Introduction to R Software

Swayam Prabha

Lecture 38

Bivariate and Three Dimensional Plots

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Slides can be downloaded from

http://home.iitk.ac.in/~shalab/sp

Bivariate plots:

Provide first hand visual information about the nature and degree of relationship between two variables.

Relationship can be linear or nonlinear.

We discuss several types of plots through examples.

Scatter Plot

Plot command:

`x, y:` **Two data vectors**

```
plot(x, y)
```

```
plot(x, y, type)
```

`type`	
“**p**" for **p**oints	“**l**" for **l**ines
“**b**" for **b**oth	“**c**" for the lines part alone of “**b**"
“**o**" for both ‘**o**verplotted’	“**s**" for stair **s**teps.
“**h**" for ‘**h**istogram’ like (or ‘high-density’) vertical lines	

Scatter Plot

Plot command:

`x, y:` **Two data vectors**

```
plot(x, y)
```

```
plot(x, y, type)
```

Get more details from help: `help("type")`

Other options:

`main`	**an overall title for the plot.**
`suba`	**sub title for the plot.**
`xlaba`	**title for the x axis.**
`ylaba`	**title for the y axis.**
`aspthe`	**y/x aspect ratio.**

Example:

Daily water demand in a city depends upon weather temperature.

We know from experience that water consumption increases as weather temperature increases.

Data on 27 days is collected as follows:

Example:

Daily water demand (in million litres)

```
water <- c(45050, 42849,43038,43873,42924,46061,
36069, 37497,33044,35216,5383,37066,38037,38495,
39895,41311, 43923, 45078,46935,47951,
46085,48003, 33710,31666,33495,32758,34067)
```

Temperature (in centigrade)

```
temp <- c(30, 41,37,40,45,45.5,45,46,44,44,25,
25,26,27,28,23,26,29,32,33,34,35,38,39,42,43,
44)
```

Scatter Plot

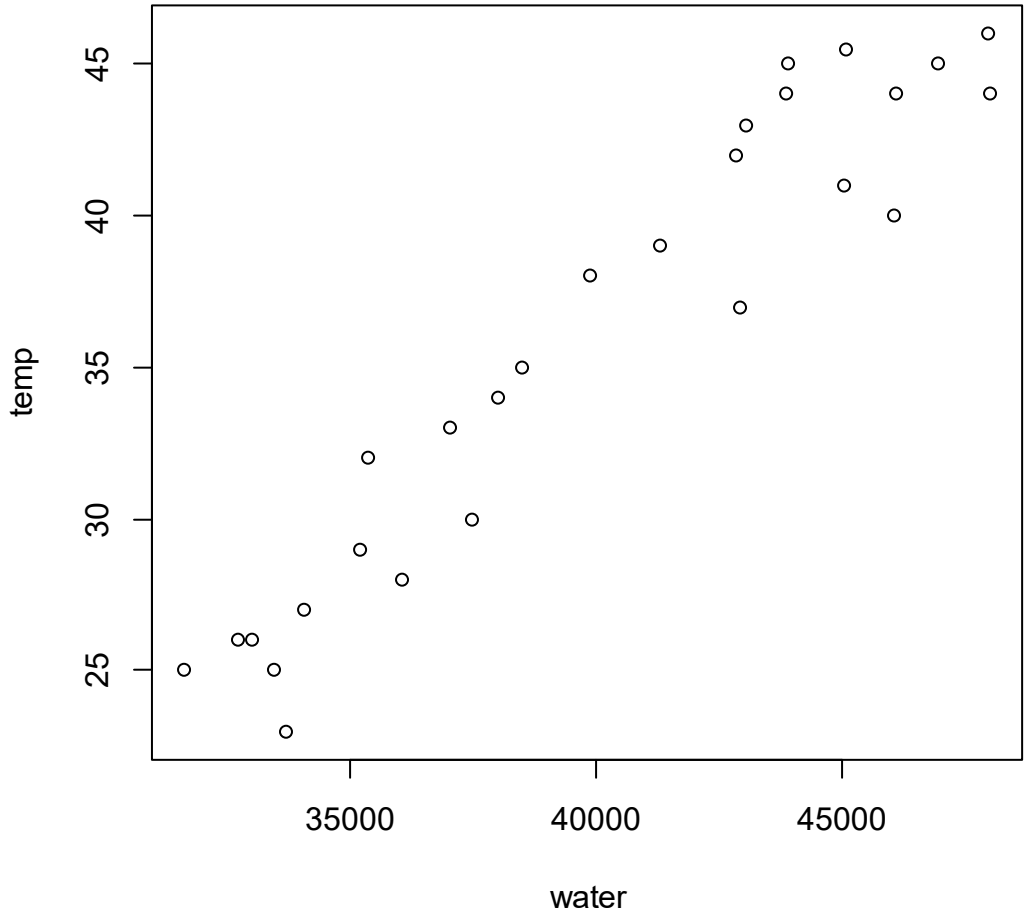
`plot` command:

