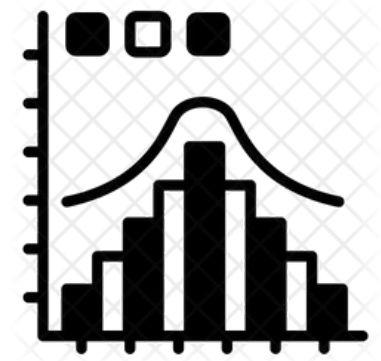


Gamma Distribution

Tushar B. Kute,
<http://tusharkute.com>



Gamma Distribution

- The gamma distribution is a family of right-skewed, continuous probability distributions.
- These distributions are useful in real-life where something has a natural minimum of 0.
- For example, it is commonly used in finance, for elapsed times, or during Poisson processes.
- It is widely used in different fields of science to model continuous variables that are always positive and have skewed distributions.
- It occurs naturally in the processes where the waiting times between events are relevant.

Gamma Distribution

- If X is a continuous random variable then the probability distribution function is:

$$f(x; \alpha, \beta) = \begin{cases} \frac{1}{\beta^\alpha \Gamma(\alpha)} x^{\alpha-1} e^{-x/\beta} & x \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Gamma Distribution

- Where

$$\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} dt,$$

$\Gamma(x)$ = the gamma function, .
 α = The shape parameter.

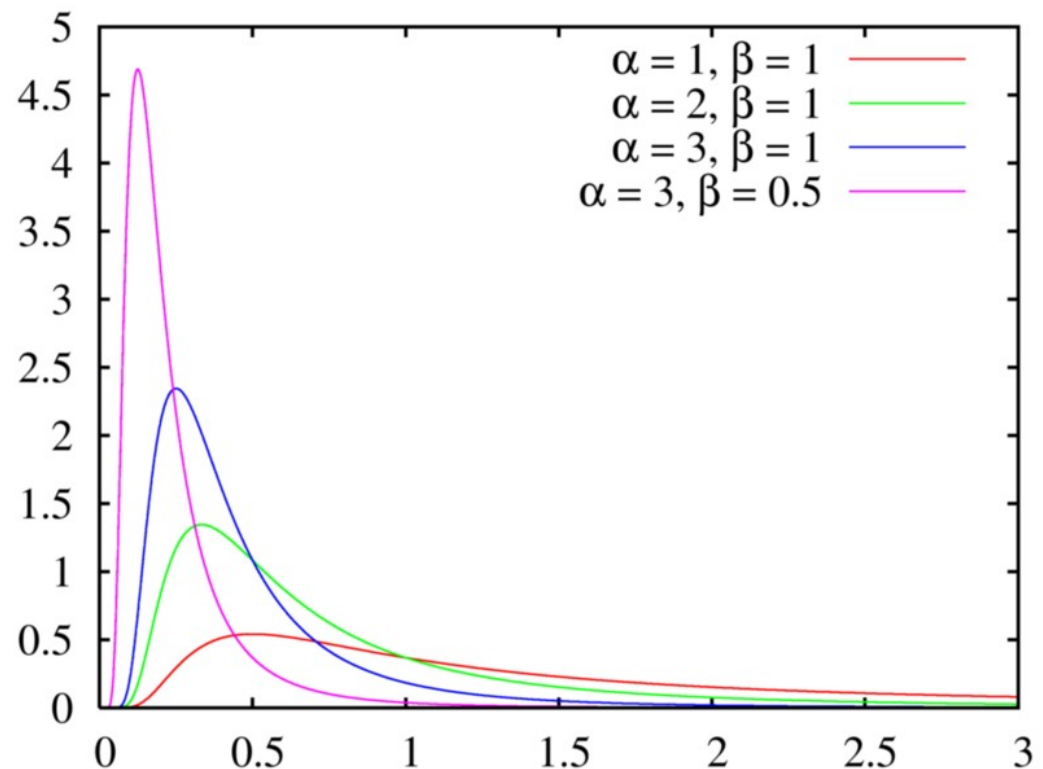
β (sometimes θ is used instead) = The rate parameter
(the reciprocal of the scale parameter).

α and β are both greater than 1.

- When $\alpha = 1$, this becomes the exponential distribution.
- When $\beta = 1$ this becomes the standard gamma distribution.

