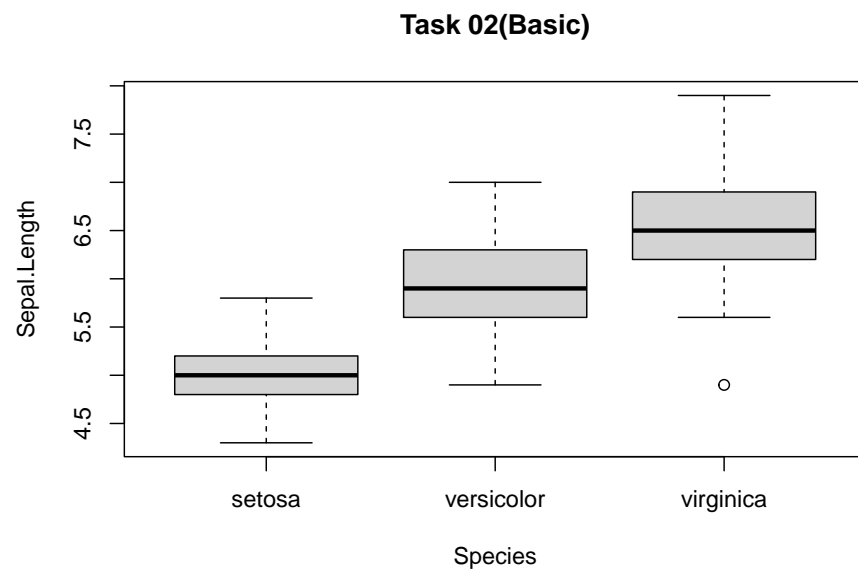
# Basic
# Task 01
colors =
  c("setosa" = "red",
    "versicolor" = "green",
    "virginica" = "blue")
plot(
  iris$Sepal.Length,
  iris$Petal.Length,
```

```
pch = 19,  
col = colors[iris$Species],  
xlab = "Sepal.Length",  
ylab = "Petal.Length",  
main = "Sepal.Length vs Petal.Length(Basic)"  
)  
legend(  
  "topright",  
  legend = levels(iris$Species),  
  col = colors,  
  pch = 19,  
  title = "Species"  
)
```



```
# Task 02  
boxplot(  
  Sepal.Length ~ Species,  
  data = iris,
```

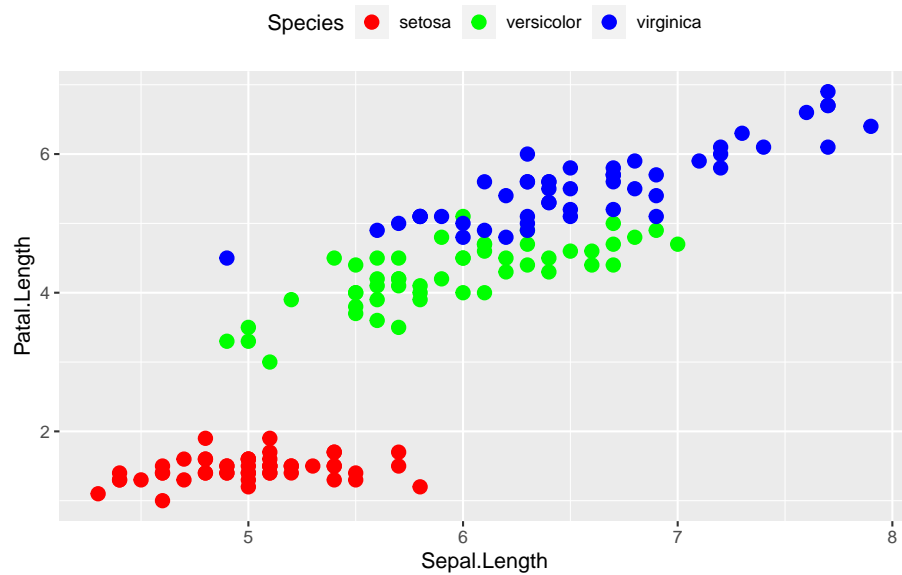
```
  xlab = "Species",  
  ylab = "Sepal.Length",  
  main = "Task 02(Basic)"  
)
```



```
# ggplot  
# Task 01  
ggplot(  
  iris,  
  aes(  
    x = Sepal.Length,  
    y = Petal.Length,  
    color = Species  
  )  
) +  
  geom_point(size = 3) +  
  labs(  
    title =
```

