Distributions

Name	***pdf***	***mean***	***variance***
Hypergeometric	$p(x)=\dfrac{\binom{D}{x}\binom{N-D}{n-x}}{\binom{N}{n}} \qquad x=0,1,2,\ldots\min(n,D)$	$\dfrac{nD}{N}$	$\dfrac{nD}{N}\left(1-\dfrac{D}{N}\right)\left(\dfrac{N-n}{N-1}\right)$
Binomial	$p(x)=\binom{n}{x}p^{x}(1-p)^{n-x} \qquad x=0,1,2,\ldots n$	np	$np(1-p)$
Poisson	$p(x)=\dfrac{e^{-\lambda}\lambda^{x}}{x!} \qquad x=0,1,\ldots$	λ	λ
Normal	$f(x)=\dfrac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^{2}} \qquad -\infty<x<\infty$	μ	σ^{2}
Exponential	$f(x)=\lambda e^{-\lambda x} \qquad x\geq 0$	$\dfrac{1}{\lambda}$	$\dfrac{1}{\lambda^{2}}$

Two-sided confidence intervals

statistic	***Interval***
mean (variance known)	$\bar{x} - Z_{\alpha/2}\frac{\sigma}{\sqrt{n}} \le \mu \le \bar{x} + Z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$
mean (variance unknown)	$\bar{x} - t_{\alpha/2,n-1}\frac{S}{\sqrt{n}} \le \mu \le \bar{x} + t_{\alpha/2,n-1}\frac{S}{\sqrt{n}}$
variance	$\frac{(n-1)S^2}{X^2_{\alpha/2,n-1}} \le \sigma^2 \le \frac{(n-1)S^2}{X^2_{1-\alpha/2,n-1}}$
difference between means (variance known)	$\bar{x}_1 - \bar{x}_2 - Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}} \le \mu_1 - \mu_2 \le \bar{x}_1 - \bar{x}_2 + Z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1}+\frac{\sigma_2^2}{n_2}}$
difference between means (variance unknown)	$\bar{x}_1 - \bar{x}_2 - t_{\alpha/2,n_1+n_2-2}S_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}} \le \mu_1 - \mu_2 \le \bar{x}_1 - \bar{x}_2 + t_{\alpha/2,n_1+n_2-2}S_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}$ where $S_p = \sqrt{\frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}}$
Ratio of variances (for normal distributions)	$\frac{S_1^2}{S_2^2}F_{1-\alpha/2,n_2-1,n_1-1} \le \frac{\sigma_1^2}{\sigma_2^2} \le \frac{S_1^2}{S_2^2}F_{\alpha/2,n_2-1,n_1-1}$

Hypothesis tests:

Test on means with known variance		
Hypothesis	Criteria for Rejection	Test Statistic
$H_0 : \mu = \mu_0$ $H_1 : \mu \neq \mu_0$	$\lvert Z_0 \rvert > Z_{\alpha/2}$	$Z_0 = \dfrac{\bar{x} - \mu_0}{\sigma / \sqrt{n}}$
$H_0 : \mu = \mu_0$ $H_1 : \mu < \mu_0$	$Z_0 < -Z_\alpha$	
$H_0 : \mu = \mu_0$ $H_1 : \mu > \mu_0$	$Z_0 > Z_\alpha$	
$H_0 : \mu_1 = \mu_2$ $H_1 : \mu_1 \neq \mu_2$	$\lvert Z_0 \rvert > Z_{\alpha/2}$	$Z_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$
$H_0 : \mu_1 = \mu_2$ $H_1 : \mu_1 < \mu_2$	$Z_0 < -Z_\alpha$	
$H_0 : \mu_1 = \mu_2$ $H_1 : \mu_1 > \mu_2$	$Z_0 > Z_\alpha$	

Hypothesis tests (continued):

<table>
<tr><th colspan="4">Test on means of normal distributions with unknown variance</th></tr>
<tr><th>Hypothesis</th><th>Criteria for Rejection</th><th colspan="2">Test Statistic</th></tr>
<tr><td>$H_0 : \mu = \mu_0$
$H_1 : \mu \neq \mu_0$</td><td>$|t_0| > t_{\alpha/2, n-1}$</td><td colspan="2" rowspan="3">$t_0 = \dfrac{\bar{x} - \mu_0}{S/\sqrt{n}}$</td></tr>
<tr><td>$H_0 : \mu = \mu_0$
$H_1 : \mu < \mu_0$</td><td>$t_0 < -t_{\alpha, n-1}$</td></tr>
<tr><td>$H_0 : \mu = \mu_0$
$H_1 : \mu > \mu_0$</td><td>$t_0 > t_{\alpha, n-1}$</td></tr>
<tr><td>$H_0 : \mu_1 = \mu_2$
$H_1 : \mu_1 \neq \mu_2$</td><td>$|t_0| > t_{\alpha/2, v}$</td><td rowspan="3">if $\sigma_1^2 = \sigma_2^2$,
$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{S_p \sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}}$
$v = n_1 + n_2 - 2$</td><td rowspan="3">if $\sigma_1^2 \neq \sigma_2^2$,
$t_0 = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\dfrac{S_1^2}{n_1} + \dfrac{S_2^2}{n_2}}}$
$v = \dfrac{\left(\dfrac{S_1^2}{n_1} + \dfrac{S_2^2}{n_2}\right)^2}{\dfrac{\left(S_1^2/n_1\right)^2}{n_1 + 1} + \dfrac{\left(S_2^2/n_2\right)^2}{n_2 + 1}} - 2$</td></tr>
<tr><td>$H_0 : \mu_1 = \mu_2$
$H_1 : \mu_1 < \mu_2$</td><td>$t_0 < -t_{\alpha, v}$</td></tr>
<tr><td>$H_0 : \mu_1 = \mu_2$
$H_1 : \mu_1 > \mu_2$</td><td>$t_0 > t_{\alpha, v}$</td></tr>
</table>

