Production Management (ME-419)

Guest Speaker

Amin Kaboli

Week 6 – Session 1 – Oct 17th, 2024

Production Management (ME-419)

Module 2 – Demand Management

Optimizing Smoothing Coefficients & Demand Plan

Amin Kaboli

Week 6 – Session 2 – Oct 17th, 2024

Indicative Feedback

Course Framework

Business plan
Strategic plan
Financial plan

Production Management (ME-419)

Module 1	Module 2	Module 3	Module 4	
Introduction to PM	Demand Management	Supply Management	Digital Transformation	Final Presentation
Sep	**Sep-Oct**	**Oct-Nov**	**Dec**	**Dec 18th & 20th**
Value Adding Network Production Process Flows, Bill of materials, Production procedures, Value adding activities	Demand disruptions Forecasting Methods Qualitative methods Quantitative methods Demand plan	Supply disruptions Production Planning AP, MPS, MRP Capacity Planning Inventory Management Supply Plan	Digital technologies for PM, Demand and Supply Analytics, From Products to Ecosystems	Final presentation & solid understanding of the course

Demand Management – Forecasting Steps

Demand forecast at the item and aggregate levels

Goal: What is the purpose of the forecast (Type of products, Granularity, Horizon)

Data: Obtain, clean, and analyze appropriate data

Method: Select a forecasting method (Qualitative *vs* Quantitative)

Forecast: Make the forecast

Performance: Monitor the forecast errors

Model Initialization – Smoothing Coefficient Optimization

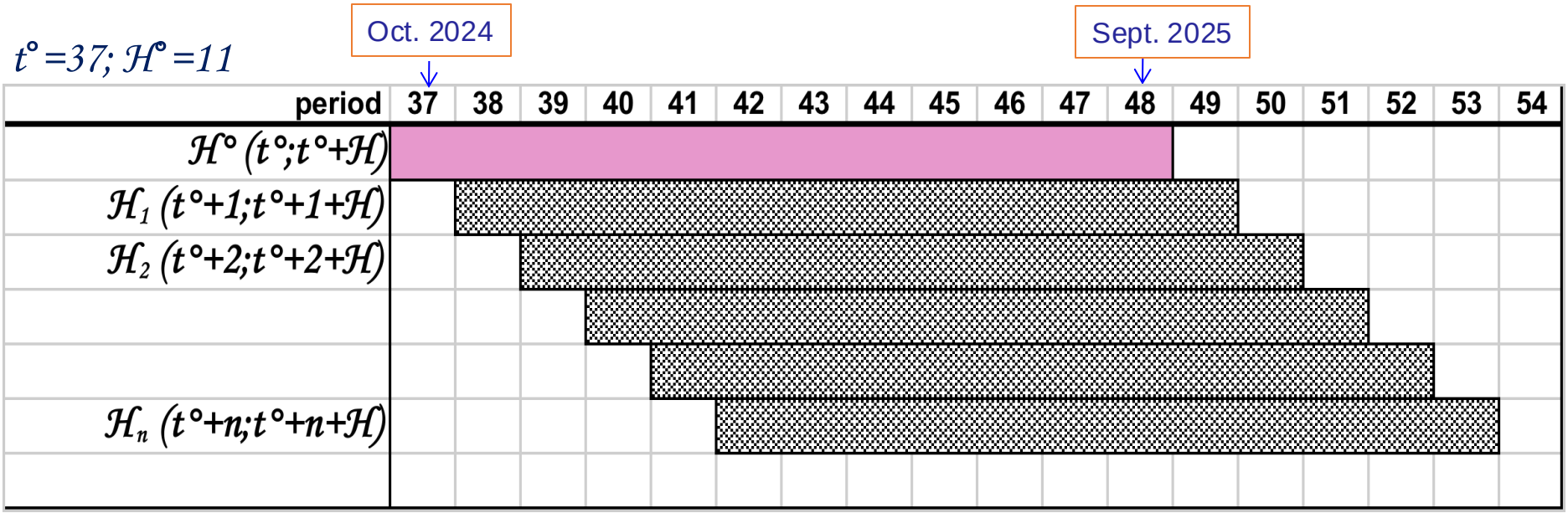
1. Initial forecast model $F'_{t+h} = (B' + hT') \times S'_{t+h}$ Horizon = $\mathcal{H}^\circ\ (t^\circ; t^\circ + \mathcal{H})$

Initial values = B', T', S'