`x, y:` Two data vectors

Various type of plots are possible to draw.

```
plot(x, y)
```

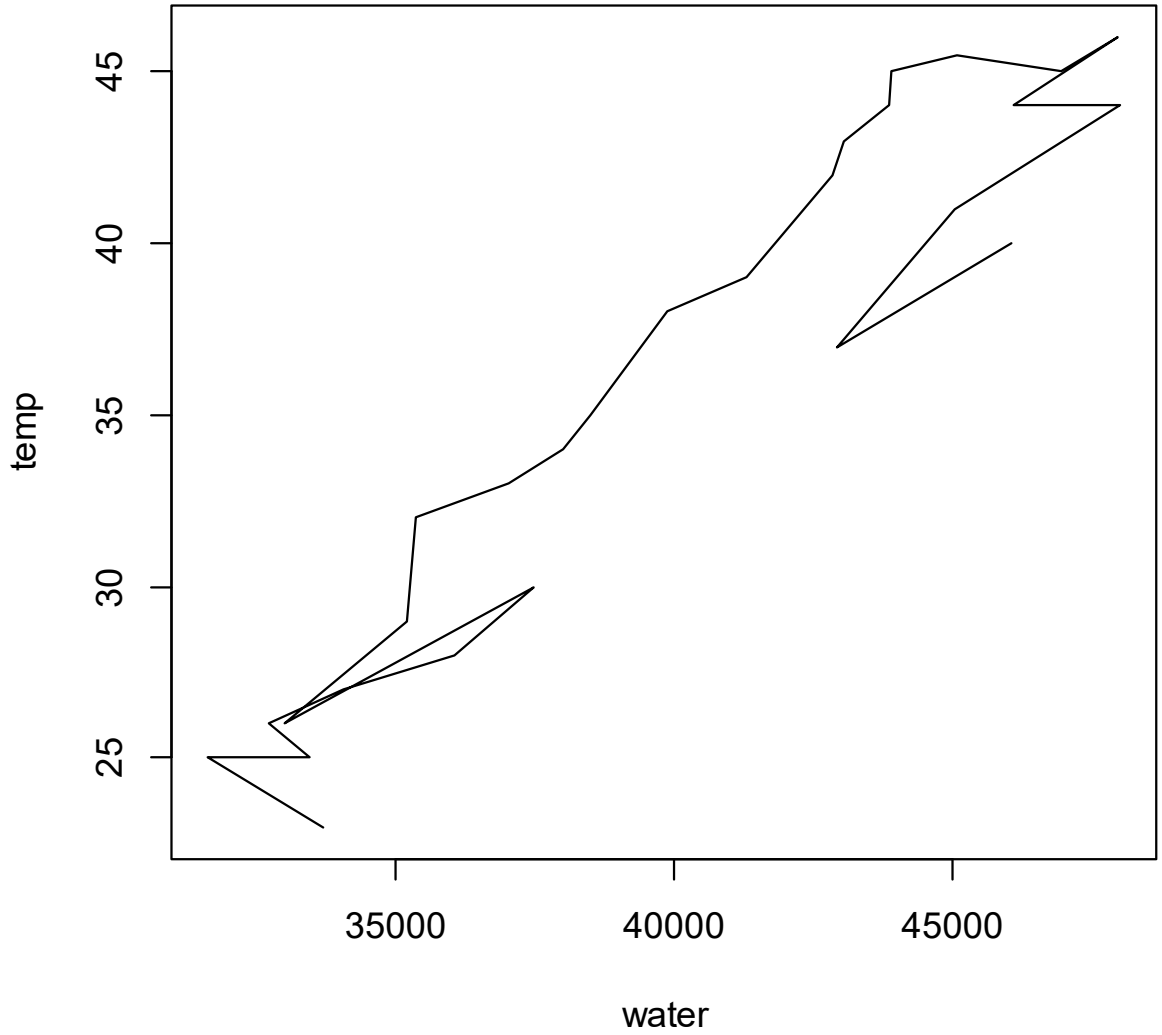
```
plot(water, temp)
```



Scatter Plot

```
plot(water, temp, "l")
```

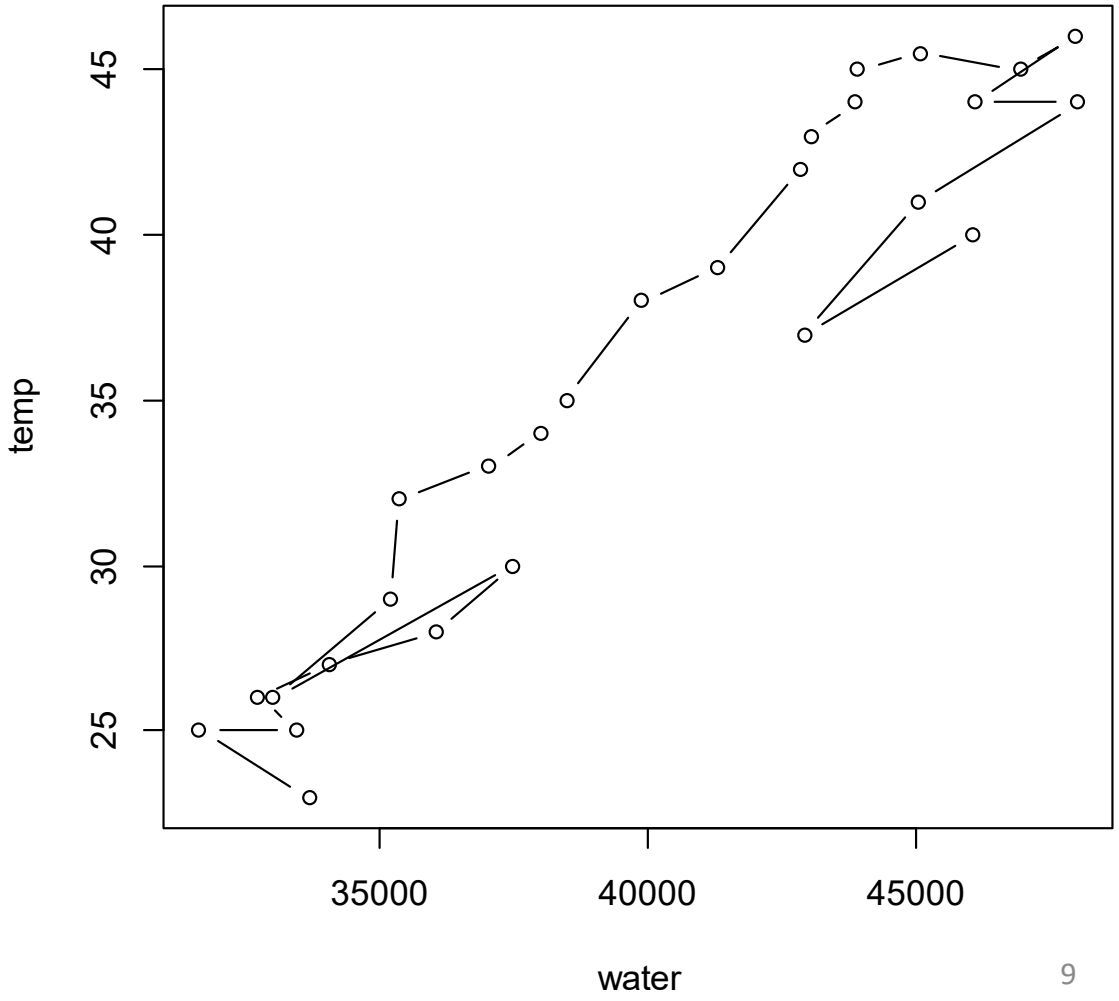
“`l`" for lines,



Scatter Plot

```
plot(water, temp, "b")
```

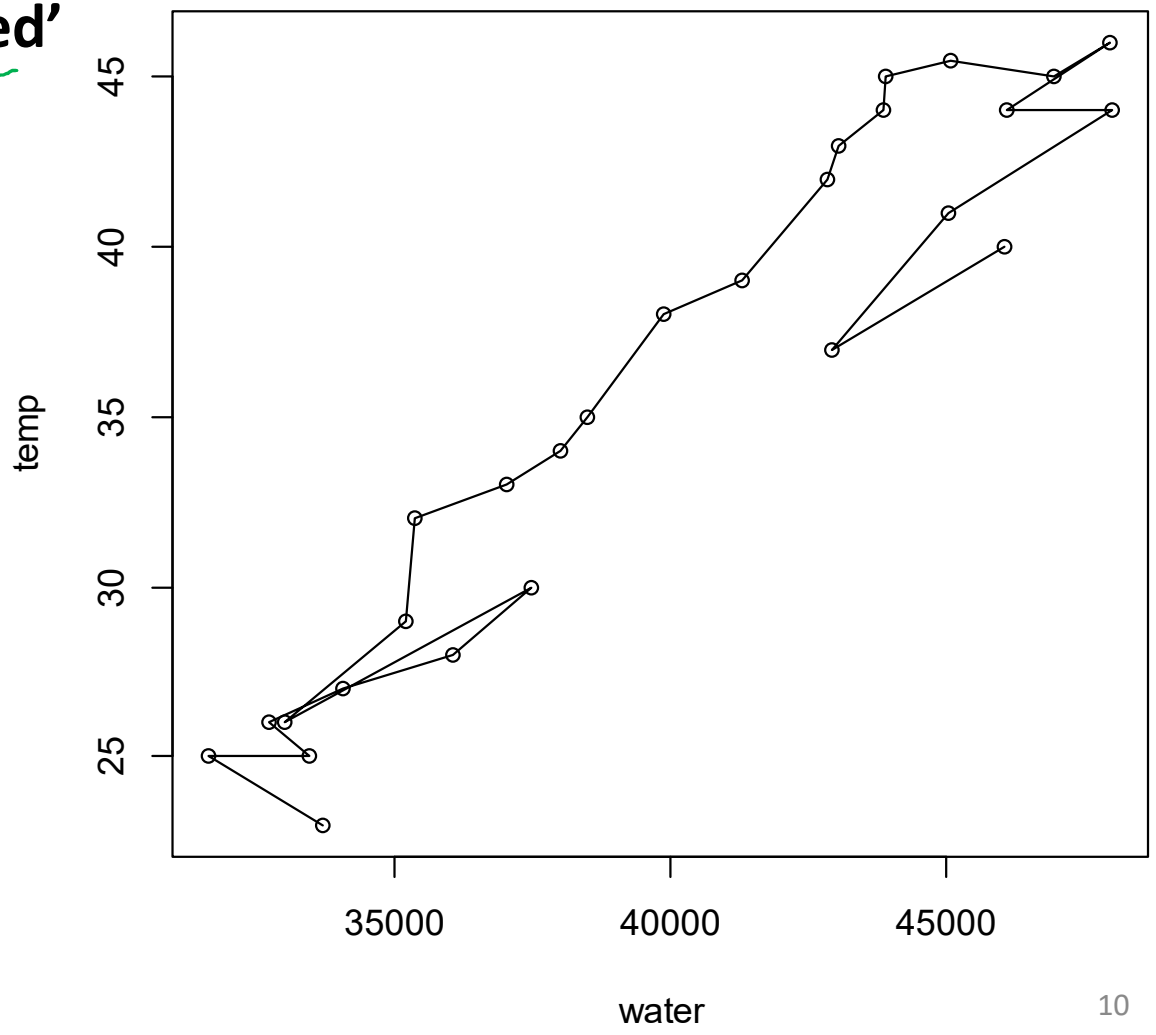
