Some Important Continuous Distributions

1.1 Uniform $\mathcal{U}(a, b)$ Distribution

Random variable $X$ has uniform $\mathcal{U}(a, b)$ distribution if its density is given by

$$f(x|a, b) = \begin{cases} \frac{1}{b-a}, & a \leq x \leq b \\ 0, & \text{else} \end{cases}$$

$$F(x|a, b) = \begin{cases} 0, & x < a \\ \frac{x-a}{b-a}, & a \leq x \leq b \\ 1, & x > b \end{cases}$$

- Moments: $EX^k = \frac{1}{b-a} \frac{b^{k+1} - a^{k+1}}{k+1}$, $k = 1, 2, \ldots$
- Variance $\text{Var}X = \frac{(b-a)^2}{12}$.
- Characteristic Function $\varphi(t) = \frac{1}{b-a} e^{itb} - e^{ita}$.
- If $X \sim \mathcal{U}(a, b)$ then $Y = \frac{X-a}{b-a} \sim \mathcal{U}(0, 1)$.
- Typical model: Rounding (to the nearest integer) Error is often modeled as $\mathcal{U}(-1/2, 1/2)$.
- If $X \sim F$, where $F$ is a continuous cdf, then $Y = F(X) \sim \mathcal{U}(0, 1)$.

1.2 Exponential $\mathcal{E}(\lambda)$ Distribution

Random variable $X$ has exponential $\mathcal{E}(\lambda)$ distribution if its density and cdf are given by

$$f(x|\lambda) = \begin{cases} \lambda e^{-\lambda x}, & x \geq 0 \\ 0, & \text{else} \end{cases}$$

$$F(x|\lambda) = \begin{cases} 1 - e^{-\lambda x}, & x \geq 0 \\ 0, & \text{else} \end{cases}$$

- Moments: $EX^k = k! \lambda^{-k}$, $k = 1, 2, \ldots$
- Variance $\text{Var}X = \frac{1}{\lambda^2}$.
- Characteristic Function $\varphi(t) = \lambda e^{-\lambda t}$.
- Exponential random variable $X$ possesses memoryless property $P(X > t+s|X > s) = P(X > t)$.
- Typical model: Lifetime in reliability.
- Alternative parametrization, $\lambda'$ as scale. $f(x|\lambda') = \frac{1}{\lambda'} e^{-\lambda' x}$, $EX^k = k!(\lambda')^k$, $k = 1, 2, \ldots$, $\text{Var}X = (\lambda')^2$.

1.3 Double Exponential $\mathcal{DE}(\mu, \sigma)$ Distribution

Random variable $X$ has double exponential $\mathcal{DE}(\mu, \sigma)$ distribution if its density and cdf are given by

$$f(x|\mu, \sigma) = \frac{1}{2\sigma} e^{-|x-\mu|/\sigma}, \quad F(x|\mu, \sigma) = \frac{1}{2} \left( 1 + \text{sgn}(x-\mu)(1 - e^{-|x-\mu|/\sigma}) \right), \quad x, \mu \in \mathbb{R}; \sigma > 0.$$

- Moments: $EX = \mu$, $EX^{2k} = \left[ \frac{\mu^{2k}}{(2k)!} + \frac{\sigma^2 (k-1)^2}{(2k-2)!} + \ldots + \frac{\sigma^{2k}}{(2k-1)!} \right] (2k)!$, $EX^{2k+1} = \mu^{2k+1}(2k+1)!$.
- Variance $\text{Var}X = 2\sigma^2$.
- Characteristic Function $\varphi(t) = e^{it\mu} \frac{1}{1+(\sigma t)^2}$.
1.4 Normal (Gaussian) $\mathcal{N}(\mu, \sigma^2)$ Distribution

Random variable $X$ has normal $\mathcal{N}(\mu, \sigma^2)$ distribution with parameters $\mu \in \mathbb{R}$ (mean, center) and $\sigma^2 > 0$ (variance) if its density is given by

$$f(x|\alpha, \beta) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}, \quad -\infty < x < \infty$$

- Moments: $EX = \mu, E(X - \mu)^{2k-1} = 0; E(X - \mu)^{2k} = (2k-1)(2k-3)\ldots5\cdot3\cdot\sigma^{2k}, \quad k = 1, 2, \ldots$
- Characteristic function $\varphi(t) = e^{i\mu t - t^2\sigma^2/2}$.
- $Z = \frac{X-\mu}{\sigma}$ has standard normal distribution $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}$. The cdf of standard normal distribution is a special function $\Phi(x) = \int_{-\infty}^x \phi(t) dt$ and its values are tabulated in many introductory statistical texts.
- Standard half-Normal distribution is given by $f(x) = 2\phi(x)1(x \geq 0)$.

