Chapter 5

Decision-Making under Uncertain Conditions

Operations Management

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Agenda

- **Newsvendor Problem**
- Newsvendor Example
- Procurement Contracts
- Decision Challenge
- Decision Biases

Newsvendor Model

- Businesses which are based on ordering seasonal or perishable products:
  - Newspaper vendors (daily)
  - Fashion (couple of months)
  - Ski equipment retailers (annually, before ski season)
  - Halloween custom sellers (annually, before Halloween)
  - Dairy product sellers (couple of days or weeks)
  - …
- Demand is uncertain and materialize after you receive the product

Newsvendor Model

- The challenge of finding the best order size:
  - Order size smaller than demand: lost sales (underage cost)
  - Order size larger than demand: excess inventor (overage cost)

- What is the optimal order size which balances these two costs?

Newsvendor Model

- Unit cost = c
- Selling price = p
- Salvage price = s
- Demand = D (random)
- Order size = Q

- Overage Cost = $C_o = c - s$
- Underage cost = $C_u = p - c$

- Optimal Order Quantity = Q^*

$$\Pr(D \le Q^*) = F(Q^*) = \frac{C_u}{C_u + C_o} = \frac{p - c}{p - s}$$

- Uniform Demand Distribution: $D \sim \mathrm{U}(a,b)$

$$Q^* = \frac{C_u}{C_u + C_o}(b - a) + a$$

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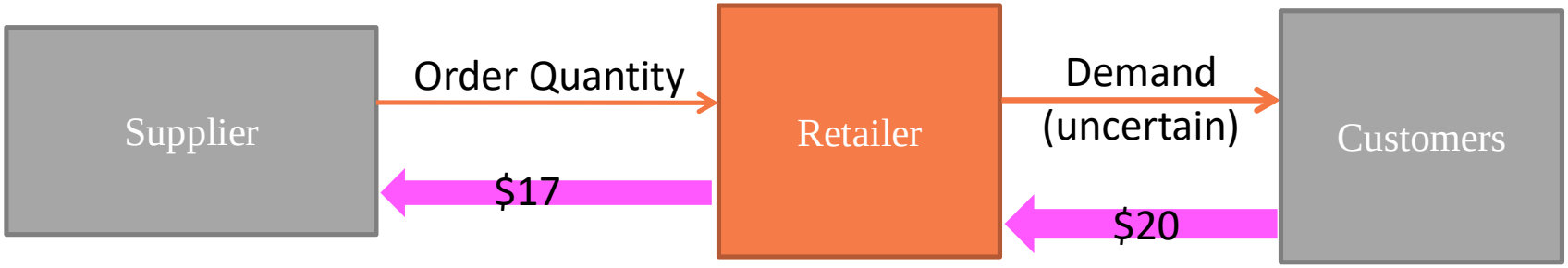
Newsvendor Example

Average Demand: 200

100< Demand < 300



Overage Cost = Co =	17
Underage Cost = Cu =	20-17=3
(Uniform Dist.) a =	100
(Uniform Dist.) b =	300

$$Q^* = \frac{3}{17+3} \times 200 + 100 = 130$$

Newsvendor Model Example

- The commute time from your home to your work is a random variable. It is never less than 20 minutes and in the worst traffic it takes 40 minutes for you to get to work. Your experience tells you the commute time is (approximately) uniformly distributed between these to extremes.
- Getting to your work earlier than work hours is a waste of time. Getting to work late creates a bad image for you in the work place. So, both being late and being early creates a level discomfort for you.
- If you are asked to give weights to the level of discomfort from being early or late (on a scale of 1 to 10), you give a weight of 3 for every minute of being early and a weight of 9 for every minute of being late.
- How many minutes before the start of work hours should you leave your home to minimize your discomfort in this regard?