“b" for both – line and point



Scatter Plot

```
plot(water, temp, "o")
```

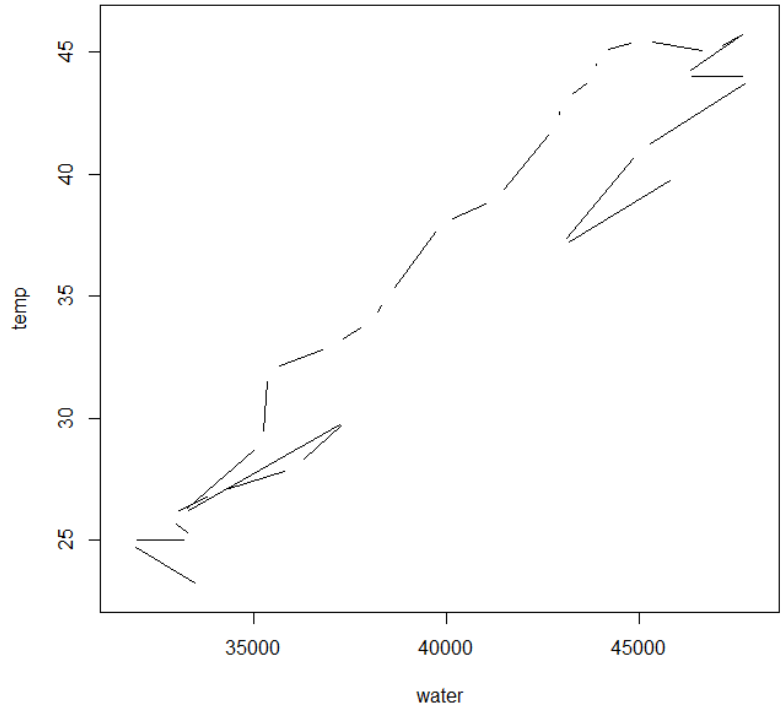
“o" for both ‘overplotted’



Scatter Plot

```
plot(water, temp, "c")
```

“c" for the lines part alone of “b"



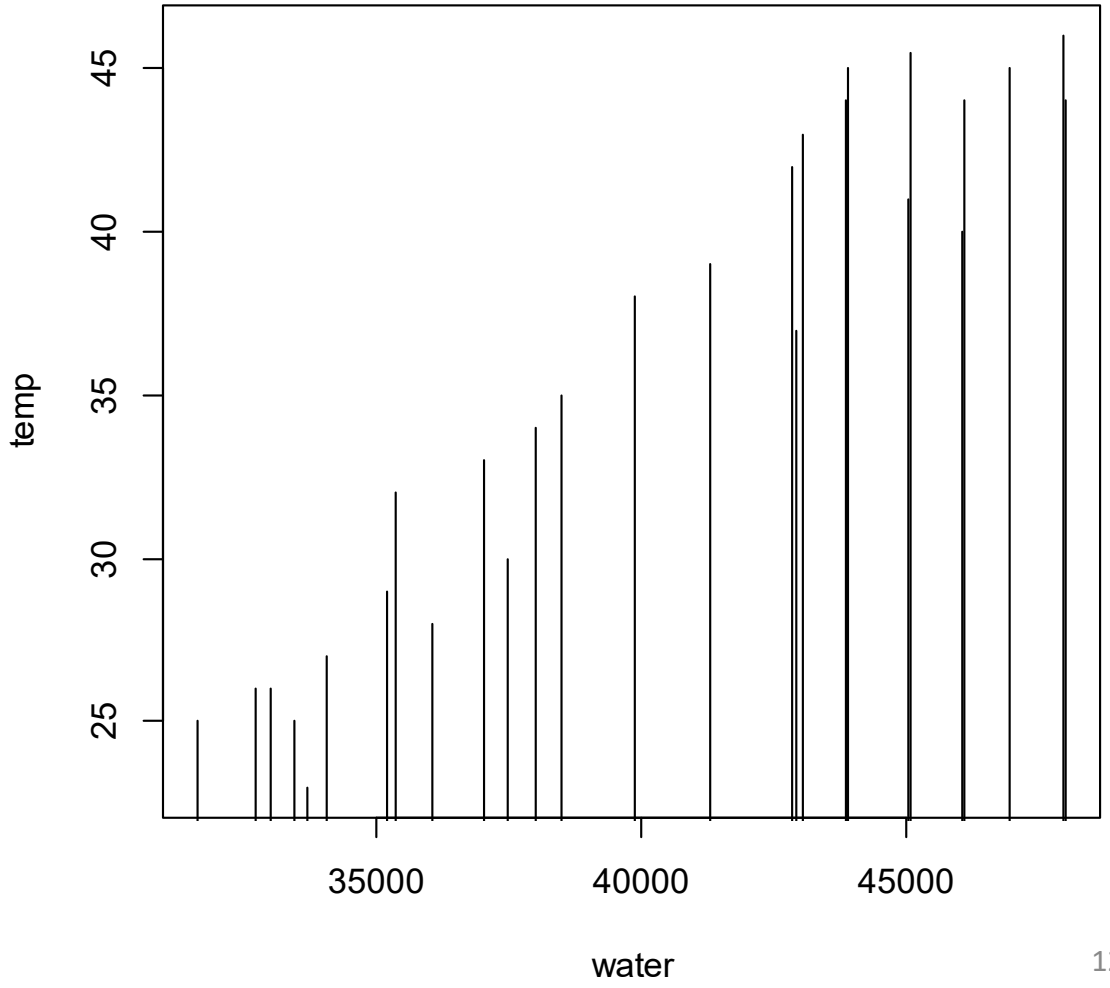
Scatter Plot

```
plot(water, temp, "h")
```

“h" for ‘histogram’

like (or ‘high-density’)

