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AUTO-ID LABS

Customer Loyalty Based Dynamic Pricing by Using RFID-enabled Floor Level Sales Information

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Agenda

- **Summary**
- **Introduction**
- **Supporting Practices**
  - Frequent Shoppers Program (FSP)
  - Dynamic Pricing (DP)
- **System Overview and Flow**
- **Proposed Algorithms**
- **Evaluation**
- **Conclusion, Limitation and Future Possibilities**

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Summary

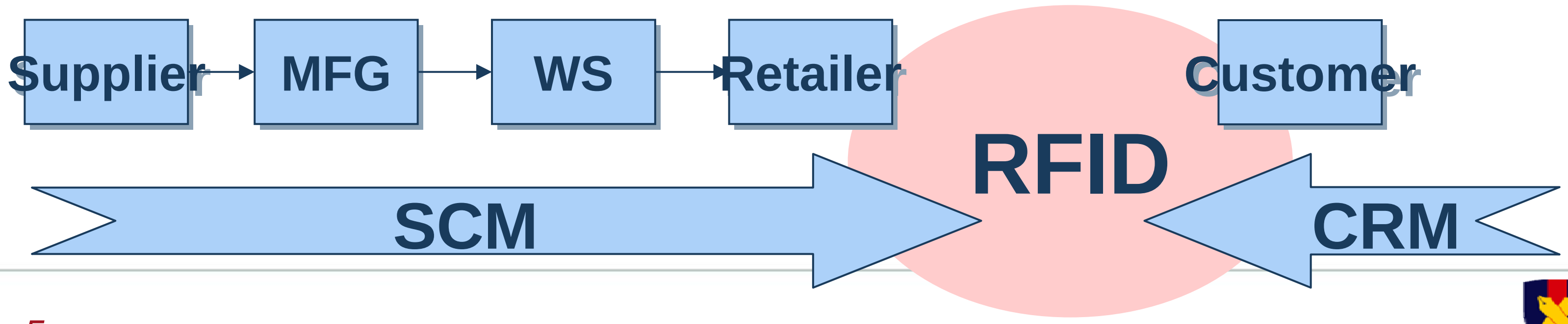
- **Propose an application and algorithms to achieve two goals together:**
  - Target inventory turnover rate to increase profit of retailers that have physical stores
  - Rewarding Frequent Shoppers Program members based on their loyalty status

Introduction: Background

- **Physical store retailers' situation**
  - Space constraint (of course this is a strong point as well)
  - Difficult forecasting because of shorter product lifecycle
- **Retailers' strategies**
  - Improve inventory turnover rate to make the most use of the store floor space (SCM)
  - Build good relationship with loyal customers (CRM)

Introduction: Challenges & Role of RFID

- **Combining SCM with CRM!**
  – Challenge for retailers for long time
  – Differentiate members through FSP, but not loyalty basis
  – Critical issue: Customers do not identify themselves
- **RFID fills the gap**
  – FSP members card with RFID and readers at the store floor connects SCM and CRM



RFID reader with display

- Customers scan loyalty card with RF tags
- Reader displays information only to the customers