h=1 ; F'$_{36+1}$ = (44'492 + (*1*) * 166)* S' $_{24+1}$

h=1 ; F'$_{37}$ = (44'492 + (*1*) * 166)* S' $_{25}$

h=1 ; F'$_{37}$ = (44'492 + (*1*) * 166)* 1.56 = 69'695

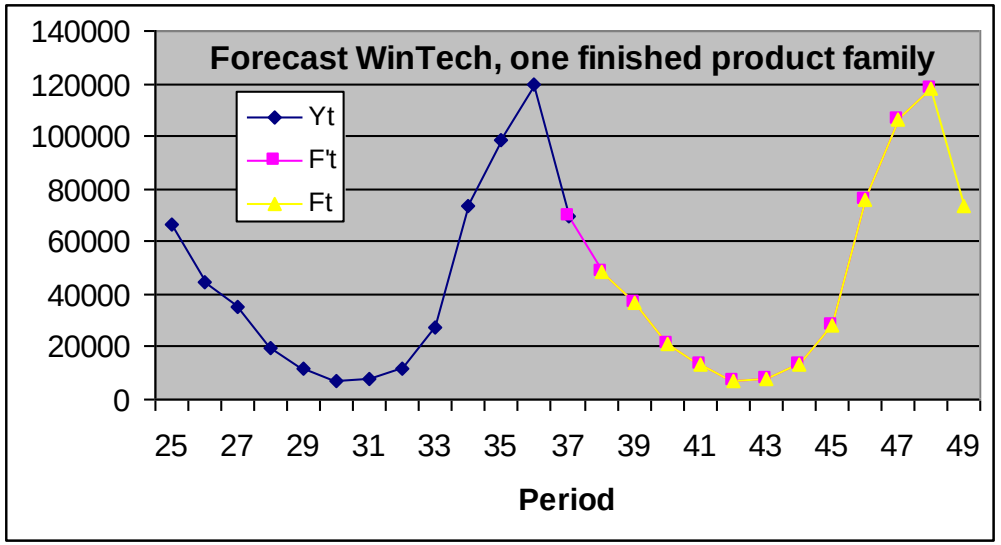


Final Forecast – Demand Plan

1. Initial forecast model $F'_{t+h} = (B' + hT') \times S'_{t+h}$

2. Running forecast model (cycle 1) $F_{t+h} = (B_t + hT_t) \times S'_{t+h}$

3. Running forecast model (cycle 2) $F_{t+h} = (B_t + hT_t) \times S_{t+h-c}$

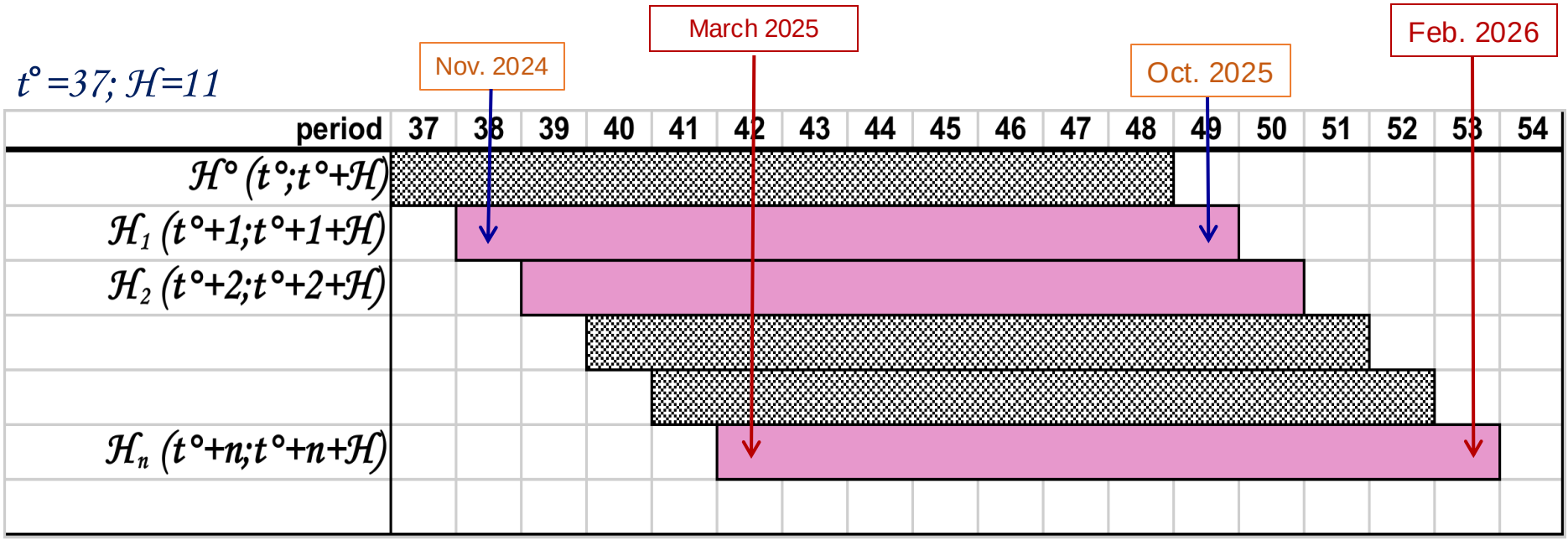


Running Model – Smoothing Coefficient Optimization

2. Following forecast model $F_{t+h} = (B_t + hT_t) \times S'_{t+h}$

Horizon = $\mathcal{H}_1(t^\circ+1;t^\circ+1+\mathcal{H})$; $\mathcal{H}_2(t^\circ+2;t^\circ+2+\mathcal{H})$; $\mathcal{H}_n(t^\circ+n;t^\circ+n+\mathcal{H})$

Adjusted values by exponential smoothing = B_t , T_t



Running Model – Smoothing Coefficient Optimization

2. Running forecast model

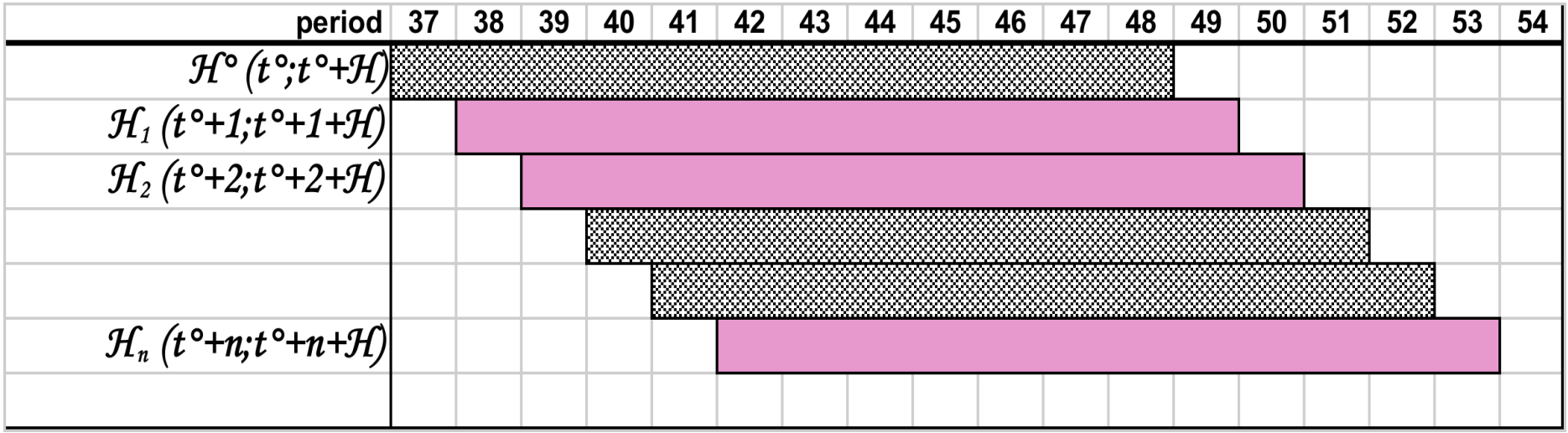
$$F_{t+h} = (B_t + hT_t) \times S'_{t+h}$$