Newsvendor Model Example

Overage Cost = Co =	3
Underage Cost = Cu =	9
(Uniform Dist.) a =	20
(Uniform Dist.) b =	40

$$Q^* = \frac{C_u}{C_u + C_o}(b-a) + a = \frac{9}{9+3}(40-20) + 20 = 35 \text{ min}$$

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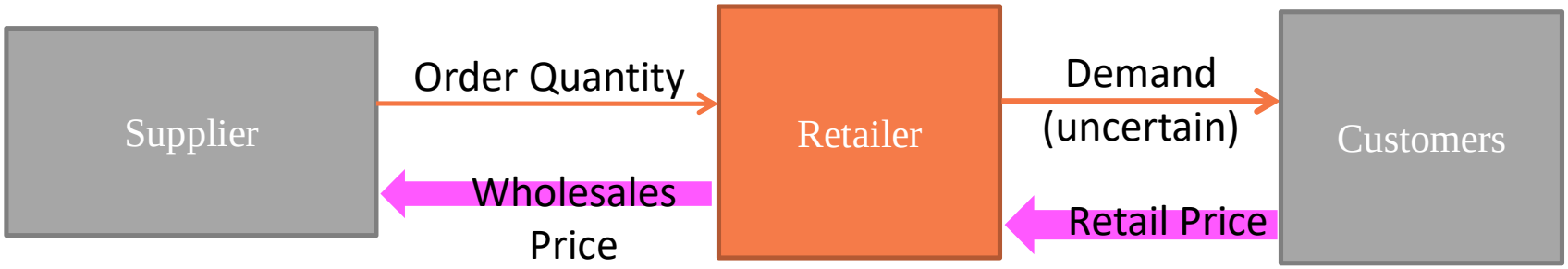
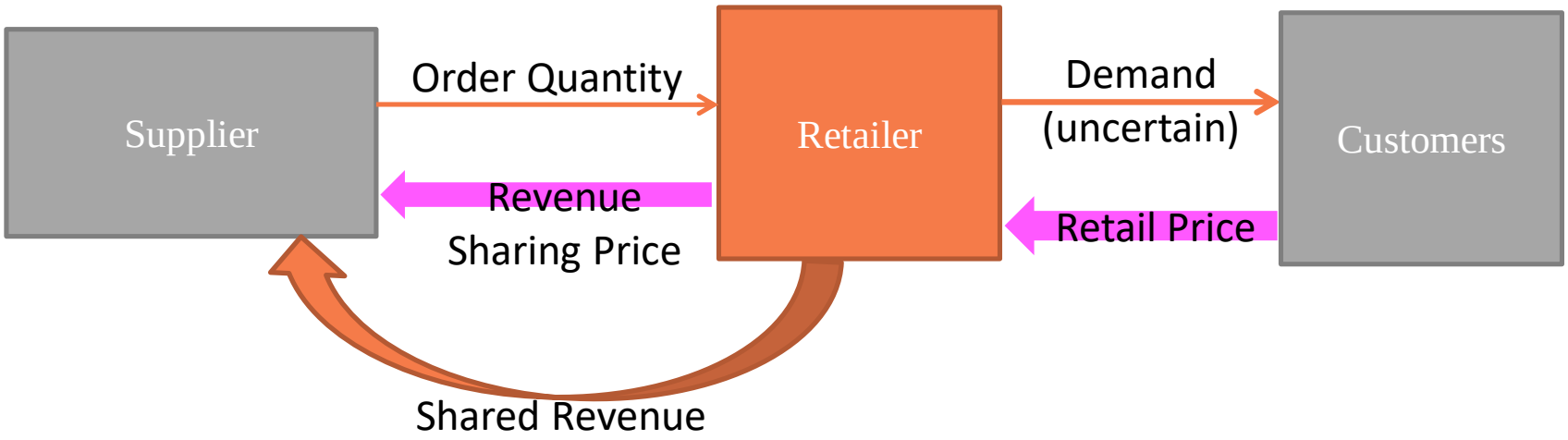
Wholesales Price Contract



What is wrong with this type of contract?

The retailer bears all the risk and therefore, to avoid overage cost, orders less than what is best for the whole chain.

