Basics of Manufacturing Process Analyses

$$CT_q = \left(\frac{U}{1-U} \right) \cdot E[S] \cdot \left(\frac{U^{\sqrt{2C+2}-2}}{C} \right)$$

HYUNSOO LEE

Simulation & Control

- Simulation

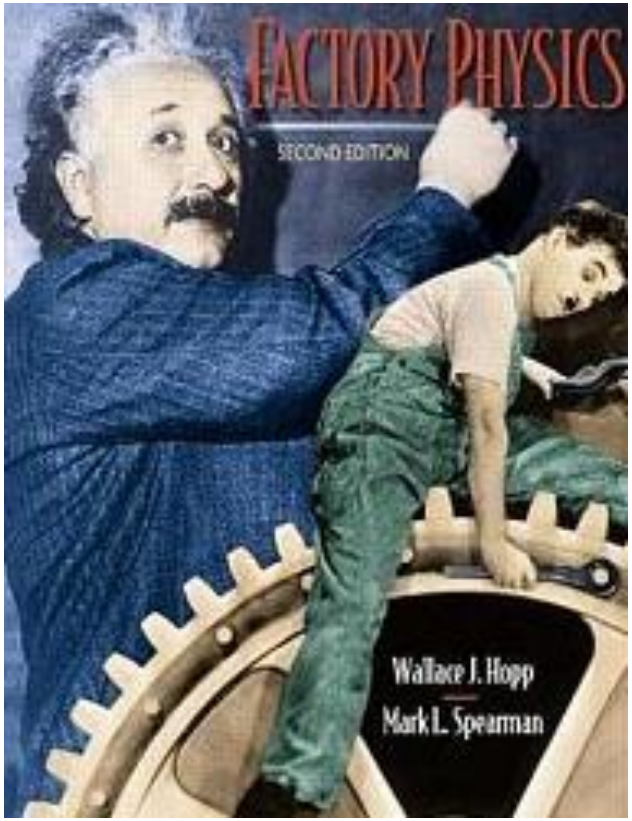
$$Y = f(X)$$

- Control

$$Y = f(X)$$

Manufacturing Process Modeling

- Factory Physics



$$L = \lambda W$$

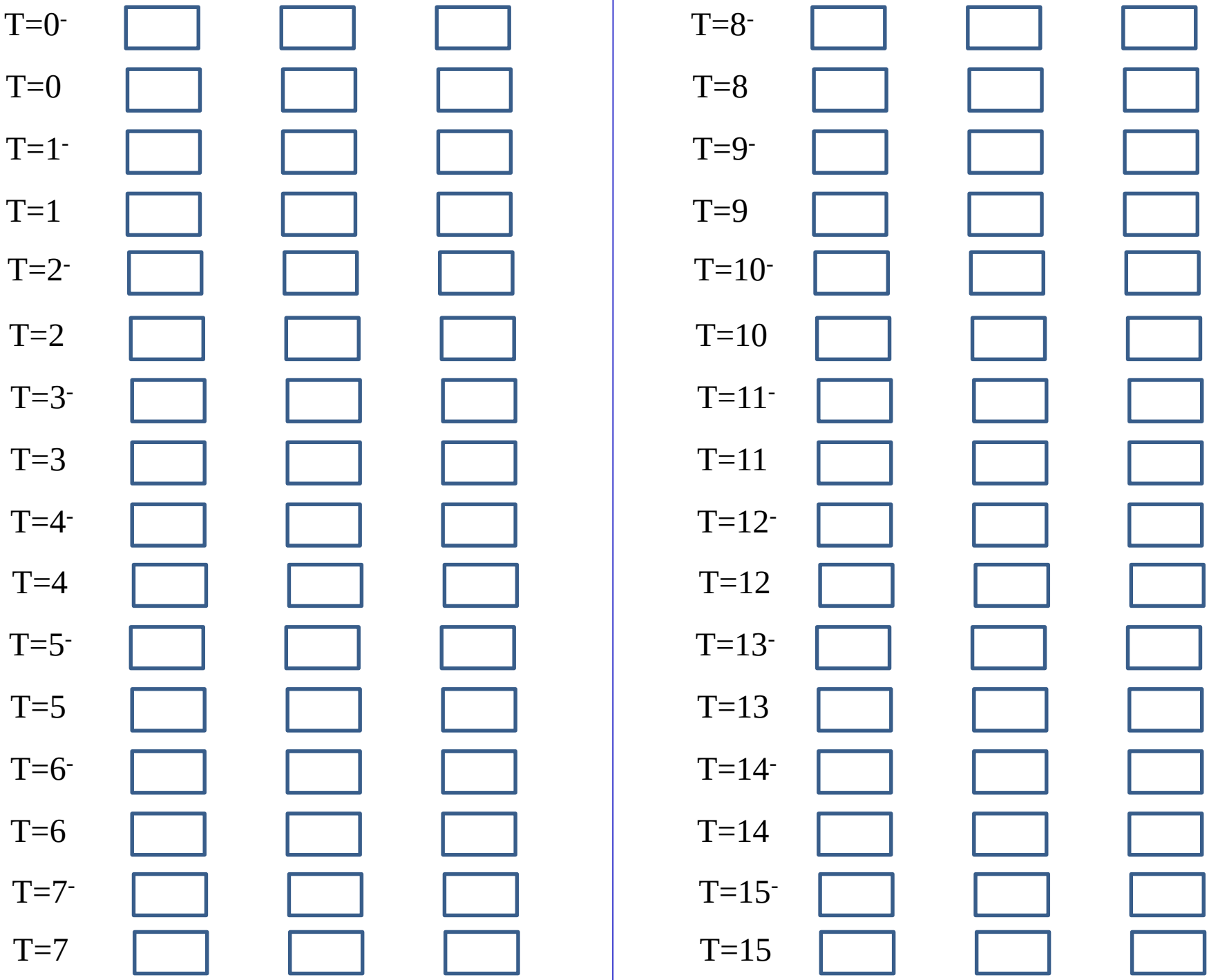
Process Analyses (I)

