Production Management (ME-419)

Module 2 – Demand Management

Forecasting Methods – Qualitative

Amin Kaboli

Week 4 – Session 1 – Oct 04th, 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 20th**
Value Adding Network Production Process Flows, Production procedures, Items, BOM	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

Production Management Happy Hour

Next week, drink at 4:45 PM in Sat.

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

Forecasting Methods – Qualitative & Quantitative

Forecasting Methods

Qualitative methods

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

Quantitative methods

- Causal models
- Time series
- Machine Learning

Demand Forecast – Step 3: Methods (Comparing)

	 Quantitative methods	 Qualitative methods
Characteristics	Based on mathematics; and past data	Based on human judgement, opinions, subjective, and nonmathematical
Strengths	Consistent and objective; able to consider much information and data at one time	Can incorporate latest changes in the environment and “inside information”
Weaknesses	Often quantifiable data are not available. Only as good as the data on which they are based.	Can bias the forecast and reduce forecast accuracy

Forecasting Methods – Qualitative Methods

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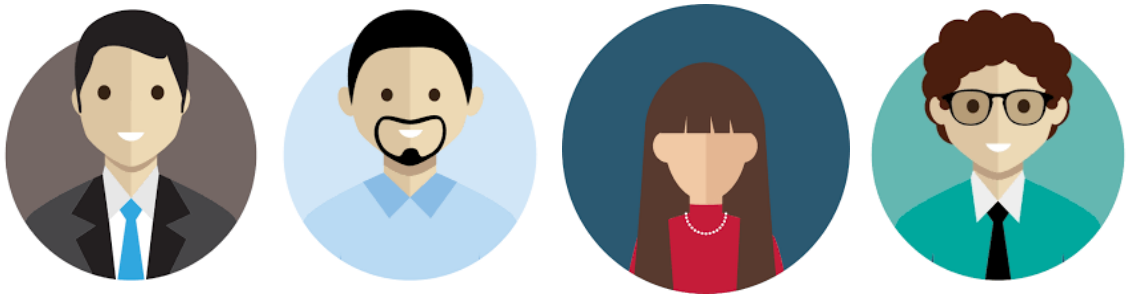
Qualitative Method – Executive Opinions

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 Method – Comparing Qualitative Methods

5 min

	Pros	Cons
1. Executive Opinion		
2. Salesforce Opinions		
3. Consumer Surveys		
4. Delphi Method		

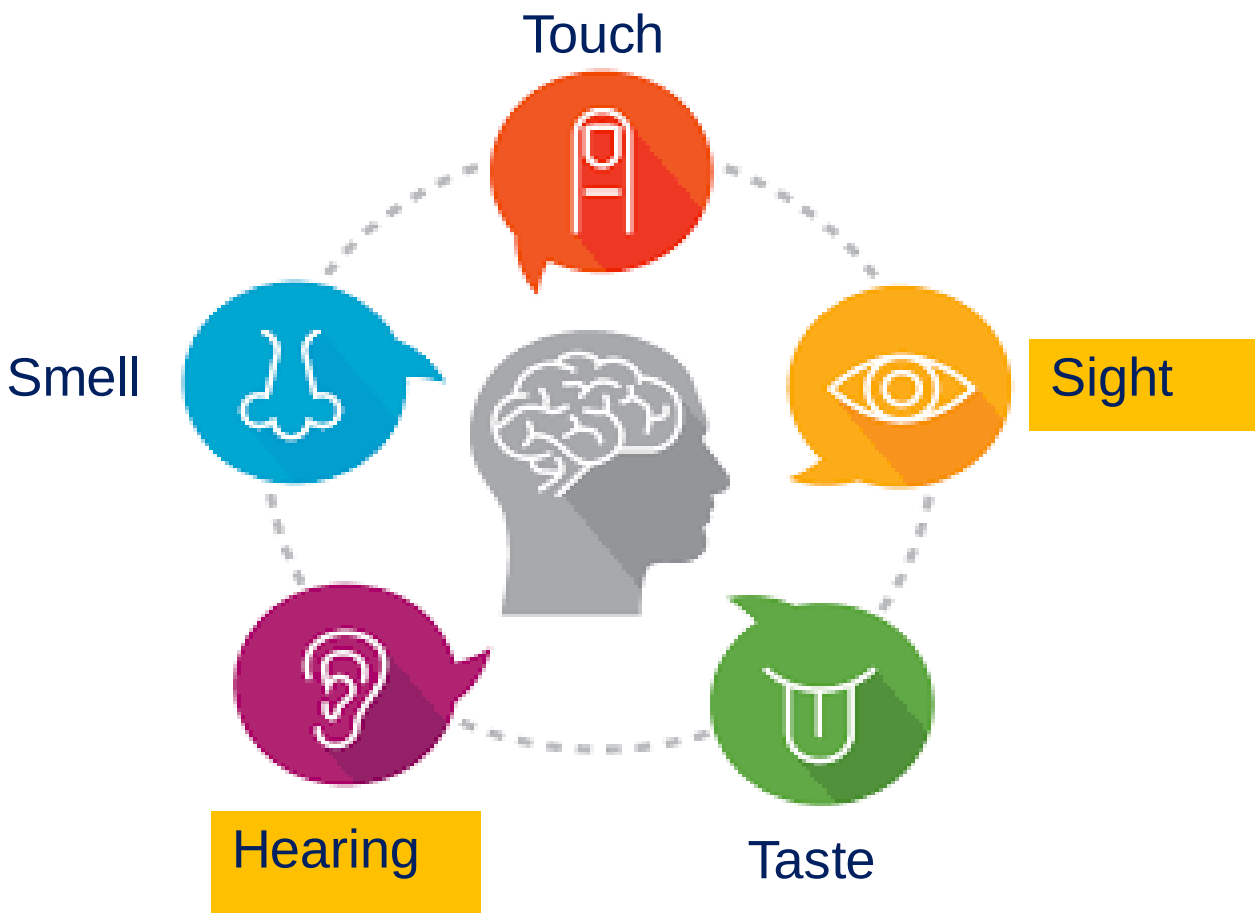
Qualitative Methods

What is the base for the qualitative method?

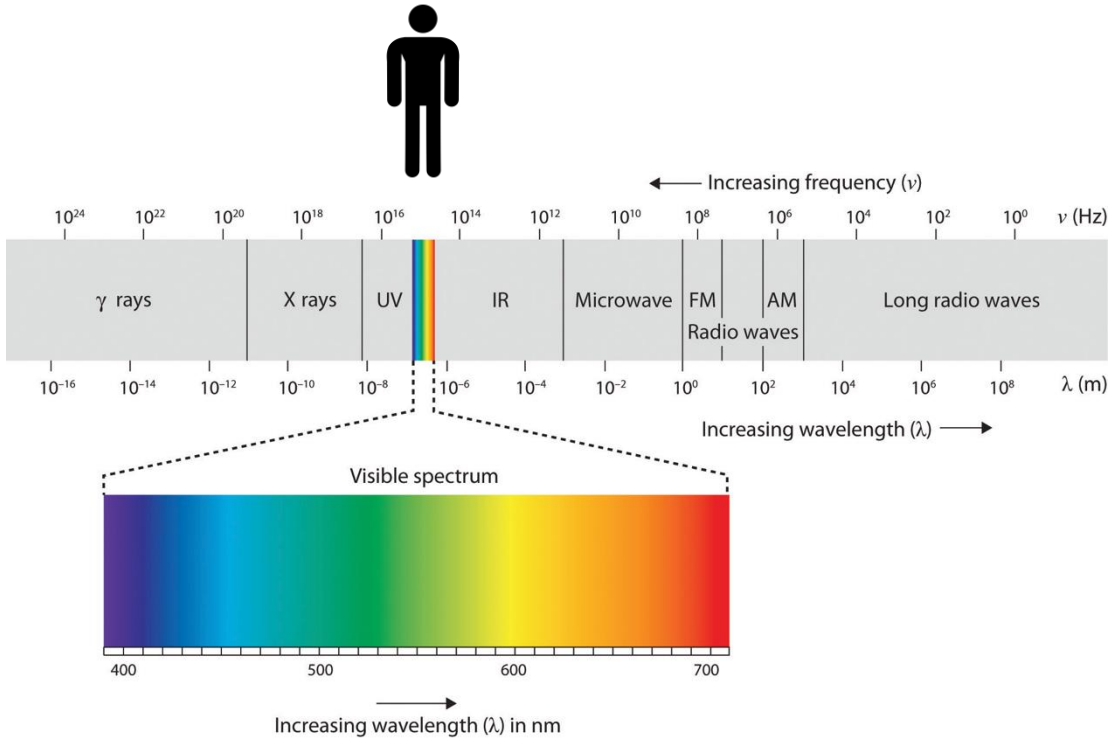
Do We See The Same?