Hypothesis tests (continued):

Tests on variances of normal distributions		
Hypothesis	Criteria for Rejection	Test Statistic
$H_0 : \sigma^2 = \sigma_0^2$ $H_1 : \sigma^2 \neq \sigma_0^2$	$X_0^2 > X_{\alpha/2,n-1}^2$ ***or*** $X_0^2 < X_{1-\alpha/2,n-1}^2$	$X_0^2 = \dfrac{(n-1)S^2}{\sigma_0^2}$
$H_0 : \sigma^2 = \sigma_0^2$ $H_1 : \sigma^2 < \sigma_0^2$	$X_0^2 < X_{1-\alpha,n-1}^2$	
$H_0 : \sigma^2 = \sigma_0^2$ $H_1 : \sigma^2 > \sigma_0^2$	$X_0^2 > X_{\alpha,n-1}^2$	
$H_0 : \sigma_1^2 = \sigma_2^2$ $H_1 : \sigma_1^2 \neq \sigma_2^2$	$F_0 > F_{\alpha/2,n_1-1,n_2-1}$ ***or*** $F_0 < F_{1-\alpha/2,n_1-1,n_2-1}$	$F_0 = \dfrac{S_1^2}{S_2^2}$
$H_0 : \sigma_1^2 = \sigma_2^2$ $H_1 : \sigma_1^2 < \sigma_2^2$	$F_0 > F_{\alpha,n_2-1,n_1-1}$	$F_0 = \dfrac{S_2^2}{S_1^2}$
$H_0 : \sigma_1^2 = \sigma_2^2$ $H_1 : \sigma_1^2 > \sigma_2^2$	$F_0 > F_{\alpha,n_1-1,n_2-1}$	$F_0 = \dfrac{S_1^2}{S_2^2}$

Variables control charts:

μ, σ given.		
Quality Characteristic	Center Line	Control Limits
$\bar{x}$	μ	$\mu \pm A\sigma$
R	$d_2\sigma$	$UCL = D_2\sigma$, $LCL = D_1\sigma$
S	$c_4\sigma$	$UCL = B_6\sigma$, $LCL = B_5\sigma$
μ, σ not given (unknown).		
$\bar{x}$	$\bar{\bar{x}}$	$\bar{\bar{x}} \pm A_2\bar{R}$, *or* $\bar{\bar{x}} \pm A_3\bar{S}$
R	$\bar{R}$	$UCL = D_4\bar{R}$, $LCL = D_3\bar{R}$
S	$\bar{S}$	$UCL = B_4\bar{S}$, $LCL = B_3\bar{S}$

Attributes control charts:

Quality Characteristic	Center Line	Control Limits
Fraction non-conforming (p given)	p	$p \pm 3\sqrt{\frac{p(1-p)}{n}}$
Fraction non-conforming (p ***not*** given)	$\bar{p}$	$\bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$
Number non-conforming (p given)	np	$np \pm 3\sqrt{np(1-p)}$
Number non-conforming (p ***not*** given)	$n\bar{p}$	$n\bar{p} \pm 3\sqrt{n\bar{p}(1-\bar{p})}$
Non-conformities (c given)	c	$c \pm 3\sqrt{c}$
Non-conformities (c ***not*** given)	$\bar{c}$	$\bar{c} \pm 3\sqrt{\bar{c}}$
Average number of non-conformities per unit	$\bar{u}$	$\bar{u} \pm 3\sqrt{\frac{\bar{u}}{n}}$

ANOVA testing:

There are *a* different treatment levels, with *n* replicates per treatment.

$y_{i.} = \sum_{j=1}^{n} y_{ij}$	$\bar{y}_{i.} = y_{i.} / n$
$y_{..} = \sum_{i=1}^{a} \sum_{j=1}^{n} y_{ij}$	$\bar{y}_{..} = y_{..} / N$

$SS_T = SS_{Treatments} + SS_E$, where	$SS_T = \sum_{i=1}^{a} \sum_{j=1}^{n} \left(y_{ij} - \bar{y}_{..} \right)^2$
	$SS_{Treatments} = n \sum_{i=1}^{a} \left(\bar{y}_{i.} - \bar{y}_{..} \right)^2$
	$SS_E = \sum_{i=1}^{a} \sum_{j=1}^{n} \left(y_{ij} - \bar{y}_{i.} \right)^2$

$MS_{Treatments} = \frac{SS_{Treatments}}{a-1}$	$MS_E = \frac{SS_E}{a(n-1)}$

The test statistic is $F_0 = \frac{MS_{Treatments}}{MS_E}$,

which – if H_0 is true – is F-distributed with *a-1* and *a(n-1)* degrees of freedom.