$$B_t = \alpha \frac{Y_t}{S_{t-c}} + (1-\alpha)(B_{t-1} + T_{t-1})$$

$$T_t = \beta(B_t - B_{t-1}) + (1-\beta)T_{t-1}$$

$$S_t = \gamma \frac{Y_t}{B_t} + (1-\gamma)S_{t-c}$$

$t^\circ = 37;\ \mathcal{H} = 11$



Running Model – Smoothing Coefficient Optimization

2. Following forecast model

$$F_{t+h} = (B_t + hT_t) \times S'_{t+h}$$

$$B_t = \alpha \frac{Y_t}{S_{t-c}} + (1-\alpha)(B_{t-1} + T_{t-1})$$

$$T_t = \beta(B_t - B_{t-1}) + (1-\beta)T_{t-1}$$

$$S_t = \gamma \frac{Y_t}{B_t} + (1-\gamma)S_{t-c}$$

The values of α, β influence forecast reliability

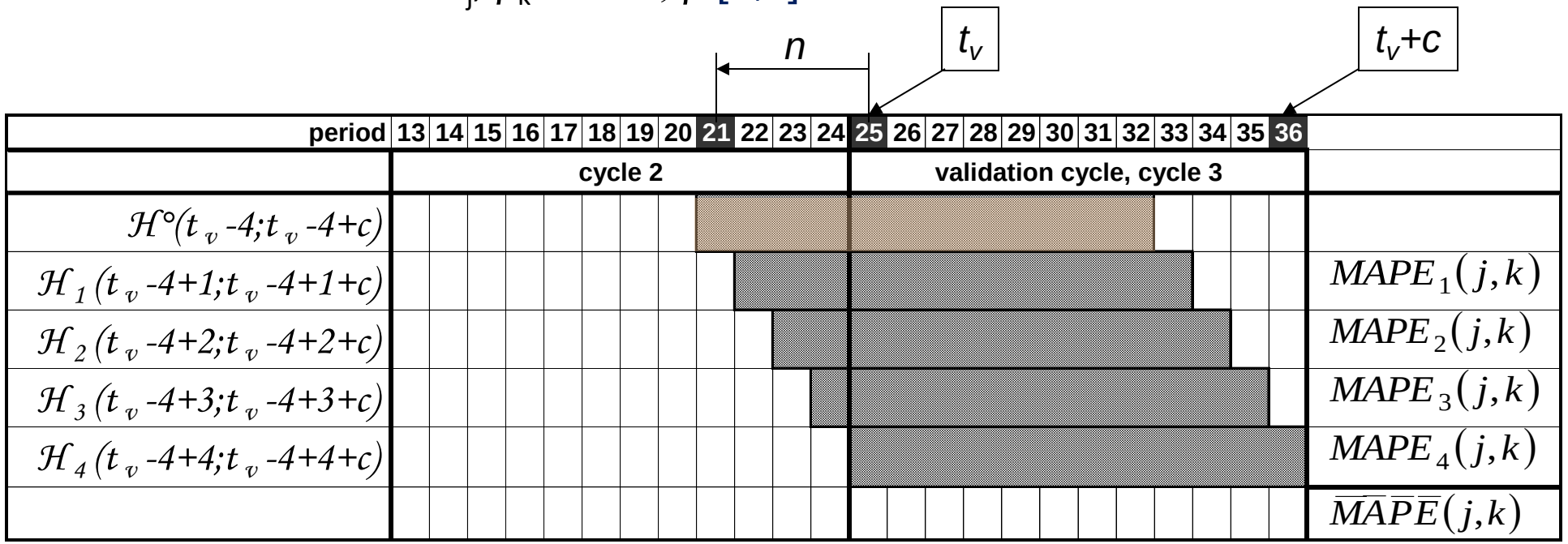
3. Choose set of values $(\alpha, \beta)_0$ that minimizes the forecasting error

Procedure – Smoothing Coefficient Optimization (I)

Step 1. Following Initiate forecast over horizon H at period t_v-n, with n [3;c/2] forecast model

Step 2. Compute initial forecast for the horizon H° (t_v-n; t_v-n+c-1) Initiate forecast over horizon H at period t_v-n, with n [3;c/2] forecast model $F'_{t+h} = (B' + hT') \times S'_{t+h}$ h Î [1;c]

Step 3. Choose set of values α_j, β_k with α, β [0;1]



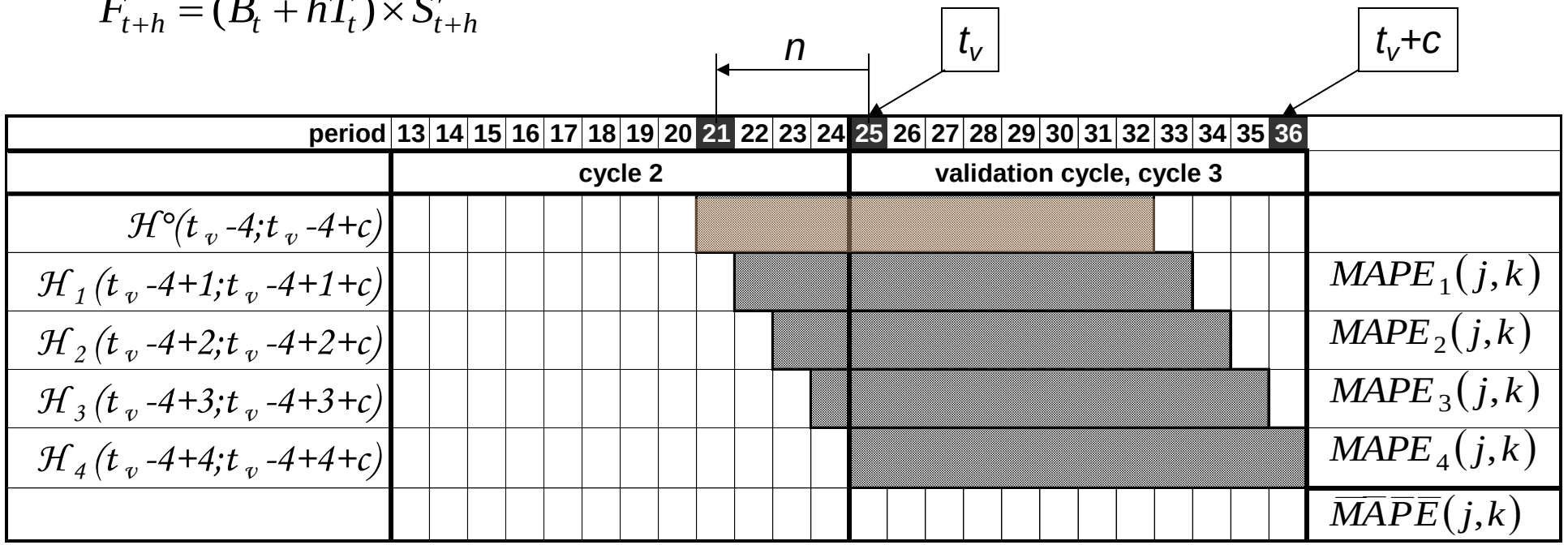
Procedure – Smoothing Coefficient Optimization (II)

Step 4. Compute new forecast over the horizon H1 (tv-n+1;tv-n+c) by adjusting model parameters:

$$B_t = \alpha_j \frac{Y_t}{S_{t-c}} + (1-\alpha_j)(B_{t-1} + T_{t-1})$$

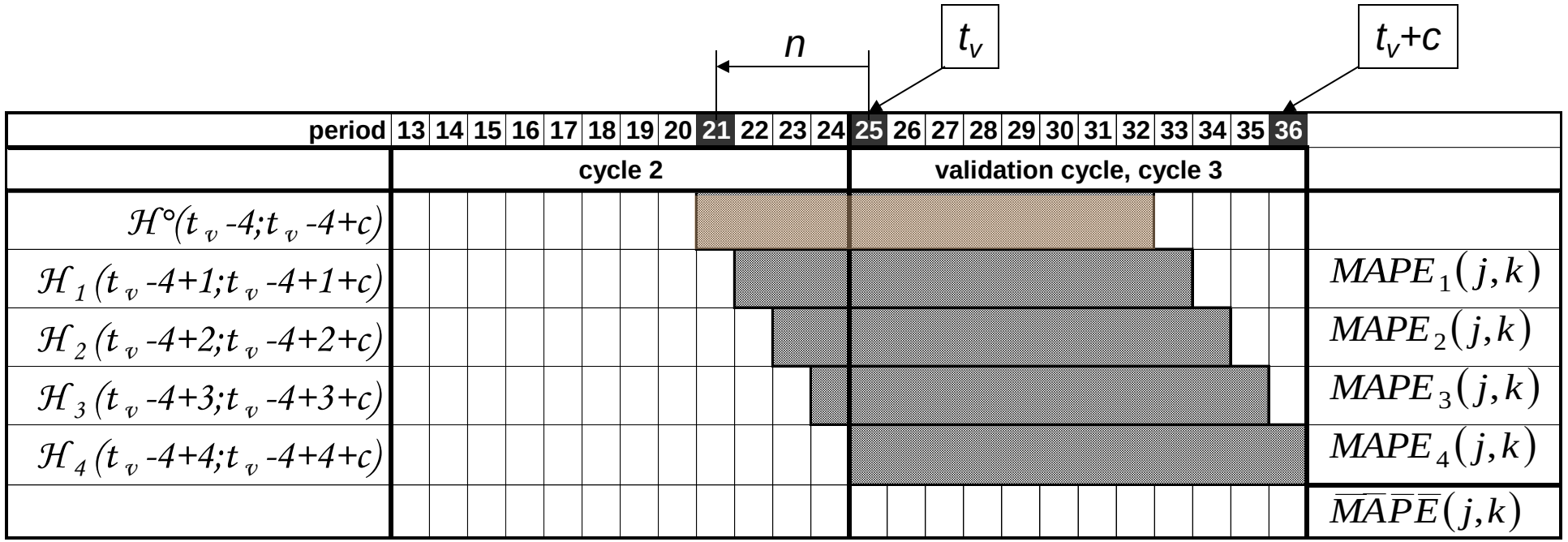
$$T_t = \beta_k (B_t - B_{t-1}) + (1-\beta_k) T_{t-1}$$

