Manufacturing System Analysis Experiment

MRP

1. Experiment Overview

■ Title

Development and nervousness observation of MRP using Excel

■ Objective

- Understanding the concept and fundamental of MRP
- Developing the MRP for the product with simple BOM structure in Excel
- Analyzing the nervousness of MRP by observing the changes in MRP calculation results according to the changes in demand

2. Theoretical Background

■ Material Requirement Planning (MRP)

- One of the production management tasks
- First appeared in 1970s, but had difficulty in application due to lack of database technology
- Technique to manage the material flow from raw material to final product
- **To supply the needed resource(what) of needed amount (how much) at needed time (when) to needed place (where)**
- Allow supply and demand for materials responding promptly to changes
- Continued to MRP (Material Resource Planning) II concept in 1980s
- Currently, combined to ERP (Enterprise Resource Planning)

2. Theoretical Background

- **Assumptions**
  - Known deterministic demands
  - Fixed, known production lead times
  - Infinite capacity

2. Theoretical Background

- **Key terms**
  - Netting : net requirements against projected inventory
  - Lot sizing : planned order quantities
  - Time phasing : panned orders backed out by lead time
  - BOM Explosion : gross requirements for components

2. Theoretical Background

■ Lot sizing types

1. Lot-for-lot

- The simplest lot sizing rule
- Simply produce in period t the net requirements for period t
- No inventory at the end of any period

2. Theoretical Background

■ Lot sizing types (cont.)

2. Fixed Order Quantity

- To order a predetermined quantity whenever an order is placed
- Choosing an appropriate fixed order quantity is very similar to EOQ problem, however, in the EOQ model, it assumes a constant demand rate whereas in MRP, demand need not be constant
- We can make use of the EOQ model by replacing the constant demand of that model with an estimate of the average demand $\bar{D}$

$$Q = \sqrt{\frac{2A\bar{D}}{h}}$$

$$A = setup\ cost, \qquad h = inventory\ carrying\ cost$$

2. Theoretical Background

■ Lot sizing types (cont.)

3. Fixed Order Period

- If we are going to produce in period t, then produce all the demand for period t, t+1, …, t+P+1, where P is a parameter of the policy. If P = 1, the policy is lot-for-lot.
- If there are periods with no demand, they are skipped
- The way to determine an optimal value for P is from EOQ model

$$Q = \sqrt{\frac{2A\bar{D}}{h}} \qquad and \qquad P = \frac{Q}{D}$$

2. Theoretical Background

■ Lot sizing types (cont.)

4. Part-Period Balancing

- To balance the inventory carrying cost and setup cost
- That is, making the inventory carrying cost as close to the setup cost as possible

2. Theoretical Background

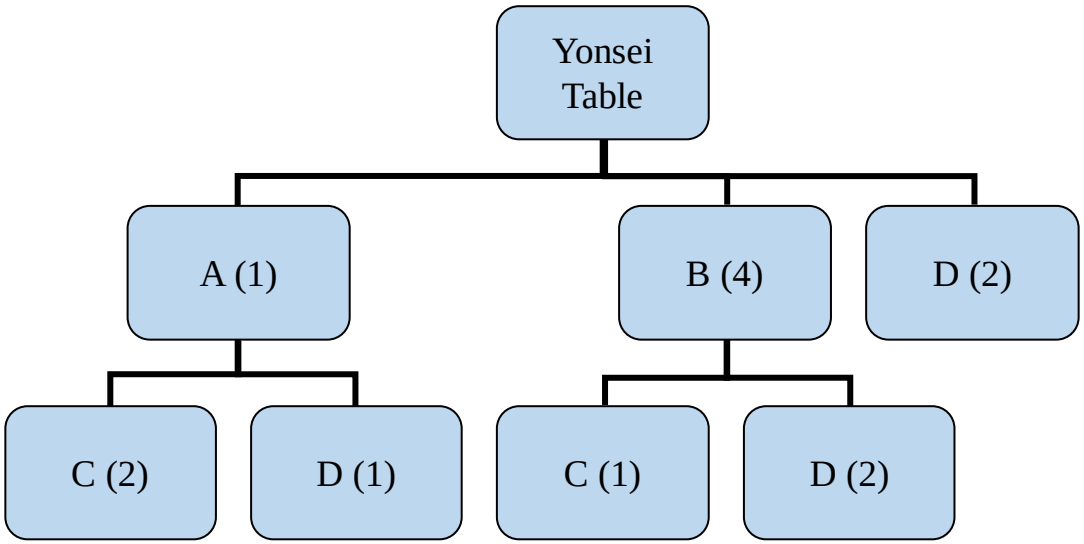
- **Inputs**
  - Master Production Schedule(MPS): due dates and quantities for all top level items
  - Bills of Material (BOM): for all parent items
  - Inventory Status: (on hand plus scheduled receipts) for all items
  - Planned Lead times: for all items