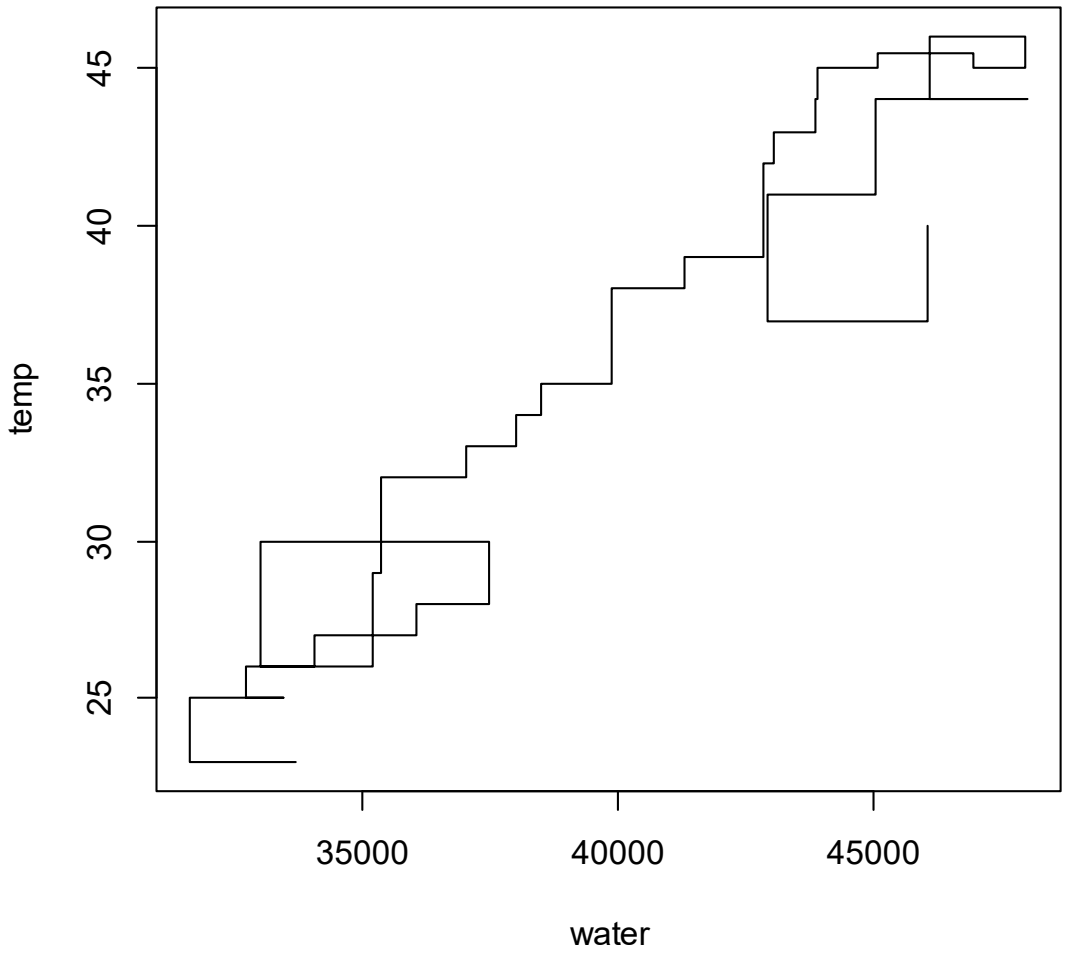
vertical lines



Scatter Plot

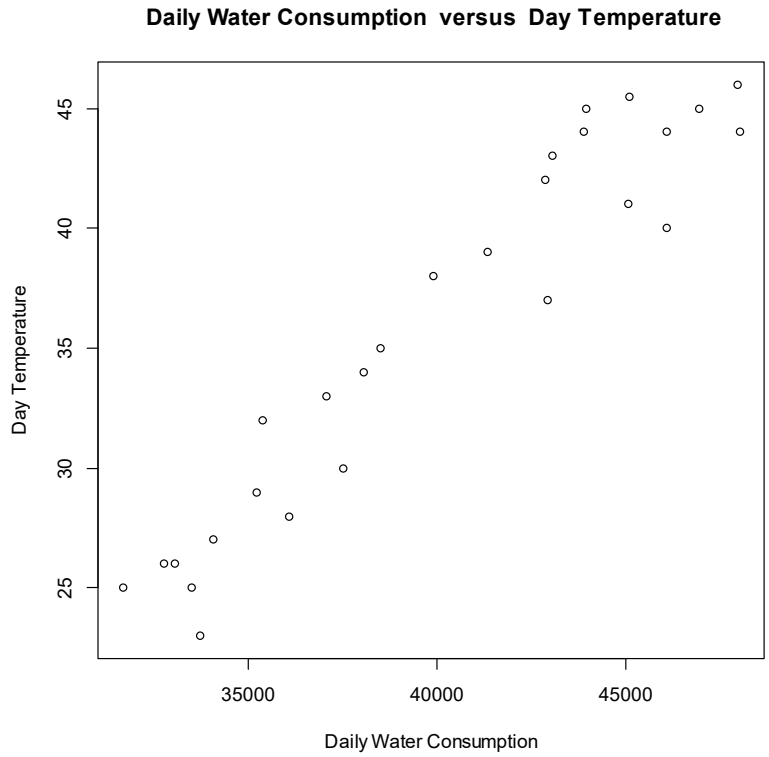
```
plot(water, temp, "s")
```

"**s**" for stair **s**teps.



Scatter Plot

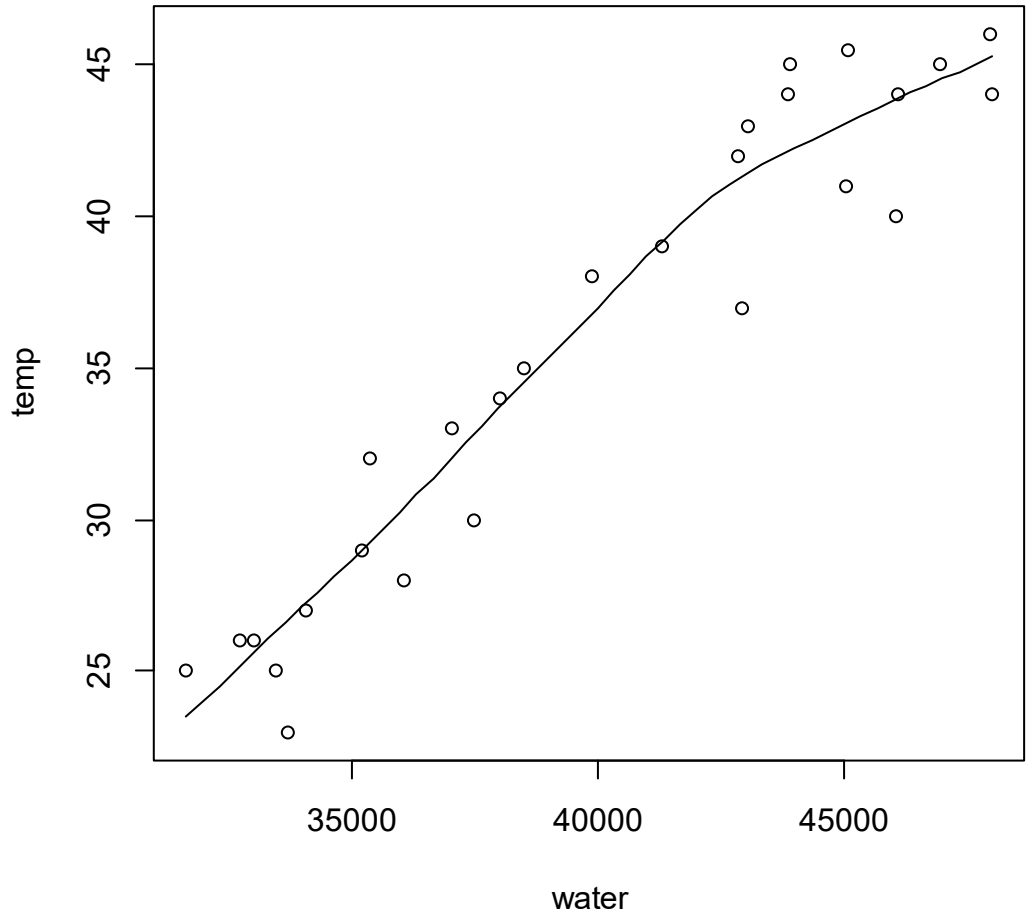
```
> plot(water, temp, xlab="Daily Water
Consumption", ylab="Day Temperature",  main="
Daily Water Consumption versus Day Temperature")
```



