SISTEM MODELING

Materi 6

Model Testing & Sensitivity Analysis

Model Testing & Sensitivity Analysis

- Internal Validity (Verification)
  - Is the model mathematically **correct and logically** consistent?
  - This also involves verifying that each expression is **dimensionally** consistent.
- External Validity (Validation)
  - Is the model a sufficiently **valid representation of reality**?
- Testing the solution performance
  - To determine **the expected benefits**, such as net profits or net savings

Analysis of Sensitivity of Solution

- Analysis of Sensitivity of Solution
  - **Sensitivity analysis** (evaluate the response of the best solution to changes in various inputs)
  - **Error analysis**
    - The input parameters are estimated on the basis of past data
    - There is no guarantee that the future will be similar to the past
    - There could be an error in input data

Rules for Testing Validity

- The evaluation of the proposed policy has to be based on **observations of actual** (or simulated) **performance**
- **The data used** for the test should be **independent** of the data used to derive the best policy
- The test should not just give expected performance, but also some **measure of its variability**, such the standard deviation

Purpose of Sensitivity Analysis

- If the optimal solution is **relatively insensitive**, then the decision maker and user can place more confidence in the validity and usefulness of the model
- Sensitivity analysis provides information about the **value of additional amounts of each scarce resource** (shadow price of the resource)
- Sensitivity analysis is used for exploring how the optimal solution **changes as a function of such uncertain data**

Procedure of Error Analysis

1. Determine the optimal policy based on the best estimate values for all input parameters (assume that one of these, **say *p***, is in error).
2. Assume that the value of the input parameter *p* differs from **the correct value, *P*** *(p=kP).* Find the optimal policy, using the (assumed) correct value *P.*
3. Compute the actual value of the objective function if the pseudo-optimal policy determined in (1) were implemented.
4. Find the difference between the optimal objective function values obtained from (2) –using the correct value and (3) –using the estimate value.

Math. Model For The LOD Problem

$$T(Q) = 0.5Qvr + sD/Q$$

$$EOQ = \sqrt{2Ds/vr}$$

$$T(Q) = 0.5Qvr + sD/Q$$

$$T(Q) = 0.5vr\sqrt{2Ds/vr} + \frac{sD}{\sqrt{2Ds/vr}}$$

$$T(Q) = \sqrt{0.5Dsvr} + \sqrt{0.5Dsvr} = 2\sqrt{0.5Dsvr}$$

$$T(Q) = \sqrt{2Dsvr}$$

Sensitivity Analysis For The LOD Problem

- How do EOQ expression and T(Q) respond to changes in the input parameters D, s, v, and r?

An Example

$$EOQ = \sqrt{2Ds/vr} = \sqrt{2(4140)18/320(0.18)} = 50.87$$

- A year later its is discovered that actual demand in not 4140, but only 2875 (over estimate 44%)

$$EOQ = \sqrt{2Ds/vr} = \sqrt{2(2875)18/320(0.18)} = 42.4$$

- If we had implemented this solution, the minimum relevan cost, would have been

$$T(42.4) = \sqrt{2(2875)18/320(0.18} = \$2442$$

- Instead, we implemented the pseudo-optimal solution

$$T(50.87) = 0.5(50.87)(320)(0.18) + 18(2875)/50.87 = \$2482$$

- The difference beetween actual cost & the minimum cost (lost in potential benefit)

$$\frac{2482 - 2442}{2442} x100\% = 1.64\%$$

error in demand	-80%	-50%	-20%	0%	20%	50%	100%	300%
k (known)	20%	50%	80%	100%	120%	150%	200%	400%
D implied (4140/k)	20700	8280	5175	4140	3450	2760	2070	1035
T(EOQ) based on D	6552	4144	3276	2930	2675	2392	2072	1465
T(50.87) based on D	8790	4395	3296	2930	2686	2442	2198	1831
Cost increase	34.2%	6.1%	0.6%	0.0%	0.4%	2.1%	6.1%	25.0%

