Random variables 01

Josep Fortiana 2018-09-26

Load auxiliary functions

```
source( "Random.vars.r" )
```

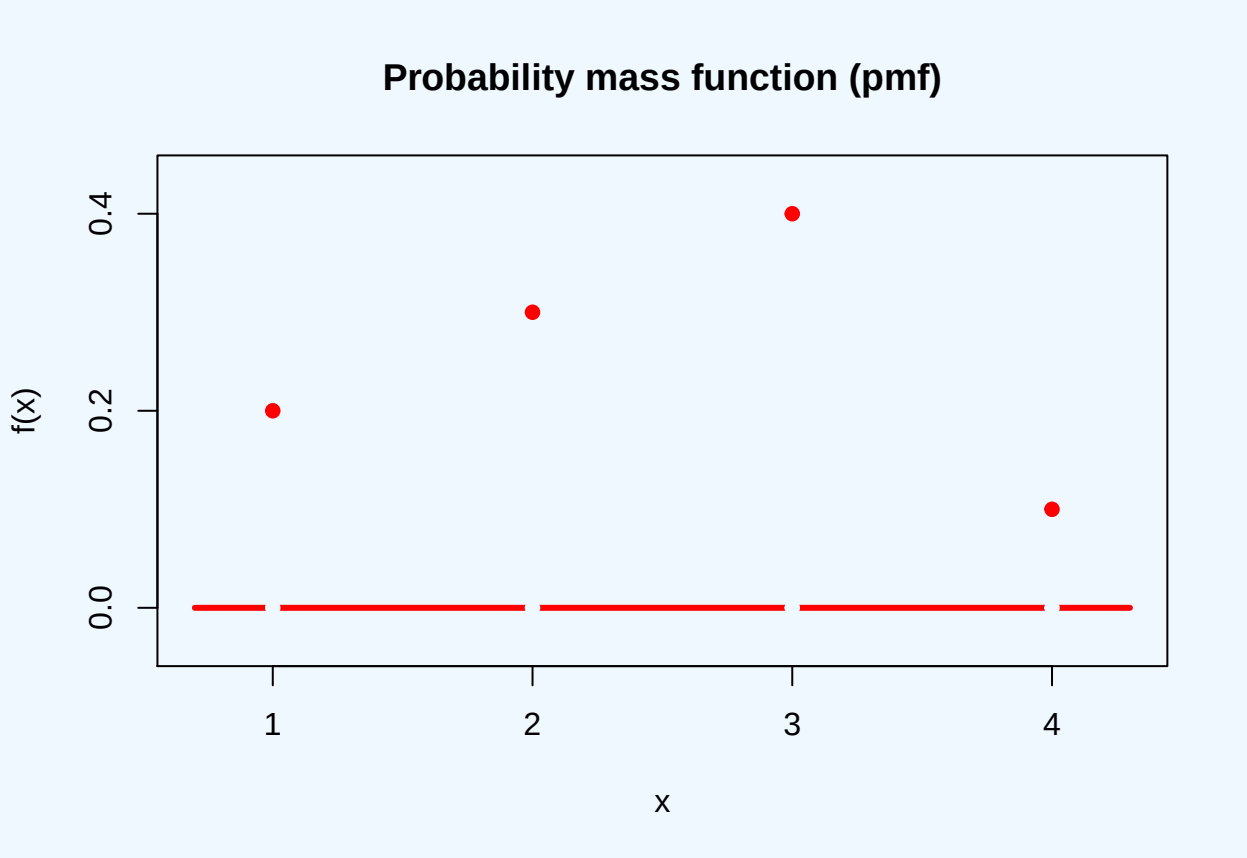
Discrete random variables

A discrete r.v.

```
x<-c(1,2,3,4)
d<-c(0.2, 0.3, 0.4, 0.1)
```

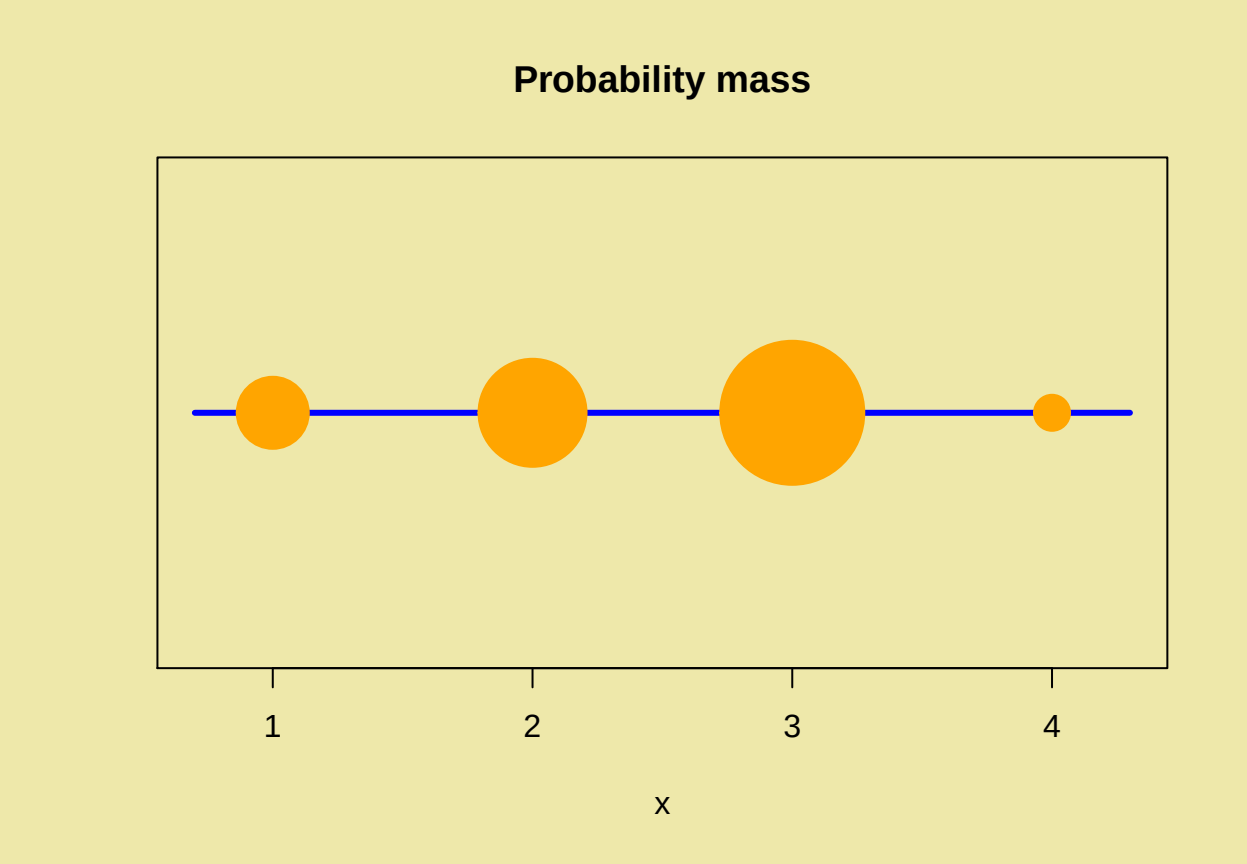
Probability mass function (pmf)

```
plotmass(x,d)
```



