



國立臺灣大學

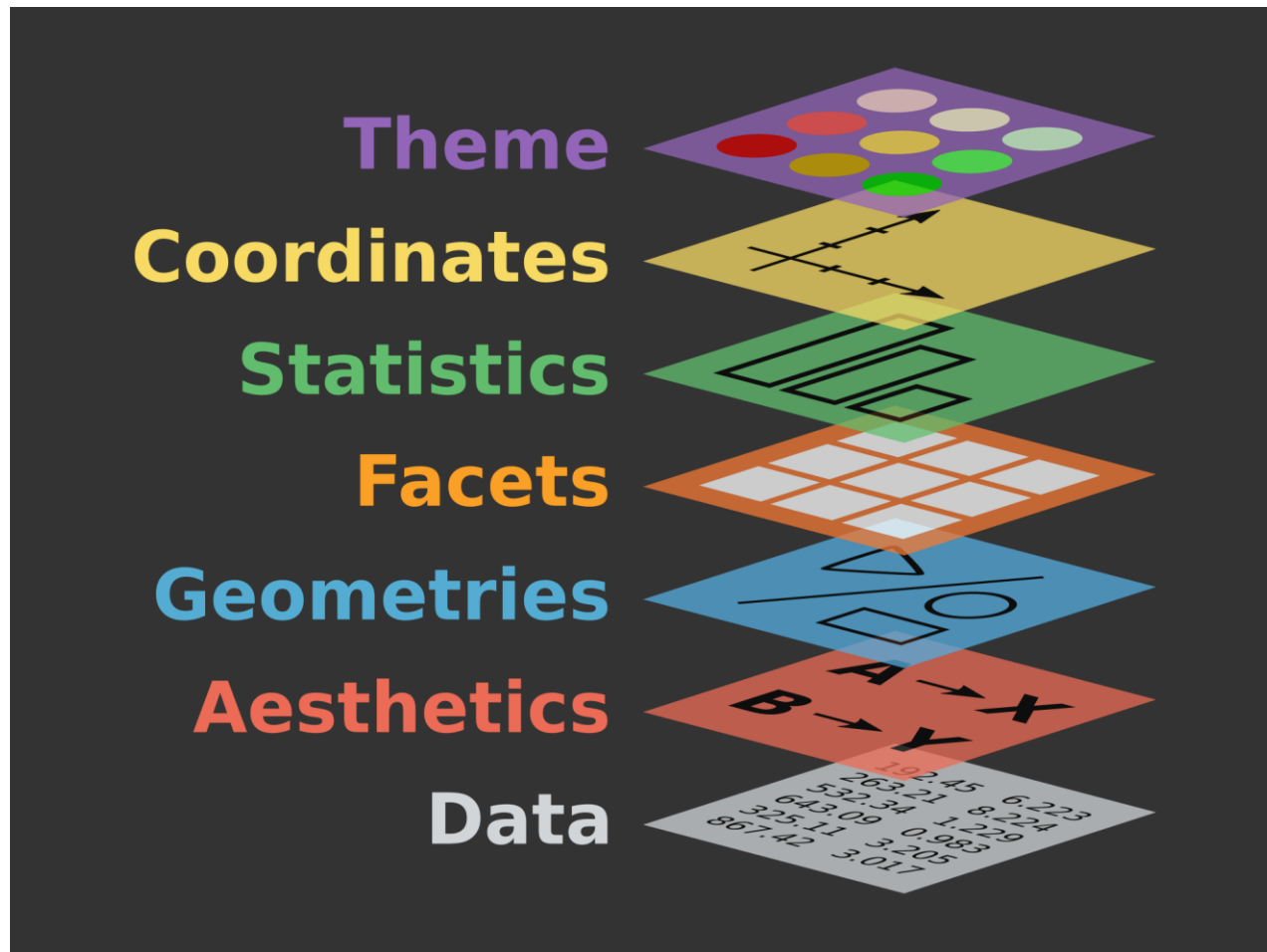
National Taiwan University

使用R語言進行資料分析 Using R for Data Analysis

國立臺灣大學共同教育中心

助理教授 蔡芸琇

ggplot2 繪圖文法

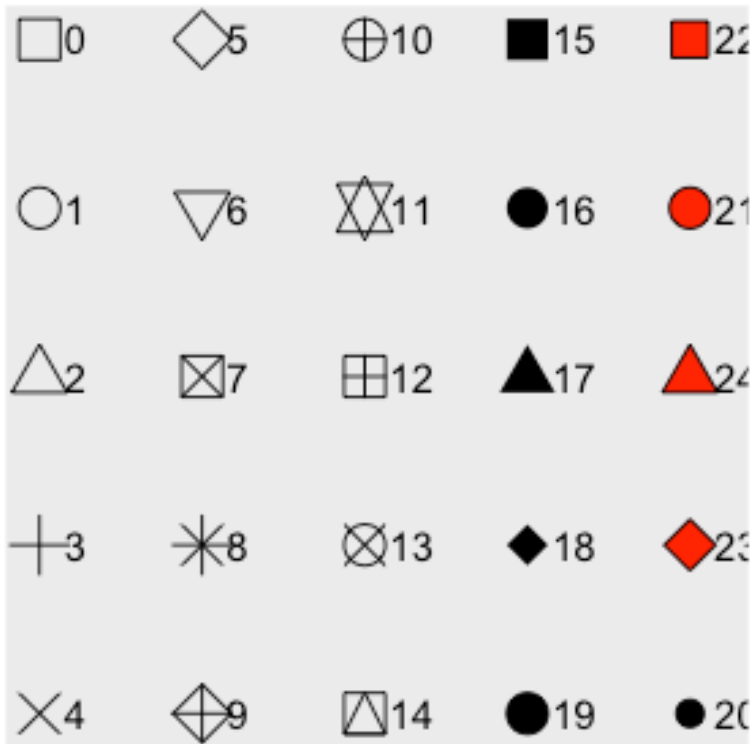


<https://blog.gtwang.org/r/ggplot2-tutorial-basic-concept-and-qplot/>
<http://ggplot2.tidyverse.org/reference/>

ggplot2 繪圖文法

- ▶ 資料來源 (data) : 指定原始資料來源的 data frame。
- ▶ 美學對應 (aesthetic) : 指定原始資料與圖形之間的對應關係，例如哪一個變數要當作 x 座標變數，而哪一個要當作 y 座標變數，還有資料繪圖時的樣式等。
- ▶ 幾何圖案 (geometry) : 要用什麼幾何圖形繪製資料，例如點、線條、多邊形等。

Aesthetic



shape

linetype

Geometry

- ▶ 直條圖：geom_bar()
- ▶ 線：geom_line()
- ▶ 點：geom_point()
- ▶ 階梯：geom_step()
- ▶ 路徑：geom_path()
- ▶ 盒形圖：geom_boxplot()

ggplot2 繪圖文法

- ▶ 繪圖面 (**facet**) : 指定如何將資料分散在多張子圖形中繪製，以利互相比較。
- ▶ 統計轉換 (**statistical transformation**) : 指定如何以將資料轉換為各種統計量。
- ▶ 座標系統 (**coordinate system**) : 指定繪圖時所使用的座標系統。
- ▶ 主題 (**theme**) : 控制資料以外的繪圖組件，例如座標軸、說明文字等。

<https://blog.gtwang.org/r/ggplot2-tutorial-basic-concept-and-qplot/>

未統計資料

RStudio Source Editor

raw x

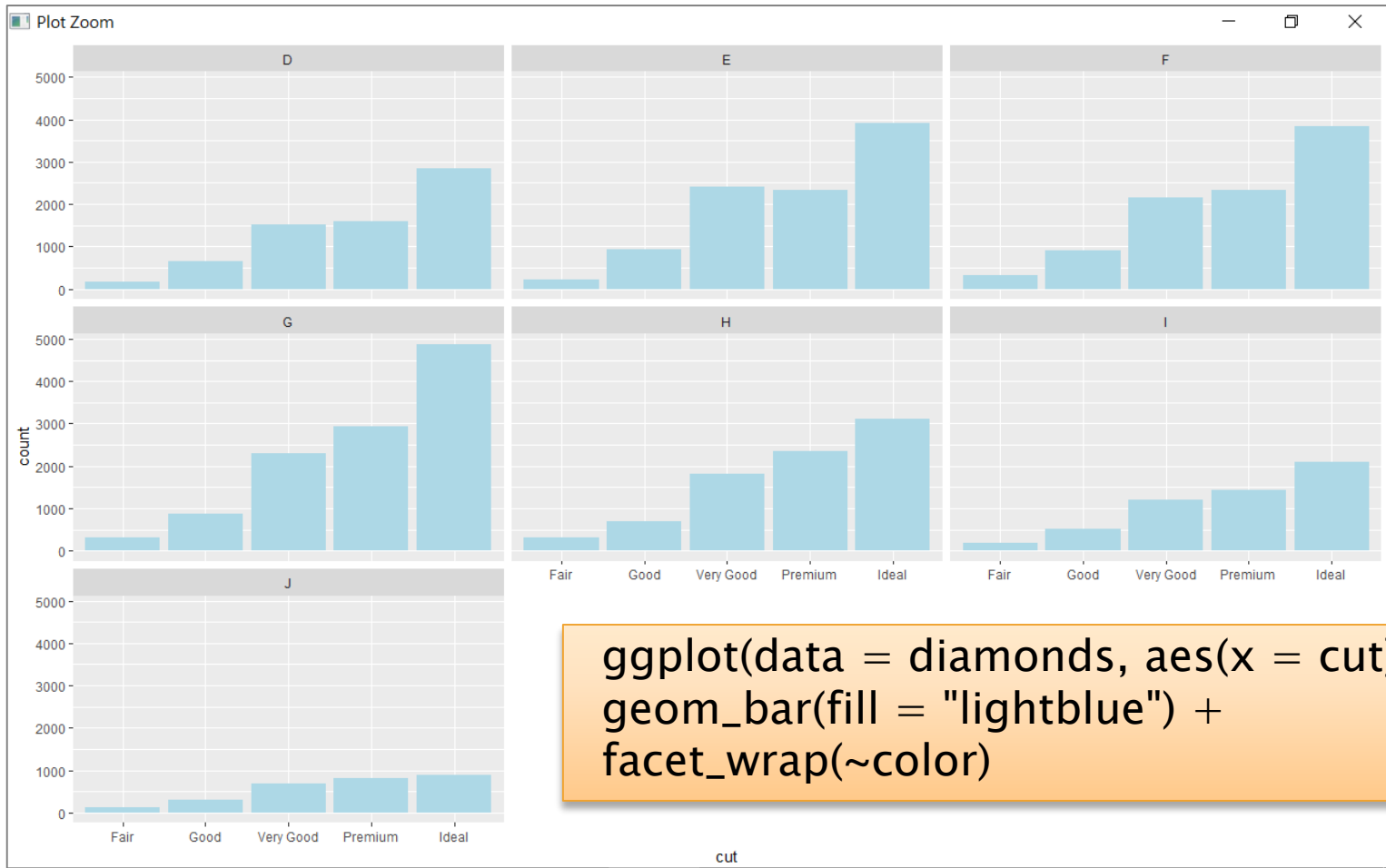
Filter

	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88		
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35		
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79		
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70
19	0.30	Good	J	SI1	63.8	56.0	351	4.23	4.26	2.71
20	0.30	Very Good	J	SI1	62.7	59.0	351	4.21	4.27	2.66
21	0.30	Good	I	SI2	63.3	56.0	351	4.26	4.30	2.71
22	0.23	Very Good	E	VS2	63.8	55.0	352	3.85	3.92	2.48
23	0.23	Very Good	H	VS1	61.0	57.0	353	3.94	3.96	2.41
24	0.31	Very Good	J	SI1	59.4	62.0	353	4.39	4.43	2.62
25	0.31	Very Good	J	SI1	58.1	62.0	353	4.44	4.47	2.59
26	0.23	Very Good	G	VVS2	60.4	58.0	354	3.97	4.01	2.41
27	0.24	Premium	I	VS1	62.5	57.0	355	3.97	3.94	2.47
28	0.30	Very Good	J	VS2	62.2	57.0	357	4.28	4.30	2.67
29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40
30	0.23	Very Good	E	VS1	60.0	57.0	357	3.95	3.98	2.43

