Production Management (ME-419)

Module 2 – Demand Management

Optimizing Smoothing Coefficients & Demand Plan

Amin Kaboli

Week 6 – Session 1&2 – Oct 17th, 2025

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	Next-Gen Production	Final Presentation
Sep	**Sep-Oct**	**Oct-Nov**	**Dec**	**Dec 19th**
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	Latest trends in Production Management Orchestrating supply chain effectively From linear to circular models	Final presentation & solid understanding of the course

Demand Management – Forecasting Steps

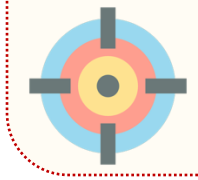
Demand forecast at the item and aggregate levels

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 Initiation – Use of Our Dataset

cycle 1	cycle 2	cycle 3
used to initiate trend and seasonal components		
	used to initiate the base	
		used to validate the model

Holt & Winter Model

$$F_{t+h} = (B_t + hT_t) \times S_{t+h-c}$$

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

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

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

Initial trend component (T'): Cycle 1, 2, 3

Initial Seasonal component (S'): Cycle 1, 2, 3

Initial base (B'): Cycle 2

Model validation: Cycle 3

Model Initiation – Step 4

4.1. Define the validation cycle (Year 3)

4.2. Define the initial model $F'_{t+h} = (B' + hT') \times S'_{t+h}$

Initial model (F'_{t+h}) = (40243 + h * 166)* S'_{t+h}

h =1,2, …, 12

Examples:

h=1 ; F'_{24+1} = (40243 + (1) * 166)* S'_{24+1}

h=5 ; F'_{24+5} = (40243 + (5) * 166)* S'_{25+5}

h=11 ; F'_{24+11} = (40243 + (11) * 166)* S'_{25+11}

Note: I used the third cycle of my data for initial forecast and validation of my model

Final Forecast – Demand Plan

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

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

Model Initialization – Smoothing Coefficient Optimization

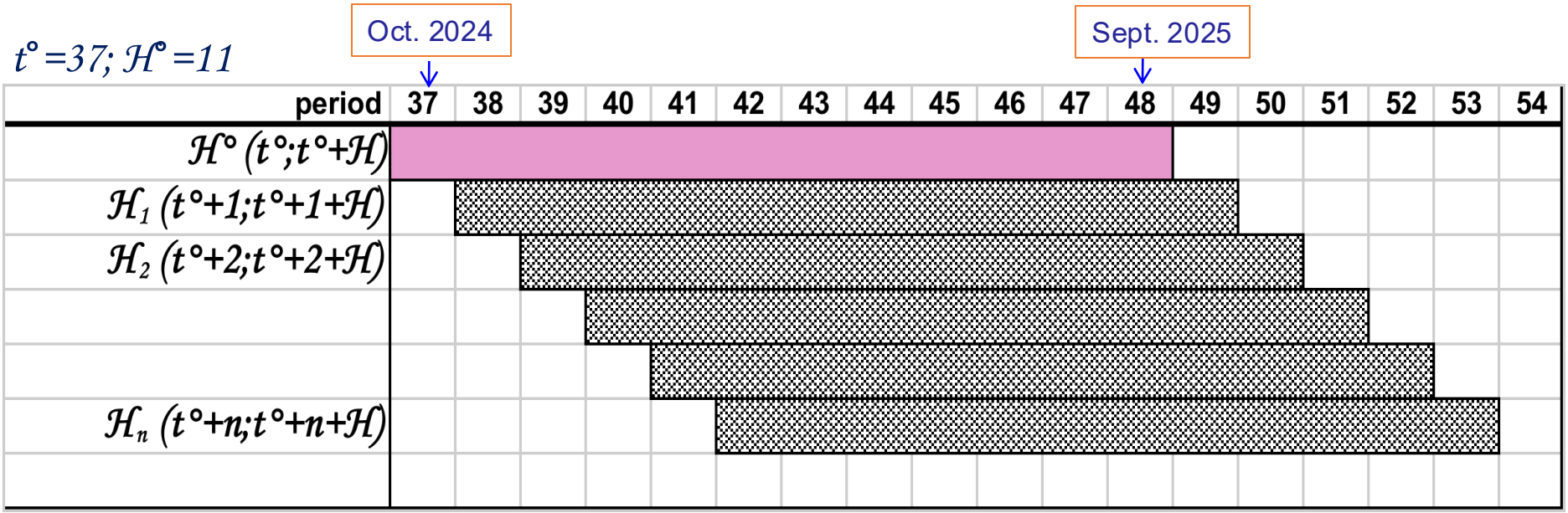
1. Initial forecast model $F'_{t+h} = (B' + hT') \times S'_{t+h}$ Horizon = $\mathcal{H}^\circ\ (t^\circ;t^\circ+\mathcal{H})$

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

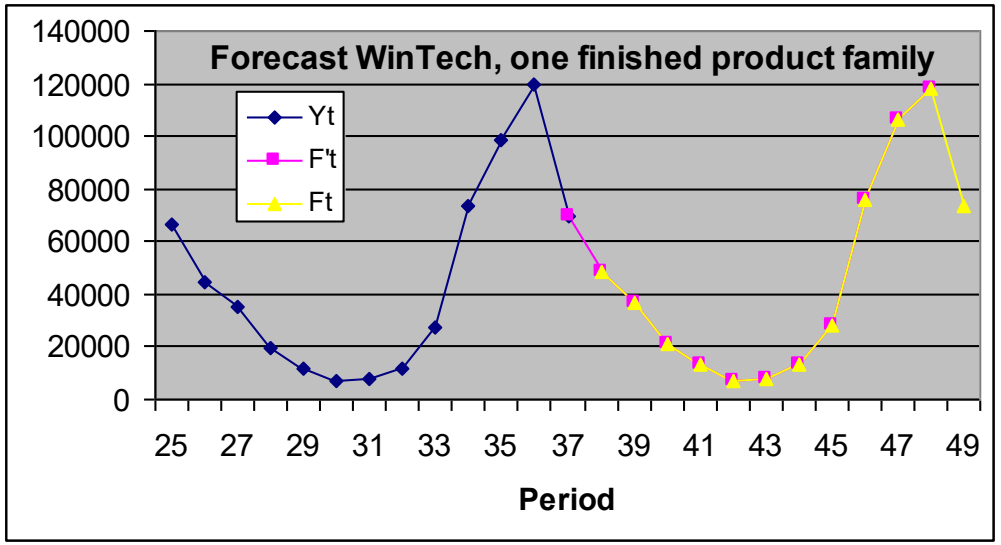


Final Forecast – Demand Plan

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) $F_{t+h} = (B_t + hT_t) \times S_{t+h-c}$

