

MSIN0095: Operations Analytics

Class 1-4: Process Analysis

Class 5,7: Waiting Time Analysis

Class 6: Inventory Management – Newsvendor Model

Class 8: Inventory Management – Newsvendor, Periodic Review

Class 9: Inventory Management – EOQ

Class 10: Supply Chain Management I: Beer Game

Class 11: Inventory Management – Amazon Distribution Strategy

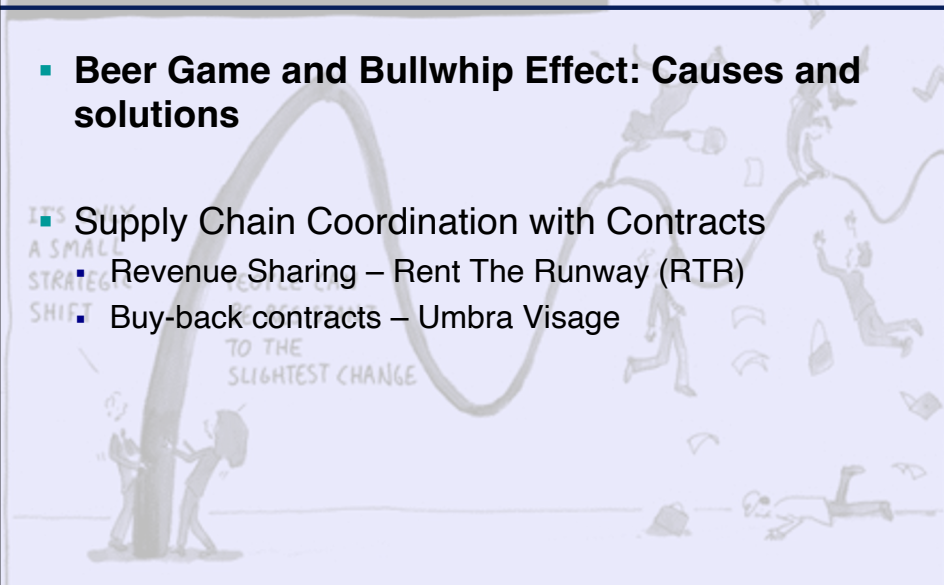
Class 12: Supply Chain Management II

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BRAND CAMP by Tom Fishburne

Learning Objectives

- **Beer Game and Bullwhip Effect: Causes and solutions**
- **Supply Chain Coordination with Contracts**
 - Revenue Sharing – Rent The Runway (RTR)
 - Buy-back contracts – Umbra Visage



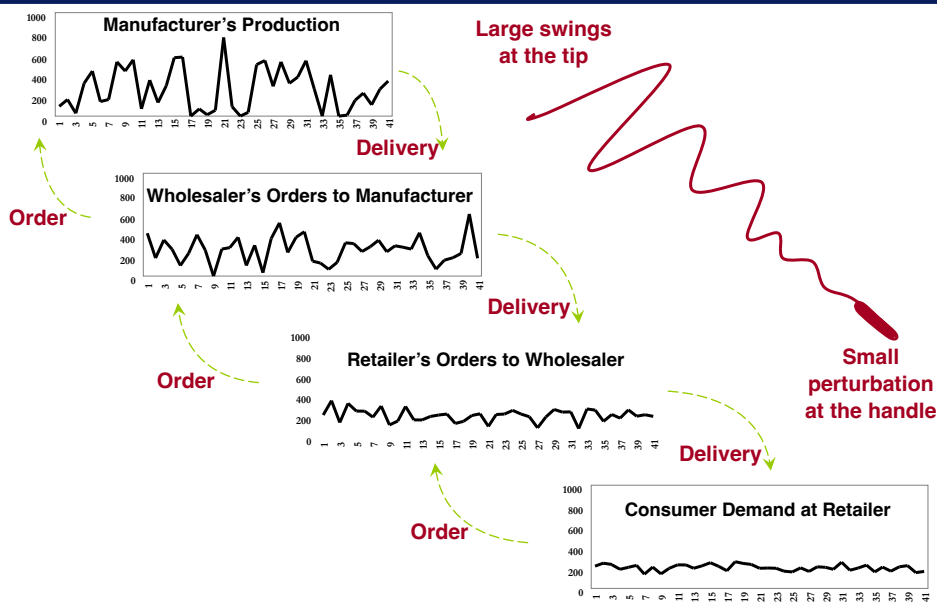
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Beer Game Discussion