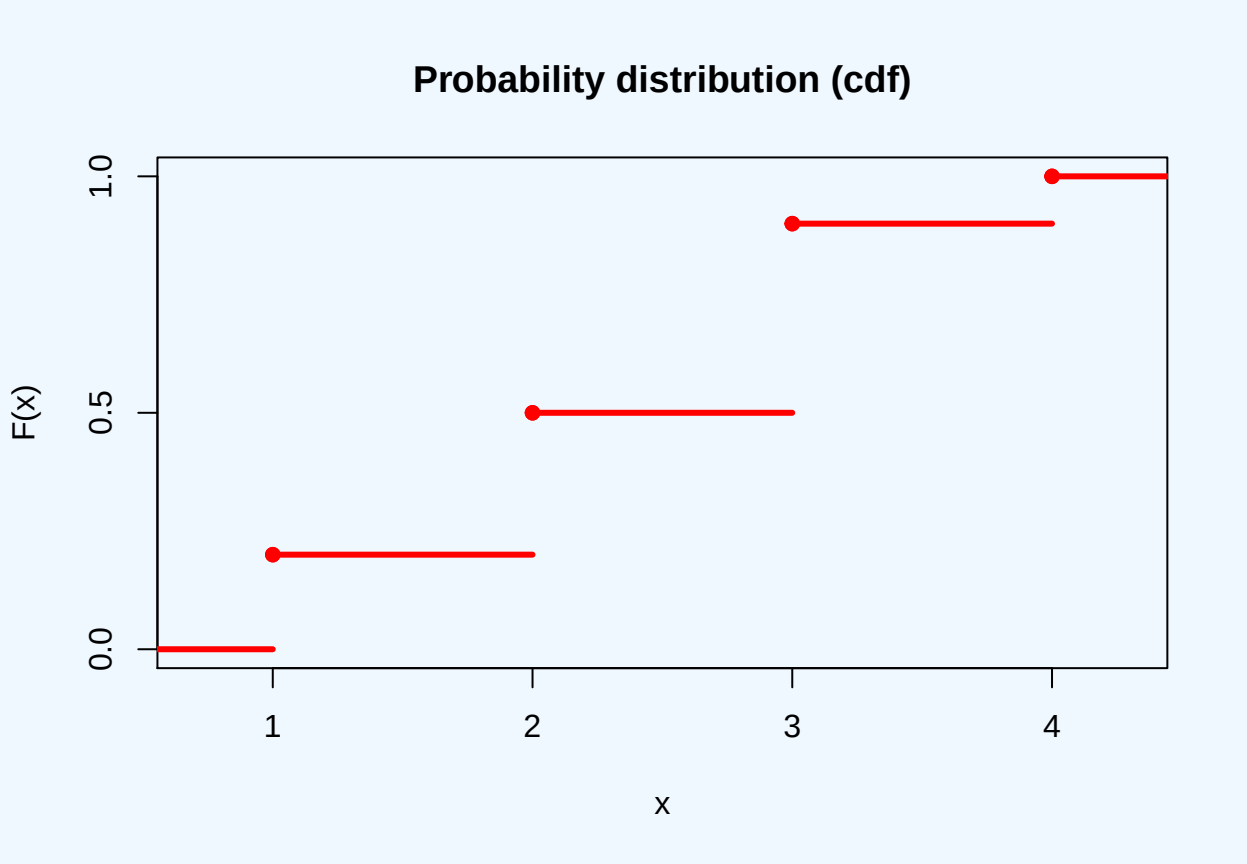
A visualization of the probability distribution as a set of probability mass points on the line

```
plotmasspoints(x,d)
```



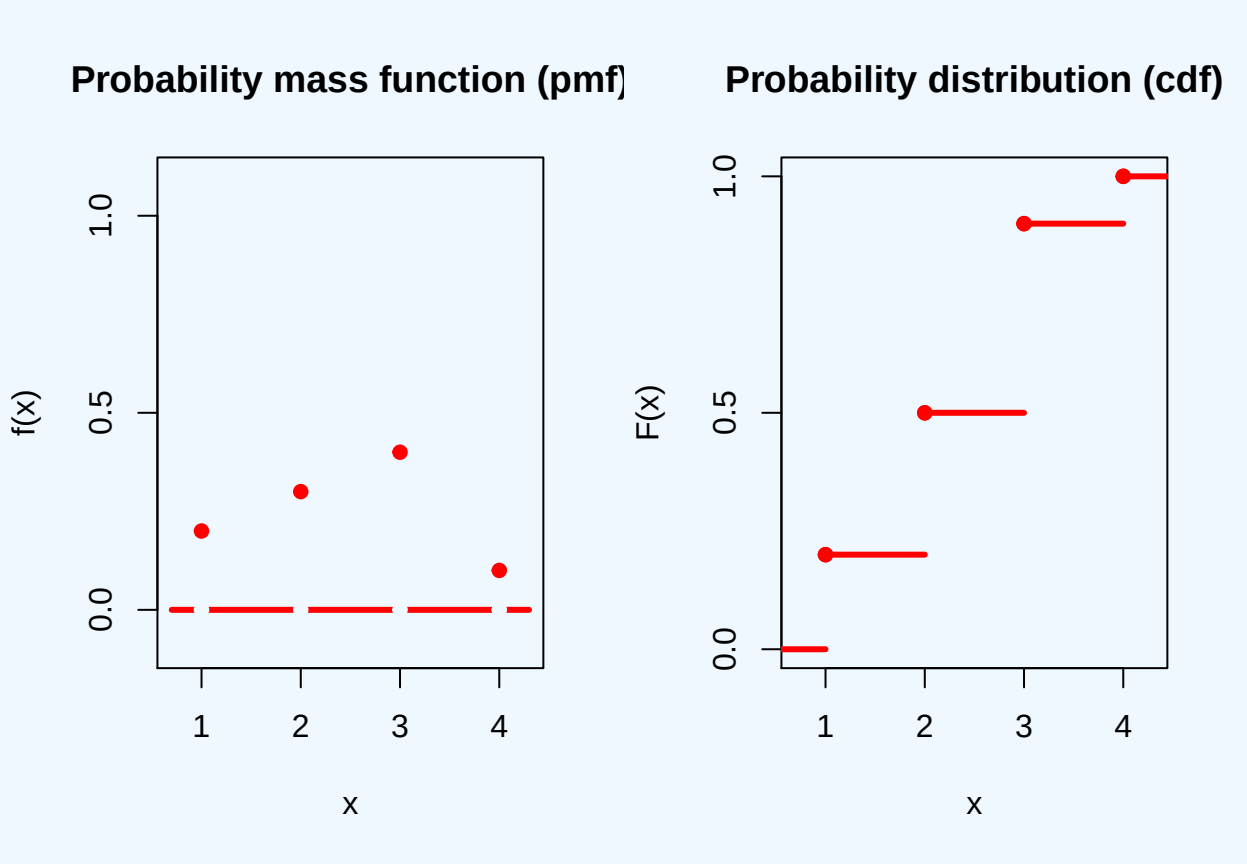
The cumulative distribution function (cdf) or probability distribution function

```
plotdist(x,d)
```



Joint plot of pmf and cdf

```
plotmassdist(x,d)
```



Constant (degenerate) r.v.

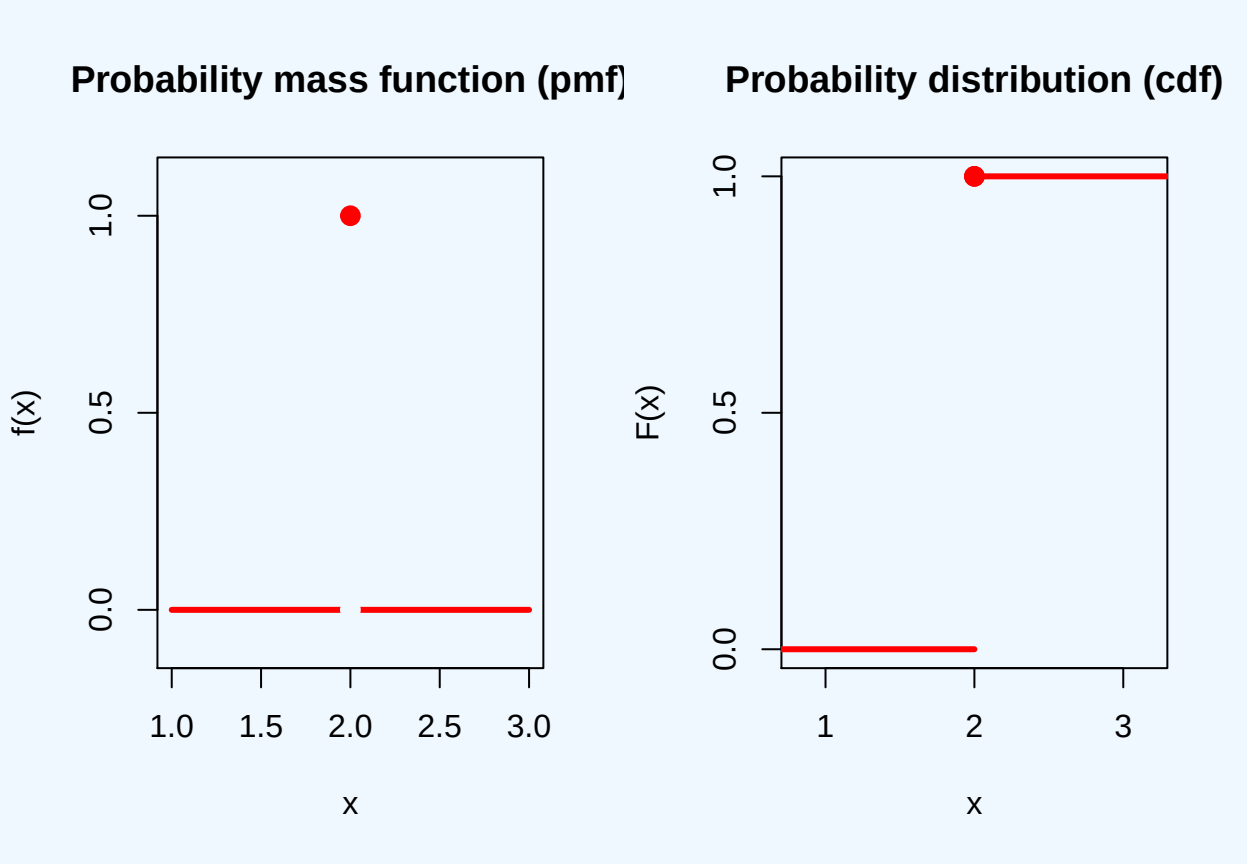
Vector of values, x, and vector of probabilities, d

