

Managerial economics

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Modeling in Managerial Economics

1. Types of models in Managerial Economics
2. Graphical models in Managerial Economics
3. Mathematical and economic models in Managerial Economics

Modeling in management helps to:

- take into account main factors influencing problem
- take into account previous experience in the area of problem
- to get a right decision by using modern mathematical methods
- provide a visibility of the problem
- Etc.

Types of models in Managerial Economics

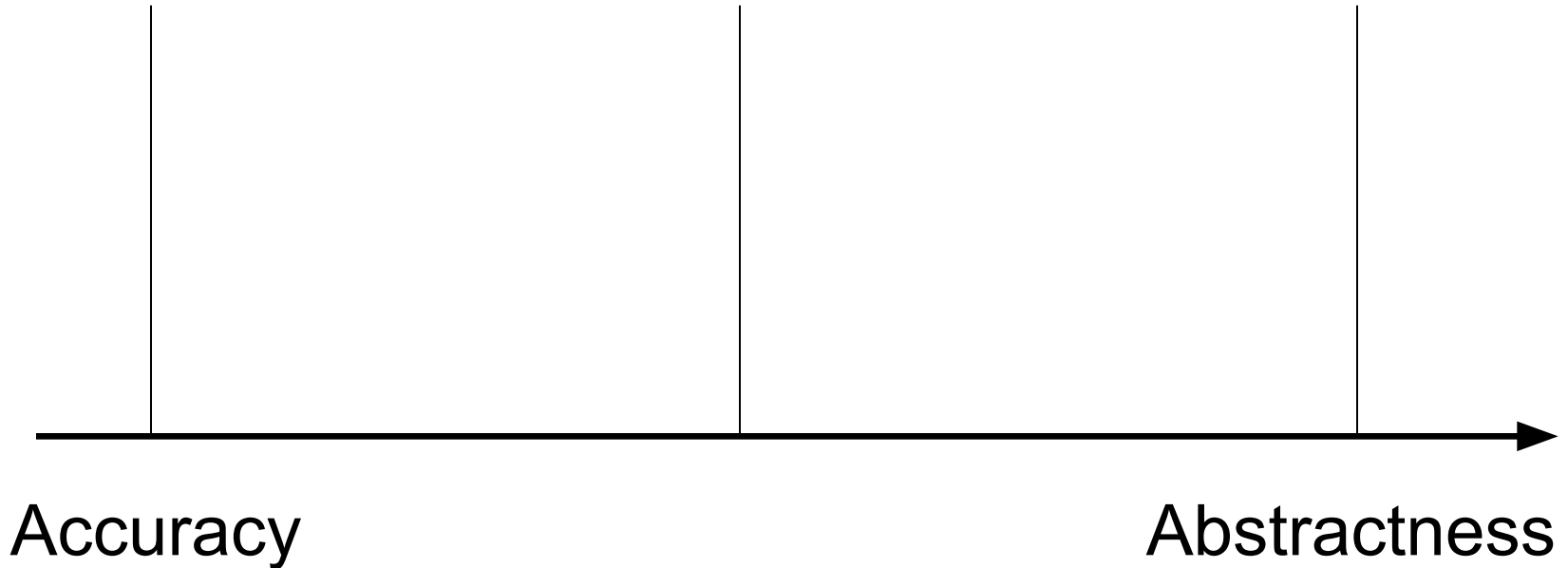
Model is a simplified imagination of a modeling object, which adequately reflects its properties, most significant in terms of modeling

Types of models in Managerial Economics

Physical

Analog

Mathematical



Types of models in Managerial Economics

Physical - a model that is a physical object which is a reduced or enlarged copy of the original, such as model airplane;

Types of models in Managerial Economics

Analog - a model with the original properties, but that differs significantly from it in appearance, such as a map, chart organizational structure, a graph between certain values, the scheme of the algorithm to perform a function.

An important type of analog is a game model that allow to understand the possible way of development of real events and to train staff to operate effectively and interact in similar situations by organizing games, such as military exercises, management games

Types of models in Managerial Economics

Mathematical - a model that uses mathematical symbols and methods to describe the characteristics of the object, such as the formula for calculating revenue from sales through the sales revenue and cost of sales.