Showing 1 to 30 of 53,940 entries

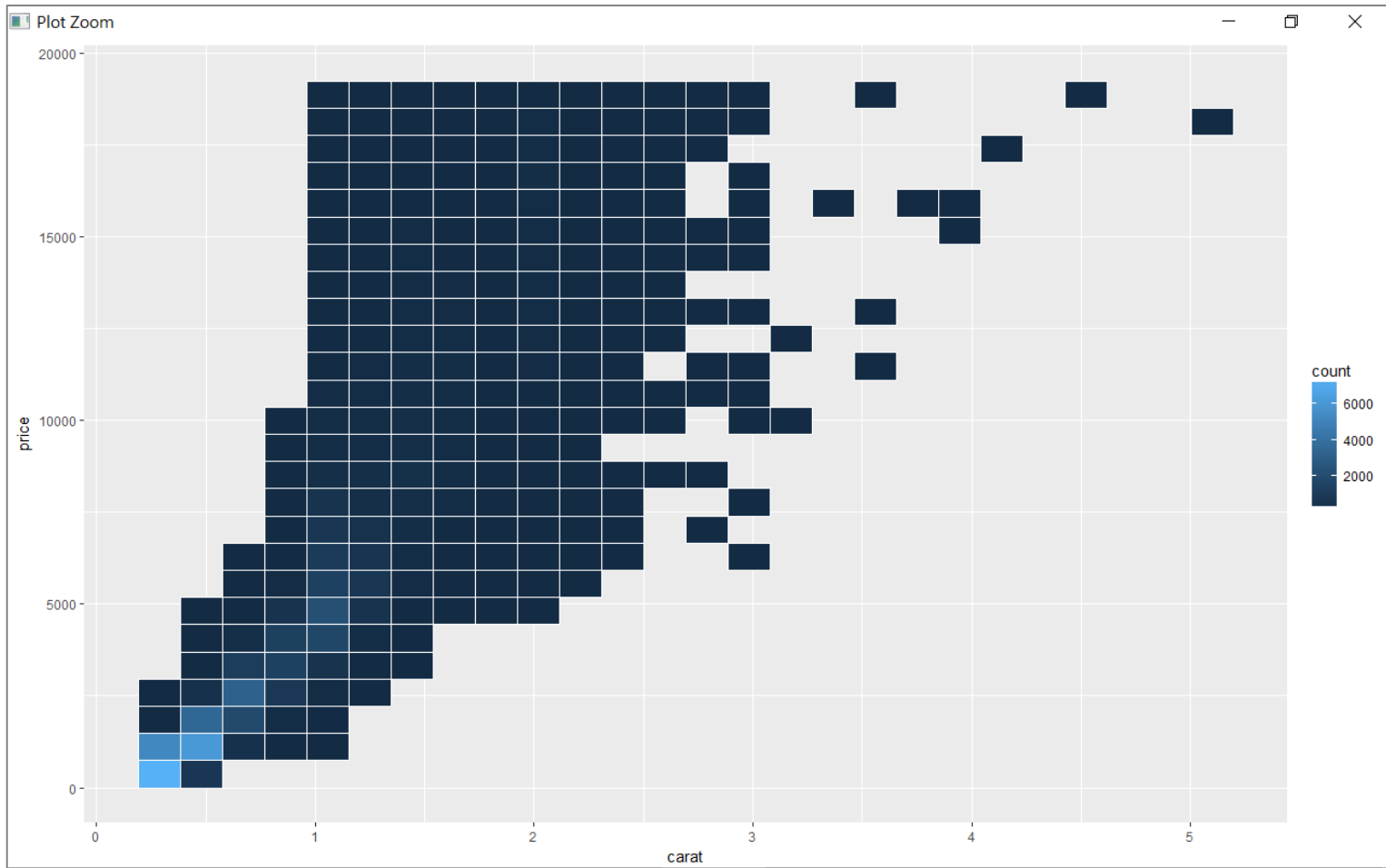
diamonds

繪圖面 (facet)



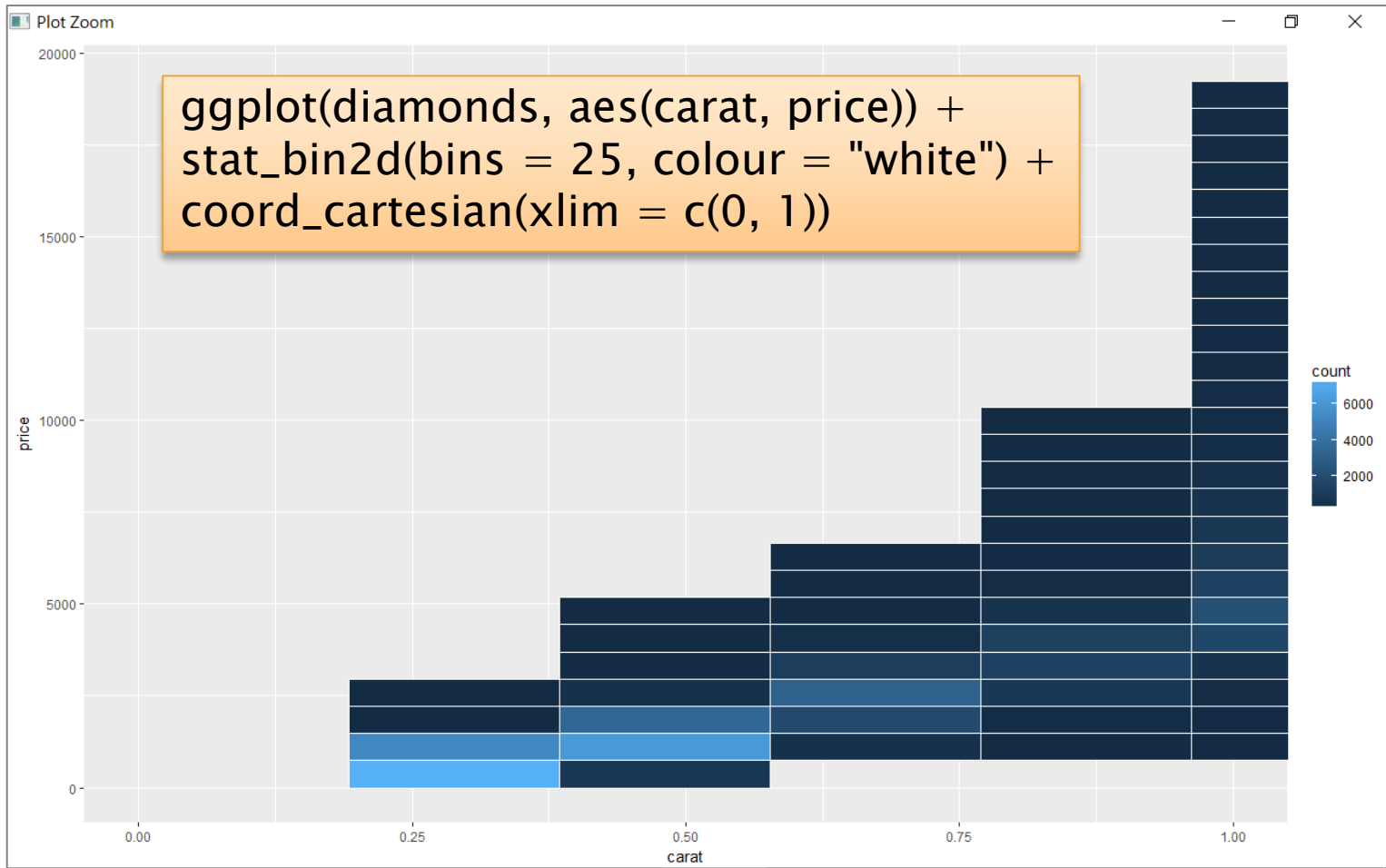
```
ggplot(data = diamonds, aes(x = cut)) +  
  geom_bar(fill = "lightblue") +  
  facet_wrap(~color)
```


Statistical Transformation



```
ggplot(diamonds, aes(carat, price)) +  
  stat_bin2d(bins = 25, colour = "white")
```

Coordinate System

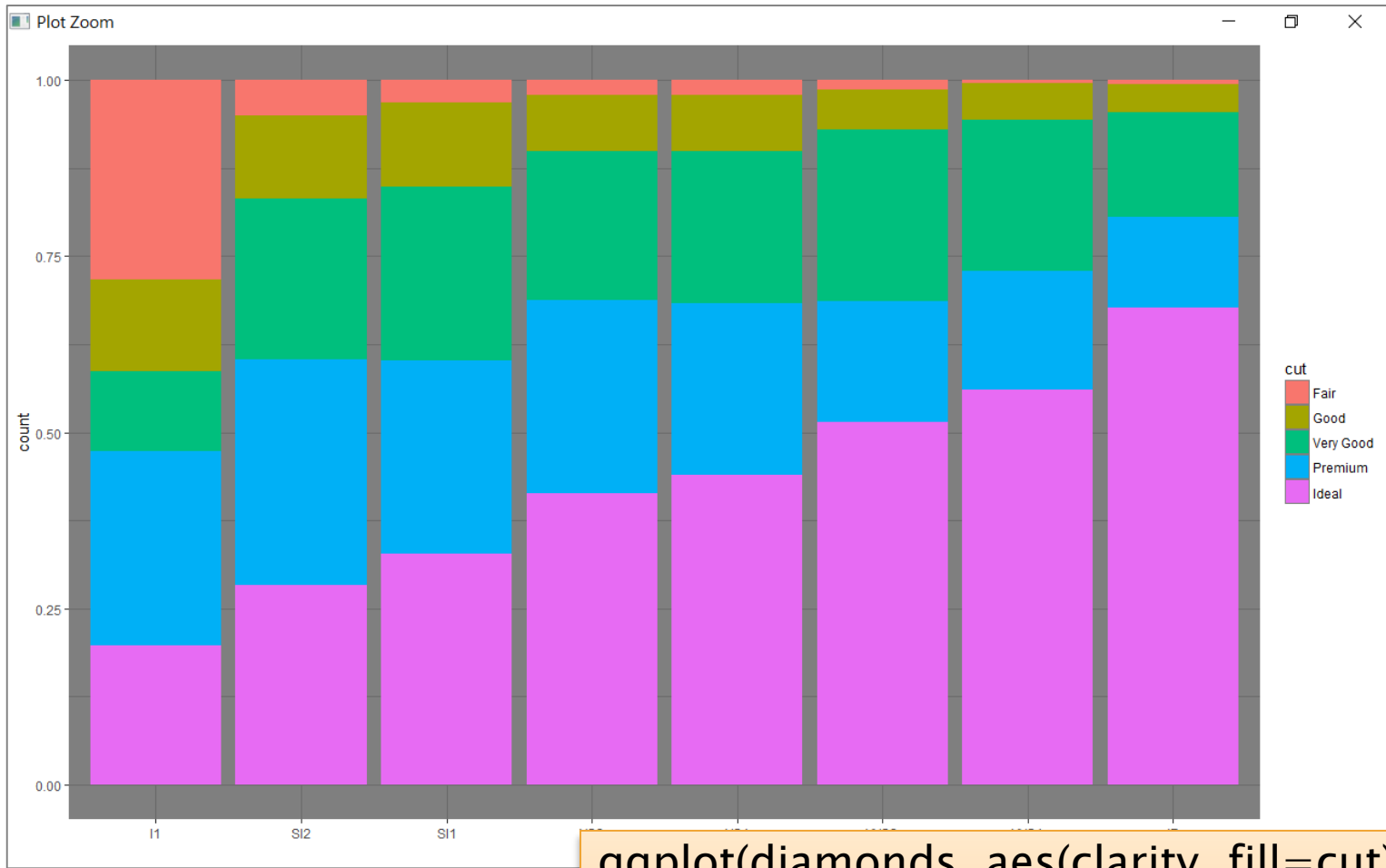


Theme

- ▶ `theme_bw()`
- ▶ `theme_classic()`
- ▶ `theme_dark()`
- ▶ `theme_get()`
- ▶ `theme_gray()`
- ▶ `theme_grey()`
- ▶ `theme_light()`
- ▶ `theme_linedraw()`
- ▶ `theme_minimal()`

<https://www.r-bloggers.com/ggplot2-themes-examples/>

Theme



```
ggplot(diamonds, aes(clarity, fill=cut)) +  
geom_bar(position="fill") +  
theme_dark()
```

應用 ggplot2

- ▶ ggplot2 中的 gg 分別為 grammar graphics
- ▶ 字面上的意思就是，用程式文法來控制圖形
- ▶ 依序介紹
 - 折線圖
 - 長條圖
 - 散佈圖
 - 堆疊直方圖
 - 盒形圖

折線圖 - 單線資料

The screenshot displays the RStudio interface with the following components:

- Source Editor:** Contains R code for installing ggplot2, loading the library, and creating a data frame 'df' with columns 'dose' and 'len'.
- Console:** Shows the execution of the code, including the creation of the data frame and the output of the 'head(df)' command.
- Environment Pane:** Shows the 'Data' environment with 'df' having 3 observations.
- Viewer Pane:** Displays the 'R: Matrices' help page, explaining that a matrix is a special case of a two-dimensional array.

```
1 #install.packages("ggplot2")
2 library(ggplot2)
3 df <- data.frame(c("D0.5", "D1", "D2"),
4                  c(4.2, 10, 29.5))
5 names(df) <- c("dose", "len")
6 head(df)
```