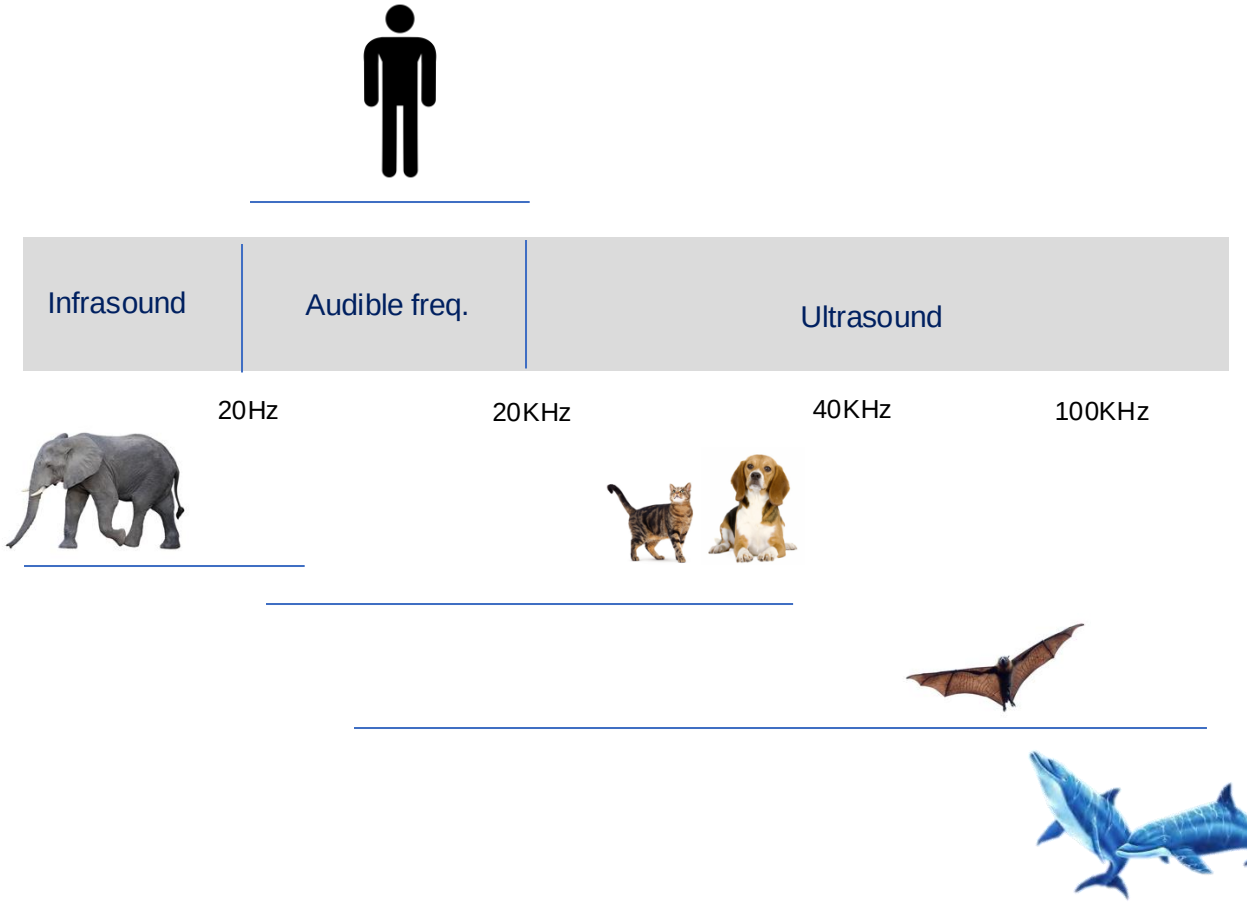
Perception – Our Five Senses

Perception – Two Main Senses

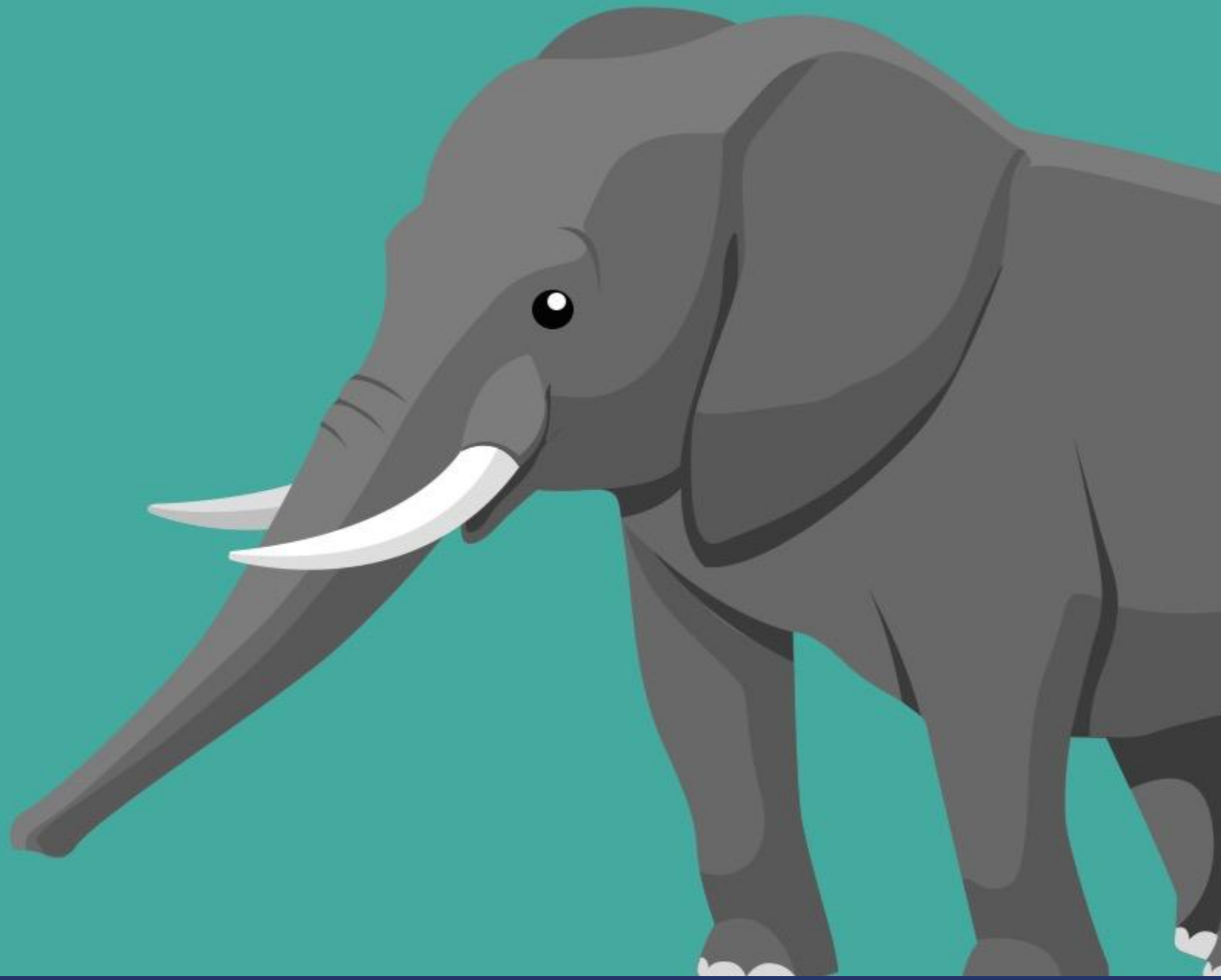


Perception Limitations – Sight and Hearing

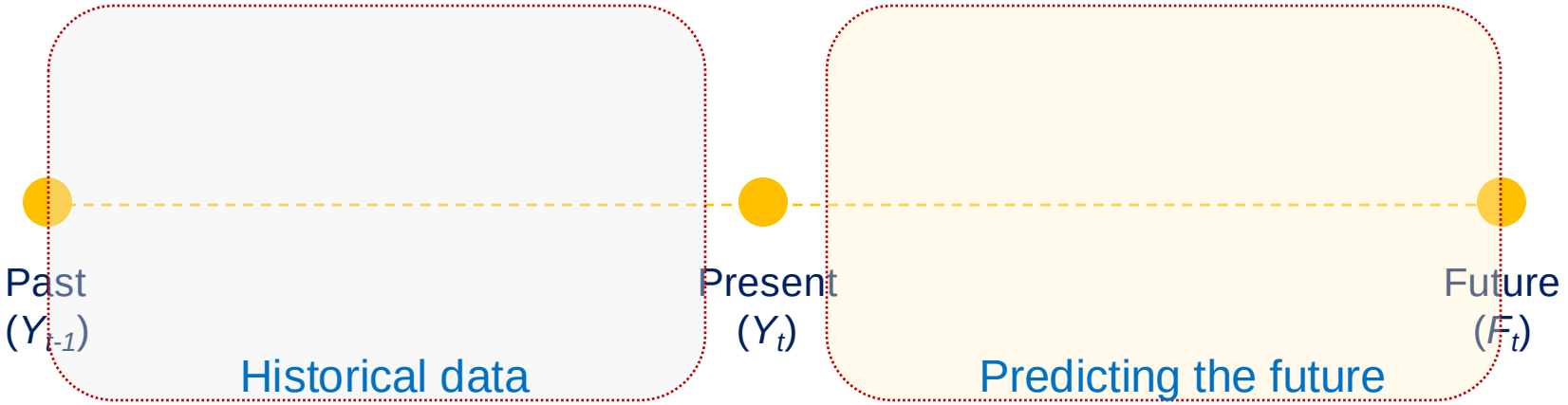




ELEPHANT AND 6 BLIND MEN METAPHOR



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

Inside view

+

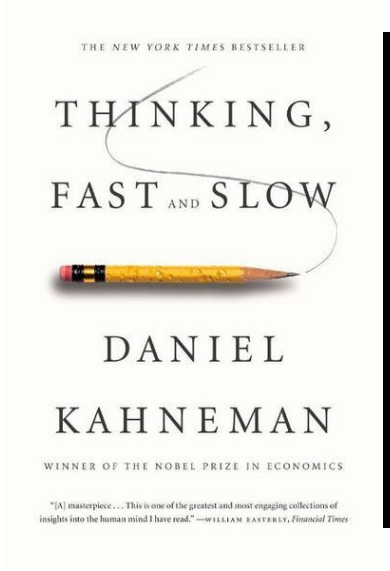
Outside view

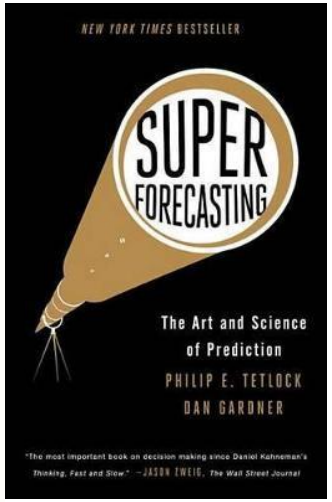
Your assumptions, models, perceptions, realities, …

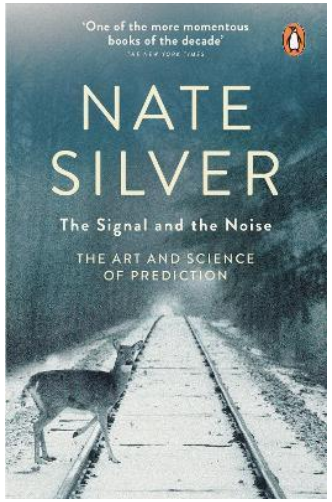
Reference class, events that would impact the projects' future course, feedback, ...

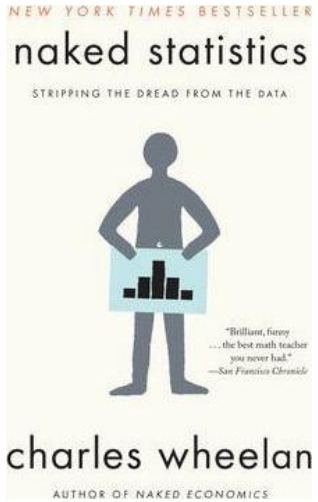
Sources:
1. Kahneman, D., & Lovallo, D. (2003). Delusions of success—How optimism undermines executive's decisions. *Harvard Business Review*, *81*(7), 56-63.
2. Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. *Management science*, *39*(1),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

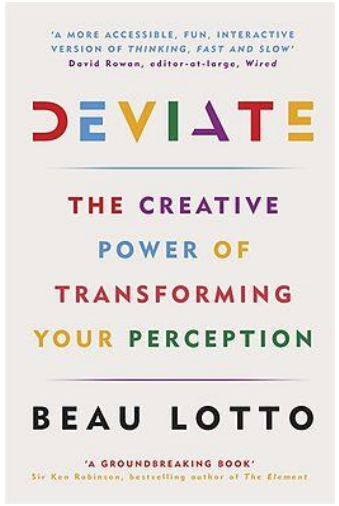
Want to Know More? – Selected Books

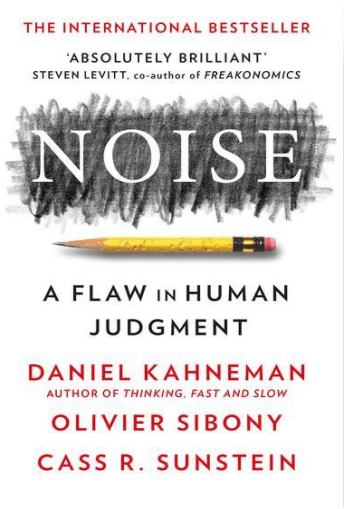












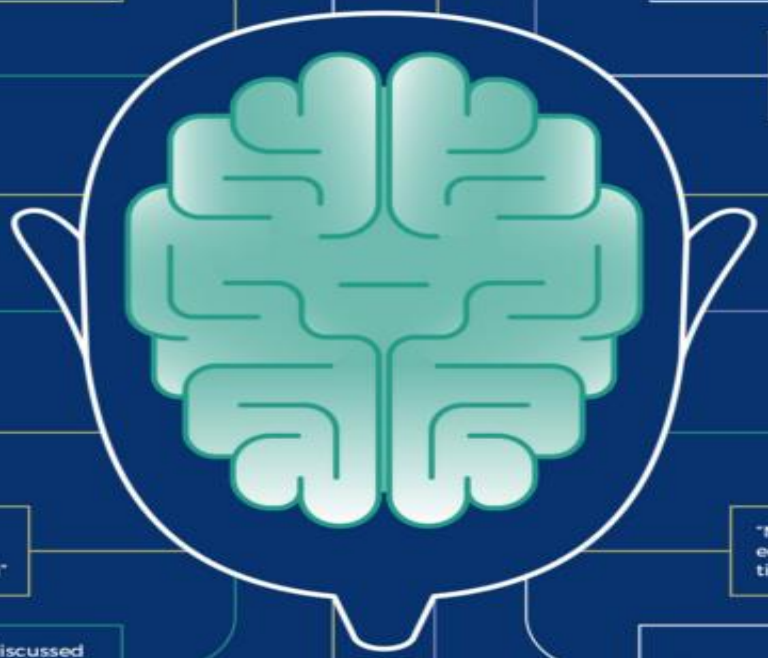
Cognitive bias

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

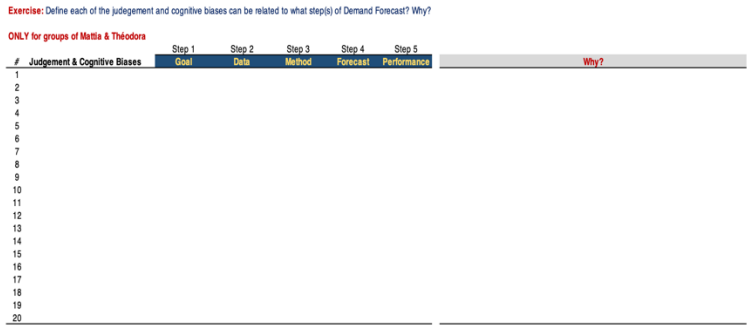
RACONTEUR

EPFL

Group Exercise – Judgement & Cognitive Biases

10 min

Task1: Define each of the judgment and cognitive biases can be related to what step(s) of Demand Forecast? Why?