```
"Sepal.Length vs Petal.Length(ggplot2)",  
  x = "Sepal.Length",  
  y = "Patal.Length"  
) +  
scale_color_manual(  
  values =  
    c("setosa" = "red",  
      "versicolor" = "green",  
      "virginica" = "blue")  
) +  
theme(  
  legend.position = "top"  
)
```

Sepal.Length vs Petal.Length(ggplot2)

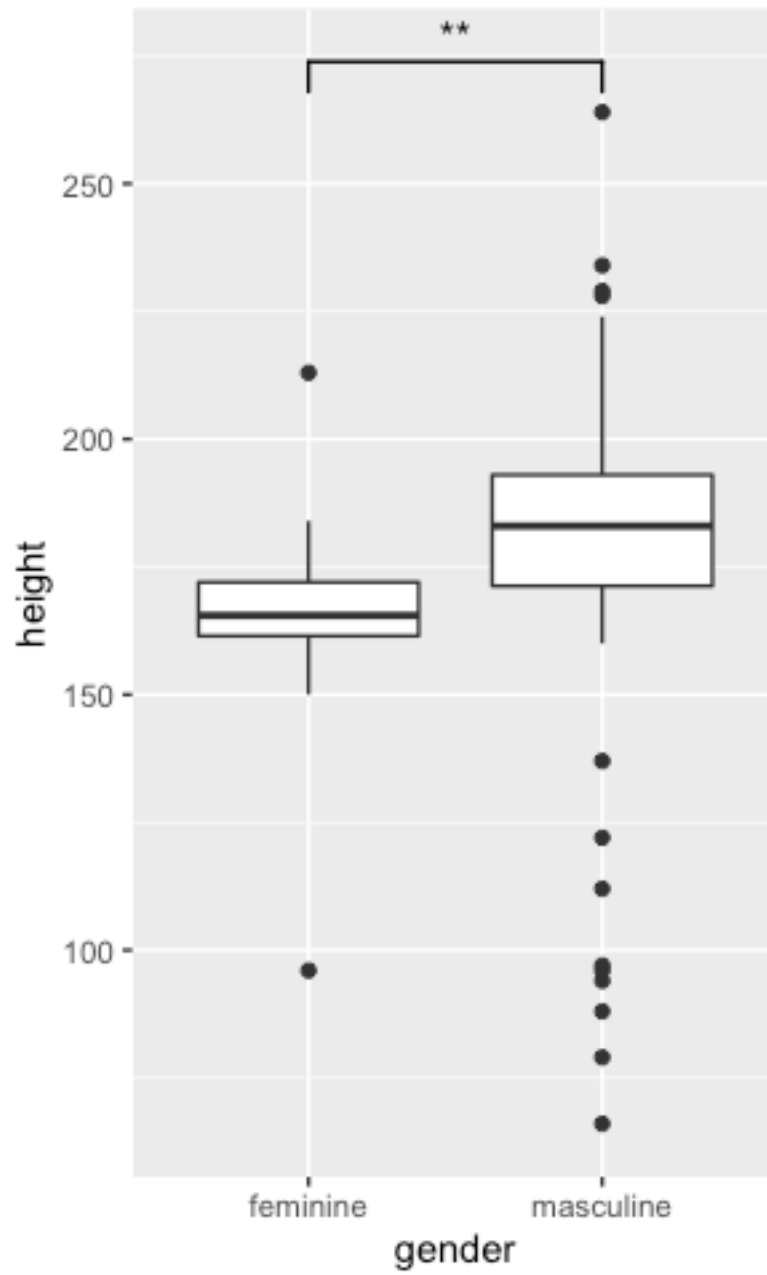


### 0.4.3 用 ggplot 作图: boxplot

用 `starwars` 的数据作图，画 `boxplot` 显示身高 `height` 与性别 `gender` 的关系。要求：

1. `height` 为 `NA` 的，不显示；
2. 用 `ggsignif` 包计算 `feminine` 和 `masculine` 两种性别的身高是否有显著区别，并在图上显示。
3. 将此图的结果保存为变量 `p1`，以备后面使用；

最终结果如图所示：



```
## 代码写这里，并运行；
```

```
library(ggplot2)
```

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr      1.1.3      v readr      2.1.4
## v forcats    1.0.0      v stringr   1.5.0
## v lubridate  1.9.2      v tibble    3.2.1
## v purrr      1.0.2      v tidyr     1.3.0
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts
```

```
library(ggsignif)
```

```
# Load the data
```

```
data("starwars")
```

```
starwars_filtered =
```

```
  na.omit(starwars)
```

```
# Initializing the plot
```

```
# Ignore 'NA' in "height"
```

```
p1 =
```

```
  ggplot(
```

```
    starwars_filtered,
```

```
    aes(
```

```
      x = gender,
```

```
      y = height,
```

```
      fill = gender,
```

```
    )
```

```
  ) +
```

```
  geom_boxplot() +
```

```
  labs(
```

```
    title = "Boxplot of Height by Gender",
```

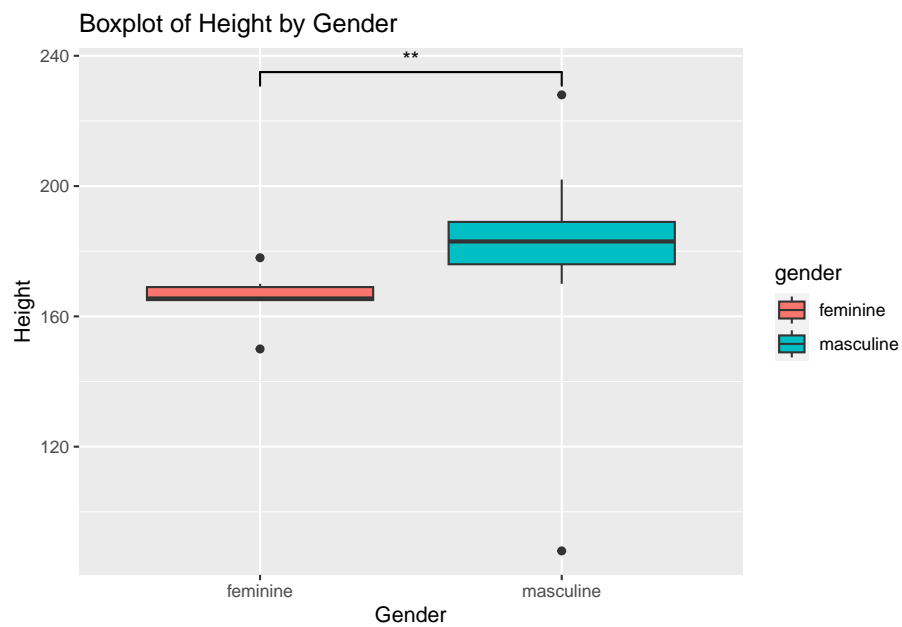
```
x = "Gender",
y = "Height"
)

# Calculate height
p1_with_signif =
  p1 +
  geom_signif(
    comparisons =
      list(
        c("feminine", "masculine")
      ),
    map_signif_level = TRUE
  )

# Save it
p1 = p1_with_signif

print(p1)
```