Both have a single element each

```
x<-2
d<-1
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

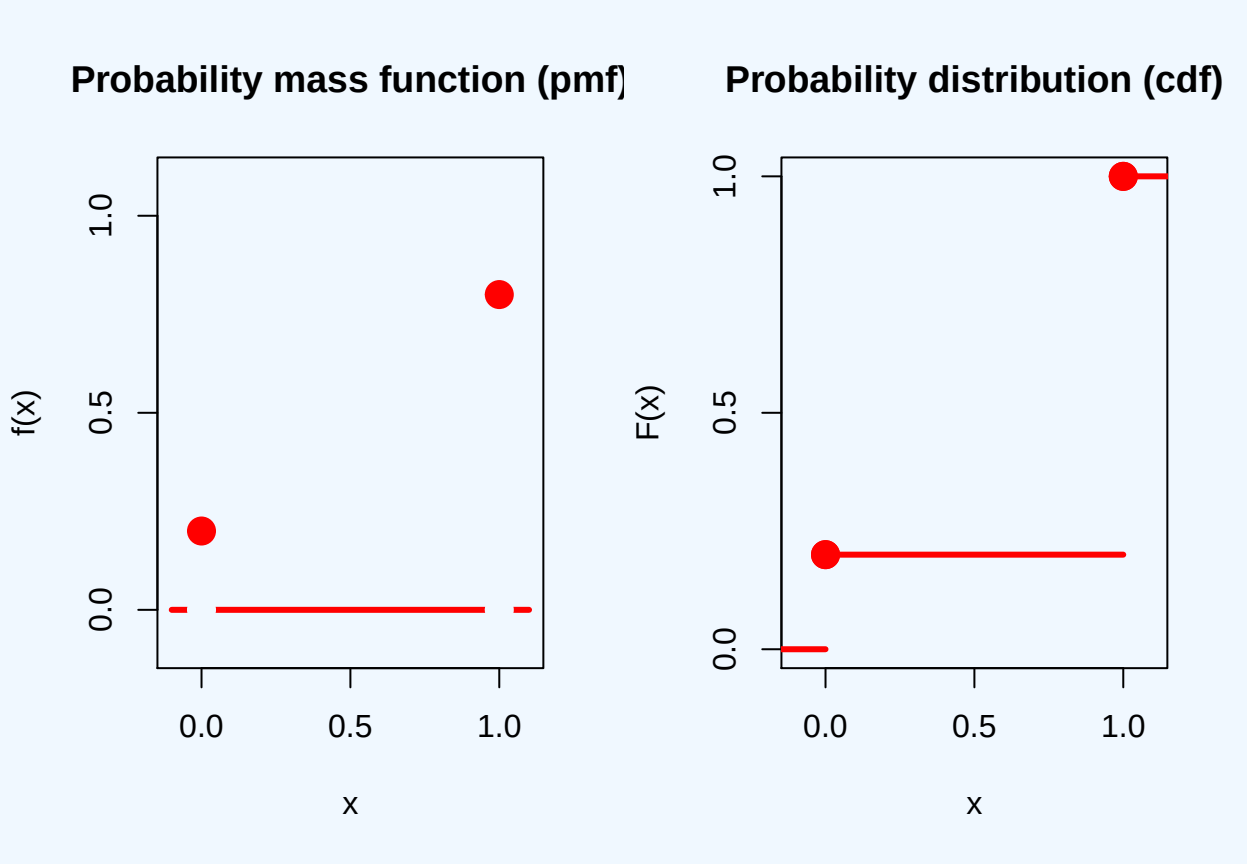


Bernoulli r.v.

```
x<-c(0,1)
d<-c(0.2,0.8)
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

