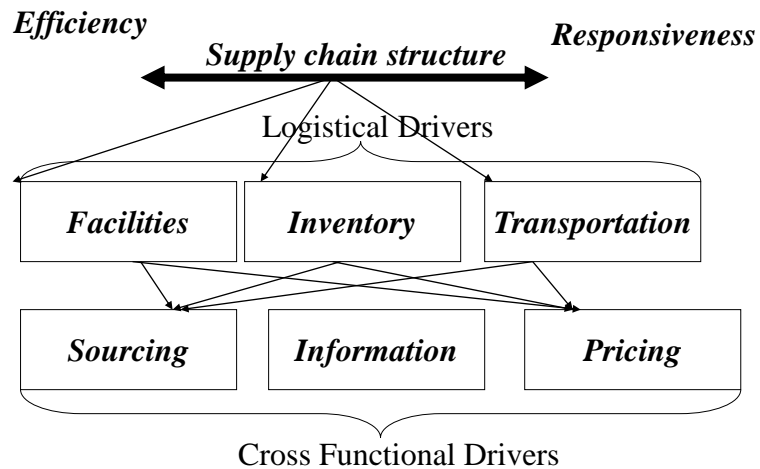


## Drivers of Supply Chain Performance



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## Selling Diamonds



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## Some Supply Chain Issues

- McMaster Carr/W.W. Grainger have succeeded with high cost supply chains. How is that possible?
- Where should Amazon locate its warehouses? How large? Which markets should they serve?
- How should diamonds be sold in the future?
- Electronics retailer are struggling. Why? What should BestBuy do?
- What would be a good supply chain structure for same day delivery?
- How should supply chains manage risk such as COVID-19?

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## What is Supply Chain Management?

Managing supply chain flows and assets, *to grow supply chain surplus in a financially sustainable manner.*

- What are the *supply chain flows*?
- What is *supply chain surplus*?
- What is *financially sustainable*?

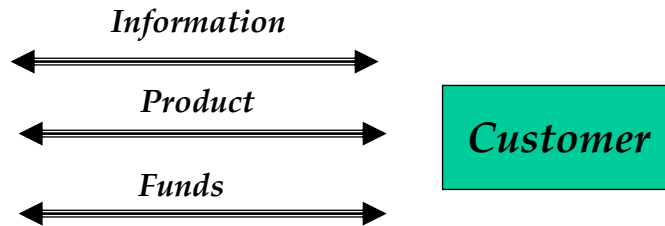
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## Flows in a Supply Chain



**SUPPLY CHAIN**

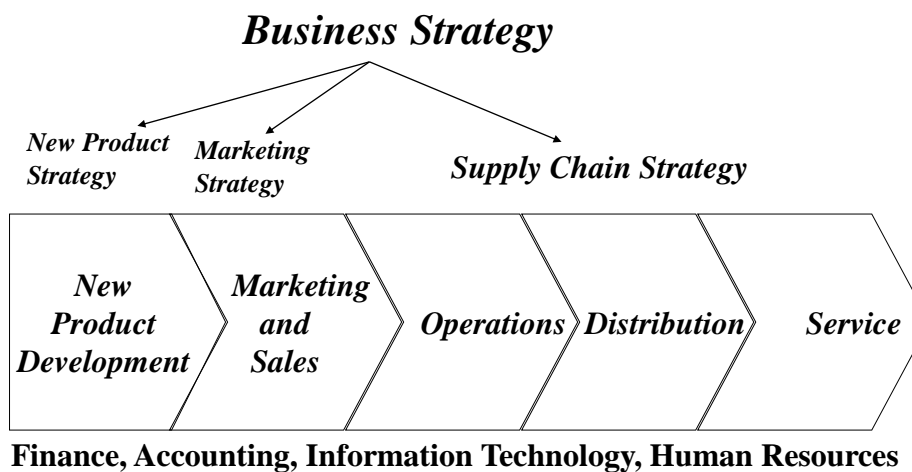
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## Maximizing Supply Chain Surplus: The Value Chain