Graphical models in Managerial Economics

The most frequently used **graphical models** in Managerial Economics are:

- Graphs and diagrams;
- Gantt graph;
- Block chart;
- Process diagrams;
- PERT chart

Graphical models in Managerial Economics

Graphs and diagrams are used to illustrate:

- Relation between economic indicators;
- Tendencies in development of economic objects, phenomena;
- Probability distribution;
- Structure of an object
- Etc

Graphical models in Managerial Economics

Gantt graphs are used to illustrate a project schedule to plan and control its performance.

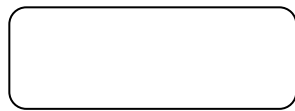
Elements of a chart create **work breakdown structure** (WBS) that is a deliverable oriented decomposition of a project into smaller components

WBS should contain **all elements** of a project, but each element should be **exclusive**

Graphical models in Managerial Economics

Block chart illustrates the algorithm of any activity.

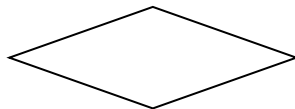
Meaning of symbols used:



point of beginning or end of the operation;



step or action of a process;



decision point;



entrance or exit;



document

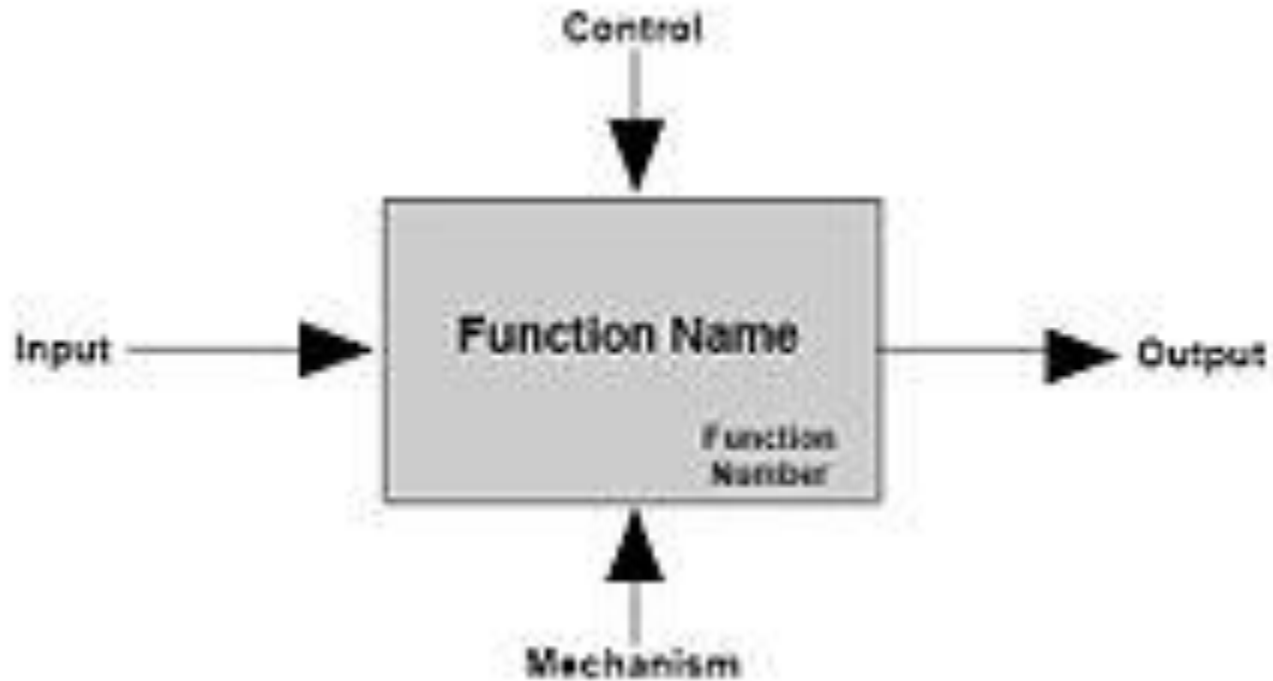
Graphical models in Managerial Economics

Process diagram shows a structure of a process as a sequence of activities and flows of materials (information) between them.