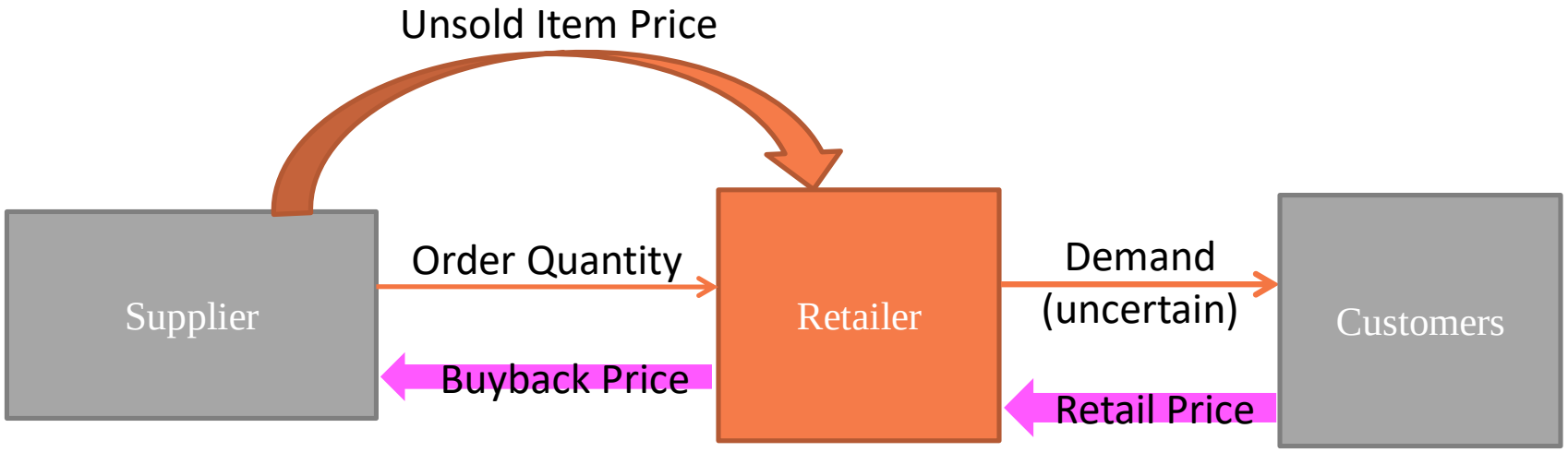
Revenue Sharing Contract



The supplier shares the risk?

If the "Revenue Sharing Price" and the "Shared Revenue" are set to the right value, the retailer order enough items to maximize the profit of the whole chain.

Buyback Contract



The supplier shares the risk?

If the "Buyback Price" and the "Unsold Item Price" are set to the right value, the retailer order enough items to maximize the profit of the whole chain.

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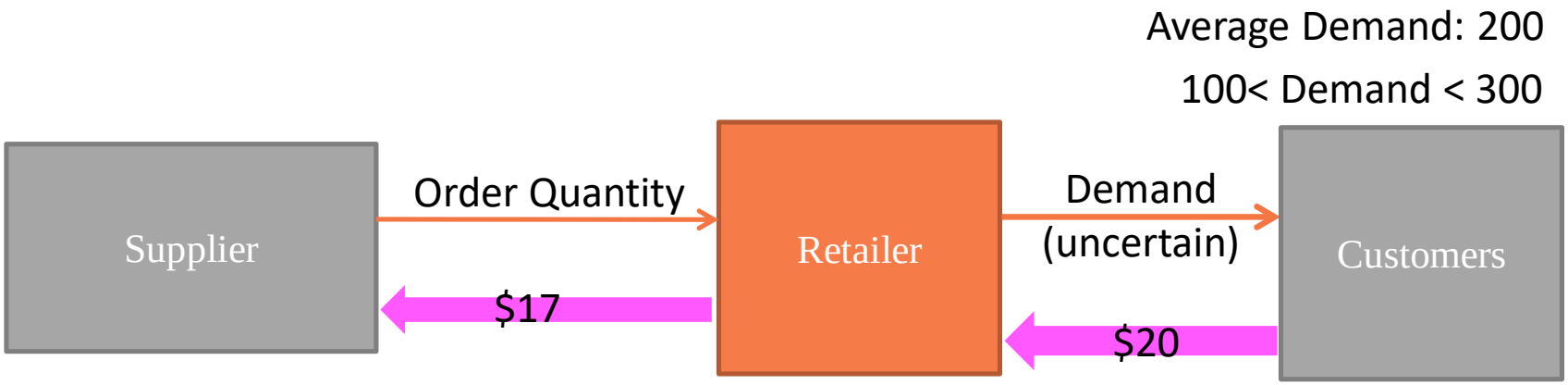
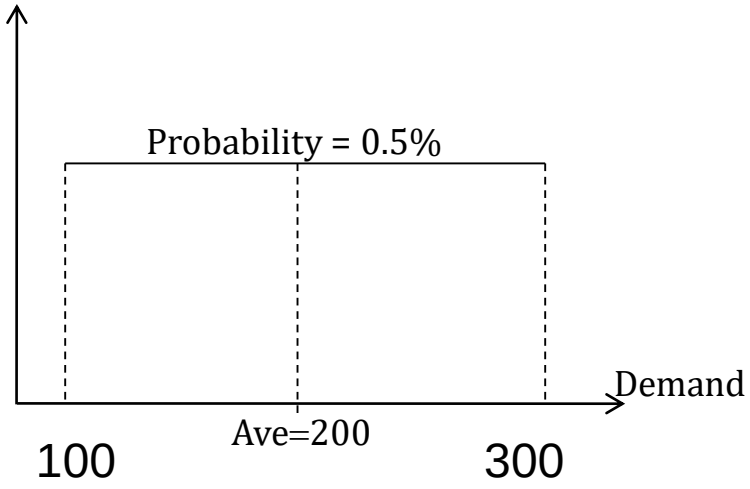
Wholesale Contract