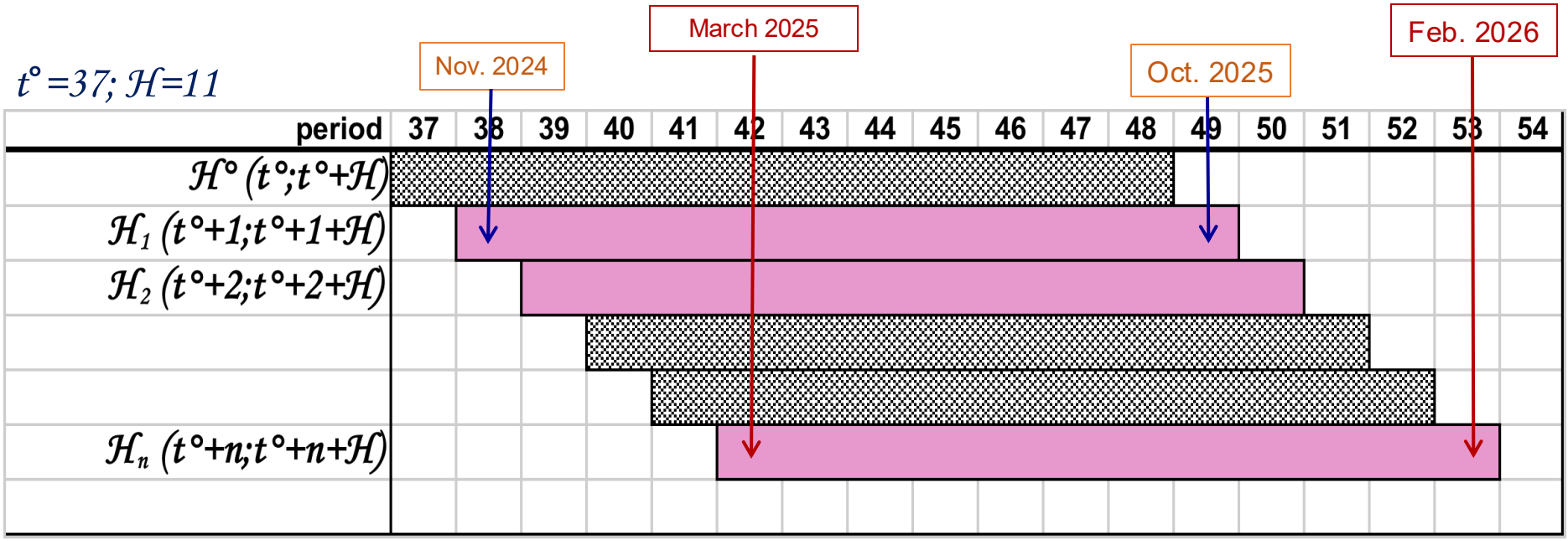


Running Model – Smoothing Coefficient Optimization

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

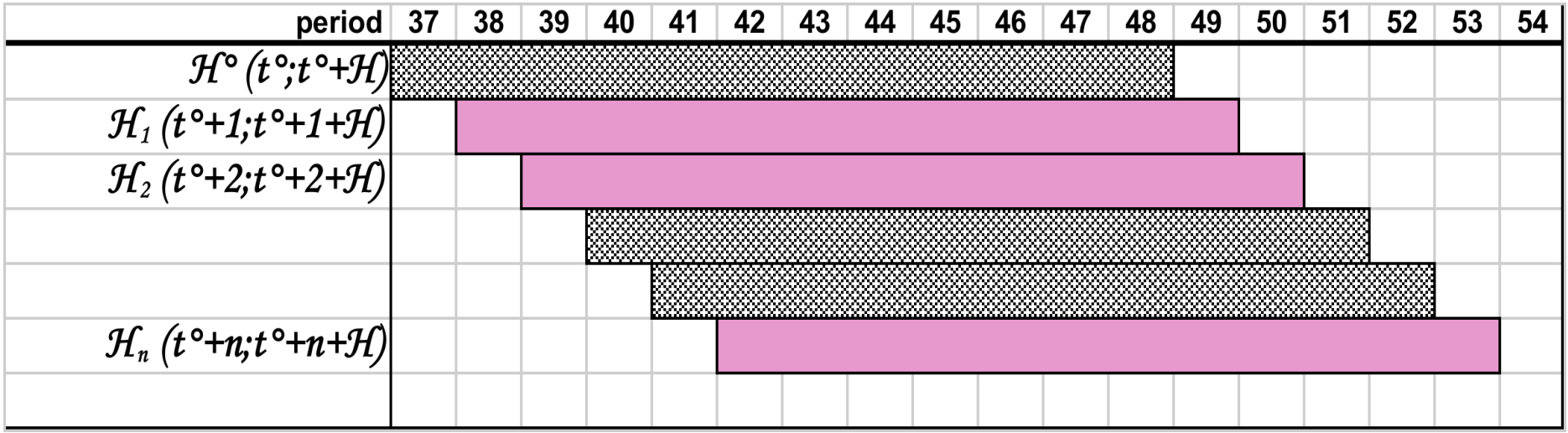
$$F_{t+h} = (B_t + hT_t) \times S'_{t+h}$$

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

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

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

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



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

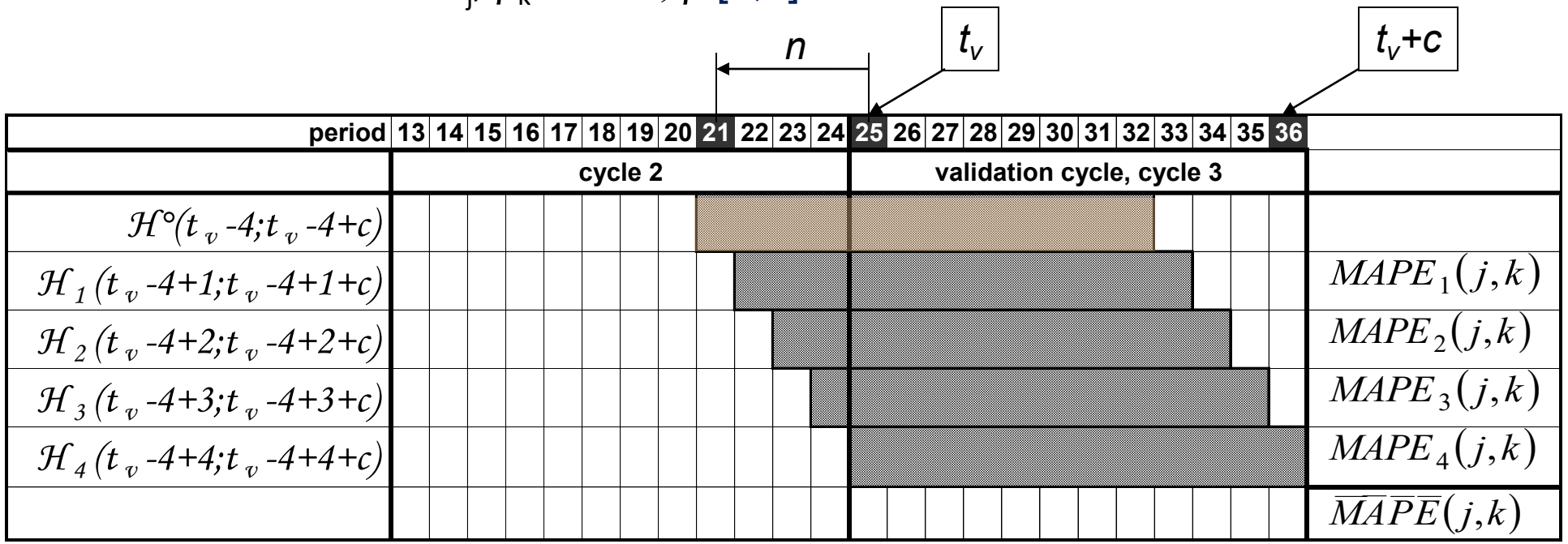
3. Choose set of values $(\alpha, \beta)_0$ that minimizes the forecasting error

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 $F'_{t+h} = (B' + hT') \times S'_{t+h}$ $h \in [1;c]$

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



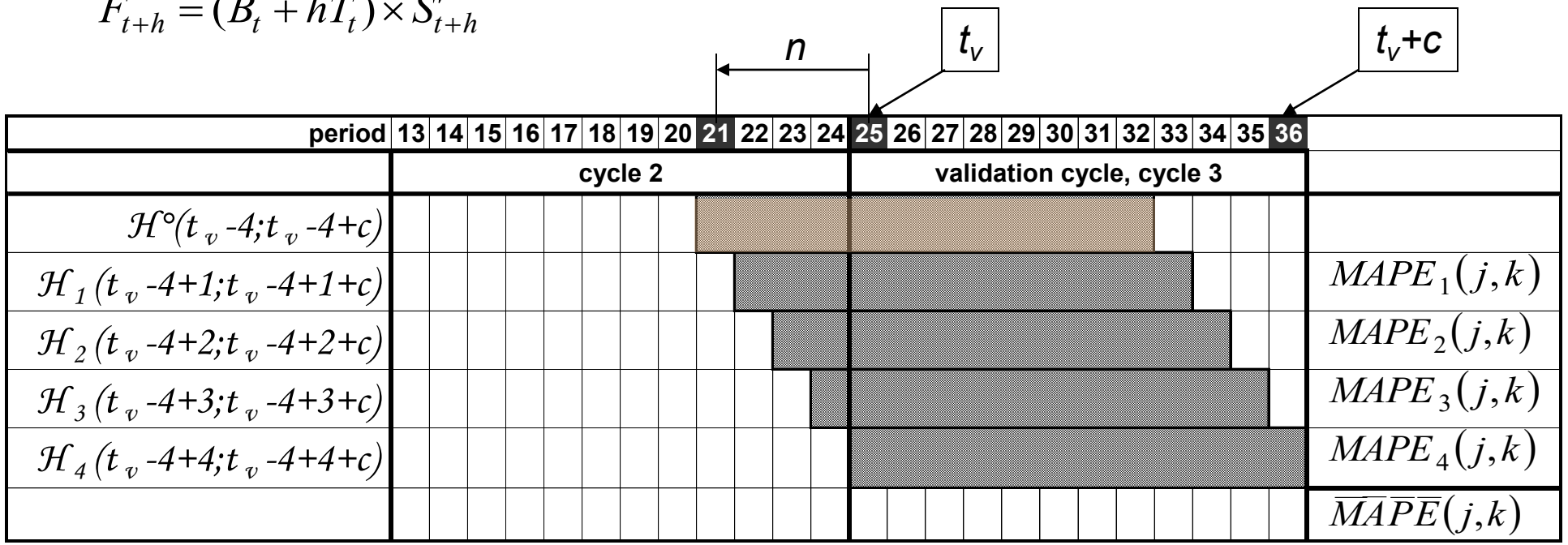
Procedure – Smoothing Coefficient Optimization (II)