Process diagrams can be built according to several standards:

- IDEF0
- IDEF3
- ARIS
- BPMN
- UML and so on

Graphical models in Managerial Economics



IDEF0 box format

Graphical models in Managerial Economics

The **Program (or Project) Evaluation and Review Technique (PERT)** is a statistical tool, that is designed to analyze and represent the tasks involved in completing a given project.

Graphical models in Managerial Economics

To create a project model it is necessary to use:

- A list of all activities required to complete the project (WBS),
- Events that are milestones between activities
- The time (duration) that each activity will take to completion,
- The dependencies between the activities

Graphical models in Managerial Economics

Main PERT terms

- ***PERT event***: a point that marks the start or completion of one or more activities. It consumes no time and uses no resources. When it marks the completion of one or more tasks, it is not “reached” (does not occur) until *all* of the activities leading to that event have been completed.
- ***predecessor event***: an event that immediately precedes some other event without any other events intervening. An event can have multiple predecessor events and can be the predecessor of multiple events.
- ***successor event***: an event that immediately follows some other event without any other intervening events. An event can have multiple successor events and can be the successor of multiple events.

Main PERT terms

- ***PERT activity***: the actual performance of a task which consumes time and requires resources (such as labor, materials, space, machinery). It can be understood as representing the time, effort, and resources required to move from one event to another.

A PERT activity cannot be performed until the predecessor event has occurred.

Main PERT terms

- ***optimistic time*** (O): the minimum possible time required to accomplish a task, assuming everything proceeds better than is normally expected
- ***pessimistic time*** (P): the maximum possible time required to accomplish a task, assuming everything goes wrong (but excluding major catastrophes).

Main PERT terms

- ***most likely time*** (M): the best estimate of the time required to accomplish a task, assuming everything proceeds as normal.
- ***expected time*** (TE): the best estimate of the time required to accomplish a task, accounting for the fact that things don't always proceed as normal (the implication being that the expected time is the average time the task would require if the task were repeated on a number of occasions over an extended period of time).

