UGBA 141
Discussion 1

Agenda

- Process flow diagram
- Gantt chart
- Basic probability review

Jan 21, 2022
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Logistics

- Access to course reader
  - https://bcourses.berkeley.edu/courses/1510160/external_tools/79374
- Reminder: Required reading for Jan 24 (next Monday) lecture: Kristen's Cookie Company
- Discussion agenda uploaded to bcourses before discussion; annotated discussion material uploaded shortly after discussion
- For more questions, feel free to ask on Discord! Let me know if you don't have course Discord access yet

Recap on Processes

- Main components
  - Inputs
  - Resources
  - Outputs
- Key quantities
  - Flow unit
  - Inventory or Work-in-process (WIP)
  - Flow rate or throughput rate
  - Capacity

Examples of Processes

- Process is everywhere…
- Example 1: Airline

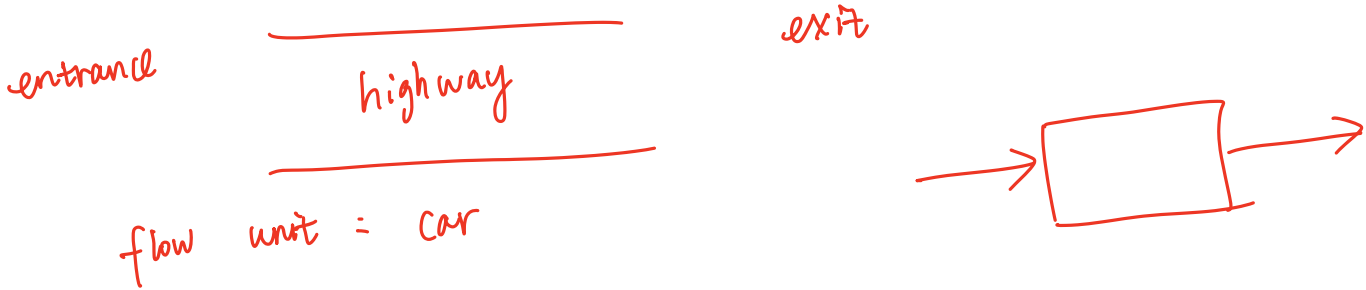
check-in

Input: passenger ← flow unit

Resource: staff / machine

Output passenger

- Example 2: Highway

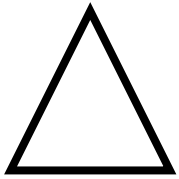


Draw a Process Flow Diagram

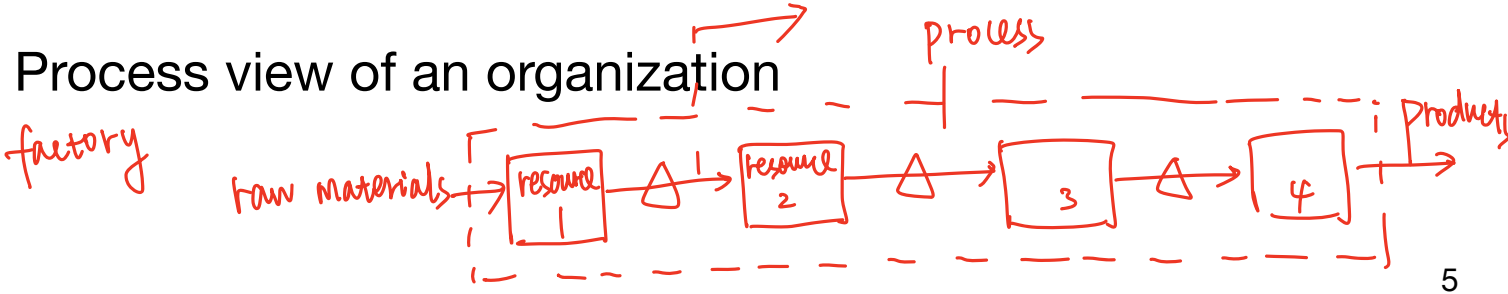
- Boxes
  - Process activities carried out by resources
  - Have a capacity