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

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

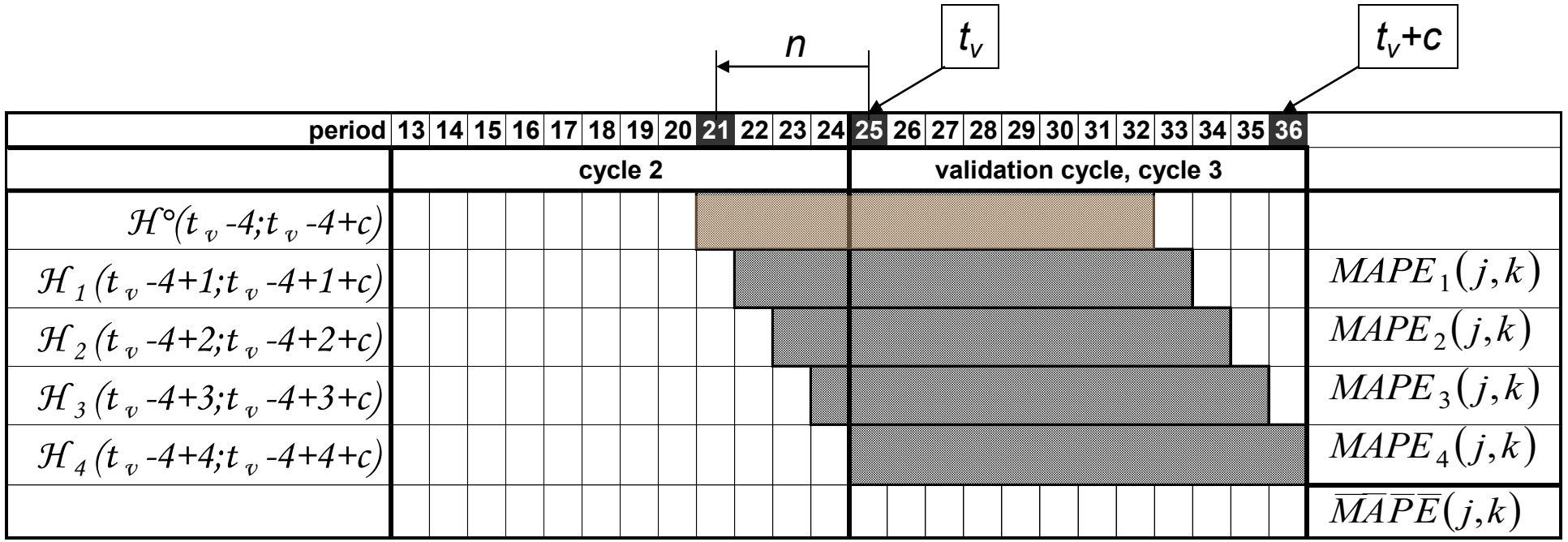
$$T_t = \beta_k (B_t - B_{t-1}) + (1-\beta_k) T_{t-1}$$

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



Procedure – Smoothing Coefficient Optimization (III)

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

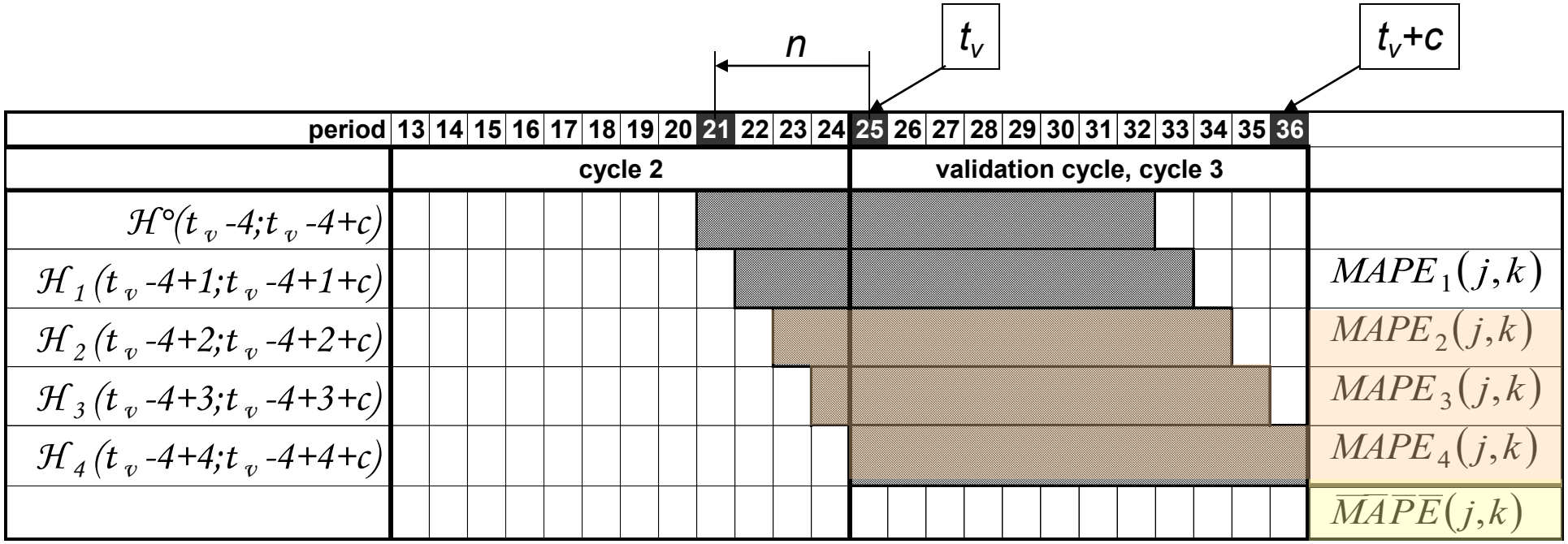


Procedure – Smoothing Coefficient Optimization (IV)

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]