1.5 Chi-Square $\chi^2_n$ Distribution

Random variable $X$ has chi-square $\chi^2_n$ distribution with $n$ degrees of freedom if its density is given by

$$f(x) = \begin{cases} \frac{1}{2^{n/2} \Gamma(n/2)} x^{n/2-1} e^{-x/2}, & x > 0 \\ 0, & \text{else} \end{cases}$$

- Moments: $EX^k = n(n+2)\ldots(n+2(k-1)), \quad k = 1, 2, \ldots$
- Expectation $EX = n$, Variance $\text{Var}X = 2n$, and Mode $m = n-2$, $n > 2$.
- Characteristic function $\varphi(t) = (1 - 2it)^{-n/2}$.
- Noncentral chi-square $nc\chi^2_n$ distribution is the distribution of sum of squares of $n$ normals: $\mathcal{N}(\mu_i, 1)$.
The non-centrality parameter is $\delta = \sum_i \mu_i^2$. Density of $nc\chi^2_n$ distribution involves Bessel function of the first kind. The simplest representation for the cdf of $nc\chi^2_n$ is an infinite Poisson mixture of central $\chi^2$'s where degrees of freedom are mixed:

$$F(x|n, \delta) = \sum_{i=0}^{\infty} \frac{(\delta/2)^i}{i!} e^{-\delta/2} P(\chi^2_{n+2i} \leq x).$$

- $\chi^2_n$ is $\mathcal{G}(n/2, 2)$ or in alternative parametrization $\Gamma\text{amma}(n/2, 1/2)$.
- Inverse $\chi^2_n$, $\text{inv} - \chi^2_n$ is defined as $\mathcal{I}\mathcal{G}(n/2, 2)$ or $\mathcal{I}\Gamma\text{amma}(n/2, 1/2)$. Scaled inverse $\chi^2_n$, $\text{inv} - \chi^2_n(s^2)$ is $\mathcal{I}\mathcal{G}(n/2, 2/(ns^2))$ or $\mathcal{I}\Gamma\text{amma}(n/2, ns^2/2)$.

1.6 Chi $\chi_n$ Distribution

Random variable $X$ has chi-square $\chi_n$ distribution with $n$ degrees of freedom if its density is given by

$$f(x) = \begin{cases} \frac{1}{2^{n/2-1} \Gamma(n/2)} x^{n-1} e^{-x^2/2}, & x > 0 \\ 0, & \text{else} \end{cases}$$
• Moments: $EX^k = \frac{2^{k/2} \Gamma(a+k)}{\Gamma(a/2)}$, $k = 1, 2, \ldots$.
• Variance $VarX = n - 2 \left[ \frac{\Gamma(n+1/2)}{\Gamma(n/2)} \right]^2$.
• Characteristic function $\varphi(t) = \frac{1}{\Gamma(n/2)} \sum_{k=0}^{\infty} \frac{(i\sqrt{2})^k}{k!} \Gamma((n + k)/2)$.
• $\chi_n$ for $n = 2$ is Raleigh Distribution, for $n = 3$ Maxwell distribution.