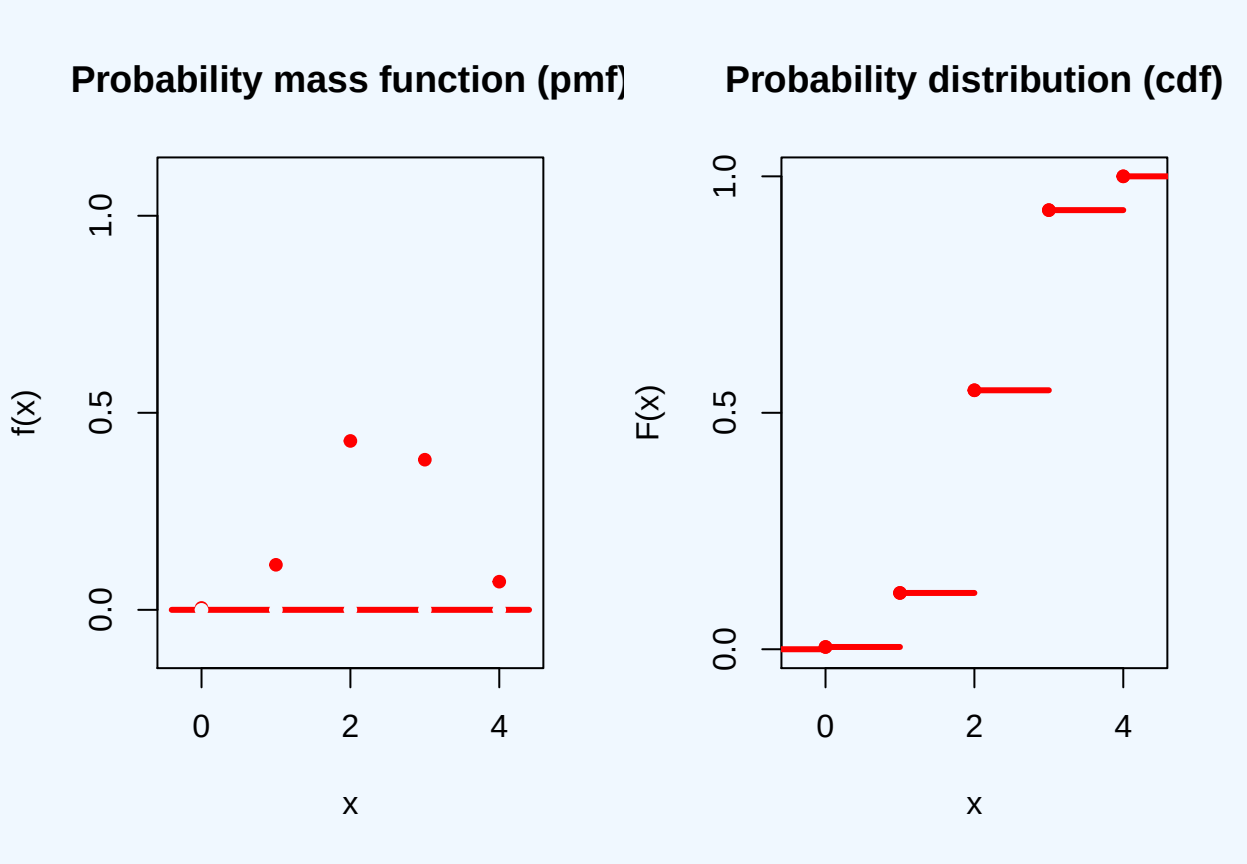


Hypergeometric r.v.

```
# Results of drawing k=4 balls without replacement from an urn containing m=6 balls, n=4 of which are w
#(and m-n=2 are black). The hypergeometric random variable $X$ is the number of white balls obtained.
m<-6
n<-4
k<-4
# Vector of values
x<-0:4
# Vector of probabilities
d<-dhyper(x, m, n, k)
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

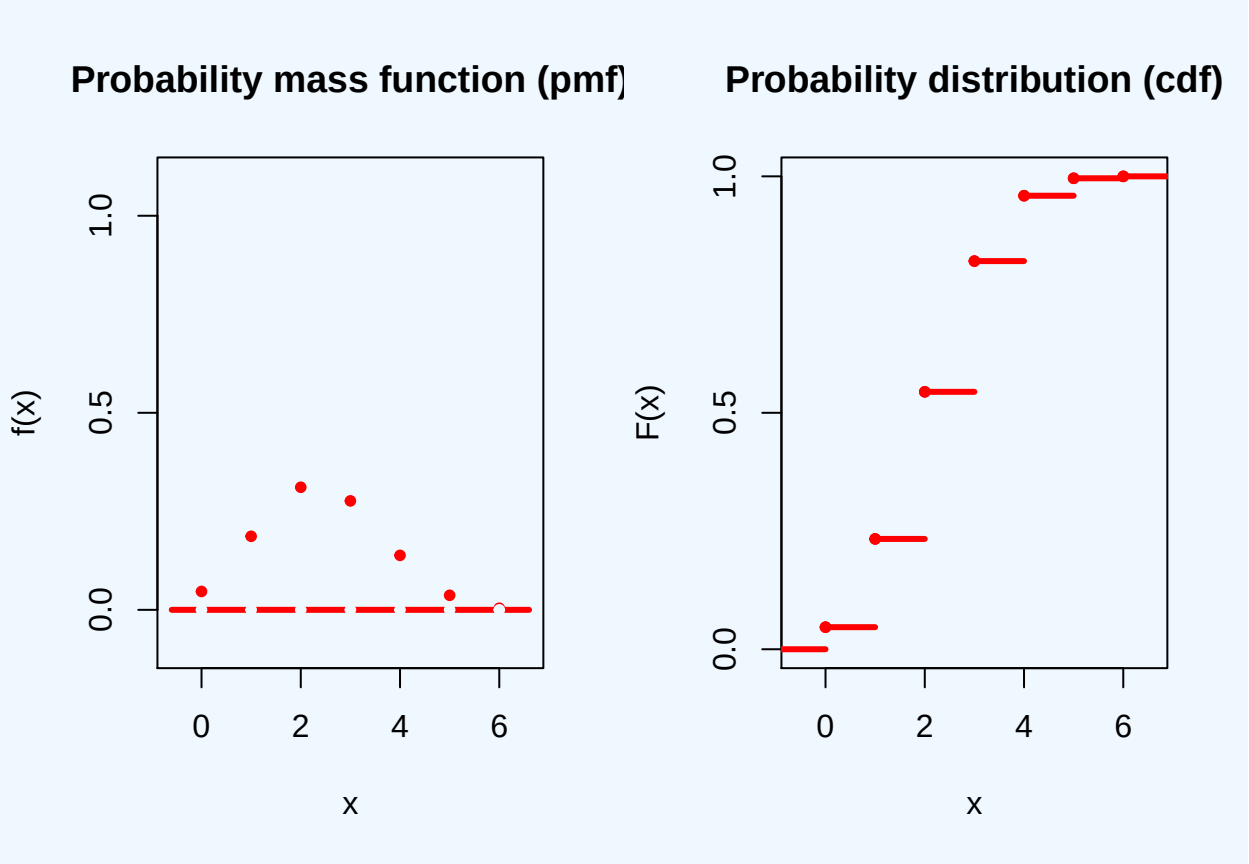


Binomial r.v.

```
# Binomial B(6,0.4) r.v.
n<-6
p<-0.4
x<-0:n
```

Joint plot of pmf and cdf

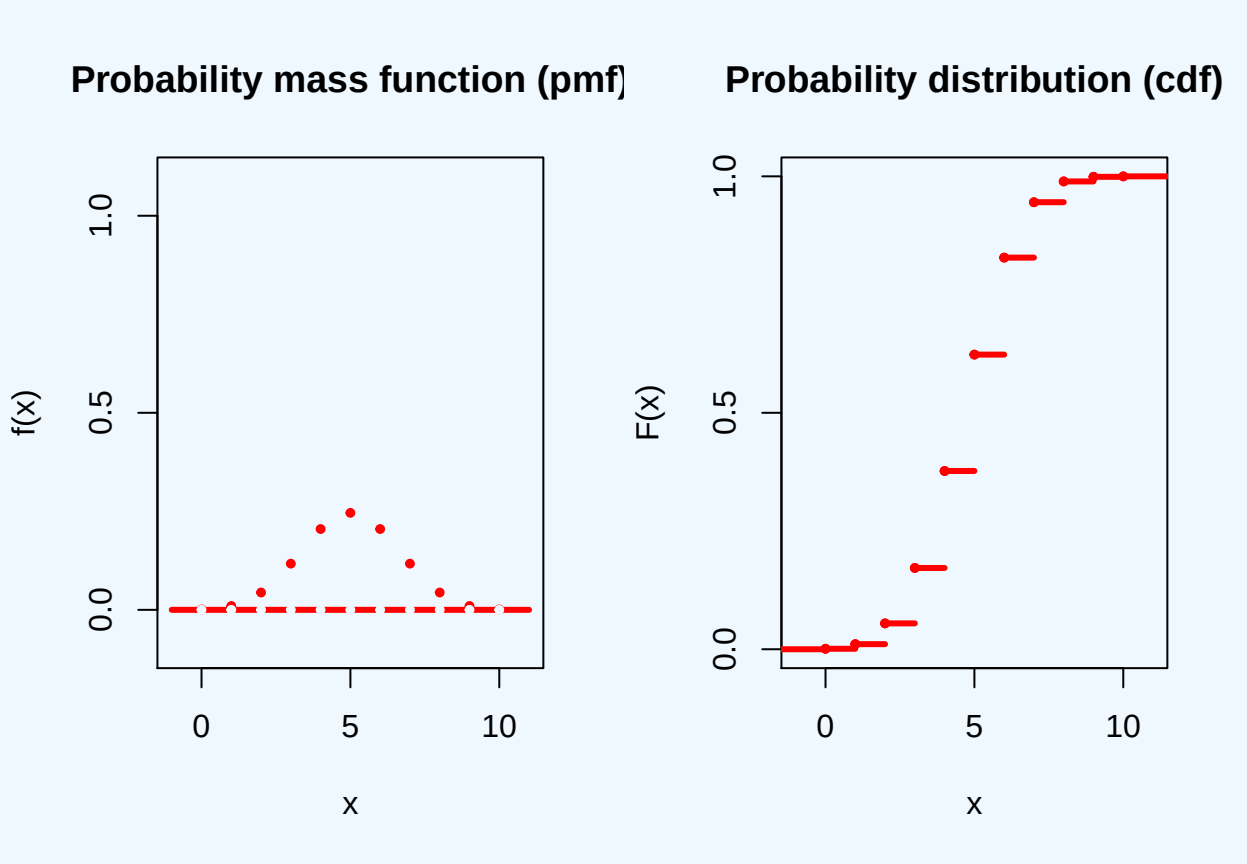
```
d<-dbinom(x, size=n,prob=p)
plotmassdist(x,d)
```




```
# Binomial B(10,0.5) r.v.
n<-10
p<-0.5
x<-0:n
d<-dbinom(x, size=n,prob=p)
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