Console output:

```
+                  c(4.2, 10, 29.5))

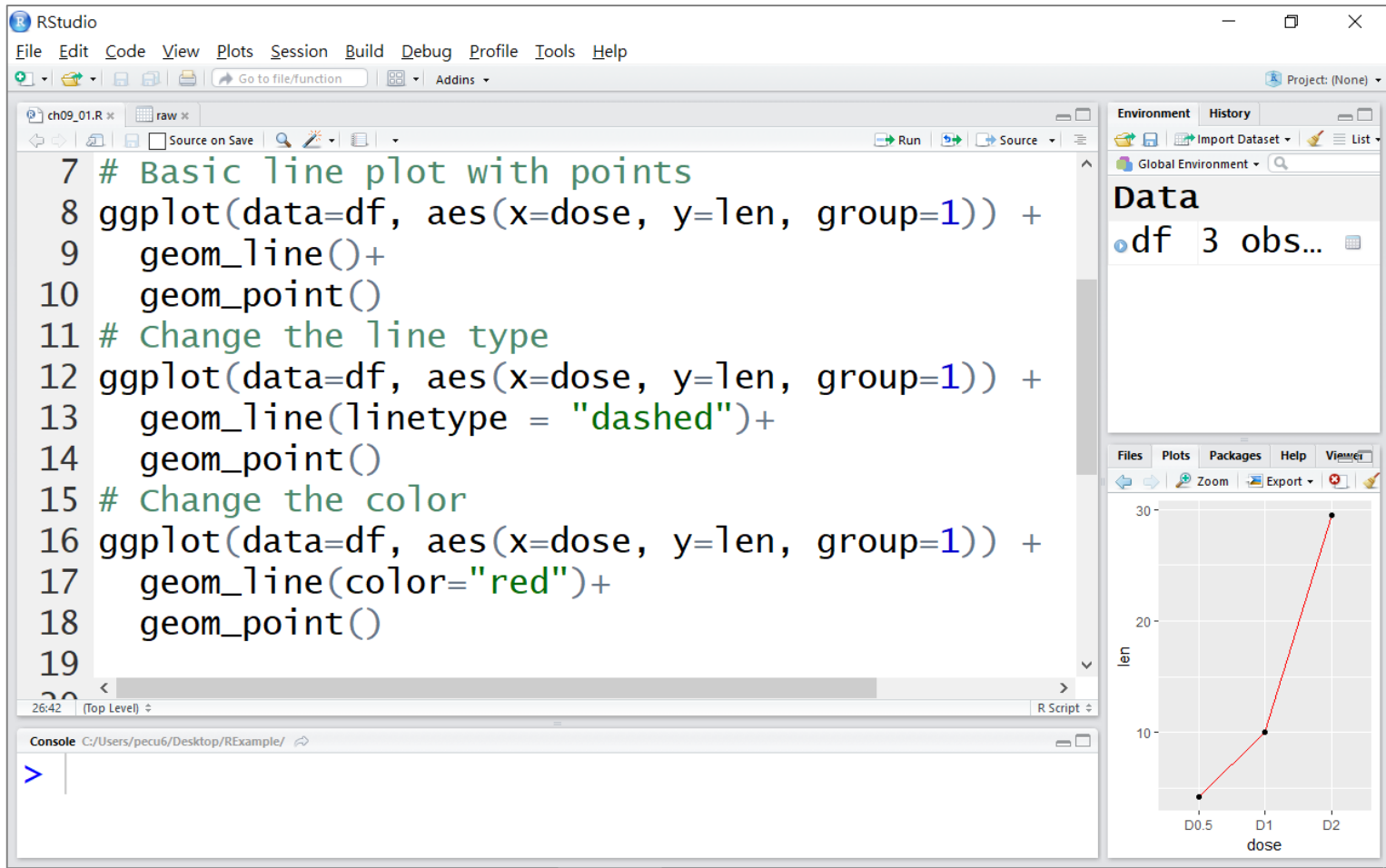
> names(df) <- c("dose", "len")

> head(df)
  dose len
1 D0.5  4.2
2   D1 10.0
3   D2 29.5
>
```

Environment pane shows 'df' with 3 observations.

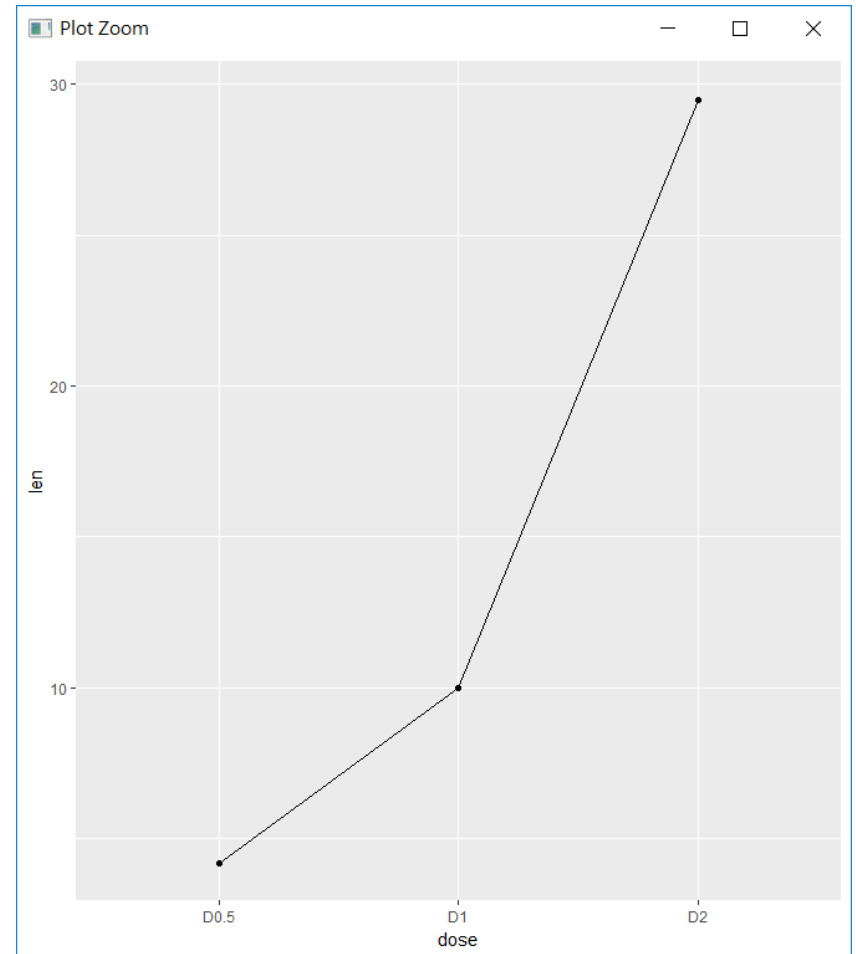
Viewer pane shows 'R: Matrices' help page.

折線圖 - 單線



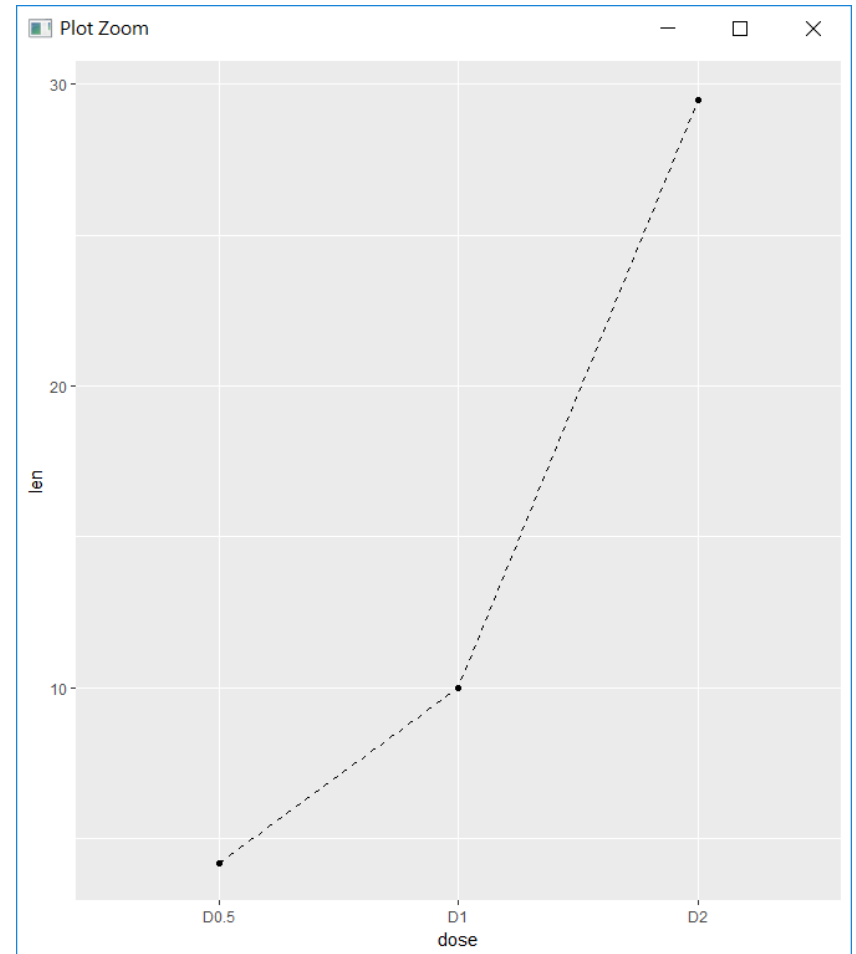
折線圖 - 單線

```
ggplot(data=df,  
  aes(x=dose, y=len,  
    group=1)) +  
  geom_line() +  
  geom_point()
```



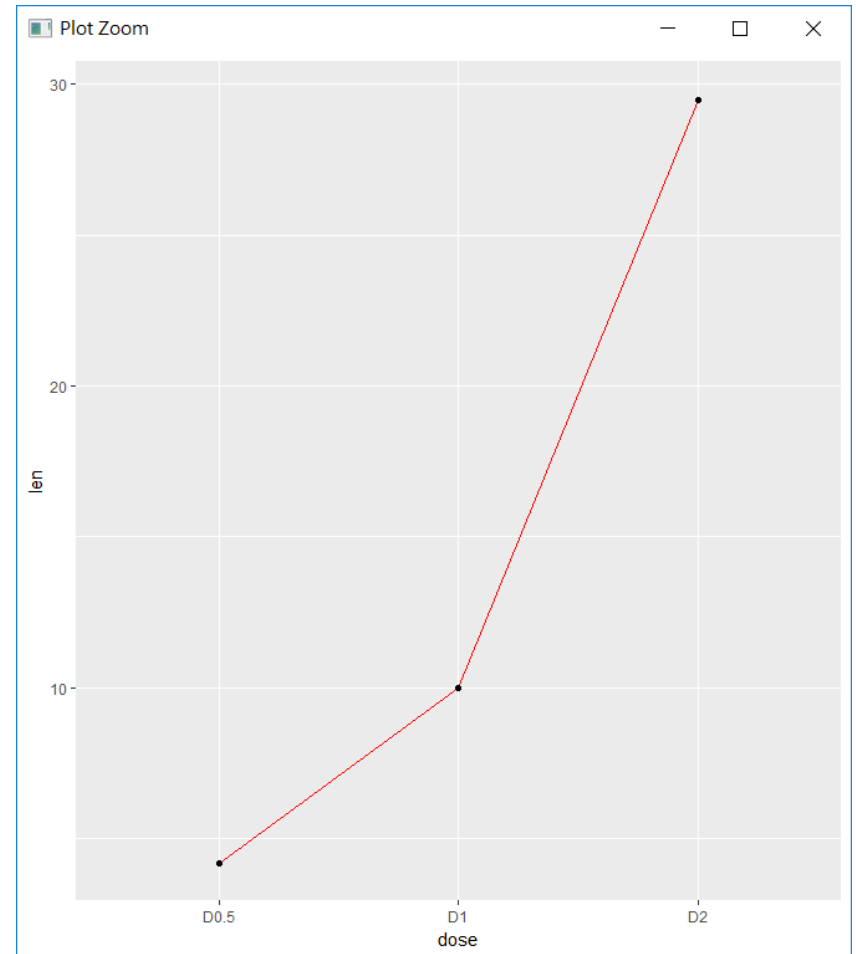
折線圖 - 單線

```
ggplot(data=df,  
  aes(x=dose, y=len,  
    group=1)) +  
  geom_line(linetype =  
    "dashed") +  
  geom_point()
```

