Descriptive Statistics With R Software

Association of Variables
::
Univariate and Bivariate Scatter Plots

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Association of Two Variables

Example

- **Number of hours of study affect the marks obtained in an examination.**
- **Electricity/power consumption increases when the weather temperature increases.**
- **Weight of infants and small children increases as their height increases under normal circumstances.**

Association of Two Variables

The observations on both the variables are related to each other.

How to know the variables are related?

How to know the degree of relationship between the two variables?

Graphical procedures – Two dimensional plots, three dimensional plots etc.

Quantitative procedures – Correlation coefficients, contingency tables, Chi-square statistic, linear regression, nonlinear regression etc.

Association of Two Variables

How to judge or graphically summarize the association of two variables?

***X*, *Y* : Two variables**

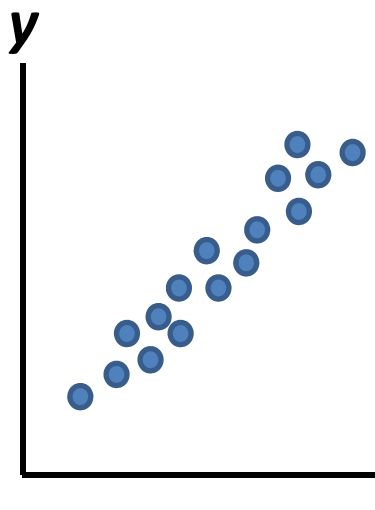
***n* pairs of observations are available as (x_1,y_1), (x_2,y_2),…,(x_n,y_n)**

Scatter Plot

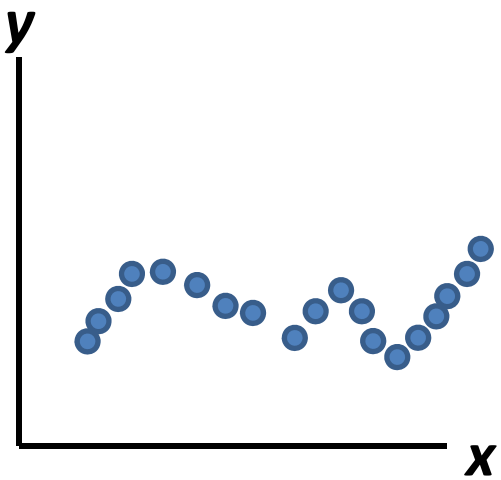
Plot the paired observations in a single graph, called as scatter plot.

Scatter plot reveals the nature and trend of possible relationship.

Relationships : Linear or nonlinear.



