**Why data is important in planning and control**

**EOQ & (Q, r)**

**<Problem Description>**

|  |
| --- |
| Yonsei IMS retail is a retailer that handles variety of household products. The manager, Mr. Smith, recently achieved 100 million won in monthly sales, and decided to introduce a decision-making system to reduce the cost of store managing in order to open a second store. Currently, the store has daily product sales data. Through the analysis of these data, Mr. Smith wants to come up with the appropriate amount of orders to reduce costs through inventory management of 3 main sellers.  Until now, Mr. Smith used a fixed period order system by using the three main sellers selected from the products sales data. However, if demand changes, excess inventory or inventory shortages can occur. Mr. Smith wants to make changes as it can cause cash flow problems. Thus, he is trying to derive an efficient operation by utilizing the data on the daily product sales in the past month.  Let’s utilize the data given below and come up with an appropriate product-specific order plan for Yonsei IMS retail. |

**<Basic data>**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Yonsei IMS retail picked 3 main sellers (Y01, Y02, Y03) based on the sales data collected for a month. Daily sales for each product is given in Table 1, Table 2, and Table 3. Necessary basic parameters are also given in Table 4.  <Table 1> Y01 demand data (1)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 11 | 12 | 12 | 14 | 14 | 12 | 11 | 11 | 12 | 13 | 12 | 13 | 12 | 12 | 11 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 13 | 11 | 13 | 12 | 13 | 12 | 12 | 10 | 10 | 12 | 12 | 12 | 13 | 12 | 11 |   <Table 2> Y02 demand data (1)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 10 | 13 | 8 | 9 | 11 | 8 | 13 | 12 | 11 | 13 | 9 | 10 | 13 | 8 | 12 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 13 | 13 | 13 | 10 | 10 | 10 | 8 | 10 | 13 | 10 | 9 | 9 | 12 | 11 | 9 |   <Table 3> Y03 demand data (1)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 15 | 14 | 14 | 16 | 15 | 13 | 17 | 16 | 15 | 15 | 16 | 17 | 13 | 18 | 17 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 16 | 18 | 17 | 17 | 15 | 16 | 14 | 13 | 18 | 16 | 14 | 14 | 16 | 18 | 17 |   <Table 4> Base parameter   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Notation | Description | Value | | | |  | Total planning horizon (days) | 30 | | | |  | Replenishment lead time (days) | Y01 | Y02 | Y03 | | 2 | 3 | 2 | |  | Unit purchasing cost per unit ($) | Y01 | Y02 | Y03 | | 30 | 40 | 50 | |  | Fixed ordering cost ($) | 150 | | | |  | Daily interest rate (%) | 20 | | | |  | Backorder penalty cost ($) | Y01 | Y02 | Y03 | | 45 | 60 | 75 |   <Table 5> Y01 demand data (2)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 11 | 9 | 14 | 17 | 5 | 11 | 18 | 19 | 7 | 11 | 12 | 17 | 6 | 20 | 9 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 16 | 11 | 19 | 11 | 9 | 9 | 6 | 16 | 8 | 17 | 10 | 12 | 11 | 14 | 5 |   <Table 6> Y02 demand data (2)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 