Smooth Scatter Plot

`scatter.smooth(x,y)` provides scatter plot with smooth curve

Example: `scatter.smooth(water,temp)`



Smooth Scatter Plot

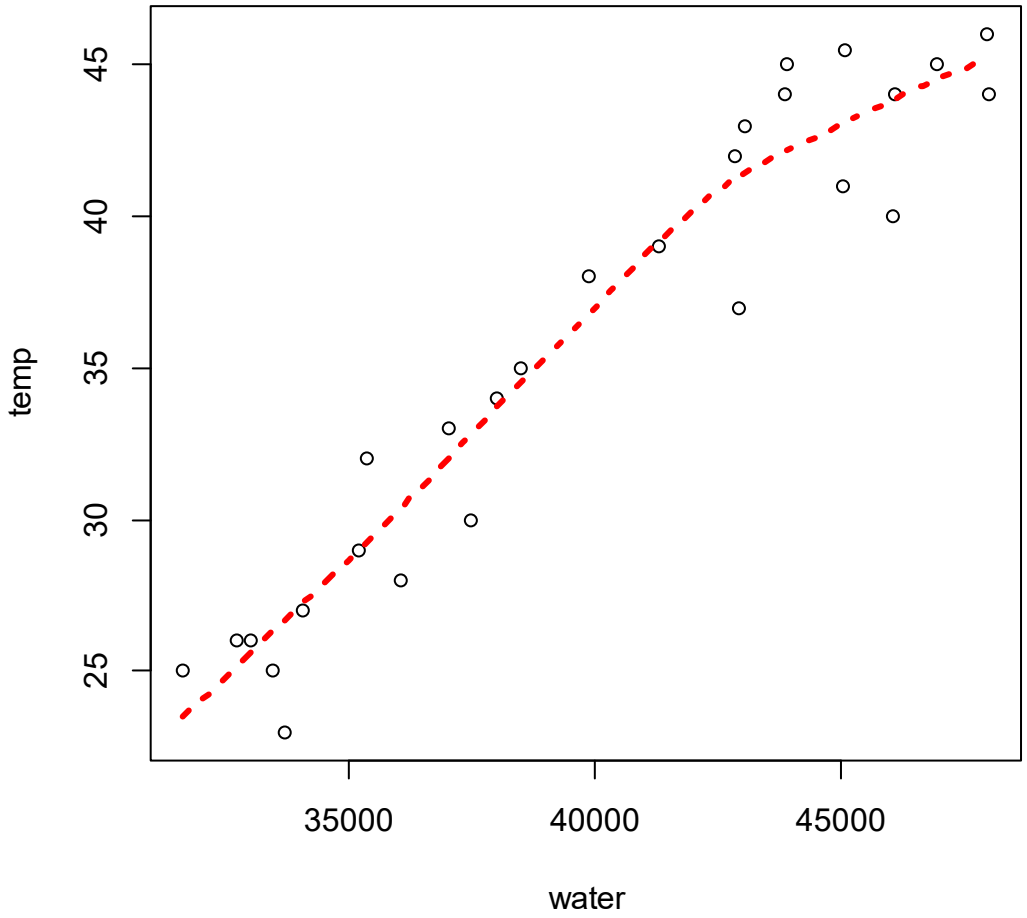
Other options are available.

```
scatter.smooth(x, y = NULL, span = 2/3, degree =
1, family = c("symmetric", "gaussian"), xlab =
NULL, ylab = NULL, ylim = range(y, pred$y, na.rm
= TRUE), evaluation = 50, ..., lpars = list())
```

Smooth Scatter Plot

Example：

```
> scatter.smooth(water, temp, lpars = list(col =
"red", lwd = 3, lty = 3))
```



Matrix Scatter Plot

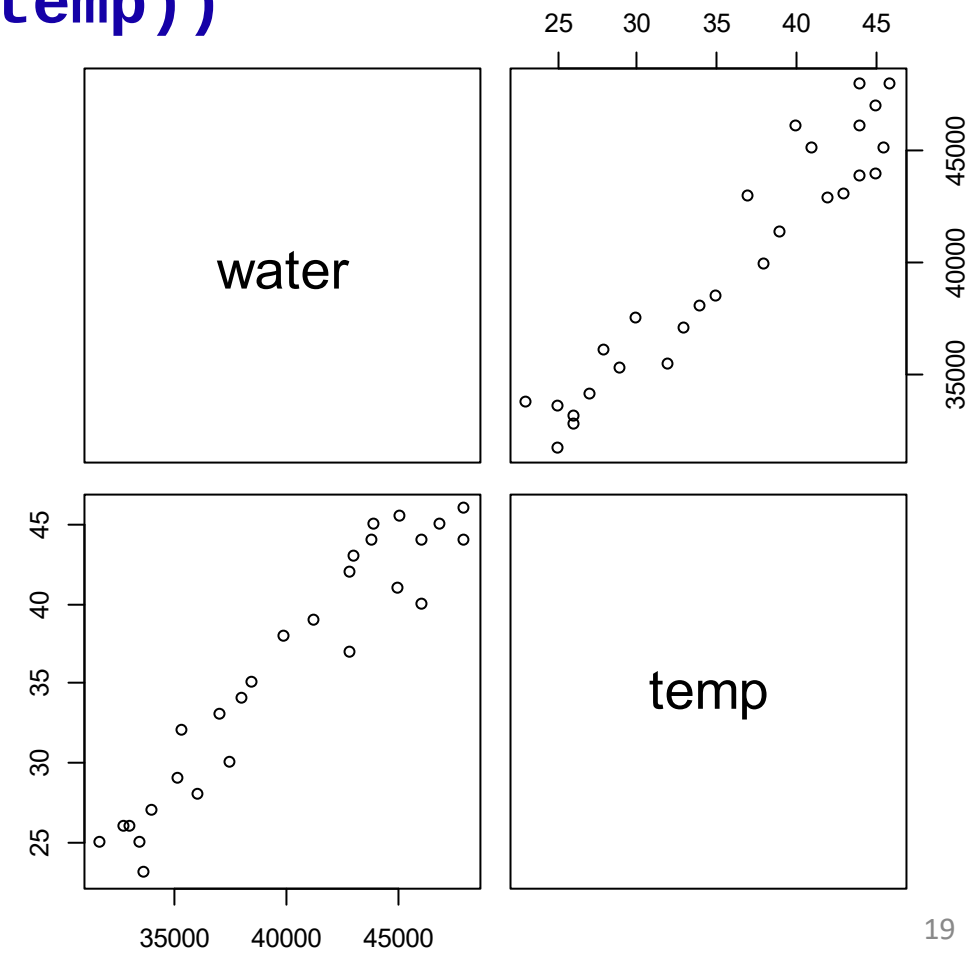
Matrix plot provides a unified view of plot when there are more than two variables.

Scatter plots are arranged in the form of a matrix.

Matrix Scatter Plot

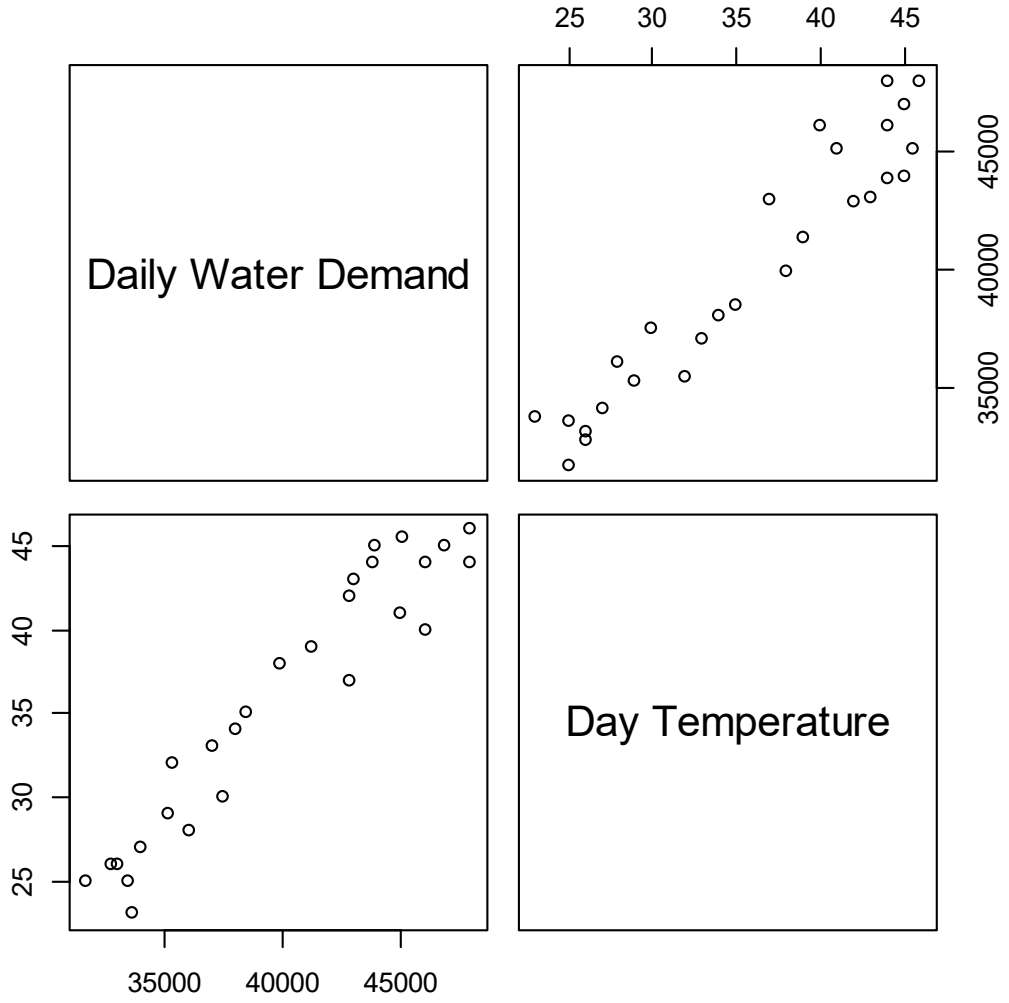
The command `pairs()` allows the simple creation of a matrix of scatter plots.

```
> pairs( cbind(water,temp))
```