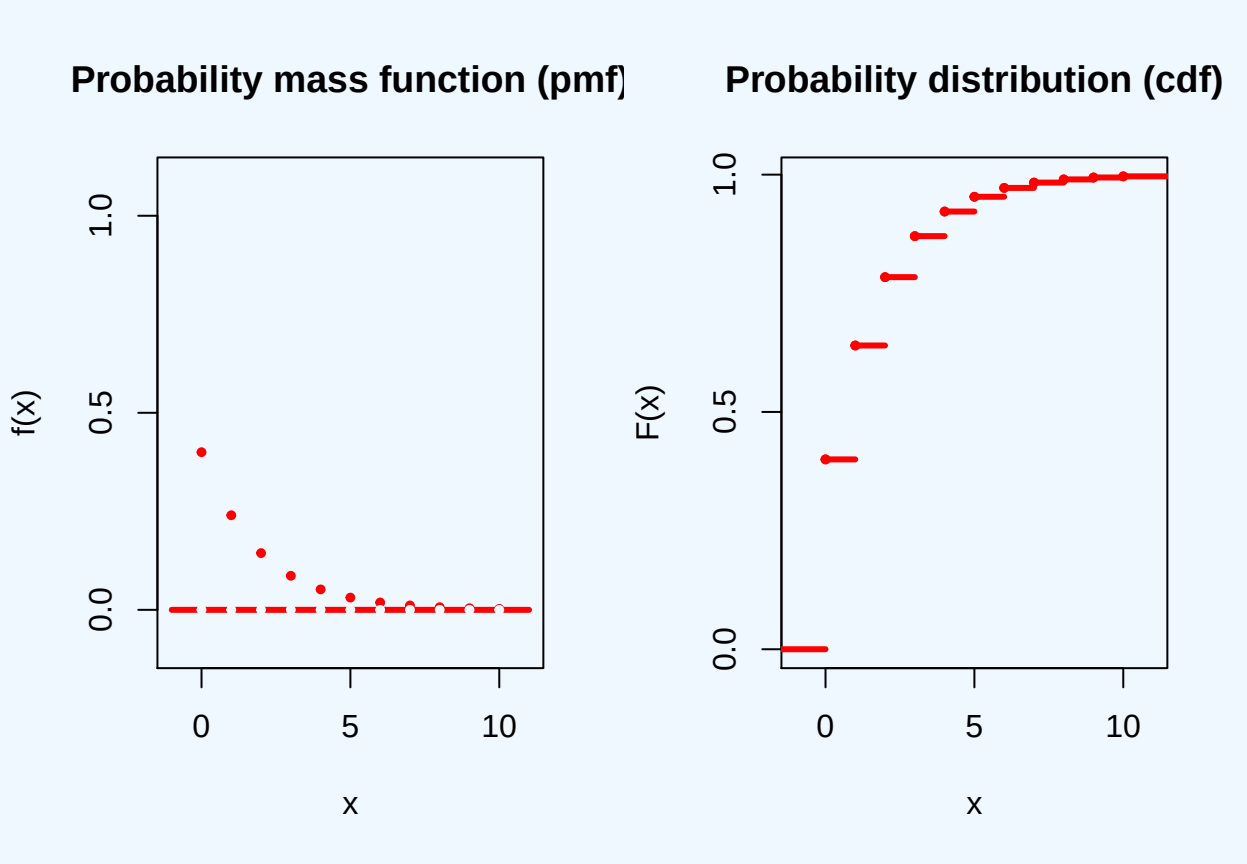


Geometric r.v.

```
# Geometric Geom(0.4) r.v.
n<-10
p<-0.4
x<-0:n
d<-dgeom(x,prob=p)
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

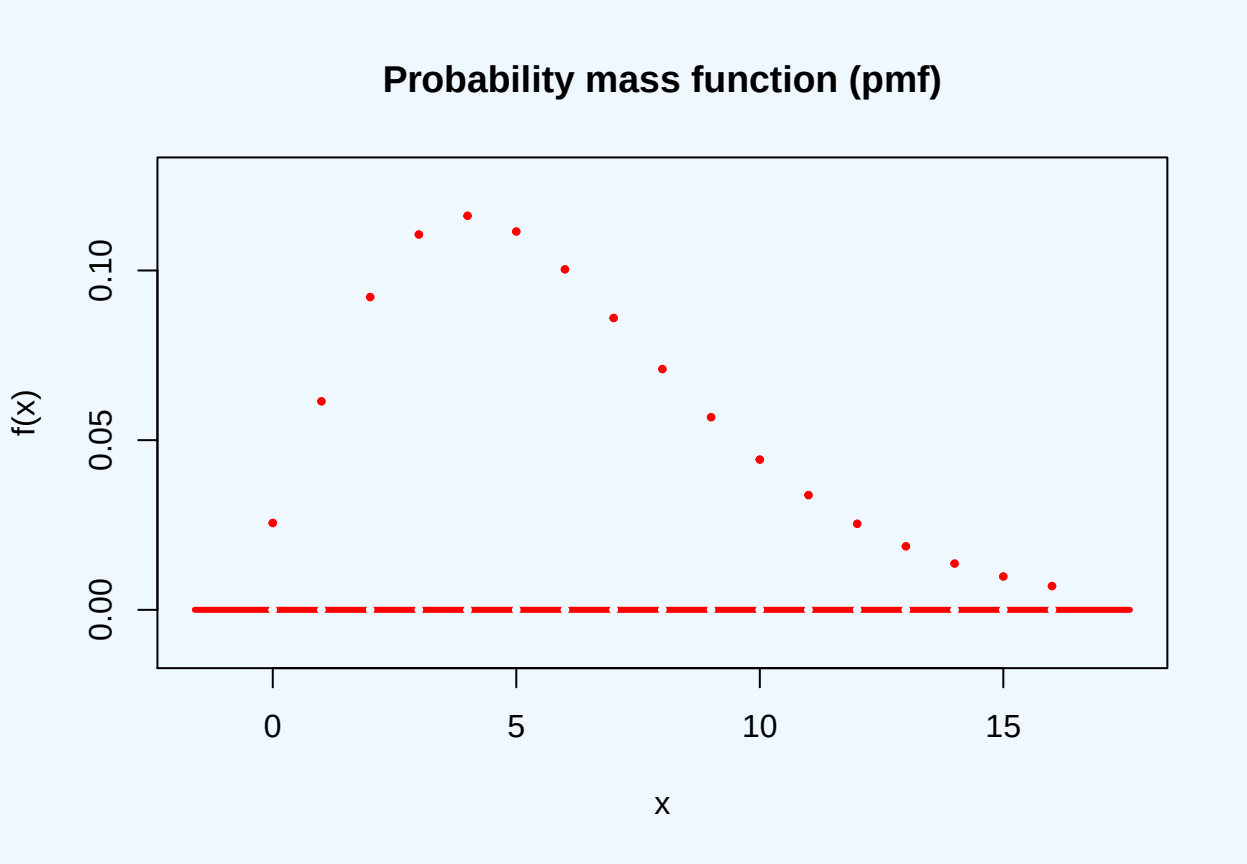


Negative binomial r.v.

```
p<-0.4
r<-4
y<-0:16
d<-dnbinom(y,size=r,prob=p)
```

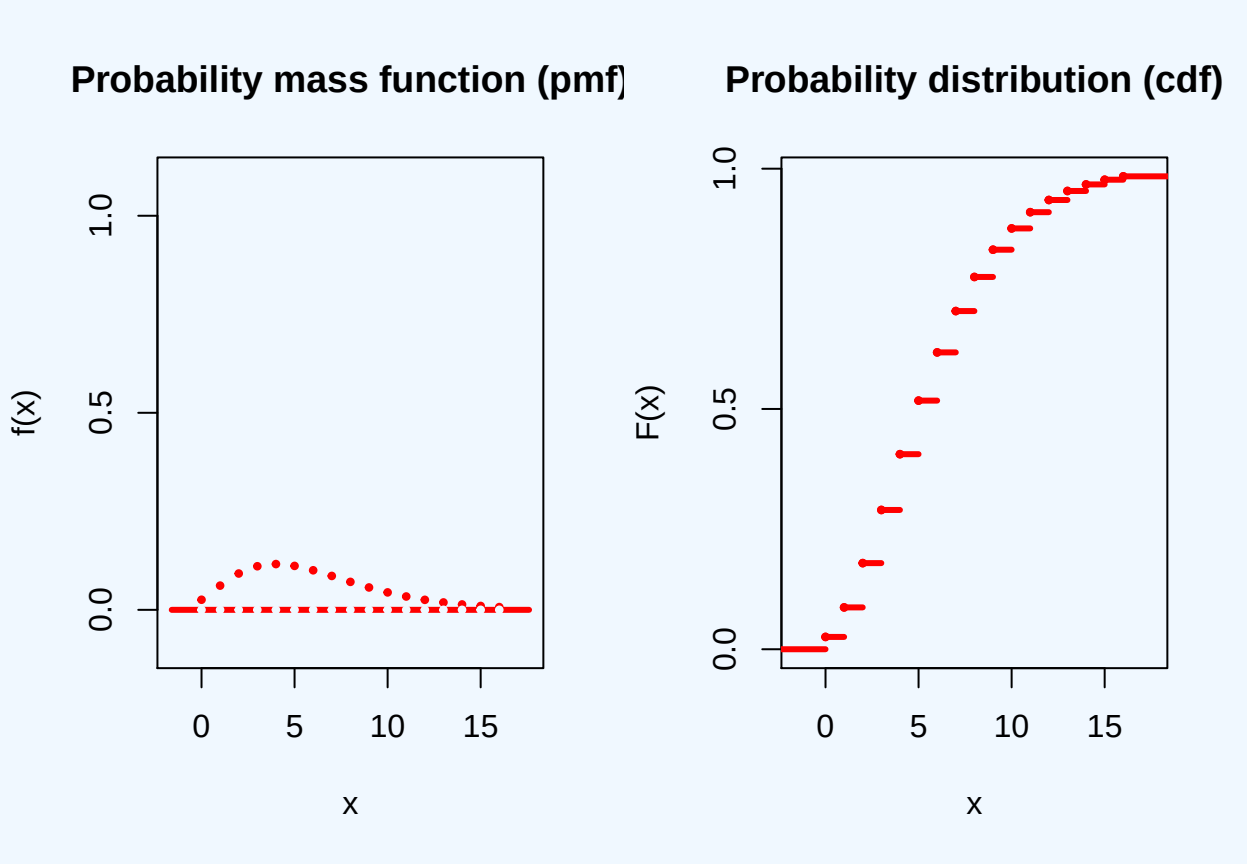
Probability mass function (pmf)