1.7 Gamma $G(\alpha, \beta)$ Distribution

Random variable $X$ has gamma $G(\alpha, \beta)$ distribution with parameters $\alpha > 0$ (shape) and $\beta > 0$ (scale) if its density is given by

$$f(x|\alpha, \beta) = \begin{cases} \frac{1}{\Gamma(\alpha)\beta^\alpha} x^{\alpha-1}e^{-x/\beta}, & x \geq 0 \\ 0, & \text{else} \end{cases} \quad F(x|\alpha, \beta) = \begin{cases} 0, & x \leq 0 \\ \text{inc}\Gamma(x|\alpha, \beta), & x \geq 0 \end{cases}$$

• Moments: $EX^k = \alpha(\alpha + 1)\ldots(\alpha + k - 1)/\beta^k$, $k = 1, 2, \ldots$
• Mean $EX = \beta \alpha$, Variance $VarX = \alpha \beta^2$.
• Mode $m = (\alpha - 1)/\beta$.
• Characteristic function $\varphi(t) = \frac{1}{(1 - i\beta t)^\alpha}$.
• Alternative parametrization, $Gamma(a, b)$: $f(x|a, b) = \frac{b^a}{\Gamma(a)} x^{a-1}e^{-bx}$, $x \geq 0$, $EX^k = \frac{a(a+1)\ldots(a+k-1)}{b^{a+k-1}}$, $k = 1, 2, \ldots$, $VarX = a/b^2$.
• Special cases $E(\lambda) \equiv G(1, 1/\lambda) \equiv Gamma(1, \lambda)$ and $\chi_n^2 \equiv G(n/2, 2) \equiv Gamma(n/2, 1/2)$.
• If $\alpha$ is an integer, $Ga(\alpha, \beta) = -\frac{1}{\beta} \sum_{i=1}^{\alpha} \log(U)$. If $\alpha < 1$, then if $Y \sim Be(\alpha, 1 - \alpha)$ and $Z \sim E(\infty)$, $X = YZ \sim Ga(\alpha, 1)$.

1.8 Inverse Gamma $IG(\alpha, \beta)$ Distribution

Random variable $X$ has inverse gamma $IG(\alpha, \beta)$ distribution with parameters $\alpha > 0$ and $\beta > 0$ if its density is given by

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

• Moments: $EX^k = \{(\alpha - 1)(\alpha - 2)\ldots(\alpha - k)\beta^k\}^{-1}$, $k = 1, 2, \ldots$ ($\alpha > k$).
• Mean $EX = \frac{1}{\beta(\alpha - 1)}$, $\alpha > 1$, Variance $VarX = \frac{1}{(\alpha - 1)^2\beta^2}$, $\alpha > 2$
• Mode $m = \frac{1}{(\alpha + 1)\beta}$.
• Characteristic function $\varphi(t) = \ldots$.
• If $X \sim Ga(\alpha, \beta)$ then $X^{-1} \sim IG(\alpha, \beta)$.
• Alternative parametrization, $IGamma(a, b)$. $f(x|a, b) = \frac{b^a}{\Gamma(a)} x^{a-1}e^{-b/x}$, $x \geq 0$, $EX^k = \frac{b^k}{(a-1)\ldots(a+k-1)}$, $k = 1, 2, \ldots$, $VarX = b^2/((a-1)^2(a - 2))$.

1.9 Beta $Be(\alpha, \beta)$ Distribution

Random variable $X$ has beta $Be(\alpha, \beta)$ distribution with parameters $\alpha > 0$ and $\beta > 0$ if its density is given by
\[ f(x|\alpha, \beta) = \begin{cases} \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}, & 0 \leq x \leq 1 \\ 0, & \text{else} \end{cases} \]

\[ F(x|\alpha, \beta) = \begin{cases} 0, & x \leq 0 \\ \frac{\Gamma(x\alpha + \beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha}, & 0 < x \leq 1 \\ 1, & x \geq 1 \end{cases} \]

- Moments: \( EX^k = \frac{\Gamma(\alpha+k)\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\alpha+\beta+k)} \frac{\alpha(\alpha+1)\ldots(\alpha+k-1)}{(\alpha+\beta)(\alpha+\beta+1)\ldots(\alpha+\beta+k-1)} \)
- Mean \( EX = \frac{\alpha}{\alpha+\beta} \)
- Mode \( m = \frac{\alpha-1}{\alpha+\beta+2} \), if \( \alpha > 1, \beta > 1 \)
- Characteristic function \( \varphi(t) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha+\beta+k)} \sum_{k=0}^{\infty} \frac{(it)^k}{k!} \Gamma(\alpha+k) \)
- If \( X_1, X_2, \ldots, X_n \) is a sample from the uniform \( U(0,1) \) distribution, and \( X_{(1)}, X_{(2)}, \ldots, X_{(n)} \) its order statistics. Then \( X_{(k)} \sim \text{Be}(k, n-k+1) \).
- \( \text{Be}(1,1) \equiv U(0,1); \text{Be}(1/2,1/2) \equiv \text{Arcsine Law} \)