Photo courtesy of *Dai Nippon Printing* and *Sears*

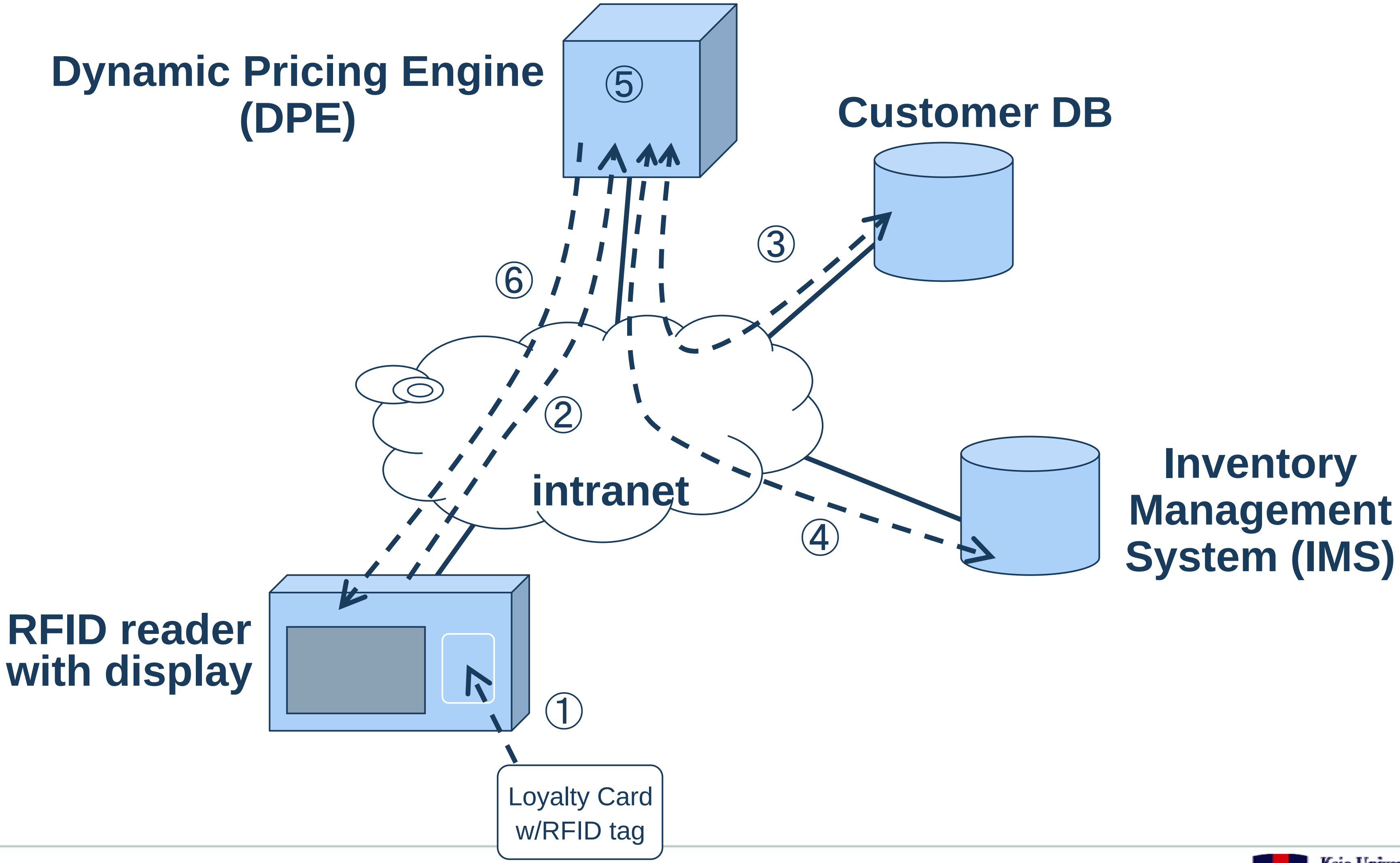
Supporting Practices

- **Frequent Shoppers Program (FSP)**
  - Practice to build strong customer relationship
  - Rewarding customers based on customers' loyalty level
  - Popular in airline industry and retail industry
- **Dynamic Pricing (DP)**
  - Optimize revenue out of given resources
  - Manipulating price to meet customer demand

$$\max \sum_{t=1}^{T} r(t, d(t)) \qquad s.t. \sum_{t=1}^{T} d(t) \leq C \quad d(t) \geq 0$$