$$F_{t+h} = (B_t + hT_t) \times S'_{t+h}$$



Procedure – Smoothing Coefficient Optimization (III)

Step 5. Compute the forecast error: $MAPE_1(j,k)$

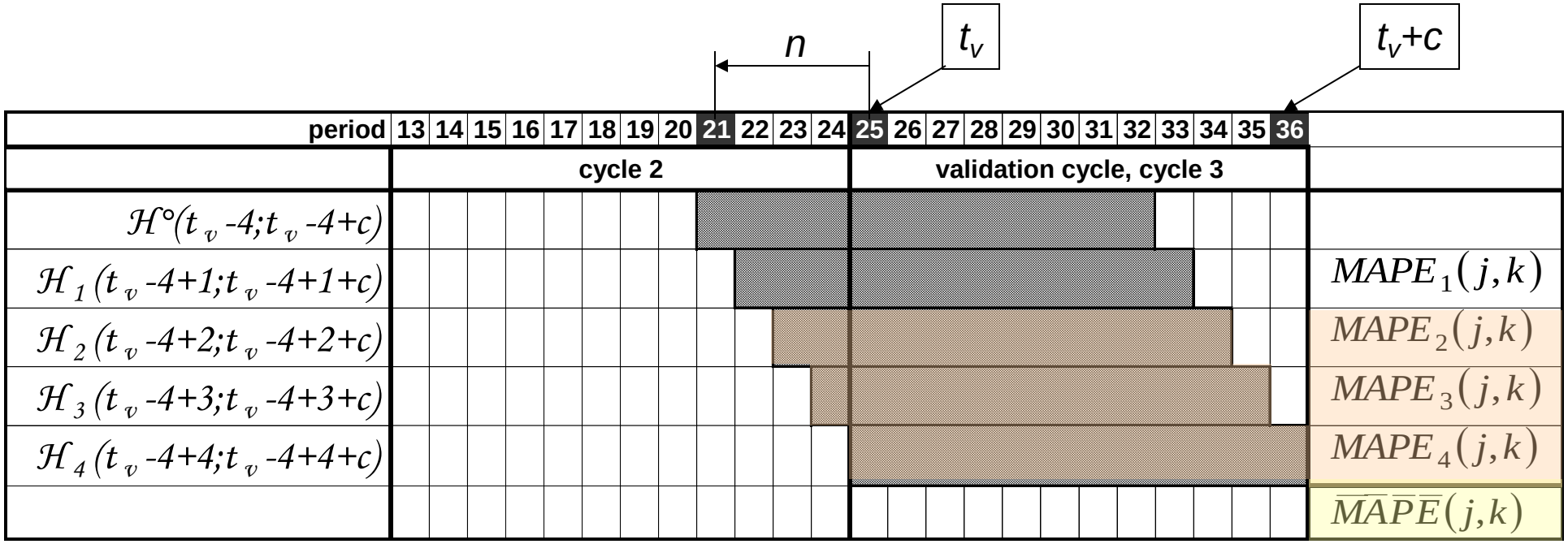


Procedure – Smoothing Coefficient Optimization (IV)

Step 6. Repeat steps 4 to 5 with n other horizons H_q (tv-n+q;tv-n+q+c-1) with q=[2;n]

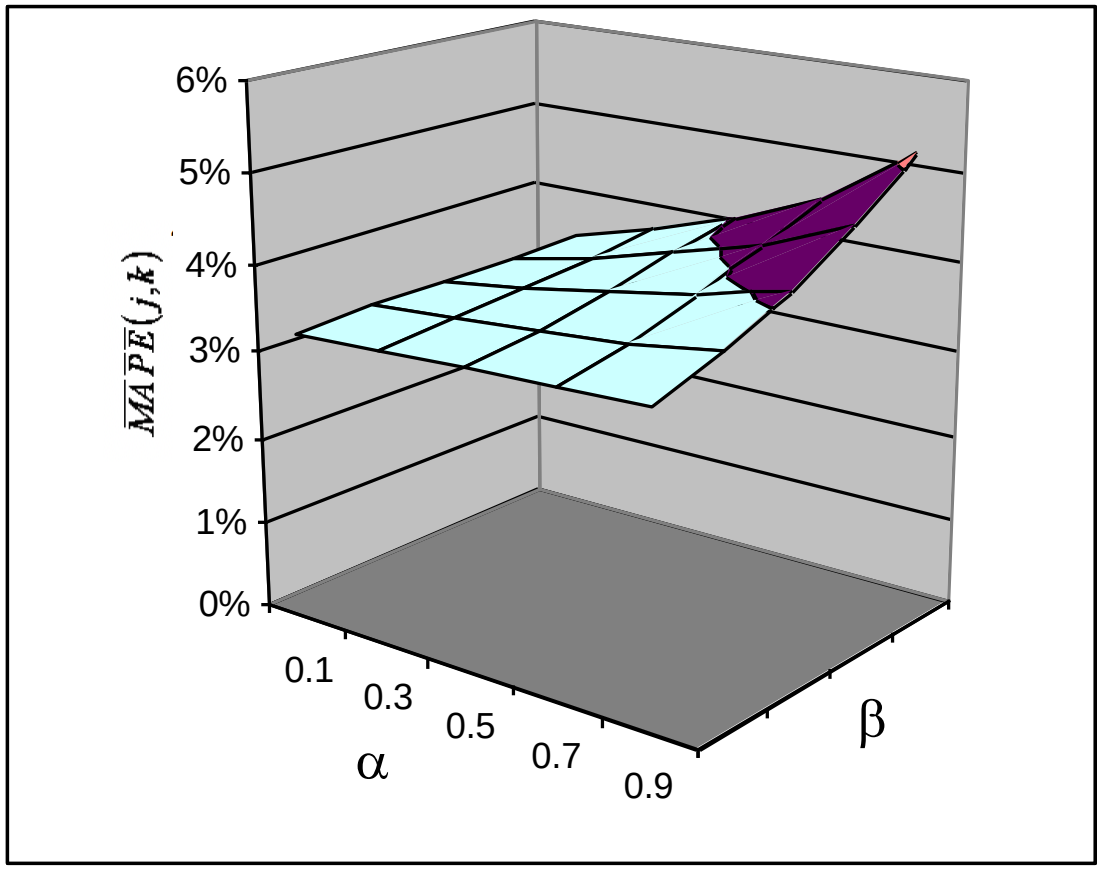
Step 7. Compute average $\overline{MAPE}(j,k)$ of the n forecast horizons