10 | 6 | 17 | 6 | 9 | 18 | 9 | 8 | 6 | 14 | 10 | 13 | 8 | 7 | 10 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 6 | 15 | 14 | 10 | 10 | 7 | 12 | 18 | 11 | 5 | 10 | 14 | 15 | 8 | 14 |   <Table 7> Y03 demand data (2)   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Day** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | **Demand** | 25 | 24 | 10 | 10 | 5 | 7 | 22 | 12 | 10 | 11 | 22 | 21 | 12 | 15 | 25 | | **Day** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | | **Demand** | 18 | 14 | 16 | 6 | 10 | 24 | 7 | 30 | 24 | 22 | 21 | 8 | 10 | 8 | 21 |   **\*\*\*Initial Inventory is 30 and included in calculating the inventory cost** |

**<Experiment result & analysis>**

**※ Based on the data given above, answer the following questions. Please show calculations if necessary, and answer the questions in detail.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **1. Using the information given, obtain the economic order quantity (EOQ) and order cycle for each product.**   |  |  |  |  | | --- | --- | --- | --- | |  | Y01 | Y02 | Y03 | |  | 24 | 20 | 21 | |  | 2.181818182 | 2.068965517 | 1.431818182 |   EOQ 모델에서, 수식을 통해 위 값을 구할 수 있다.  Basic data와 Demand data에 기반하여, 각 변수들의 값을 계산했다.  A : Fixed ordering cost ($)  D : Expected demand rate over T – initial inventory. 이미 보유하고 있는 initial inventory 30을 제외했다.  h : Holding cost \* Total planning horizon T,  ( Holding cost = Unit purchasing cost per unit ($) \* Daily interest rate (%) )  구체적인 계산 과정은 아래 표와 같다.  의 경우, 주문”량”이기에 올림해서 정수 값을 취했다.  의 경우, Order cycle을 day 단위로 얻기 위하여 Total planning horizon (days)인 T로 D를 나눈 값을 사용했다. 주문 일자 역시 정수이어야 하므로 반올림하여 의 정수배를 반올림하여 실제 주문 일자를 구했다.   |  |  |  |  | | --- | --- | --- | --- | |  | Y01 | Y02 | Y03 | |  |  |  |  | |  |  |  |  | | 실제  주문 지점 |  |  |  |   **2. Using the information given, obtain the reorder point (r) and order quantity (Q).**   |  |  |  |  | | --- | --- | --- | --- | |  | Y01 | Y02 | Y03 | |  | 27 | 23 | 25 | |  | 24 | 32 | 33 |   (Q, r)모델에서는 고정된 lead time을 고려한다. 지속적인 inventory level 관찰로, reorder point에 도달하면 Q만큼 주문한다.  𝜃 계산 이후, p(r), G(r), n(r)을 계산했다.  𝜃 = expected demand during replenishment lead time =   |  |  |  |  | | --- | --- | --- | --- | |  | Y01 | Y02 | Y03 | | 𝜃 | 22 | 29 | 29.333333 |   𝑝(𝑟) = density function of demand during lead time  𝐺(𝑟) = cumulative distribution function of demand during lead time  이 두 값은 초기값이 매우 작기 때문에, 소수 넷째자리에서 올림을 수행했다.  𝑛(𝑟) = expected quantity by which lead-time demand exceeds the base stock level  =  이후, iteration을 반복하며 reorder point (r\*) and order quantity (Q\*)를 찾았다.  초기값으로 은 EOQ를 사용한다.  , 계산 후, 인 최소의 r 값 을 찾았다.  이면 iteration 종료, 아니면 n을 1 증가시키고 반복한다.   |  |  |  |  | | --- | --- | --- | --- | |  | Y01 | Y02 | Y03 | | (Q, r) calculation |  |  |  |   (1)번 문제에서와 같이 D를 계산할 때 이미 보유하고 있는 initial inventory를 고려하고, h를 계산할 때 기간을 맞추기 위하여 Holding cost에 Total planning horizon T를 곱한 값을 이용했다.  **3. Based on the results obtained, establish an operational plan for historical data of each product and show whether the results can satisfy the customer demands. (Make 2 tables for each product, total of 6 tables)**  -Y01  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 312 | 13 | 284 | 64 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 15894 | | 9360 | 1950 | 1704 | 2880 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 378 | 14 | 457 | 0 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 16182 | | 11340 | 2100 | 2742 | 0 |   -Y02  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 280 | 14 | 346 | 68 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 20148 | | 11200 | 2100 | 2768 | 4080 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 345 | 15 | 884 | 1 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 23182 | | 13800 | 2250 | 7072 | 60 |   -Y03  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 441 | 21 | 492 | 13 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 31095 | | 22050 | 3150 | 4920 | 975 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 475 | 19 | 439 | 1 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 31065 | | 23750 | 2850 | 4390 | 75 |   Y01, Y02의 경우, EOQ 모델이 (Q, r) 모델보다 total cost가 적게 든다. 이를 살펴보면, (Q, r) 모델은 주문량을 늘림으로써(24→27, 20→23) backorder가 거의 0이 되었으나, 그보다 주문과 재고 유지에 드는 비용이 더 크기에 총 비용이 늘었음을 확인할 수 있다.  Y03의 경우, (Q, r) 모델이 EOQ 모델보다 total cost가 적게 든다. 이 역시 주문량을 늘림으로써(21→25) backorder가 단 1개로 줄어 backorder cost에서 비용이 줄었는데, 이 양이 주문과 재고 유지에서 추가된 비용보다 컸기 때문이다.  상품별로, 수요를 충족하는 모델을 선택해야 한다. Y01의 경우 수요(360개)를 EOQ 모델은 기존 재고량 30개를 더한다고 하더라도 총 주문량이 단 312개로 충족하지 못한다. Y02의 경우(수요 320개)도 마찬가지이다. 따라서 비용이 다소 추가되더라도 (Q, r) 모델을 선정하는 것이 바람직하다. Y03의 경우(수요 470개) EOQ 모델도 기존 재고량을 더하면 수요를 만족한다. 그러나 이 경우 (Q, r) 모델이 총 비용이 더 적으므로 이를 선택하는 것이 바람직하다.  즉, 모든 상품에 대하여 (Q, r) 모델로 operational plan을 세우는 것이 고객의 수요를 만족하며 비용을 줄이는 방법이다.  **4. What is the cause if inventory shortages or excess inventory occur despite using EOQ or (Q, r) model? Describe based on assumptions for EOQ and (Q, r).**  EOQ 모델은 다음과 같은 가정을 필요로 한다.  • **Constant** and continuous demand  • Constant ordering and holding cost  • Zero lead time  • No shortages are allowed  (Q, r) 모델은 다음과 같은 가정을 필요로 한다.  • Random & **stationary** demand  • Fixed Lead time  • Inventory level: continuous review  두 모델 모두 수요를 실시간으로 반영하는 것이 아니라, 단위 시간 당 일정한 수요가 발생한다는 가정을 필요로 한다. EOQ 모델은 정해진 주기마다 일정량을 주문하고, (Q, r)모델은 lead time을 고려하여 reorder point 지점에서 일정량을 주문한다. 즉, 안전재고가 존재하는 것이다. 이에 따라 EOQ 모델에 비해 inventory shortages가 적다.  그러나, 문제와 같이 실제에서는 수요가 일정하지 않고 변화한다. 따라서 이를 실시간으로 포착하지 않고, 기존 데이터로 내린 결정을 따르는 두 모델에서는 모두 실제 수요가 많으면 inventory shortages, 수요가 적으면 excess inventory가 발생하는 것이다.  **5. Mr. Smith obtained demand data with same mean, but daily demand with more fluctuations from Question #3 demand data (Table 5, Table 6, Table 7). Establish an operational plan for each product and show whether the results can satisfy the customer demands. (Make 2 tables for each product, total of 6 tables)**  -Y01  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 312 | 13 | 260 | 132 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 18810 | | 9360 | 1950 | 1560 | 5940 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 378 | 14 | 447 | 1 