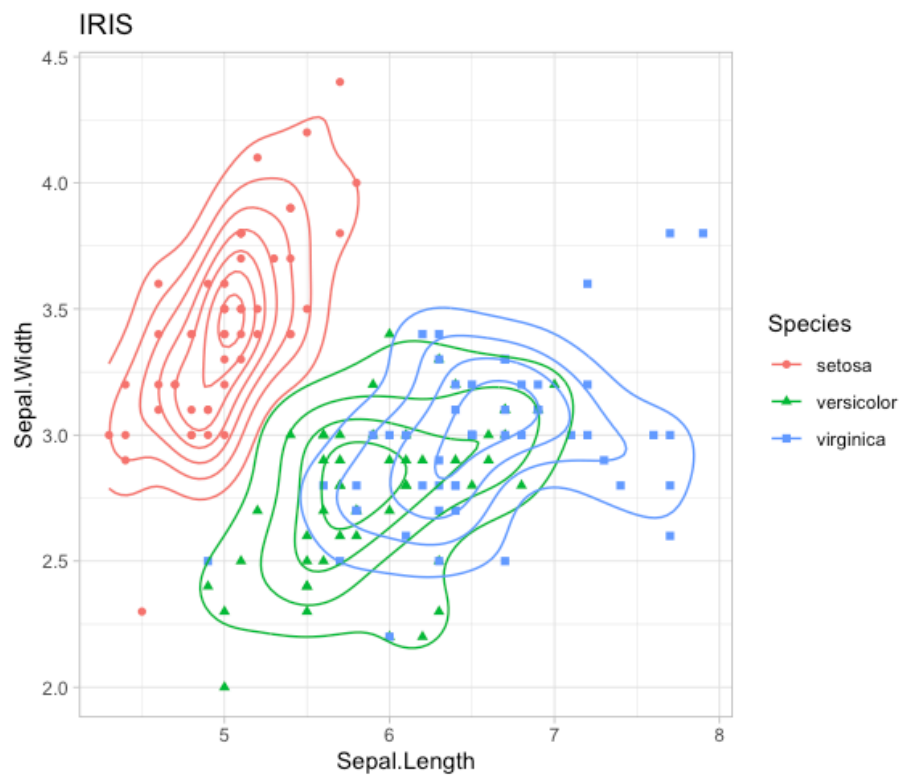




#### 0.4.4 用 ggplot 作图：使用 iris 做图

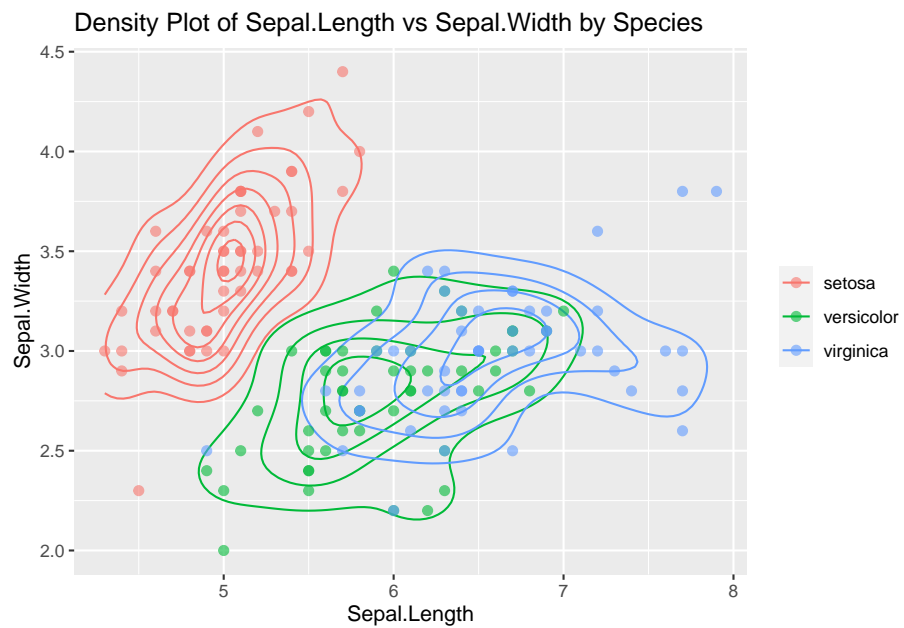
用 `geom_density2d` 显示 `Sepal.Length` 和 `Sepal.Width` 之间的关系，同时以 `Species` 为分组，结果如图所示：

将此图的结果保存为变量 `p2`，以备后面使用；



```
## 代码写这里，并运行；  
library(ggplot2)  
library(tidyverse)  
  
# Draw the plot  
p2 =  
  ggplot(  
    iris,  
    aes(  
      x = Sepal.Length,  
      y = Sepal.Width,  
      color = Species  
    )  
  ) +
```