Step 8. Repeat steps 3 to 7 with several other sets of values $a_j, b_k \in [0;1]$



Procedure – Smoothing Coefficient Optimization (V)

Step 9. Plot function $\overline{MAPE}(j,k) = f(a_j, b_k)$



Step 10. Select set $(\alpha, \beta)_0$ that minimizes $\overline{MAPE}(j,k)$

Assignment 6 – Tasks

1) Optimize smoothing coefficients (alpha, beta, Gamma) for running your forecasting model

2) Forecast and update the demand plan of your product families for the next 18 months

3) Measure performance of your forecasting model

4) Implement comments and feedback of your coach

Assignment 6 – Tasks

15 min

1) Identify the demand typology for each product family (constant, cyclic, seasonal, with trend).

2) Test whether there is seasonality in your dataset or not (use auto-correlation)

3) Select a preliminary forecast model (align with task 1 and 2)

4) Compute possible initial trend components

5) Compute possible initial seasonal components

6) Validate the proposed initial model

7) Comment the results of the validation process

8) Set a logic for smoothing coefficients (alpha, beta, Gamma) for running your forecasting model.

9) Forecast the demand of your product (product family level) for the next 18 months.

10) Measure performance of your forecasting model (Use MAPE).

Learning Points of Module 2 – Summary

- How to forecast and predict demand for a company
- What are the main components of demand management
- What are the main challenges of demand management
- Approaches to deal with demand management: Qualitative and Quantitative
- Qualitative: How to turn vision of decision makers into numbers (and remove biases)
- Qualitative: How to use historical data to better plan production for future
- How to create a demand plan
- How to measure the performance of a demand plan

Production Management (ME-419)

Module 2 – Supply Management

Supply Disruptions

Aggregate Planning

Amin Kaboli

Week 6 – Session 2 – Oct 17th, 2024

Course Framework

Business plan
Strategic plan
Financial plan

Production Management (ME-419)

Module 1	Module 2	Module 3	Module 4	
Introduction to PM	Demand Management	Supply Management	Digital Transformation	Final Presentation
Sep	**Sep-Oct**	**Oct-Nov**	**Dec**	**Dec 18th & 20th**
Value Adding Network Production Process Flows, Bill of materials, Production procedures, Value adding activities	Demand disruptions Forecasting Methods Qualitative methods Quantitative methods Demand plan	Supply disruptions Production Planning AP, MPS, MRP Capacity Planning Inventory Management Supply Plan	Digital technologies for PM, Demand and Supply Analytics, From Products to Ecosystems	Final presentation & solid understanding of the course

Module 3 – Supply Management

Objectives

- Understanding the basic principals of supply management
- Mastering the following concepts and tools
    - Production Planning (AP, MPS, MRP)
    - Capacity Planning (RCCP, CPOPF)
    - Inventory Management
- Developing a feasible supply plan

Question?

2 min

How to manage demand variation (change) in your manufacturing company?

How to Manage Demand Variation in Your Company?

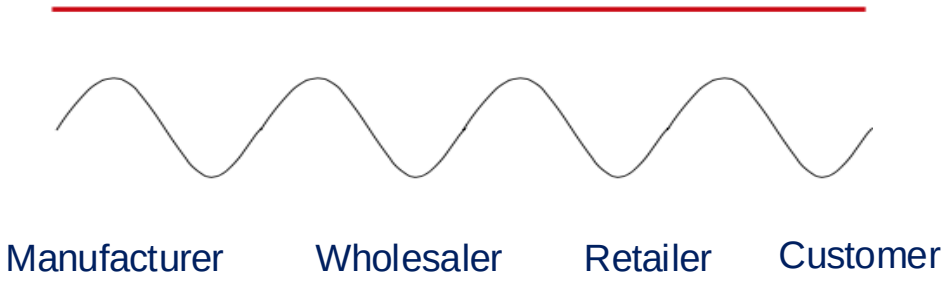
Varying the production rate by introducing overtime and/idle time or outside subcontracting

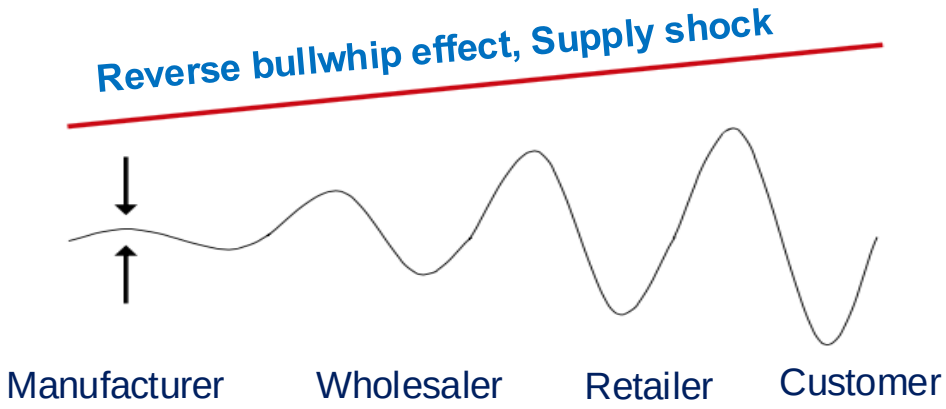
Changing the size of workforce by hiring and firing!

