

# Project Management

Management 560: Management Science

Tuesday, April 7, 2009

## 1

### 1.1 Goals

#### Goals of this class meeting

- Learn how to manage projects that involve many different steps.
- Learn when to assign various activities necessary for completing the project.
- Learn how to compute a project's expected completion time.

## 2 Deterministic Models

### 2.1 What is Project Management

#### Project Management

- Typically, a project involves a number of activities.
  - Some activities can be completed concurrently.
  - Some activities are prerequisites for other steps.
  - Different activities have different completion times.
- Project management: science of figuring out when various activities should be assigned in order to minimize project completion time.
- Methodology - extension of network modeling.

#### Example: Building a House

1. Designing the house.
2. Lay foundation – requires (1).
3. Order and receive materials – requires (1).

4. Build house – requires (2) and (3).
5. Paint – requires (4).
6. Carpet floors – requires (4).
7. Move in – requires (5) and (6).

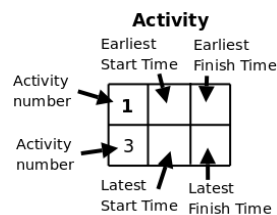
## 2.2 Methodology

### Methodologies

- **Critical Path Method (CPM):** project management solution technique.
  - Assumes deterministic activity times.
  - Traditionally uses activity-on-node (AON) representation.
  - **Critical Path:** the sequence of activities that *must start on time*.
- **Project Evaluation and Review Technique (PERT):** another project management solution technique.
  - Assumes activity times may be probabilistic.
  - Historically used activity-on-arrow (AOA) representation – we don't do that anymore.

### Network Nodes

- Each activity is a node.
- Each activity takes a deterministic amount of time.
- **Earliest start (ES):** the earliest time all prerequisite activities are completed.
- **Earliest finish (EF):** the earliest time a project can be finished.
- **Latest start (LS):** the latest a task can be started, and still finish the project on time.
- **Latest finish (LF):** the latest a task can be finished, and still finish the project on time.



## 2.3 Example

See Figure 1.

# 3 Probabilistic Model

## 3.1 Overview

### Project Evaluation and Review Technique

- PERT deals with probabilistic finishing times.
- Techniques involve finding:
  - Expected finishing time.
  - Confidence intervals for finishing time.
  - Finding expected critical paths (beyond scope of book).
  - Finding probabilities for alternative critical paths (beyond scope of book).

## 3.2 Probabilistic Finishing Times

### Probabilistic Finishing Times

- Exact finishing times are unknown.
- Past data has been collected, and there are estimates of the finishing times and standard deviations.
- House example duration estimates:
  1. Design House:  $\bar{x}_1 = 3$ ,  $\sigma_1 = 0.8$ .
  2. Lay Foundation:  $\bar{x}_2 = 2$ ,  $\sigma_2 = 0.5$ .
  3. Order/receive materials:  $\bar{x}_3 = 1$ ,  $\sigma_3 = 0.25$ .
  4. Build house:  $\bar{x}_4 = 3$ ,  $\sigma_4 = 1.0$ .
  5. Paint:  $\bar{x}_5 = 2$ ,  $\sigma_5 = 0.7$ .
  6. Carpet:  $\bar{x}_6 = 1$ ,  $\sigma_6 = 0.1$ .
  7. Move in:  $\bar{x}_7 = 1$ ,  $\sigma_7 = 0.05$ .

### Expected Finishing Time

- The actual times will likely be different from estimates.
- Big-time simplifying assumption: suppose the optimal critical path remains the same after actual realizations of finishing times.

Figure 1: Example: Finding Critical Path for Building a House