Linear relationship between *X* and *Y*



Nonlinear relationship between *X* and *Y*

Strength and Trend of Relationships

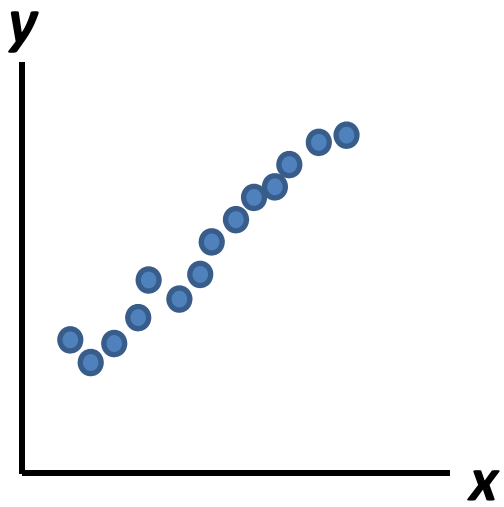


Fig. 1: Strong positive linear relationship

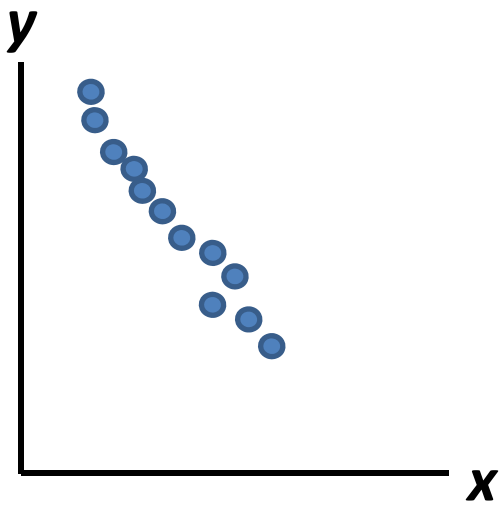


Fig. 2: Strong negative linear relationship

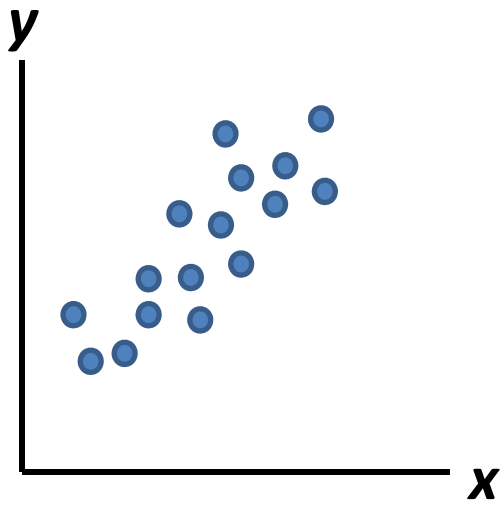


Fig. 3: Moderate positive linear relationship

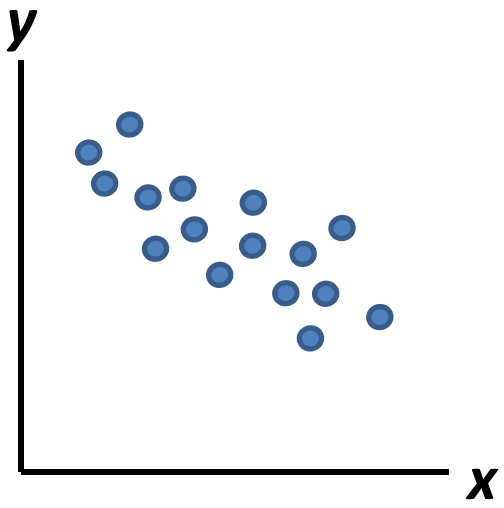


Fig. 4: Moderate negative linear relationship

Strength and Trend of Relationships

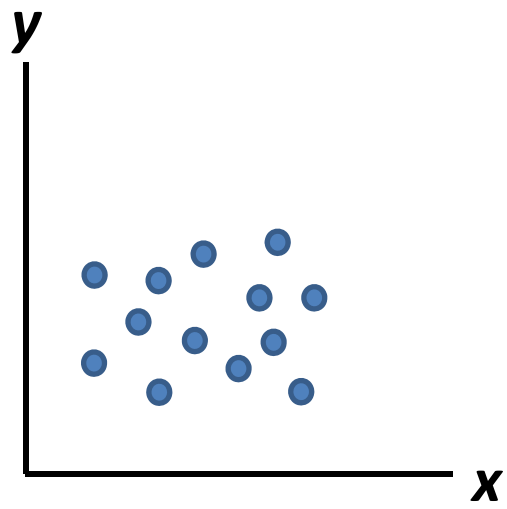


Fig. 5: No clear relationship

We will study about the direction and degree of linear relationships.

Two aspects – graphical and quantitative

Scatter Plot

Plot command for one variable:

`x:` **Data vector**

```
plot(x)
```

Scatter Plots

Example

Height of 50 persons are recorded as follows:

