

## Mathematical Vs. Physical Models

- ❑ **Mathematical Model:** is the one in which symbols and logic constitute the model. The symbolism used can be a language or a mathematical notation.
  - A simulation model is built in terms of logic and mathematical equations and is an abstract model.
- ❑ **Physical Model:** Physical model is a smaller or larger physical copy of an object. The object being modeled may be small (for example, an atom) or large (for example, the Solar System).
  - A model of an airplane (scaled down), a model of the atom (scaled up), a map, a globe, a model car are examples of physical (iconic) models.

## Static Vs. Dynamic (Abstract /Physical/Computer) Models

- ❑ **Static Model:** is the one which describes relationships that do not change with respect to time.
  - An architectural model of a house is a **static physical model**.
  - An equation relating the lengths and weights on each side of a playground variation is a **static mathematical model**.
  - Static computer model which means fixed.
- ❑ **Dynamic Model:** is the one which describes time-varying relationships.
  - A wind tunnel is a **dynamic physical model**.
  - The equations of motion of the planets around the sun constitute a **dynamic mathematical model** of the solar system.
  - Dynamic computer usually means capable of action and/or change.

## Analytical Vs. Numerical Mathematical Models

- ❑ **Analytical Model:** is the one which is solved by using the deductive reasoning of mathematical theory.
  - A Linear Programming model, a Mixed Integer Linear Programming model, a nonlinear optimization model are examples of analytical models.
- ❑ **Numerical Model:** is the one which is solved by applying computational procedures.
  - Finding the roots of a nonlinear algebraic equation,  $f(x) = 0$ , using the numerical model.

## Linear Vs. Nonlinear Mathematical Models

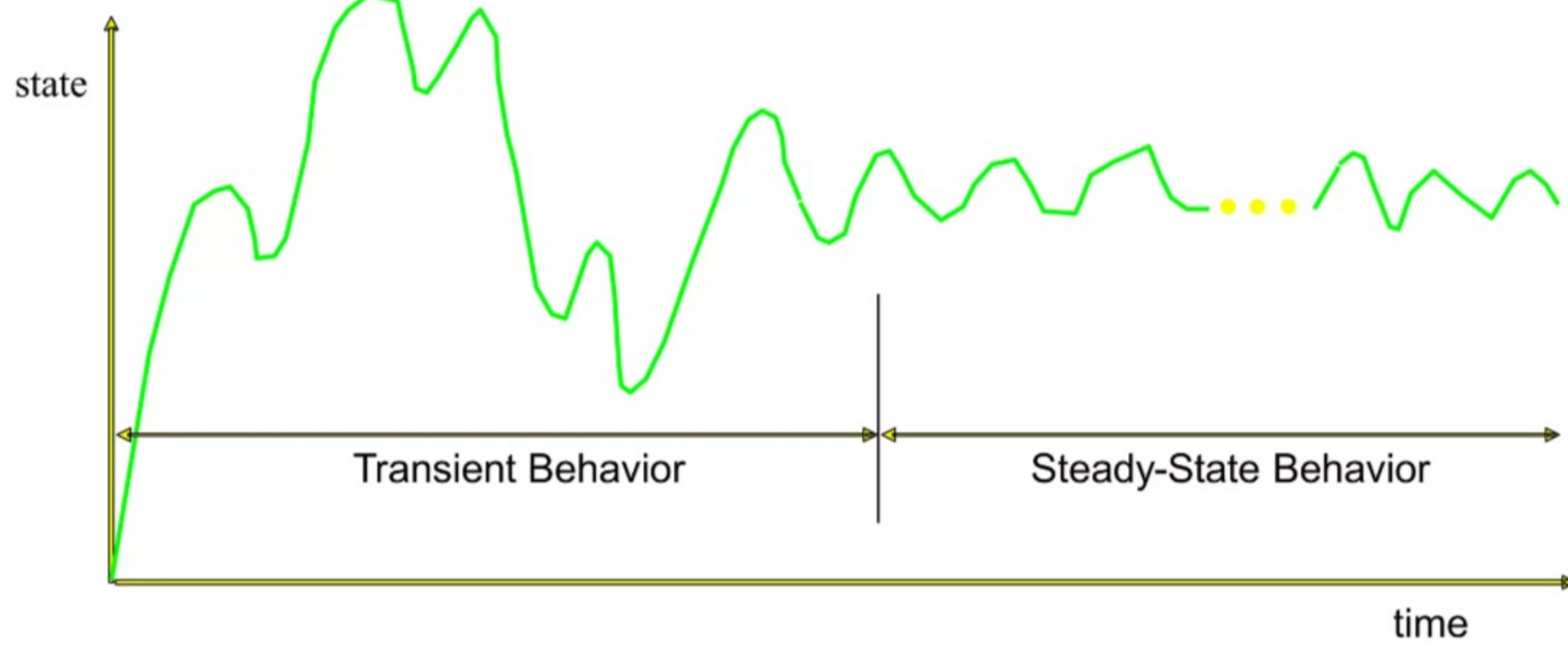
- ❑ **Linear Model:** is the one which describes relationships in linear form.
  - The equation  $3x + 4z + 1=0$  is a linear model.
- ❑ **Nonlinear Model:** is the one which describes relationships in nonlinear form.
  - The equation  $2x^2 + y^3 - 2=0$  is a nonlinear model.

