Gamma, Exponential, and Chi-square Distributions

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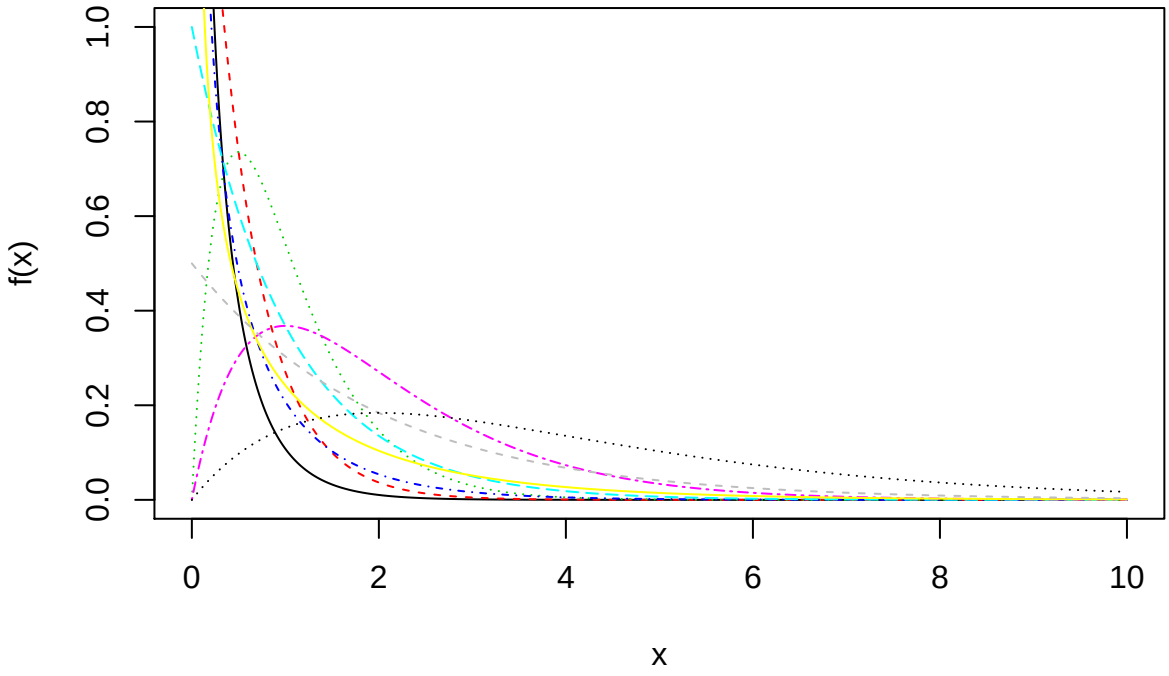
Gamma

We can use the base plot functions in R to create a plot of the pdf for a gamma random variable X with variaous parameters α and β. Note that R defines α = shape and β = scale — and **scale = 1/rate**.