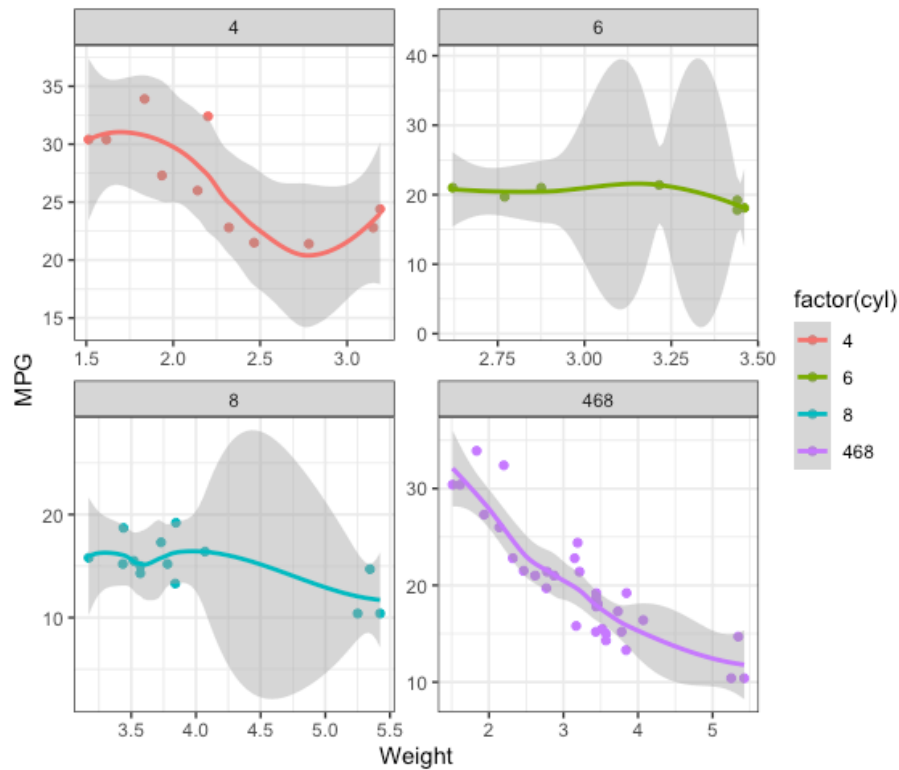
```
geom_density2d() +  
geom_point(  
  aes(color = Species),  
  size = 2,  
  alpha = 0.6) +  
labs(  
  title = "Density Plot of Sepal.Length vs Sepal.Width by Species",  
  x = "Sepal.Length",  
  y = "Sepal.Width"  
) +  
theme(  
  legend.title = element_blank()  
)  
  
print(p2)
```



### 0.4.5 用 ggplot 作图: facet

用 `mtcars` 作图, 显示 `wt` 和 `mpg` 之间的关系, 但用 `cyl` 将数据分组; 见下图:

将此图的结果保存为变量 `p3`, 以备后面使用;



注此图中的 468 组为所有数据合在一起的结果。

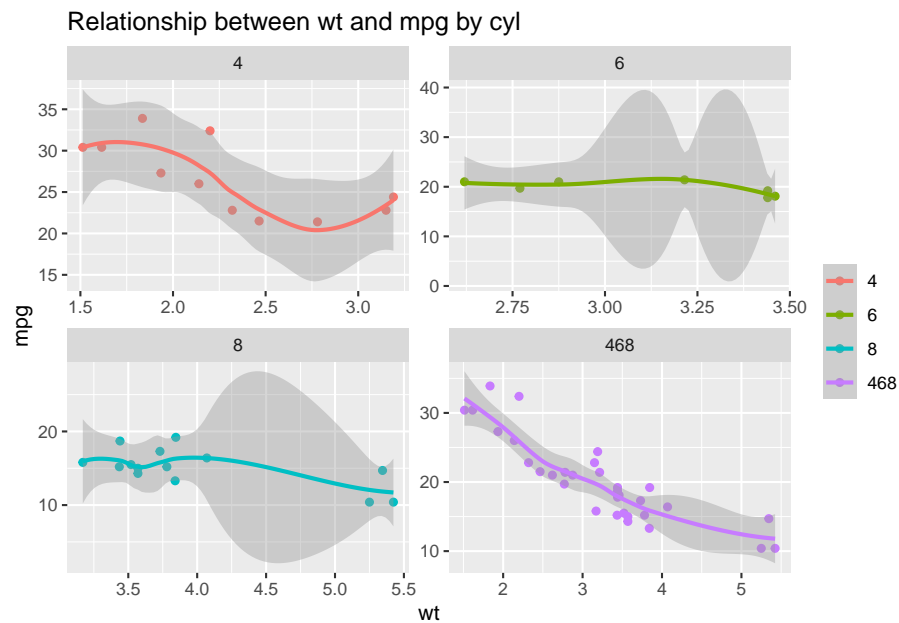
```
## 代码写这里, 并运行;  
library(ggplot2)  
library(tidyverse)  
library(dplyr)  
  
# Load data  
data(mtcars)
```

```
# Create new data that combines all data
mtcars_modified =
  mtcars %>%
    mutate(cyl = ifelse(cyl %in% c(4, 6, 8), 468, cyl))
mtcars_filtered =
  mtcars_modified %>%
    filter(cyl == 468)
merged_mtcars =
  bind_rows(mtcars, mtcars_filtered)

# Creating facet graphics
p3 =
  ggplot(merged_mtcars, aes(x = wt, y = mpg)) +
    geom_point(aes(color = factor(cyl))) +
    geom_smooth(aes(color = factor(cyl))) +
    labs(title = "Relationship between wt and mpg by cyl", x = "wt", y = "mpg") +
    theme(legend.title = element_blank()) +
    facet_wrap(. ~ cyl,
              ncol = 2,
              dir = "h",
              scales = "free",
              drop = FALSE)

# Save it
p3
```

```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



#### 0.4.6 用 ggplot 作图: facet 2

用 `airquality` 作图，显示 `Wind` 和 `Temp` 之间的关系，用 `Month` 将数据分组；得到的子图按 2 行 3 列组织。

注画点线图，并增加 `smooth` 图层。