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 16167 | | 11340 | 2100 | 2682 | 45 |   -Y02  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 280 | 14 | 478 | 22 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 18444 | | 11200 | 2100 | 3824 | 1320 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 345 | 15 | 627 | 3 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 21246 | | 13800 | 2250 | 5016 | 180 |   -Y03  **<** EOQ **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 441 | 21 | 546 | 44 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 33960 | | 22050 | 3150 | 5460 | 3300 |   **<** (Q, r) **>**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Total order quantity | Total order frequency | Total inventory | Total backorder | Total cost | | 475 | 19 | 486 | 25 | | Total purchase cost | Total ordering cost | Total inventory cost | Total backorder cost | 33335 | | 23750 | 2850 | 4860 | 1875 |   이전 상황과 비교하여 수요의 평균은 같지만 변동이 더 큰 상황이다. 해석은 크게 달라지지 않는다.  Y02의 경우, EOQ 모델이 (Q, r) 모델보다 total cost가 적게 든다. 이를 살펴보면, (Q, r) 모델은 주문량을 늘림으로써(20→23) backorder가 거의 단 3개로 줄었으나, 그보다 주문과 재고 유지에 드는 비용이 더 크기에 총 비용이 늘었음을 확인할 수 있다.  Y01, Y03의 경우, (Q, r) 모델이 EOQ 모델보다 total cost가 적게 든다. 이 역시 주문량을 늘림으로써(24→27, 21→25) backorder가 EOQ 모델보다 크게 줄어 backorder cost에서 비용이 줄었는데, 이 양이 주문과 재고 유지에서 추가된 비용보다 컸기 때문이다.  상품별로, 수요를 충족하는 모델을 선택해야 한다. Y01의 경우 수요(360개)를 EOQ 모델은 기존 재고량 30개를 더한다고 하더라도 총 주문량이 단 312개로 충족하지 못한다. Y02의 경우(수요 320개)도 마찬가지이다. 따라서 비용이 다소 추가되더라도 (Q, r) 모델을 선정하는 것이 바람직하다. Y03의 경우(수요 470개) EOQ 모델도 기존 재고량을 더하면 수요를 만족한다. 그러나 이 경우 (Q, r) 모델이 총 비용이 더 적으므로 이를 선택하는 것이 바람직하다. 단, 이전과 달리 수요의 변동이 커짐에 따라 backorder가 25개 발생하긴 했다.  즉, 이번에도 모든 상품에 대하여 (Q, r) 모델로 operational plan을 세우는 것이 고객의 수요를 만족하며 비용을 줄이는 방법이다. 그러나 수요의 변동이 커짐에 따라 backorder와 재고가 증가하여 추가적인 비용이 발생한다.  추가로, 모든 상품을 주문할 때 드는 총 비용을 생각해보자.  - Q#3(작은 변동)  EOQ 모델 15894 + 20148 + 31095 = 67,137 / (Q, r) 모델 16182 + 23182 + 31065 = 70,429  - Q#5(큰 변동)  EOQ 모델 18810 + 18444 + 33960 = 71,214 / (Q, r) 모델 16167 + 21246 + 33335 = 70,748  즉, (Q, r) 모델이 수요의 변동에 덜 민감하다는 것까지 확인할 수 있다.  **6. We identified that EOQ and (Q, r) model showed poor performance with demand fluctuations. Suggest a methodology for an order plan to minimize the cost considering the demand fluctuation occurring in real life.**  앞서 Q#4에서 설명했듯, 실제에서는 수요가 일정하지 않고 변화하기에 두 모델에서는 모두 실제 수요가 많으면 inventory shortages, 수요가 적으면 excess inventory가 발생하고, 이에 따라 추가적인 비용을 부담하게 된다.  따라서, 현실에서의 수요 변동성을 고려하여 비용을 줄이는 방법이 존재한다. L4L, FPD와 같은 모델을 사용한다면 변화하는 수요에 보다 잘 대처하여 비용을 절감할 수 있다.  - Lot-for-lot (L4L) 모델:  L4L 모델은 생산 주기에 필요한 정확한 수량만큼 생산하는 방식이다. 이 모델은 재고량을 줄일 수 있지만, 잦은 수요 예측을 필요로 하며 주문을 자주 하기에 setup cost가 클 경우 큰 비용이 들 수 있다. 그러나 매번 수요만큼 주문하기에, 수요의 변동에는 잘 대처할 수 있다.  - Fixed period demand (FPD) 모델:  FPD 모델은 EOQ 모델과 유사하지만, 생산량을 일정한 기간동안 필요한 양만큼 생산하는 방식이다. 이 모델은 EOQ 모델보다 더 현실적인 수요 예측을 기반으로 하며, 생산 계획을 일정 기간동안 분할하여 수행함으로써 보다 안정적인 재고 관리가 가능하다. 이 역시 변화하는 수요를 반영하는 모델이다.  추가로, Wagner-Whitin이라는 알고리즘은 제한된 생산 용량과 일정한 수요를 갖는 상황에서 최소 비용 생산 계획을 찾는 알고리즘이다. 이 알고리즘은 동적 계획법을 기반으로 최적해를 찾아준다.  나아가, 추세와 계절성 등 시계열적 요소를 파악한 수요 예측과 인공지능을 활용한 수요 예측을 통해 수요 변동성에 대처할 수 있다. |