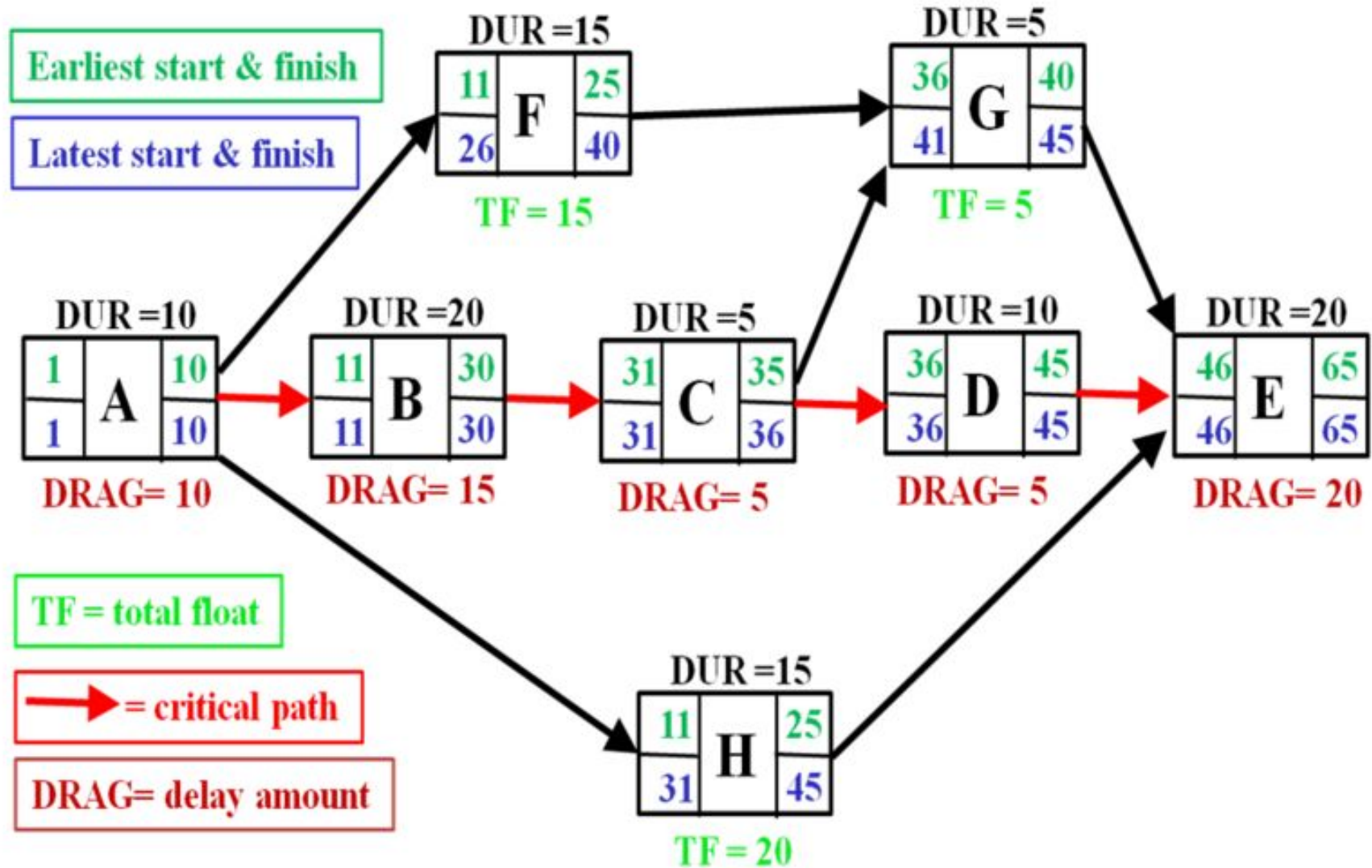
$$TE = (O + 4M + P) \div 6$$

Graphical models in Managerial Economics

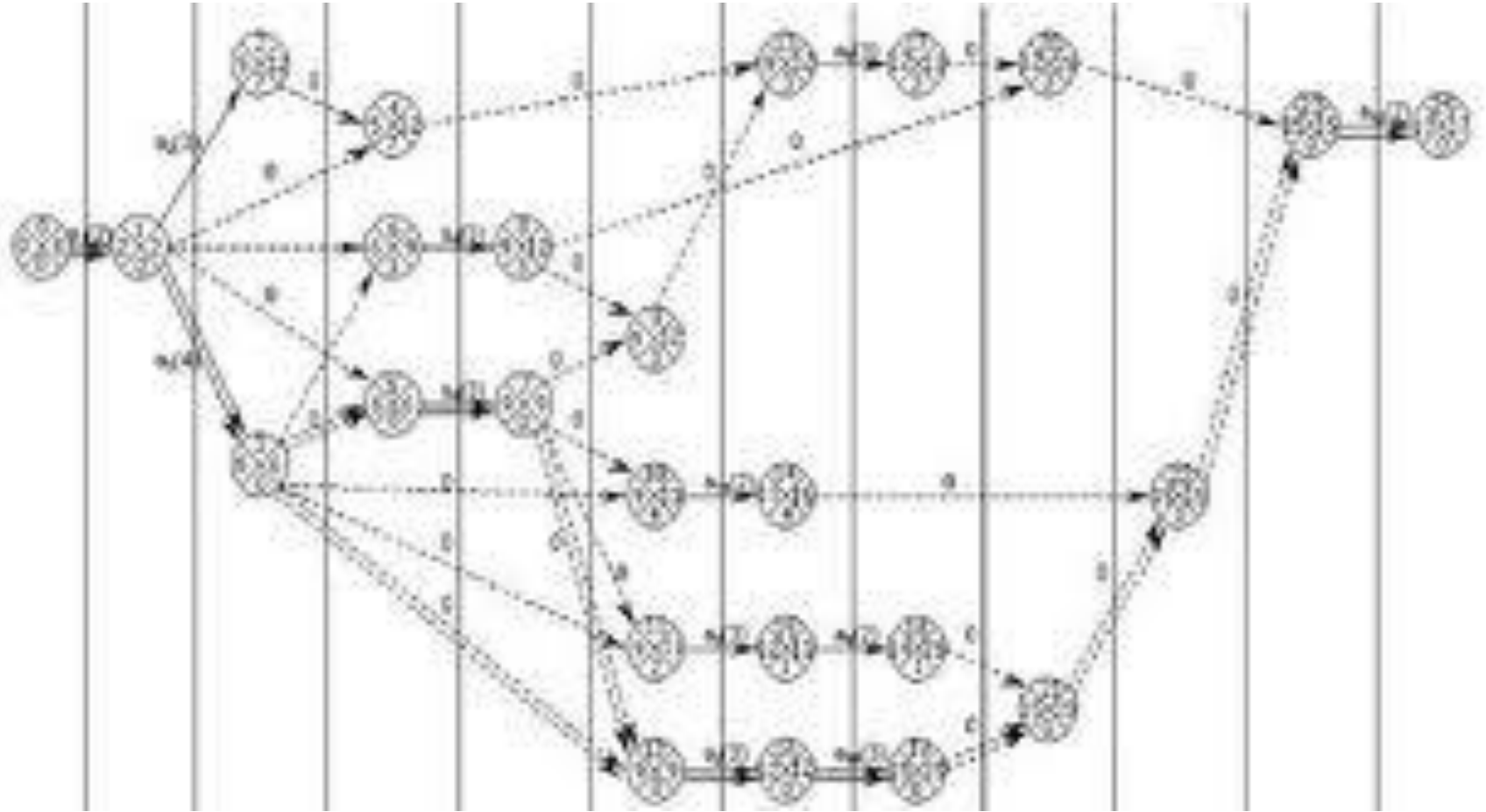
Main PERT terms

- **Float (slack)** is a measure of the excess time and resources available to complete a task. It is the amount of time that a project task can be delayed without causing a delay in any subsequent tasks (*free float*) or the whole project (*total float*). Positive slack would indicate *ahead of schedule*; negative slack would indicate *behind schedule*; and zero slack would indicate *on schedule*.
- **Critical path**: the longest possible continuous pathway taken from the initial event to the terminal event. It determines the total calendar time required for the project; and, therefore, any time delays along the critical path will delay the reaching of the terminal event by at least the same amount.
- **Critical activity**: An activity that has total float equal to zero. An activity with zero float is not necessarily on the critical path since its path may not be the longest.

Graphical models in Managerial Economics



Graphical models in Managerial Economics



Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Linear algebra and mathematical analysis	Creating and solving of algebraic equations	<ul style="list-style-type: none">- Break-even point calculating;- the optimal level of compensation calculating;- demand elasticity calculating;- financial and investment decision-making

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Linear programming	the optimal set of objects (resources, products, etc.) determining to get an extremal (maximum or minimum) value of the target	- optimal output by types of enterprise products determination using limited resources and taking into account the requirement for profit maximization; - minimizing the cost of transportation specified number of goods from producer to consumer (retail outlets)