166,125,130,142,147,159,159,147,165,156,149,164,137,166,135,142,

133,136,127,143,165,121,142,148,158,146,154,157,124,125,158,159,

164,143,154,152,141,164,131,152,152,161,143,143,139,131,125,145,

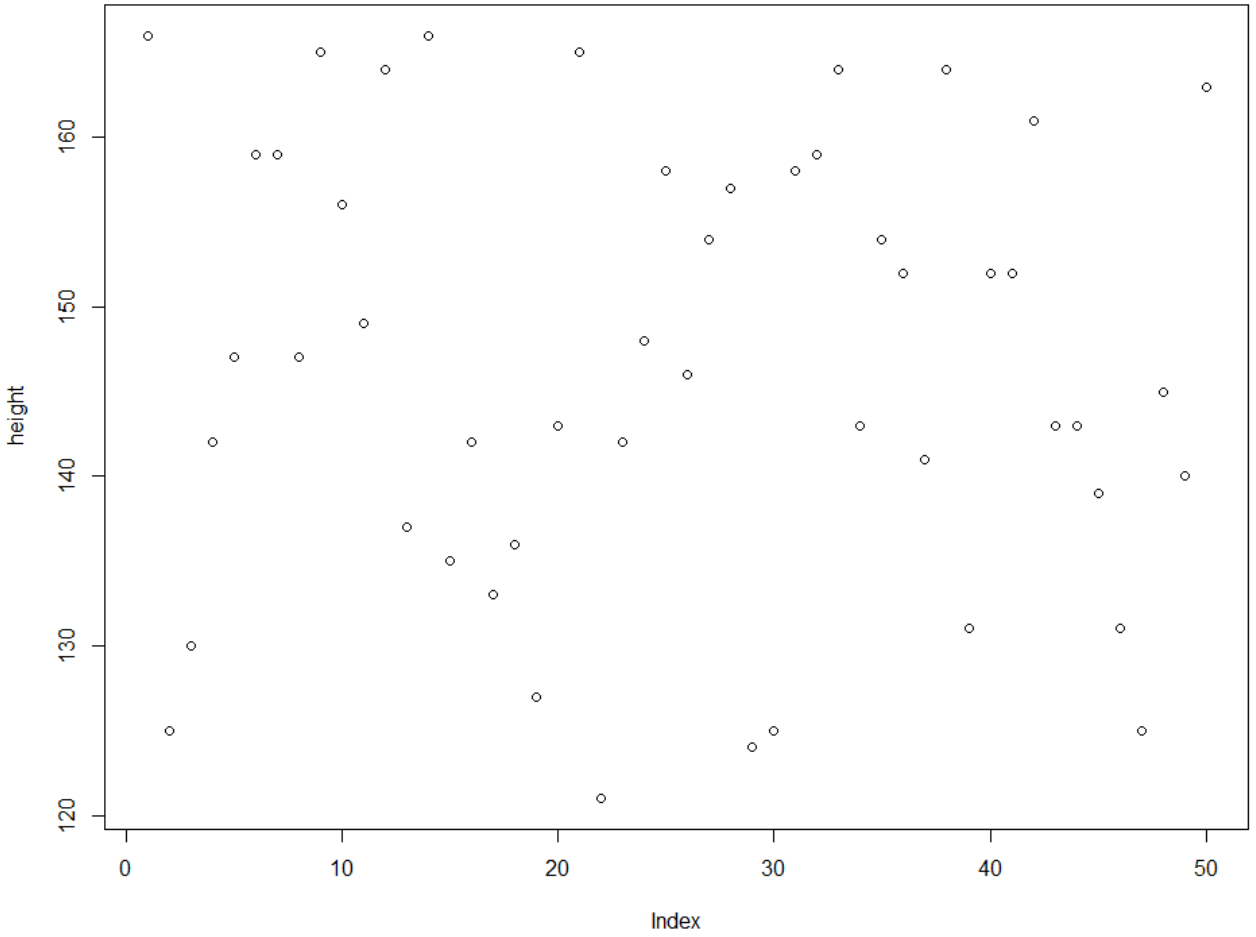
140,163

```
> height = c(166,125,130,142,147,159,159,147,
165,156,149,164,137,166,135,142,133,136,127,143,
165,121,142,148,158,146,154,157,124,125,158,159,
164,143,154,152,141,164,131,152,152,161,143,143,
139,131,125,145,140,163)
```

Scatter Plots

Example

```
plot(height)
```



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 '**h**igh-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.

Scatter Plot

Example

Data on marks obtained by 20 students out of 500 marks and the number of hours they studied per week are recorded as follows:

We know from experience that marks obtained by students increase as the number of hours increase.