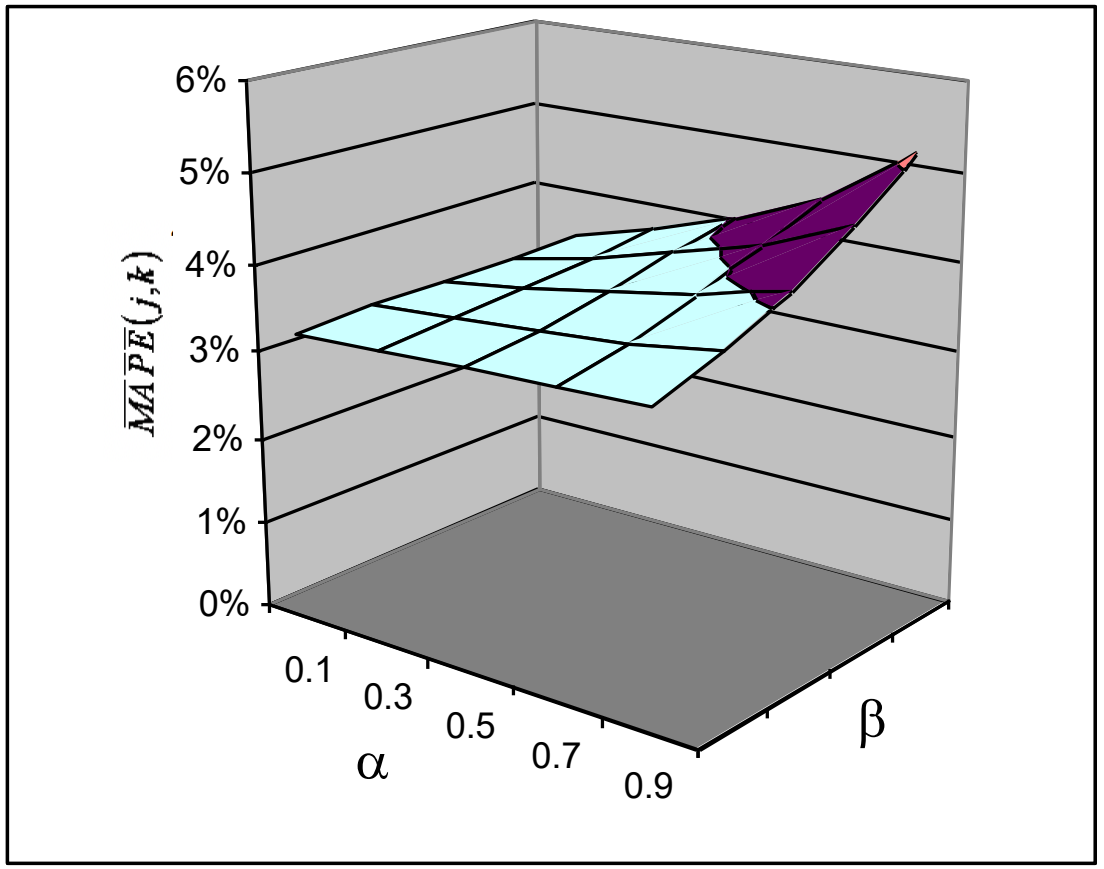
Step 7. Compute average $\overline{MAPE}(j,k)$ of the n forecast horizons

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



Procedure – Smoothing Coefficient Optimization (V)

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



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

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

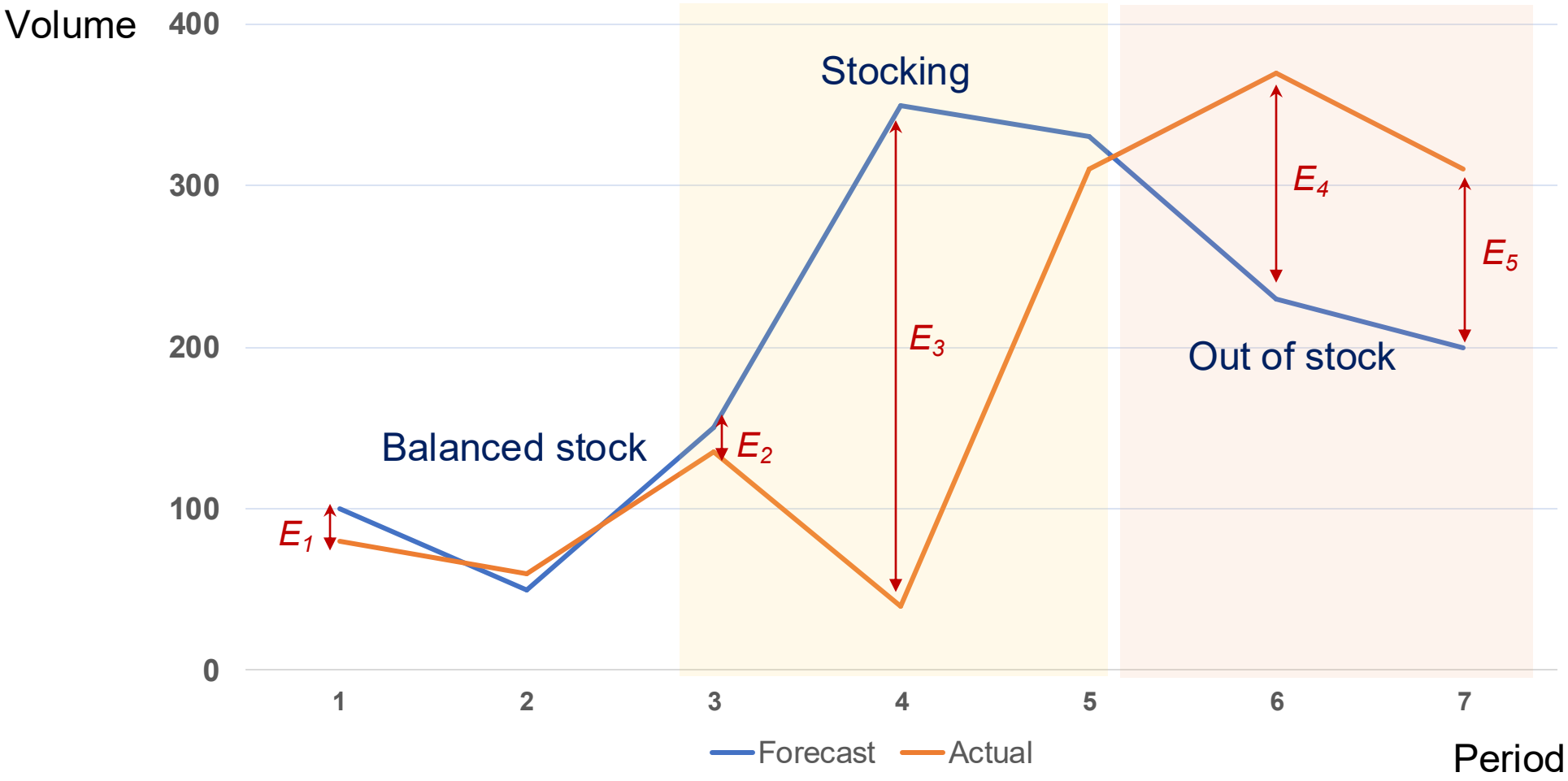
7) Comment the results of the validation process

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).

Step 5: Performance – Monitor the Forecasting Error



Step 5: Performance – Monitor the Forecasting Error

E_t : forecast error calculated at the end of period *t* when the actual value Y_t is known;
Y_t : actual demand for period *t*
F_t : forecasting for period *t*

$$error: E_t = Y_t - F_t$$

PE_t : percentage error calculated at the end of period t when actual value Y_t is known

$$percentage\ error: PE_t = \frac{Y_t - F_t}{Y_t} = \frac{E_t}{Y_t}$$

Monitoring Forecasting Error – ME & MAE

E_t : forecast error calculated at the end of period *t* when the actual value Y_t is known;

F_t : forecasting for period *t*

$$error: E_t = Y_t - F_t$$

Mean Error (ME)

$$ME_t = \frac{1}{n} \sum_{i=t-n+1}^{t} [E_i]$$

Mean Absolute Error (MAE)

$$MAE_t = \frac{1}{n} \sum_{i=t-n+1}^{t} |E_i|$$

Monitoring Forecasting Error – MPE & MAPE

E_t : forecast error calculated at the end of period *t* when the actual value Y_t is known;

F_t : forecasting for period *t*

$$error: E_t = Y_t - F_t$$

$$percentage\ error: PE_t = \frac{Y_t - F_t}{Y_t} = \frac{E_t}{Y_t}$$

Mean Percentage Error (MPE)

$$MPE_t = \frac{1}{n} \sum_{i=t-n+1}^{t} PE_i$$

Mean Absolute Percentage Error (MAPE)

$$MAPE_t = \frac{1}{n} \sum_{i=t-n+1}^{t} |PE_i|$$

Monitoring Forecasting Error – With Smoothing

E_t : forecast error calculated at the end of period *t* when the actual value Y_t is known;