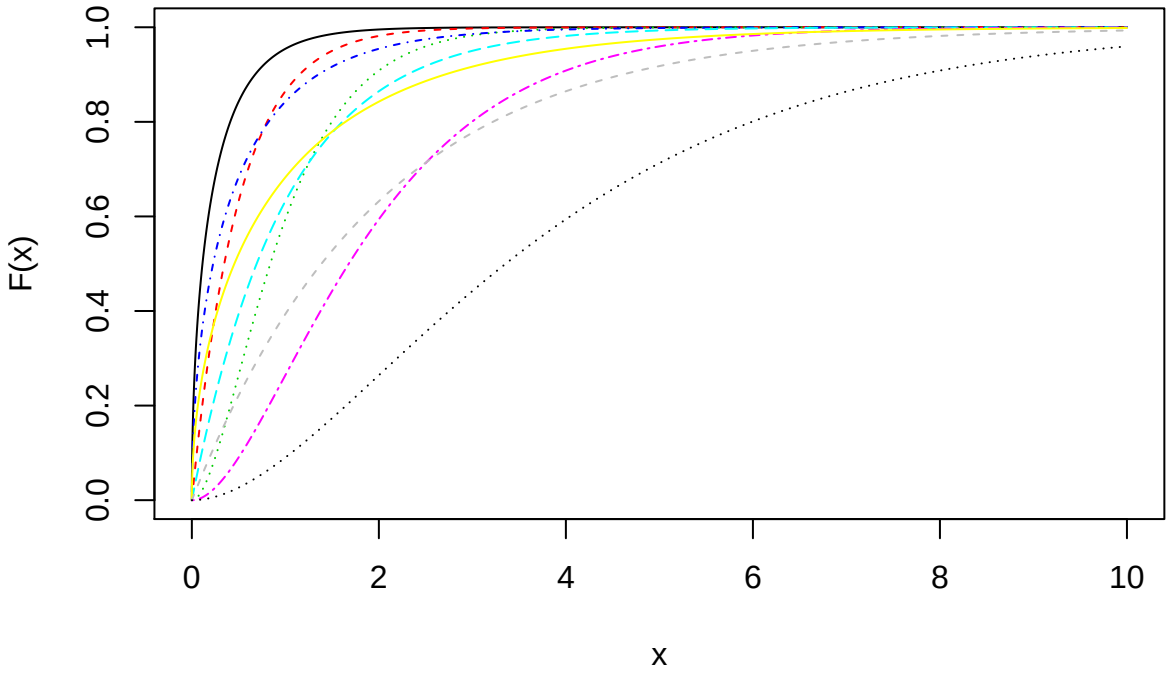
```
x <- seq(0, 10, by=0.001)
plot(x, dgamma(x, shape=0.5, scale=0.5), lty=1, col=1, type="l", xlab="x", ylab="f(x)", ylim=c(0,1))
lines(x, dgamma(x, shape=1, scale=0.5), lty=2, col=2)
lines(x, dgamma(x, shape=2, scale=0.5), lty=3, col=3)
lines(x, dgamma(x, shape=0.5, scale=1), lty=4, col=4)
lines(x, dgamma(x, shape=1, scale=1), lty=5, col=5)
lines(x, dgamma(x, shape=2, scale=1), lty=6, col=6)
lines(x, dgamma(x, shape=0.5, scale=2), lty=7, col=7)
lines(x, dgamma(x, shape=1, scale=2), lty=8, col=8)
lines(x, dgamma(x, shape=2, scale=2), lty=9, col=9)
```



The CDF may be plotted analogously.

```
x <- seq(0, 10, by=0.001)
plot(x, pgamma(x, shape=0.5, scale=0.5), lty=1, col=1, type="l", xlab="x", ylab="F(x)")
lines(x, pgamma(x, shape=1, scale=0.5), lty=2, col=2)
lines(x, pgamma(x, shape=2, scale=0.5), lty=3, col=3)
```