```
## 代码写这里，并运行；
library(ggplot2)

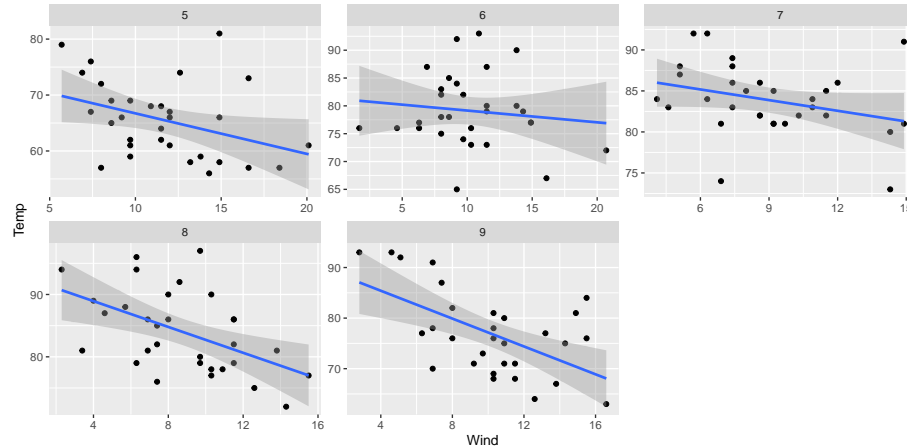
# Creating Scatterplots
ggplot(
  airquality,
  aes(
    x = Wind,
    y = Temp
  )
) +
```

```

# Draw the dots
geom_point() +
# Add smooth layer and
# fit using a linear model
geom_smooth(
  method = "lm"
) +
# Grouping with Month and
# organizing subgraphs by 2 rows and 3 columns
facet_wrap(
  ~ Month,
  ncol = 3,
  scales = "free"
)

```

## `geom\_smooth()` using formula = 'y ~ x'

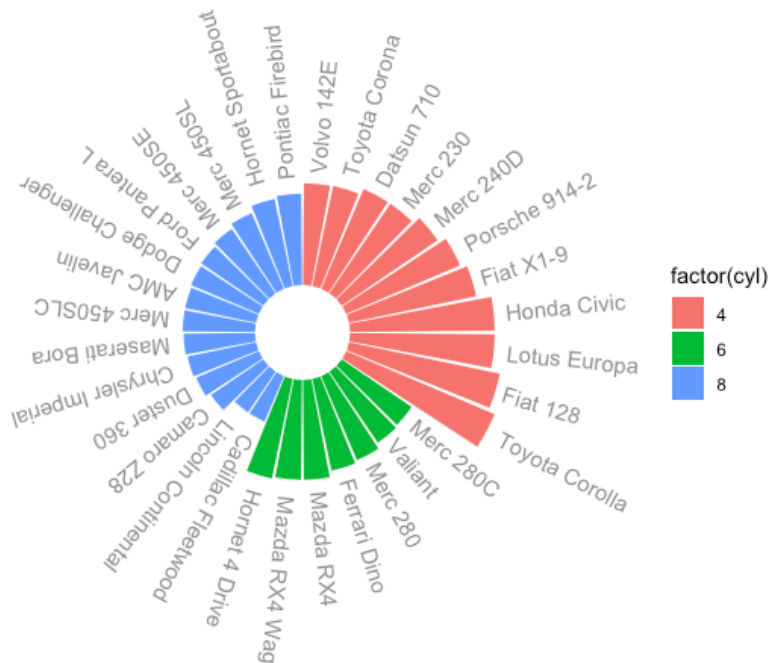


#### 0.4.7 用 ggplot 作图：用 mtcars 做 polar 图

用 mtcars 的 mpg 列做如下图，要求：先按 cyl 排序；每个 cyl 组内按 mpg 排序；将此图的结果保存为变量 p4，以备后面使用；

## 提示

1. 先增加一列,用于保存 rowname: `mtcars %>% rownames_to_column()`  
注: 将行名变为列, 列名为 `rowname`
2. 完成排序
3. 更改 rowname 的 factor
4. 计算每个 rowname 的旋转角度: `mutate( id = row_number(),  
angle = 90 - 360 * (id - 0.5) / n() )`



```
## 代码写这里, 并运行;
# Load the packages
library(ggplot2)
library(tidyverse)
library(dplyr)

data(mtcars)
```



```
# Add a column to save row names
mtcars_named =
  mtcars %>% rownames_to_column(var = "car_name")

# Sorted data
mtcars_arranged =
  mtcars_named %>%
  arrange(cyl, mpg)

# Factors for changing line names
mtcars_arranged$car_name =
  factor(
    mtcars_arranged$car_name,
    levels = mtcars_arranged$car_name)

# Calculate the rotation angle for each line name
mtcars_arranged =
  mtcars_arranged %>%
  mutate(id = row_number(),
         angle = 90 - 360 * (id - 0.5) / n())

# Creating a Coordinate Chart
p4 =
  ggplot(
    mtcars_arranged,
    aes(
      x = car_name,
      y = mpg,
      fill = factor(cyl)
    )
  ) +
  scale_y_continuous(expand = c(0.01, max(mtcars_arranged$mpg)/3)) +
```