- Arrows
  - flow direction

- Triangles
  - Inventory/buffer
  - Does not have capacity

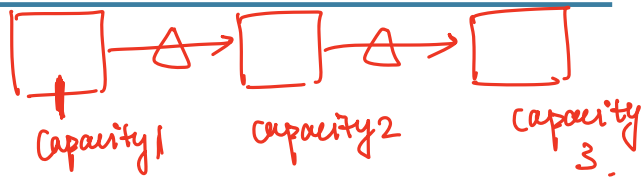


- Process view of an organization



Process Analysis

- Compute Process capacity
  1. Compute resource capacity
     - Maximum amount of flow units that the resource can produce in a given time unit
  2. Identify resource bottleneck
     - Resource with the smallest capacity



= # flow unit / time to process one unit

Process capacity = Minimum{Capacity of resource 1, …, Capacity of resource n }

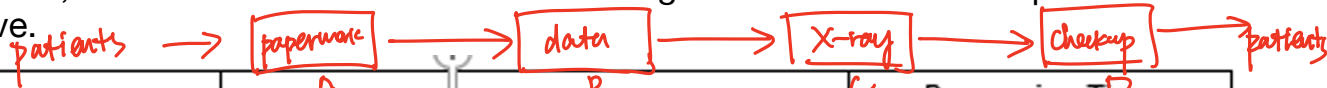
- Flow rate

Capacity constrained : input > capacity

Flow rate = Minimum{Available input, Demand, Process capacity}

Practice Problem: Glenn Dental

Dental Clinic provides general dental care to residents of Philadelphia on a walk-in basis. The clinic has started receiving complaints from patients that the waiting time is too long and has asked you to investigate whether this problem can be solved. Upon arrival, customers first receive a series of paperwork from the receptionist and fill out relevant information such as personal health records and insurance provider. The form is then handed back to a receptionist who enters the information into the computer system for the dentist to see. A dental assistant then takes an X-ray from the patient. A dentist then performs the check-up and discusses any issues with the patient. Based on conversations with staff members at the clinic, you have obtained the following information on the process: It takes about 2 minutes for a customer to check in at one self-service kiosk. Entry of information on the paperwork into the system and verification with past records takes another 5 minutes for a receptionist. There are two receptionists. It takes 15 minutes on average for the dental assistant to take an X-ray. There are three dental assistants on shift at any moment. There are ten dentists working at the clinic. Each check-up takes 30 minutes on average. Assume that there exists unlimited demand, unless otherwise stated. The following table summarizes the process data collected above.



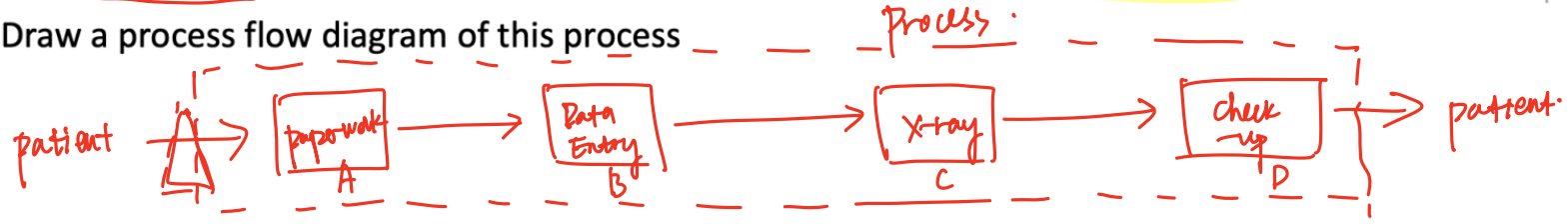
Resource	Process	Number of resources	Processing Time (Minutes per Patient)
A. Self-service Kiosk	Paperwork	1	2
B. Receptionists	Data Entry	2	5
C. Dental Assistant	X-ray	3	15
D. Dentist	Check-up	10	30

Practice Problem: Glenn Dental

Resource		Process	Number of resources	Processing Time (Minutes per Patient)
A.	Self-service Kiosk	Paperwork	1	2
B.	Receptionists	Data Entry	2	5
C.	Dental Assistant	X-ray	3	15
D.	Dentist	Check-up	10	30

capacity: 30, 24, 12, 20 (bottleneck)

Draw a process flow diagram of this process



What is the capacity (patients/hour) at the resource "Dentist"?

