STAT6494: Adv Topics Bayesian Statistics
Summary of Distributions

- **Discrete Univariate**
  - Bernoulli: $p^r(1-p)^{1-r}$, $r = 0, 1$
  - Binomial: $\frac{n!}{r!(n-r)!}p^r(1-p)^{n-r}$; $r = 0, ..., n$
  - Negative Binomial: $\frac{(x+r+1)!}{x!(r-1)!}p^r(1-p)^x$, $x = 0, 1, 2, ...$
  - Poisson: $e^{-\lambda}\frac{\lambda^x}{(r-1)!}$, $r = 0, 1, ...$
- **Continuous Univariate**
  - Beta: $p^{a-1}(1-p)^{b-1}\frac{\Gamma(a+b)}{\Gamma a\Gamma(b)}$, $0 < p < 1$
  - Chi-squared: $\frac{2^{-k/2}x^{k/2-1}e^{-x/2}}{\Gamma(\frac{k}{2})}$, $x > 0$
  - Double Exp: $\frac{\tau}{2}exp(-\tau|x-\mu|)$; $-\infty < x < \infty$
  - Exp: $\lambda e^{-\lambda x}$; $x > 0$
  - Gamma: $\frac{\mu^r x^{r-1}e^{-\mu x}}{\Gamma(r)}$, $x > 0$
  - Generalized Gamma: $\frac{\beta}{\Gamma(r)}\mu^{\beta r}x^{\beta r-1}exp[-(\mu x)^\beta]$, $x > 0$
  - Log-normal: $\sqrt{\frac{\tau}{2\pi}}exp(-\frac{\tau}{2}(logx-\mu)^2)$, $x > 0$
  - Logistic: $\frac{\tau exp(\tau(x-\mu))}{(1+exp(\tau(x-\mu)))^2}$, $-\infty < x < \infty$
  - Normal: $\sqrt{\frac{\tau}{2\pi}}exp(-\frac{\tau}{2}(x-\mu)^2)$, $-\infty < x < \infty$
  - Pareto: $\alpha c^\alpha x^{-(\alpha+1)}$, $x > c$
  - Student t: $\frac{\Gamma(\frac{k+1}{2})}{\Gamma(\frac{k}{2})}\sqrt{\frac{\tau}{k\pi}}[1+\frac{\tau}{k}(x-\mu)^2]^{-(k+1)/2}$, $-\infty < x < \infty$, $k \geq 2$
  - Uniform: $\frac{1}{b-a}$; $a < x < b$
  - Weibull: $\nu\lambda x^{\nu-1}exp(-\lambda x^\nu)$; $x > 0$
- **Discrete Multivariate**
  - Multinomial: $\frac{(\sum_i x_i)!}{\prod_i x_i!}\prod_i p_i^{x_i}$, $\sum x_i = N$, $0 < p_i < 1$, $\sum p_i = 1$
- **Continuous Multivariate**
  - Dirichlet $\frac{\Gamma(\sum_i \alpha_i)}{\prod_i \Gamma(\alpha_i)}\prod_i p_i^{\alpha_i-1}$, $0 < p_i < 1$, $\sum_i p_i = 1$
  - Multivariate Normal: $(2\pi)^{-d/2}|T|^{1/2}exp(-\frac{1}{2}(x-\mu)'T(x-\mu))$, $-\infty < x < \infty$.

– Multivariate Student t: $\frac{\Gamma((k+d)/2)}{\Gamma(k/2)k^{d/2}\pi^{d/2}}|T|^{1/2}[1+\frac{1}{k}(x-\mu)'T(x-\mu)]^{-(k+d)/2}$, $-\infty < x < \infty$; $k \geq 2$

– Wishart: $|R|^{k/2}|x|^{(k-p-1)/2}exp(-\frac{1}{2}Tr(Rx))$, x symmetric and positive definite.