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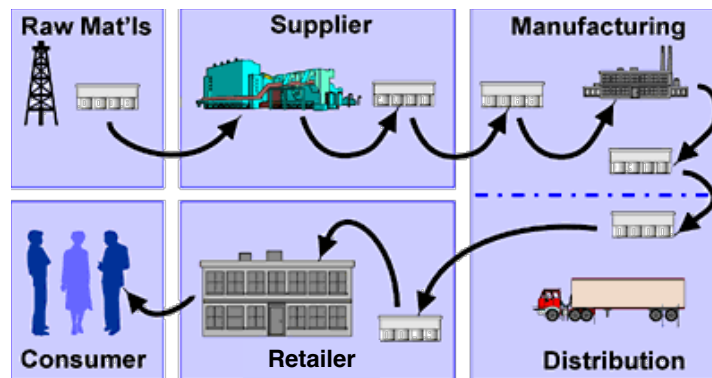
The Bullwhip Effect



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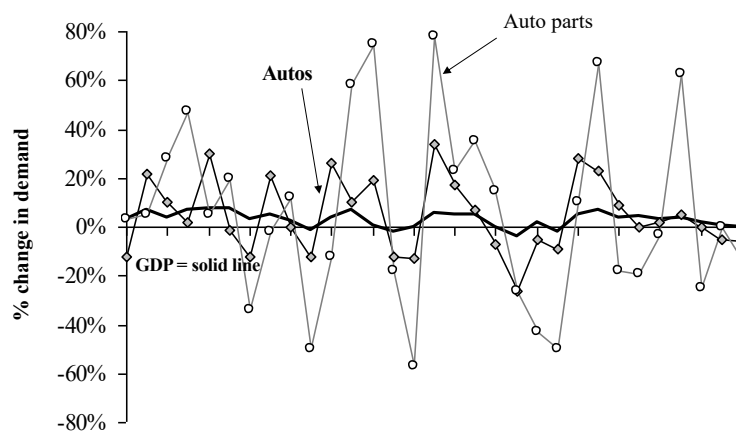
A chain of independent players

- Local information
- Decentralized decision making



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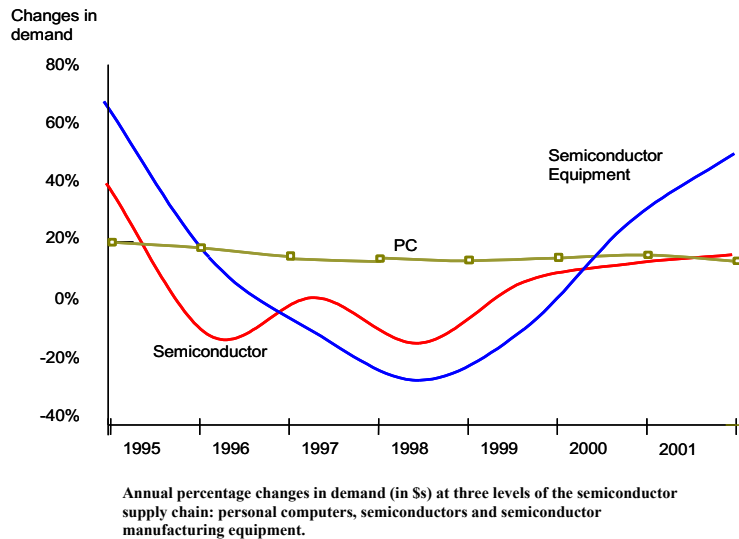
Bullwhip effect in autos to machine tools



Source: Anderson, Fine and Parker (1996)