Exercise: Define each of the judgement and cognitive biases can be related to what step(s) of Demand Forecast? Why?

ONLY for groups of Mattia & Théodora

#	Judgement & Cognitive Biases	Step 1 Goal	Step 2 Data	Step 3 Method	Step 4 Forecast	Step 5 Performance	Why?
1							
2							
3							
4							
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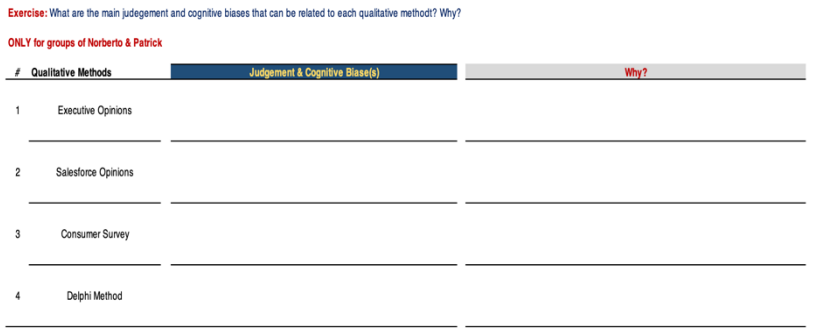
18							
19							
20							

Task3: What are the main judgment and cognitive biases that can be related to each qualitative method? Why?



Exercise: What are the main judgement and cognitive biases that can be related to each qualitative methodt? Why?

ONLY for groups of Norberto & Patrick

#	Qualitative Methods	Judgement & Cognitive Biase(s)	Why?
1	Executive Opinions		
2	Salesforce Opinions		
3	Consumer Survey		
4	Delphi Method		

Forecasting Methods – Quantitative Methods

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Learning Points – Summary

- Demand forecasting steps
- Methods to forecast: qualitative and quantitative
- Different qualitative methods

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Forecasting Methods – Quantitative

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Forecasting Methods – Qualitative & Quantitative

Forecasting Methods

Qualitative methods

Executive opinions

Salesforce opinions

Customer surveys

Delphi method

Quantitative methods

Causal models

Time series

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Demand Forecast – Step 3: Methods (Comparing)

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Forecasting Methods – Quantitative Methods

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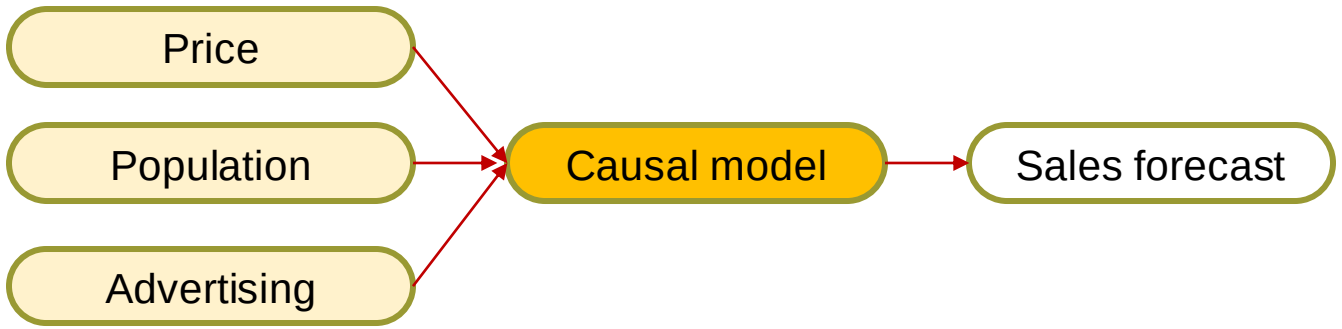
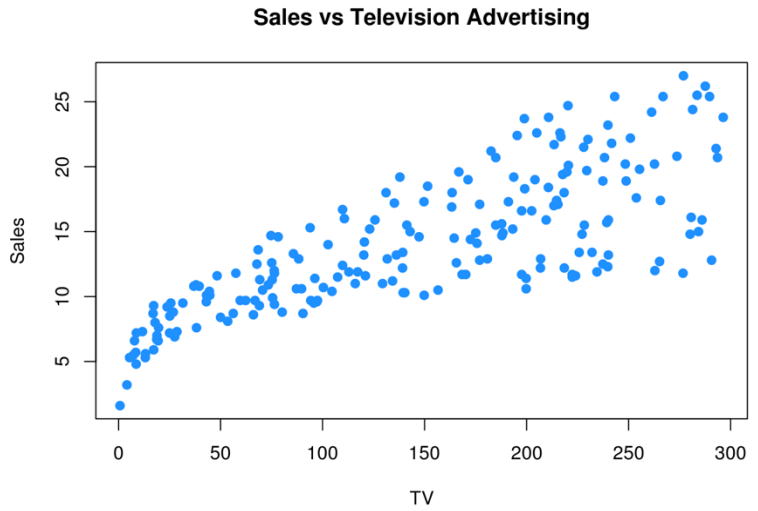
Comparing Quantitative Methods

	 Causal models	 Time series	 Machine Learning
Ability to consider numerous variables and data sources	Needs substantial effort		Smoothly incorporates multiple variables and data sources thanks to the high level of automation
Volume of manual work	High		Low
Amount of data required	Small		Large
Maintenance complexity	Low		High
Technology requirements	Low		High
Best fit	Mid/long-term planning Established products Stable demand		Short/mid-term planning New products Volatile demand scenarios

Demand Forecast – Causal Model

Sales forecast = f (Price, Population, Advertising, …) + Constant



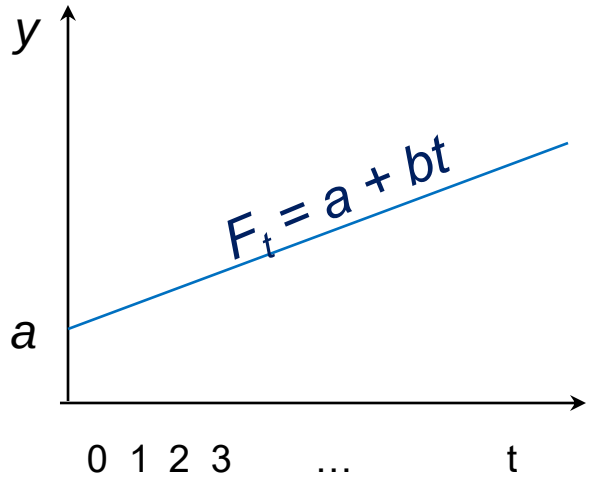


Demand Forecast – Step 3: Method (Causal Model - Trend)

This model is used to develop forecasts when trend is present:

$$F_t = a + bt$$

$$b = \frac{n\sum ty - \sum t \sum y}{n\sum t^2 - (\sum t)^2} \qquad a = \frac{\sum y - b\sum t}{n}$$

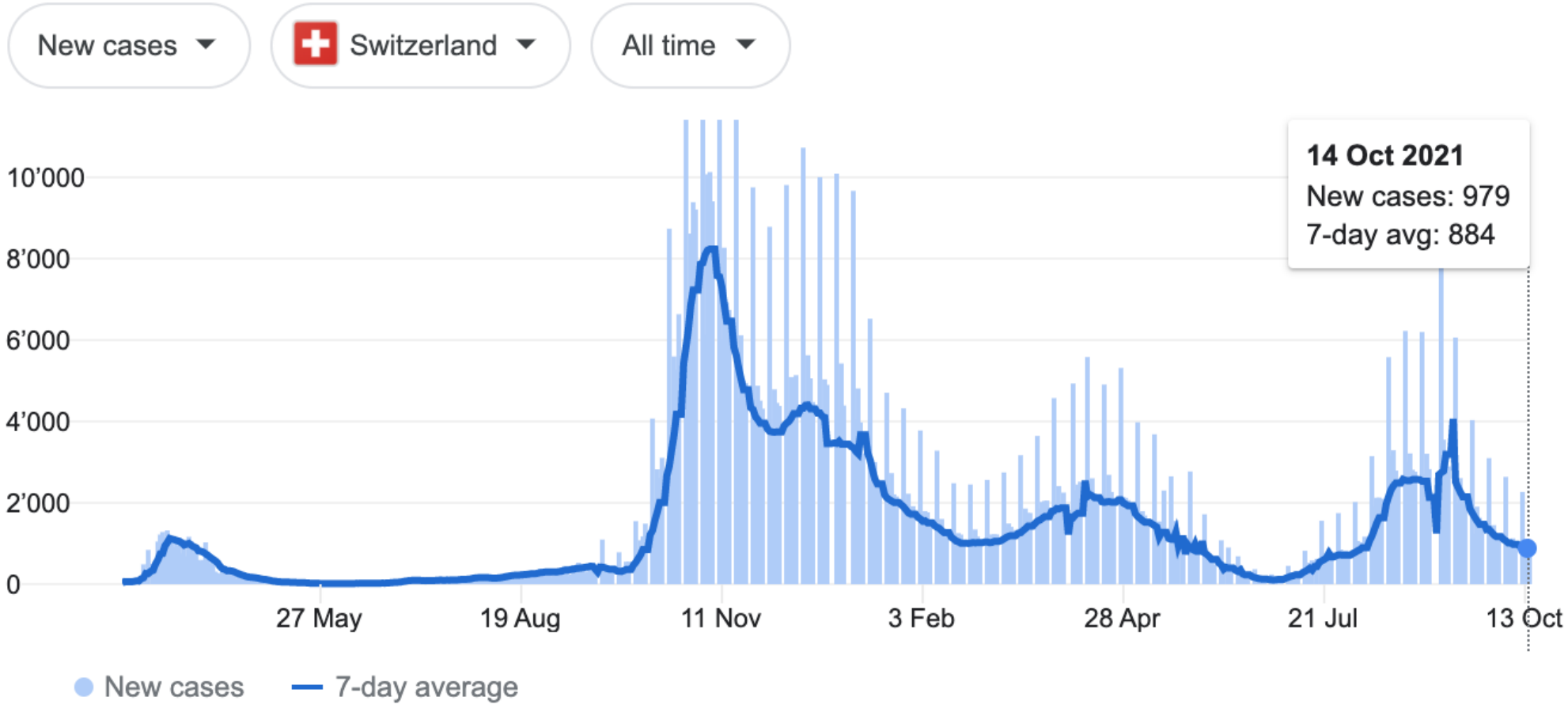


- F_t : demand forecast for period t
- a : value of F_t at $t = 0$, which is the y intercept
- b : slope of the line
- t : specified number of time periods from $t = 0$

Time Series

- A time-series is a set of observations on a quantitative variable collected over time.
- In other words: Time-series data are historical data in chronological order, with only one value per time period (day, week, month, quarter, year, …).
- Examples of historical data on:
  - Sales of iPhone
  - Stock
  - Interest rates
  - Customer engagements
  - Weather forecast, earthquake prediction, …
- Businesses are often very interested in forecasting time series variables. Why?

