Statistics Formulas

Means and Variances

	Mean	Variance
Sample (of size n)	$\bar{x} = \frac{1}{n} \sum_i x_i$	$s^2 = \frac{1}{n-1} \sum_i (x_i - \bar{x})^2$
Random variable X		
discrete X		
General	$E(X) = \sum_x x f_X(x)$	$\mathrm{Var}(X) = \sum_x (x-\mu_X)^2 f_X(x) = E([X - E(X)]^2) = E(X^2) - [E(X)]^2$
$X \sim \mathsf{Binom}(n, \pi)$	$E(X) = n\pi$	$\mathrm{Var}(X) = n\pi(1-\pi)$
$X \sim \mathsf{Hyper}(m, n, k)$	$E(X) = \frac{km}{m+n}$	$\mathrm{Var}(X) = k\left(\frac{m}{m+n}\right)\left(\frac{n}{m+n}\right)\left(\frac{m+n-k}{m+n-1}\right)$
continuous X		
General	$E(X) = \int_{-\infty}^{\infty} x f_X(x)\,dx$	$\mathrm{Var}(X) = \int_{-\infty}^{\infty} [x - E(X)]^2 f_X(x)\,dx = E([X - E(X)]^2) = E(X^2) - [E(X)]^2$
$X \sim \mathsf{Unif}(a, b)$	$E(X) = \frac{1}{2}(a+b)$	$\mathrm{Var}(X) = \frac{1}{12}(b-a)^2$
$X \sim \mathsf{Exp}(\lambda)$	$E(X) = 1/\lambda$	$\mathrm{Var}(X) = 1/\lambda^2$
$X \sim \mathsf{Norm}(\mu, \sigma)$	$E(X) = \mu$	$\mathrm{Var}(X) = \sigma^2$

$100(1-\alpha)\%$ Confidence Intervals

For $T \sim t(\nu)$ choose $t_{\beta,\nu}$ so that $P(T > t_{\beta,\nu}) = \beta$. The 2-sided $100(1-\alpha)\%$ CI is

$$(\text{estimate}) \pm t^*(\text{std. error}),$$

with $t^* = t_{\alpha/2,\nu}$, and the degrees of freedom ν chosen appropriately (see below).

What estimating?	Sample size	Estimate	std. error	ν
μ_X	n	$\bar{x}$	$\frac{s}{\sqrt{n}}$	$n-1$
$\mu_X - \mu_Y$	m, n (resp.)	$\bar{x} - \bar{y}$	$\left(\frac{s_X^2}{m} + \frac{s_Y^2}{n}\right)^{1/2}$	$\dfrac{\left(\frac{s_X^2}{m} + \frac{s_Y^2}{n}\right)^2}{\frac{(s_X^2/m)^2}{m-1} + \frac{(s_Y^2/n)^2}{n-1}}$
β_1	n	b_1	$s_{b_1} = \sqrt{\frac{\mathrm{MSE}}{\sum_i (x_i - \bar{x})^2}}$	$n-2$