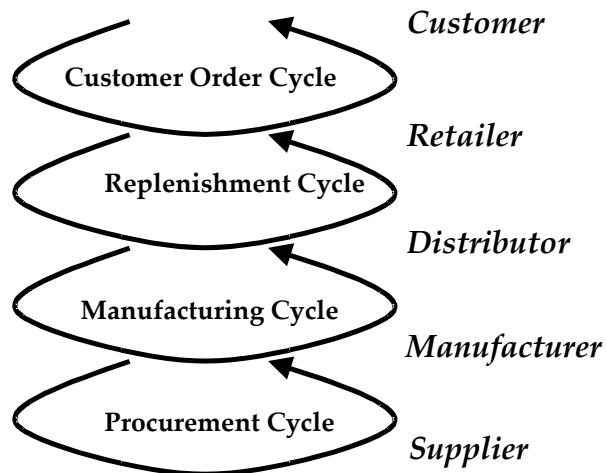
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## Cycle View of Supply Chains



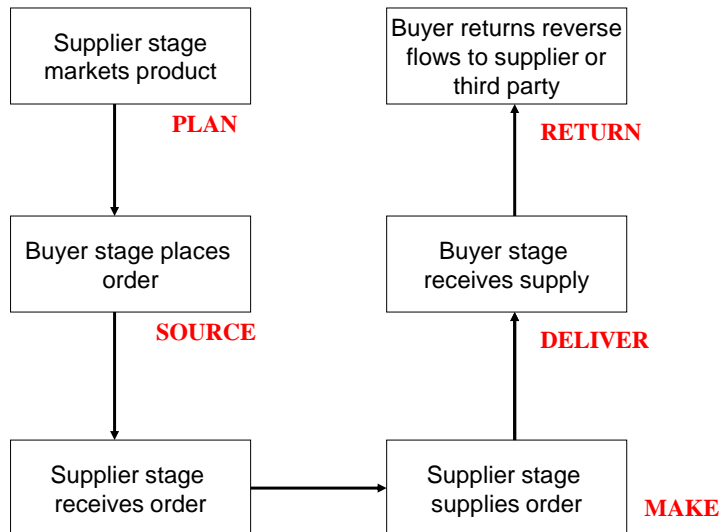
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## Sub-Processes in Each Cycle



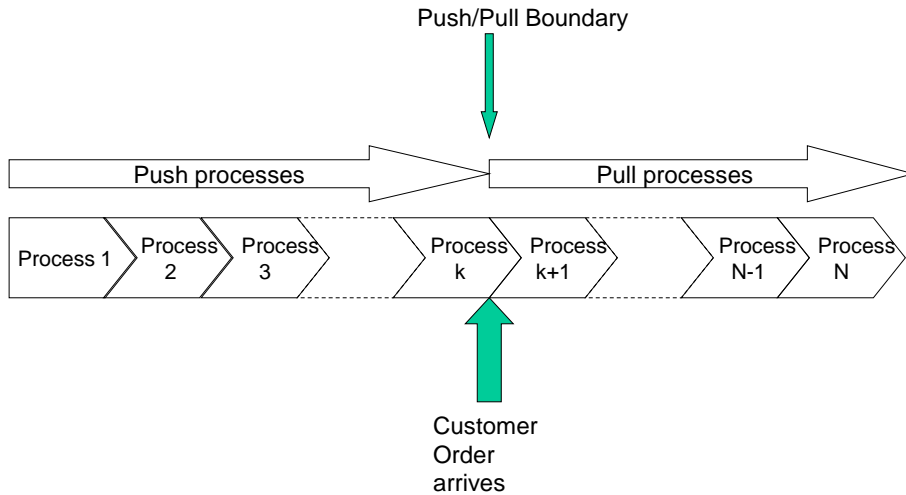
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## Push-Pull View of Supply Chains



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## Maximizing SC Surplus: Achieving Strategic Fit

### Understanding the Customer

- ❖ Lot size
- ❖ Response time
- ❖ Service level
- ❖ Product variety
- ❖ Price
- ❖ Innovation