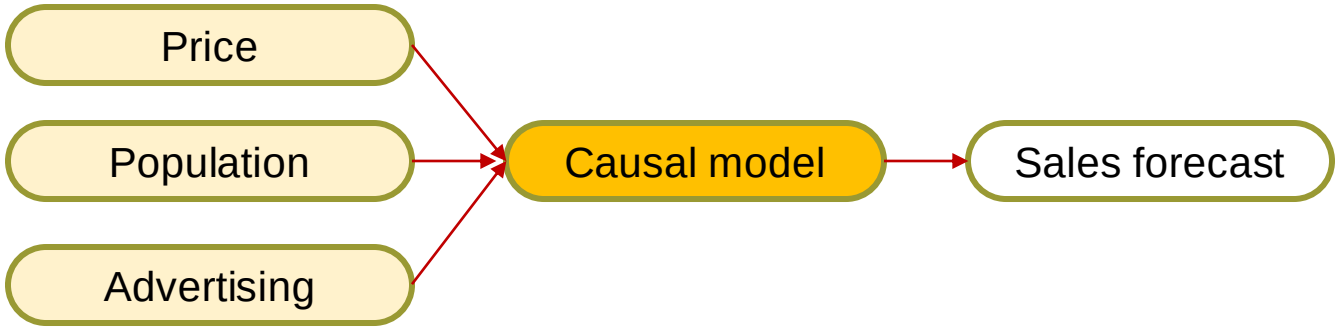
Time Series – COVID in Switzerland

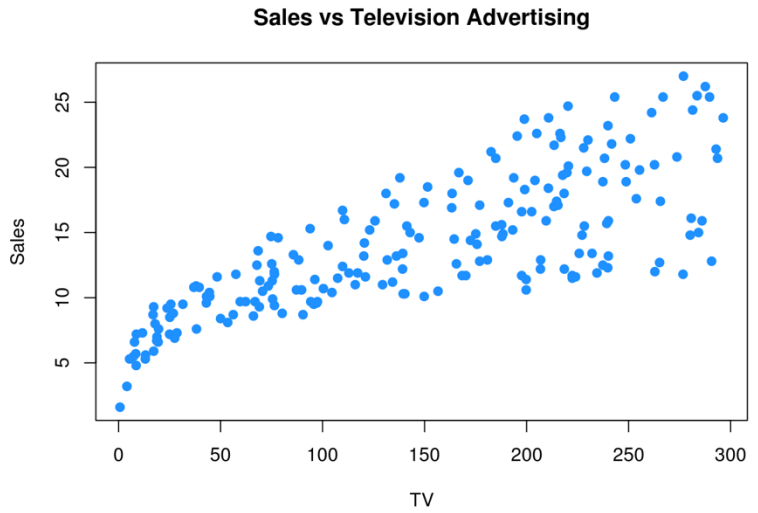


Source: Google,

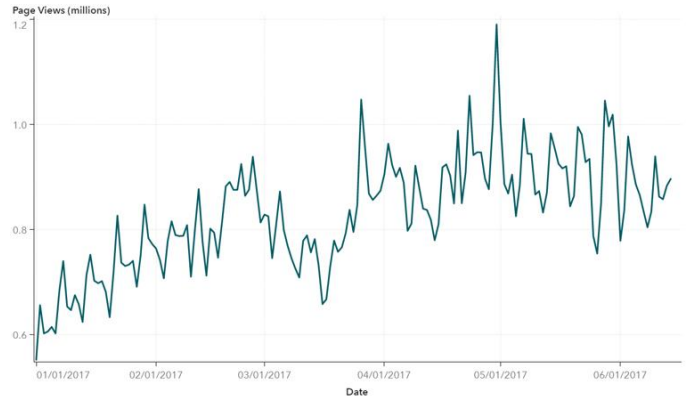
Demand Forecast – Causal Model *vs* Time Series

- **Causal models**



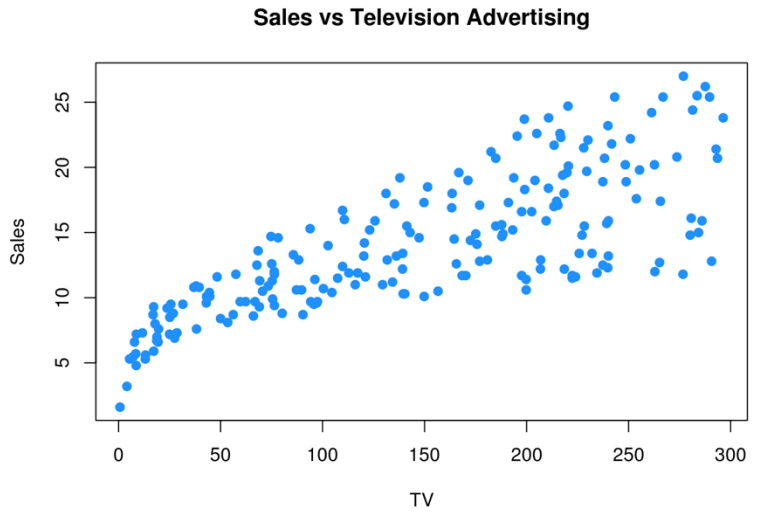


- **Time series models**

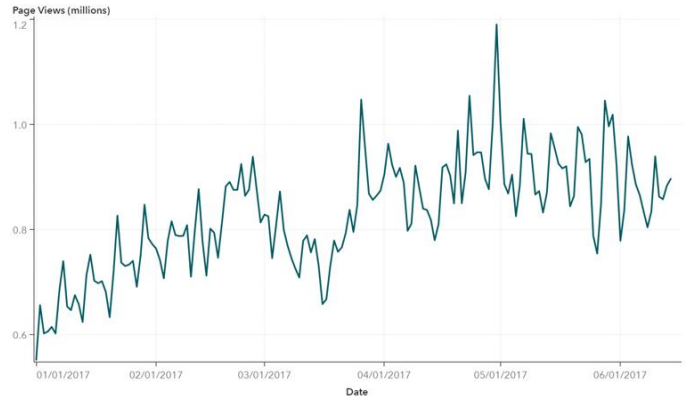


Demand Forecast – Causal Model *vs* Time Series

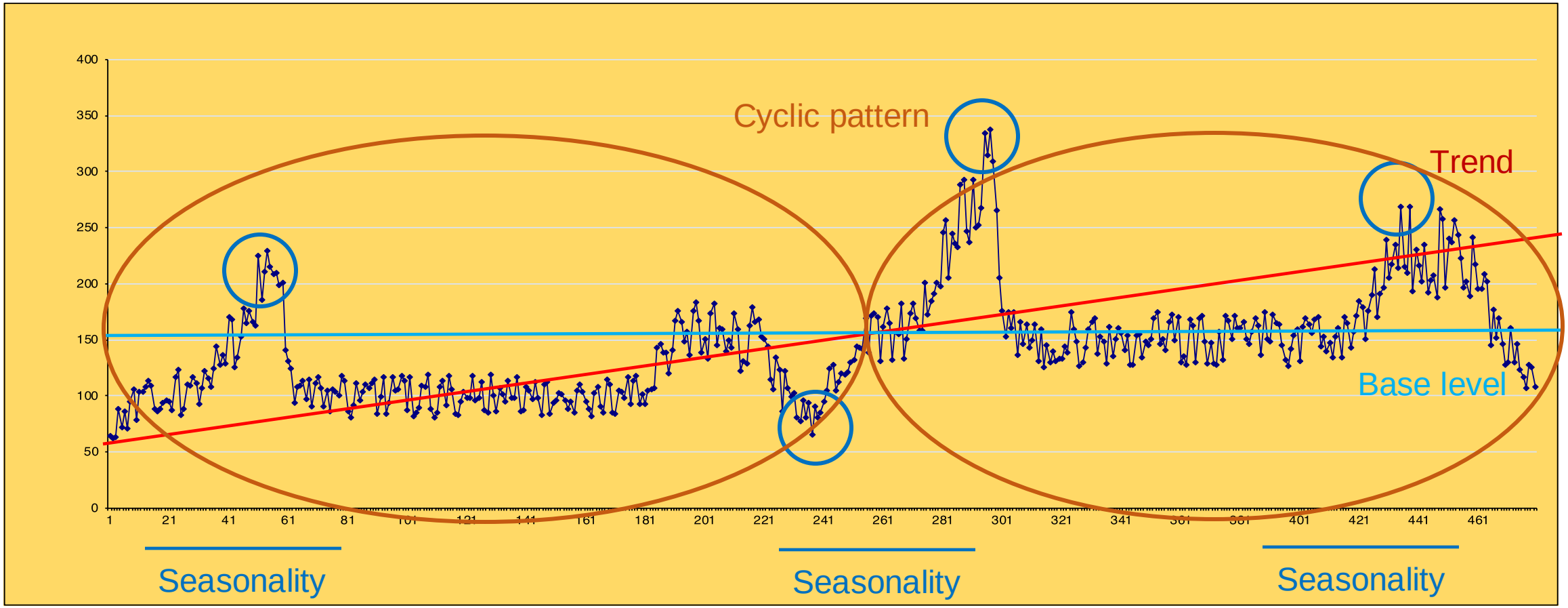
- **Causal models**
  - **Regression** analysis useful in short-term forecasting, but flawed.
  - Often, **independent variables** are not available to build a regression model of a time series variable.



- **Time series models**
  - In time series analysis, we analyze the **past behavior** of a variable in order **to predict its future behavior**.
  - Our focus in this chapter is on time series methods for forecasting.



Demand Forecast – Time Series



Time series – Analysis & Definitions

Base level: Pattern in which data values fluctuate around a constant mean

Trend: Pattern in which data exhibit increasing or decreasing values over time

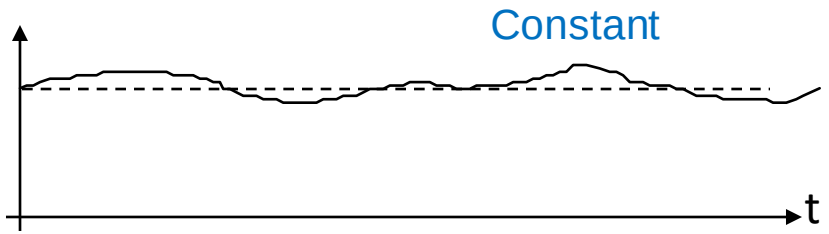
Seasonality: Any pattern that regularly repeats itself and is constant in length.

Cycles: Data patterns created by economic fluctuations.

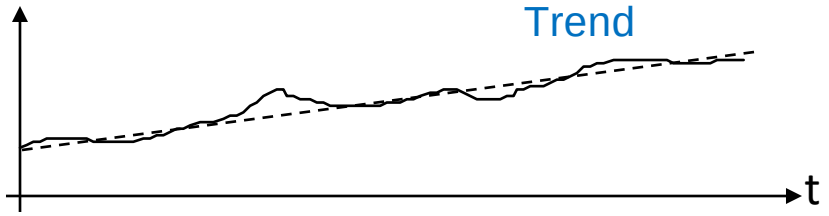
Time Series Models

Time Series

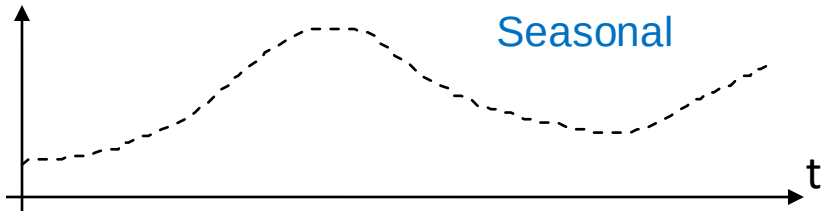
Stationary



Trend



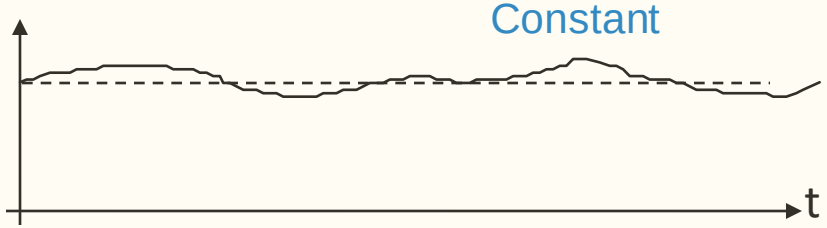
Trend + Seasonality



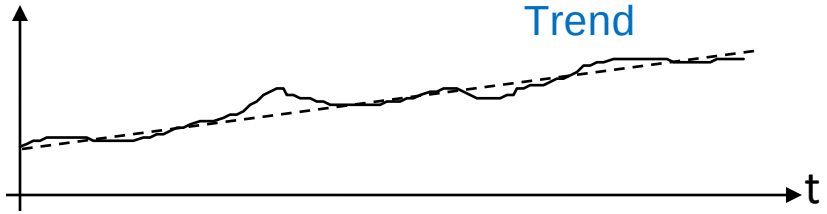
Time Series Models

Time Series

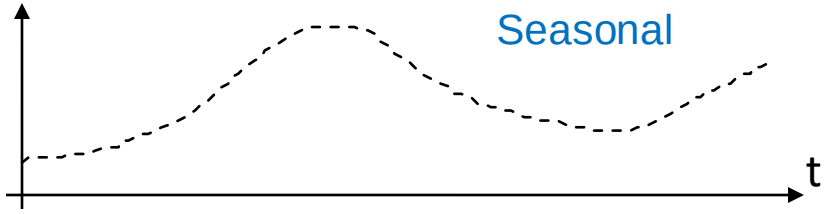
Stationary



Trend



Trend + Seasonality



Time Series – Stationary

Data = Pattern + Random fluctuation

Time Series – Stationary

Data = Pattern + Random fluctuation

$$\mathcal{Y} = \mathcal{F}(\mathcal{B}, \mathcal{T}, \mathcal{S}) + \mathcal{R}$$