Matrix Scatter Plot

```
> pairs( cbind(water,temp), labels=c("Daily
Water Demand", "Day Temperature") )
```



Matrix Plot with More than Two Variables

Suppose a variable *y* depends upon three variables X_1, X_2 and X_3 and 20 tuples of observations are obtained as (y, X_1, X_2, X_3) follows:

```
X1=c(34,12,15,33,31,24,40,31,21,37,29,15,17,38
,17,36,13,39,36,34)

X2=c(3,1,3,1,5,1,5,5,2,3,4,1,1,5,1,3,1,5,5,1)

X3=c(15,13,11,10,17,15,18,13,20,19,16,10,16,16
,19,20,11,18,15,19)

y=c(180,116,118,139,195,152,218,170,179,210,17
8,104,145,203,163,216,106,216,191,197)
```

Matrix Plot with More than Two Variables

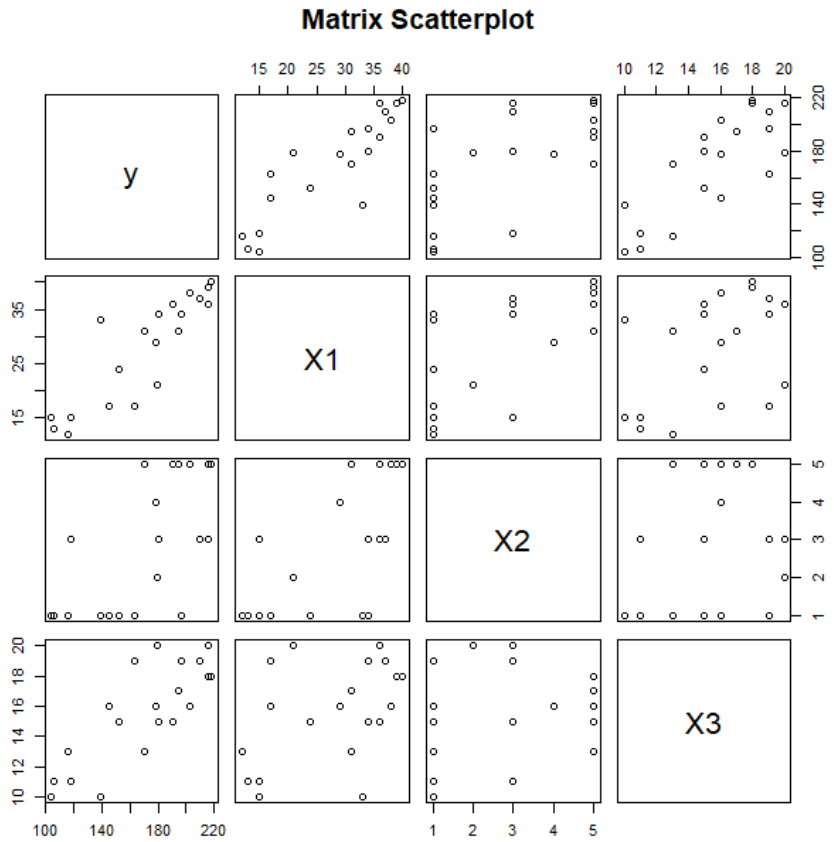
R Console

```
> X1=c(34,12,15,33,31,24,40,31,21,37,29,15,17,38,17,36,13,39,36,34)
> X2=c(3,1,3,1,5,1,5,5,2,3,4,1,1,5,1,3,1,5,5,1)
> X3=c(15,13,11,10,17,15,18,13,20,19,16,10,16,16,19,20,11,18,15,19)
> y=c(180,116,118,139,195,152,218,170,179,210,178,104,145,203,163,216,106,216,191,197)
> X1
 [1] 34 12 15 33 31 24 40 31 21 37 29 15 17 38 17 36 13 39 36 34
> X2
 [1] 3 1 3 1 5 1 5 5 2 3 4 1 1 5 1 3 1 5 5 1
> X3
 [1] 15 13 11 10 17 15 18 13 20 19 16 10 16 16 19 20 11 18 15 19
> y
 [1] 180 116 118 139 195 152 218 170 179 210 178 104 145 203 163 216 106 216 191 197
>
```

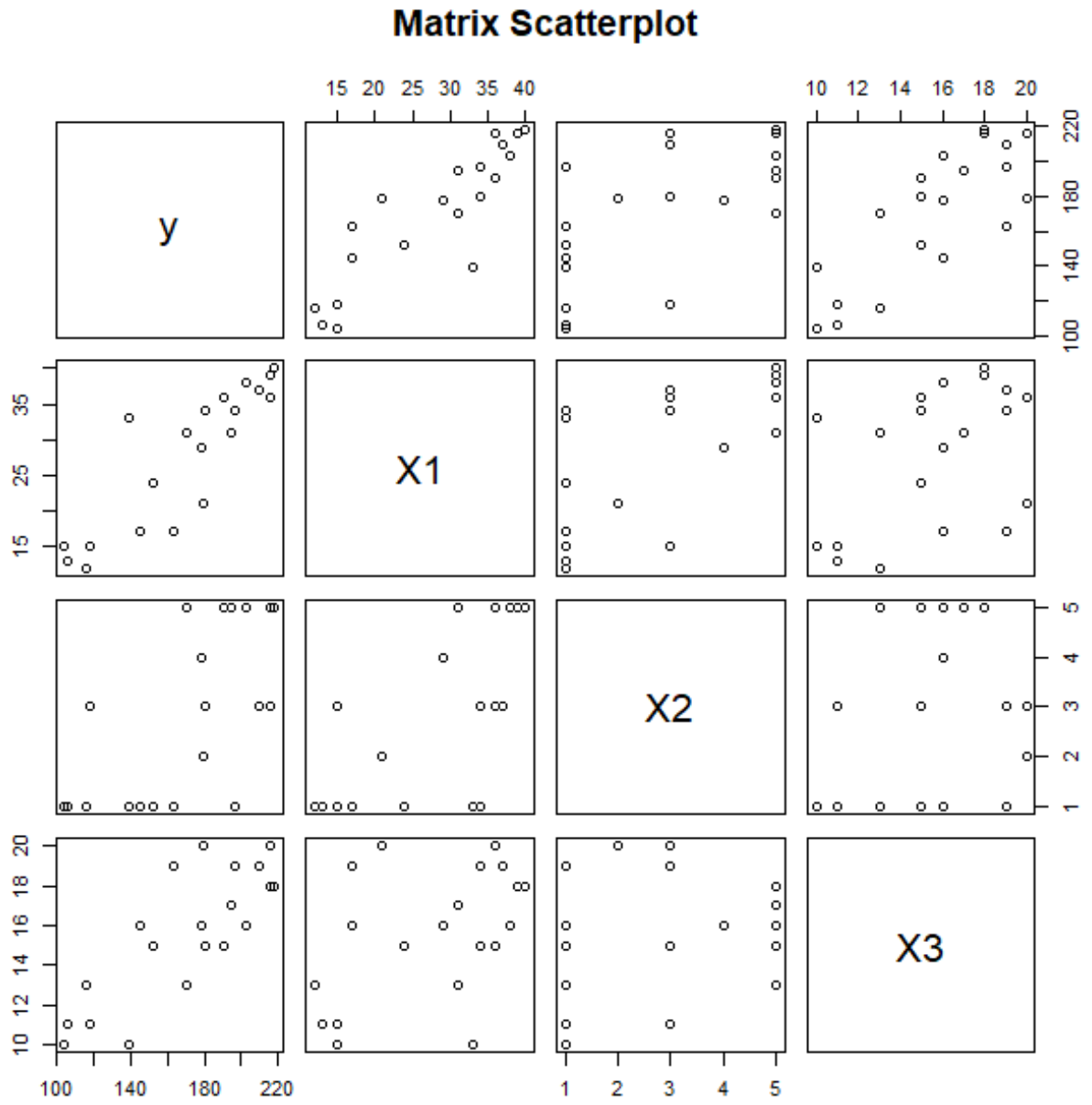
Matrix Scatter Plot with More than Two Variables