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Bullwhip effect in the PC supply chain



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Consequences of the bullwhip effect

- Inefficient production or excessive inventory
- Low utilization of the distribution channel
- Necessity to have capacity far exceeding average demand
- High transportation costs
- Poor customer service due to stockouts

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Causes of the bullwhip effect

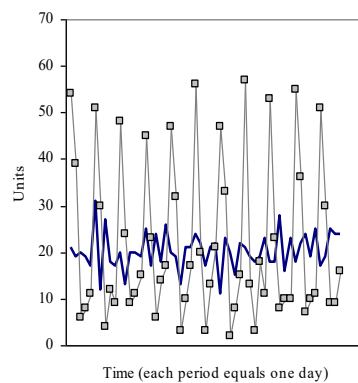
- Order synchronization
- Order batching
- Trade promotions and forward buying
- Reactive and over-reactive ordering
- Shortage gaming



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Order synchronization

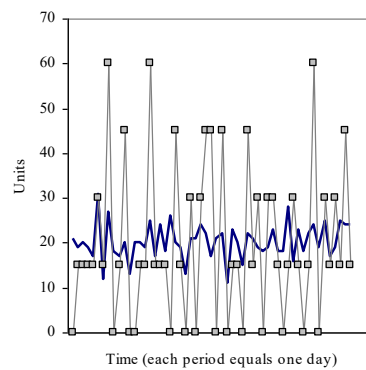
- Customers order on the same order cycle, e.g., first of the month, every Monday, etc.
- 20 retailers order weekly: 9 retailers order on Monday, 5 on Tuesday, 1 on Wednesday, 2 on Thursday and 3 on Friday.
- Simulated daily consumer demand (solid line) and supplier demand (squares)



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Order batching

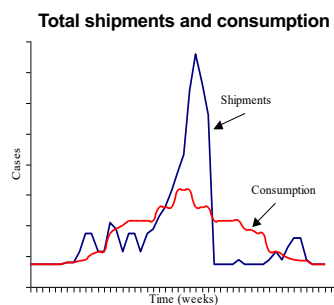
- Retailers may be required to order in integer multiples of some batch size, e.g., case quantities, pallet quantities, full truck load, etc.
- Retailers order in batches of 15 units, i.e., every 15th demand a retailer orders one batch from the supplier that contains 15 units.
- Simulated daily consumer demand (solid line) and supplier demand (squares)



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Trade promotions and forward buying

- **Trade promotion:** Supplier gives retailer a temporary discount.
- Retailer purchases enough to satisfy demand until the next trade promotion.
 - Example: Campbell's Chicken Noodle Soup over a one year period:



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Reactive and over-reactive ordering

- Each location forecasts demand to determine shifts in the demand process.
- How should a firm respond to a “high” demand observation?
 - Is this a signal of higher future demand or just random variation in current demand?
 - Hedge by assuming this signals higher future demand, i.e. order more than usual.
- Rational reactions at one level propagate up the supply chain.
- Unfortunately, it is human to *over* react, thereby further increasing the bullwhip effect.

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Shortage gaming

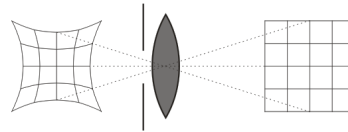


- Setting:
 - Retailers submit orders for delivery in a future period.
 - Supplier produces.
 - If supplier production is less than orders, orders are rationed, i.e., retailers are “put on allocation”.
- ... to secure a better allocation, the **retailers inflate their orders**, i.e., order more than they need...
- ... So retailer orders do not convey good information about true demand ...
- Big problem for the supplier
 - especially if retailers are later able to cancel a portion of the order (phantom orders)

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Summary: Strategies to combat the bullwhip effect

- Information sharing:
 - Collaborative Planning, Forecasting and Replenishment (CPFR)
- Smooth the flow of products
 - Coordinate with retailers to spread deliveries evenly (ERP)
 - Reduce minimum batch sizes.
 - Smaller and more frequent replenishments (EDI).
- Eliminate pathological incentives
 - Every day low price
 - Restrict returns and order cancellations
 - Order allocation based on past sales in case of shortages
- Vendor Managed Inventory (VMI): delegation of stocking decisions
 - Used by Barilla, P&G/Wal-Mart and others.