### 1.10 Student \( t_n \) Distribution

Random variable \( X \) has Student \( t_n \) distribution with \( n \) degrees of freedom if its density is given by

\[ f_n(x) = \frac{\Gamma\left(\frac{n+1}{2}\right)}{\sqrt{n\pi} \Gamma\left(\frac{n}{2}\right)} \left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}}, \quad -\infty < x < \infty. \]

- Moments: \( EX^{2k} = \frac{n^k}{n-2} \frac{\Gamma(n/2-k)\Gamma(k+1/2)}{\Gamma(n/2)} \), \( 2k < n \). \( EX^{2k-1} = 0, k = 1, 2, \ldots. \)
- \( \text{Var}X = \frac{n}{n-2}, n > 2 \)
- Characteristic function \( \varphi(t) = \frac{\sqrt{\pi} \Gamma(m)}{\Gamma(n/2)} \frac{\Gamma\left(m/2,\frac{|t|}{\sqrt{n}}\right)}{\Gamma\left(m/2\right)} \sum_{k=0}^{m-1} \frac{(-1)^k (2k)! (m-k-1)!}{(m-1)!} \left(2\sqrt{n}|t|\right)^{m-k-1}, \) for \( m = \frac{n+1}{2} \) integer.
- \( t_{2k-1}, k = 1, 2, \ldots \) is infinitely divisible.
- If \( Z \sim N(0,1) \) and \( Y \sim \chi^2_n \), then \( X = Z/\sqrt{Y/n} \) has \( t_n \) distribution.
- \( t_1 \equiv C\mathcal{a}(0,1) \).

### 1.11 Cauchy \( C\mathcal{a}(a,b) \) Distribution

Random variable \( X \) has Cauchy \( C\mathcal{a}(a,b) \) distribution with center \( a \in \mathbb{R} \) and scale \( b \in \mathbb{R}^+ \) if its density is given by

\[ f(x) = \frac{1}{b\pi} \frac{1}{1 + \left(\frac{x-a}{b}\right)^2} = \frac{b}{\pi(b^2 + (x-a)^2)}, \quad -\infty < x < \infty. \]

If \( a = 0 \) and \( b = 1 \), the distribution is called standard Cauchy. The cdf is

\[ F(x) = 1/2 + \frac{1}{\pi} \arctan \frac{x-a}{b}, \quad -\infty < x < \infty. \]

- Moments: No finite moments. Value \( x = a \) is the mode and median of the distribution.
- Characteristic function. \( \varphi(t) = e^{iat - b|t|} \), Cauchy distribution is infinitely divisible. Since \( \varphi(t) = (\varphi(t/n))^n \), if \( X_1, \ldots, X_n \) are iid Cauchy, \( X \) is also a Cauchy.
- If \( Y, Z \) are independent standard normal \( N(0,1) \) then \( X = Y/Z \) has Cauchy \( C\mathcal{a}(0,1) \) distribution. If a variable \( U \) is uniformly distributed between \(-\pi/2 \) and \( \pi/2 \), then \( X = \tan U \) will follow standard Cauchy distribution.
- The Cauchy distribution is sometimes called the Lorentz distribution (especially in engineering community).
1.12 Fisher $F_{m,n}$ Distribution

Random variable $X$ has Fisher $F_{m,n}$ distribution with $m$ and $n$ degrees of freedom if its density is given by

$$f(x|m, n) = \frac{m^{m/2}n^{n/2}x^{m/2-1}}{B(m/2,n/2)} (n + mx)^{-(m+n)/2}, \ x > 0.$$  

The cdf $F(x)$ is of no closed form.