3. Experiment Design

Yonsei Co. is the company that produces tables. BOM (Bill Of Materials) for the items needed to make tables is given the next slide. This company uses MRP to manage the inventory, and all the items are ordered using [Lot-for-Lot]. However, conditions are changing. Company wants to try different lot sizing rules for the Item C and D because their production is fluctuating. Company considers [Fixed Order Quantity] as another lot sizing rule. If [Fixed Order Quantity] is used for Item C and D, order quantity Q would be 1500 and 1400 each. If you were to make a recommendation to Yonsei Co., which lot sizing rule would you choose? Explain by comparing [Lot-for-Lot] and [Fixed Order Quantity].

3. Experiment Design

- **BOM (Bill Of Materials)**



3. Experiment Design

- **MPS (Master Production Schedule) for Tables of Yonsei Co.**

Week	3	7	11	12	15
Demand	160	180	170	50	160

- **Item Master and Inventory Data**

Item	Lead time	Projected on-hand	Scheduled receipt	
			amount	week
Table	1	40		
A	1	0	80	14
B	2	500		
C	3	300	40	9
D	1	320	200	5
			120	13

4. Experimental Procedure

Step 1. Make a table to insert given data

Table	
Lead time	1
On-hand	40
Scheduled receipt	0

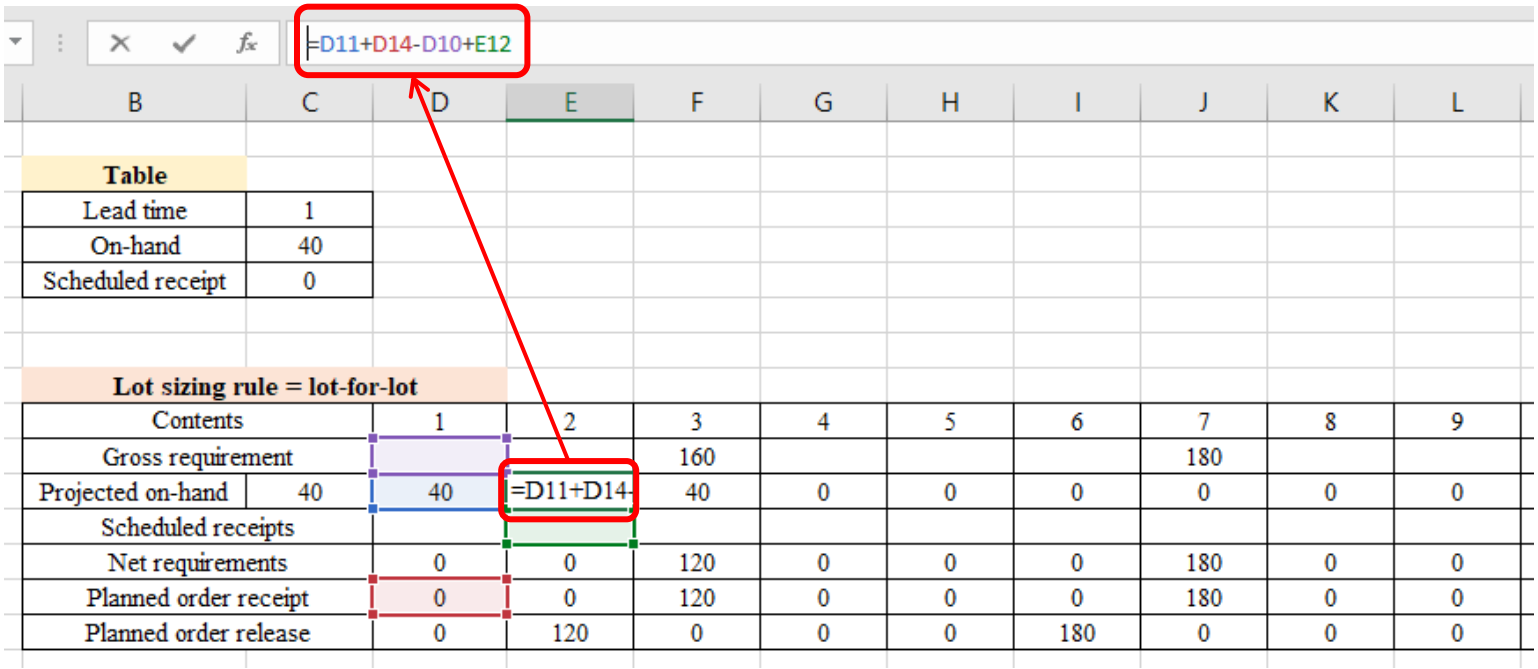
Lot sizing rule = lot-for-lot

Contents		1	2	3	4	5	6	7	8	9	10	11	12	13
Gross requirement				160				180				170	50	
Projected on-hand	40	40	40	40	0	0	0	0	0	0	0	0	0	0
Scheduled receipts														
Net requirements		0	0	120	0	0	0	180	0	0	0	170	50	0
Planned order receipt		0	0	120	0	0	0	180	0	0	0	170	50	0
Planned order release		0	120	0	0	0	180	0	0	0	170	50	0	0

4. Experimental Procedure

Step 2. Projected on-hand at time t

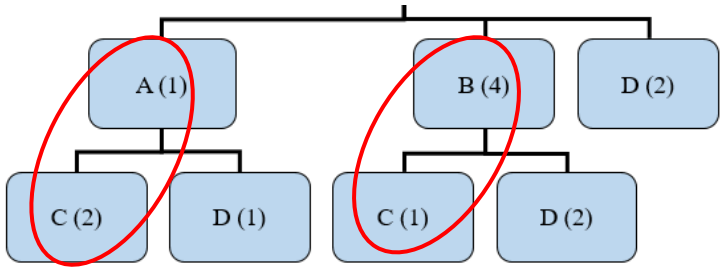
= [(Projected on-hand + Planned order receipt – Gross requirements) of t – 1] + [Scheduled receipt of t]