- No trend and seasonal component, thus:

$$\mathcal{Y} = \mathcal{F}(\mathcal{B}) + \mathcal{R}$$

- **What are the models to forecast trend patterns in data?**
  - Stationary models

Summary – Time Series – Stationary Models

1) Naïve: $F_{t+1} = Y_t$

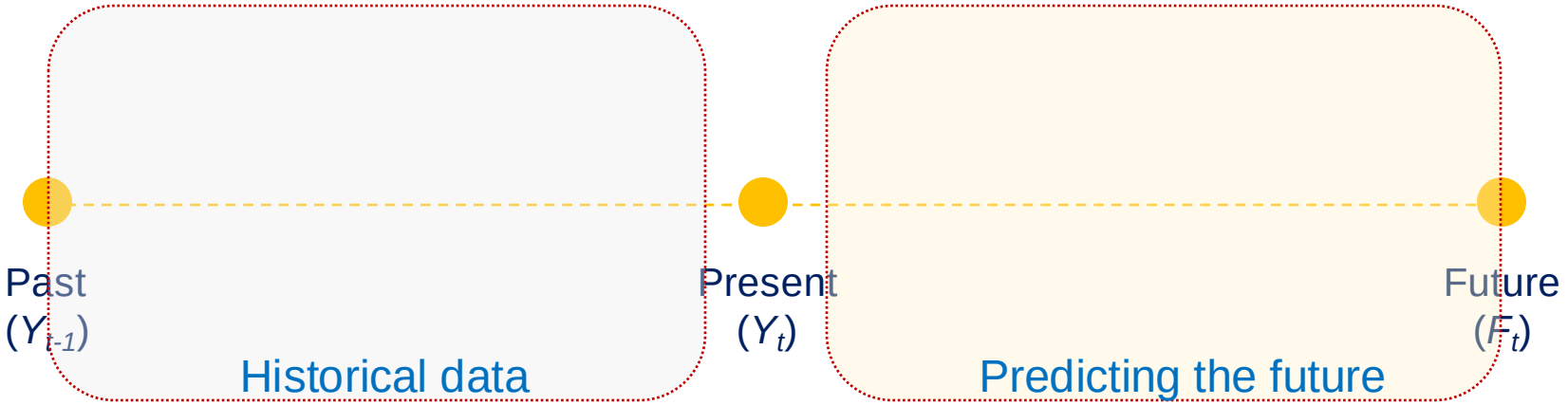
2) Simple mean: $F_{t+1} = \Sigma Y_t / n$

3) Simple moving average: $F_{t+1} = \Sigma Y_t / n$ or $F_{t+1} = \frac{1}{p} \sum_{i=0}^{p-1} [Y_{t-i}]$

4) Weighted moving average: $F_{t+1} = \sum w_t * Y_t$

5) Exponential Smoothing $F_{t+1} = \alpha Y_t + (1- \alpha) F_t$

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*

Quantitative Method – Stationary; Naïve

Forecast in period $_{t+1}$ = Actual demand of period $_{t}$

$$F_{t+1} = Y_t$$

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

Quantitative Method – Stationary; Simple Mean

Forecast in period $_{t+1}$ = Sum (Actual demand of period $_{t}$) / n

$$F_{t+1} = \Sigma Y_t / n$$

- F_t : demand forecast for period t
- Y_t : actual demand for period t
- n : number of periods or data points to be averaged

Quantitative Method – Stationary; Simple Moving Average

Forecast in period $_{t+1}$ = Sum (Actual demand of period $_t$) / n

$$F_{t+1} = \Sigma Y_t / n$$

$$F_{t+1} = Y_t + Y_{t\_1} + Y_{t\_2} + \ldots + Y_{t\_n} / n$$

- F_t : demand forecast for period t
- Y_t : actual demand for period t
- n : number of periods or data points used in the moving average

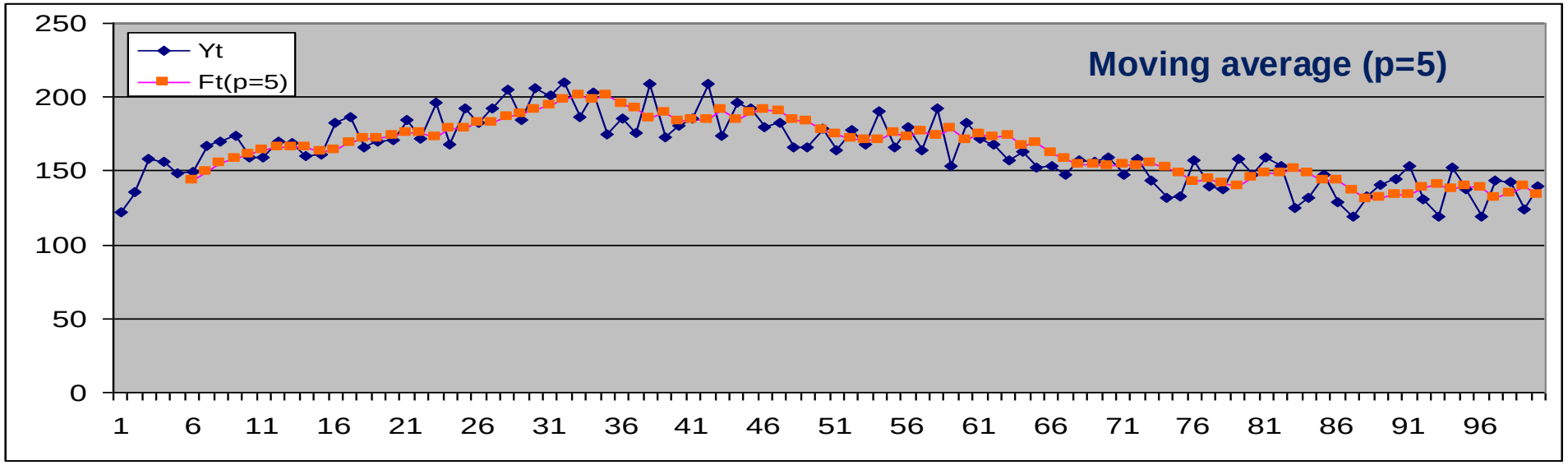
Quantitative Method – Stationary; Simple Moving Average

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

p =1 : Naive model

$$F_{t+1} = \frac{1}{p} \sum_{i=0}^{p-1} [Y_{t-i}]$$

p: order of moving average = number of periods taken into account



Quantitative Method – Stationary; Weighted Moving Average

Forecast in period $_{t+1}$ = Sum (Weights * (Actual demand of period $_{t}$)) / *n*

$$F_{t+1} = \sum w_t * Y_t$$

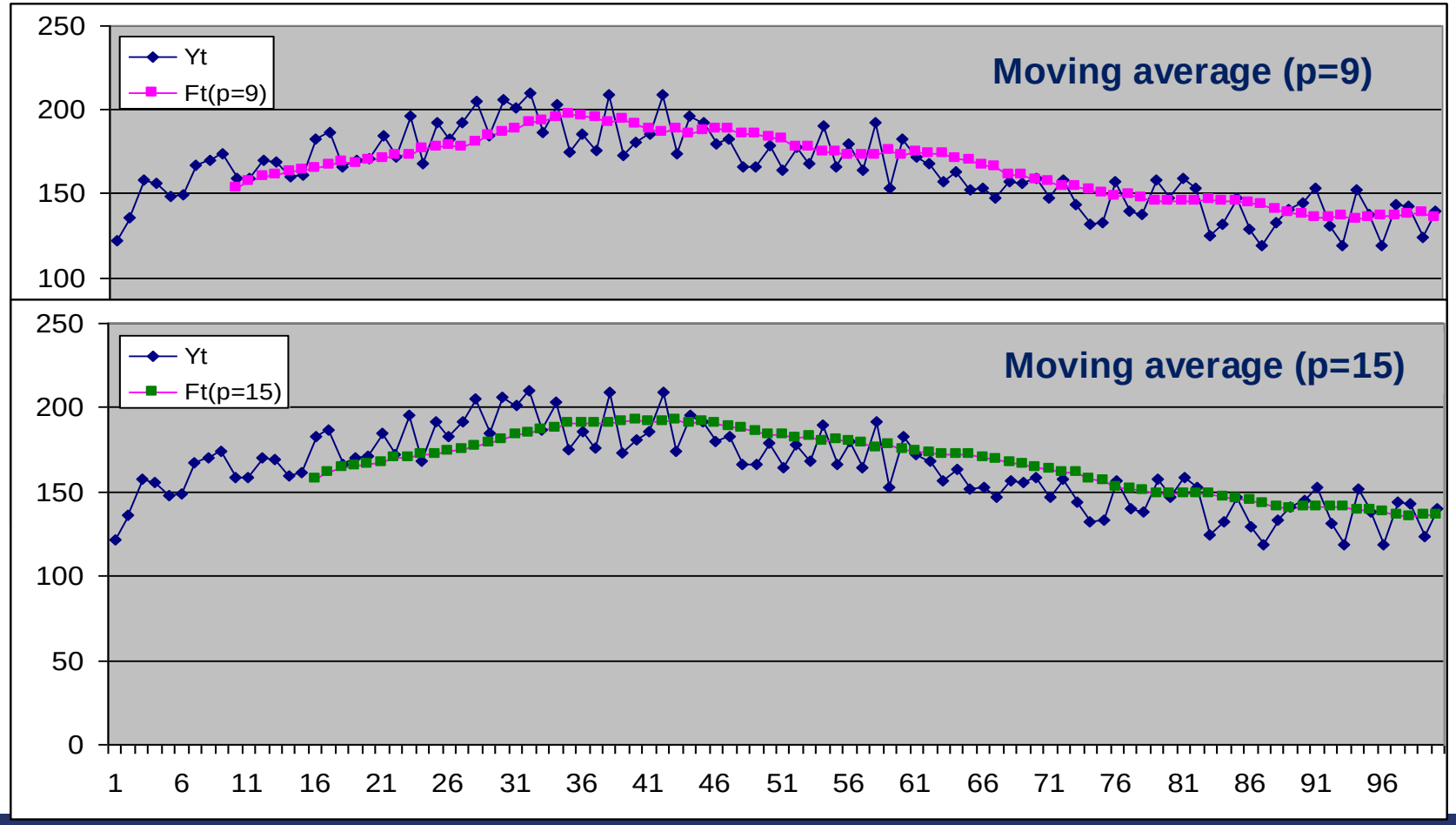
$$F_{t+1} = w_1 Y_t + w_2 Y_2 + \ldots + w_t Y_t$$

- F_t : demand forecast for period *t*
- Y_t : actual demand for period *t*
- w_t : weight placed on the actual value in period *t*