Gamma Distribution

- Alpha and beta define the shape of the graph. Although they both have an effect on the shape, a change in β will show a sharp change, as shown by the pink and blue lines in this graph:



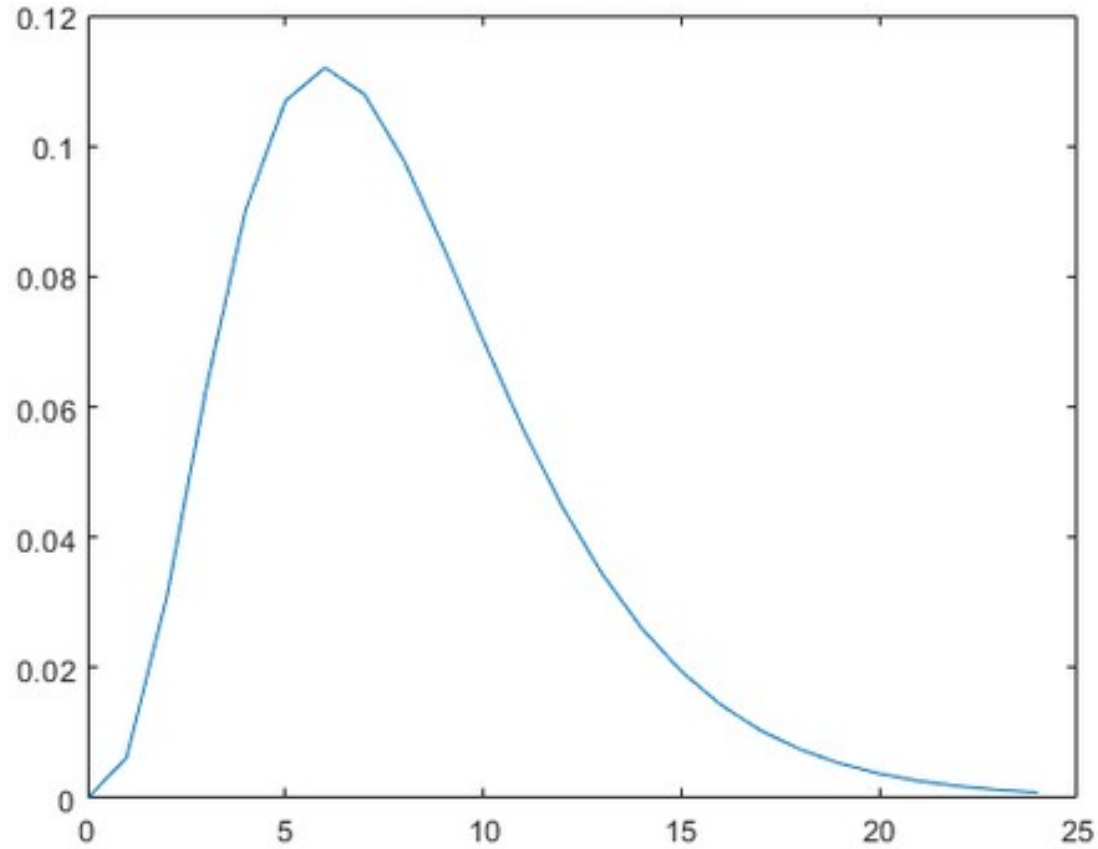
Gamma Distribution

- You can think of α as the number of events you are waiting for (although α can be any positive number — not just integers), and β as the mean waiting time until the first event.
- If α (number of events) remains unchanged but β (mean time between events) increases, it makes sense that the graph shifts to the right as waiting times will lengthen.
- Similarly, if the mean waiting time (β) stays the same but the number of events (α) increases, the graph will also shift to the right. As α approaches infinity, the gamma closely matches the normal distribution.

Gamma Distribution

- Mean: $E(X) = \alpha\beta$
- Variance: $\text{var}(X) = \alpha\beta^2$
- Moment generating function: $M_X(t) = 1 / (1 - \beta t)^\alpha$

Gamma Distribution



Gamma Distribution in Python

- You can generate a gamma distributed random variable using `scipy.stats` module's `gamma.rvs()` method which takes shape parameter `a` as its argument.
- When `a` is an integer, gamma reduces to the Erlang distribution, and when `a=1` to the exponential distribution.
- To shift distribution use the `loc` argument, to scale use `scale` argument, `size` decides the number of random variates in the distribution. If you want to maintain reproducibility, include a `random_state` argument assigned to a number.

Thank you

This presentation is created using LibreOffice Impress 5.1.6.2, can be used freely as per GNU General Public License



@mitu_skillologies



/mITuSkillologies



@mitu_group



/company/mitu-
skillologies



MITUSkillologies

Web Resources

<https://mitu.co.in>
<http://tusharkute.com>

contact@mitu.co.in
tushar@tusharkute.com