4. Experimental Procedure

Step 3. Gross requirement

= Planned or release of upper level item * number of item required



=2*D10+D11

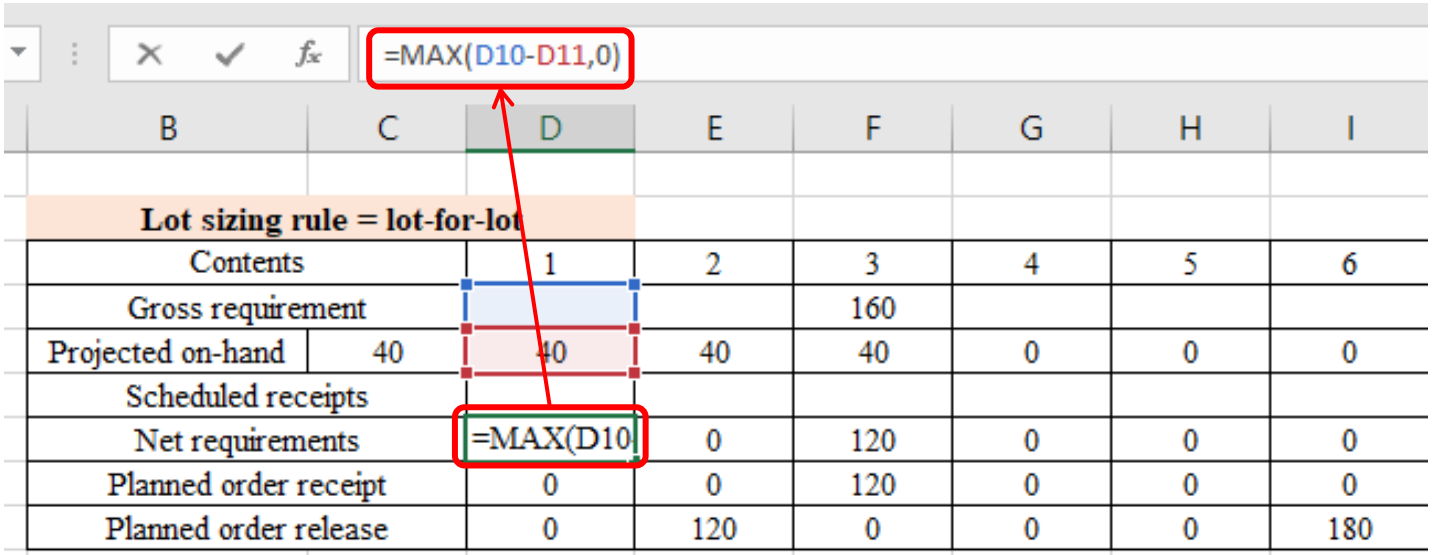
B	C	D	E	F	G	H	I
Lot sizing rule = lot-for-lot							
Contents		1	2	3	4	5	6
Order release A		120	0	0	0	180	0
Order release B		0	0	0	700	0	0
Gross requirement		=2*D10+D	0	0	700	360	0
Projected on-hand	300	300	60	60	60	0	0
Scheduled receipts							
Net requirements		0	0	0	640	360	0
Planned order receipt		0	0	0	640	360	0
Planned order release		640	360	0	0	680	500

4. Experimental Procedure

Step 4. Net requirement

= Gross requirement – Projected on-hand

Net requirement is positive value (MAX function)