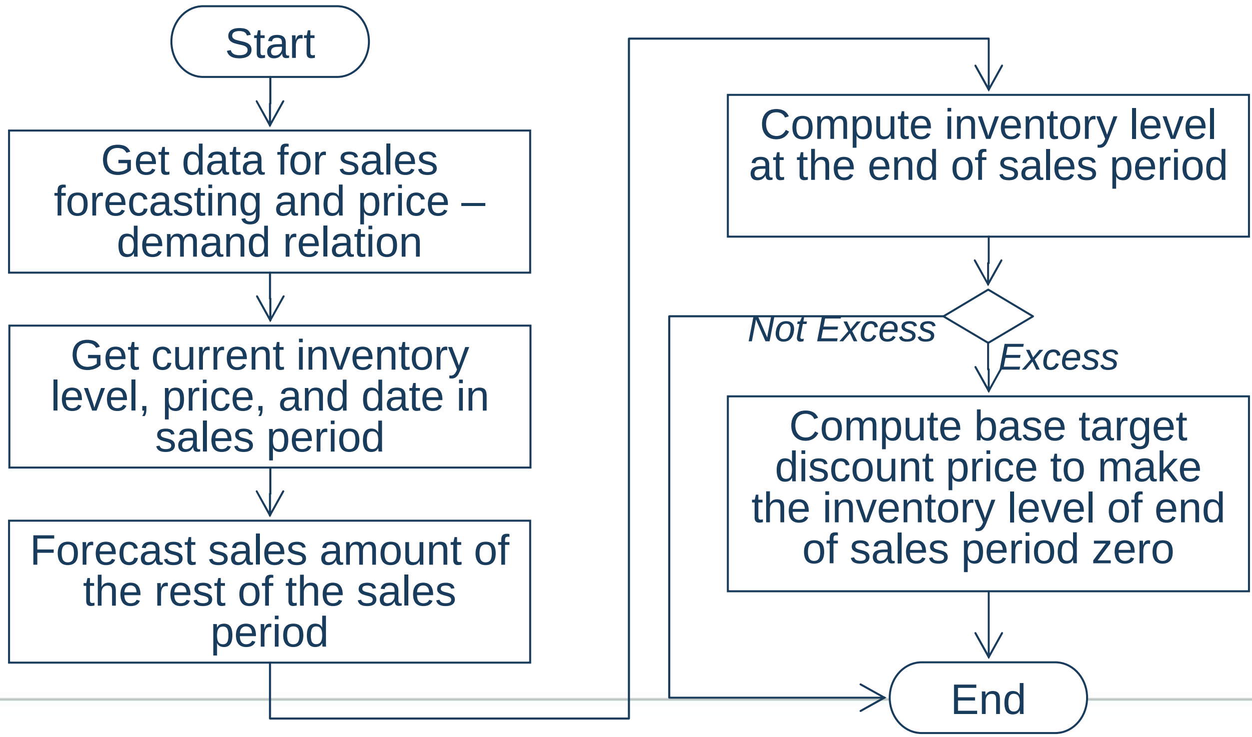
r(t,d): revenue, d(t): demand, C: constraint

System Overview and Flow



Proposed Algorithms: BTDP Algorithm

- **Base Target Discount Price (BTDP) Calculation**
  - Compute a price to achieve inventory turnover rate goal
  - Difference in loyalty status is not taken into account



Proposed Algorithms: MTDP Algorithm

- **Member type Target Discount Price (MTDP) Calculation**
  - Compute prices appropriate for each member status
  - Use a price computed through BTDP algorithm

$$P_{BTDP} = cust\_class(0) \cdot P_{LIST} + \sum_{k=1}^{n} cust\_class(k) \cdot (1 - disc)^{k-1} \cdot P_{MTDP}(1)$$