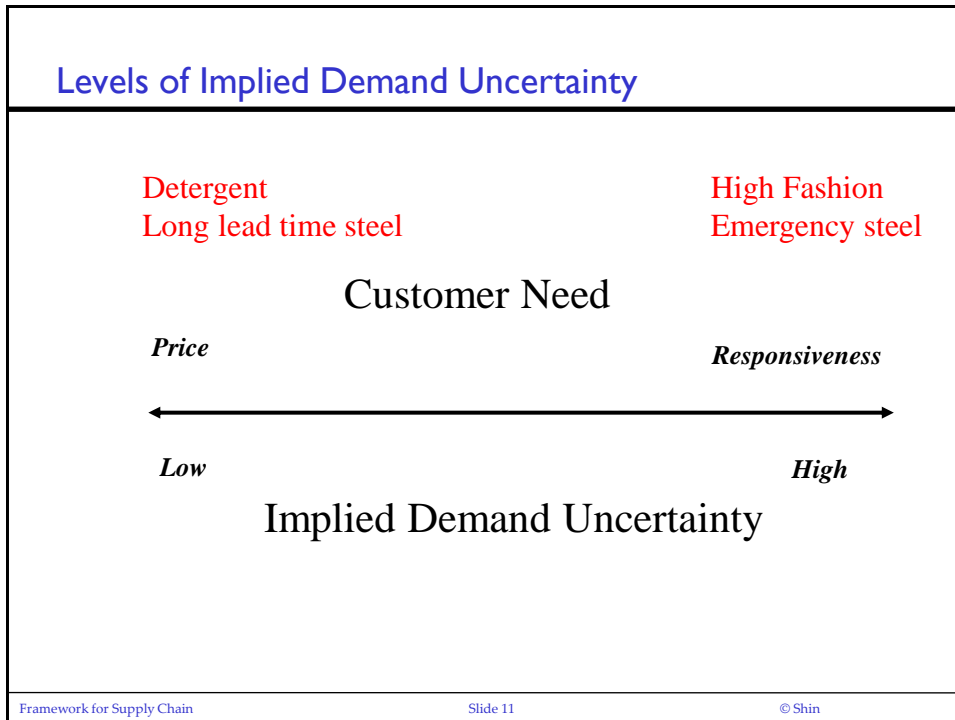
***Implied  
Demand  
Uncertainty***

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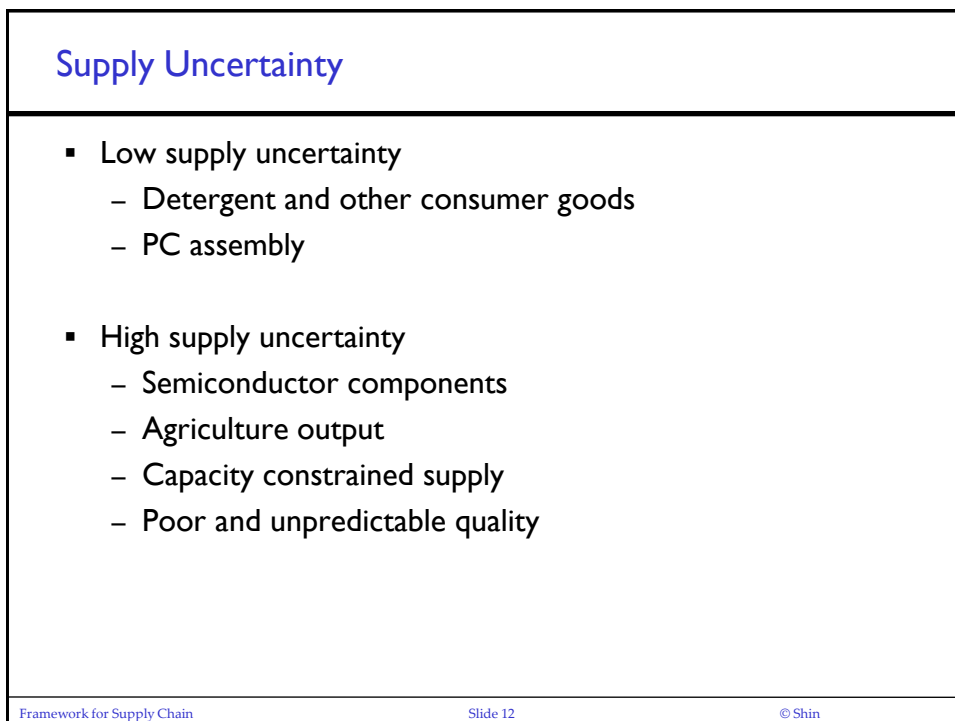
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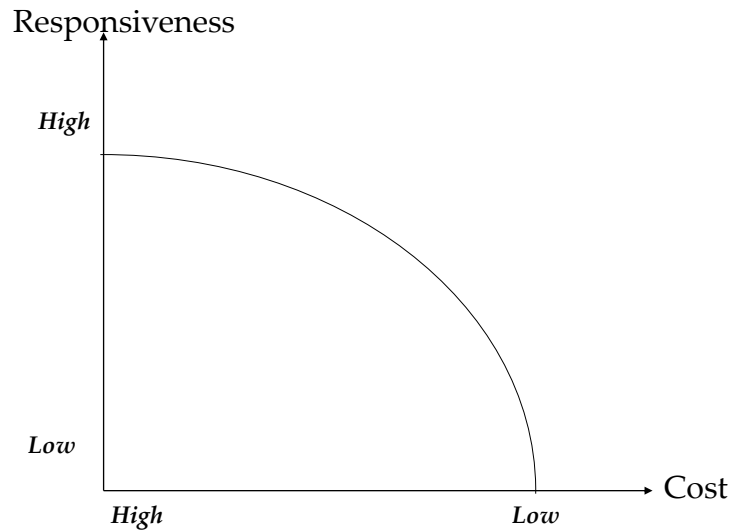


