Common probability distributions

Gaussian/Normal

- Continuous
- Parameters
  - $\mu \in \mathbb{R}$ (mean)
  - $\sigma^2 > 0$ (variance)
- Support: $x \in \mathbb{R}$
- PDF: $\frac{1}{\sigma \sqrt{2\pi}}e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}$
- Mean/expectation: μ
- Variance: σ^2

Calculating CDF

$P(X < x)$ for $X \sim \mathcal{N}(mu, sigma)$

```
p = normcdf(x, mu, sigma)
```

Calculating inverse CDF or quantile

$\mathbb{P}(X \leq q) = 1 - alpha$ for $X \sim \mathcal{N}(mu, sigma)$

```
q = norminv(1 - alpha, mu, sigma)
```

Binomial distribution

- Discrete
- Parameters
  - $n \in \mathbb{N}_0$ (number of trials)
  - $p \in [0, 1]$ (probability of success of single trial)
- Support: $\{0, 1, \ldots, n\}$
- PMF: ${n \choose k} p^k (1-p)^{n-k}$
- Mean: np
- Variance: $np(p-1)$

Bernoulli

- Discrete

- Special case of binomial for $n=1$
- Parameter: $p \in [0, 1]$ (probability of success)
- Support: $\{0, 1\}$ (either 0 or 1)
- PMF: $p^k(1-p)^{1-k}$
- Mean/expectation: p
- Variance: $p(1-p)$

Poisson

- Discrete
- Parameter: $\lambda > 0$
- Support: $\mathbb{N}_0$ (0, 1, …)
- PMF: $\frac{\lambda^ke^{-\lambda}}{k!}$
- Mean/expectation: λ
- Variance: λ

Exponential

- Continuous
- Parameter: $\lambda > 0$ (rate)
- Support: $[0, \infty]$
- Mean: $\frac{1}{\lambda}$
- Variance: $\frac{1}{\lambda^2}$

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