```
geom_bar(stat = "identity") +
coord_polar(theta = "x") +
# Change the
geom_text(
  aes(x = 1:length(mtcars_arranged$car_name),
      label = mtcars_arranged$car_name,
      angle = mtcars_arranged$angle,
      hjust = -0.05
  )
) +

# Change the theme
# Hide the axis lable
theme(
  panel.grid.major =
    element_blank(),
  panel.grid.minor =
    element_blank()) +
theme(
  axis.ticks =
    element_blank(),
  axis.text.y =
    element_blank(),
  axis.text.x =
    element_blank()) +

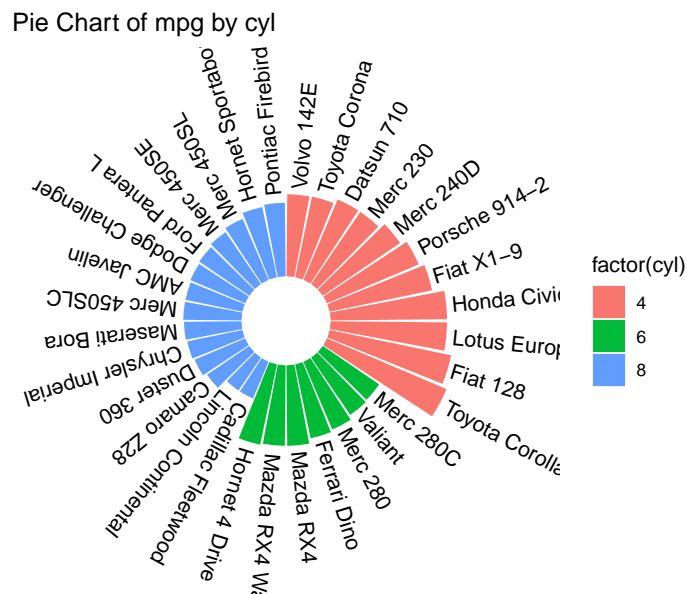
# Make the background color transparent
theme(
  panel.background =
    element_rect(
      fill = "transparent",
      colour = NA),
  plot.background =
```

```

element_rect(
  fill = "transparent",
  colour = NA)) +
labs(
  x = "",
  y = "",
  title = "Pie Chart of mpg by cyl")

# Save to p4
p4

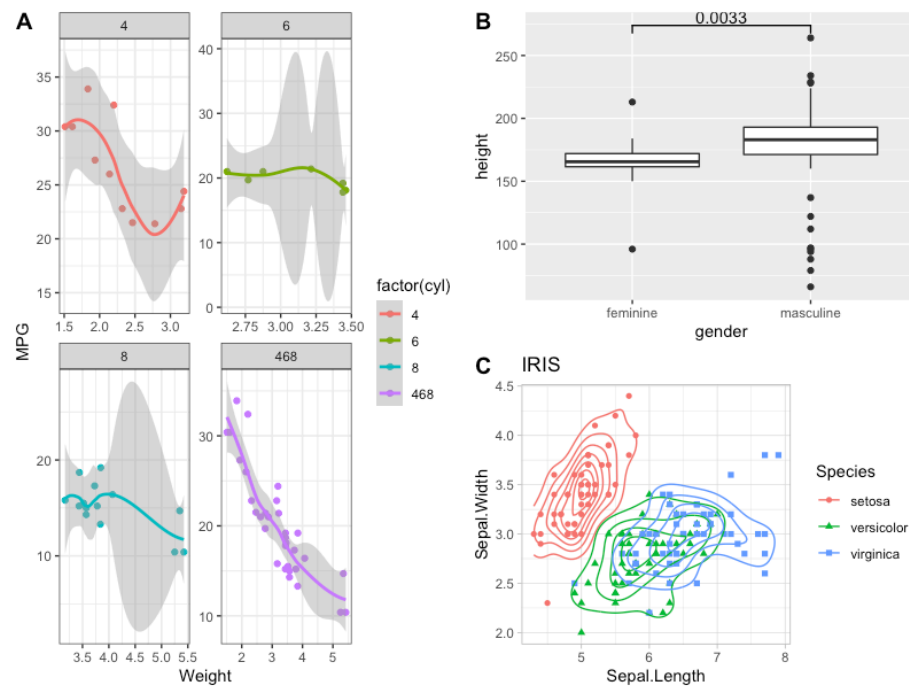
```



## 0.5 练习与作业 2：多图组合，将多个图画在一起

### 0.5.1 用 `cowplot::ggdraw` 将 p1, p2 和 p3 按下面的方式组合在一起

注：需要先安装 `cowplot` 包