$$P_{MTDP}(i) = (1 - disc)^{i-1} \cdot P_{MTDP}(1) \, , \, i = 2, \ldots, n$$

P_{BTDP}: Price from BTDP
$P_{MTDP}(i)$: Price from MTDP
P_{List}: List Price

cust_class(): % of each group
disc: Discount rate difference

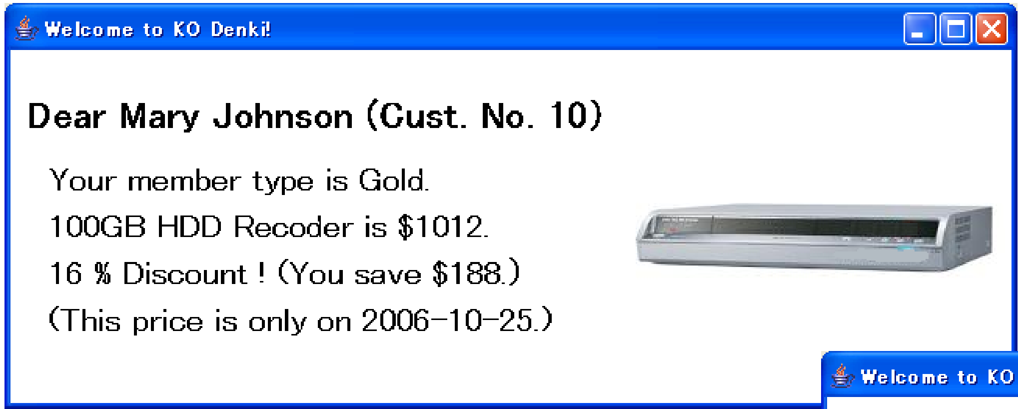
Evaluation

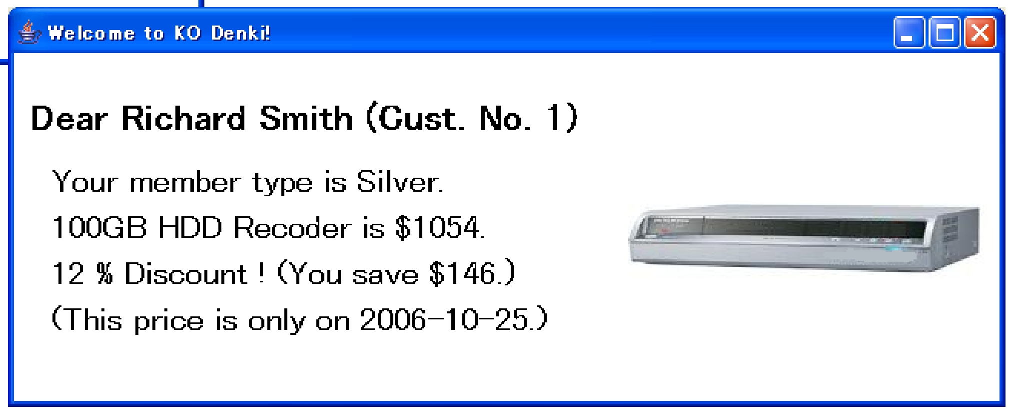
- **Demo system development**
  - Demo system spec.
    - Hardware
      - PC: Panasonic CF-W4 (Mobile Pentium 1.2GHz)
      - Reader/Writer: Omron V720S-HME01
    - Software
      - Windows XP Professional Version 2002 SP2
      - DB: MySQL 4.0.20a
- **Numerical study**
  - A) Increase retailer's profit or not
  - B) Reward customers based on loyalty status
  - C) Control inventory turn over rate

Evaluation: Demo System Development

Demo System Screen Shot

- **Build demo system**
  - Work fine but may need improvements (e.g., performance)