- Moments $E(X^k) = \frac{n}{m} \frac{\Gamma(m/2+k)\Gamma(n/2-k)}{\Gamma(m/2)\Gamma(n/2)} 2k < n$.
- Mean $EX = \frac{n}{n-2}, n > 2$,  
  Variance $VarX = \frac{2m(m+n-2)}{m(n-2)^2(n-4)}, n > 4$.
- Mode $n/m \cdot (m-2)/(n-2)$

1.13 Logistic $Lo(\mu, \sigma^2)$ Distribution

Random variable $X$ has logistic $Lo(\mu, \sigma^2)$ distribution with parameters $\mu \in \mathbb{R}$ and $\sigma^2 > 0$ if its density is given by

$$f(x|\mu, \sigma^2) = \frac{\pi \exp \left[ - \frac{\pi}{\sqrt{3}} \left( \frac{x-\mu}{\sigma} \right) \right]}{\sigma \sqrt{3} \left( 1 + \exp \left[ - \frac{\pi}{\sqrt{3}} \left( \frac{x-\mu}{\sigma} \right) \right] \right)^2}.$$  

- Expectation: $EX = \mu$  
  Variance: $VarX = \sigma^2$.
- Characteristic function $\varphi(t) = e^{it\mu} (1 - i \frac{\sqrt{3}}{\pi} \sigma t) \Gamma(1 + i \frac{\sqrt{3}}{\pi} \sigma t)$.
- Used in modeling in biometry (drug response, toxicology, etc.)
- Alternative parametrization

1.14 Lognormal $LN(\mu, \sigma^2)$ Distribution

Random variable $X$ has lognormal $LN(\mu, \sigma^2)$ distribution with parameters $\mu \in \mathbb{R}$ and $\sigma^2 > 0$ if its density is given by

$$f(x|\alpha, \beta) = \left\{ \begin{array}{ll} \frac{1}{x \sigma \sqrt{2\pi}} e^{-\frac{(\ln(x) - \mu)^2}{2\sigma^2}}, & x > 0 \\ 0, & \text{else} \end{array} \right.$$  

- Moments: $EX^k = \exp\{\frac{1}{2} k^2 \sigma^4 + k\mu\}$.
- Variance $VarX = e^{\sigma^4 + \mu^2} (e^{2\sigma^2} - 1)$.
- Mode $e^{\mu - \sigma^2}$
- If $Z \sim N(0, 1)$ then $X = \exp\{\sigma^2 Z + \mu\} \sim LN(\mu, \sigma^2)$.

1.15 Pareto $Pa(x_0, \alpha)$ Distribution.

Random variable $X$ has Pareto $Pa(x_0, \alpha)$ distribution with parameters $0 < x_0 < \infty$ and $\alpha > 0$ if its density and cdf are given by

$$f(x|x_0, \alpha) = \frac{\alpha}{x_0} \left( \frac{x_0}{x} \right)^{\alpha+1} 1(x \geq x_0), \ \alpha > 0,$$

$$FX = \frac{\alpha x_0^n}{x - x_0}, \ \alpha > n.$$  

Random Pareto observations can be obtained as $x_0[1/(1-U)]^{1/\alpha}$, where $U \sim U(0, 1)$.  

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2 Some Important Discrete Distributions

2.1 Point Mass $\delta_a$ Distribution

Random variable $X$ has point mass $\delta_a$ distribution concentrated at $a \in \mathbb{R}$ if its probability mass function is given by

$$f(x|a) = \delta_a = \begin{cases} 1, & x = a \\ 0, & x \neq a \end{cases}$$

- Moments: $EX^k = a^k$
- Variance: $VarX = 0$.
- Characteristic function $\varphi(t) = e^{ita}$.

2.2 Bernoulli $Ber(p)$ Distribution

Random variable $X$ has Bernoulli $Ber(p)$ distribution with parameter $0 \leq p \leq 1$ if its probability mass function is given by

$$f(x|p) = p^x(1-p)^{1-x}, \ x \in \{0, 1\}.$$ 

- Moments: $EX^k = p$  
- Variance: $VarX = p(1-p)$.
- Characteristic function $\varphi(t) = 1 + p(e^{it} - 1)$.