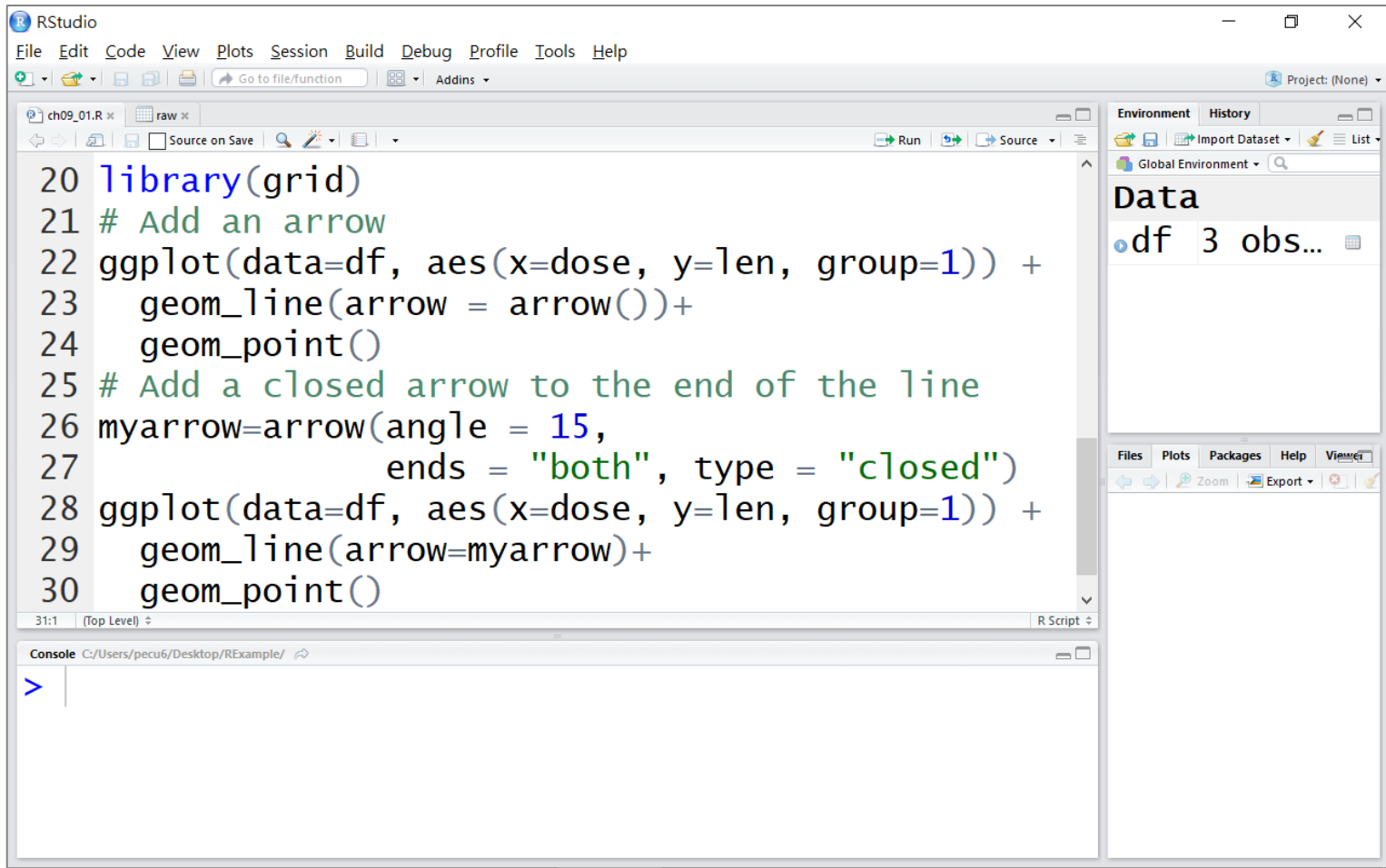


折線圖 - 單線

```
ggplot(data=df,  
  aes(x=dose, y=len,  
    group=1)) +  
  geom_line(color="red") +  
  geom_point()
```



折線圖 - 單線



The screenshot shows the RStudio interface with a script editor containing R code for creating a single line plot with arrows. The code uses the ggplot2 package and includes comments in green. The environment pane on the right shows a data frame 'df' with 3 observations. The console at the bottom is empty, showing the R prompt '>'. The status bar at the bottom indicates the file path 'C:/Users/pecu6/Desktop/RExample/'.

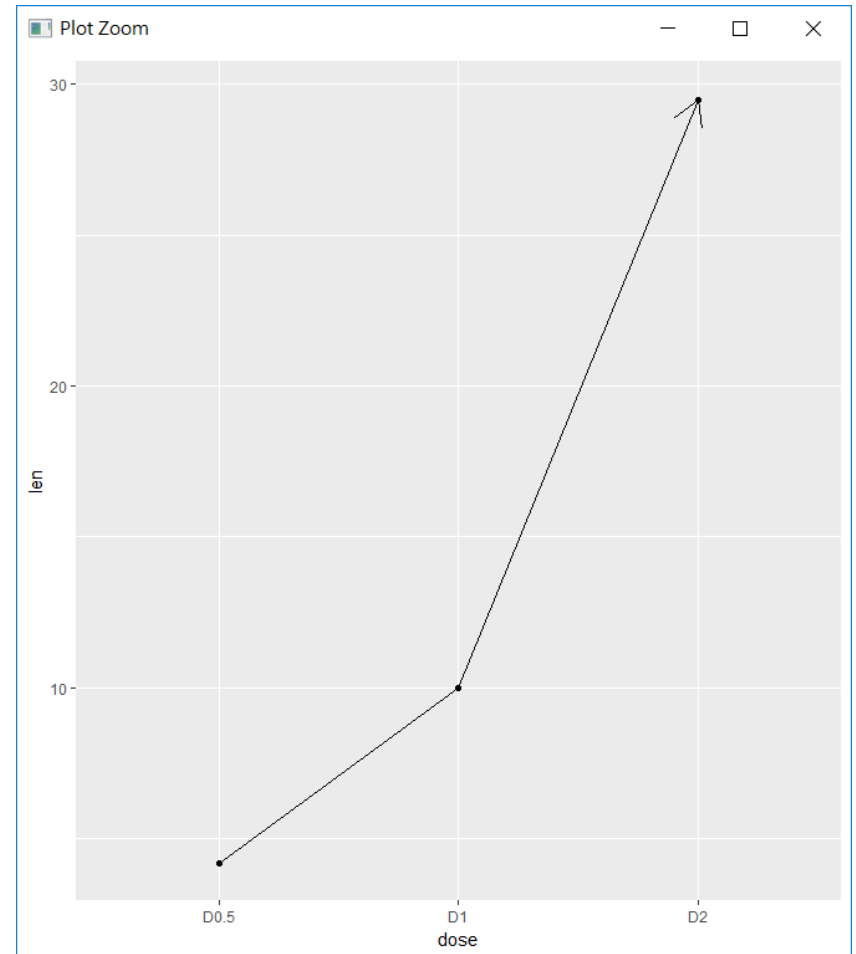
```
20 library(grid)
21 # Add an arrow
22 ggplot(data=df, aes(x=dose, y=len, group=1)) +
23   geom_line(arrow = arrow()) +
24   geom_point()
25 # Add a closed arrow to the end of the line
26 myarrow=arrow(angle = 15,
27               ends = "both", type = "closed")
28 ggplot(data=df, aes(x=dose, y=len, group=1)) +
29   geom_line(arrow=myarrow) +
30   geom_point()
```

Environment: Global Environment
Data: df 3 obs...

Console: C:/Users/pecu6/Desktop/RExample/

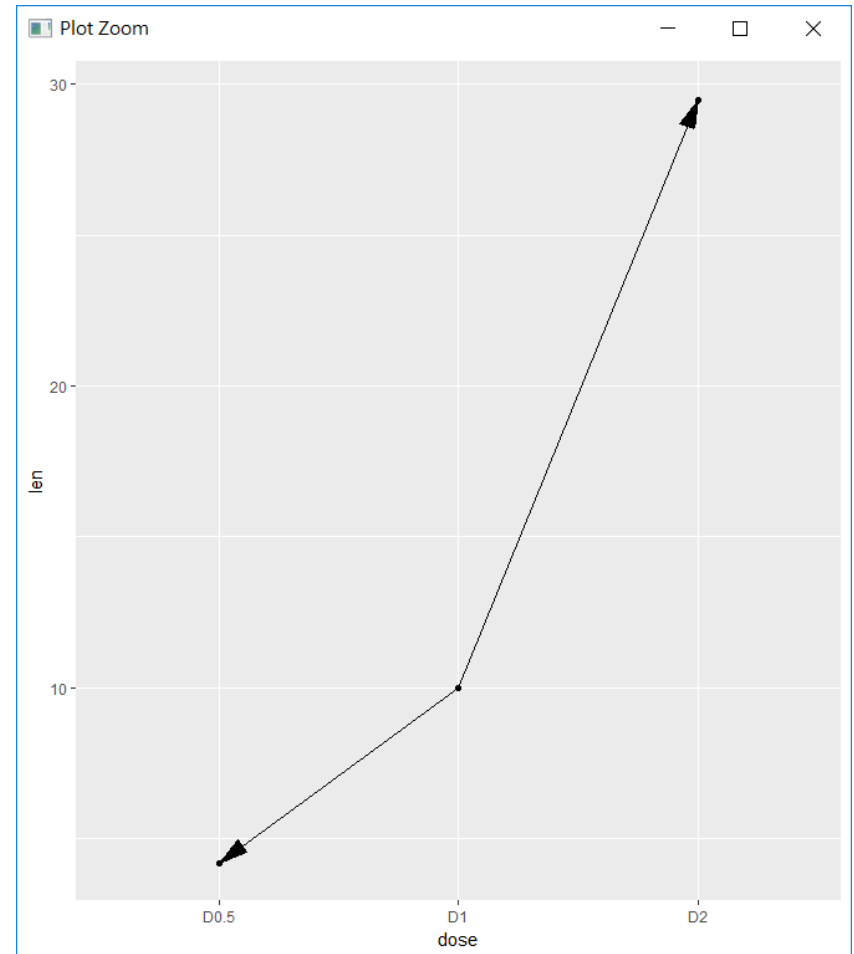
折線圖 - 單線

```
ggplot(data=df,  
  aes(x=dose, y=len,  
    group=1)) +  
  geom_line(arrow =  
    arrow()) +  
  geom_point()
```



折線圖 - 單線

```
myarrow=arrow(angle = 15, ends =  
"both", type =  
"closed")  
ggplot(data=df,  
aes(x=dose, y=len,  
group=1)) +  
geom_line(arrow=my  
arrow) +  
geom_point()
```



R 老師教學時間

The screenshot displays the RStudio interface. The main editor window shows R code for creating a plot with arrows. The code is as follows:

```
20 library(grid)
21 # Add an arrow
22 ggplot(data=df, aes(x=dose, y=1
23   geom_line(arrow = arrow())+
24   geom_point()
25 # Add a closed arrow to the end
26 myarrow=arrow(angle = 15,
27               ends = "both",
28               type = "closed")
29 ggplot(data=df, aes(x=dose, y=1
30   geom_line(arrow=myarrow)
```

The right-hand pane shows the help documentation for the `arrow` function. The search bar at the top of the pane contains the text "arrow". The help text includes the following sections:

- Description**: Produces a description of what arrows to add to a line. The result can be passed to a function that draws a line, e.g., `grid.lines`.
- Usage**:

```
arrow(angle = 30, length = unit(0.25, "inches"),
      ends = "last", type = "open")
```
- Arguments**:
 - angle**: The angle of the arrow head in degrees (smaller numbers produce narrower, pointier arrows). Essentially describes the width of the arrow head.
 - length**: A unit specifying the length of the arrow head (from tip to base).
 - ends**: One of "last", "first", or "both", indicating which ends of the line to draw arrow heads.
 - type**: One of "open" or "closed" indicating whether the arrow head should be a closed triangle.
- Examples**:

```
arrow()
```

At the bottom of the help pane, it says "[Package `grid` version 3.3.3 [Index](#)"]".