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## Understanding Supply Chain Capabilities



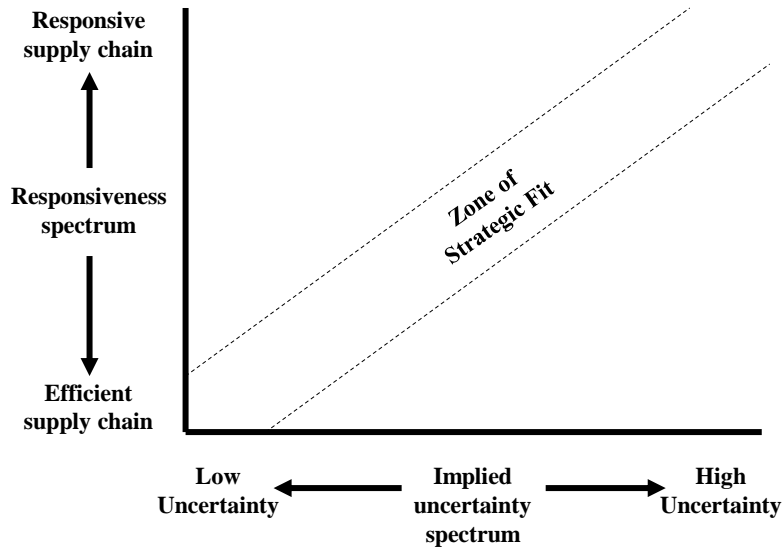
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## Achieving Strategic Fit



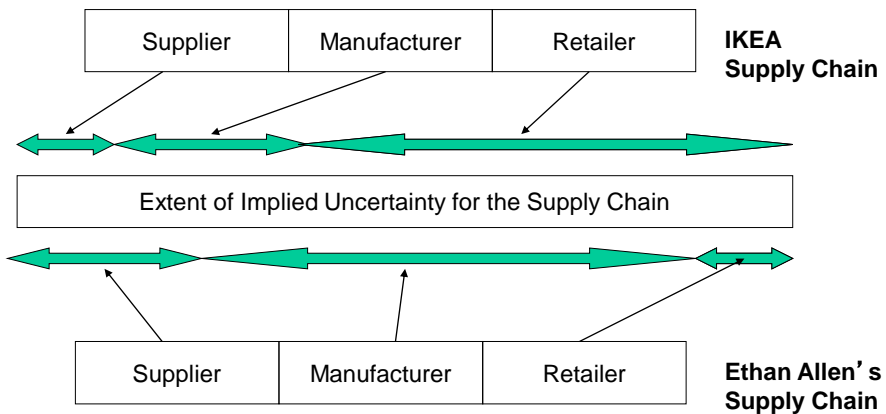
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## Allocating Uncertainty: Two Furniture SCs



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## Seven Eleven Japan



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## A Key Idea: Tailor your Supply Chain

- **Distinct business units, customer segments, product lines may have distinct requirements in terms of**
  - Inventory
  - Transportation
  - Facility
  - Information
  - Sourcing
  - Pricing

**Key:** How to design the supply chain to achieve capabilities tailored to a range of requirements while realizing possible efficiencies?