Screen shot of demo system

Evaluation: Numerical Study

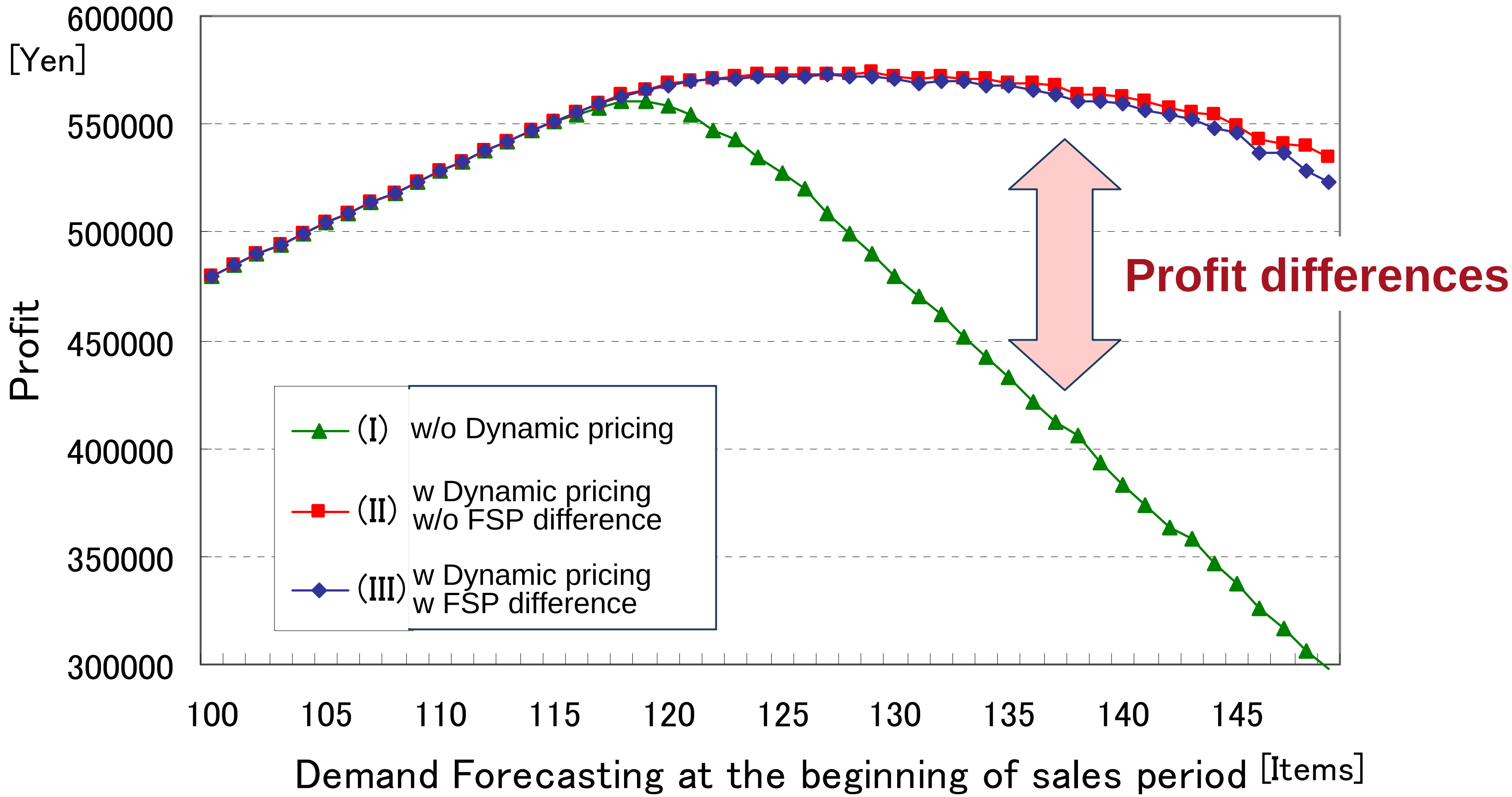
- **Three points for evaluation**
  A) Increase retailer's profit or not
  B) Reward customers based on loyalty status or not
  C) Control inventory turn over rate successfully or not

- **Show effectiveness of the algorithms through comparison**
  i. Without Dynamic Pricing
  ii. With Dynamic Pricing. Without loyalty status differentiation (only difference in FSP member and non-member)
  iii. With Dynamic Pricing. With loyalty status differentiation (three statuses: *Platinum, Gold*, and *Silver*; and non-member)

- **Common settings**
  – Poisson distribution, 3 months, 5 days/week, P_{List}: *¥1,200, Disc: 4%*
  – Demand-price curve: *demand = 600 – 0.4*price*
  – Actual demand: 120 [items/wk], Forecast range: 100 – 150 [items/wk]