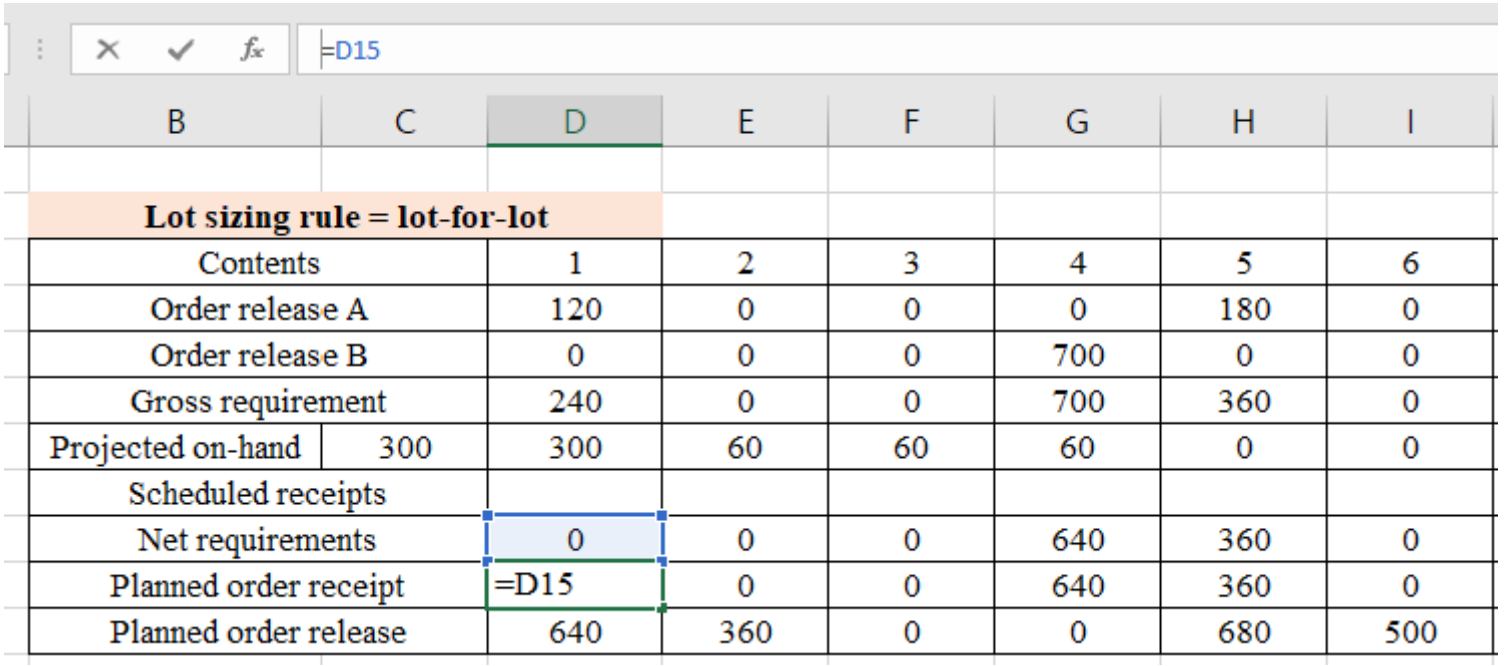


4. Experimental Procedure

Step 5. Planned order receipt

a. [Lot-for-Lot] case

Planned order receipts = Net requirements



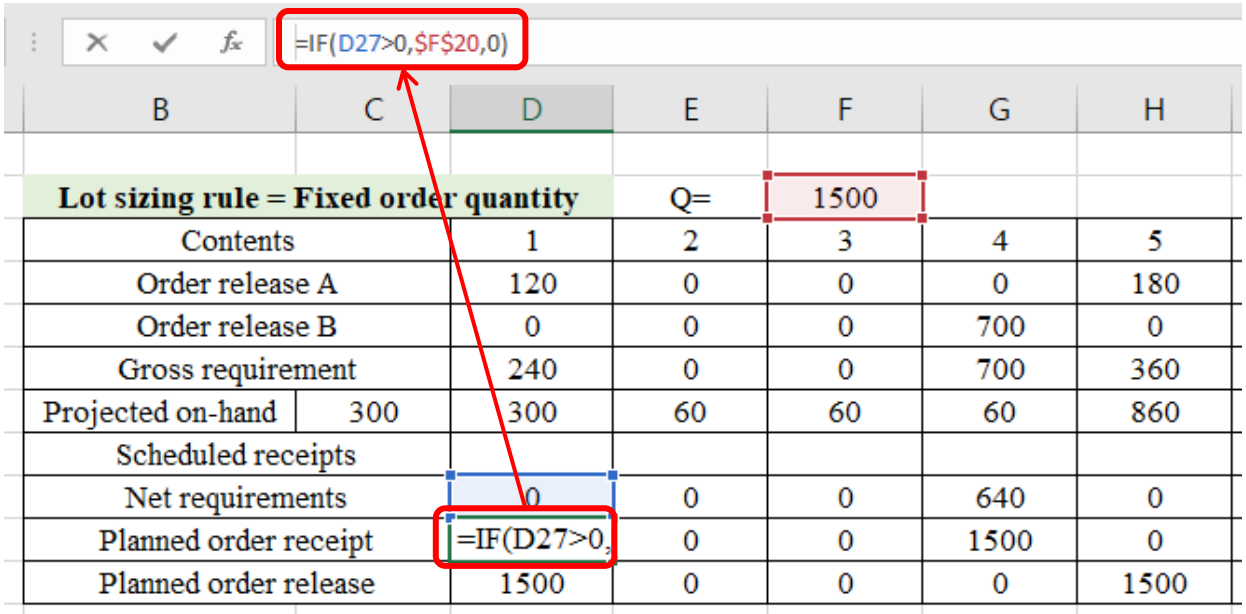
4. Experimental Procedure

Step 5. Planned order receipt

b. [Fixed order quantity] case

If net requirements is bigger than 0, order fixed order quantity Q (IF function)