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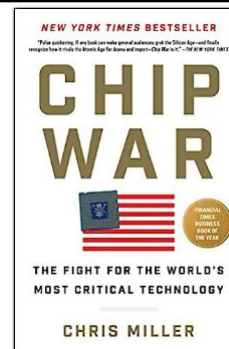
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## Book Publisher: HW#1

- You own a bookstore.
- A new book “Chip War” by Chris Miller is published at Oct. 4, 2023.
- **You purchase from the Publisher, Scribner, at \$14 a copy, and it will sell to the customers at the retail price of \$22 a copy.**
- You need to decide how many books to order.
- You have a demand forecast from the past demands of similar books. The demand/forecast data is given in Canvas.
- After talking with the publisher’s sales agent, you learned that it costs \$2 per book for the publisher to print one hard copy.
- Q1: How many books should you order?
- Q2: What can you do better?



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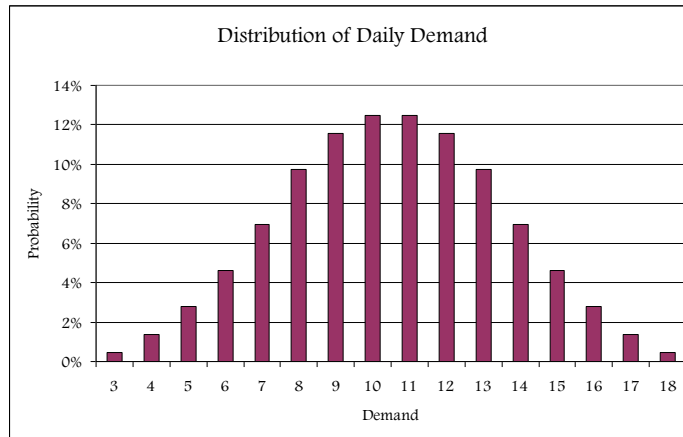
## Book Publisher: HW#1

- Q1: Consider that the publisher, Scribner, acquired your bookstore, BN, i.e., you manage the whole supply chain, both the Publisher and the bookstore. In this case, what is the cost of understocking, the cost of overstocking, and the target service level of the supply chain (Note that the supply chain here means the Publisher and the bookstore)? How many books the supply chain should print? In this case, what is the supply chain average profit based on the data?

## Book Publisher: HW#1

- Q2: Consider the original case that we studied in class, i.e., the bookstore is BN, and the Publisher is a separate entity. You, as a bookstore owner, decides how many books to order considering the wholesale price and the buy-back price. We considered the buy-back contract, in which the buy-back price was \$12 in class.
- Can you find the pair of the wholesale price (note that the status-quo wholesale price is \$14) and the buy-back price that will make both the bookstore and the publisher better off compared to the price pair of the wholesale price \$14 and the buy-back price \$12? As you change the wholesale price and the buy-back price, the order quantity of books will change.

## Summary data



Retail price = \$2.49   Cost = \$1.24   Leftover price = \$0.99

Mean demand = 10.5

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## Finding the right number of cupcakes

- What is the cost of under-stocking?
- What is the cost of overstocking?
- What is the optimal service level?
- What is the optimal quantity?

D	P(Dem = D)	P(Dem ≤ D)
3	0.5%	0.5%
4	1.4%	1.9%
5	2.8%	4.6%
6	4.6%	9.3%
7	6.9%	16.2%
8	9.7%	25.9%
9	11.6%	37.5%
10	12.5%	50.0%
11	12.5%	62.5%
12	11.6%	74.1%
13	9.7%	83.8%
14	6.9%	90.7%
15	4.6%	95.4%
16	2.8%	98.1%
17	1.4%	99.5%
18	0.5%	100%

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## Optimal expected profit (Q=13)

Demand	P(Demand)	Production Cost	Unit Sales	Full Price Revenue	Left-overs	Leftover Revenue	Profit
3	0.46%	\$ 16.12	3	\$ 7.47	10	\$ 9.90	\$ 1.25
4	1.39%	\$ 16.12	4	\$ 9.96	9	\$ 8.91	\$ 2.75
5	2.78%	\$ 16.12	5	\$ 12.45	8	\$ 7.92	\$ 4.25
6	4.63%	\$ 16.12	6	\$ 14.94	7	\$ 6.93	\$ 5.75
7	6.94%	\$ 16.12	7	\$ 17.43	6	\$ 5.94	\$ 7.25
8	9.72%	\$ 16.12	8	\$ 19.92	5	\$ 4.95	\$ 8.75
9	11.57%	\$ 16.12	9	\$ 22.41	4	\$ 3.96	\$ 10.25
10	12.50%	\$ 16.12	10	\$ 24.90	3	\$ 2.97	\$ 11.75
11	12.50%	\$ 16.12	11	\$ 27.39	2	\$ 1.98	\$ 13.25
12	11.57%	\$ 16.12	12	\$ 29.88	1	\$ 0.99	\$ 14.75
13	9.72%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
14	6.94%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
15	4.63%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
16	2.78%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
17	1.39%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
18	0.46%	\$ 16.12	13	\$ 32.37	0	\$ -	\$ 16.25
Expected Profit =							\$ 12.01

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## What happens if...