Quantitative Method – Stationary; Moving Average

$$F_{t+1} = \frac{1}{p} \sum_{i=0}^{p-1} [Y_{t-i}]$$

p: order of moving average = number of periods taken into account



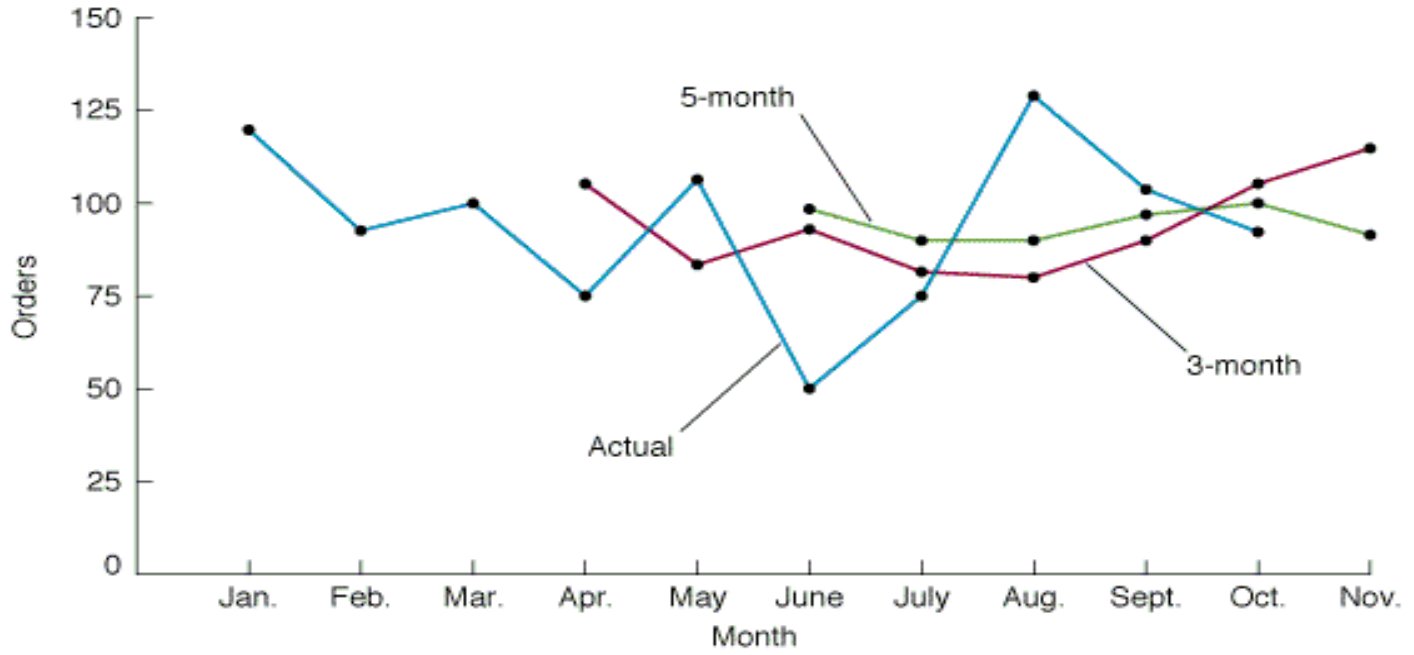
Quantitative Method – Stationary; Averaging

Exercise 1

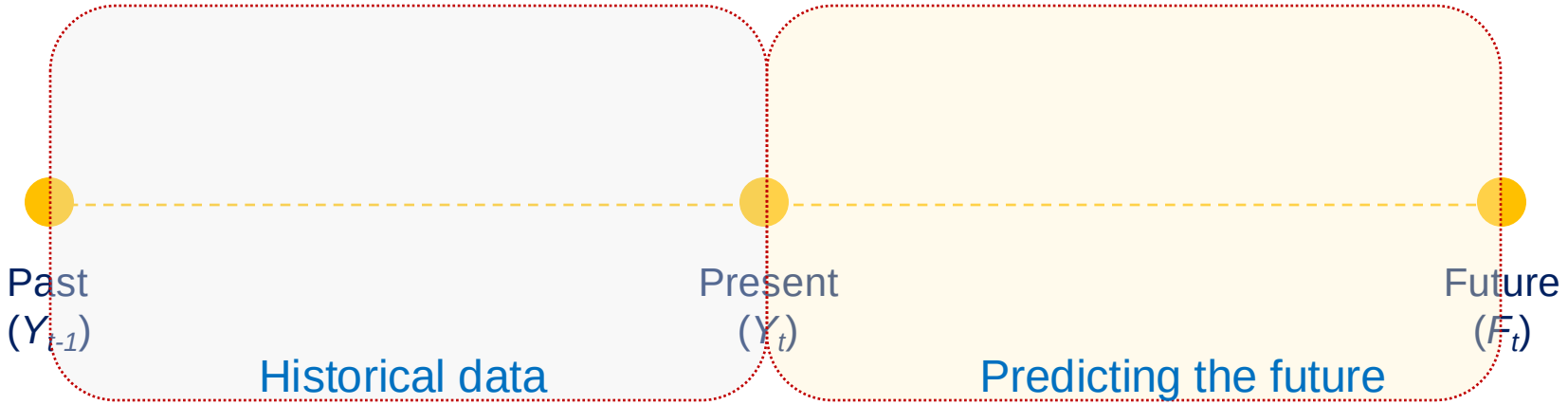
Complete the exercise in Excel
(file on Moodle)

Moving Average – Important Notes

- Suitable for relatively stable time series with NO trend or seasonal pattern
- A 3-period model (*p=3*) will be more responsive to change
- The larger the "*p*" the more stable the forecast
- The larger p, the slower reaction to actual changes



The Science of Predicting The Future



Assumption: The future will be what happened in the **present and the past!**

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

Quantitative Method – Stationary; Exponential Smoothing

To make a forecast for the next period, you need three pieces of information:

$$F_{t+1} = \alpha\, Y_t + (1- \alpha)\, F_t$$

1) The current period's forecast (F_t)

2) The current period's actual demand (Y_t)

3) The value of a smoothing coefficient, α , which varies between 0 and 1.

Quantitative Method – Stationary; Exponential smoothing

$$F_{t+1} = F_t + \alpha(Y_t - F_t)$$

$$F_{t+1} = \alpha Y_t + (1-\alpha)F_t$$

$$F_t = \alpha Y_{t-1} + (1-\alpha)F_{t-1}$$

$$F_{t-1} = \alpha Y_{t-2} + (1-\alpha)F_{t-2}$$

$$F_{t+1} = \alpha Y_t + (1-\alpha)[\alpha Y_{t-1} + (1-\alpha)(\alpha Y_{t-2} + (1-\alpha)F_{t-2})]$$

$$F_{t+1} = \alpha[Y_t + (1-\alpha)Y_{t-1} + (1-\alpha)^2 Y_{t-2}] + (1-\alpha)^3 F_{t-2}$$

$$F_{t+1} = \alpha \sum_{p=0}^{\infty} (1-\alpha)^p Y_{t-p}$$

Infinite series of the actual values with exponentially decreasing importance.

Quantitative Method – Stationary; Exponential smoothing

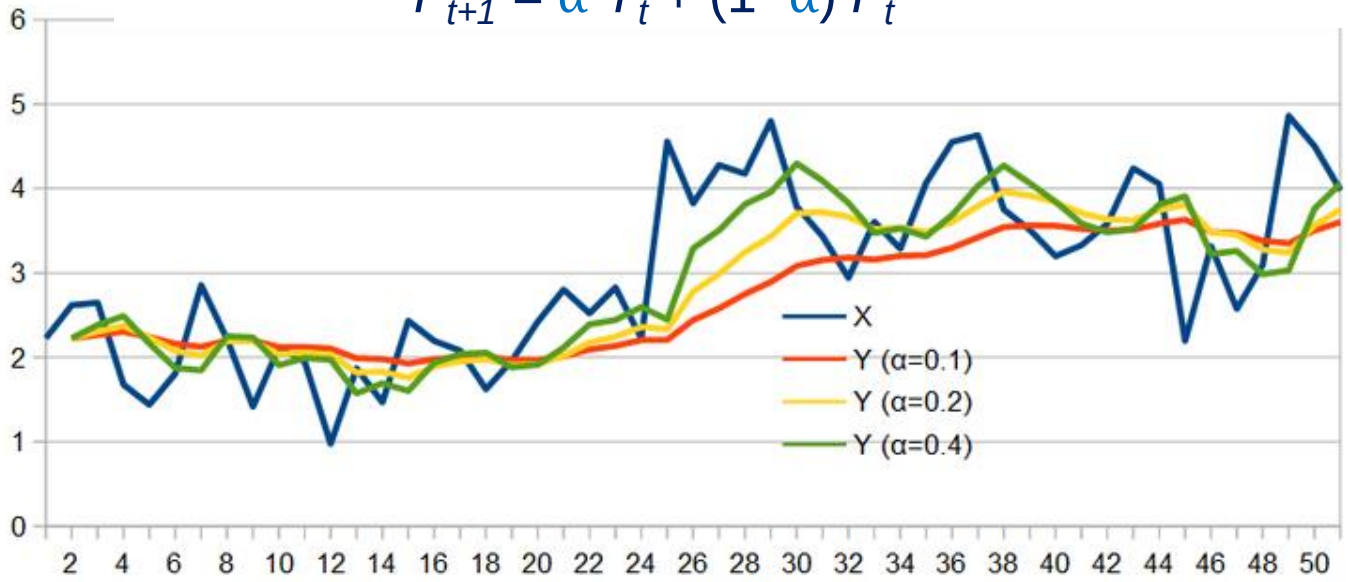
Exercise 1

Complete the exercise in Excel
(file on Moodle)

Exponential Smoothing – Important Notes

- Suitable for relatively stable time series
- Does NOT do well when there is a trend in data
- Widely used model and it requires limited data
- The larger α, the more responsive forecast
- The smaller α, the smoother forecast

$$F_{t+1} = \alpha\, Y_t + (1- \alpha)\, F_t$$



Summary – Time Series – Stationary Models

1) Naïve: $F_{t+1} = Y_t$

2) Simple mean: $F_{t+1} = \Sigma Y_t / n$

3) Simple moving average: $F_{t+1} = \Sigma Y_t / n$ or $F_{t+1} = \frac{1}{p} \sum_{i=0}^{p-1} [Y_{t-i}]$

4) Weighted moving average: $F_{t+1} = \sum w_t * Y_t$

5) Exponential Smoothing $F_{t+1} = \alpha Y_t + (1- \alpha) F_t$

Learning Points – Summary

- Demand forecasting steps
- Methods to forecast: qualitative and quantitative
- Different qualitative methods

Assignment 4 – 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).

Production Management (ME-419)

Module 2 – Demand Management

Forecasting Methods – Quantitative

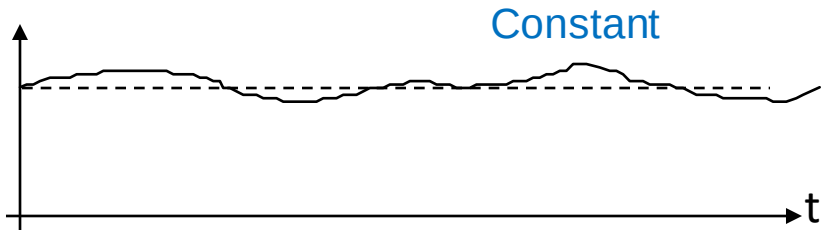
Amin Kaboli

Week 4 – Session 1 – Oct 04th, 2024

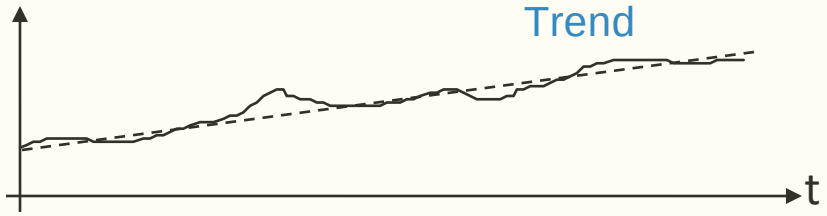
Time Series Models

Time Series

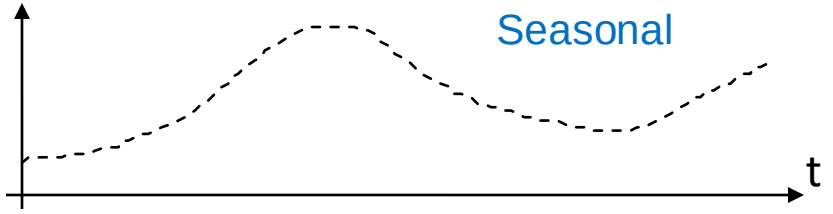
Stationary



Trend



Trend + Seasonality



Summary – Time Series – Stationary Models

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Exponential Smoothing – Important Notes