F_t : forecasting for period *t*

$$error: E_t = Y_t - F_t$$

Smoothed Mean Error (SME)

$$SME_t = \alpha E_t + (1-\alpha) SME_{t-1}$$

Smoothed Mean Absolute Error (SAME)

$$SMAE_t = \alpha |E_t| + (1-\alpha) SMAE_{t-1}$$

Smoothed Mean Absolute Percentage Error (SMAPE)

$$SMAPE_t = \alpha |PE_t| + (1-\alpha) SMAPE_{t-1}$$

Step 5: Performance – Monitoring Forecasting Errors

Forecasting Error (E)

$$E_t = Y_t - F_t$$

Forecasting Percentage Error (PE)

$$PE_t = \frac{Y_t - F_t}{Y_t} = \frac{E_t}{Y_t}$$

Mean Error (ME)

$$ME_t = \frac{1}{n}\sum_{i=t-n+1}^{t}[E_i]$$

Mean Absolute Error (MAE)

$$MAE_t = \frac{1}{n}\sum_{i=t-n+1}^{t}|E_i|$$

Mean Percentage Error (MPE)

$$MPE_t = \frac{1}{n}\sum_{i=t-n+1}^{t}PE_i$$

Mean Absolute Percentage Error (MAPE)

$$MAPE_t = \frac{1}{n}\sum_{i=t-n+1}^{t}|PE_i|$$

Smoothed Mean Error (ME)

$$SME_t = \alpha E_t + (1-\alpha)SME_{t-1}$$

Smoothed Mean Absolute Error (MAE)

$$SMAE_t = \alpha|E_t| + (1-\alpha)SMAE_{t-1}$$

Smoothed Mean Absolute Percentage Error (MAPE)

$$SMAPE_t = \alpha|PE_t| + (1-\alpha)SMAPE_{t-1}$$

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)
- Quantitative: 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 – Demand Management

Forecasting Methods – Qualitative

Amin Kaboli

Week 4 – Session 1&2 – Oct 03rd, 2024

Forecasting Methods – Qualitative Methods

Forecasting Methods

Qualitative methods

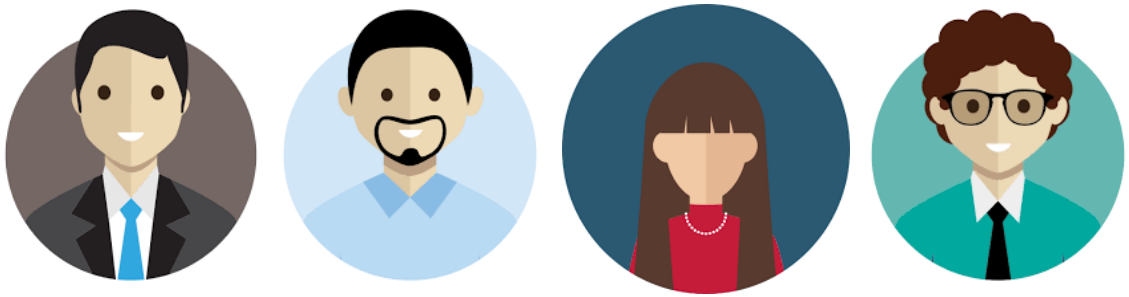
- Executive opinions
- Salesforce opinions
- Customer surveys
- Delphi method

Quantitative methods

- Causal models
- Time series
- Machine Learning

Qualitative Method – Executive Opinions

Senior Executive Level



Finance Operations Marketing R&D

Developing long range plan

New Product

Qualitative Method – Salesforce Opinions

Members of Sales & Customer Service

Sales manager

Sales staff

Customer Service

Sales staff

Developing sales plan

Current product

Qualitative Method – Consumer Surveys

Survey

Art of constructing a survey,
administer it, and
correctly interpret the results

Qualitative Method – Delphi Method

Facilitator

1

Implement and manage the process

Panel of experts

2

Forecast task is set and distributed among experts (unknown to each other)

Facilitator

3

Consolidates and shares with all experts w/o their names

Panel of experts

4

Review and adjustments

Facilitator

5

Final consolidation and forecast

Forecasting Methods – Qualitative Methods

Forecasting Methods

Qualitative methods

- Executive opinions
- Salesforce opinions
- Customer surveys
- Delphi method

Quantitative methods

- Causal models
- Time series
- Machine Learning

Qualitative Methods

What is the base for the qualitative method?

Qualitative Methods

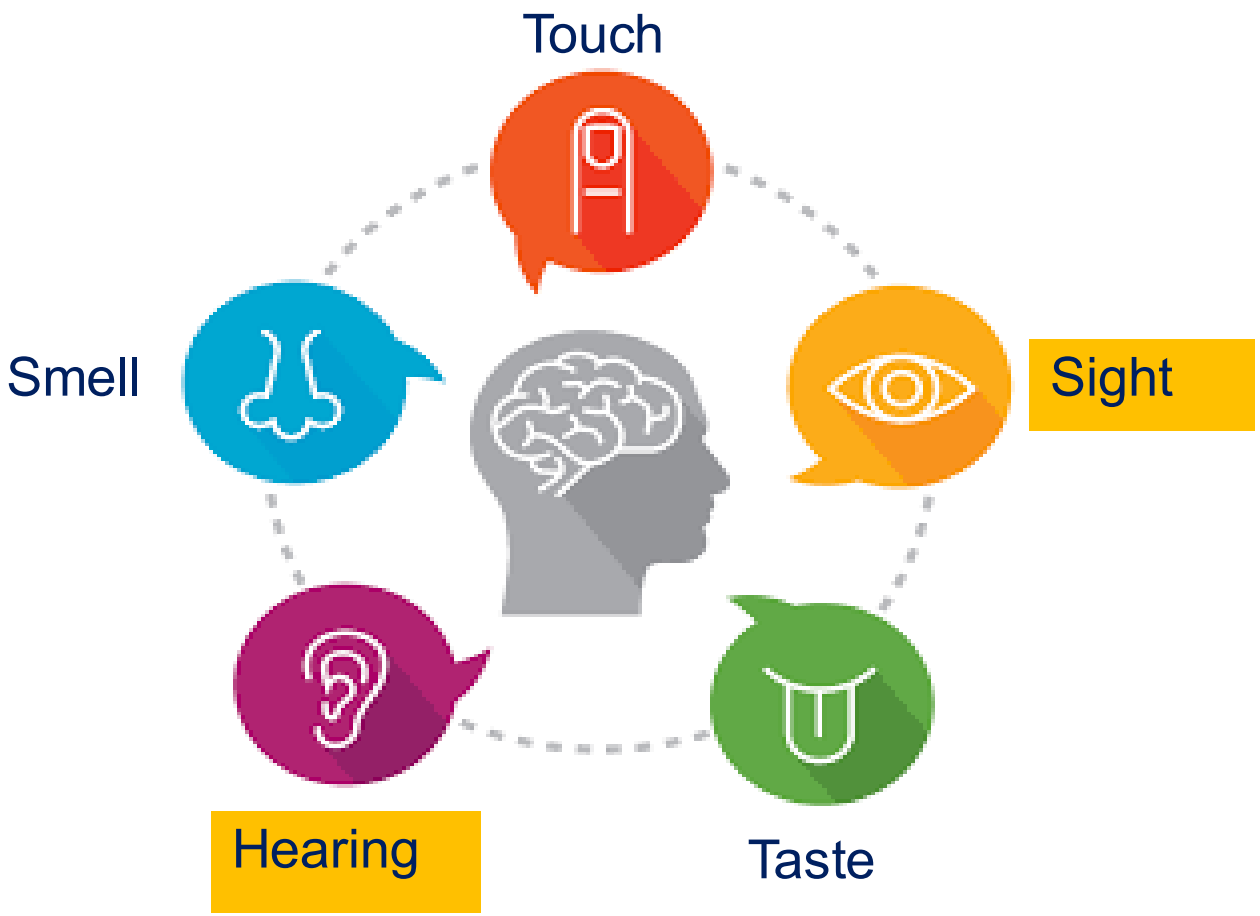
What is the base for the qualitative method?