```
plotmass(y,d)
```



Joint plot of pmf and cdf

```
plotmassdist(y,d)
```

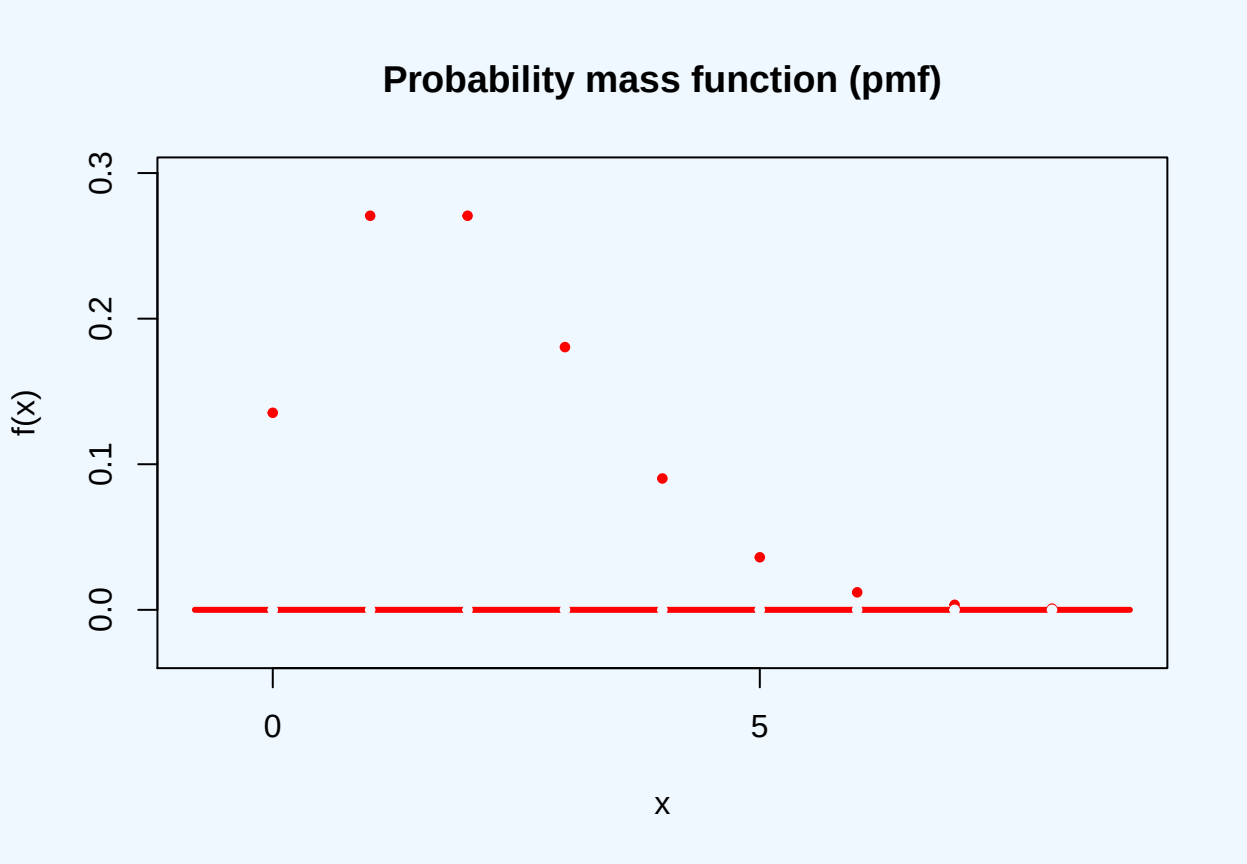


Poisson r.v.

```
# Poisson Pois(2) r.v.
n<-8
lambda<-2
x<-0:n
d<-dpois(x,lambda=lambda)
```

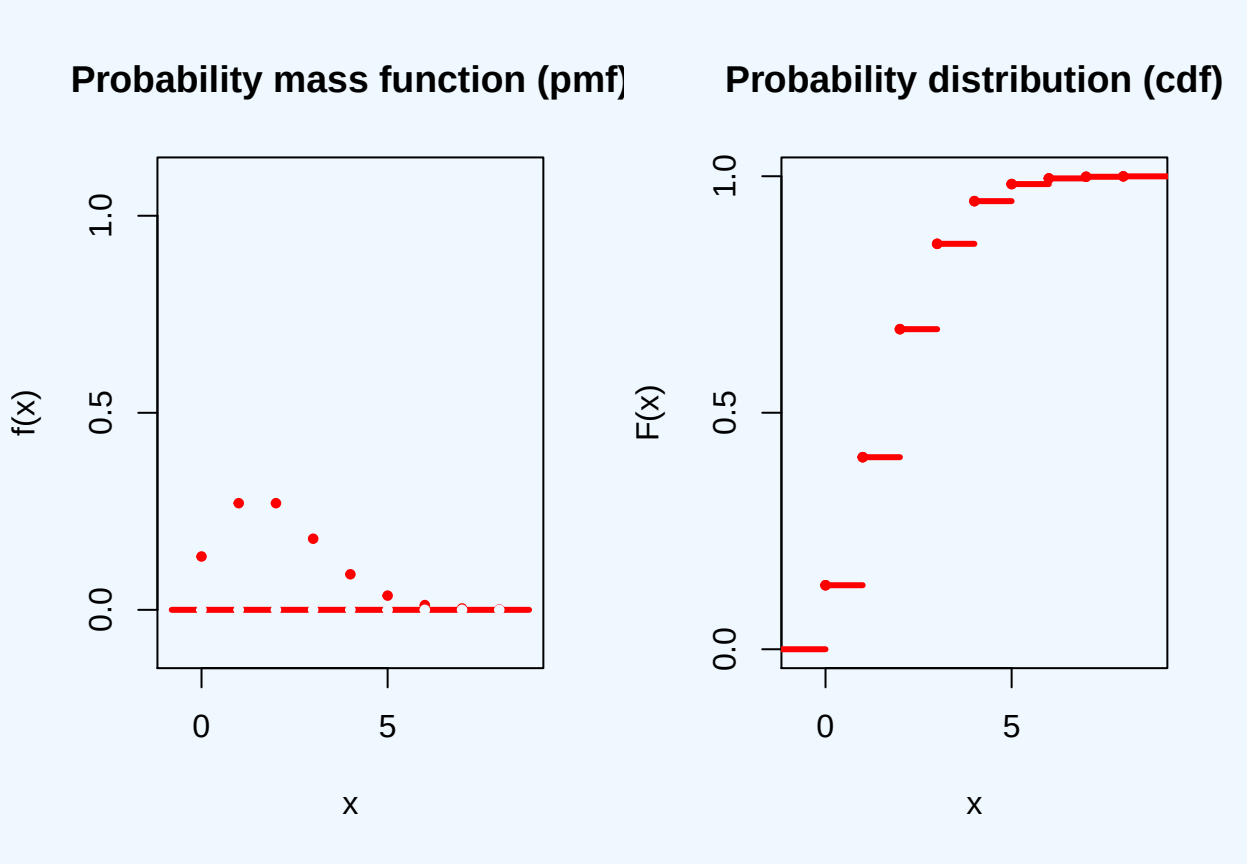
Probability mass function (pmf)