D. $\frac{1 \text{ patient}}{30 \text{ min}} \times 10 \times \frac{60 \text{ min}}{\text{hr}} = 20 \frac{\text{patient}}{\text{hr}}$

What is the bottleneck in the process?

A. $\frac{1}{2} \times 1 \times 60 = 30$

B. $\frac{1}{5} \times 2 \times 60 = 24$

C. $\frac{1}{15} \times 3 \times 60 = 12$

12 is smallest among 30, 24, 12, 20.

So bottleneck is X-ray

Gantt Chart: Preview of Kristen's Cookies Case

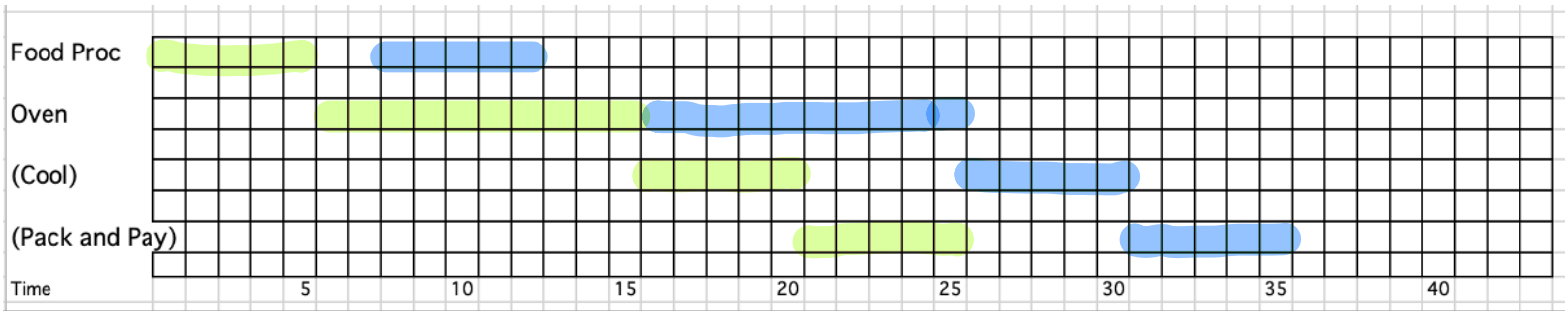
- Business: Suppose you want to launch Kristen's Cookie Company in your on-campus apartment to provide cookies to hungry students at night

- Production:
  - Food processing (mix ingredients; shape dough onto tray; put cookies into oven)
  - Oven (bake)
  - Cool
  - Pack and pay

- Question: what is the resource and duration of each process step?

Draw a Gantt chart

1. Organize process sequence: Food proc, Oven, Cool, Pack and Pay
2. Estimate duration: 5min 10 min 5 min 5 min.
3. Draw
   - Horizontal: time axis
   - Vertical: process sequence



Basic Probability Review

Standard deviation

std

- Random variable

X. $\Pr(X = a) = p_a$; e.g. Bernoulli random variable B

$B = 1$ with prob. p

$B = 0$ with prob $1-p$.

- Cumulative distribution function (CDF)

$F(x) = \Pr(X \le x)$; e.g. for Bernoulli B

$F(1) = 1$ $F(\frac{1}{2}) = 1-p$

$F(-1) = 0$

- Expectation

Discrete. $\mathbb{E}[X] = \sum_a a \cdot \Pr(X = a)$;

Continuous $\mathbb{E}[X] = \int_{-\infty}^{\infty} t f(t)\, dt$;

- Example

Normal distribution $\mathbb{E}[X] = \mu$

Exponential distribution (λ) $\mathbb{E}[X] = \frac{1}{\lambda}$