Observations, judgement, experience, …

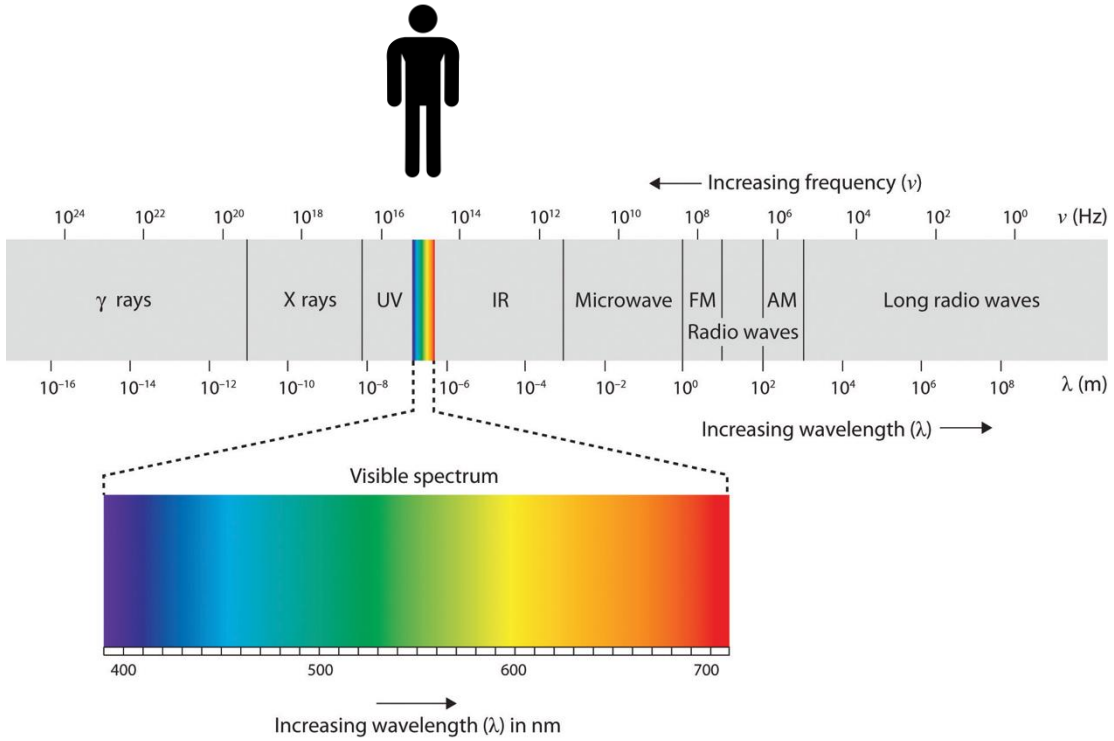
Do We See The Same?