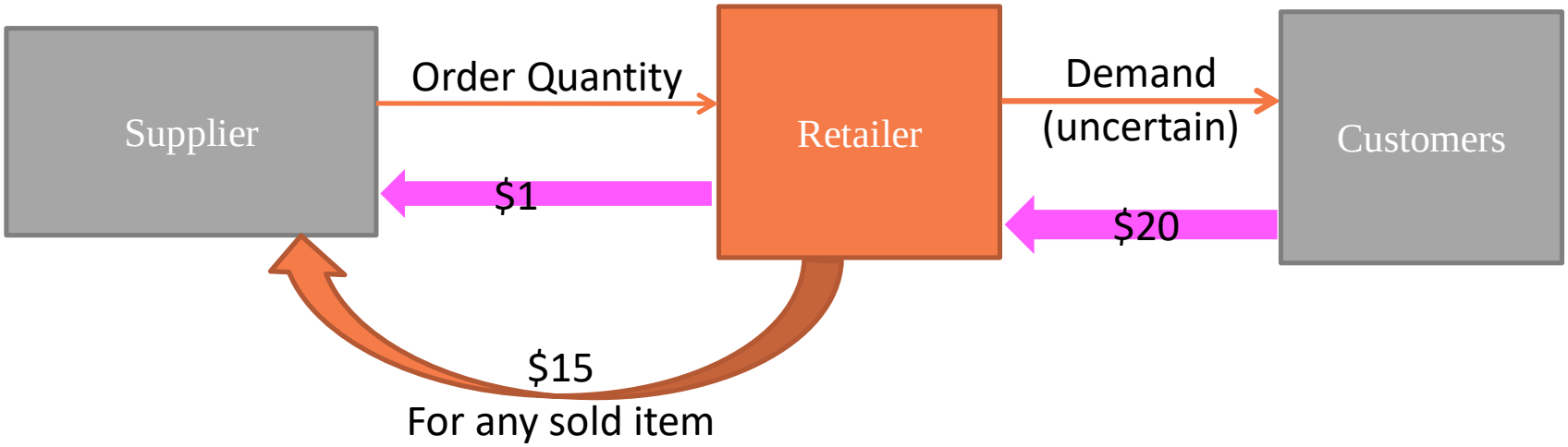


Demand Distribution

- Uniform Demand Distribution ~(100,300)



Revenue Sharing Contract



Demand > Order Quantity → You lose $4 for any unsatisfied demand ($4=$20-$1-$15)

Order Quantity> Demand → You lose $1 for any unsold product

Demand > Order Quantity

- Order Quantity = 200 units
- Realized Demand= 250 units

- You loose the opportunity to sell: **(250-200)=50** units

- Lost SALES opportunity: **50*$4=$200**!