Marks	337	316	327	340	374	330	352	353	370	380
Number of hours per week	23	25	26	27	30	26	29	32	33	34

Marks	384	398	413	428	430	438	439	479	460	450
Number of hours per week	35	38	39	42	43	44	45	46	44	41

Scatter Plot

Example

```
marks =
c(337,316,327,340,374,330,352,353,370,380,384,39
8,413,428,430,438,439,479,460,450)

hours =
c(23,25,26,27,30,26,29,32,33,34,35,38,39,42,43,4
4,45,46,44,41)
```

Scatter Plot

Example

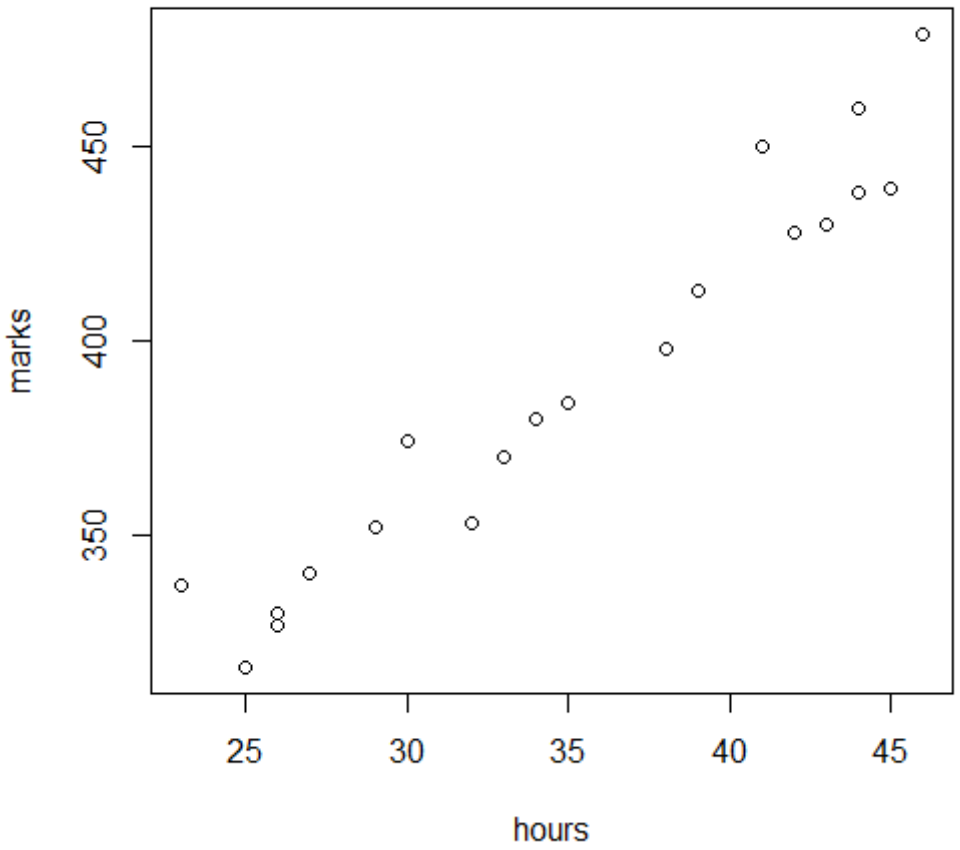
`plot` command:

`x, y:` Two data vectors

Various type of plots are possible to draw.

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

```
plot(hours, marks)
```

