Advanced Applications of Systems *Modeling & Simulation*

::Multiple Runs

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How to Make Multiple Runs

- The need
  - Ad hoc multiple runs??
  - Recall HW#2 open question

- Let’s simply use the “case study – 2” as an example
  - Save as “Phase-3”

New modules

- Parameter
- Dataset

Parameter variation

ParametersVariation - Parameter Variation Experiment

Name: ParametersVariation ☐ Ignore

Top-level agent: Main

Maximum available memory: 256 Mb

Create default UI

Parameters

Parameters: (•) Varied in range ( ) Freeform

Number of runs: 10

Parameter	Type	Value		
		Min	Max	Step
pRun	Range	1	1000	1

Java actions

Initial experiment setup:

Before each experiment run:

Before simulation run:

After simulation run:

```
dsTIS.add(getCurrentIteration(), root.timeMeasureEnd.distribution.mean());
dsTIS1.add(getCurrentIteration(), root.timeMeasureEnd1.distribution.mean());
```

After iteration:

After experiment:

CaseStudy02Phase3.alp

CaseStudy02Phase3 : ParametersVariation

Run

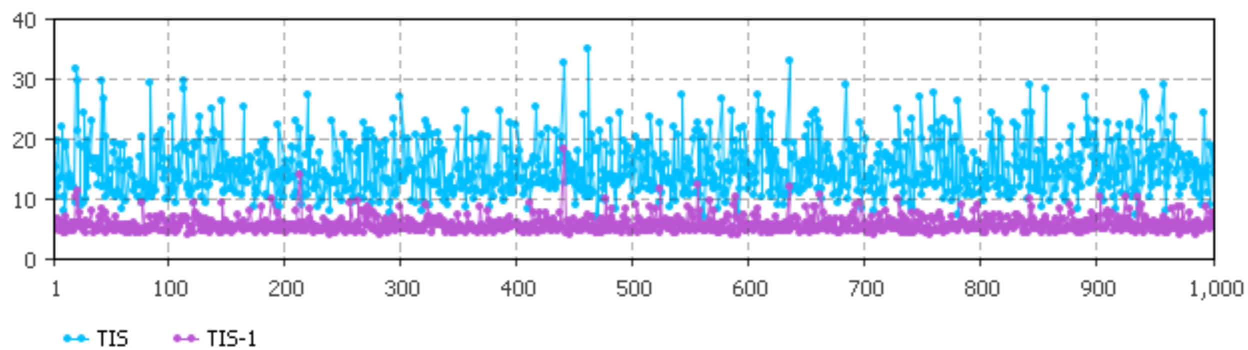
dsTIS
1,000 samples ...[998, 8.956]

dsTIS1
1,000 samples ...[998, 5.619]

Iteration:	1,000

Parameters

pRun	1,000



How many runs are needed??

Half Width, Number of Replications

- Prefer smaller confidence intervals — *precision*
- Notation:

$$n = \text{no. replications}$$
$$\overline{X} = \text{sample mean}$$
$$s = \text{sample standard deviation}$$
$$t_{n-1,1-\alpha/2} = \text{critical value from } t \text{ tables}$$

- Confidence interval:

$$\overline{X} \pm t_{n-1,1-\alpha/2} \frac{s}{\sqrt{n}}$$

- Half-width = $t_{n-1,1-\alpha/2} \dfrac{s}{\sqrt{n}}$

Want this to be "small," say $\leq h$ where h is prespecified

- Can't control *t* or *s*
- Must increase *n* — how much?

Half Width, Number of Replications
(cont'd.)

- Set half-width = h, solve for $$n = t^2_{n-1,1-\alpha/2} \frac{s^2}{h^2}$$
- Not really solved for n (t, s depend on n)
- Approximation:
  - Replace t by z, corresponding normal critical value
  - Pretend that current s will hold for larger samples
  - Get

$$\boxed{n \cong z^2_{1-\alpha/2} \frac{s^2}{h^2}}$$

s = sample standard deviation from "initial" number n_0 of replications

n grows quadratically as h decreases

- Easier but different approximation:

$$\boxed{n \cong n_0 \frac{h_0^2}{h^2}}$$

h_0 = half width from "initial" number n_0 of replications