- AnyLogic, ExtendSim, flexSim, ……
- Output of D.E.S.
  - Cycle Time
  - WIP
  - Throughput

Process Analyses (II)

- Assumption
  - Three machines & serial processing
  - Machining time = {1, 2, 1}
  - Input strategy = when one output is leaving, one input enters

$T=0^-$


T=0-
T=0
T=1-
T=1
T=2-
T=2
T=3-
T=3
T=4-
T=4
T=5-
T=5
T=6-
T=6
T=7-
T=7
T=8-
T=8
T=9-
T=9
T=10-
T=10
T=11-
T=11
T=12-
T=12
T=13-
T=13
T=14-
T=14
T=15-
T=15

Process Analyses (III)

- Performances
  - # of machines = ?
  - Works in Process = ?
  - Throughput = ?
  - Cycle time = ?
  - Formula → ?

Exercise

- Assumption
  - Three machines & serial processing
  - Machining time = {1, 2, 1}
  - Input strategy = when one output is leaving, one input enters

$T=0^-$ 

1) Draw transition diagram
2) Compute cycle time
3) Compute WIP
4) Compute Throughput

Control of “Process model”

- Control model 1

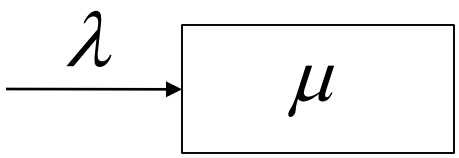
$$L = \lambda \cdot W$$

- Control model 2

$$W = f(\lambda,\ \mu_1, \sigma_1, \mu_2, \sigma_2, \cdots)$$

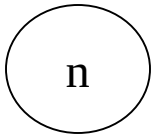
In one machine case (1)

- One machine case



In one machine case (2)

- Case of P_n



In one machine case (3)

- WIP, Cycle time and Throughput

In two machine case

- Case of $M/M/2/\infty$
  - Transition diagram
  - Balance equation

In non-identical machines

- Fast server (μ) , slow server (δ)

In break-down case

- Rate
  - Arrival rate : λ
  - Service rate : μ
  - Rate of break down : γ
  - Time to repair : υ

Again, M/M/1

- WIP in Queue : $E[W_q]$
- Cycle time in Queue : CT_q
- Cycle time in System : CT_S

In M/M/2 (1)

- Transition diagram & balanced equation

In M/M/2 (2)

- WIP in Queue : $E[W_q]$
- Cycle time in Queue : CT_q
- Cycle time in System : CT_S

In M/M/3

- Cycle time in System : CT_s