```
plotmass(x,d)
```



Joint plot of pmf and cdf

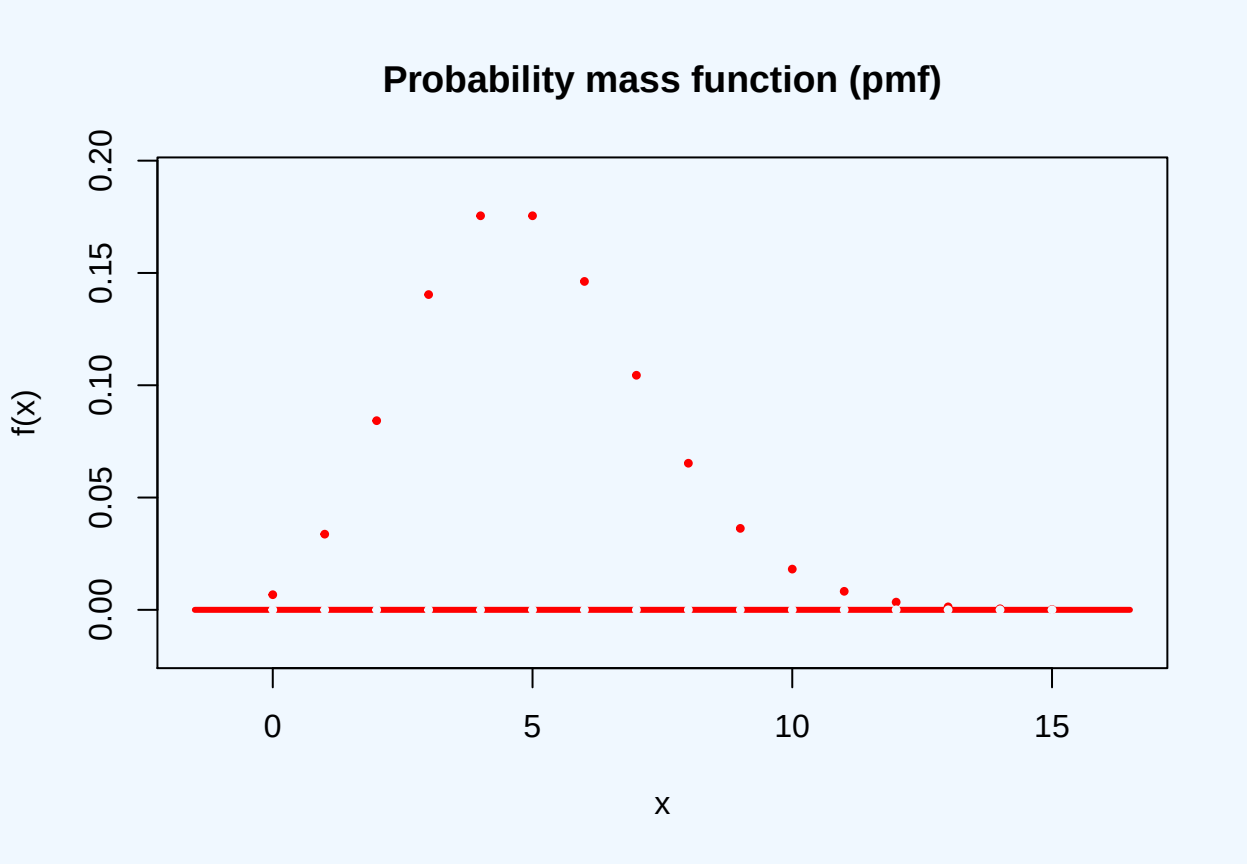
```
plotmassdist(x,d)
```




```
# Poisson Pois(5) r.v.
lambda<-5
n<-15  # A sensible maximum x for plotting (arrived at by trial and error)
x<-0:n
d<-dpois(x,lambda=lambda)
```

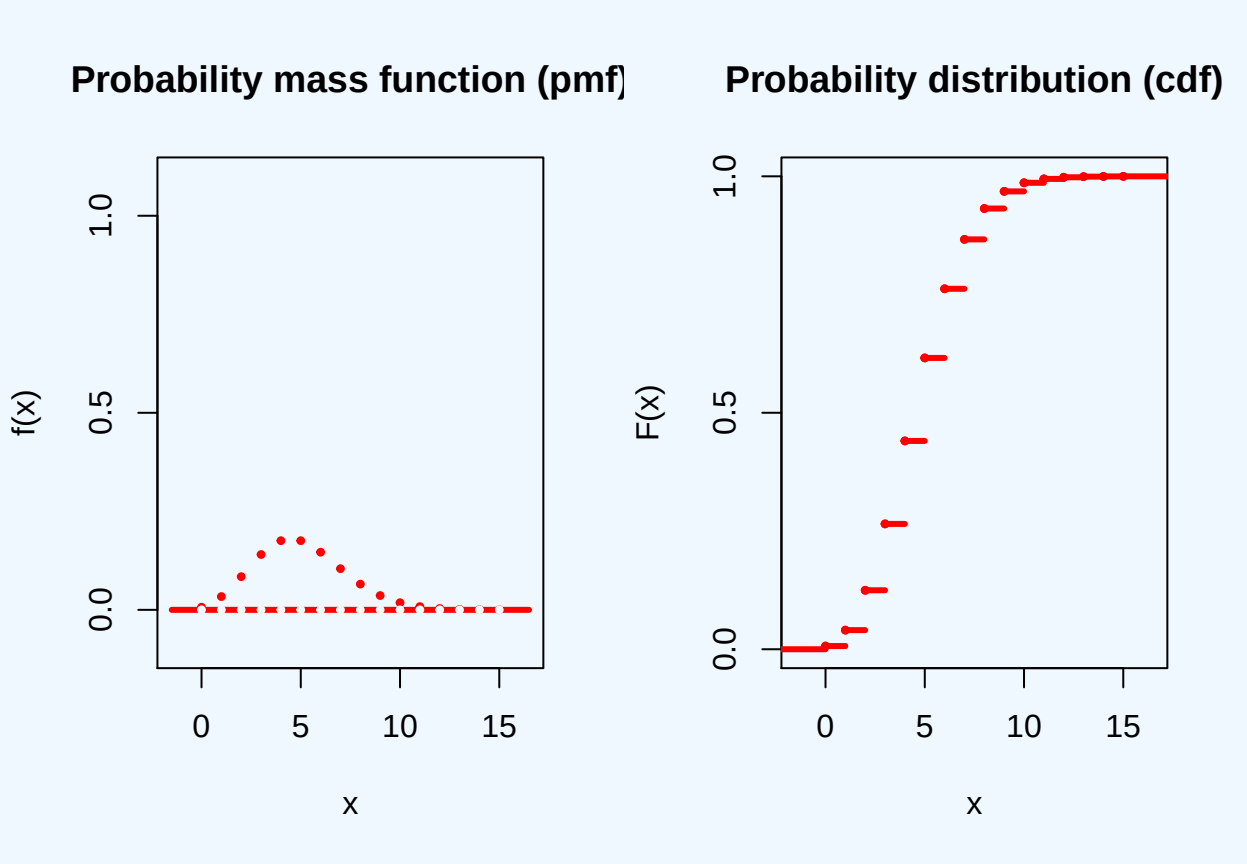
Probability mass function (pmf)

```
plotmass(x,d)
```



Joint plot of pmf and cdf

```
plotmassdist(x,d)
```

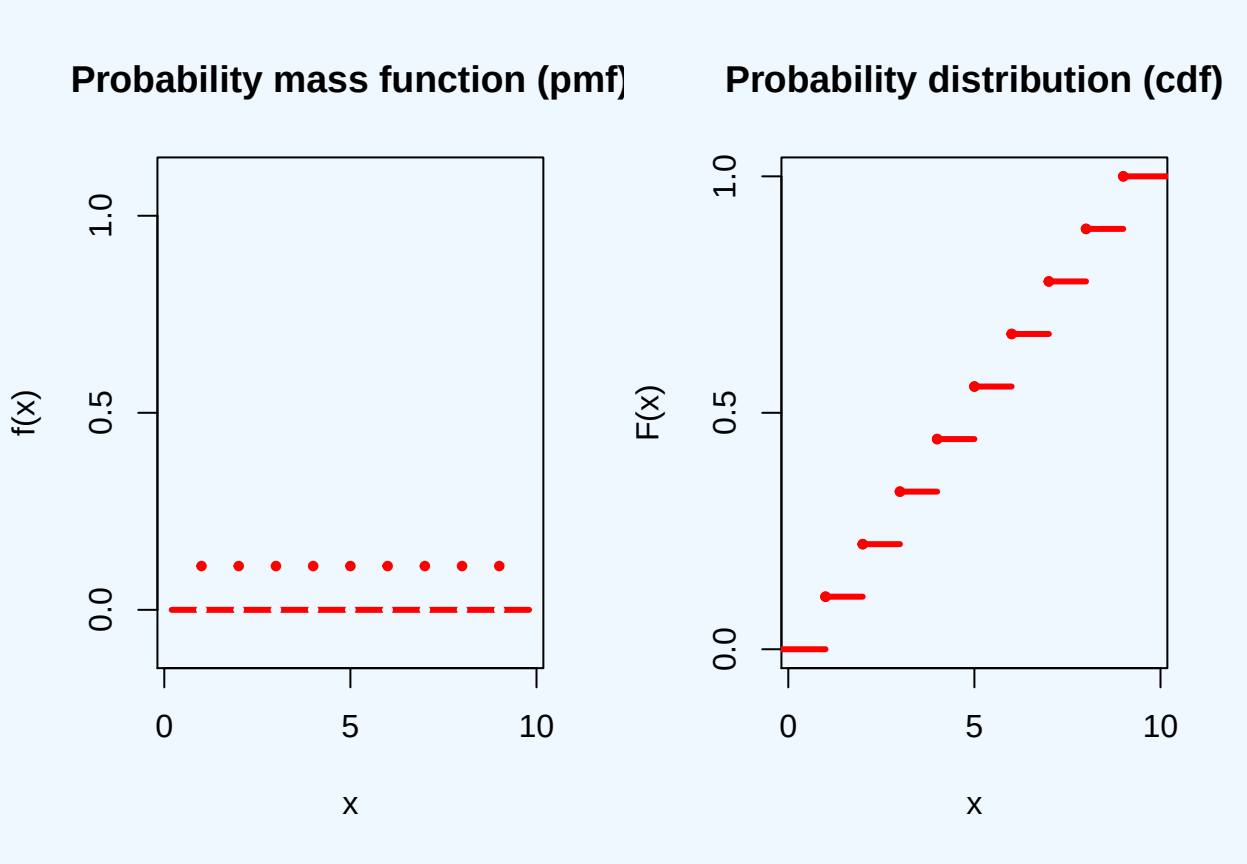


Discrete uniform r.v. (generalized die)