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Matrix methods	Operations with two-dimensional data arrays	<ul style="list-style-type: none">- Input-output model;- model of international trade;- weight (desirable) alternatives calculation according to the method of hierarchies analysis

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Graphs and networks	Graphical simulation of the route, stream processes, scenarios	<ul style="list-style-type: none">- Choosing the best routes for retail outlets by manufacturer;- planning the process of developing new products;- modeling the decision in a conditions of a risk (decision tree)

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Correlation and Regression analysis	Set a relation and dependency between two or more variables	<ul style="list-style-type: none">- Demand forecasting;- Norms setting

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Multivariate analysis	Statistical analysis of the objects described by several characteristics	<ul style="list-style-type: none">- objects classification;- market segmentation;- latent factors that determine the size of profits identification;- competitiveness assessment

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Stochastic (probability) models (incl. queuing theory)	Likelihood of occurrence of certain events, the distribution law of a random variable, expected values at risk determining	- Quality control; - determine the level of stability of business processes

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Game theory	Defining a behavior strategies of sides in a conflict situation	<ul style="list-style-type: none">- Determination of price (advertising) policy on oligopolistic markets;- Planning specific measures under uncertainty

Mathematical and economic models in Managerial Economics

Method (model)	Scope	Examples
Expert methods	Using the individual judgments of experts to assess the significance of individual indicators, identify relationships in a particular system, etc.	- macroeconomic forecasting; determine the significance of individual components of the problem; results of legislative changes forecasting