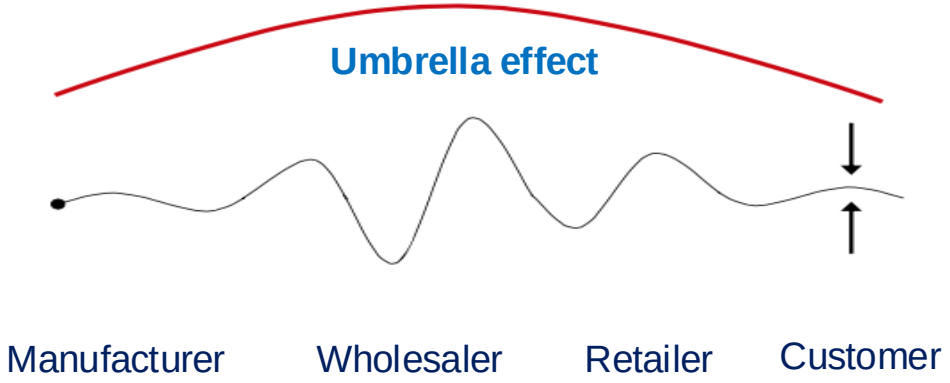
Building up stock

Planning backorders

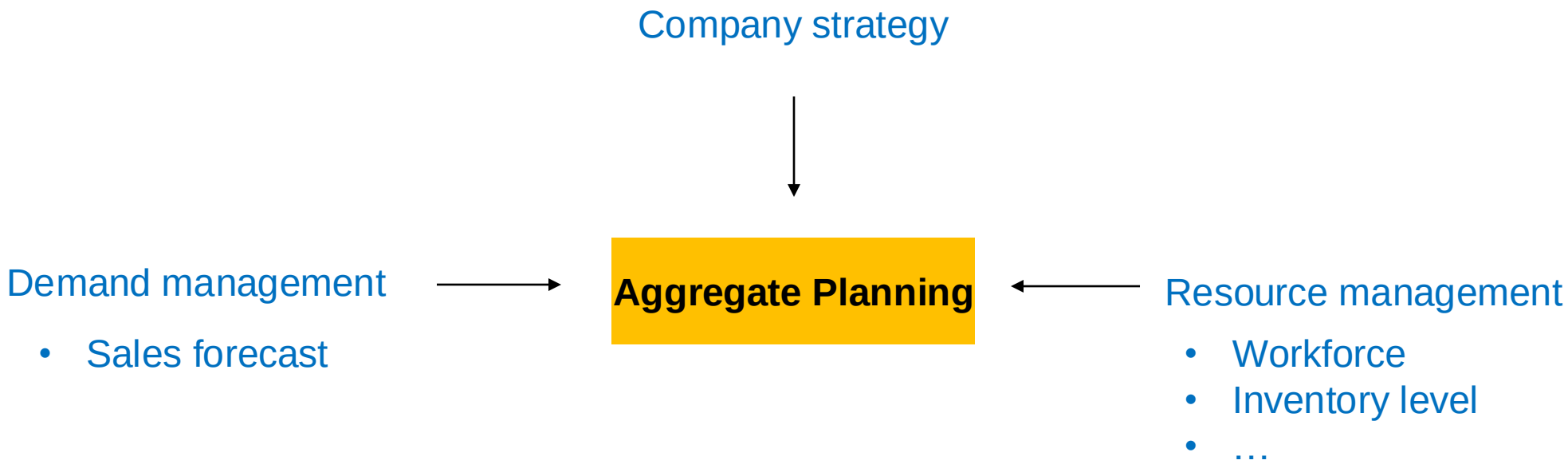
Reminder: Demand & Supply Variations







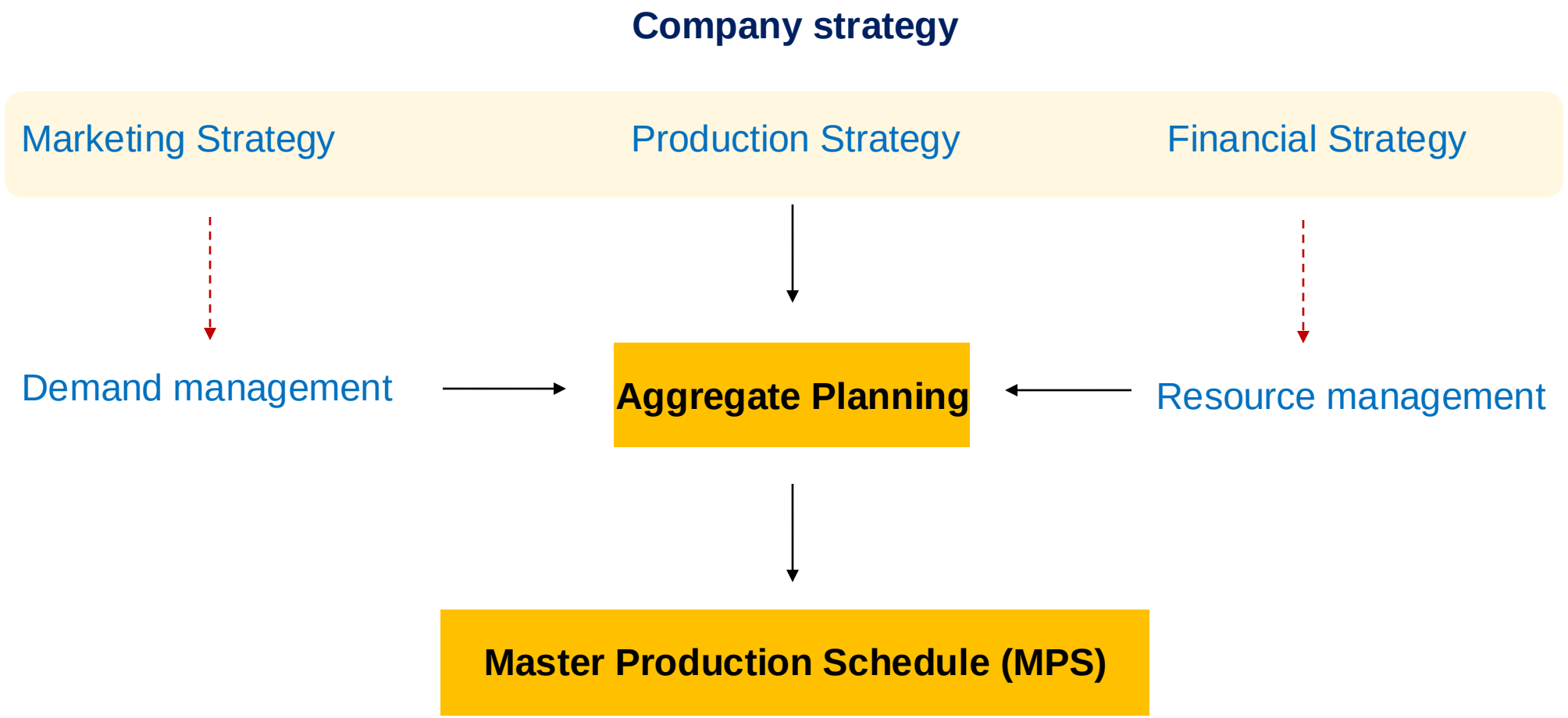
Aggregate Planning (AP)



What is aggregate planning?

It translates business plans into rough labor schedules and production plans.

Aggregate Planning – Extended



Aggregate Planning – Steps

Estimation of market demand

- Product families
- Time period

Resource availability analytics

- Workforce level
- Actual production rate
- Stock availability
- Costs (production, changing workforce, stock)

Developing alternative plans

Aggregate Planning

- **Horizon:** 12 to 18 months
- **Revision:** monthly

Aggregate Planning – Strategies

- **Level plan** (Stable)
  - Constant workforce
  - Similar production quantities each time period
  - Inventories and backorders to absorb demand
- **Chase plan** (Demand following)
  - Variable workforce (hiring & firing)
  - Variable production quantities
  - Minimizing finished good inventories
- **Hybrid plan** (Mixed)
  - Variable workforce (hiring & firing)
  - Stock build up and backorders to level extreme peaks

Aggregate Planning – Costs to be Considered

- **Production costs**

  Fixed & variable costs
  - Material costs
  - Direct labor costs
  - Overhead costs
  - …

- **Changing workforce costs**
  - Hiring workforce
  - Training workforce
  - Firing (laying off) workforce
  - Overtime compensations

- **Stock related costs**
  - Holding costs
  - Backorder costs
  - Loss on goods destroyed

Question: What Does Aggregated Plan do?

Given an aggregate sales forecast (product family level), determine production levels, inventory levels, and workforce levels, in order to minimize total relevant costs over the planning horizon.