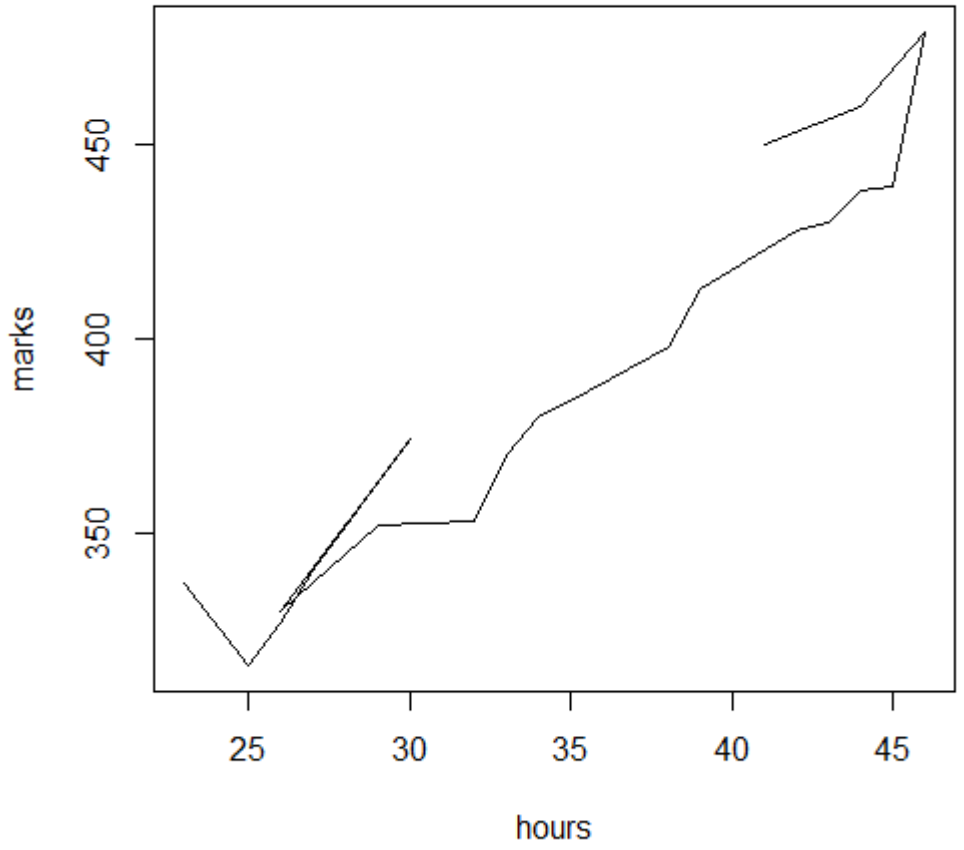


Scatter Plot

Example

```
plot(hours, marks, "l")
```

“`l`" for lines,

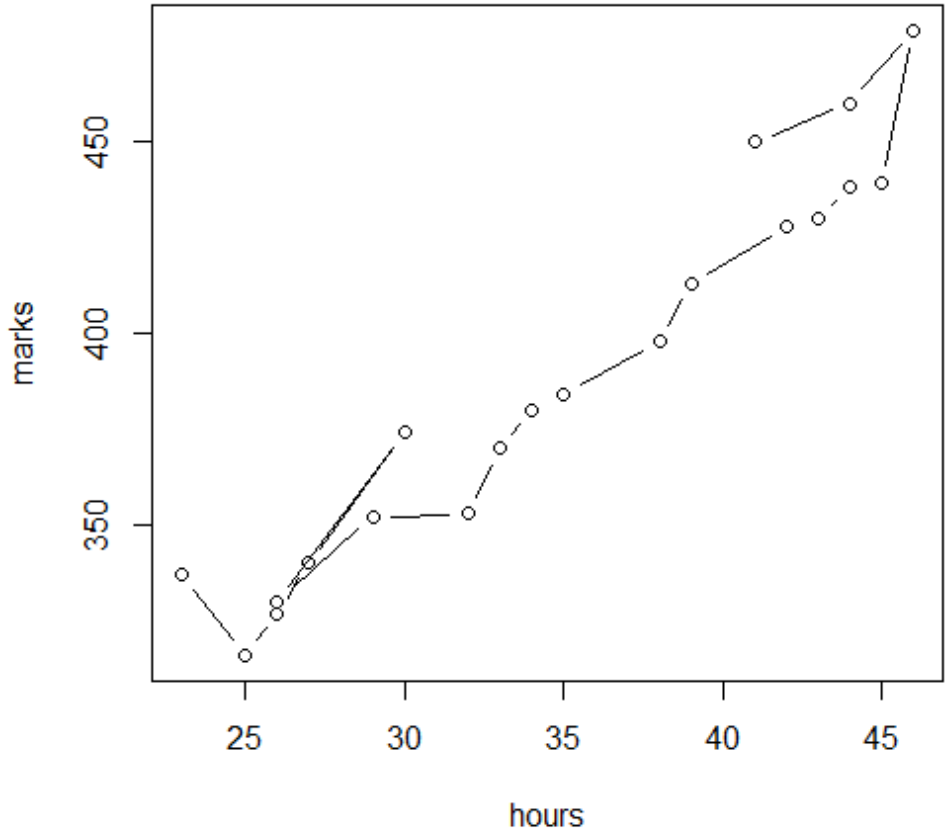


Scatter Plot

Example

```