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Information sharing: Vendor Managed Inventory



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Vendor Managed Inventory: Success Story



https://www.datalliance.com/writable/resources/CGT_Datalliance_PG.pdf

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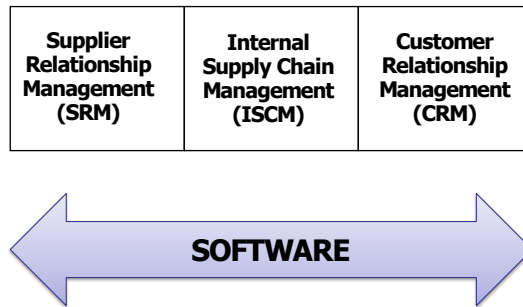
Vendor Managed Inventory: Failure Story

- Spartan Stores, a grocery chain, shut down its VMI effort about one year after its inception.
- Buyers (Spartan)
 - didn't trust the suppliers enough
 - carefully monitor inventories and intervene at the slightest hint of trouble
- Suppliers
 - didn't do much to allay buyers' fears
 - didn't do as effective a job as buyers



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Enterprise Resource Planning (ERP)



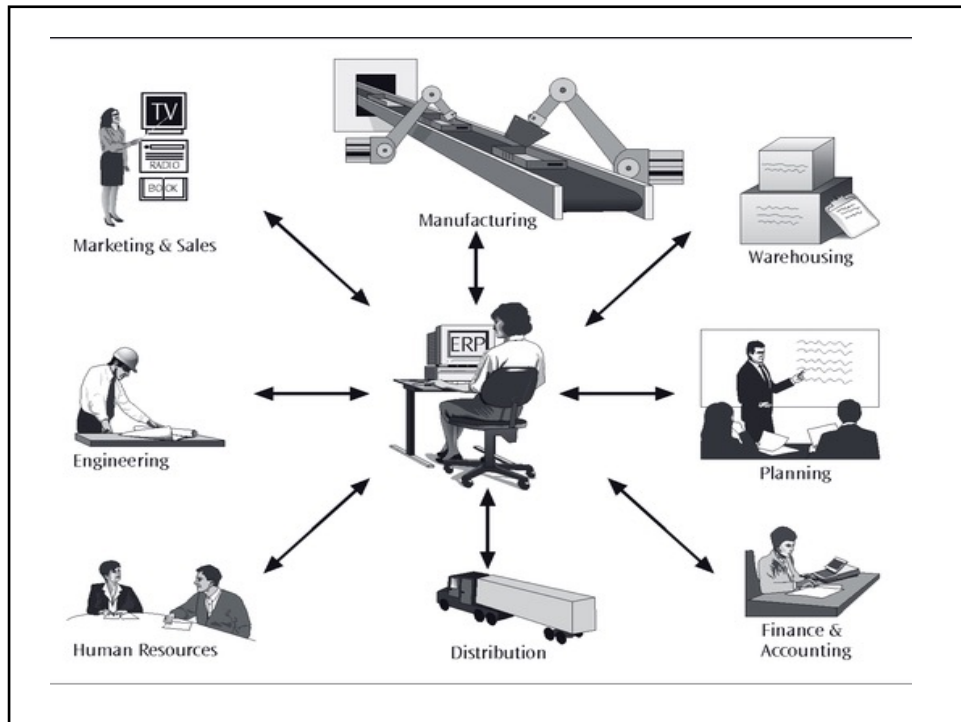
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What is ERP?