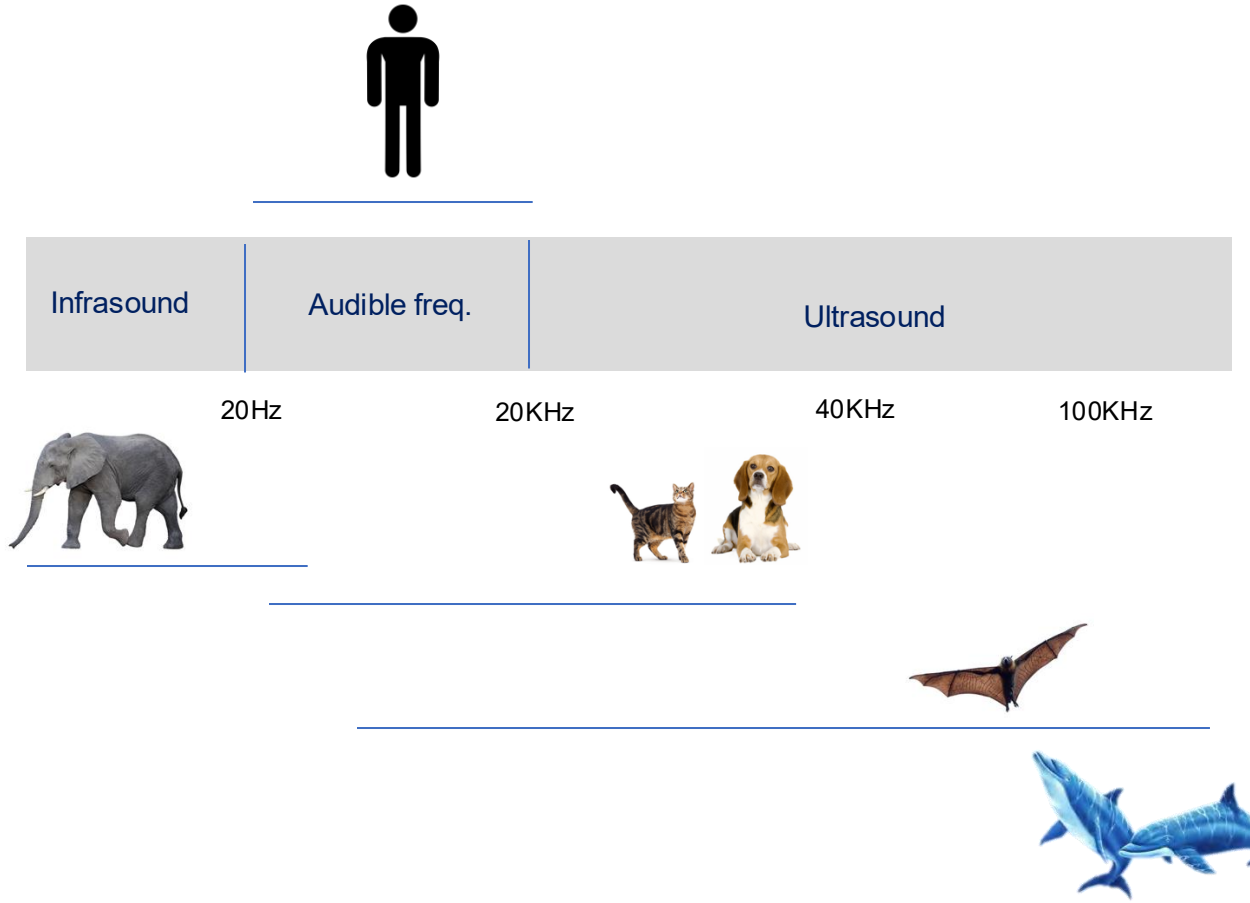
Perception – Our Five Senses

Perception – Two Main Senses

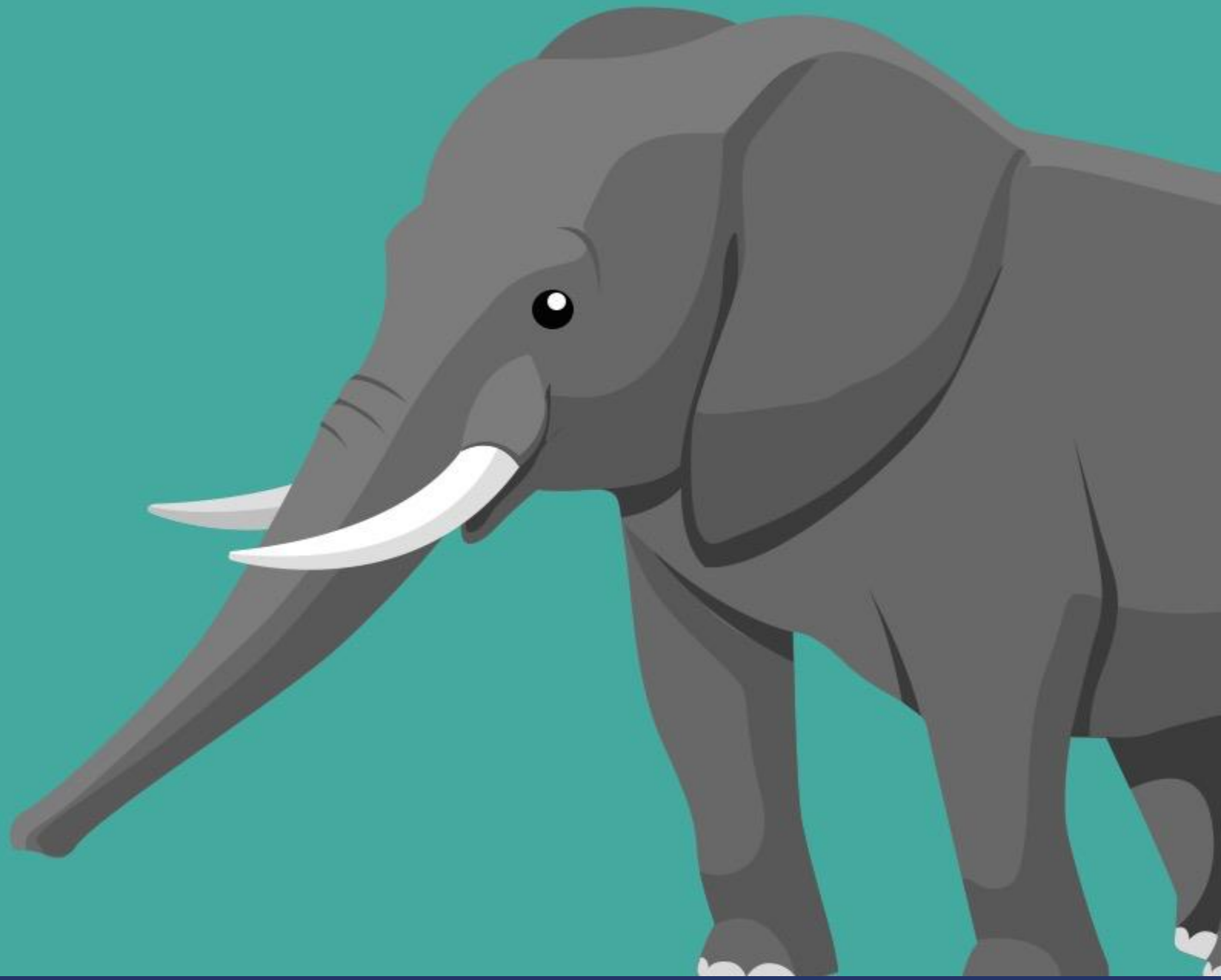


Perception Limitations – Sight and Hearing

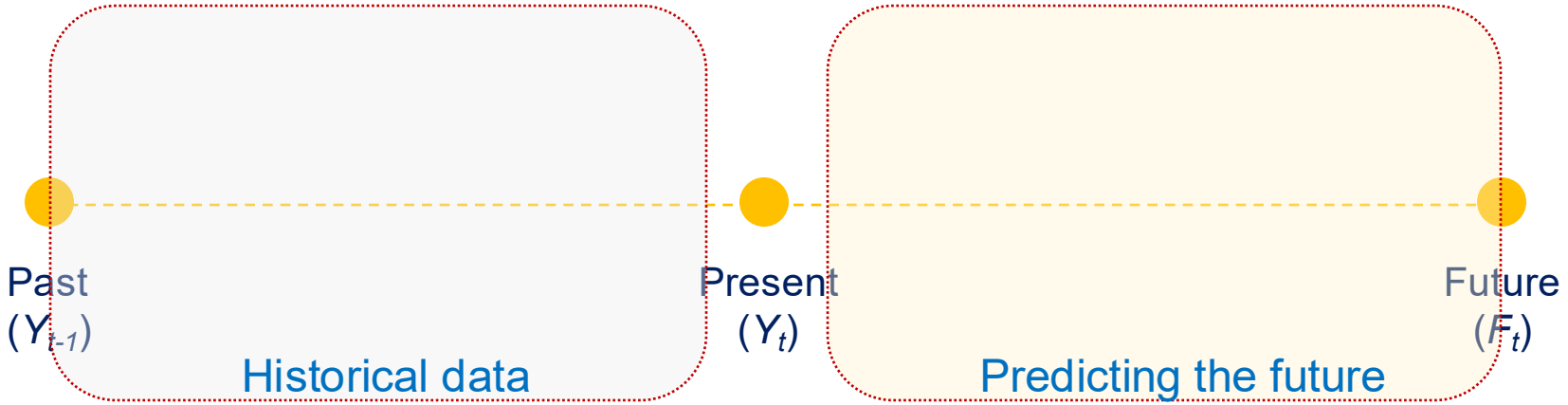




ELEPHANT AND 6 BLIND MEN METAPHOR



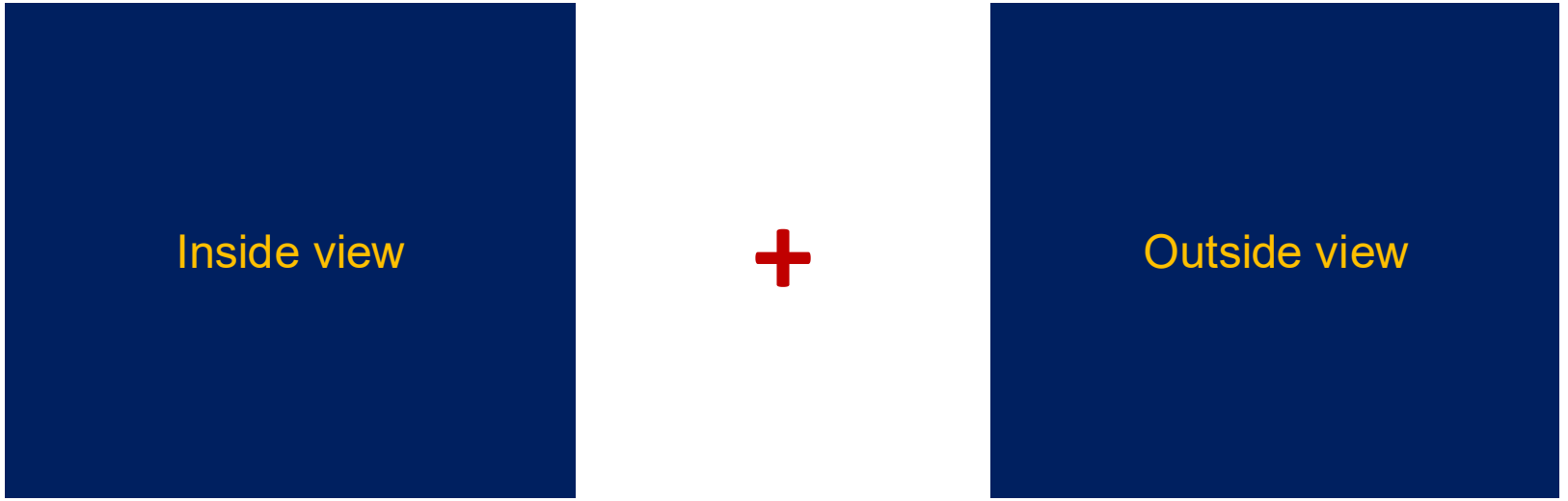
Reminder: The Science of Predicting The Future



Assumption: The future will be the same as the **past!**

- F_t : demand forecast for period *t*
- Y_t : actual demand for period *t*

Demand Management – Best Way To Forecast/Predict Future

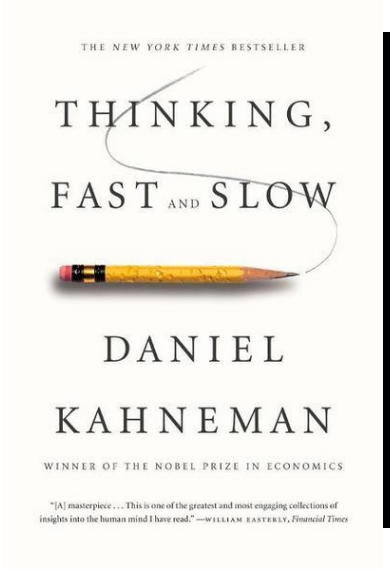


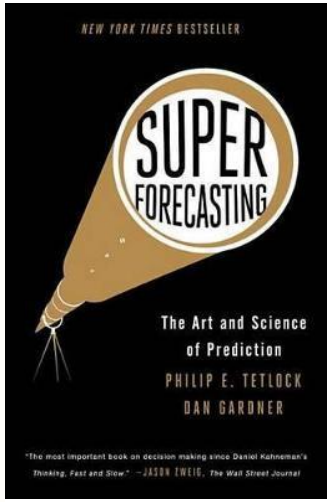
Your assumptions, models, perceptions, realities, …

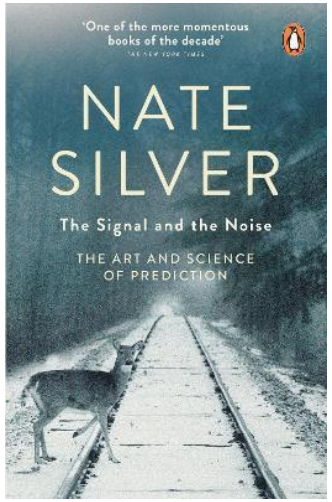
Reference class, events that would impact the projects' future course, feedback, ...