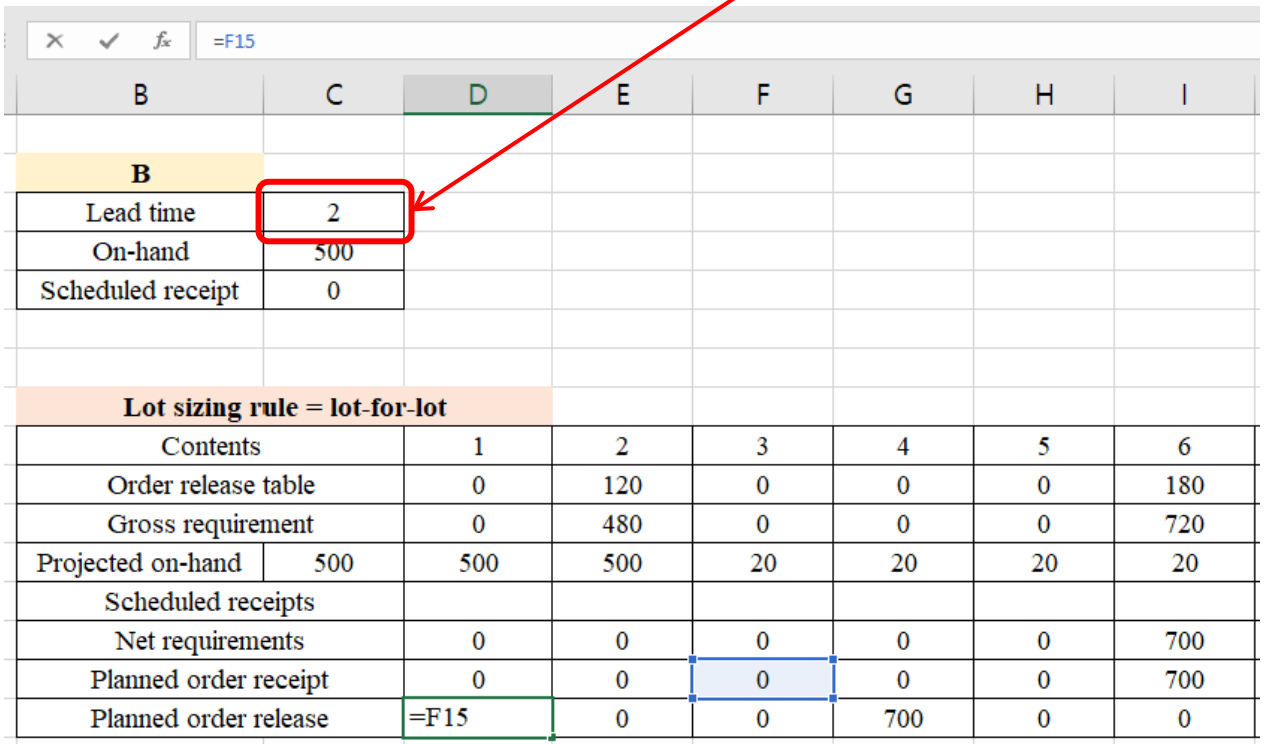
(Q for Item C = **1500,** Q for Item D = **1400**)



4. Experimental Procedure

Step 6. Planned order release

Same as Planned order receipt, but consider the **Lead time**



B	
Lead time	2
On-hand	500
Scheduled receipt	0

Lot sizing rule = lot-for-lot							
Contents		1	2	3	4	5	6
Order release table		0	120	0	0	0	180
Gross requirement		0	480	0	0	0	720
Projected on-hand	500	500	500	20	20	20	20
Scheduled receipts							
Net requirements		0	0	0	0	0	700
Planned order receipt		0	0	0	0	0	700
Planned order release		=F15	0	0	700	0	0

4. Experimental Procedure

Step 7. Repeat the same steps for all items

Step 8. Compare the MRP results when lot sizing rule is [Lot-for-Lot] and [Fixed Order Quantity] for Item C and D

5. Experimental Result & Analysis

1) **Compare the changes in production policy for Item C and D when Lot sizing Rule is [lot-for-lot] or when it is [fixed order quantity].**

2) **When demand is changing as shown in the Table below, compare the two Lot Sizing Rules for Item C and D: [lot-for-lot] and [fixed order quantity]. Find out which is more sensitive and analyze the reason.**

Week	2	7	11	12	17
Demand	100	150	120	100	90

6. Discussion & Conclusion

1) **Explain what nervousness is for MRP system, and discuss why it occurs.**

2) **Despite the nervousness of the MRP system, many manufacturers producing different number of parts use the MRP to manage the system efficiently. Consider ways to reduce the nervousness of the MRP system.**

Q & A