## Stable Or Unstable Mathematical Models

- ❑ **Stable Model:** is the one which tends to return to its initial condition after being disturbed.
  - Like a simple pendulum.
- ❑ **Unstable Model:** is the one which may or may not come back to its initial condition after being disturbed.

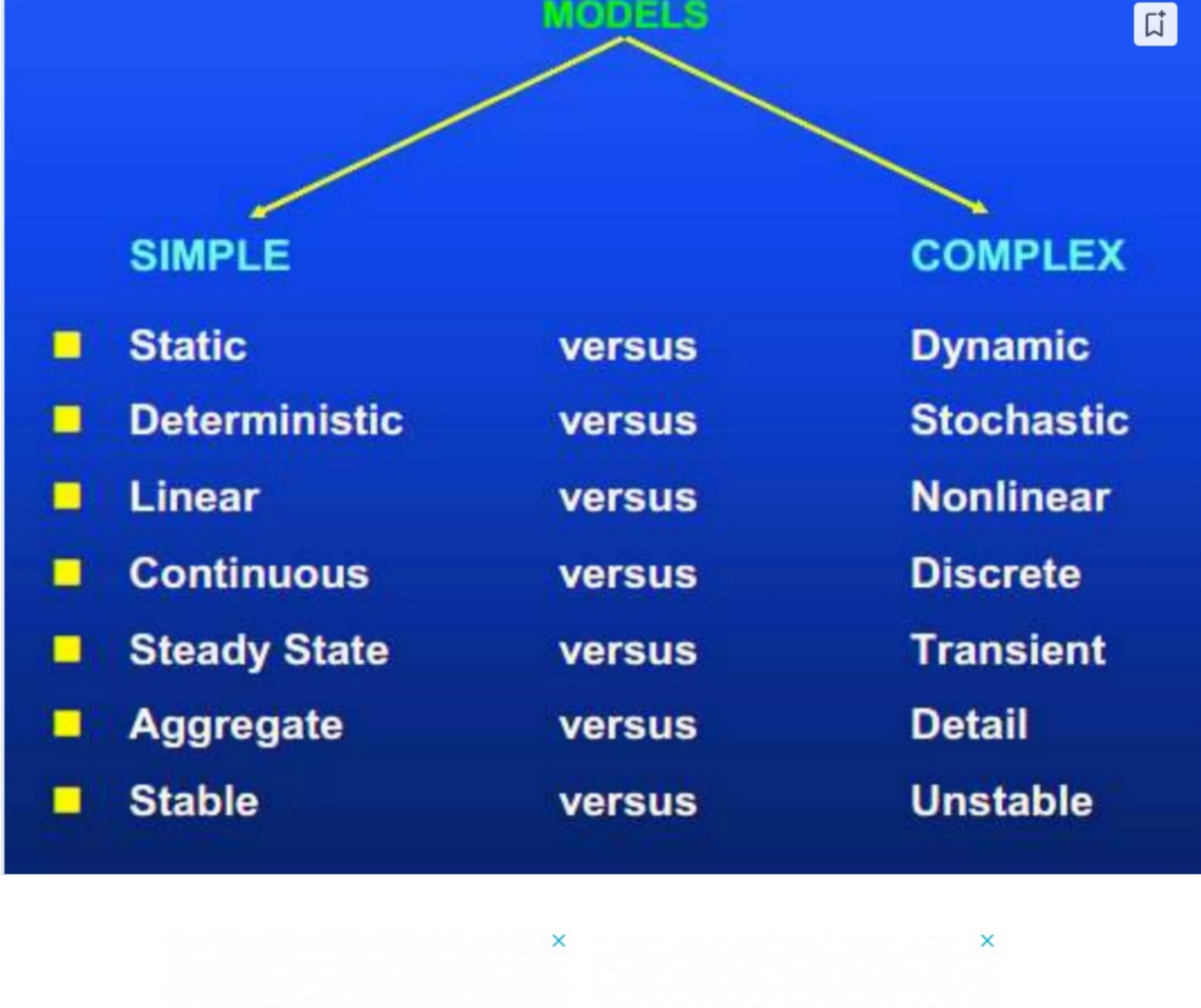
## Steady-state Or Transient Mathematical Models

- ❑ **Steady-State Model:** is the one whose behavior in one time period is of the same nature as any other period.
- ❑ **Transient Model:** is the one whose behavior changes with respect to time.



## Descriptive Vs. Prescriptive (Normative) Models

- ❑ **Descriptive Model:** a system that represent a relationship but does not indicate any course of action.
  - ❑ The equation  $F \text{ (force)} = M \text{ (mass)} \times A \text{ (acceleration)}$  is a descriptive model.
  - ❑ All simulation models are descriptive models.
- ❑ **Prescriptive or Normative Model:** a system in that it prescribes the course of action that the decision maker should take to achieve a defined objective.
  - ❑ Decision analysis models are prescriptive.



## Distributed-lag Model

- If the regression model includes not only the current but also the lagged (past) values of the explanatory variables (the X's) it is called a **distributed-lag model**.
- If the model includes one or more lagged values of the dependent variable among its explanatory variables, it is called an **autoregressive model**. This model is know as a **dynamic model**.