plot(hours, marks, "b")
```

“b" for both – line and point

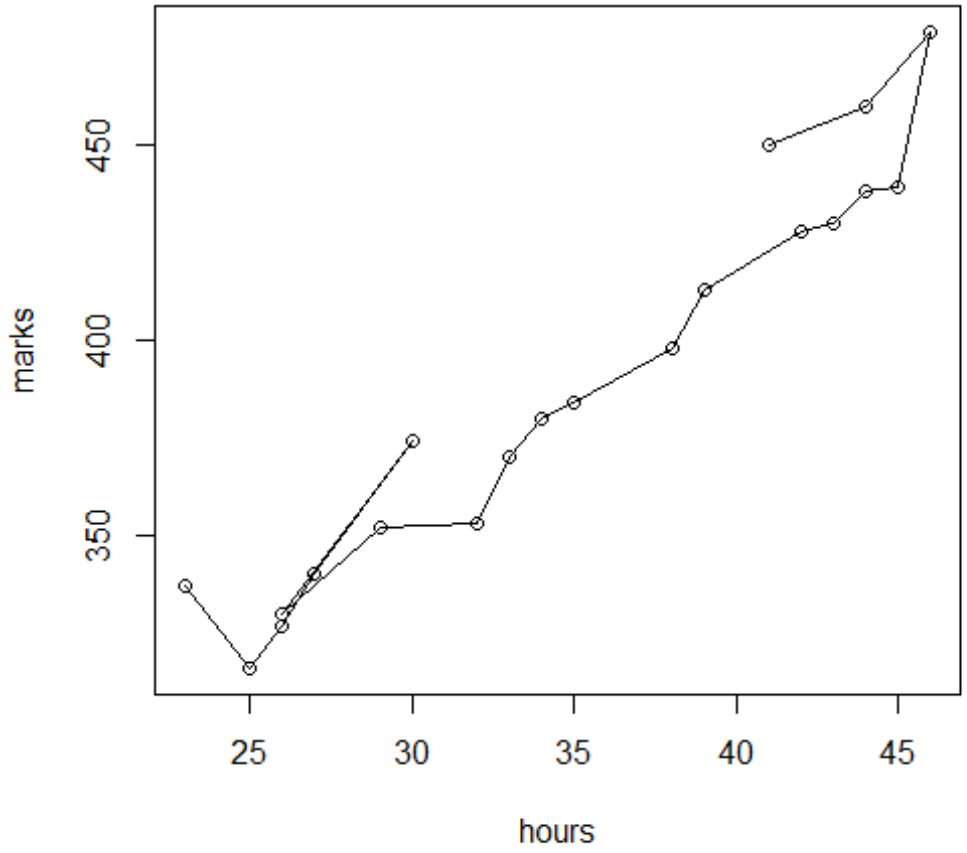


Scatter Plot

Example

```
plot(hours, marks, "o")
```

“o" for both ‘overplotted’