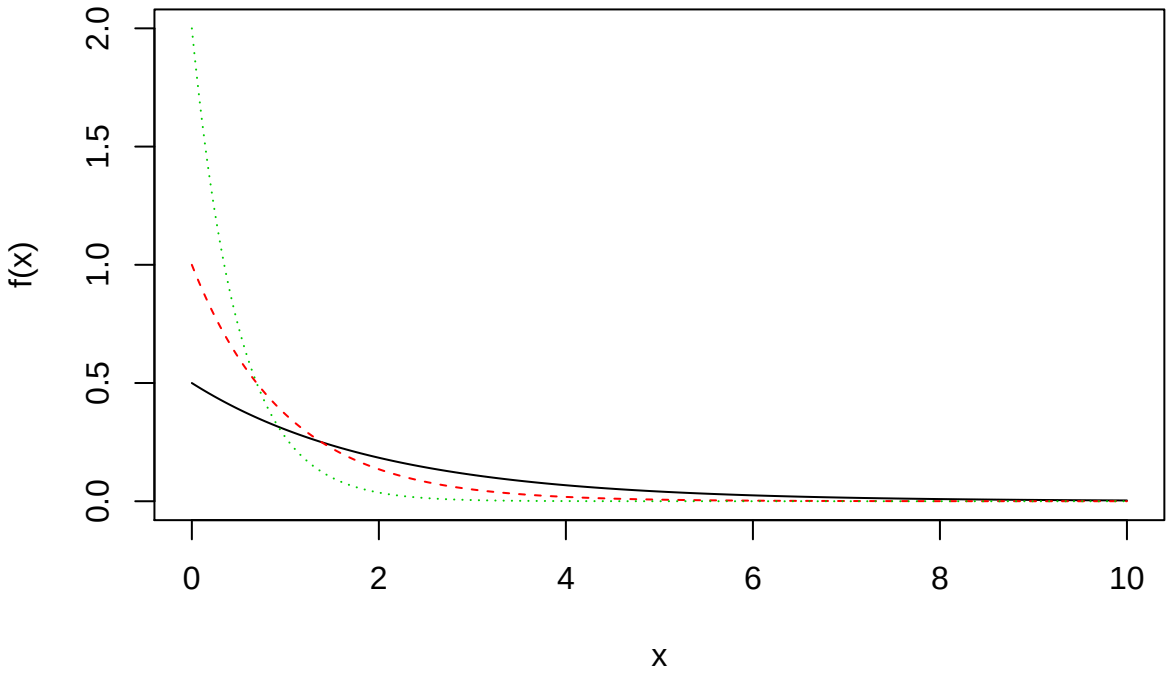
```
lines(x, pgamma(x, shape=0.5, scale=1), lty=4, col=4)
lines(x, pgamma(x, shape=1, scale=1), lty=5, col=5)
lines(x, pgamma(x, shape=2, scale=1), lty=6, col=6)
lines(x, pgamma(x, shape=0.5, scale=2), lty=7, col=7)
lines(x, pgamma(x, shape=1, scale=2), lty=8, col=8)
lines(x, pgamma(x, shape=2, scale=2), lty=9, col=9)
```