- ERP software integrates all departments and functions onto a single system that can serve the needs of the entire company
- Some of ERP's functions include:
 - Bookkeeping & Accounting
 - Human Resource Management
 - Planning Production
 - Supply-Chain Management



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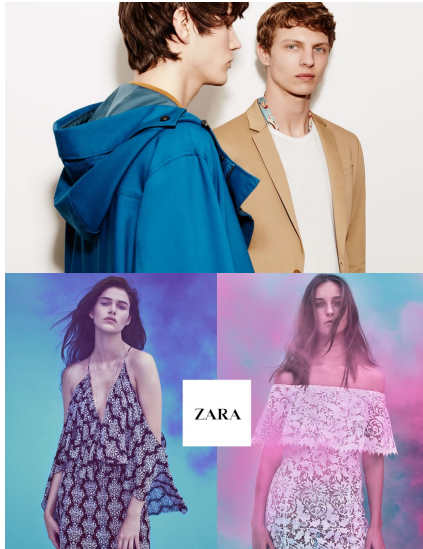
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Product Life-Cycle

2016 Spring



2017 Spring



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Product Life-Cycle



2023

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Two Types of Supply Chains

	Efficient Supply Chains	Responsive Supply Chains
Focus	Cost minimization Full capacity utilization	Revenue maximization Offer high-margin variety
Cost Concern	Make, handle, move, hold: Tangible costs	Lost sales, poor service: Opportunity costs
Operations Strategy Execution	<ul style="list-style-type: none"> ▪ Large batches ▪ Full truck load shipments 	<ul style="list-style-type: none"> ▪ Small batches ▪ Fast Design-to-Market time ▪ Postponed differentiation

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BRAND CAMP

by Tom Fishburne

Learning Objectives

- Beer Game and Bullwhip Effect: Causes and solutions

Supply Chain Coordination with Contracts

- Revenue Sharing – Rent The Runway (RTR)
- Buy-back contracts – Umbra Visage

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Characteristics of **Rent The Runway**

- RTR
 - a website that rented designer dresses charging 10% to 15% of a dress's retail price.
- With a standard wholesale price contract, RTR cannot earn a profit and satisfy demand in the initial weeks:
 - RTR's cost per dress = \$750, variable cost per rental = \$31, revenue per rental = \$90
 - Required incremental number of RTR to justify purchasing an additional dress = $750/(90-31) = 12.7$
 - A dress is unlikely to rent 12+ times in the first week or two.
- Lack of inventory
 - not due to poor forecasting or bad inventory management
 - due to the economics imposed on RTR
- **Overall supply chain** performance may not be optimal.

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Example calculation for two contracts

Standard Contract

- Wholesaler sells each Dress at \$750, the wholesaler's cost per dress is \$323.
- Optimal quantity for RTR is 2 dresses.

Standard wholesale price contract

Dress	# of Rentals	Rental profit	Dress cost	R Profit	W Profit	Total Profit
1	30	1770	750	1020	427	1447
2	55	3245	1500	1745	854	2599
3	65	3835	2250	1585	1281	2866
4	72	4248	3000	1248	1708	2956
5	79	4661	3750	911	2135	3046
6	84	4956	4500	456	2562	3018

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Example calculation for two contracts

Revenue sharing:

- Wholesaler sells each dress at a reduced price, but takes a share of the retailer's profit.
- wholesale price = \$325, retailer's share = 80%, wholesaler cost = \$323
- Wholesaler only has \$2 marginal profit per dress
- However, the total profit for both RTR and wholesaler increases!

Standard wholesale price contract

Dress	# of Rentals	Rental profit	Dress cost	R Profit	W Profit	Total Profit
1	30	1770	750	1020	427	1447
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Revenue sharing contract

