

# L0: Introduction

INSE6300 Quality Assurance in Supply Chain Management

Jia Yuan Yu

Concordia University

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# What is this course about?

- Supply: supply and demand
- Chain: interconnected system
- Management: decisions over time
- Quality assurance: Quality metric  $Q$ , decision  $a$ , given a threshold  $c$ , guarantee that  $Q(a) > c$ .

# Examples of supply chains

- Walmart
- McDonald's
- Concordia

# Management vs Design

- Design: decide and stick with your decision
- Management: sequence of decisions

## Design examples (6290)

- Choice of supplier
- Facility location
- How many employees to hire, how much to charge for each item, etc.



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<sup>1</sup>[http://canadianimmigrant.ca/wordpress/wp-content/uploads/lemonade\\_stand.jpg](http://canadianimmigrant.ca/wordpress/wp-content/uploads/lemonade_stand.jpg)

## Management examples (6300)

- Inventory management: how much and when to order
- Yield management: pricing plane tickets, concert tickets, other perishable items

## How does this course differ from 6290?

- Focus on data (from companies)
- Model data as statistical samples
- How much data is required to guarantee that  $Q(a) > c$ ?
- Given an amount  $n$  of data, what is the highest value  $c$  such that  $Q(a) > c$ ?

# Not really a chain

Actually a multi-chain!



<sup>2</sup><https://drawingbynumbers.org/sites/drawingbynumbers.org/files/Sourcemap.png>

# Why a (multi-)chain?

As far back as 1776, Adam Smith noticed something fundamental.



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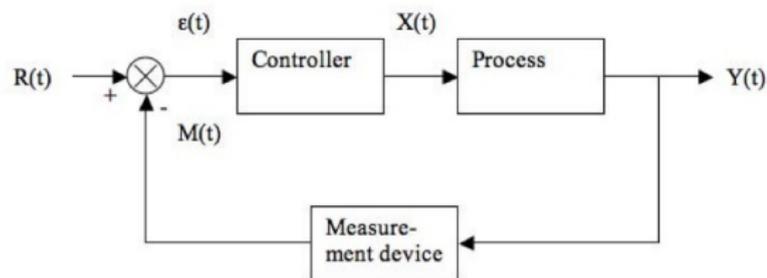
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<sup>3</sup><https://ozgurzan.files.wordpress.com/2011/01/adam-smith.jpg>

<sup>4</sup>[http://study.com/cimages/multimages/16/Divison\\_of\\_labor.jpg](http://study.com/cimages/multimages/16/Divison_of_labor.jpg)

## Approach in this course

- This is engineering (a precise science).
- A supply chain is a system.
- Cf. Block diagram in control theory:



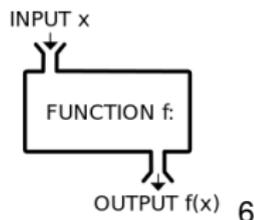
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<sup>5</sup><https://controls.engin.umich.edu/wiki/images/5/5b/BlockDiagram2.jpg>

## How do we model it?

- A system is made of interconnected components. (Each component is also a system.)
- Each component maps inputs (variables) to outputs (variables). It



is a function.

- The variables have time indices to model evolution over time.
- Examples of inputs: quantity of raw materials, decisions, demand, state variable, etc.
- Examples of outputs: quantity of finished products, revenue, etc.
- Example: inventory or queue management.

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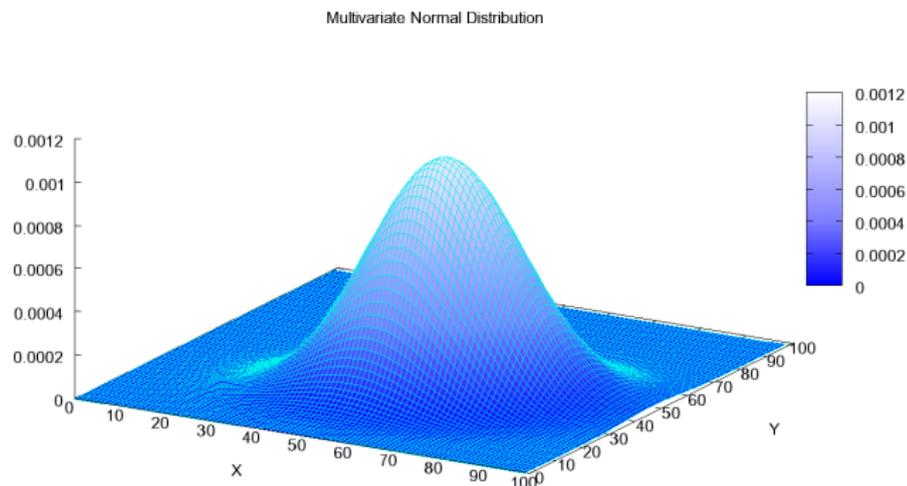
<sup>6</sup>[https://upload.wikimedia.org/wikipedia/commons/thumb/3/3b/Function\\_machine2.svg/220px-Function\\_machine2.svg.png](https://upload.wikimedia.org/wikipedia/commons/thumb/3/3b/Function_machine2.svg/220px-Function_machine2.svg.png)