```
## 代码写这里，并运行；
```

```
library(ggplot2)
```

```
library(cowplot)
```

```
##
```

```
## Attaching package: 'cowplot'
```

```
## The following object is masked from 'package:lubridate':
```

```
##
```

```
## stamp
```

```
# Combine the plots
```

```
combined_plot_01 =
```

```
  ggdraw() +
```

```
  draw_plot(
```

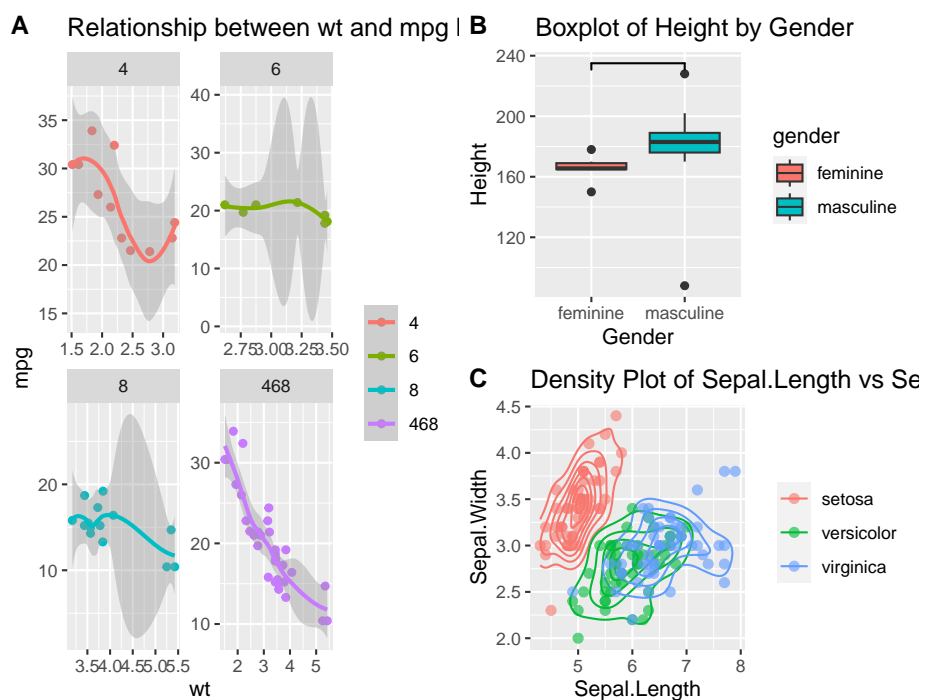
```
    plot = p3,
```

```
    x = 0,
```

```
    y = 0,  
    width = 0.5,  
    height = 1  
  ) +  
  draw_plot(  
    plot = p1,  
    x = 0.5,  
    y = 0.5,  
    width = 0.5,  
    height = 0.5  
  ) +  
  draw_plot(  
    plot = p2,  
    x = 0.5,  
    y = 0,  
    width = 0.5,  
    height = 0.5  
  ) +  
  draw_plot_label(  
    label = c("A", "B", "C"),  
    x = c(0, 0.5, 0.5),  
    y = c(1, 1, 0.5),  
    size = 13  
  )  
)
```

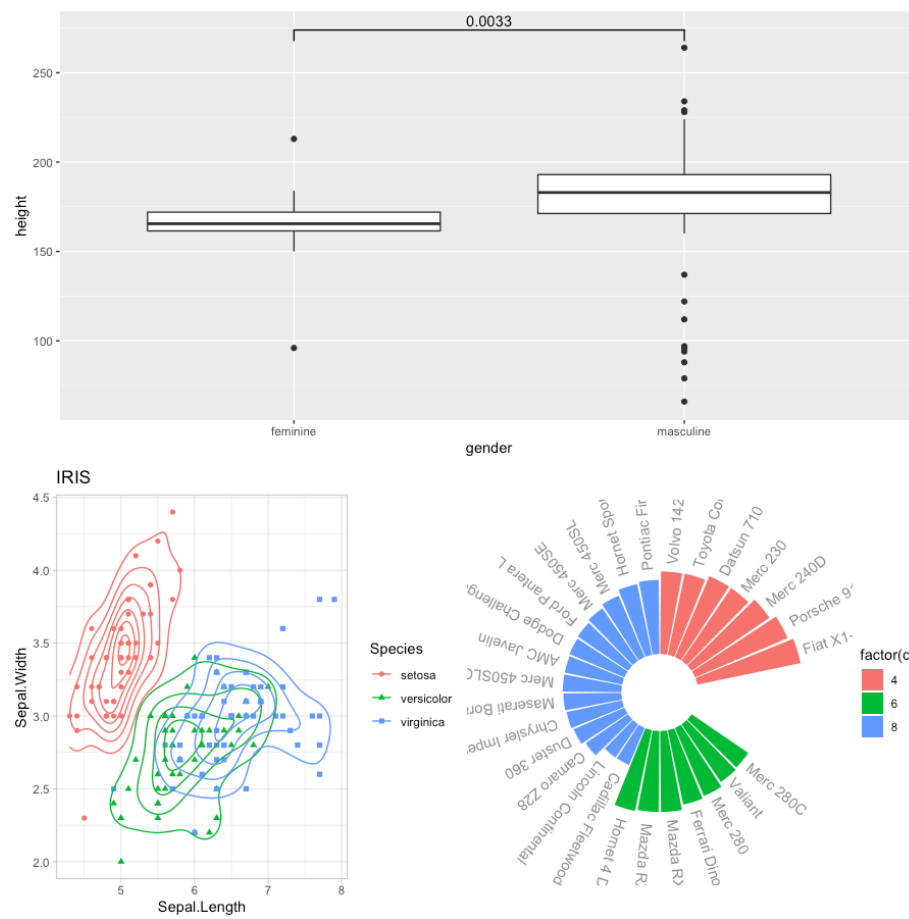
```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```

```
ggdraw(combined_plot_01)
```



### 0.5.2 用 `gridExtra::grid.arrange()` 函数将 p1, p2, p4 按下面的方式组合在一起

注：1. 需要安装 `gridExtra` 包；2. 请为三个 panel 加上 A, B, C 字样的标签。



```
## 代码写这里，并运行；
library(gridExtra)
```

```
##
## Attaching package: 'gridExtra'
```

```
## The following object is masked from 'package:dplyr':
```