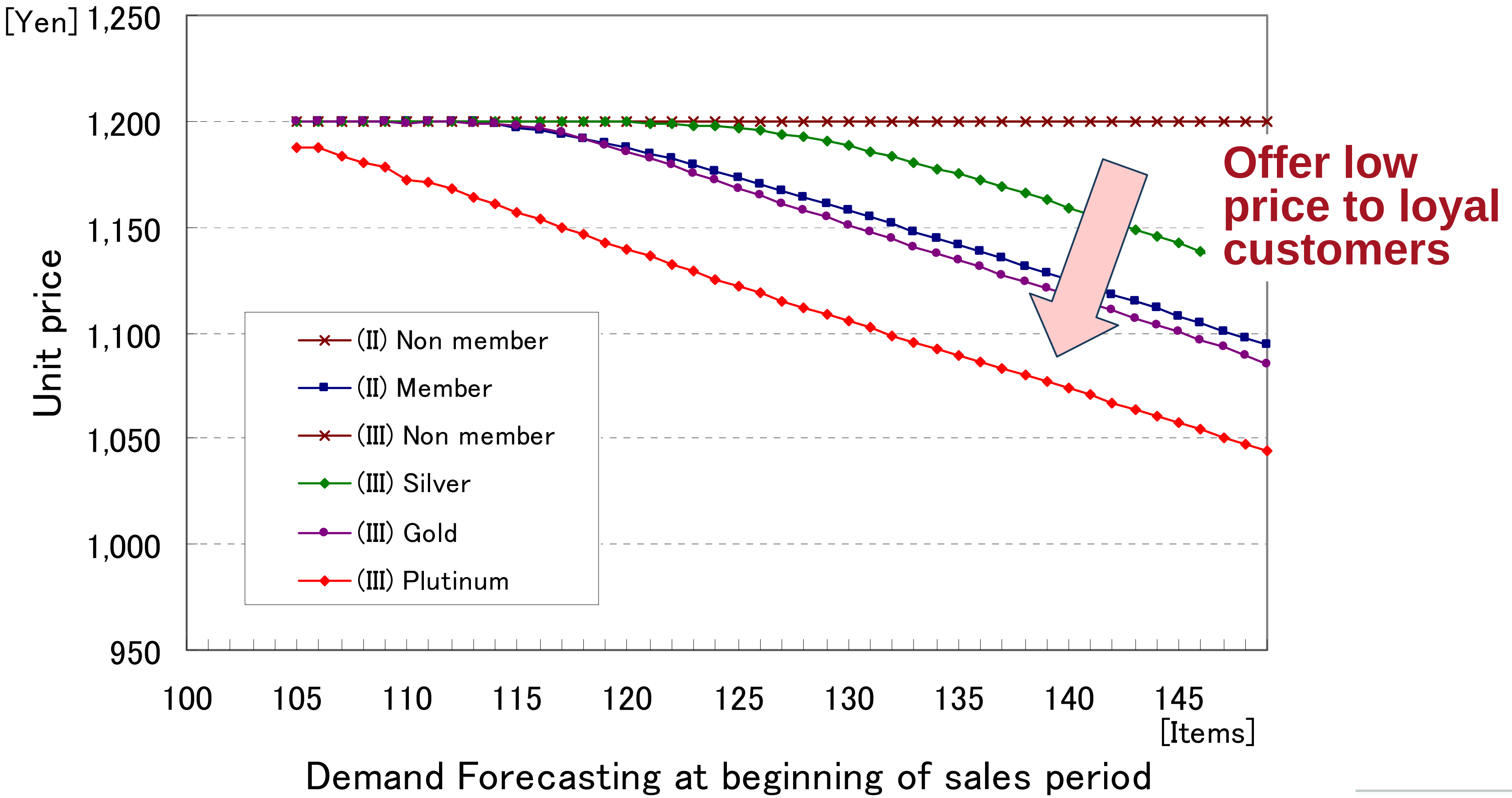
Result of Numerical Study (A)