Exercise 1: Aggregate Plan Strategies

- **Level plan** (Stable)
- **Chase plan** (Demand following)
- **Hybrid plan** (Mixed)

Task 1: Create an Aggregate plan (all three strategies)

Task 2: Compare the strategies

Level Plan

- Similar production quantities each time period
- Inventories and backorders to absorb demand
- Constant workforce

Beginning Inventory	2'500
Beginning Workforce	18
Labor Standard (units/worker)	250

Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Sales forecast	3'000	6'000	2'000	1'500	4'000	5'500	8'500
Cumulative Sales forecas	3'000	9'000	11'000	12'500	16'500	22'000	30'500
Net Cumulative Sales forecast	500	6'500	8'500	10'000	14'000	19'500	28'000

Production Planning

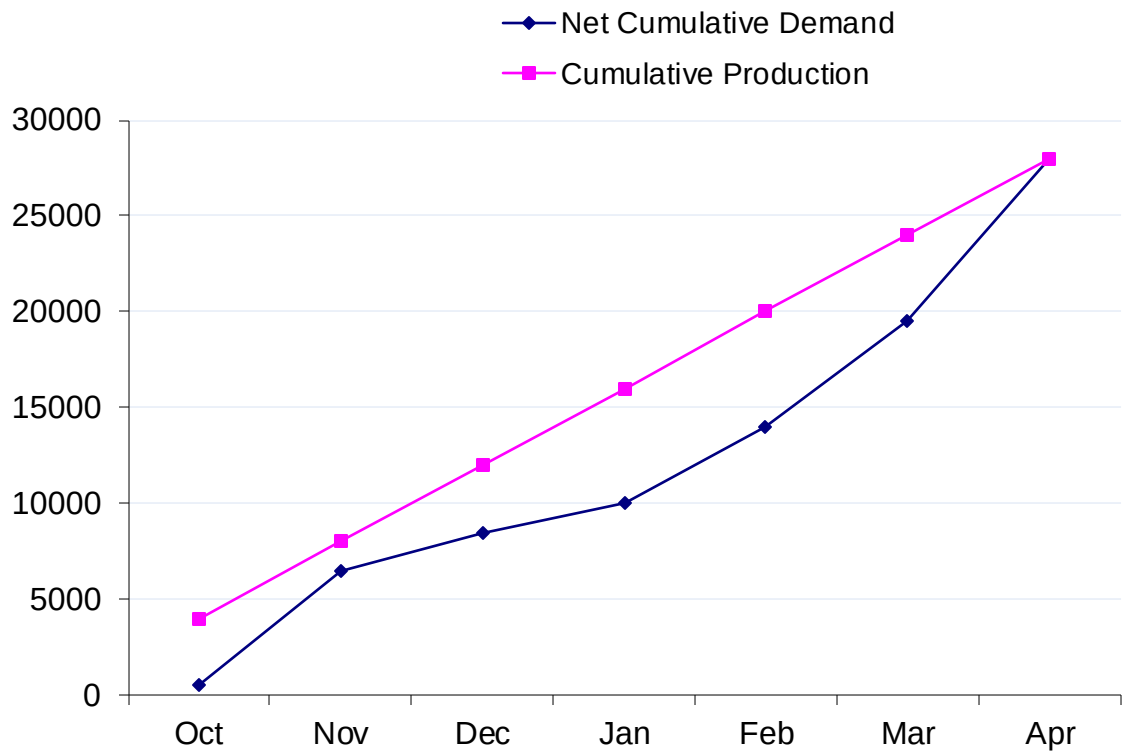
Production	4000	4000	4000	4000	4000	4000	4000
Cumulative Production	4000	8000	12000	16000	20000	24000	28000
Inventory (Excess Units)	3500	1500	3500	6000	6000	4500	0
Backorders (Units Short)	0	0	0	0	0	0	0

Capacity Planning

Workers Hired	0	0	0	0	0	0	0
Workers Layed Off	2	0	0	0	0	0	0
Workforce Available	16	16	16	16	16	16	16

Level Plan

- Similar production quantities each time period
- Inventories and backorders to absorb demand
- Constant workforce



Chase Plan

- Variable production quantities
- Minimizing finished good inventories
- Variable workforce (hiring & firing)

Beginning Inventory	2'500
Beginning Workforce	18
Labor Standard (units/worker)	250

Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Sales forecast	3'000	6'000	2'000	1'500	4'000	5'500	8'500
Cumulative Sales forecas	3'000	9'000	11'000	12'500	16'500	22'000	30'500
Net Cumulative Sales forecast	500	6'500	8'500	10'000	14'000	19'500	28'000

Production Planning

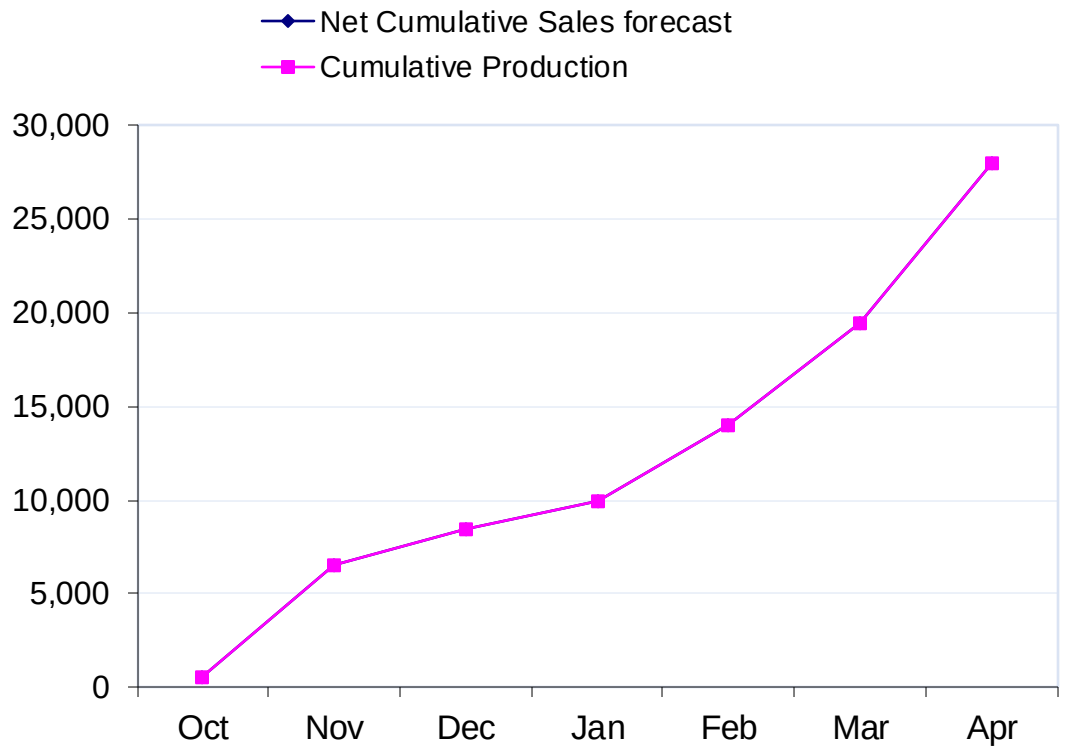
Production	500	6'000	2'000	1'500	4'000	5'500	8'500
Cumulative Production	500	6'500	8'500	10'000	14'000	19'500	28'000
Inventory (Excess Units)	0	0	0	0	0	0	0
Backorders (Units Short)	0	0	0	0	0	0	0