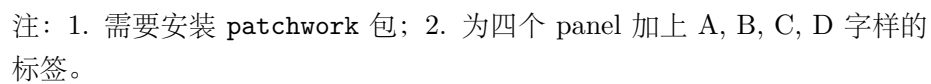
```
##
```

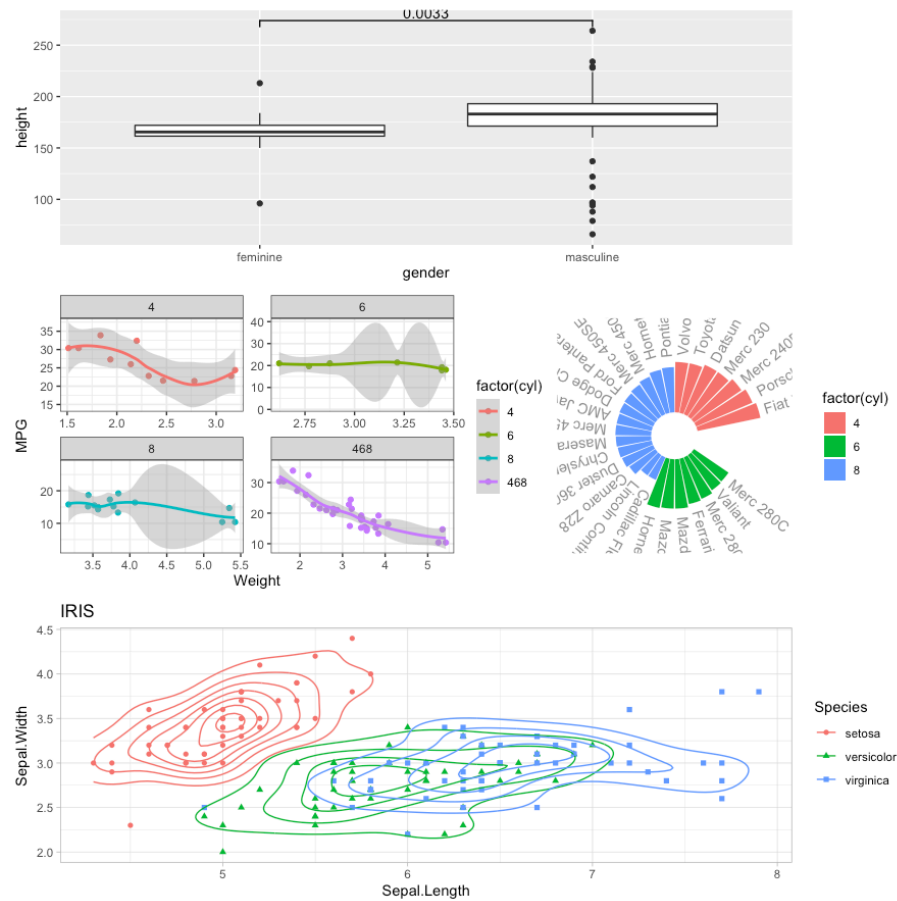
```
##      combine
```

```
# Add the tags
p1 =
  p1 +
  labs(tag = "A")
p2 =
  p2 +
  labs(tag = "B")
p4 =
  p4 +
  labs(tag = "C")

# Draw the plot
combined_plot_02 =
  grid.arrange(
    newpage = TRUE,
    p1,p2,p4,
    ncol = 2,
    layout_matrix =
      cbind(c(1, 2), c(1, 3))
  )
```







```
## 代码写这里，并运行；
```

```
library(ggplot2)
library(patchwork)
```

```
##
```

```
## Attaching package: 'patchwork'
```

```
## The following object is masked from 'package:cowplot':
```

```
##
```

```
## align_plots
```

```
# Add the tags
p1 =
  p1 +
  labs(tag = "A")
p2 =
  p2 +
  labs(tag = "D")
p3 =
  p3 +
  labs(tag = "B")
p4 =
  p4 +
  labs(tag = "C")

# Draw the plot
layout_03 =
  "
  AAAA
  BBCC
  DDDD
  "

combined_plot_03 =
  p1/p3/p4/p2 +
  plot_layout(
    design = layout_03,
    ncol = 2,
    nrow = 3,
    heights = c(1, 1, 1, 1),
    widths = c(2, 1, 1, 2)
  )

print(combined_plot_03)
```

```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



## 0.6 练习与作业 3：作图扩展

---

### 0.6.1 scatterplot

安装 `lattice` 包，并使用其 `splom` 函数作图：

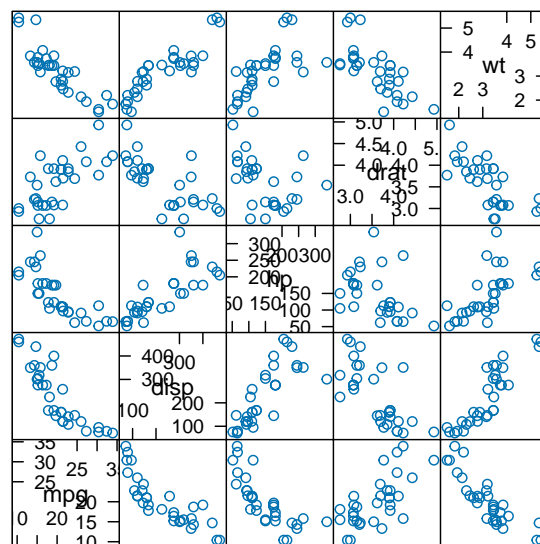
```
lattice::splom( mtcars[c(1,3,4,5,6)] )
```

```
## 代码写这里，并运行；
```

```
library(lattice)
```

```
library(tidyverse)
```

```
splom(mtcars[c(1, 3, 4, 5, 6)])
```



Scatter Plot Matrix