



# Simulation & Modeling

**Instructor : Ms. Qudsia Yousaf**

**Class : BSSE – Semester V-A**

**[qudsia.yousaf@cs.uol.edu.pk](mailto:qudsia.yousaf@cs.uol.edu.pk)**



## **Lecture No. 19&20**

# **Verification & Validation**

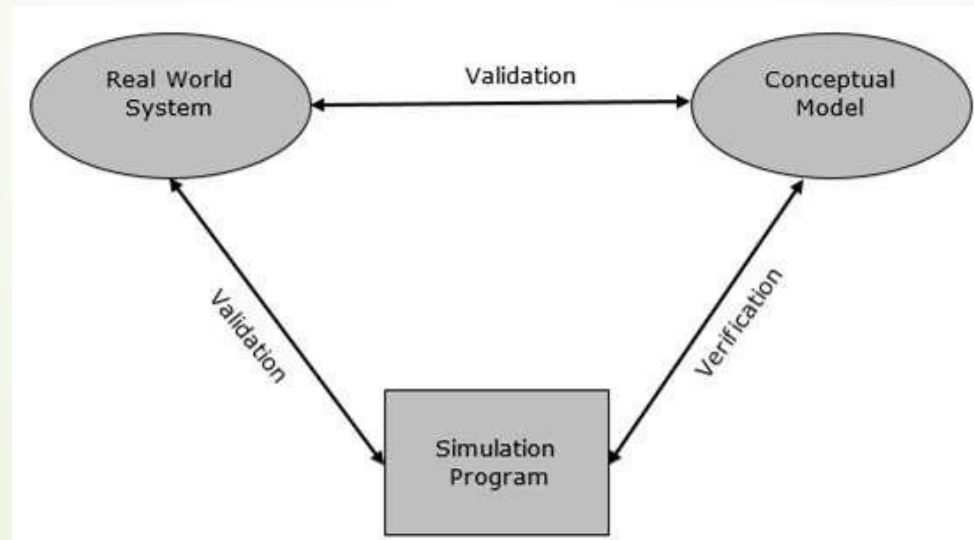
3

# Key Objectives of today's lecture

➔ Verification & Validation

# Overview

- One of the real problems that the simulation analyst faces is to validate the model.
- The simulation model is valid only if the model is an accurate representation of the actual system, else it is invalid.



# Verification & Validation

- Validation and verification are the two steps in any simulation project to validate a model.
  - **Validation** (is asking right question)
    - Validation is the process of comparing two results.
    - In this process, we need to compare the representation of a conceptual model to the real system
    - If the comparison is true, then it is valid, else invalid.
  - **Verification** (is answer to the question is right)
    - Verification is the process of comparing two or more results to ensure its accuracy
    - In this process, we have to compare the model's implementation and its associated data with the developer's conceptual description and specifications.

# Techniques to Perform Verification of Simulation Model

- Following are the ways to perform verification of simulation model – By using programming skills to write and debug the program in sub-programs
  - By using “Structured Walk-through” policy in which more than one person is to read the program.
  - By tracing the intermediate results and comparing them with observed outcomes.
  - By checking the simulation model output using various input combinations.
  - By comparing final simulation result with analytic results.

# Techniques to Perform Validation of Simulation Model

- Step 1 – Design a model with high validity. This can be achieved using the following steps
  - The model must be discussed with the system experts while designing.
  - The model must interact with the client throughout the process.
  - The output must be supervised by system experts.



# Techniques to Perform Validation of Simulation Model

- Step 2 – Test the model at assumptions data.
  - This can be achieved by applying the assumption data into the model and testing it quantitatively.
  - Sensitivity analysis can also be performed to observe the effect of change in the result when significant changes are made in the input data.



# Techniques to Perform Validation of Simulation Model

- Step 3 – Determine the representative output of the Simulation model. This can be achieved using the following steps
  - Determine how close is the simulation output with the real system output.
  - Statistical method can be used for compare the model output with the real system output.

# Model Data Comparison with Real Data

- After model development, we have to perform comparison of its output data with real system data.
- Following are the two approaches to perform this comparison.
  - Validating the Existing System
  - Validating the First Time Model

# Validating the Existing System

- In this approach, we use real-world inputs of the model to compare its output with that of the real-world inputs of the real system.
- This process of validation is straightforward, however, it may present some difficulties when carried out, such as if the output is to be compared to average length, waiting time, idle time, etc. it can be compared using statistical test.

# Validating the First Time Model

- Consider we have to describe a proposed system which doesn't exist at the present nor has existed in the past.
- Therefore, there is no historical data available to compare its performance with.
- Hence, we have to use a hypothetical system based on assumptions.
- Following useful pointers will help in making it efficient.
  - **Subsystem Validity**
  - **Internal Validity**
  - **Sensitivity Analysis**
  - **Face Validity**

# Subsystem Validity

- ▶ A model itself may not have any existing system to compare it with, but it may consist of a known subsystem
- ▶ Each of that validity can be tested separately.
- ▶ E.g., Validating the first electric vehicle

# Internal Validity

- This validity refers to the assurance that the treatment causes the outcome, rather than an uncontrolled external factor, i.e., avoid the indication of a false relationship between treatment and outcome when there is none
- E.g., Testing the car brakes in rainy day

# Sensitivity Analysis

- A sensitivity analysis determines how different values of an independent variable affect a particular dependent variable under a given set of assumptions.
- E.g., Testing the speed of passenger aircraft, when departed to by crowded city or by some remote area



# Face Validity

- **Face validity** is established by experts who evaluate a simulation and decide if it tests or outcomes are same as what it was designed to test or outcomes



**THANK YOU !**