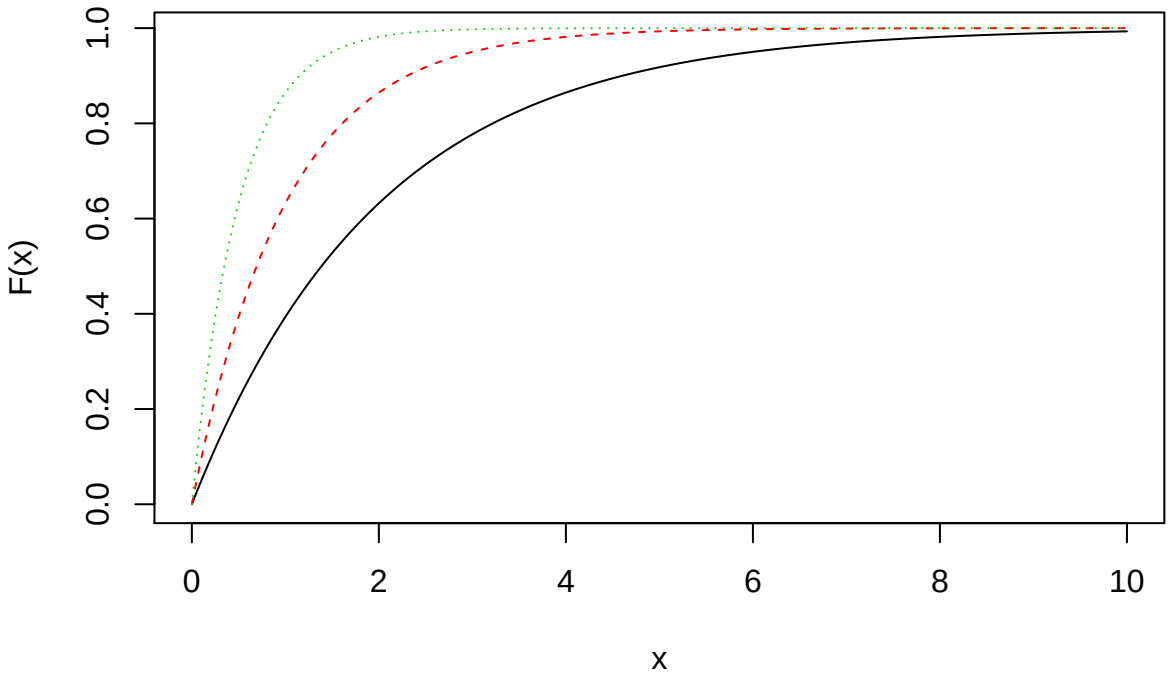
Exponential

Recall that **rate** $= \mathbf{1/scale}$. This is equivalent to $\lambda = \frac{1}{\beta}$.

```
x <- seq(0, 10, by=0.001)
plot(x, dexp(x, rate=0.5), lty=1, col=1, type="l", xlab="x", ylab="f(x)", ylim=c(0,2))
lines(x, dexp(x, rate=1), lty=2, col=2)
lines(x, dexp(x, rate=2), lty=3, col=3)
```



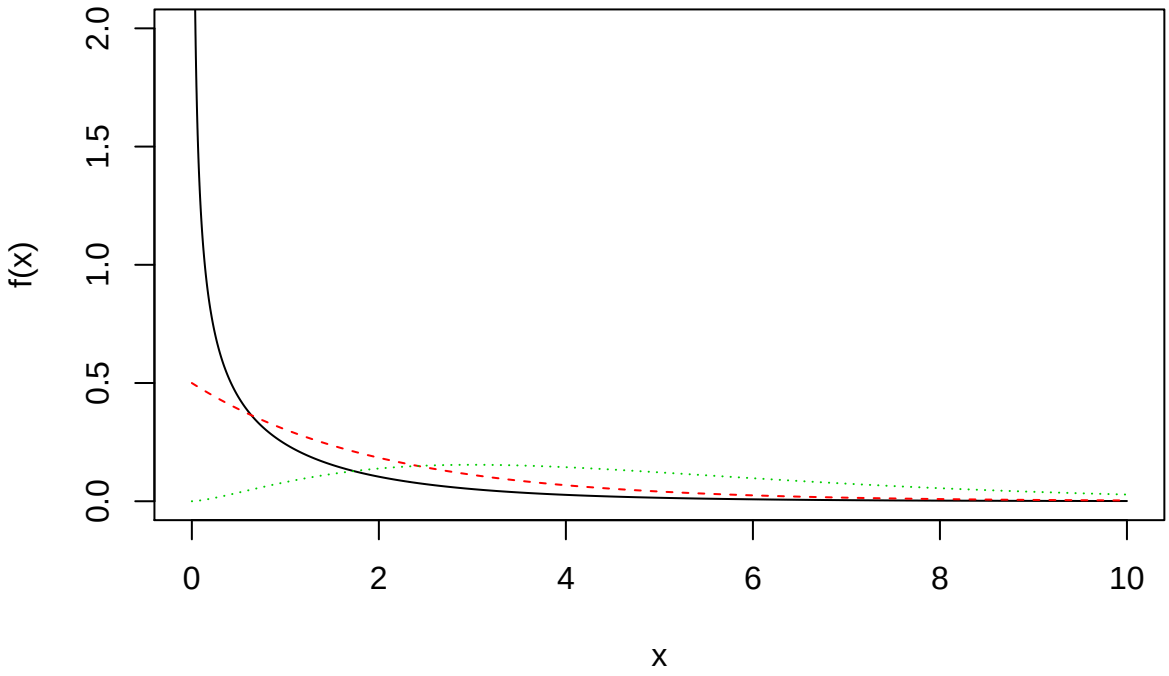

```r
plot(x, pexp(x, rate=0.5), lty=1, col=1, type="l", xlab="x", ylab="F(x)")
lines(x, pexp(x, rate=1), lty=2, col=2)
lines(x, pexp(x, rate=2), lty=3, col=3)
```