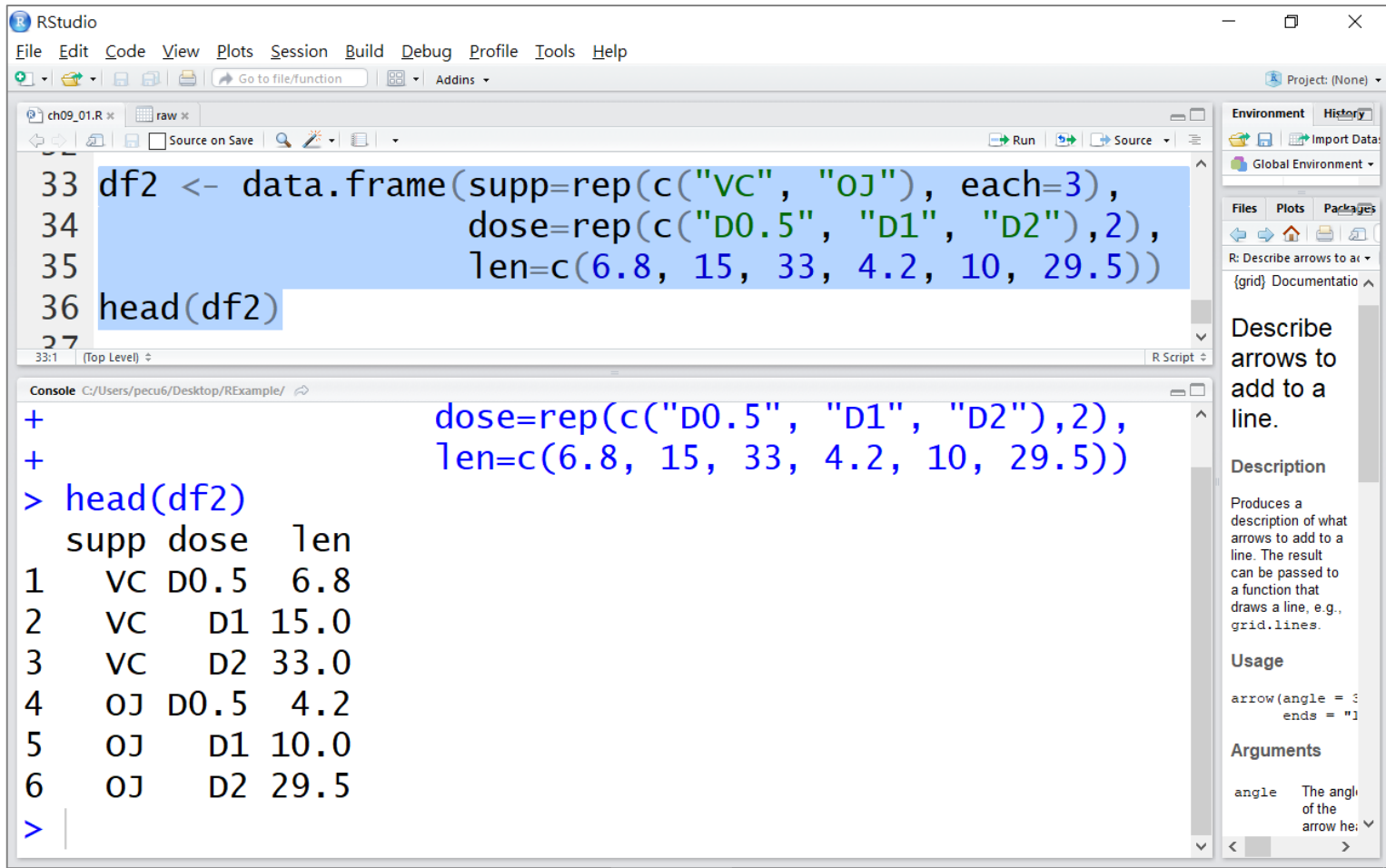
試試其他效果

1. `geom_line()` : Connecting observations, ordered by x value
2. `geom_path()` : Observations are connected in original order
3. `geom_step()` : Connecting observations by stairs

試試其他效果

1. `ggplot(data=df, aes(x=dose, y=len,
group=1)) +
geom_step() +
geom_point()`
2. `ggplot(data=df, aes(x=dose, y=len,
group=1)) +
geom_path() +
geom_point()`

折線圖 - 多線資料



The screenshot shows the RStudio interface. The source editor contains the following R code:

```
33 df2 <- data.frame(supp=rep(c("VC", "OJ"), each=3),  
34                     dose=rep(c("D0.5", "D1", "D2"), 2),  
35                     len=c(6.8, 15, 33, 4.2, 10, 29.5))  
36 head(df2)
```

The console shows the execution of the code, resulting in the following data frame:

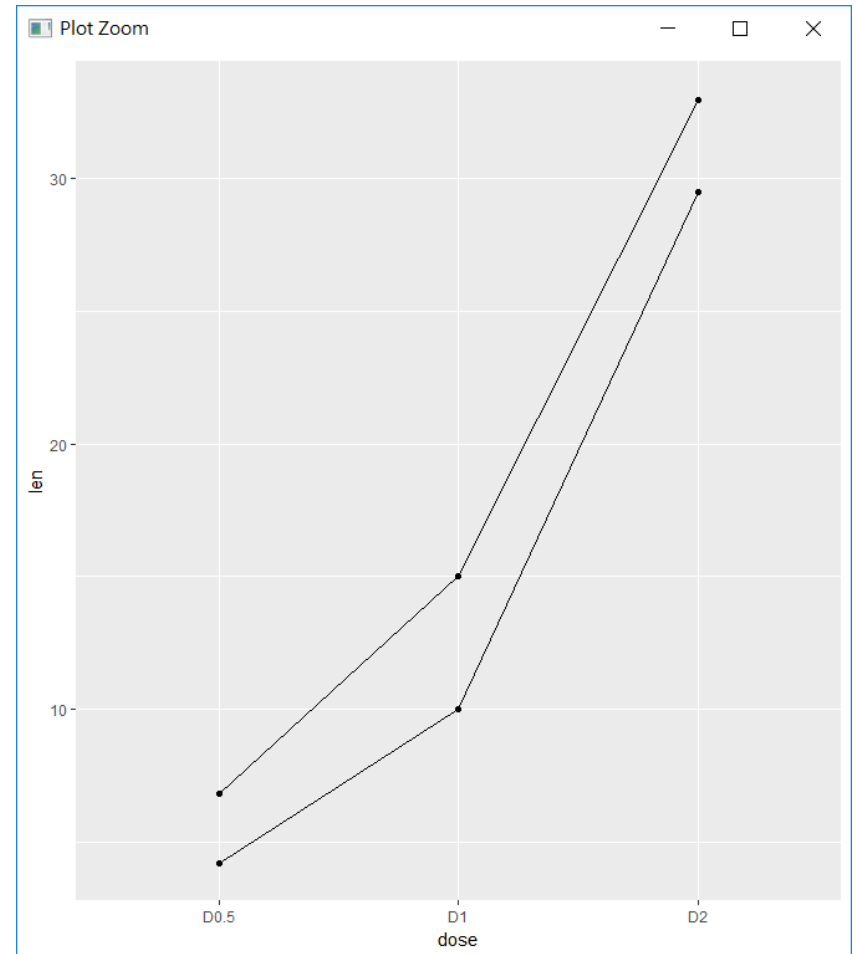
```
+ dose=rep(c("D0.5", "D1", "D2"), 2),  
+ len=c(6.8, 15, 33, 4.2, 10, 29.5))  
> head(df2)
```

	supp	dose	len
1	VC	D0.5	6.8
2	VC	D1	15.0
3	VC	D2	33.0
4	OJ	D0.5	4.2
5	OJ	D1	10.0
6	OJ	D2	29.5

The right sidebar shows the Environment pane with 'Global Environment' and the History pane. The Description pane is open, showing the description of the 'arrow' function.

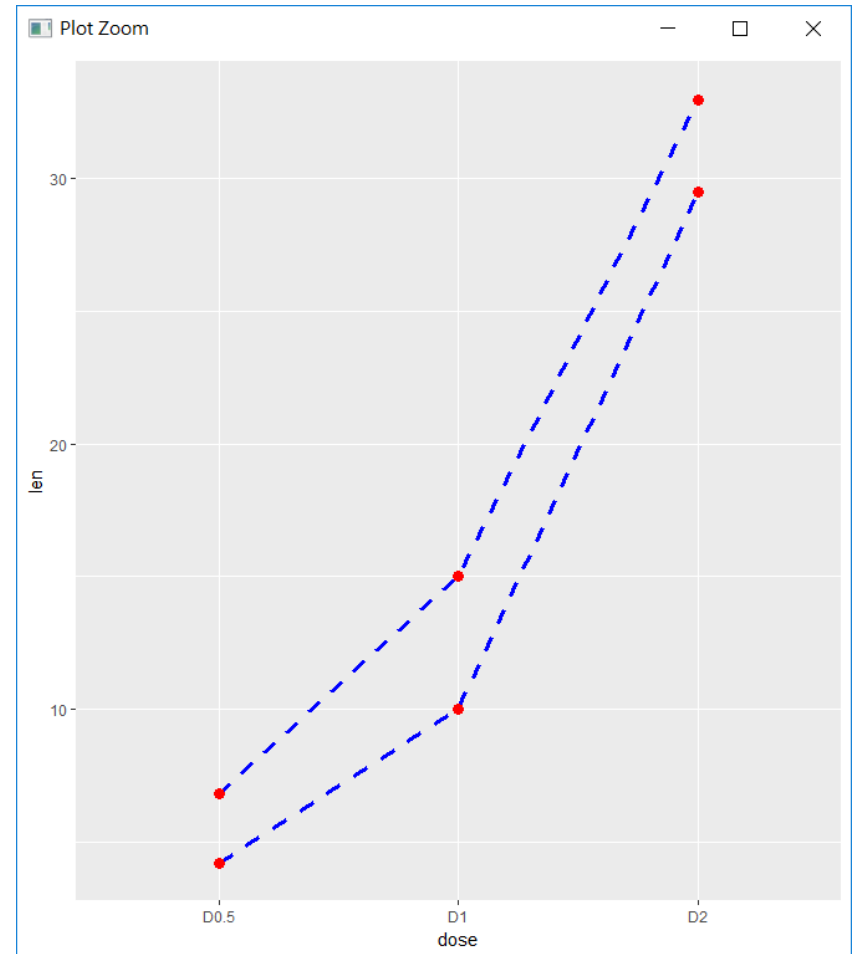
折線圖 - 多線

```
ggplot(data=df2,  
aes(x=dose, y=len,  
group=supp)) +  
geom_line() +  
geom_point()
```



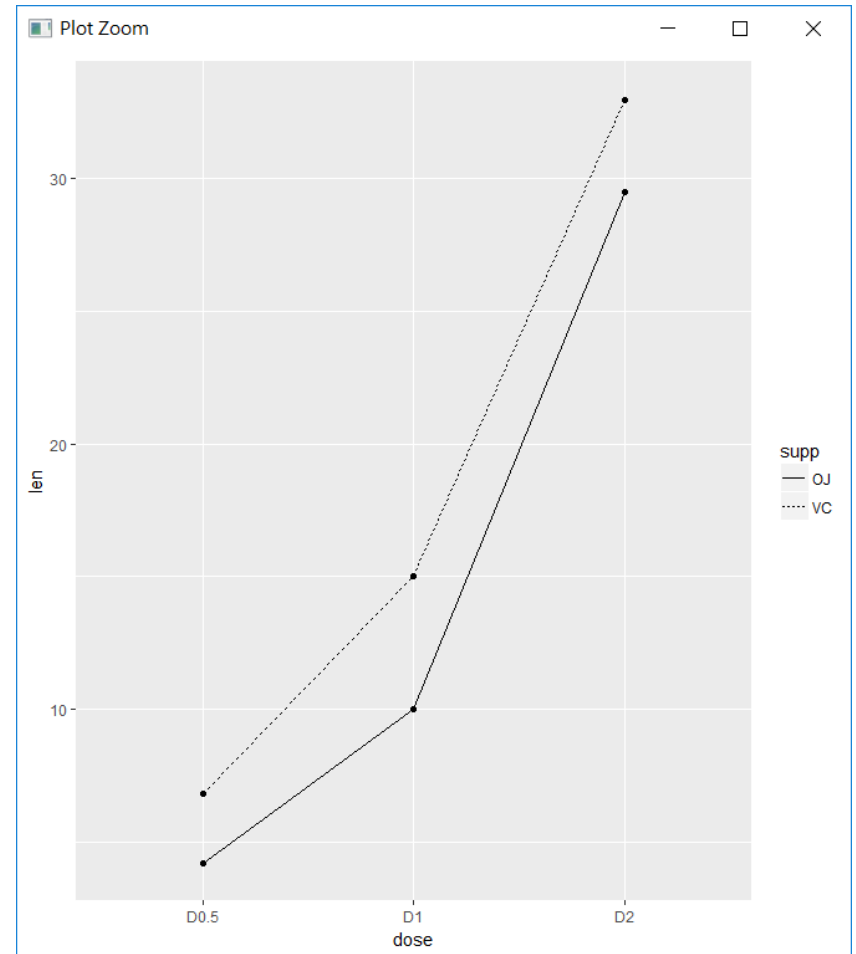
折線圖 - 多線

```
ggplot(data=df2,  
aes(x=dose, y=len,  
group=supp)) +  
geom_line(linetype="dashed",  
color="blue",  
size=1.2) +  
geom_point(color="red", size=3)
```