```
# Discrete uniform r.v. (generalized die with n=9 faces)
n<-9
x<-1:n
d<-rep(1/n,n)
```

Joint plot of pmf and cdf

```
plotmassdist(x,d)
```



Continuous random variables

Uniform r.v. on a (compact) interval

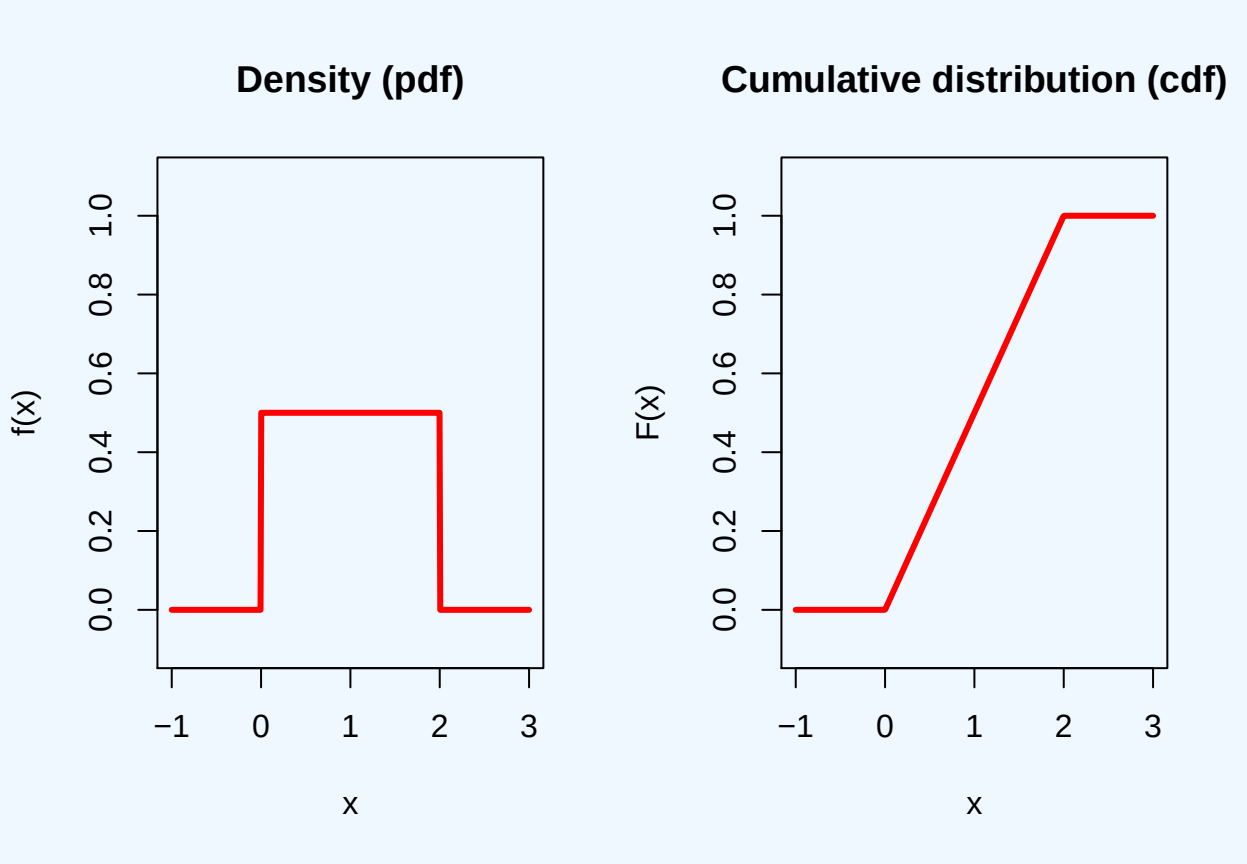
Probability density function (pdf) and cumulative distribution function (cdf)

The shape of this density gives the distribution its name as "rectangular distribution"

```
# Uniform distribution on [0,2]
f<-function(x){dunif(x,0,2)}
F<-function(x){punif(x,0,2)}
```

Joint plot of pdf and cdf

```
xmin<--1
xmax<-3
plotdensdist(f,F,xmin,xmax)
```



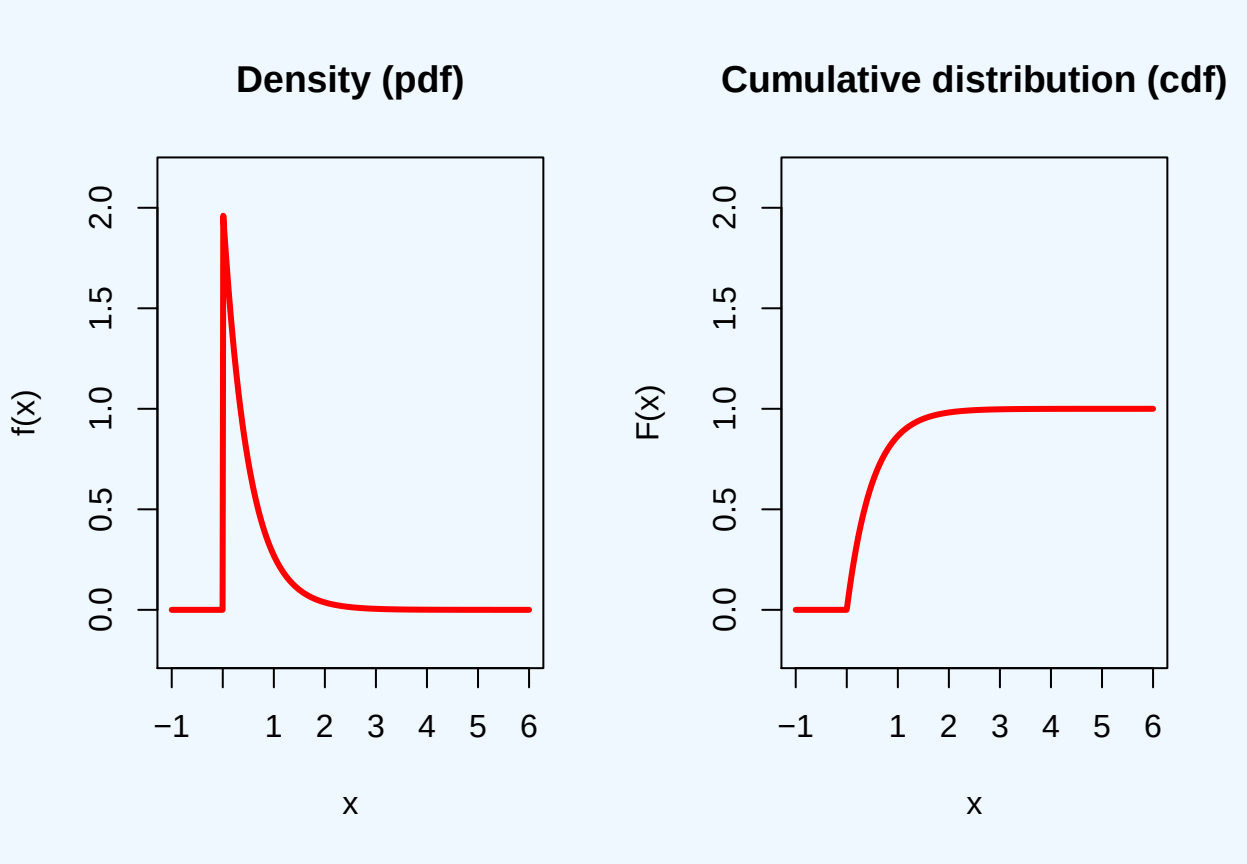
Exponential r.v.

Probability density function (pdf) and cumulative distribution function (cdf)

```
# Exponential distribution with lambda=2
f<-function(x){dexp(x,rate=2)}
F<-function(x){pexp(x,rate=2)}
```

Joint plot of pdf and cdf

```
xmin<--1
xmax<-6
plotdensdist(f,F,xmin,xmax)
```


Density (pdf)
f(x)
0.0
0.5
1.0
1.5
2.0
−1
1
2
3
4
5
6
x
Cumulative distribution (cdf)
F(x)
0.0
0.5
1.0
1.5
2.0
−1
1
2
3
4
5
6
x