Optimization via simulation

CASE STUDY:
A STOCHASTIC INSPECTION SYSTEM

Dr. Xueping Li, University of Tennessee

Preparation:

- Hold Module
- How to create a “signal” module?

A Stochastic Inspection System

- In a nuclear plant, some parts that need inspection (or some special treatment) arrive according to a Poisson process with rate Lumbda. Every T time units the system is inspected and at each inspection time all messages present (if any) are cleared from the system (this process takes almost no time). A fixed cost of K>0 is incurred for each inspection. Also, for each item there is a holding cost of h>0 per unit time the item has to wait before it is cleared from the system. We wish to determine the optimal value of T for which the long-run average cost per unit time is minimal.
- Let K=50, h=1, Lumbda=1. What's the T*?
- How about K=500, h=0.01, Lumbda=1?

Build the model

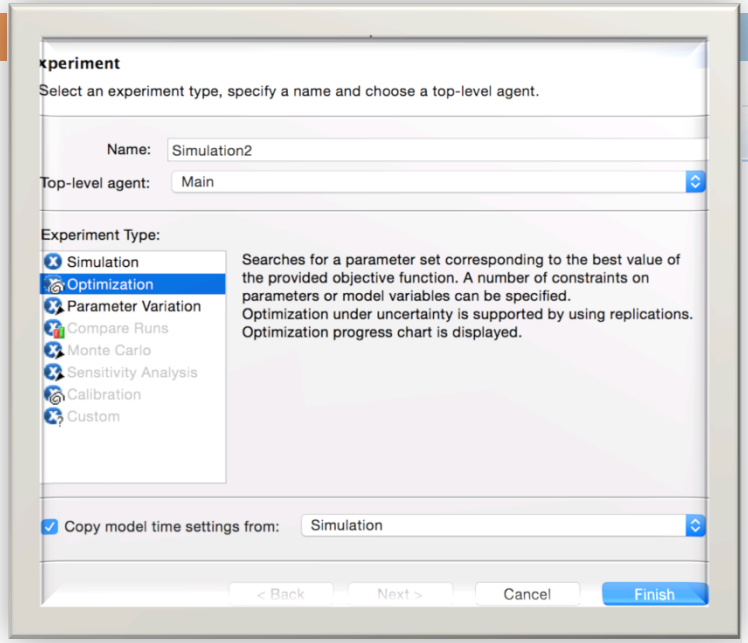
Discussions

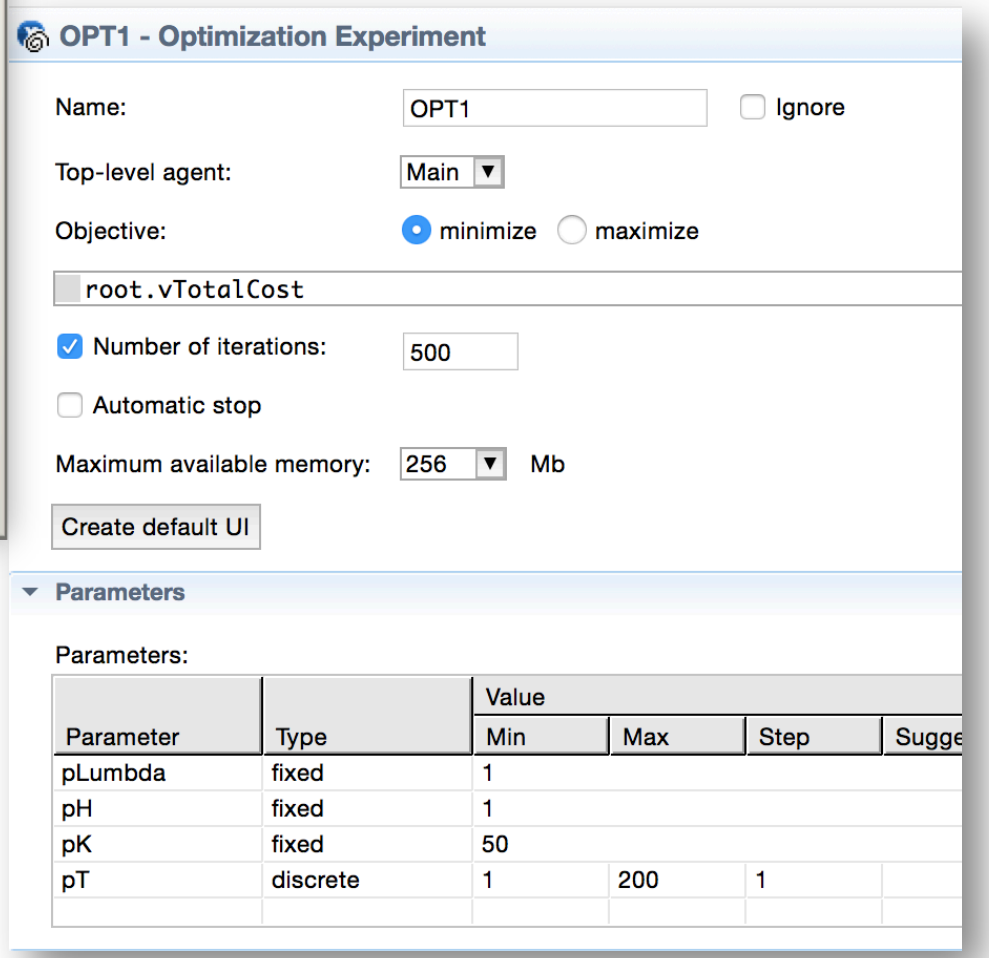
- How to find out the optimal T*?
  - Trial & error
  - Optimization techniques/DOE

OptQuest

- Steps
  - Build a base model
  - Identify control/decision variables
  - Create an “optimization” model – OptQuest
  - Change the decision variables from “fix” to “design”
  - Configure parameters, constraints, replications etc.
  - Optimize!