- Production costs rise to \$1.49?
- You no longer sell leftovers at 99¢ but give them to a food bank for free?
- You knew today's demand before deciding how much to produce?
- \$5/week for Oracle?

D	P(Dem = D)	P(Dem ≤ D)
3	0.5%	0.5%
4	1.4%	1.9%
5	2.8%	4.6%
6	4.6%	9.3%
7	6.9%	16.2%
8	9.7%	25.9%
9	11.6%	37.5%
10	12.5%	50.0%
11	12.5%	62.5%
12	11.6%	74.1%
13	9.7%	83.8%
14	6.9%	90.7%
15	4.6%	95.4%
16	2.8%	98.1%
17	1.4%	99.5%
18	0.5%	100%

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## Warner Archive Collection: DVDs on demand

- For Warner Archive Collection titles, Warner burns a DVD-R after a customer orders the movie.
  - Ships in a standard plastic case with cover art.
  - \$19.95 apiece.
- No extras except the trailer.
  - Not even scene-by-scene chaptering.
- Publishing an old movie on DVD in the traditional way costs \$75,000 to \$100,000.

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## Fast Delivery?



Made in the USA  
Las Vegas, NV  
06 March 2024

ORDER PLACED  
March 5, 2024

TOTAL  
\$0.00

SHIP TO  
hyo duk shin ▾

### Delivered March 8

Your package was delivered. It was handed directly to a resident.



El escape cubano (Spanish Edition)  
Return window closed on April 7, 2024

 Buy it again

View your item

[Archive order](#)

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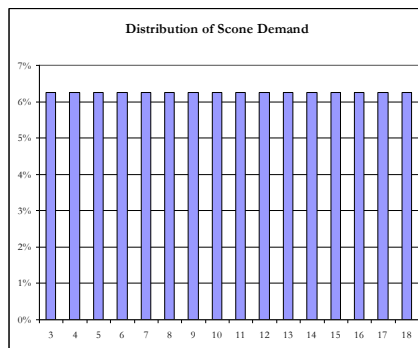
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## Scones!

- You also sell scones.
- The economics are the same as cupcakes.
  - Retail price: \$2.49
  - Cost: \$1.24
  - Sell leftovers at \$0.99
- Scones have the same average demand (10.5) but the overall distribution is different!

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## Scone demand



D	P(Dem = D)	P(Dem ≤ D)
3	6.3%	6.3%
4	6.3%	12.5%
5	6.3%	18.8%
6	6.3%	25.0%
7	6.3%	31.3%
8	6.3%	37.5%
9	6.3%	43.8%
10	6.3%	50.0%
11	6.3%	56.3%
12	6.3%	62.5%
13	6.3%	68.8%
14	6.3%	75.0%
15	6.3%	81.3%
16	6.3%	87.5%
17	6.3%	93.8%
18	6.3%	100.0%

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## Where else do you find newsvendors?

- Deciding on economic service level
- Benefits: Flexible Spending Account decision
- Capacity Management



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## Costs of not Matching Supply and Demand

- Cost of overstocking
    - liquidation, obsolescence, holding
  - Cost of under-stocking
    - lost sales and resulting lost margin
- What are the *causes* (challenges) driving this mismatch?

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## Demand Forecasting in a Supply Chain

1. Characteristics of forecasting for a supply chain
2. Components of a demand forecast
3. Forecast demand in a supply chain given historical demand data using time-series methodologies
4. Analyze demand forecasts to estimate forecast error

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## Characteristics of Forecasts

1. Forecasts are always **inaccurate** and should thus include both the expected value of the forecast and a measure of **forecast error**
2. **Long-term** forecasts are usually **less accurate** than short-term forecasts
3. **Aggregate** forecasts are usually **more accurate** than disaggregate forecasts
4. In general, **the farther up the supply chain** a company is, **the greater is the distortion** of information it receives

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## Three steps of “range” forecasting (incorporating uncertainty in core planning processes)

1. What is the range of potential future circumstances?
2. How is our operating and financial performance exposed across that range?
  - Too little supply: Lost sales and customer satisfaction
  - Too much supply: Excess capacity, inventory and other liabilities
3. How can we proactively plan and manage our business to deliver the best possible operating and financial performance?
  - “Supply side”: Assets, capacity, production...
  - “Demand side”: Sales, marketing, partners...