Using the command `pairs()` as

```
> pairs(~y+X1+X2+X3, main="Matrix Scatterplot")
```



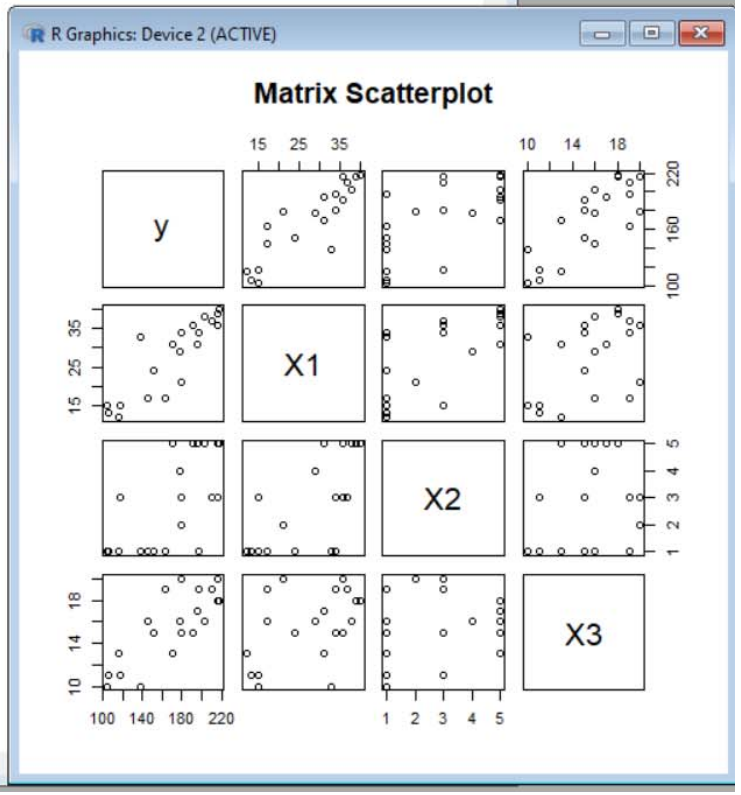
Matrix Scatter Plot with More than Two Variables



Matrix Scatter Plot with More than Two Variables

R Console

```
> y
 [1] 180 116 118 139 195 152 218 170 179 210 178 104 145 203 163 216 106 216 191 197
> X1
 [1] 34 12 15 33 31 24 40 31 21 37 29 15 17 38 17 36 13 39 36 34
> X2
 [1] 3 1 3 1 5 1 5 5 2 3 4 1 1 5 1 3 1 5 5 1
> X3
 [1] 15 13 11 10 17 15 18 13 20 19 16 10 16 16 19 20 11 18 15 19
> pairs(~y+X1+X2+X3, main="Matrix Scatterplot")
>
```



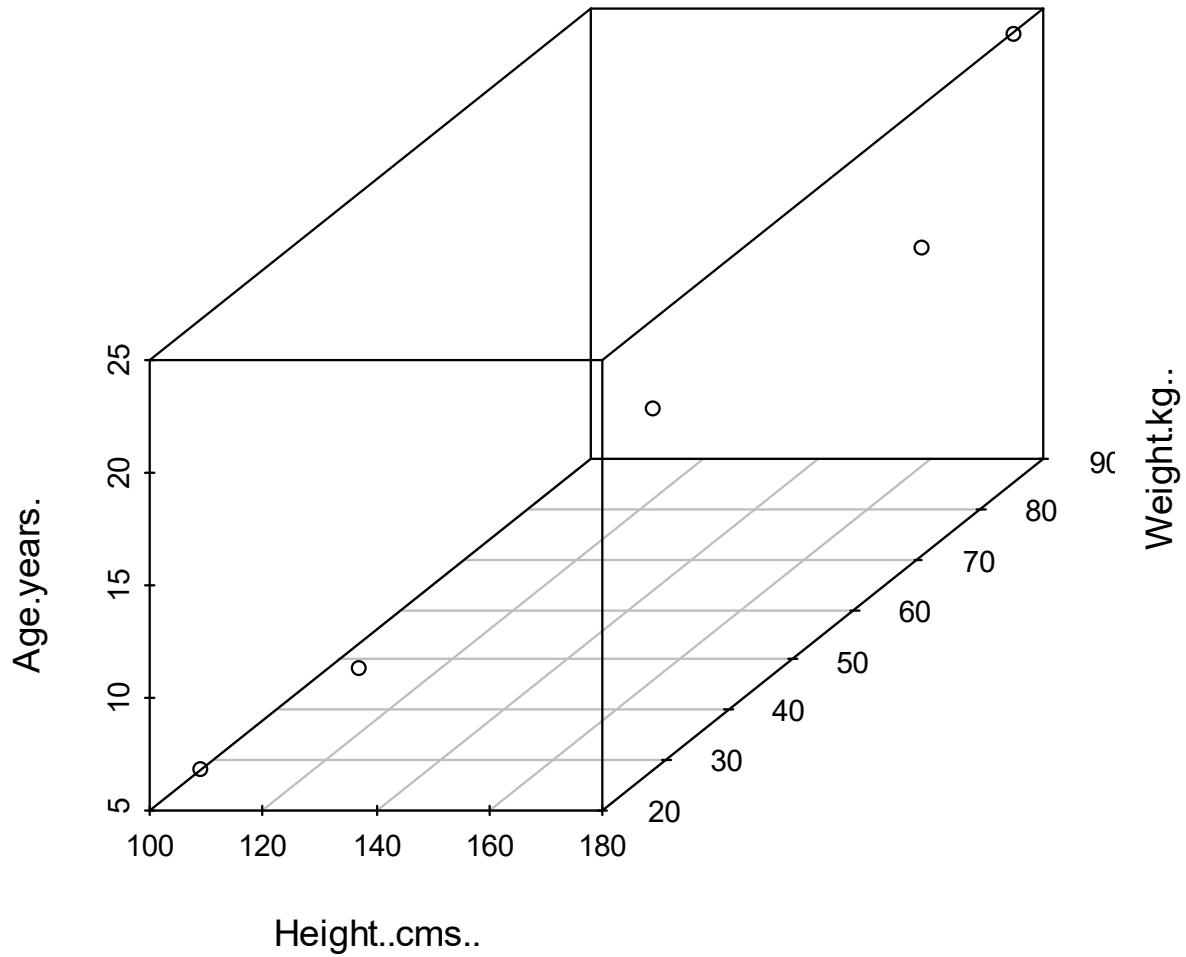
3 Dimensional Scatter Plot:

scatterplot3d() Plots a three dimensional (3D) point cloud

```
> install.packages("scatterplot3d")
> library(scatterplot3d)
> setwd("C:/RCourse/")
> data3d <- read.csv("data-age-height-
   weight.csv")
> data3d
      Height..cms.. Weight.kg.. Age.years.
1               100           28           5
2               120           35           8
3               150           55          15
4               176           74          18
5               180           85          25
```