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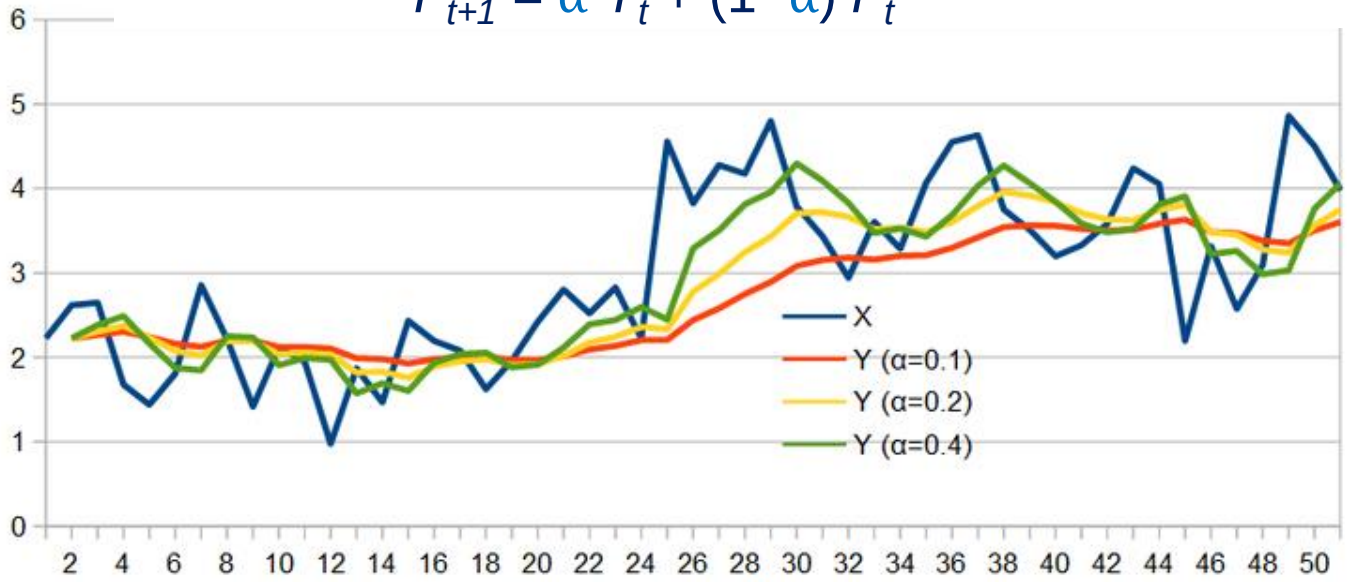
$$F_{t+1} = \alpha\, Y_t + (1- \alpha)\, F_t$$



Time Series – Trend

Data = Pattern + Random fluctuation

$$\mathcal{Y} = \mathcal{F}(\mathcal{B}, \mathcal{T}, \mathcal{S}) + \mathcal{R}$$

- No seasonal component, thus:

$$\mathcal{Y} = \mathcal{F}(\mathcal{B}, \mathcal{T}) + \mathcal{R}$$

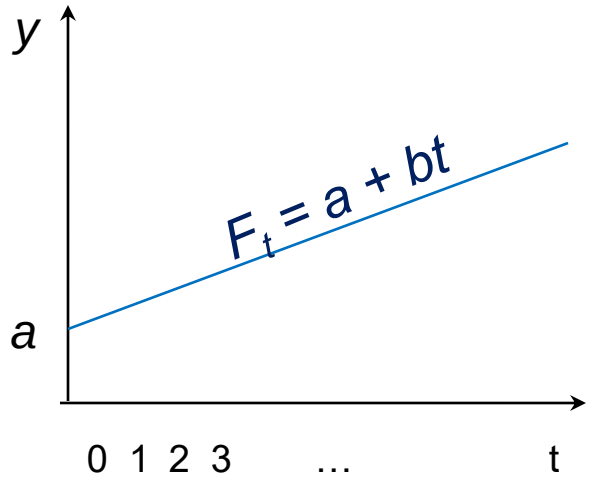
- **What are the models to forecast trend patterns in data?**
  - Linear trend line
  - Holt model (trend-adjusted exponential smoothing)

Reminder: Demand Forecast – Causal Model

This model is used to develop forecasts when trend is present:

$$F_t = a + bt$$

$$b = \frac{n\sum ty - \sum t \sum y}{n\sum t^2 - (\sum t)^2} \qquad a = \frac{\sum y - b\sum t}{n}$$



- F_t : demand forecast for period t
- a : value of F_t at $t = 0$, which is the y intercept
- b : slope of the line
- t : specified number of time periods from $t = 0$

Problem - Time Series – Trend

ABB wants to forecast demand for a piece of pollution-control equipment. A review of past sales, as shown below, indicates that an increasing trend is present:

Month (t)	Actual demand (Y_t)	Month (t)	Actual demand (Y_t)
1	12	6	21
2	17	7	31
3	20	8	28
4	19	9	36
5	24	10	-

Smoothing constants are assigned the values of $\alpha = 0.2$ and $\beta = 0.4$. The firm assumes the initial base level (B_1) is 11 units and the trend over that period (T_1) is 2 units. Define the forecast for month 1 to 10.

Time Series – Trend (Holt Model)

An exponential smoothing model (with two smoothing equations) for data with trend:

Step 1) Forecast equation $F_{t+h} = B_t + hT_t$ $h = 1,2,3,\ldots$

Step 2) Level equation $B_t = aY_t + (1- a)(B_{t-1} + T_{t-1})$ $0 \leq \alpha \leq 1$

Step 3) Trend equation $T_t = b(B_t - B_{t-1}) + (1- b)T_{t-1}$ $0 \leq \beta \leq 1$

Exercise 1 - Time Series – Trend (Holt Model)

7 min

Swiss Green is a lawn care company that uses exponential smoothing with trend to forecast monthly usage of its lawn care products. At the end of July the company desires to forecast demand of August. The trend through June has been 15 additional boxes of products sold per month.

Average demand have been 57 boxes per month. The demand for July was 62 boxes. The company uses α = 0.2 and β = 0.10 . Make a forecast including trend for the month of August.

Exercise 2 - Time Series – Trend (Holt Model)

10 min

ABB wants to forecast demand for a piece of pollution-control equipment. A review of past sales, as shown below, indicates that an increasing trend is present:

Month (t)	Actual demand (Y_t)	Month (t)	Actual demand (Y_t)
1	12	6	21
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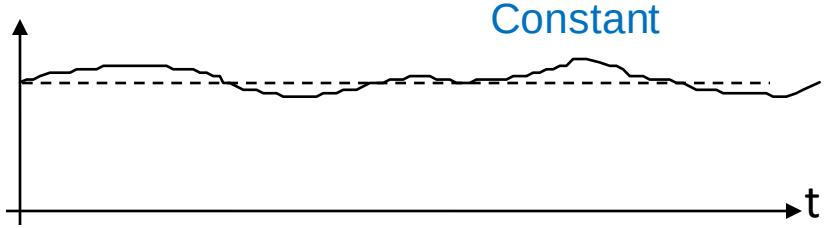
4	19	9	36
5	24	10	-

Smoothing constants are assigned the values of α = 0.2 and β = 0.4. The firm assumes the initial base level (B_1) is 11 units and the trend over that period (T_1) is 2 units. Use Holt model to define the forecast for month 1 to 10.

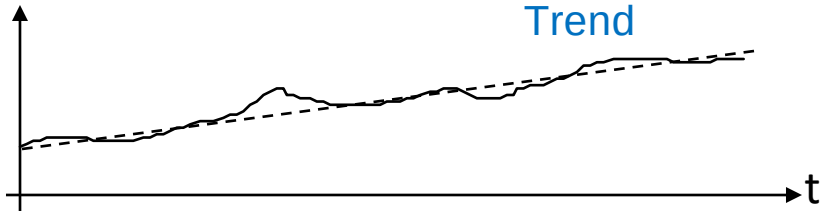
Time Series Models

Time Series

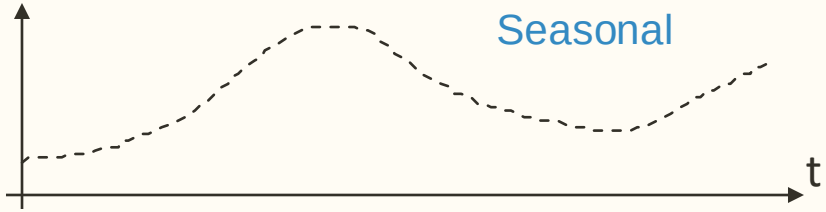
Stationary



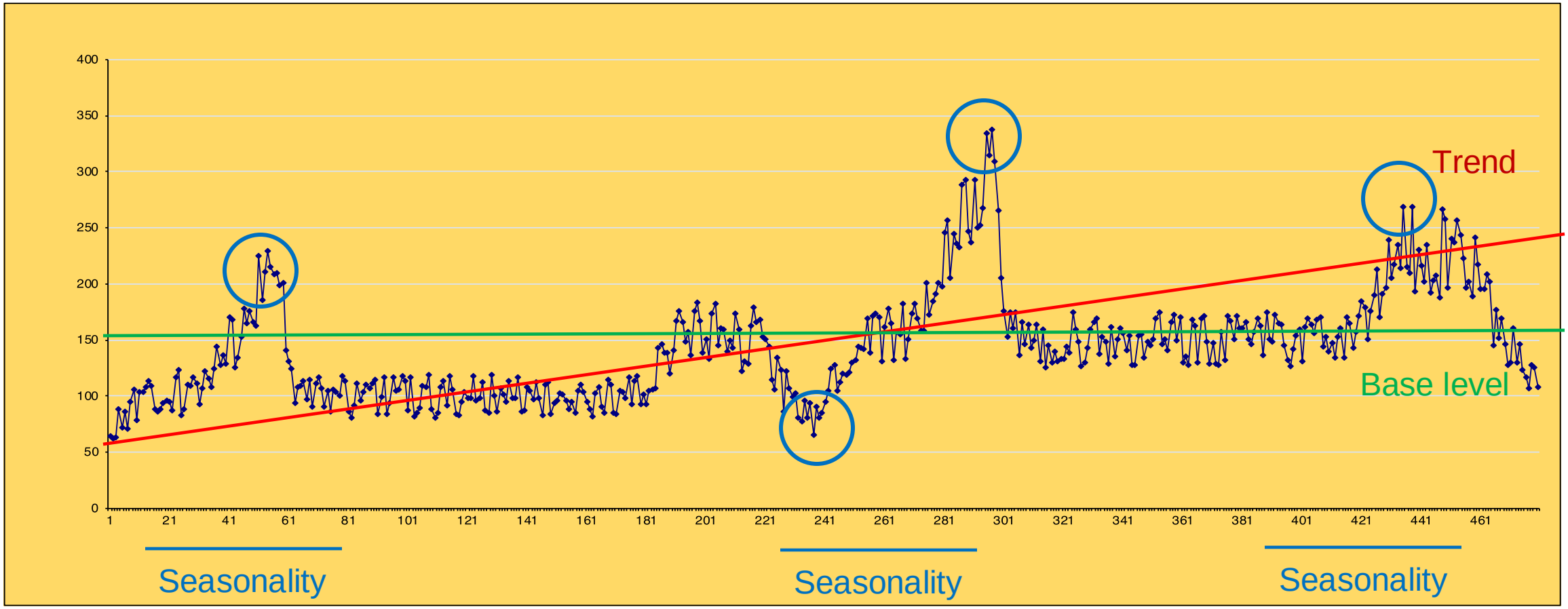
Trend



Trend + Seasonality

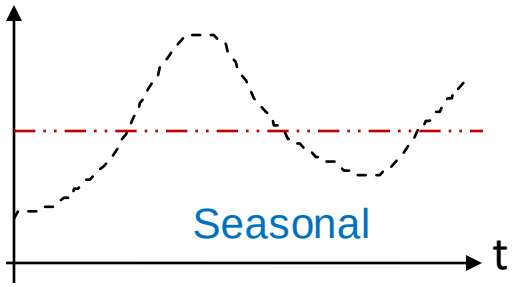


Time series – Seasonality



Seasonality: Any pattern that regularly repeats itself and is constant in length.

What Is Seasonality?