Dress	# of Rentals	Rental profit	Dress cost	R Profit	W Profit	Total Profit
1	30	1770	325	1091	356	1447
2	55	3245	650	1946	653	2599
3	65	3835	975	2093	773	2866
4	72	4248	1300	2098.4	857.6	2956
5	79	4661	1625	2103.8	942.2	3046
6	84	4956	1950	2014.8	1003.2	3018

$$1770 * 20\% + 2$$

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Some revenue sharing issues

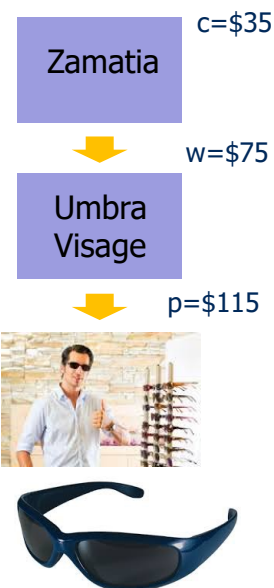
- **Monitoring costs:**
 - Supplier must incur the cost of monitoring the retailer's revenue.
 - Blockbuster and Disney litigated over rental revenues.
- **Risk:**
 - Supplier's profit becomes more variable and payment is received later.
- **Irrational retailer:**
 - The supplier risks a retailer that orders too many or too few dresses.
- **Diversion:**
 - Must avoid retailers using the low wholesale price to resell dresses
- **Effort:**
 - Retailer's incentive to exert effort to increase sales is reduced (e.g., why increase sales if you only keep ½ of the revenue)



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Double marginalization at Umbra Visage (UV)

- **Suboptimal supply chain performance occurs**
 - Double marginalization: Each firm makes decisions based on their own margin, not the supply chain's margin.
- **Example:**
 - Zamatia makes sunglasses at a cost of \$35 and sells them to UV for \$75.
 - UV sells them for \$115 and salvages left over inventory for \$25 per unit.
 - Demand is normal with mean 250 and standard deviation 125. Unmet demand is lost.
 - UV faces a newsvendor problem.
 - UV: $C_u = 115 - 75 = 40$, $C_o = 75 - 25 = 50$, Critical ratio = $40 / 90 = 0.44$
 - Supply chain:
 - $C_u = 115 - 35 = 80$, $C_o = 35 - 25 = 10$, Critical ratio = $80 / 90 = 0.89$
 - Supply chain's critical ratio > UV's critical ratio!



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A solution to double marginalization: share risk

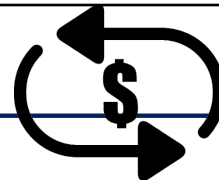
- Suppose Zamatia offers to buy-back unsold sunglasses at b per unit:
 - UV incurs a \$1.5 cost to ship sunglasses back, $C_o = 75 - (b - 1.5)$
- Choose b to make UV's critical ratio equal the supply chain's critical ratio:
 - Supply chain CR =

$$\frac{\text{retail price} - \text{cost}}{(\text{retail price} - \text{cost}) + (\text{cost} - \text{salvage})} = \frac{115 - 35}{(115 - 35) + (35 - 25)}$$
 - UV CR with buyback contract =

$$\frac{\text{retail price} - \text{wholesale price}}{(\text{retail price} - \text{wholesale price}) + (\text{wholesale price} - (b - 1.5))} = \frac{115 - 75}{(115 - 75) + (75 - b + 1.5)}$$
 - $b = 71.5$

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Buy-back contracts summary



- What are they?
 - Retailer is allowed to return to the supplier goods left over at the end of the selling season.
- How do they improve supply chain performance?
 - The retailer's overage cost is reduced.
 - Redistribution of inventory risk across the supply chain.
 - Could protect the supplier's brand image by avoiding markdowns.
 - Allows the supplier to signal that significant marketing effort will occur.
- What are the costs of buy-backs?
 - Administrative costs plus additional shipping and handling costs.
- Where are they used?
 - books, cosmetics, music CDs, agricultural chemicals, electronics
 - ...

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Supply Chain Coordination: Summary

- Coordination failure:
 - decentralized operations (i.e., multiple firms making decisions)
- A reason for coordination failure:
 - The terms of trade do not give firms the proper incentive to choose supply chain optimal actions.
- Why fix coordination failure:
 - If total supply chain profit increase, the “pie” increases and everyone can be given a bigger piece.
- How to fix coordination failure:
 - Design terms of trade to restore a firm’s incentive to choose optimal actions.
 - e.g., with revenue sharing a retailer can justify holding more units of the product.