Capacity Planning

Workers Hired	0	22	0	0	10	6	12
Workers laid Off	16	0	16	2	0	0	0
Workforce Available	2	24	8	6	16	22	34

Chase Plan

- Variable production quantities
- Minimizing finished good inventories
- Variable workforce (hiring & firing)



Hybrid Plan

- Stock build up and backorders to level extreme peaks
- Variable workforce (hiring & firing)

Beginning Inventory	2'500
Beginning Workforce	18
Labor Standard (units/worker)	250

Period	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Sales forecast	3'000	6'000	2'000	1'500	4'000	5'500	8'500
Cumulative Sales forecas	3'000	9'000	11'000	12'500	16'500	22'000	30'500
Net Cumulative Sales forecast	500	6'500	8'500	10'000	14'000	19'500	28'000

Production Planning

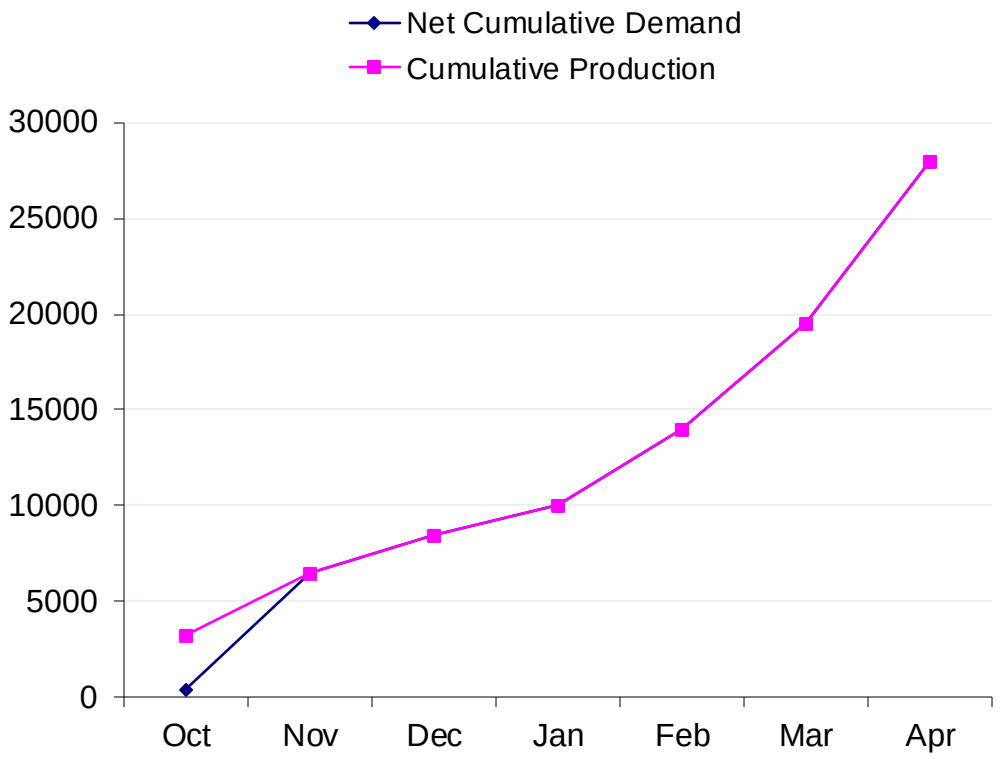
Production	3250	3250	2000	1500	4000	5500	8500
Cumulative Production	3250	6500	8500	10000	14000	19500	28000
Inventory (Excess Units)	2750	0	0	0	0	0	0
Backorders (Units Short)	0	0	0	0	0	0	0

Capacity Planning

Workers Hired	0	0	0	0	10	6	12
Workers Layed Off	5	0	5	2	0	0	0
Workforce Available	13	13	8	6	16	22	34

Hybrid Plan

- Stock build up and backorders to level extreme peaks
- Variable workforce (hiring & firing)



Plan Comparison

- **Level plan** (Stable); **CHF 1’330’500**

Costs (CHF)	Cost Per Unit	Total Units	Total Cost
Regular Time Labor Cost	43.00	28000	1'204'000
Overtime/Subcontracting	14.40	0	0
Inventory Holding Cost	5.00	25000	125'000
Backorders	7.50	0	0
Hiring	500.00	0	0
Layoff	750.00	2	1'500
	Total Costs		**1'330'500**

- **Chase plan** (Demand following) **CHF 1’254’500**

Costs (CHF)	Cost Per Unit	Total Units	Total Cost
Regular Time Labor Cost	43.00	28000	1'204'000
Overtime/Subcontracting	14.40	0	0
Inventory Holding Cost	5.00	0	0
Backorders	7.50	0	0
Hiring	500.00	50	25'000
Layoff	750.00	34	25'500
	Total Costs		**1'254'500**

- **Hybrid plan** (Demand following) **CHF 1’240’750**

Costs (CHF)	Cost Per Unit	Total Units	Total Cost
Regular Time Labor Cost	43.00	28000	1'204'000
Overtime/Subcontracting	14.40	0	0
Inventory Holding Cost	5.00	2750	13'750
Backorders	7.50	0	0
Hiring	500.00	28	14'000
Layoff	750.00	12	9'000
	Total Costs		**1'240'750**

Production Management (ME-419)

Coaching Rooms

Amin Kaboli

Week 4 – Session 4 – Oct 04th, 2024

Please Follow Your coaches to Your Designated Rooms

Coaches

Saria

GCA 330

Joao

GCA 331

Xavier

GRA 332

The Art of Giving and Receiving Effective Feedback

Feedback is a gift

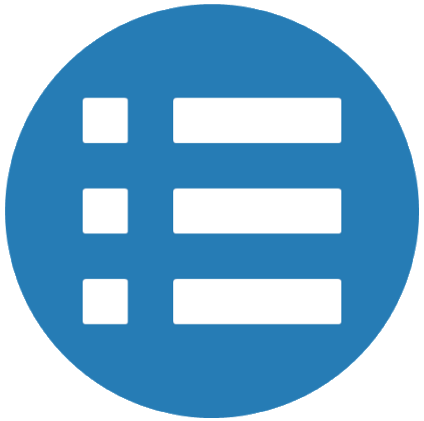
Feedback/comments are always welcome

Giving Effective Feedback

Respectful

Ask for permission

May I share my observation



Fact-based

Share facts/ your feelings

What I observed/felt is that …

Constructive

Stay focused on growth

What I suggest is that …

Concise

Be to-the-point and short

Max three key points

Open

Be open to any reaction

I respect your feeling …

Receiving Effective Feedback

Receive the gift

Be open and receptive

I appreciate your feedback

Listen

Listen to listen!

The goal is to listen not to answer, no interruption (zip it)

Understand

Focus on THE message

The goal is to understand, ask questions, clarify, repeat key points, …

Decide

You always have a choice

Thank you, I have never seen it this way

OR

Thank you, let me reflect and get back to you?

Follow up

Reach a common understanding

There are many ways to follow up: revise the work, set up a meeting, …