## Which approach do we take in this course?

- Mathematical modeling, theory of decision-making
- Connections to industry, state-of-the-art

# How to make good decisions?

- Give performance guarantees on the decisions.
- E.g., among all possible decisions,  $x^*$  maximizes the profit



function  $f$ .

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# Where does supply chain theory come from?

Scientific approach to decision making:

- Fourier (1800s): formulated linear optimization problem.
- Kantorovich (1900s): encountered linear optimization problem for economic planning in USSR.
- WW2: transportation, scheduling, allocation of resources with constraints.
- George Dantzig (1947): solving linear optimization problems quickly for military activities.

## Where is it used today?

- Petroleum industry: scheduling refineries, routing tanker ships.
- Airlines: scheduling planes, crews, pricing tickets
- Transportation: routing
- Lumber: managing forests
- Government: policies, regulations
- Customer service: managing queues

# Supply chain decision are common sense

- Inventory management at home



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<sup>8</sup>http:

//www.forrent.com/blog/wp-content/uploads/2012/02/Fridge-1.jpg

# Supply chain decision are common sense

- Combined shipping



# Where is it used?

- Games



# Where is it used?

- Electricity networks



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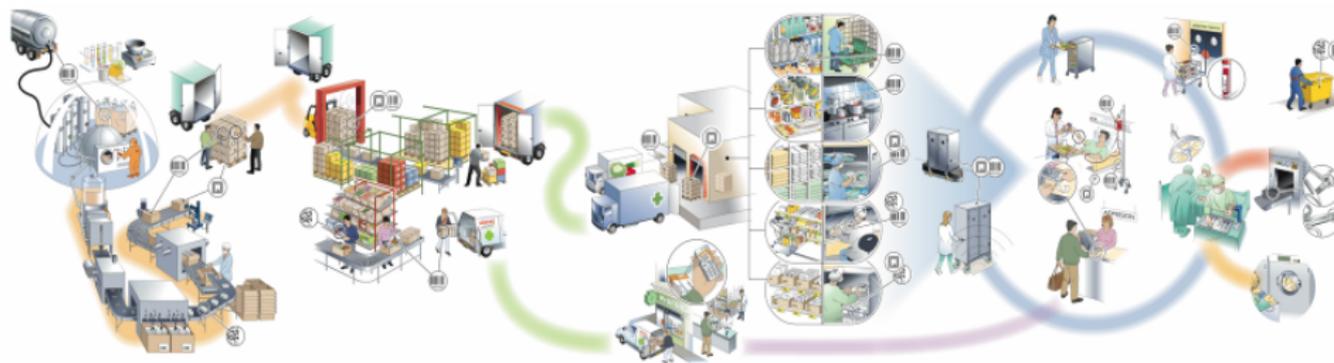
<sup>11</sup>[http:](http://kk.org/mt-files/thetechnium-mt/Electricity_Network.jpg)

[//kk.org/mt-files/thetechnium-mt/Electricity\\_Network.jpg](http://kk.org/mt-files/thetechnium-mt/Electricity_Network.jpg)

<sup>12</sup>[https://upload.wikimedia.org/wikipedia/commons/d/d7/Kuwait\\_Water\\_Towers.jpg](https://upload.wikimedia.org/wikipedia/commons/d/d7/Kuwait_Water_Towers.jpg)

# Where is it used?

- Hospitals



## Related topics

- Logistics
- Operations research
- Optimization
- Markov decision problems
- Control theory