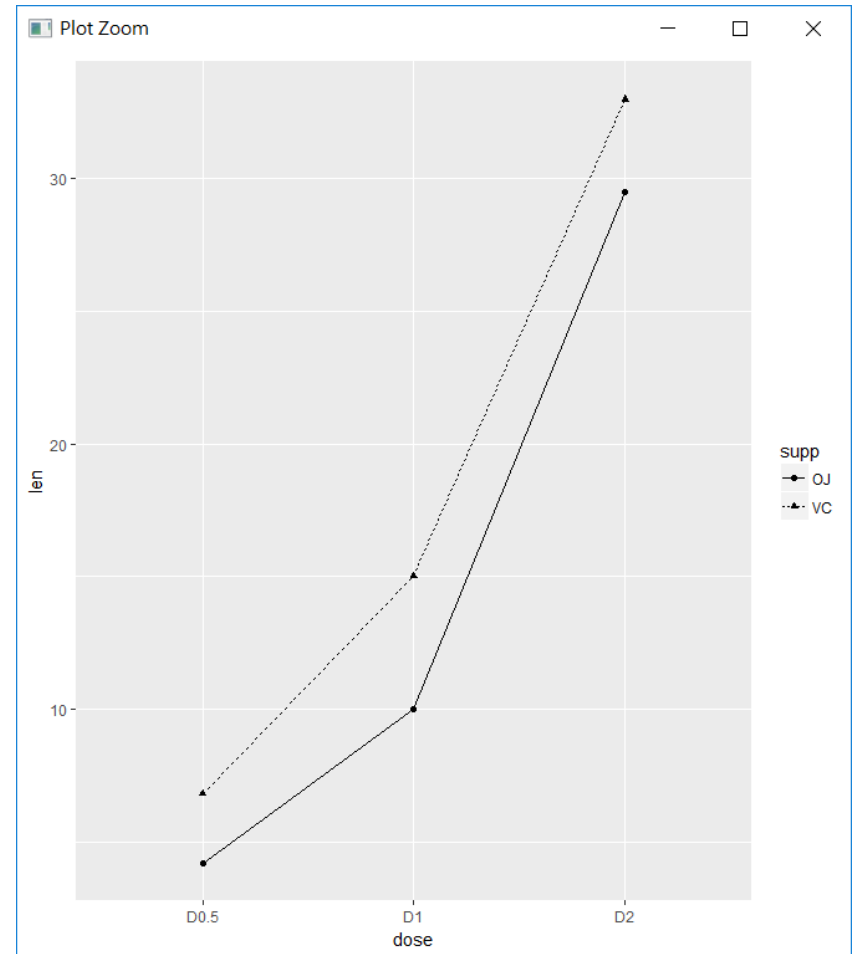
折線圖 - 多線

```
ggplot(df2,  
  aes(x=dose, y=len,  
    group=supp)) +  
  geom_line(aes(linetype=supp)) +  
  geom_point()
```



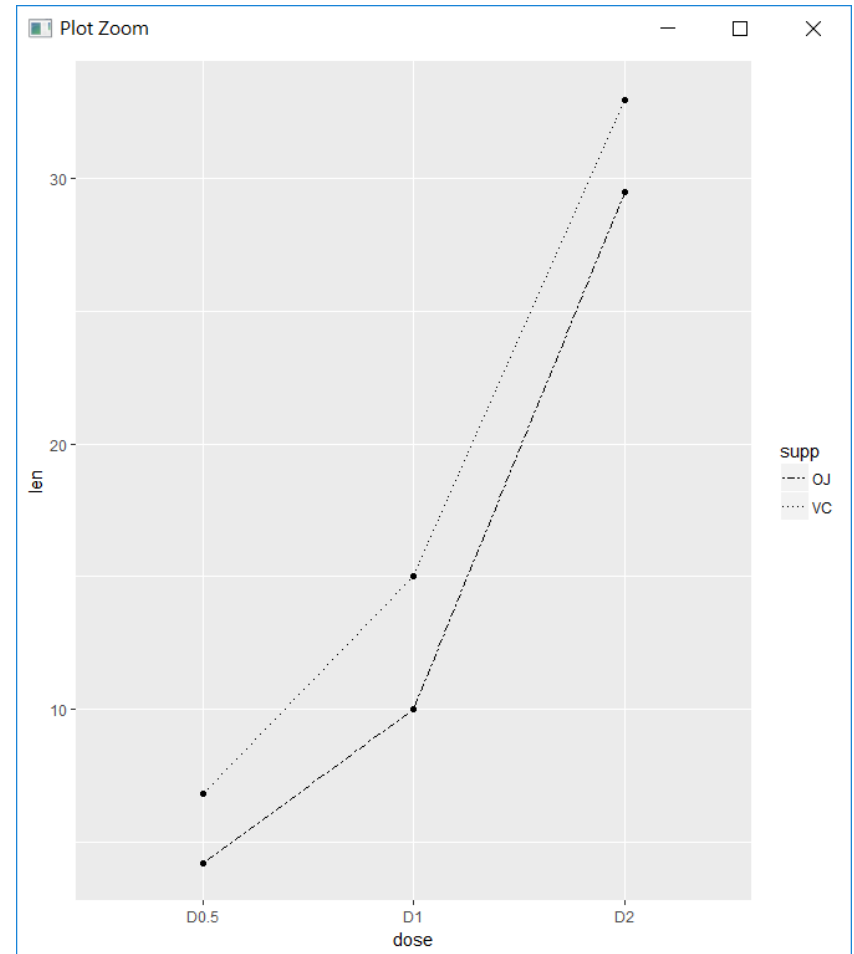
折線圖 - 多線

```
ggplot(df2,  
  aes(x=dose, y=len,  
    group=supp)) +  
  geom_line(aes(linetype=supp)) +  
  geom_point(aes(shape=supp))
```



折線圖 - 多線

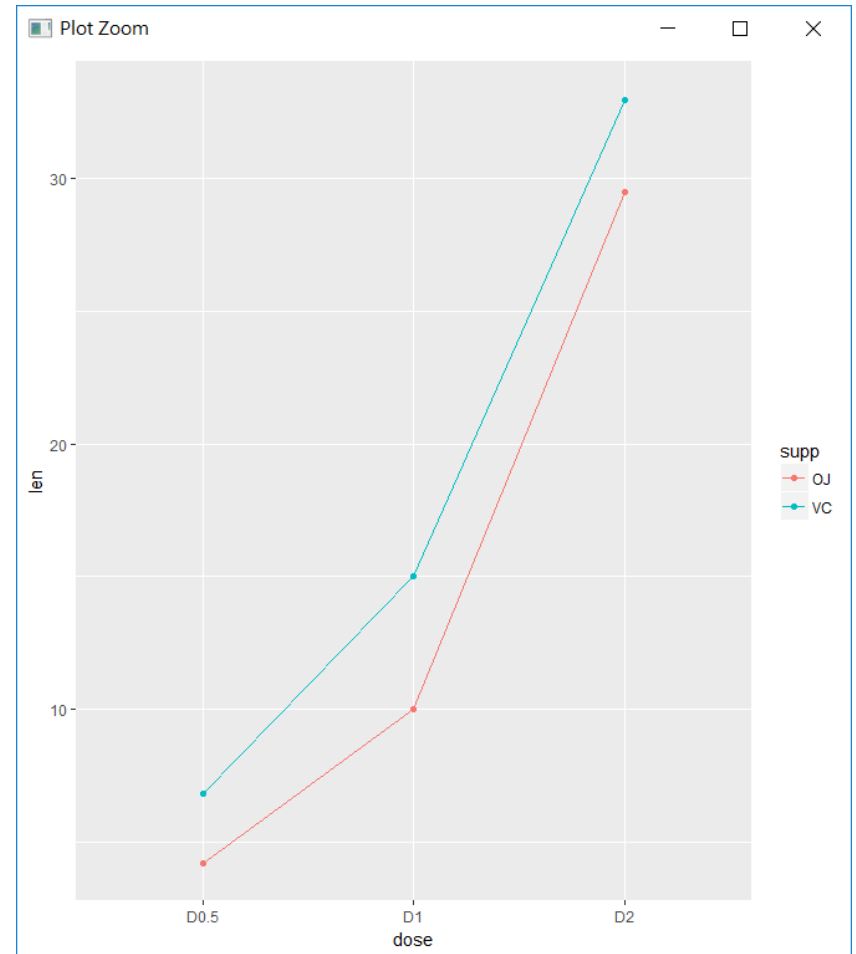
```
ggplot(df2,  
  aes(x=dose, y=len,  
    group=supp)) +  
  geom_line(aes(linetype=supp)) +  
  geom_point() +  
  scale_linetype_manual(values=c("twodash",  
    "dotted"))
```



折線圖 - 多線

```
ggplot(df2,  
  aes(x=dose, y=len,  
    group=supp)) +  
  geom_line(aes(color=supp)) +  
  geom_point(aes(color=supp))
```

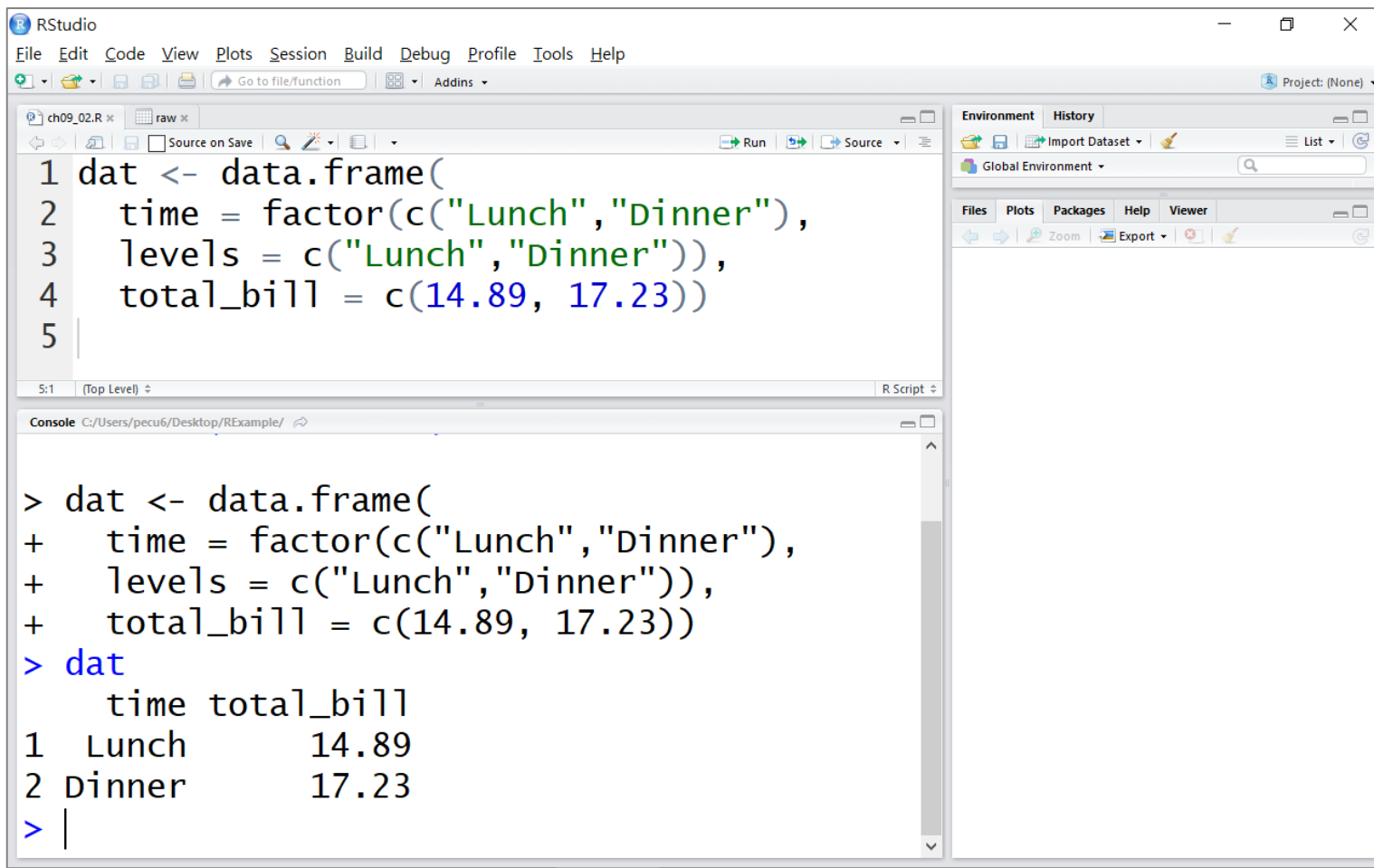
<http://www.sthda.com/english/wiki/ggplot2-line-plot-quick-start-guide-r-software-and-data-visualization>



長條圖使用時機

x axis is	Height of bar represents	Common name
Continuous	Count	Histogram
Discrete	Count	Bar graph
Continuous	Value	Bar graph
Discrete	Value	Bar graph

長條圖資料 (已統計或不需統計)



The screenshot shows the RStudio interface. The source editor on the left contains the following R code:

```
1 dat <- data.frame(  
2   time = factor(c("Lunch","Dinner"),  
3   levels = c("Lunch","Dinner")),  
4   total_bill = c(14.89, 17.23))  
5
```

The console on the right shows the execution of the code and the resulting data frame:

