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Workshop Agenda: Hands-on Session

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Hands-on workshop agenda

Goal: To introduce some of the material developed for academic institutions by PSE

- The material has been designed to:
  - Familiarise undergraduate students with the fundamental principles of mathematical modelling
  - Equip students with the knowledge to use these tools for process design, control, operations and optimisation
- Format:
  - Slides and exercises available for review
  - Bring a laptop if you want to run the exercises (USB sticks with software and examples will be provided)

Hands-on workshop agenda

- ***Sample modules*** covered during the workshop:
  - *Mathematical modelling of lumped models*
    - Introduction to the importance of modelling and simulation
    - Basics of developing customised models
    - Implementation of simple examples and hands-on assignments
  - *Custom modelling of distributed systems*
    - Fundamental concepts of developing complex distributed models
    - Introduction to numerical solutions
    - Includes interesting examples and home assignments
  - *Introduction to flowsheeting*
    - Creating your own flowsheets and simulating these processes
    - Scheduling operating procedures

Some ideas of material covered

What are mathematical models used for?

- Models help us develop a better scientific understanding of the behavior of a system

How do models

Safety: Models to accurately mea
of control rods, pressure, temp
several points inside a nuclear
operating conditions

Economy: Financial models fo
homeowners rely on to decide w

Let us analyse a simple example…

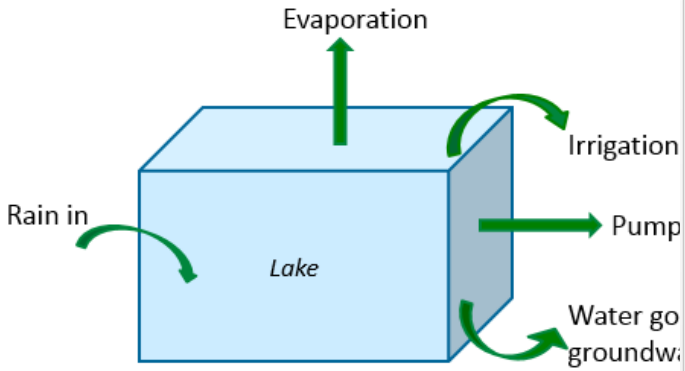
- Suppose we have a large lake surrounded by houses
- Rain causes the level of the lake to

eakage" to the

Real-life system:

Step 2 – Draw the system and its boundaries

For this model, can you define your system a
what crosses its boundaries?



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Step 5 – write down the equations

- The basis of (most) models are the balance equations
- Balance equations are "keeping track" of conserved properties
- We almost always start with the mass balance
- We track what we call the hold-up, the amount held inside the system
- The general form of a balance is:

Change in hold-up over time = in – out + generation – destruction

Change in hold-up over time is typically called accumulation

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Some ideas of material covered

Model analysis – Degrees Of Freedom (DOF)

- A Degree of freedom analysis helps us find out if we have *"enough"* or too much information to solve a particular problem

DOF = No. of unknown variables – No. of equations – No. of assigned variables

- In order to solve a system of equations require the degree of freedom to be zero
- This tells us the minimum amount of inf independent variable values) required to de state of a system

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Numerical software available for modeling

- Analytical software: Mathcad, Maple, Maxima, …
- Spreadsheets: Excel, Lotus
- Matrix Algebra tools: Matlab, Scilab, Octave
- Flowsheeting tools: Aspen, HYSYS, PRO/II, ChemCad, Unisim, gPROMS ProcessBuilder
- Equation-Oriented tools: ACM, Modelica, gPROMS ProcessBuilder, gPROMS ModelBuilder, …
- General software languages: Fortran, C++, Java, Python, …

MATLAB Mathcad aspentech Excel C++ gPROCESS ModelBuilder Java Scilab

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Thank you