OptQuest


xperiment
Select an experiment type, specify a name and choose a top-level agent.
Name: Simulation2
Top-level agent: Main
Experiment Type:
Simulation
Optimization
Parameter Variation
Compare Runs
Monte Carlo
Sensitivity Analysis
Calibration
Custom
Searches for a parameter set corresponding to the best value of the provided objective function. A number of constraints on parameters or model variables can be specified.
Optimization under uncertainty is supported by using replications.
Optimization progress chart is displayed.
Copy model time settings from: Simulation
< Back
Next >
Cancel
Finish


OPT1 - Optimization Experiment
Name: OPT1
Ignore
Top-level agent: Main
Objective: minimize maximize
root.vTotalCost
Number of iterations: 500
Automatic stop
Maximum available memory: 256 Mb
Create default UI
Parameters
Parameters:
Parameter
Type
Value
Min
Max
Step
Sugge
pLumbda fixed 1
pH fixed 1
pK fixed 50
pT discrete 1 200 1

OptQuest_Case1 : OPT1

Run

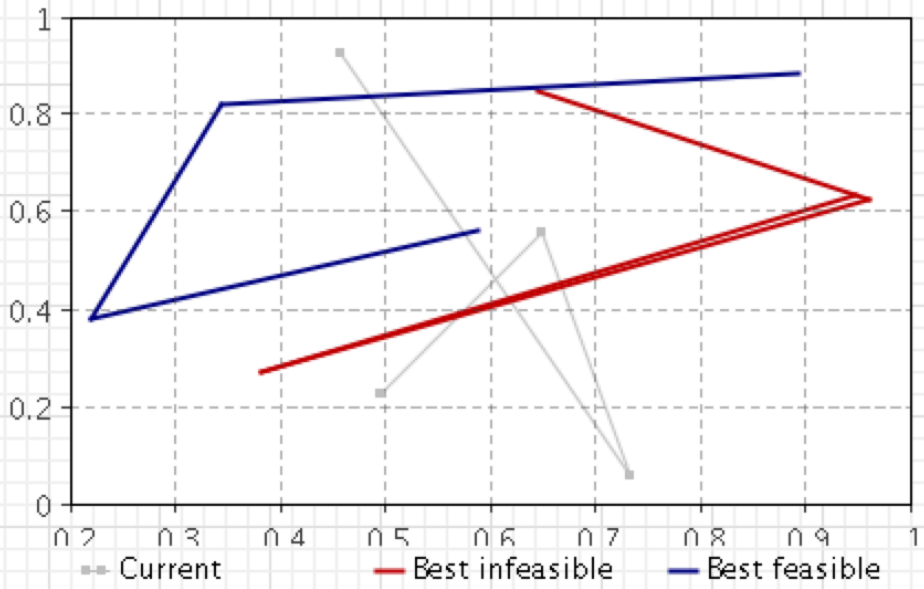
	Current	Best
Iteration:	? infeasible	? infeasible
Objective: ⬇	?	?

Parameters

pLumbda	?	?
pH	?	?
pK	?	?
pT	?	?

Copy the best solution to the clipboard

copy



OptQuest_Case1 : OPT1

Run

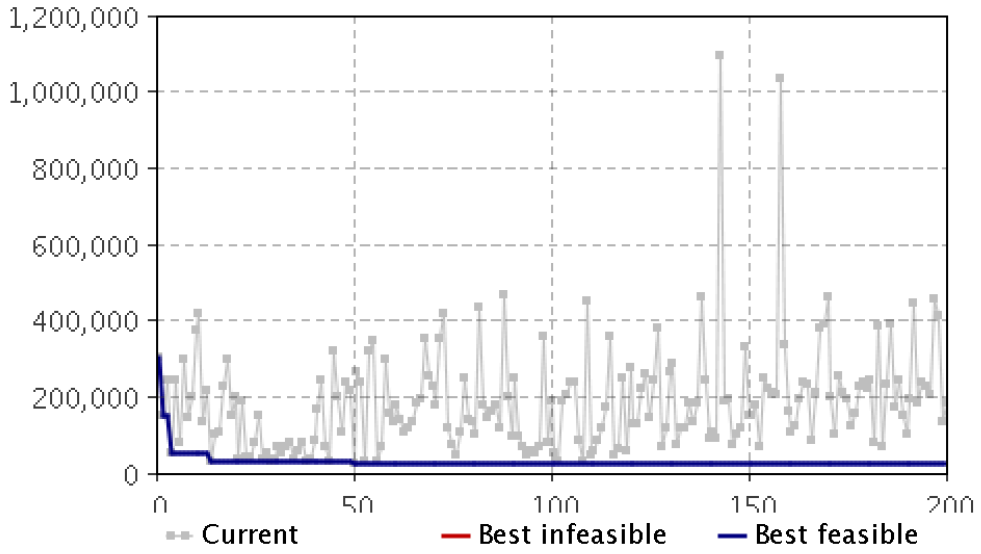
	Current	Best
Iteration:	197	51
Objective:	1[illegible],566.773	26,609.979

Parameters

pLumbda	1	1
pH	1	1
pK	50	50
pT	195	8

Copy the best solution to the clipboard

copy



Closed form

- $T^* = Sqrt(2K/(h*Lambda))$

Extension?

- What if the holding cost is $f(n\_t)$ per time unit, in which n_t is the number of items and f is a function, e.g., $f(x) = x\log(x+5)$?