Introduction to Interpreting Empirical Results and Hypothesis Testing

Mean & Variance

$$Mean(x) = \bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

$$Variance(x) = S^2 = \frac{\sum_{i=1}^{N} (\bar{x} - x_i)^2}{N}$$

$$StdDev(x) = S = \sqrt{Var(x)}$$

Confidence Interval of Mean

$$StdErr(\bar{x}) = StdDev(\bar{x}) = S / \sqrt{N}$$

$\pm 1S \approx 68\%$

$\pm 2S \approx 95\%$

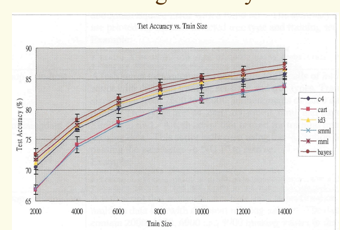
$\pm 3S \approx 99\%$

$Confidence\_Interval$

$95\% : \bar{X} - 1.96S < true\_mean < \bar{X} + 1.96S$

Error Bars

- Typically 1 or 2 standard errors about mean
- Always specify what error bars are
- If 1 StdErr error bars do not overlap over regions of graph, typically assume results significantly different in regions



Hypothesis: Two Pops Have Same Mean

- t-test
- Given sample sizes, means, and variances, what are chances of seeing this large a difference in mean by chance?

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S_{pooled}\sqrt{(1/N_1) + (1/N_2)}}$$

$$S_{pooled} = \sqrt{\frac{(N_1 - 1)S_1^{\ 2} + (N_2 - 1)S_2^{\ 2}}{N_1 + N_2 - 2}}$$

Hypothesis Testing continued (t-test)

- calculate t statistic (see previous slide)
- Find critical values of t in table for alpha = 0.05 (or 0.01, 0.001) with (N_1+N_2-2) degrees of freedom
- One-sided:
  - testing one mean is larger than other
  - E.g., for (alpha=0.05, N_1=N_2=10): t = 1.734
- Two-sided:
  - testing means are different
  - E.g., for (alpha=0.05, N_1=N_2=10): t = 2.101