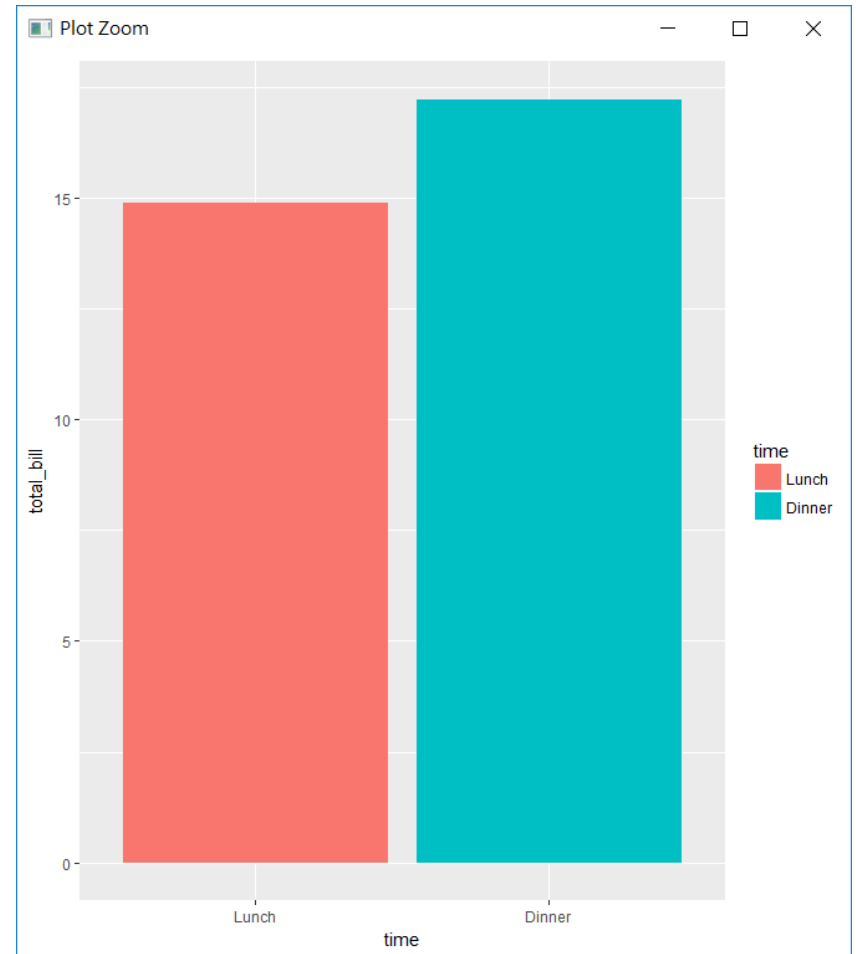
```
> dat <- data.frame(  
+   time = factor(c("Lunch","Dinner"),  
+   levels = c("Lunch","Dinner")),  
+   total_bill = c(14.89, 17.23))  
> dat  
      time total_bill  
1  Lunch      14.89  
2 Dinner      17.23  
>
```

The Environment pane on the right shows the Global Environment with the variable 'dat' listed.

長條圖

```
ggplot(data=dat,  
aes(x=time,  
y=total_bill,  
fill=time)) +  
geom_bar(stat="identity")
```

stat 設置為 identity 是直接展示樣本點綁定的縱軸值，而不設 stat 則會統計樣本點落到橫軸上各離散值的個數



長條圖資料 (未統計)

The screenshot shows the RStudio interface with the following components:

- Source Editor:** Contains R code:

```
10 raw = diamonds
11 head(raw)
12 <
```
- Console:** Displays the output of the code:

```
carat      cut  color clarity depth
<dbl>      <ord> <ord>   <ord> <dbl>
1  0.23    Ideal    E      SI2   61.5
2  0.21    Premium  E      SI1   59.8
3  0.23     Good    E      VS1   56.9
4  0.29    Premium  I      VS2   62.4
5  0.31     Good    J      SI2   63.3
6  0.24 Very Good  J      VVS2  62.8
# ... with 5 more variables: table <dbl>,
#   price <int>, x <dbl>, y <dbl>,
#   z <dbl>
> view(raw)
>
```
- Environment:** Shows the global environment with the following data objects:
 - dat: 2 obs. of 2...
 - df: 3 obs. of 2...
 - df2: 6 obs. of 3...
 - raw: 53940 obs. ...
- Values:** Shows a list of 1 element: myar...

長條圖資料 (未統計)

RStudio Source Editor

raw x

Filter

	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88		
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35		
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79		
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70
19	0.30	Good	J	SI1	63.8	56.0	351	4.23	4.26	2.71
20	0.30	Very Good	J	SI1	62.7	59.0	351	4.21	4.27	2.66
21	0.30	Good	I	SI2	63.3	56.0	351	4.26	4.30	2.71
22	0.23	Very Good	E	VS2	63.8	55.0	352	3.85	3.92	2.48
23	0.23	Very Good	H	VS1	61.0	57.0	353	3.94	3.96	2.41
24	0.31	Very Good	J	SI1	59.4	62.0	353	4.39	4.43	2.62
25	0.31	Very Good	J	SI1	58.1	62.0	353	4.44	4.47	2.59
26	0.23	Very Good	G	VVS2	60.4	58.0	354	3.97	4.01	2.41
27	0.24	Premium	I	VS1	62.5	57.0	355	3.97	3.94	2.47
28	0.30	Very Good	J	VS2	62.2	57.0	357	4.28	4.30	2.67
29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40
30	0.23	Very Good	E	VS1	60.0	57.0	357	3.95	3.98	2.43

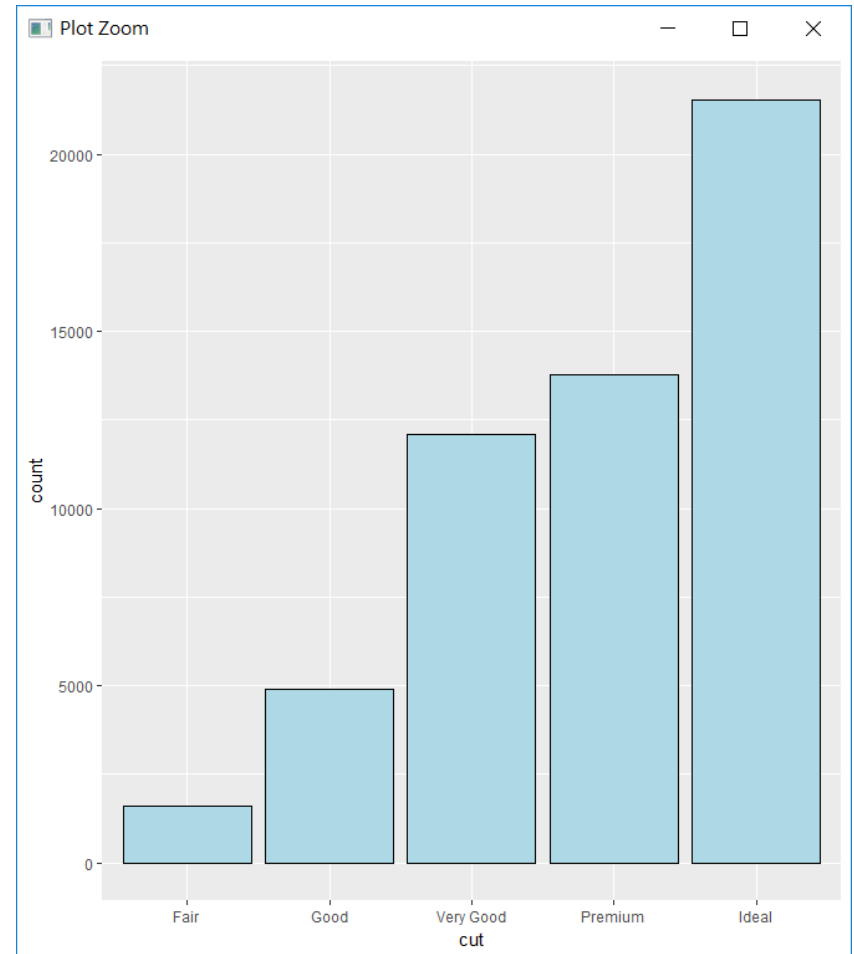
Showing 1 to 30 of 53,940 entries

diamonds

長條圖

```
ggplot(data =  
diamonds, aes(x =  
cut)) +  
geom_bar(fill =  
"lightblue", colour =  
"black")
```

[http://www.cookbook-r.com/Graphs/Bar_and_line_graphs_\(ggplot2\)/](http://www.cookbook-r.com/Graphs/Bar_and_line_graphs_(ggplot2)/)



散佈圖資料

RStudio Source Editor

raw x

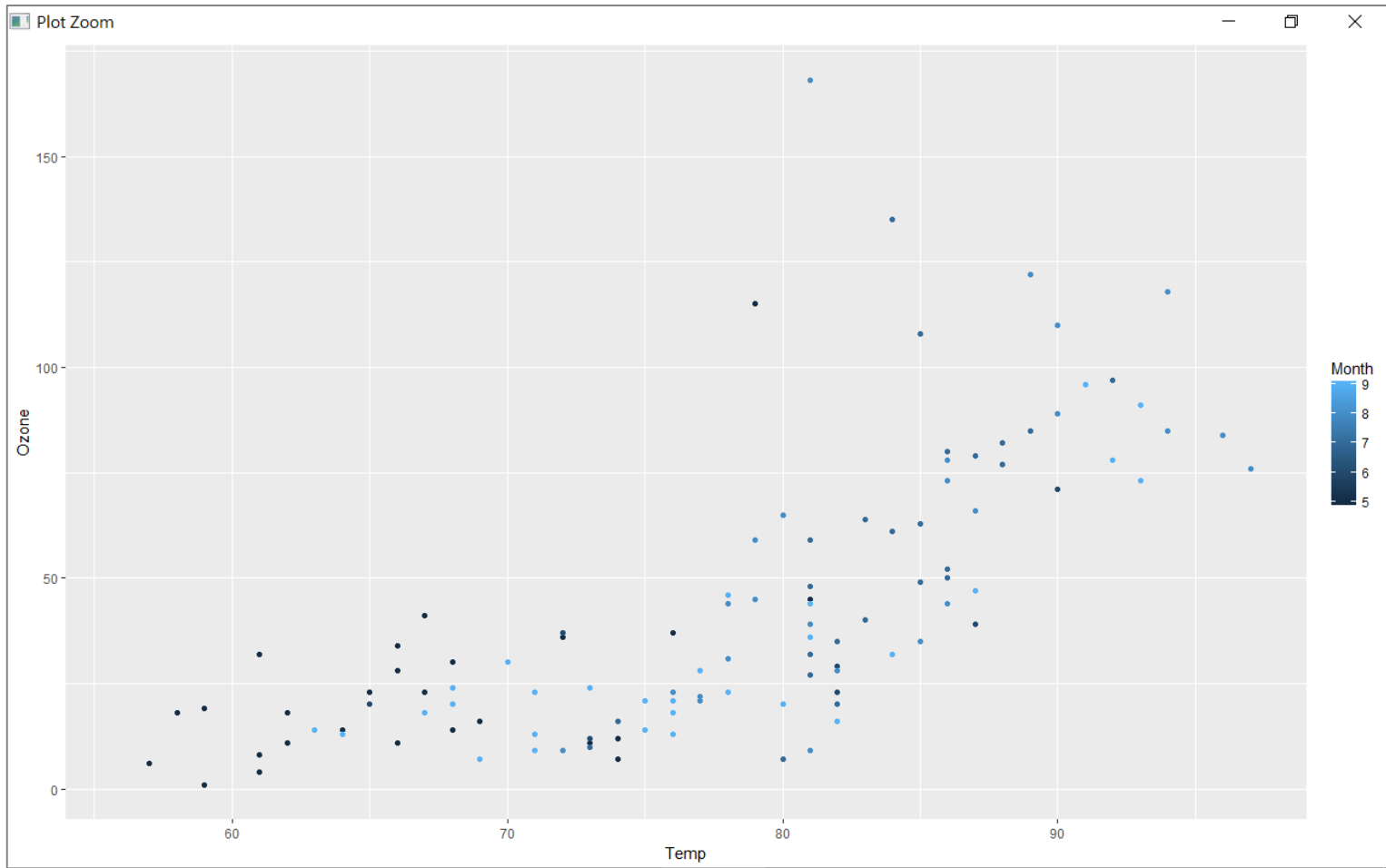
Filter

	Ozone	Solar.R	Wind	Temp	Month	Day
1	41	190	7.4	67	5	1
2	36	118	8.0	72	5	2
3	12	149	12.6	74	5	3
4	18	313	11.5	62	5	4
5	NA	NA	14.3	56	5	5
6	28	NA	14.9	66	5	6
7	23	299	8.6	65	5	7
8	19	99	13.8	59	5	8
9	8	19	20.1	61	5	9
10	NA	194	8.6	69	5	10
11	7	NA	6.9	74	5	11
12	16	256	9.7	69	5	12
13	11	290	9.2	66	5	13
14	14	274	10.9	68	5	14
15	18	65	13.2	58	5	15
16	14	334	11.5	64	5	16
17	34	307	12.0	66	5	17
18	6	78	18.4	57	5	18
19	30	322	11.5	68	5	19
20	11	44	9.7	62	5	20
21	1	8	9.7	59	5	21
22	11	320	16.6	73	5	22
23	4	25	9.7	61	5	23
24	32	92	12.0	61	5	24
25	NA	66	16.6	57	5	25
26	NA	266	14.9	58	5	26
27	NA	NA	8.0	57	5	27
28	23	13	12.0	67	5	28
29	45	252	14.9	81	5	29
30	11	333	5.7	70	5	30