3 Dimensional Scatter Plot:

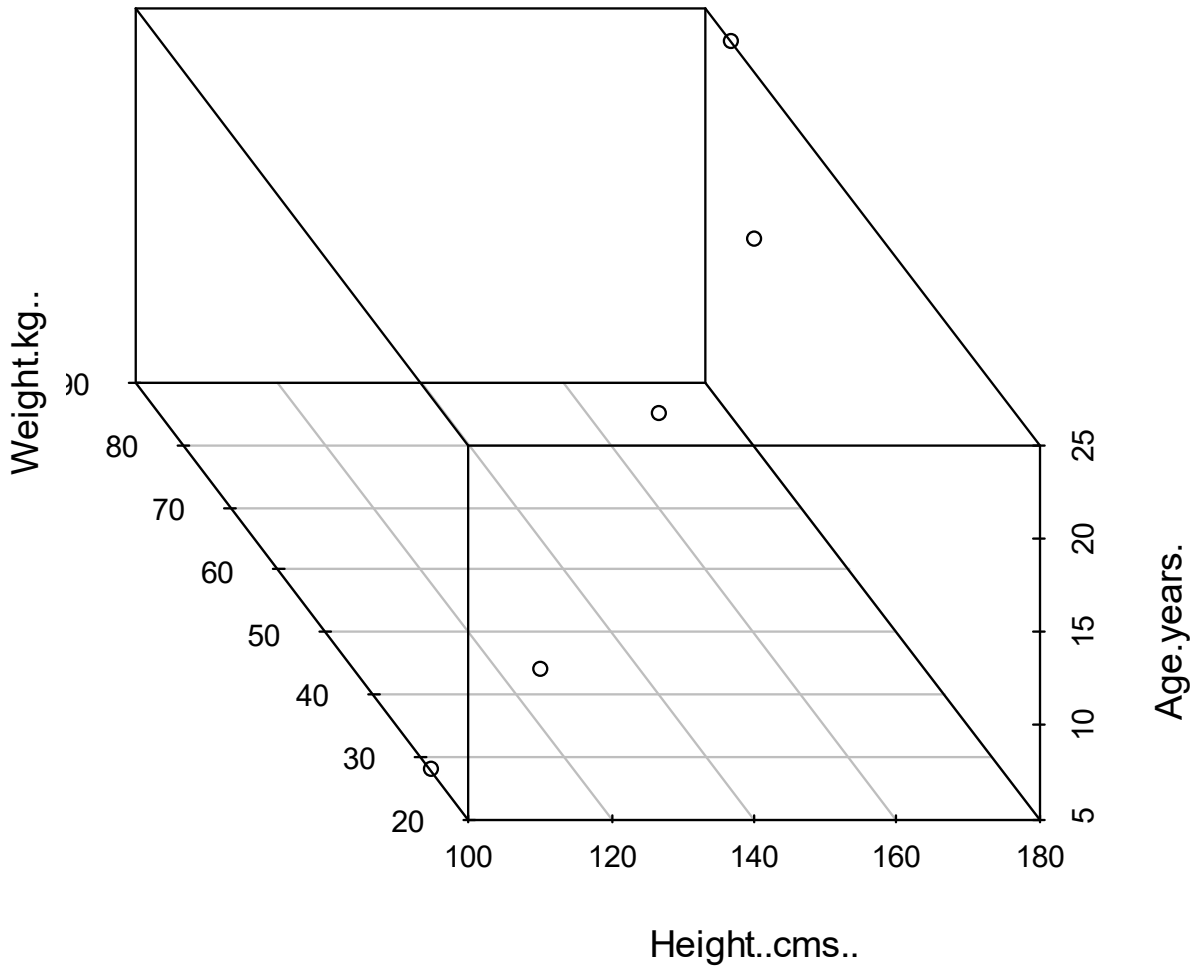
```
> scatterplot3d(data3d[,1:3])
```



3 Dimensional Scatter Plot:

Direction of the figure can be changed.

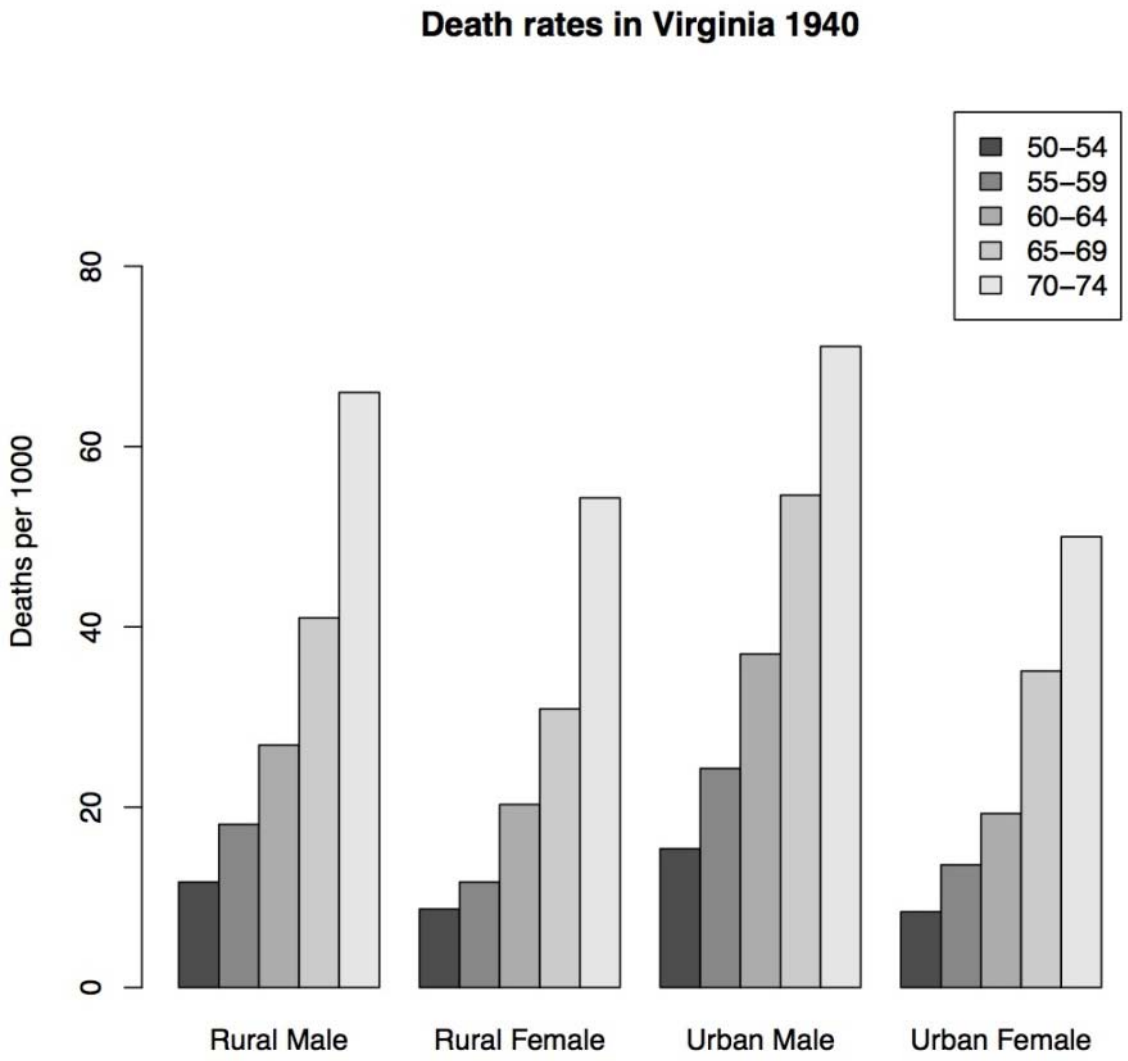
```
> scatterplot3d(data3d[,1:3], angle = 120)
```



More functions

- `contour()` for contour lines
- `dotchart()` for dot charts (replacement for bar charts)
- `image()` pictures with colors as third dimension
- `mosaicplot()` mosaic plot for (multidimensional) diagrams of categorical variables (contingency tables)
- `persp()` perspective surfaces over the x–y plane

Multiple Bar plots are possible



Grouped box plots are possible