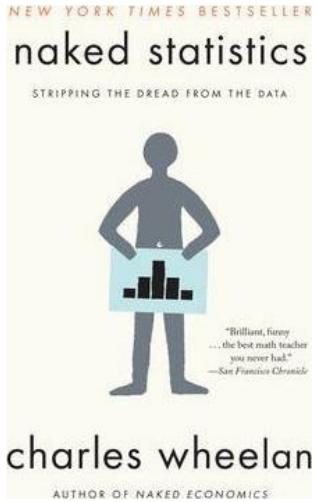
Sources:
1. Kahneman, D., & Lovallo, D. (2003). Delusions of success—How optimism undermines executive's decisions. *Harvard Business Review*, *81*(7), 56-63.
2. Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. *Management science*, *39*(1), 17-31.

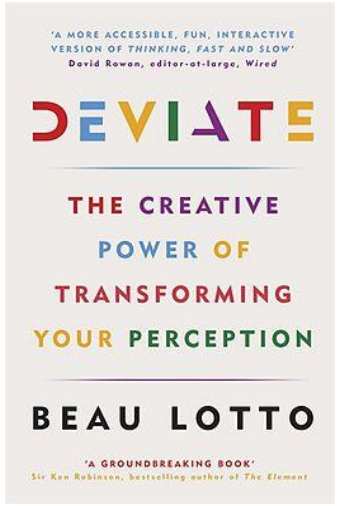
Want to Know More? – Selected Books

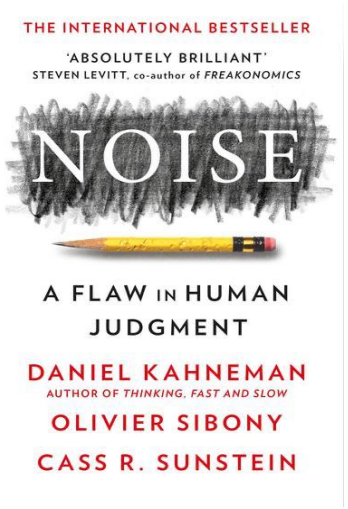












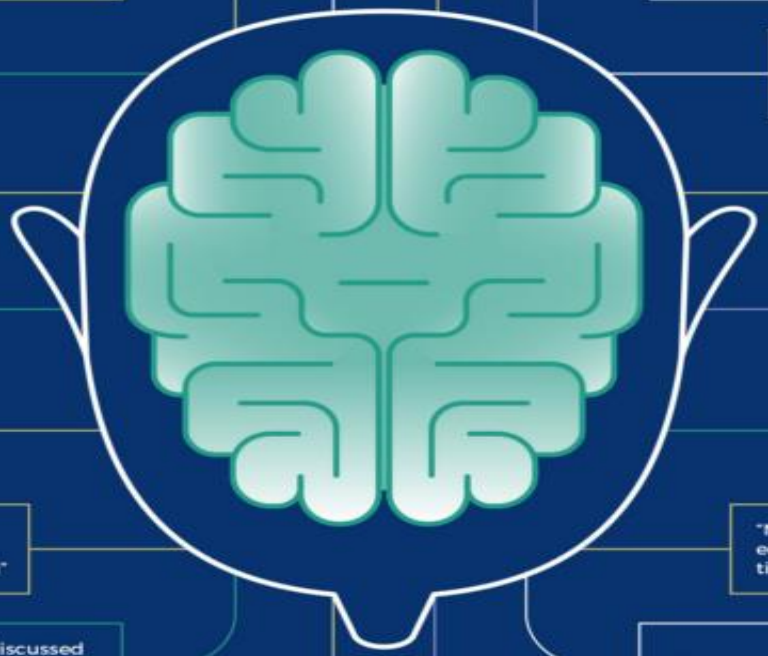
Cognitive bias

● Social ● Financial ● Failure to estimate ● Short-termism

When it comes to assessing risk, humans often fail to make rational decisions because our brains take mental shortcuts that prevent us making the correct choice. Since the 1960s behavioural scientists and psychologists have been researching these failings, and have identified and labelled dozens of them. Here are some that can cause havoc when it comes to assessing risks in business

ORIGIN

The notion of cognitive biases was first introduced by psychologists Amos Tversky and Daniel Kahneman in the early-1970s. Their research paper, 'Judgment Under Uncertainty: Heuristics and Biases', in the Science journal has provided the basis of almost all current theories of decision-making and heuristics. Professor Kahneman was awarded a Nobel Prize in 2002 after further developing the ideas and applying them to economics.



ANCHORING EFFECT
Relying too much on the initial piece of information offered when making decisions

"The first test seemed OK. Do we need to look any more?"

AVAILABILITY HEURISTIC
Overestimating the importance and likelihood of events given the greater availability of information

"I saw something very similar to this on LinkedIn. We need to take it seriously"

BANDWAGON EFFECT
Uptake of beliefs and ideas increases the more that they have already been adopted by others

"The whole department knows there's no problem here"

BELIEF BIAS
Basing the strength of an argument on the believability or plausibility of the conclusion

"I didn't quite follow your argument but the conclusion seems about right"

BLIND SPOT BIAS
Viewing oneself as less biased than others

"Let's ignore Sarah's views on this one. She's biased"

CLUSTERING ILLUSION
Erroneously overestimating the importance of small clusters or patterns in large data

"This is the second week in a row that this has happened. There must be a problem"

CONFIRMATION BIAS
Focusing on information that only confirms existing preconceptions

"We did loads of simulations. Most of them showed there's no problem"

COURTESY BIAS
Giving an opinion/conclusion that is viewed as more socially acceptable so as to avoid causing offence/controversy

"The last time we discussed this the meeting lasted for hours. Let's move on"

ENDOWMENT EFFECT
The tendency for people to ascribe more value to things merely because they already own/have them

"I know it will cost a fortune to fix but it cost us £15,000. We can't just throw it away."

"The conveyor belt broke three times last month. It's pretty unlikely it'll happen again."

GAMBLER'S FALLACY
Believing that future probabilities are altered by past events, when in fact they are unchanged

"Let's just get the deal done ASAP"

HYPERBOLIC DISCOUNTING
Preferring a smaller, sooner payoff over a larger, later reward

"This worked fine in the factory in the Korea, it should work fine here"

ILLUSION OF VALIDITY
Overestimating our ability to make accurate predictions, especially when data appears to tell a coherent "story"

"Looks like we've run out of time to discuss this"

OSTRICH EFFECT
Avoiding negative financial information by pretending it doesn't exist

"We made a good call on that one"

POST-PURCHASE RATIONALISATION
Tendency to retroactively ascribe positive attributes to an option one has selected

"Our competitors are only doing well because their products are cheap"

REACTIVE DEVALUATION
Devaluing an idea because it originated from an adversary or opponent

"Now we've got the new equipment we can cut the time spent on maintenance"

RISK COMPENSATION
Taking bigger risks when perceived safety increases; being more careful when perceived risks increases

"If it ain't broke - don't fix it"

STATUS QUO BIAS
Preferring the current state of affairs over change

"Dave from tech is worried - but frankly the tech team are always pessimists"

STEREOTYPING
Assuming a person has characteristics because they are a member of a group

RACONTEUR

EPFL

Production Management (ME-419)

Coaching Rooms

Amin Kaboli

Week 4 – Session 4 – Oct 16th, 2025

The Art of Giving and Receiving Effective Feedback

Feedback is a gift

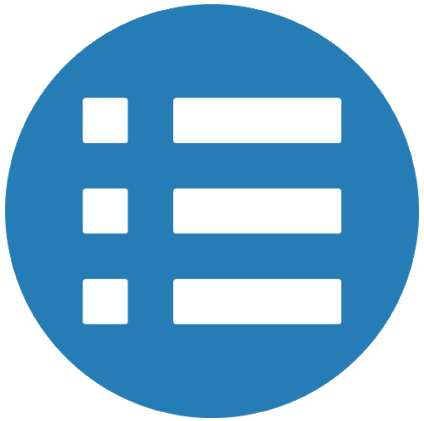
Feedback/comments are always welcome

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, …