**Topics in Confidence Intervals:**

Assumptions:

* random sample from a normal distribution with mean µ, or
* random sample from a distribution with mean µ, finite variance. Sample size must be large in this case. χ

**CI for the mean:**

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| --- | --- |
| Based on the Statistic: | CI formula |
| $$t\_{(n-1)}=\frac{\left(\overbar{X}-μ\right)}{^{s}/\_{\sqrt{n}}}$$ | $$\overbar{X}\pm t\_{\left(n-1\right),\frac{α}{2}}\frac{s}{\sqrt{n}}$$ |

**CI for the variance:**

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| --- | --- |
| Based on the Statistic: | CI formula |
| $$χ\_{(n-1)}^{2}= \frac{\left(n-1\right)S^{2}}{σ^{2}}$$ | $$\left(\frac{\left(n-1\right)S^{2}}{χ\_{\frac{α}{2}}^{2}},\frac{\left(n-1\right)S^{2}}{χ\_{1-\frac{α}{2}}^{2}}\right)$$ |

**CI for the ratio of 2 variances:** X1,…,Xm random sample from normal with variance σX2, and Y1,…,Yn random sample from normal with variance σY2. Both samples are independent of each other.

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| Based on the Statistic: | CI formula |
| $$F\left(m-1,n-1\right)=\frac{^{S\_{X}^{2}}/\_{σ\_{X}^{2}}}{^{S\_{Y}^{2}}/\_{σ\_{Y}^{2}}}$$ | $$\left(\frac{S\_{X}^{2}}{S\_{Y}^{2}}\frac{1}{F\_{\frac{α}{2}}\left(m-1,n-1\right)},\frac{S\_{X}^{2}}{S\_{Y}^{2}}F\_{\frac{α}{2}}(n-1,m-1)\right)$$ |

**CI for proportion:** $\hat{p}$ = sample proportion.

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| Based on the Statistic: | CI formula |
| $$z=\frac{\left(\hat{p}-p\right)}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}}$$ | $$\hat{p}\pm z\_{,\frac{α}{2}}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$ |
| Assumptions: $n\hat{p}\geq 10$ and $n(1-\hat{p})\geq 10$ |  |

**CI for proportion when n is not that large:** $p\_{L}\leq p\leq p\_{U}$ where $p\_{L}$ and $p\_{U}$ are the solution to the following. Let $N\_{s}$=number of success in the sample (of size N).

Upper limit: Solve $\sum\_{k=0}^{N\_{s}}\left(\begin{matrix}N\\k\end{matrix}\right)p\_{U}^{k}(1-p\_{U})^{N-k}=\frac{α}{2}$

Lower limit: solve $\sum\_{k=0}^{N\_{s}-1}\left(\begin{matrix}N\\k\end{matrix}\right)p\_{L}^{k}(1-p\_{L})^{N-k}=1-\frac{α}{2}$

The interval (*pL*, *pU*) is an exact 100(1 - )% confidence interval for *p*. However, it is not symmetric about the observed proportion defective, $\hat{p}=\frac{N\_{s}}{N}$.

To solve for *pU*:

1. Open an EXCEL spreadsheet and put the starting value of 0.5 in the A1 cell.
2. Put =BINOMDIST(*Ns*, *N*, *A1*, *1*) in B1, where *Ns* = 10 and *N* = 15.
3. Select the Data menu and click on What-if-analysis. Select: GOAL SEEK. The GOAL SEEK box requires 3 entries./li>
	* B1 in the "Set Cell" box
	* /2 = 0.05 in the "To Value" box
	* A1 in the "By Changing Cell" box.

The picture below shows the steps in the procedure.



There is a wonderful statistical software called R, that is free and does a lot of things for you. (The R project for statistical computing: http://www.r-project.org/)

The command in R: prop.test(15,20) gives you, among other things, a 95% CI for the proportion.