Showing 1 to 30 of 153 entries

airquality

散佈圖



```
ggplot(data=airquality) +  
geom_point(aes(x=Temp, y=Ozone, color=Month))
```

堆疊直方圖資料 (未統計)

RStudio Source Editor

raw x

Filter

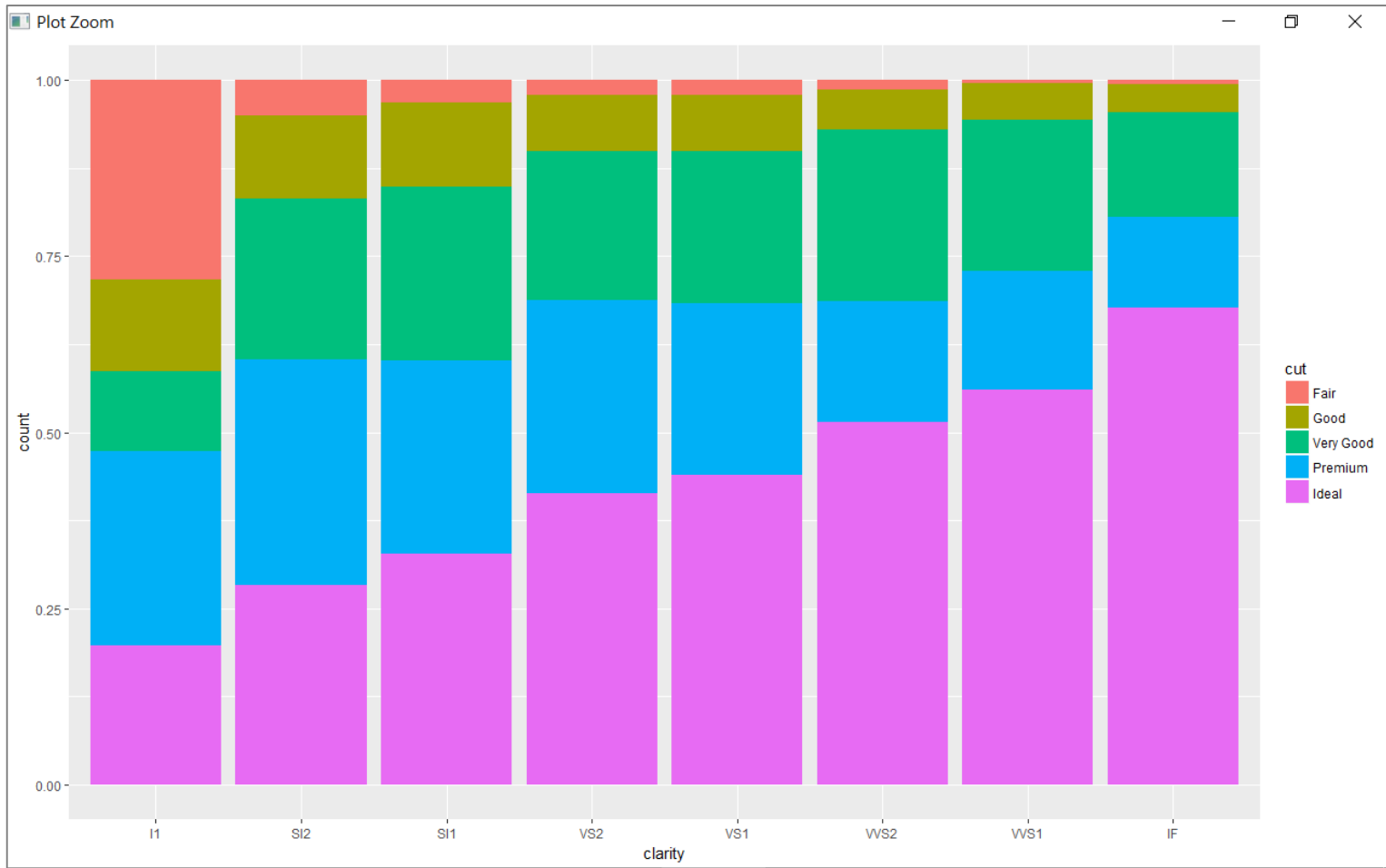
	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88		
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35		
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79		
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70
19	0.30	Good	J	SI1	63.8	56.0	351	4.23	4.26	2.71
20	0.30	Very Good	J	SI1	62.7	59.0	351	4.21	4.27	2.66
21	0.30	Good	I	SI2	63.3	56.0	351	4.26	4.30	2.71
22	0.23	Very Good	E	VS2	63.8	55.0	352	3.85	3.92	2.48
23	0.23	Very Good	H	VS1	61.0	57.0	353	3.94	3.96	2.41
24	0.31	Very Good	J	SI1	59.4	62.0	353	4.39	4.43	2.62
25	0.31	Very Good	J	SI1	58.1	62.0	353	4.44	4.47	2.59
26	0.23	Very Good	G	VVS2	60.4	58.0	354	3.97	4.01	2.41
27	0.24	Premium	I	VS1	62.5	57.0	355	3.97	3.94	2.47
28	0.30	Very Good	J	VS2	62.2	57.0	357	4.28	4.30	2.67
29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40
30	0.23	Very Good	E	VS1	60.0	57.0	357	3.95	3.98	2.43

Showing 1 to 30 of 53,940 entries

diamonds

```
ggplot(diamonds, aes(clarity, fill=cut)) +  
geom_bar(position="fill")
```


堆疊直方圖



```
ggplot(diamonds, aes(clarity, fill=cut)) +  
geom_bar(position="fill")
```

盒形圖資料 (未統計)

RStudio Source Editor

raw x

Filter

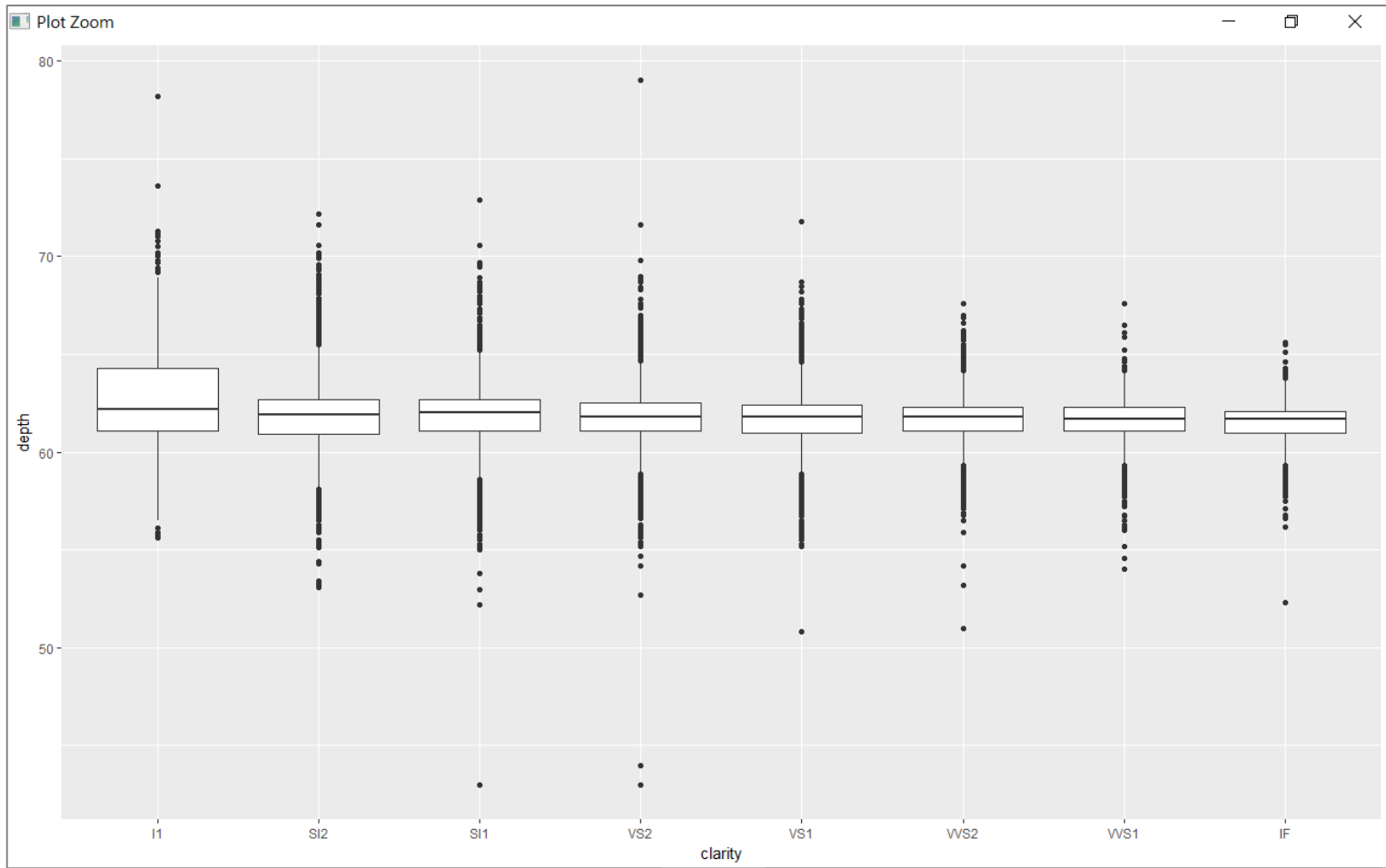
	carat	cut	color	clarity	depth	table	price	x	y	z
1	0.23	Ideal	E	SI2	61.5	55.0	326	3.95	3.98	2.43
2	0.21	Premium	E	SI1	59.8	61.0	326	3.89	3.84	2.31
3	0.23	Good	E	VS1	56.9	65.0	327	4.05	4.07	2.31
4	0.29	Premium	I	VS2	62.4	58.0	334	4.20	4.23	2.63
5	0.31	Good	J	SI2	63.3	58.0	335	4.34	4.35	2.75
6	0.24	Very Good	J	VVS2	62.8	57.0	336	3.94	3.96	2.48
7	0.24	Very Good	I	VVS1	62.3	57.0	336	3.95	3.98	2.47
8	0.26	Very Good	H	SI1	61.9	55.0	337	4.07	4.11	2.53
9	0.22	Fair	E	VS2	65.1	61.0	337	3.87	3.78	2.49
10	0.23	Very Good	H	VS1	59.4	61.0	338	4.00	4.05	2.39
11	0.30	Good	J	SI1	64.0	55.0	339	4.25	4.28	2.73
12	0.23	Ideal	J	VS1	62.8	56.0	340	3.93	3.90	2.46
13	0.22	Premium	F	SI1	60.4	61.0	342	3.88		
14	0.31	Ideal	J	SI2	62.2	54.0	344	4.35		
15	0.20	Premium	E	SI2	60.2	62.0	345	3.79		
16	0.32	Premium	E	I1	60.9	58.0	345	4.38	4.42	2.68
17	0.30	Ideal	I	SI2	62.0	54.0	348	4.31	4.34	2.68
18	0.30	Good	J	SI1	63.4	54.0	351	4.23	4.29	2.70
19	0.30	Good	J	SI1	63.8	56.0	351	4.23	4.26	2.71
20	0.30	Very Good	J	SI1	62.7	59.0	351	4.21	4.27	2.66
21	0.30	Good	I	SI2	63.3	56.0	351	4.26	4.30	2.71
22	0.23	Very Good	E	VS2	63.8	55.0	352	3.85	3.92	2.48
23	0.23	Very Good	H	VS1	61.0	57.0	353	3.94	3.96	2.41
24	0.31	Very Good	J	SI1	59.4	62.0	353	4.39	4.43	2.62
25	0.31	Very Good	J	SI1	58.1	62.0	353	4.44	4.47	2.59
26	0.23	Very Good	G	VVS2	60.4	58.0	354	3.97	4.01	2.41
27	0.24	Premium	I	VS1	62.5	57.0	355	3.97	3.94	2.47
28	0.30	Very Good	J	VS2	62.2	57.0	357	4.28	4.30	2.67
29	0.23	Very Good	D	VS2	60.5	61.0	357	3.96	3.97	2.40
30	0.23	Very Good	E	VS1	60.0	57.0	357	3.95	3.98	2.43

Showing 1 to 30 of 53,940 entries

diamonds

```
ggplot(diamonds, aes(x=clarity, y=depth)) +  
geom_boxplot()
```

盒形圖



```
ggplot(diamonds, aes(x=clarity, y=depth)) +  
geom_boxplot()
```