- **Algorithms increase the profit**



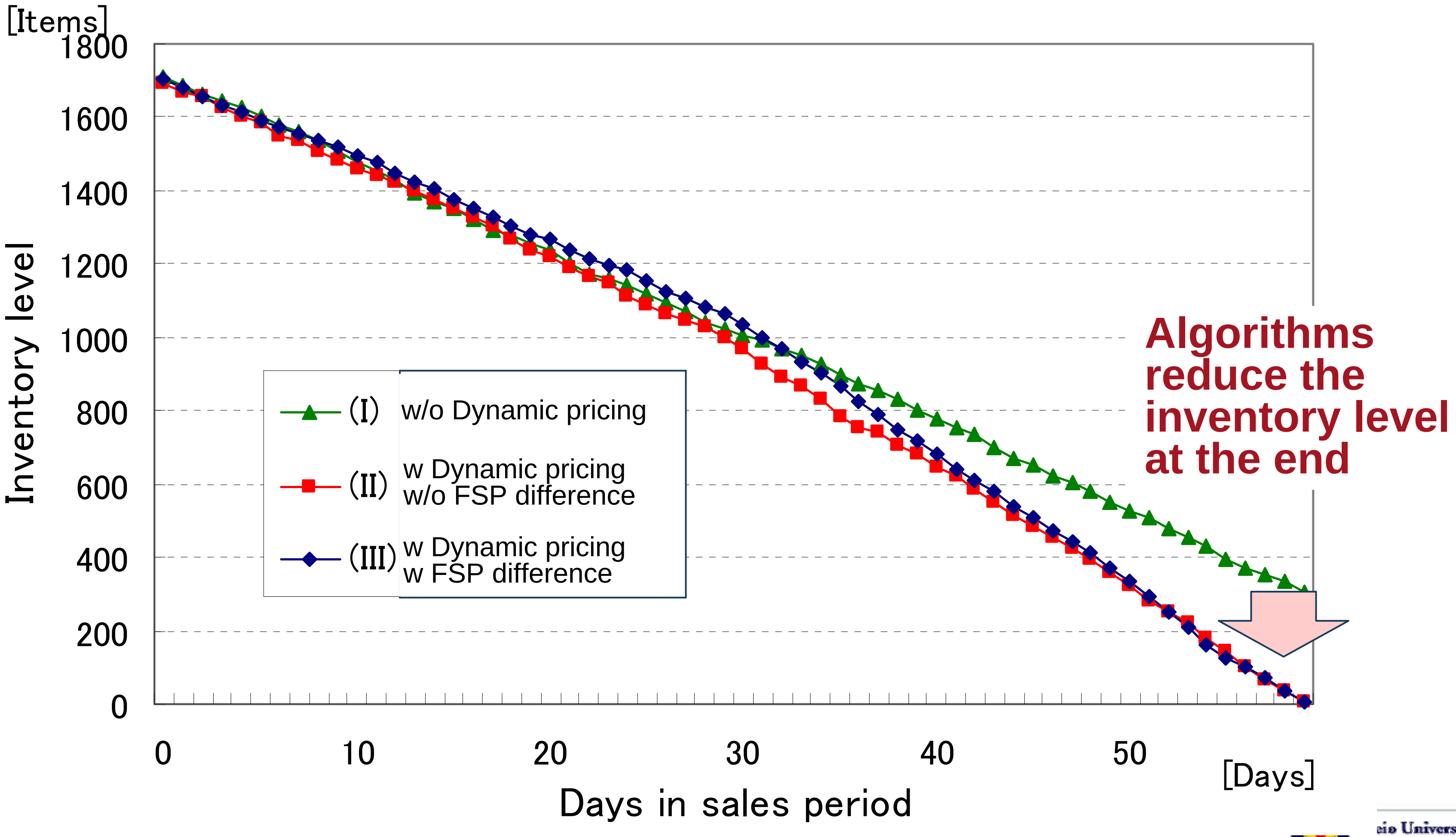
Result of Numerical Study (B)

- **Algorithms appropriately reward customers**



Result of Numerical Study (C)

- **Algorithms successfully control inventory level**



Conclusion, Limitations & Future Possibilities

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- **Conclusion**
  - Propose an application and algorithms to achieve two goals together:
    - Target inventory turnover rate to increase profit
    - Rewarding FSP members based on loyalty status
  - Connect the gap between SCM and CRM
- **Limitations**
  - Privacy
  - Legality of the practice
- **Future Possibilities**
  - More information for consumers
    - Not only discount but also recommendation
  - More information for retailers and manufacturers
    - Behavior information (Promotion, List price decision)

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Thank you!