Source: Blake Johnson from Stanford University

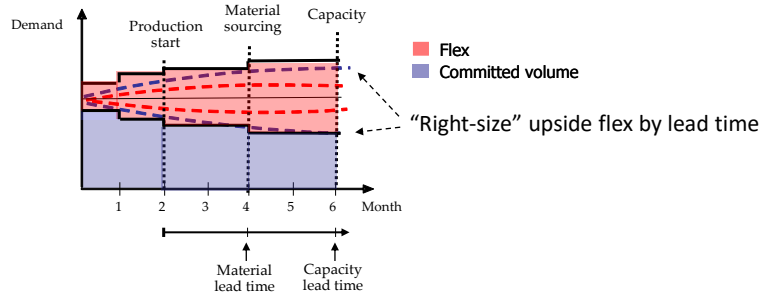
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## Range planning: Financial analogies



### Financial instrument analogy:

- Blue is futures contract (fixed quantity)
- Pink is options contract (flex quantity)

### Insurance analogy:

- Blue is "demand insurance" buyer provides to supplier
- Pink is "availability insurance" supplier provides to buyer

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Source: Blake Johnson from Stanford University

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## Components and Methods

1. Qualitative
  - Primarily subjective
  - Rely on judgment
2. Time Series
  - Use historical demand only
  - Best with stable demand
3. Causal
  - Relationship between demand and some other factor
4. Simulation
  - Imitate consumer choices that give rise to demand

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## Components of an Observation

**Observed demand ( $O$ ) = systematic component ( $S$ )  
+ random component ( $R$ )**

- Systematic component – expected value of demand
  - *Level* (current deseasonalized demand)
  - *Trend* (growth or decline in demand)
  - *Seasonality* (predictable seasonal fluctuation)
- *Random component* – part of forecast that deviates from systematic part
- *Forecast error* – difference between forecast and actual demand

## Moving Average

- ❑ Used when demand has **no observable trend or seasonality**

Systematic component of demand = level

- ❑ The level in period  $t$  is the average demand over the last  $N$  periods

$$L_t = (D_t + D_{t-1} + \dots + D_{t-N}) / N$$

$$F_{t+1} = L_t \quad \text{and} \quad F_{t+N} = L_t$$

- ❑ After observing the demand for period  $t + 1$ , revise the estimates

$$L_{t+1} = (D_{t+1} + D_t + \dots + D_{t-N+2}) / N, \quad F_{t+2} = L_{t+1}$$

## Moving Average Example

- A supermarket has experienced weekly demand of eggs of  $D_1 = 1974$ ,  $D_2 = 1919$ ,  $D_3 = 1731$ , and  $D_4 = 1668$  over the first four weeks
  - Forecast demand for Week 5 using a four-period moving average?
  - What is the forecast error if demand in Week 5 turns out to be 1895?

## Moving Average Example

$$L_4 = (D_4 + D_3 + D_2 + D_1)/4$$

- Forecast demand for Period 5

$$F_5 = L_4$$

- Error if demand in Period 5 = 1895

$$E_5 = D_5 - F_5$$

- Revised demand → becomes the forecast for week 6

$$L_5 = (D_5 + D_4 + D_3 + D_2)/4$$

### Moving Average Exercise I

- What is the forecast demand for week 301 using the moving average of past 4 weeks?
- [challenging] Suppose that the price of a carton of eggs is \$4, and the cost is \$0.8. You order the eggs once a week, and throw away all leftovers, i.e., salvage value of \$0. Then, right before week 301, without knowing the actual demand, how many cartons of eggs you will order?

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### Moving Average Exercise II

- Suppose that you don't do the moving average forecasting. Instead, you follow the approach we learned during the last session, i.e., looking at the histogram and decide the same order quantity every week. Use the dataset from week 301 to week 500. In this case, what is the order quantity?
- [Challenging] Compared to the above, what is the daily value of moving average forecasting system?

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