Order Quantity> Demand

- Order Quantity = 200 units
- Realized Demand= 150 units

- Unsold Items: **(200-150)=50** units

- Cost of Unsold Items: **50*$1=$50**!

Do the Decision Practice in Excel File

Watch the video for Decision Practice

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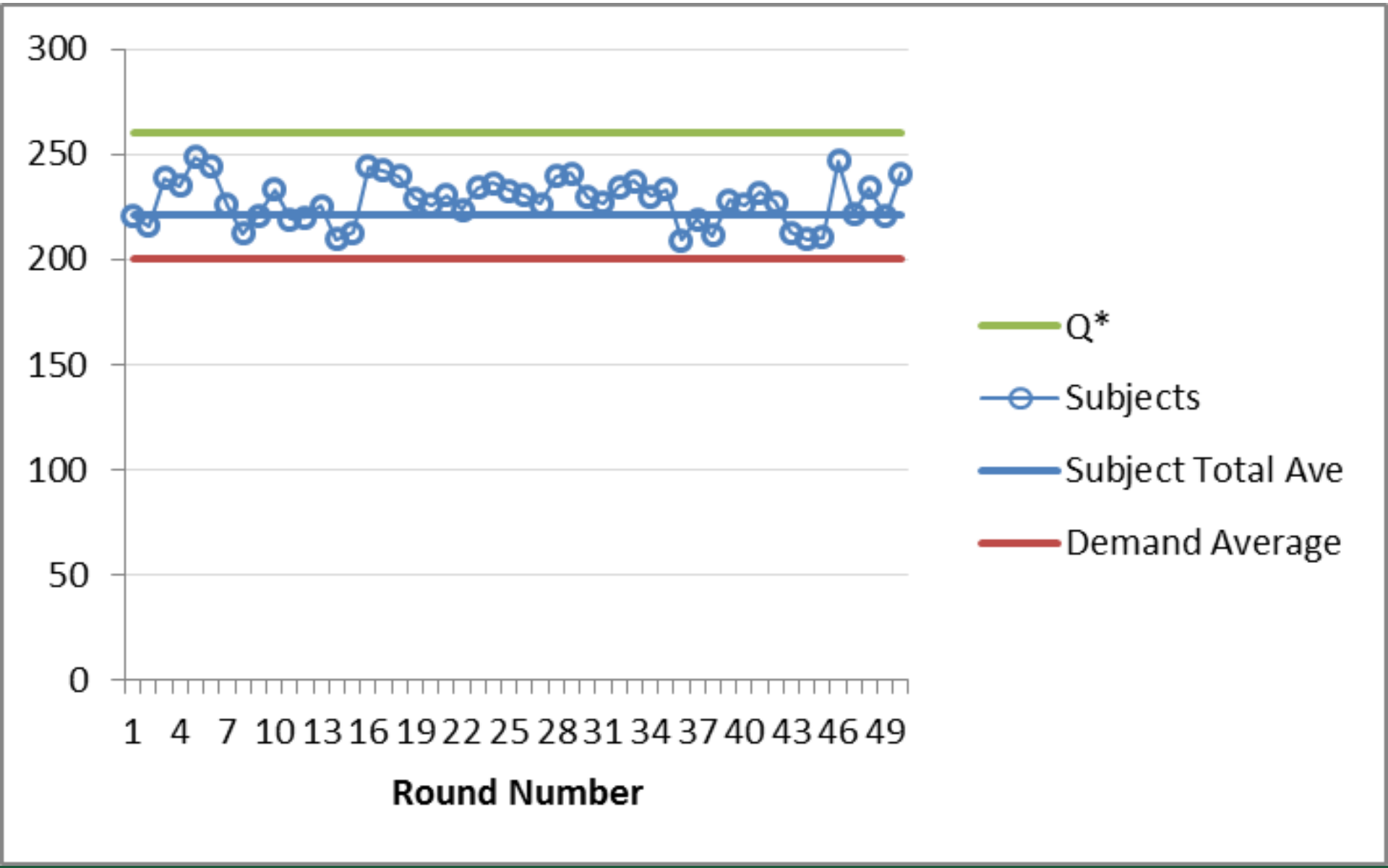
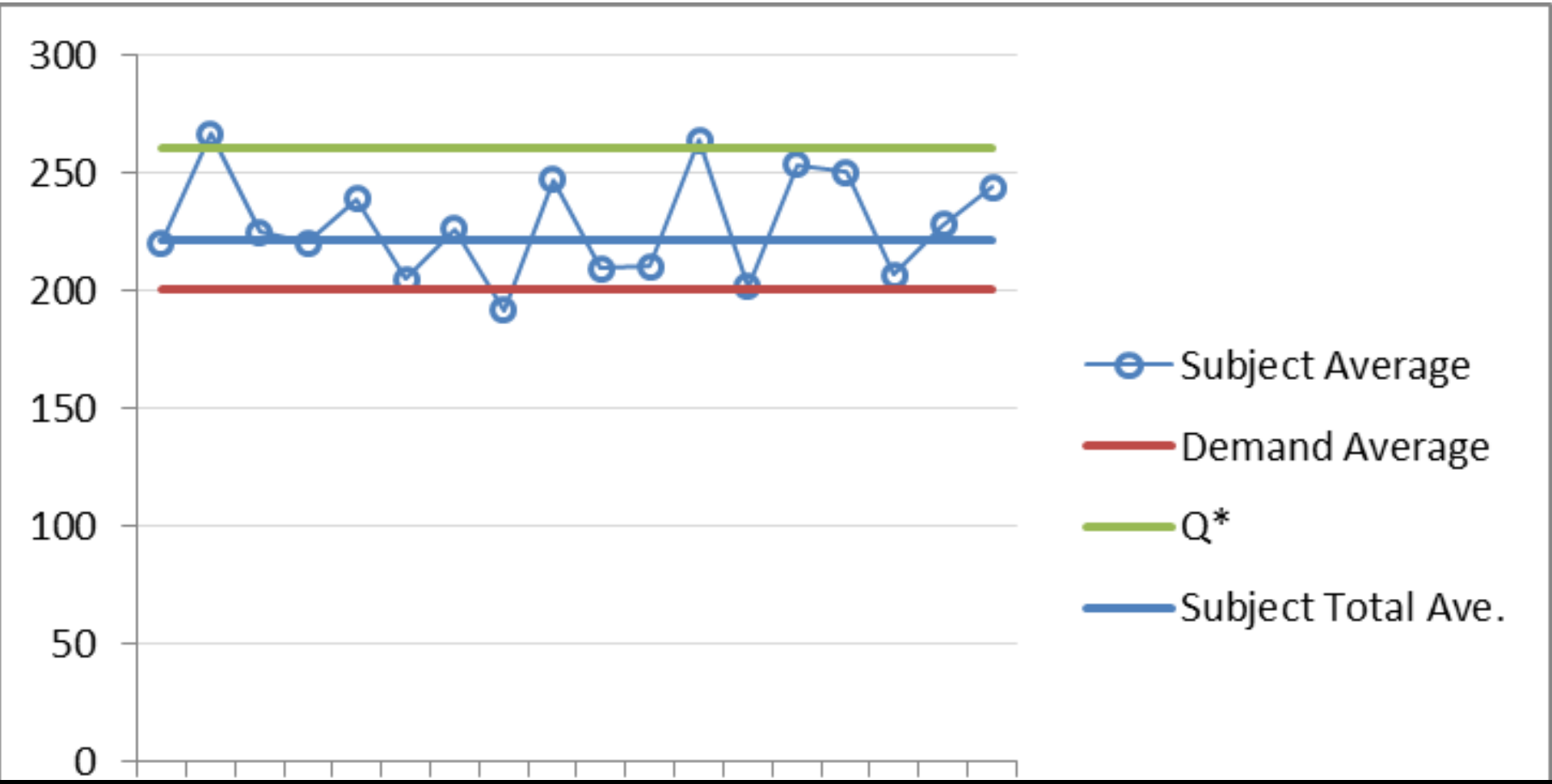
Decision Practice Results



Decision Competition Results



This is Called Pull to Center Effect