2.3 Binomial $Bin(n, p)$ Distribution

Random variable $X$ has Binomial $Bin(n, p)$ distribution with parameters $n \in \mathbb{N}$, and $0 \leq p \leq 1$ if its probability mass function is given by

$$f(x|p) = \binom{n}{x}p^x(1-p)^{n-x}, \ x \in \{0, 1, \ldots, n\}.$$ 

- Moments: $EX = np$, $EX^2 = np + n(n-1)p^2$, $EX^3 = np(1-p)(1-2p)$, $EX^4 = 3n^2p(1-p^2) + np(1-p)(1-6p(1-p))$  
- Skewness: $\gamma = \frac{p}{\sqrt{np(1-p)}}$.
- Characteristic function $\varphi(t) = [1 + p(e^{it} - 1)]^n$.

2.4 Geometric $Geom(p)$ Distribution

Random variable $X$ has geometric $Geom(p)$ distribution with parameter $0 \leq p \leq 1$ if its probability mass function is given by

$$f(x|p) = p(1-p)^x, \ x = 0, 1, 2, \ldots$$ 

- Expectation: $EX = \frac{1-p}{p}$  
- Variance: $VarX = \frac{1-p}{p^2}$.
- Characteristic function $\varphi(t) = \frac{p}{1-(1-p)e^{it}}$. 

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• Geometric distribution is the only discrete distribution with memoryless property,
  \[ P(X \geq m + n | X \geq m) = P(X \geq n). \]

• \( X \sim Geom(p) \) models the number of failures until first success in the Binomial setup.
• Alternative definition of Geometric distribution is \( Y \sim Geom(p) \),
  \[ f(y|p) = p(1-p)^{y-1}, \quad y = 1, 2, \ldots \]
representing total number of experiments until the first success. Of course, \( Y = X + 1 \), \( EY = \frac{1-p}{p} - 1 = \frac{1}{p} \), \( varY = VarX \).

2.5 Negative Binomial \( NB(r, p) \) Distribution

Random variable \( X \) has negative binomial \( NB(r, p) \) distribution with parameters \( r \in \mathbb{N} \) and \( 0 \leq p \leq 1 \) if its probability mass function is given by

\[ f(x|r, p) = \binom{x+r-1}{r-1} p^r (1-p)^x, \quad x = 0, 1, 2, \ldots \]

• Expectation: \( EX = \frac{r(1-p)}{p} \)
• Variance: \( VarX = \frac{r(1-p)}{p^2} \).
• Characteristic function \( \varphi(t) = \left[ \frac{p}{1-(1-p)e^{it}} \right]^r \).
• If \( r \) is integer, random variable \( X \) having negative binomial \( NB(r, p) \) distribution represents the number of failures in the binomial setup until \( r \) successes are obtained. If \( r = 1, NB(r, p) \equiv Geom(p) \).
• Negative binomial is a marginal distribution for Poisson likelihood and Gamma prior, i.e., if \( X|\theta \sim Poi(\theta) \) and \( \theta \sim G(\frac{r}{p}, \frac{1-p}{p}) \), then the marginal for \( X \) is \( NB(r, p) \).

2.6 Poisson \( Poi(\lambda) \) Distribution

Random variable \( X \) has Poisson \( Poi(\lambda) \) distribution with parameter \( \lambda > 0 \) if its probability mass function is given by

\[ f(x|\lambda) = \frac{\lambda^x}{x!} e^{-\lambda}, \quad x = 0, 1, 2, \ldots \]

• Expectation: \( EX = \lambda, \quad EX^2 = \lambda^2 + \lambda \) \quad Variance: \( VarX = \lambda \).
• Characteristic function \( \varphi(t) = e^{\lambda(e^{it}-1)} \).
• If \( np \to \lambda, \quad n \to \infty \), then \( \binom{n}{x} p^x (1-p)^{n-x} \to \frac{\lambda^x}{x!} e^{-\lambda} \).
• A random variable \( X \) having Poisson \( Poi(\lambda) \) distribution models the number of rare events (in a time interval or in a part of space).
• If \( \lambda \) is large, \( \sqrt{X} \approx N \left( \sqrt{\lambda}, \frac{1}{4} \right) \).
2.7 Hypergeometric Distribution
2.8 Logarithmic Distribution
2.9 Borel Distribution

3 Some Important Multivariate Distributions
3.1 Multivariate Normal (Gaussian) $\mathcal{MN}(\mu, \Sigma)$ Distribution
3.2 Multinomial Distribution
3.3 Wishart Distribution