Seasonality: Regular repeating movements in series values that can be tied to recurring events

Examples:

- Daily (2x rush hours of traffic)
- Weekly (Netflix views at weekends)
- Monthly (Salary payments)
- Any other regular recurring patterns

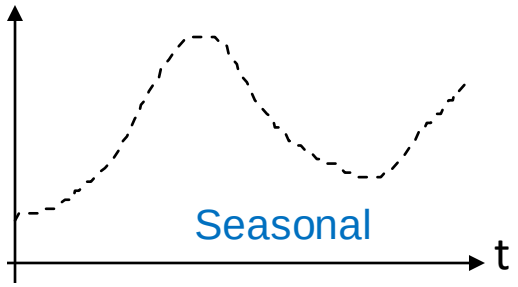
Characteristics:

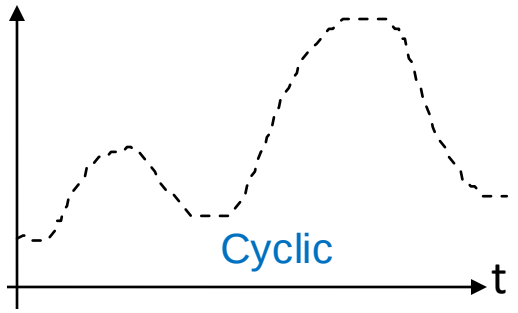
- The period is fixed and unchanging
- Series are influenced by seasonal factors (Additive, Multiplicative)

Importance:

- In upfront planning; Capacity planning and scheduling (e.g: Retail)

Time series – Seasonality *vs* Cyclic pattern





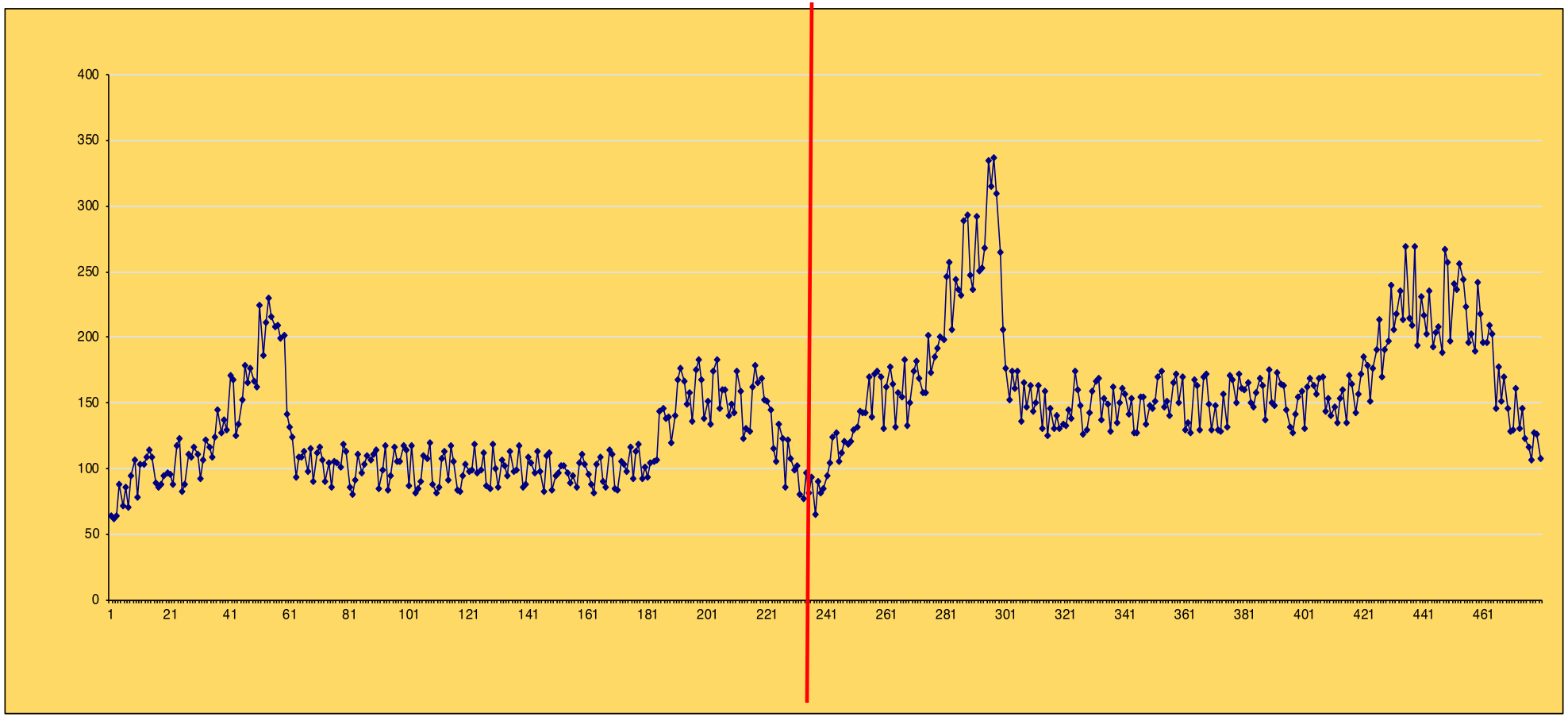
Seasonality pattern

- The period is fixed and unchanging
- Series are influenced by seasonal factors
  - Day of the week/month
  - Week of the month
  - Quarter of the year

Cyclic pattern

- The period is NOT fixed and changing
- Current cycle is unknown beforehand
  - Business cycles
  - Economic recession
  - Inflation

Detecting Seasonality



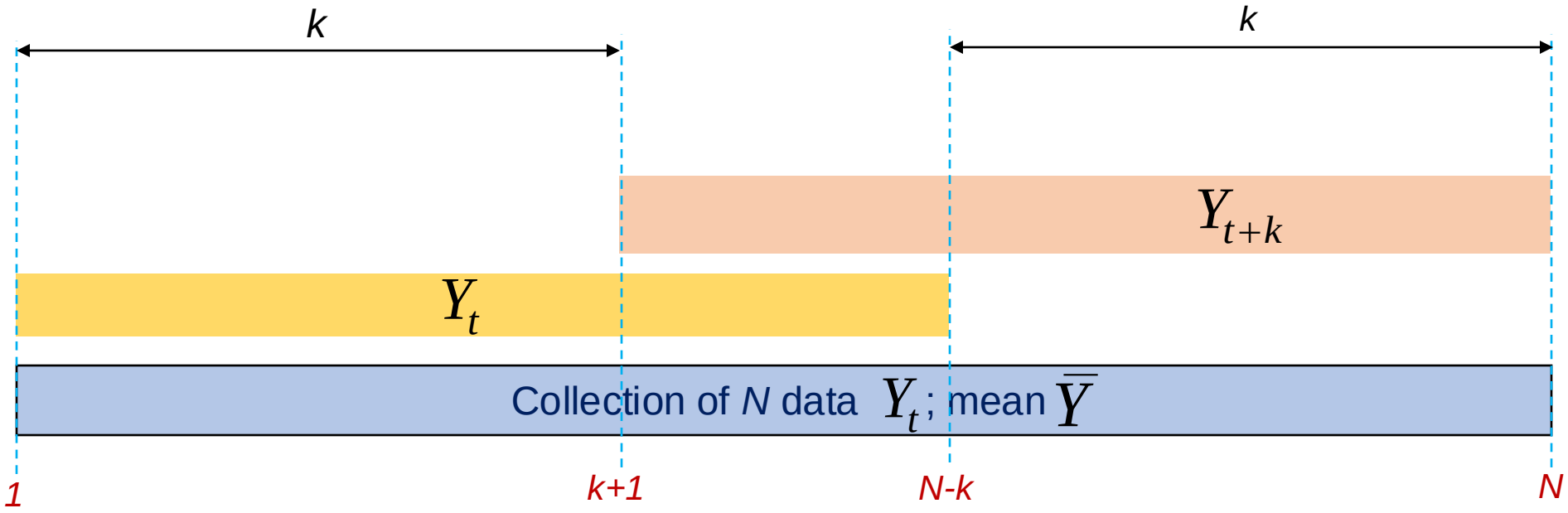
Question: Is it random or we have a real seasonal effect? – Autocorrelation Analysis Function (ACF)

Autocorrelation Analysis Function (ACF)

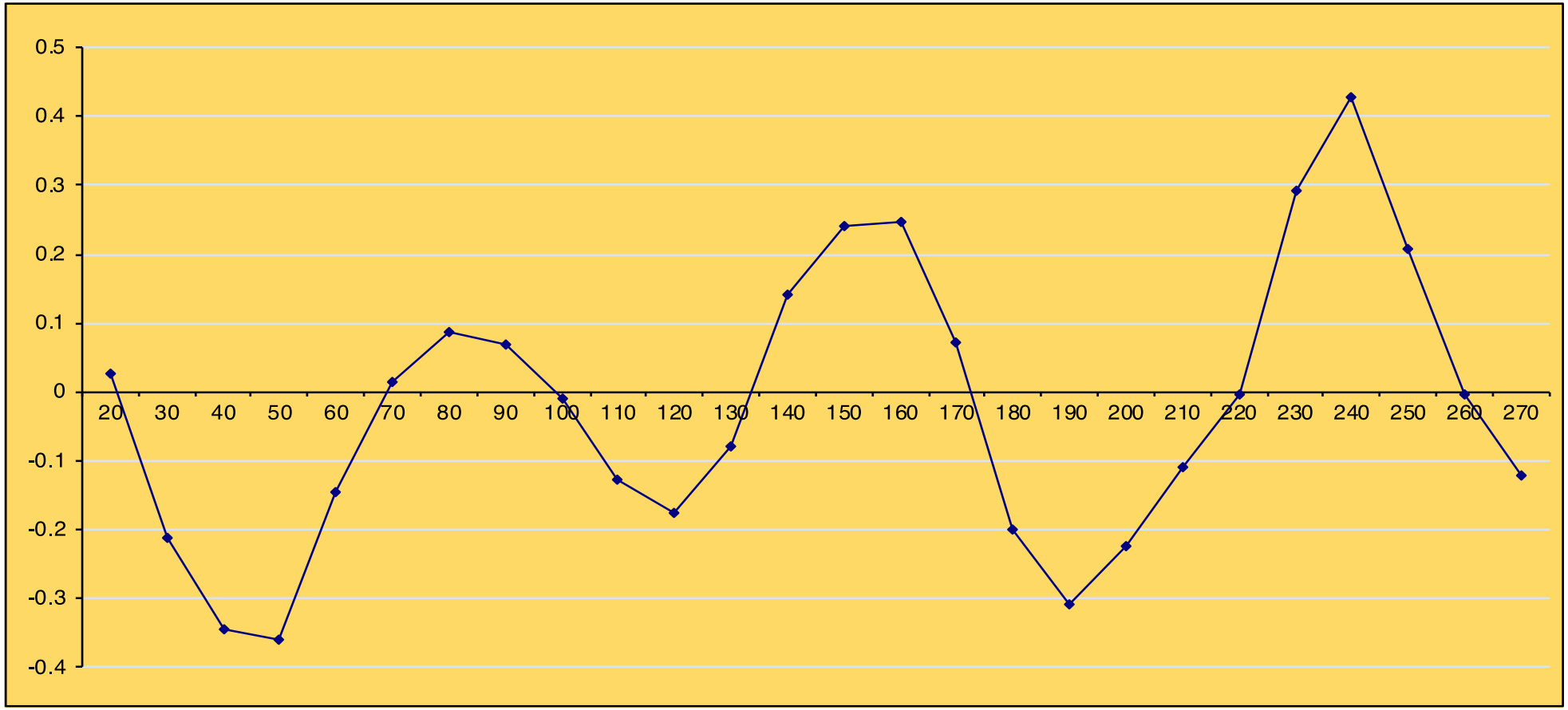
Auto-correlation coefficient $r_k = f(k)$

$$r_k = \frac{\sum_{t=1}^{N-k} (Y_t - \bar{Y})(Y_{t+k} - \bar{Y})}{\sum_{t=1}^{N} (Y_t - \bar{Y})^2}$$

k: time lag (1, 2, 3, …, N)



Autocorrelation Analysis Function (ACF)



Exercise 1 - Time Series – Autocorrelation in Excel

Two following approaches;

$$r_k = \frac{\sum_{t=1}^{N-k}(Y_t - \bar{Y})(Y_{t+k} - \bar{Y})}{\sum_{t=1}^{N}(Y_t - \bar{Y})^2}$$

= build up the formula

= CORREL

Learning Points – Summary

- Types of quantitative models
- Casual models vs Time series vs Machine learning
- Time series – stationary models
- Time series – trend
- Time series – Seasonality detection

Assignment 4 – 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).

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

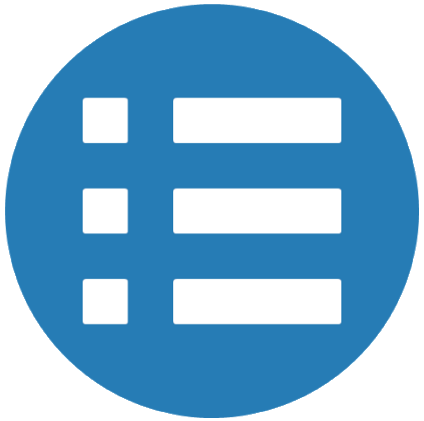
Feedback/comments are always welcome

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, …