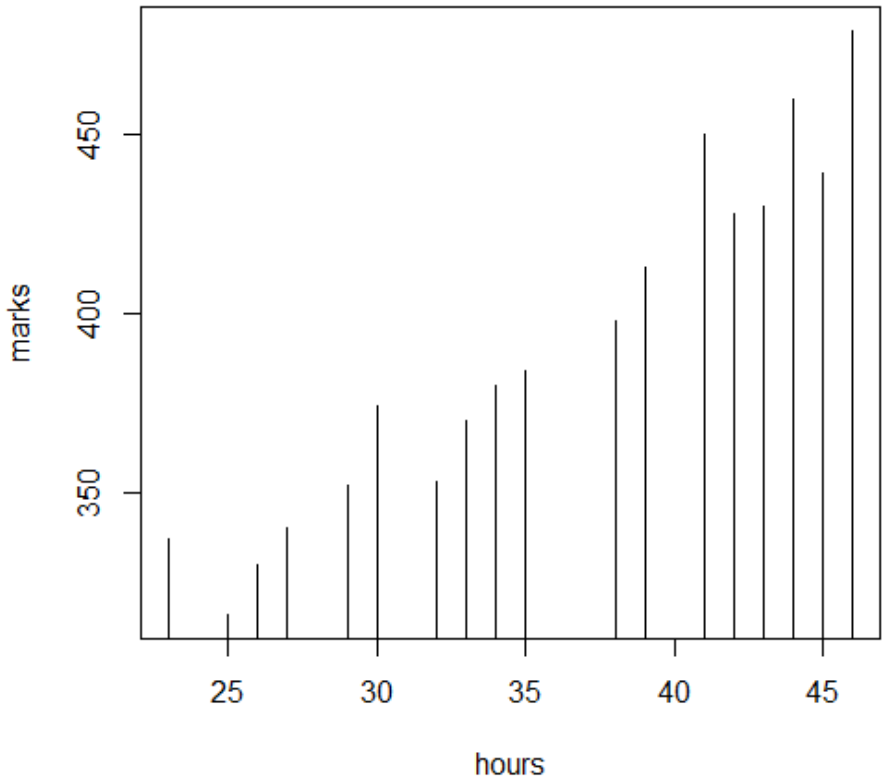


Scatter Plot

Example

```
plot(hours, marks, "h")
```

"h" for 'histogram' like (or 'high-density') vertical lines

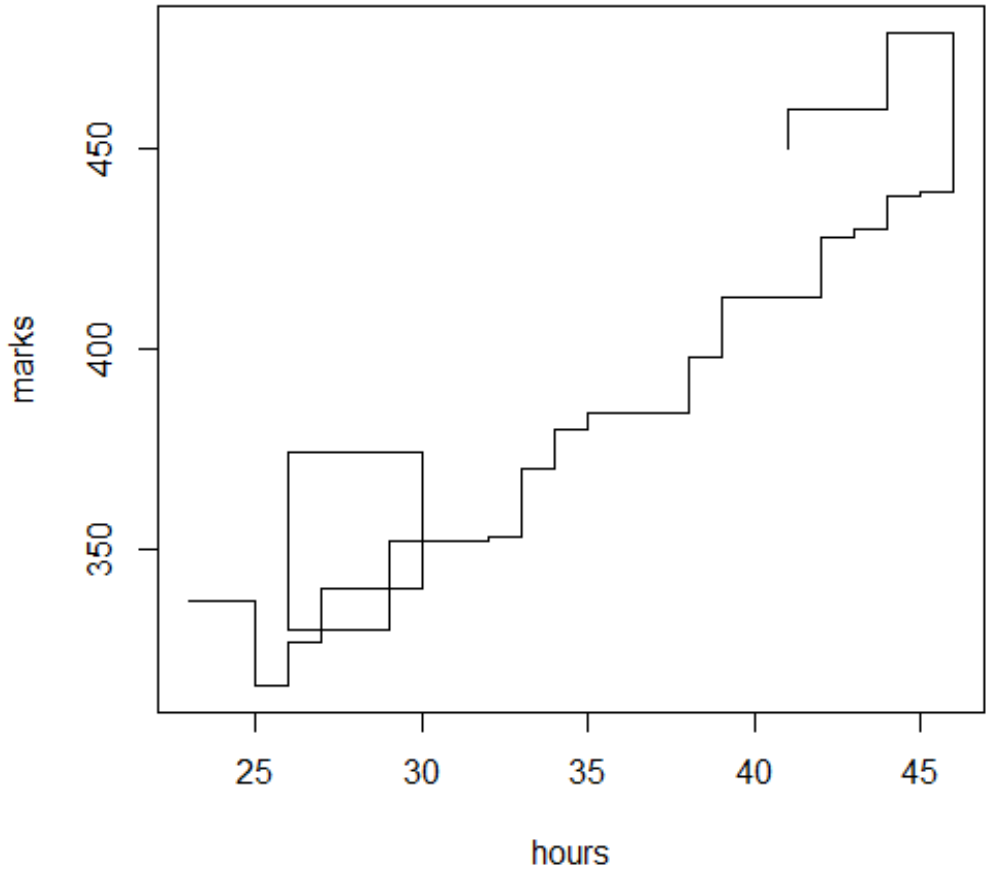


Scatter Plot

Example

```
plot(hours, marks, "s")
```

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



Scatter Plot

Example

```
plot(hours, marks, xlab="Number of weekly
hours", ylab="Marks obtained",  main="Marks
obtained versus  Number of hours per week")
```