Important continuous distributions

1. Exponential distribution

Density	$f(x) = \lambda e^{-\lambda x}$
CDF	$F(x) = 1 - e^{-\lambda x}$
Failure rate	$h(t) = \lambda$
Parameter	λ
Possible values	$x > 0$

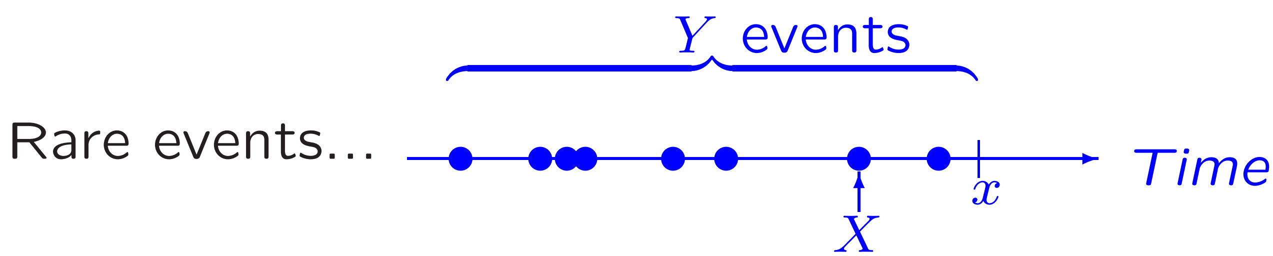
2. Gamma (Erlang) distribution

X = a sum of r independent $Exp(\lambda)$ random variables.

Density	$f(x) = \frac{\lambda^r}{\Gamma(r)} x^{r-1} e^{-\lambda x}$
For integer r, $\Gamma(r) = (r-1)!$	
CDF	$F(x) = \int_0^x f(t)dt$
Parameters	λ, r
Possible values	$x > 0$

A sum of independent $Exp(\lambda)$ random variables with different λ has *Hypoexponential distribution*

Gamma-Poisson formula



$$X = \text{time of the } r\text{-th event}$$
$$X \sim Gamma(r, \lambda)$$

$$Y = \text{number of events by the time } x$$
$$Y \sim Poisson(\lambda x)$$

$$P(X < x) = P(Y \geq r)$$

$$P(X > x) = P(Y < r)$$

3. Uniform distribution

Density	$f(x) = \dfrac{1}{b-a}$ (constant)
Parameters	a, b
Possible values	$a < x < b$

Uniform property:

$$P(x < X < x + h) = \frac{h}{b-a}$$

for all x such that $[x, x + h] \subset [a, b]$

Standard Uniform distribution: $a = 0$, $b = 1$.

$$f(x) = 1 \qquad \text{for} \qquad 0 < x < 1$$

4. Normal (Gaussian) distribution

Density	$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$
CDF	Table C3 for Standard Normal
Parameters	μ, σ
Possible values	$-\infty < x < +\infty$

Standard Normal distribution: $\mu = 0$, $\sigma = 1$.

Normal approximation to Binomial distribution

$$Binomial(n,p) \approx Normal(\mu,\sigma)$$

if
- n is large
- p is neither small nor large
- $\mu = np$
- $\sigma = \sqrt{np(1-p)}$

Continuity correction:

For a discrete (Binomial) X,

$$P(X < 10) = P(X < 9.5)$$

$$P(X \leq 10) = P(X < 10.5)$$