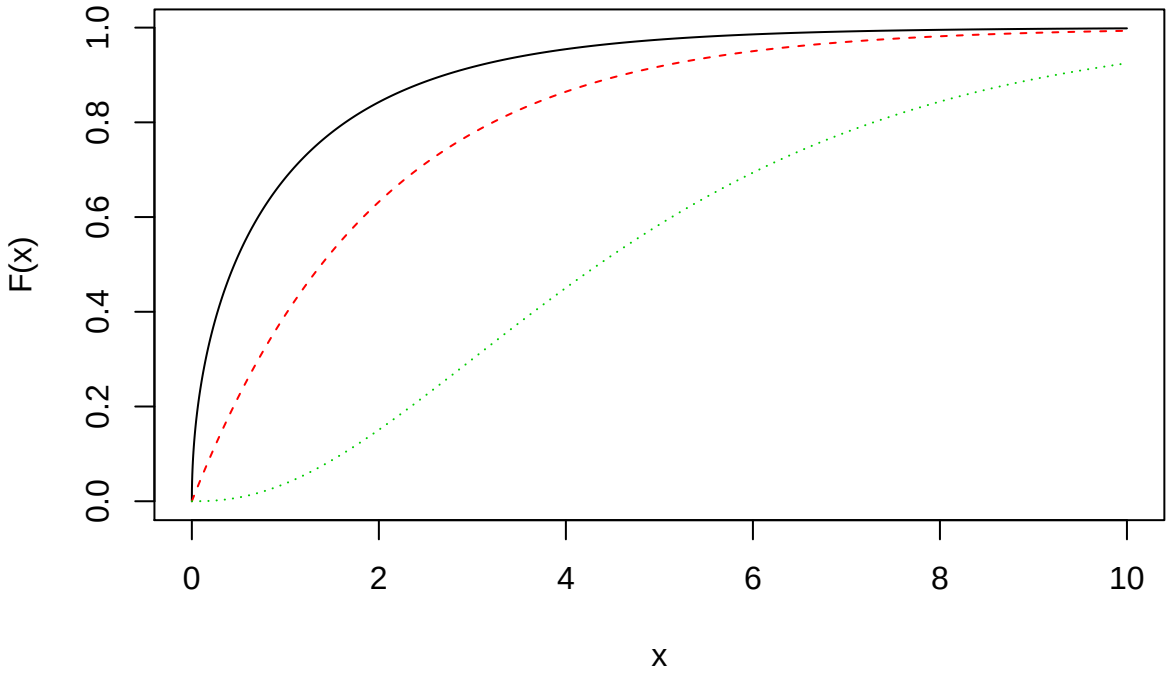
Chi-Squared

The chi-squared distribution is dependent on the degrees of freedom.

```
x <- seq(0, 10, by=0.001)
plot(x, dchisq(x, df=1), lty=1, col=1, type="l", xlab="x", ylab="f(x)", ylim=c(0,2))
lines(x, dchisq(x, df=2), lty=2, col=2)
lines(x, dchisq(x, df=5), lty=3, col=3)
```




```r
plot(x, pchisq(x, df=1), lty=1, col=1, type="l", xlab="x", ylab="F(x)")
lines(x, pchisq(x, df=2), lty=2, col=2)
lines(x, pchisq(x, df=5), lty=3, col=3)
```


F(x)
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8
10
x