

# Comparing System Configurations

4/8/2009

# Opening Discussion

- Do you have any questions about the quiz?
- Minute Essay comments
  - Quantum computing has been added to the schedule.
  - A few more changes were made to the code. We should look over that and make sure we understand it.

# Comparing System Configurations

- We have moved into chapter 10 back in the Law book.
- Imagine that we have a few different configurations of a particular system that have been told to work with. How should we go about comparing the results of those different systems?
- Most of the time we want to answer a question like, which configuration is better?

# Example

- Single fast server versus two slow servers.
- The two server model has shorter wait times on average, but in any given set of runs that might not be true.
- Obviously, you can't just compare one run of each. The more runs we do of each the more likely we get the right results.
- How can we be more rigorous?

# Fixed Length vs. Steady State

- One of the things that has to be considered in this work is the nature of the simulations.
- The earlier example is intended for looking at the behavior over a fixed number of customers or a fixed time period. The simulation has a clear end.
- This becomes more of a challenge if there isn't a clear end and we are looking for steady state behavior.

# Paired-t Confidence Interval

- Requires equal number of samples.

$$Z_j = X_{1j} - X_{2j}$$

$$\bar{Z}(n) = \frac{\sum_{j=1}^n Z_j}{n}$$

$$\hat{Var}[\bar{Z}(n)] = \frac{\sum_{j=1}^n [Z_j - \bar{Z}(n)]^2}{n(n-1)}$$

$$\bar{Z}(n) \pm t_{n-1, 1-\alpha/2} \sqrt{\hat{Var}[\bar{Z}(n)]}$$

# Two-Sample-t Confidence Interval

$$\bar{X}_i(n_i) = \frac{\sum_{j=1}^{n_i} X_{ij}}{n_i}$$

$$S_i^2(n_i) = \frac{\sum_{j=1}^{n_i} [X_{ij} - \bar{X}_i(n_i)]^2}{n_i - 1}$$

$$\hat{f} = \frac{[S_1^2(n_1)/n_1 + S_2^2(n_2)/n_2]^2}{[S_1^2(n_1)/n_1]^2/(n_1 - 1) + [S_2^2(n_2)/n_2]^2/(n_2 - 1)}$$

$$\bar{X}_1(n_1) - \bar{X}_2(n_2) \pm t_{\hat{f}, 1-\alpha/2} \sqrt{\frac{S_1^2(n_1)}{n_1} + \frac{S_2^2(n_2)}{n_2}}$$

# Using Steady-State Measures

- When we are working with a system where the simulation doesn't have a clear termination and we are interested in the steady state behavior, we need to let the simulations run past the transient state and collect our data from the time period after that.
- That data can be analyzed using the earlier methods.

# 3-D Visualization

- A few people have requested that we look at how you could do a 3-D visualization.
- This is all about tools and it will be different in every tool. I have only recently added this capability to SwiftVis and it isn't very mature.
- 3-D is harder to set up than 2-D because things like camera location and lighting become significant. While a scatter plot can “just work” it is much less likely that a 3-D plot will do the same.

# Making our MD 3-D

- Just for fun, let's try to make a 3-D visualization of a little MD simulation and see what that looks like.

# Minute Essay

- Questions?
- There is no class Friday because it is a University holiday.
- Our High School programming contest is on Saturday. If you would like to volunteer that would be great.