



دفتر :

# تخطيط وضبط الإنتاج ppc Ch1+Ch8

للطالبة بتول مصلح د.عبدالله علاوين

اللجنة الأكاديمية لقسم الهندسة الصناعية

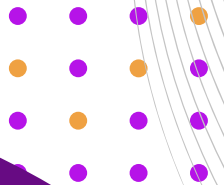
2025



Turbo IEG.Com



Turbo Team Youtube



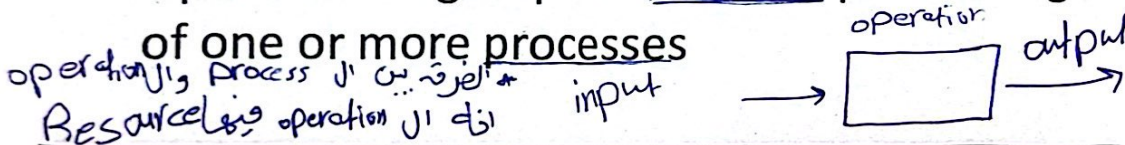
# What is Operations Management?

planning and control =  
activity + time

## تعريف Operations Management

The systematic design, direction, and control of processes that transform inputs into services and products for internal, as well as external, customers

- Process: Any activity or group of activities that takes one or more inputs, transforms them, and provides one or more outputs for its customers
- Operation: A group of resources performing all or part of one or more processes



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1-2

بالقادة ال . output يكونوا اعالى من ال input  
لا يكون في ال add value

# What is Supply Chain Management?

## Supply Chain Management

The synchronization of a firm's processes with those of its suppliers and customers to match the flow of materials, services, and information with customer demand

## Supply Chain

An interrelated series of processes within and across firms that produces a service or product to the satisfaction of customers



# Role of Operations in an Organization

## Integration between Different Functional Areas of a Business

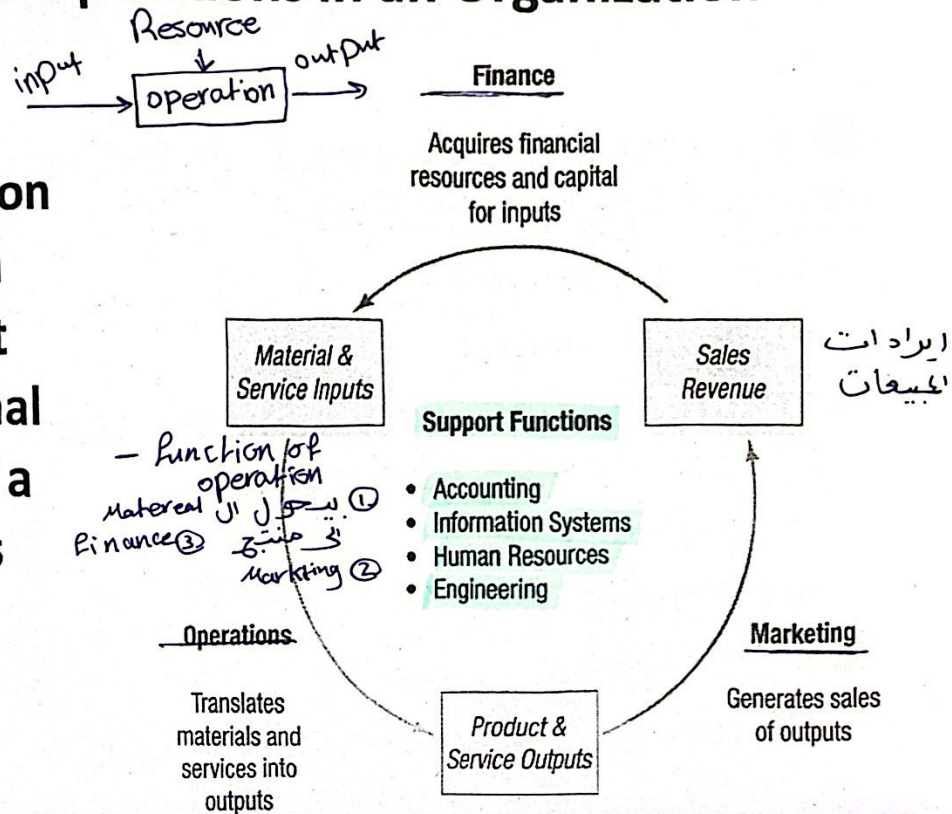


Figure 1.1

## How Processes Work

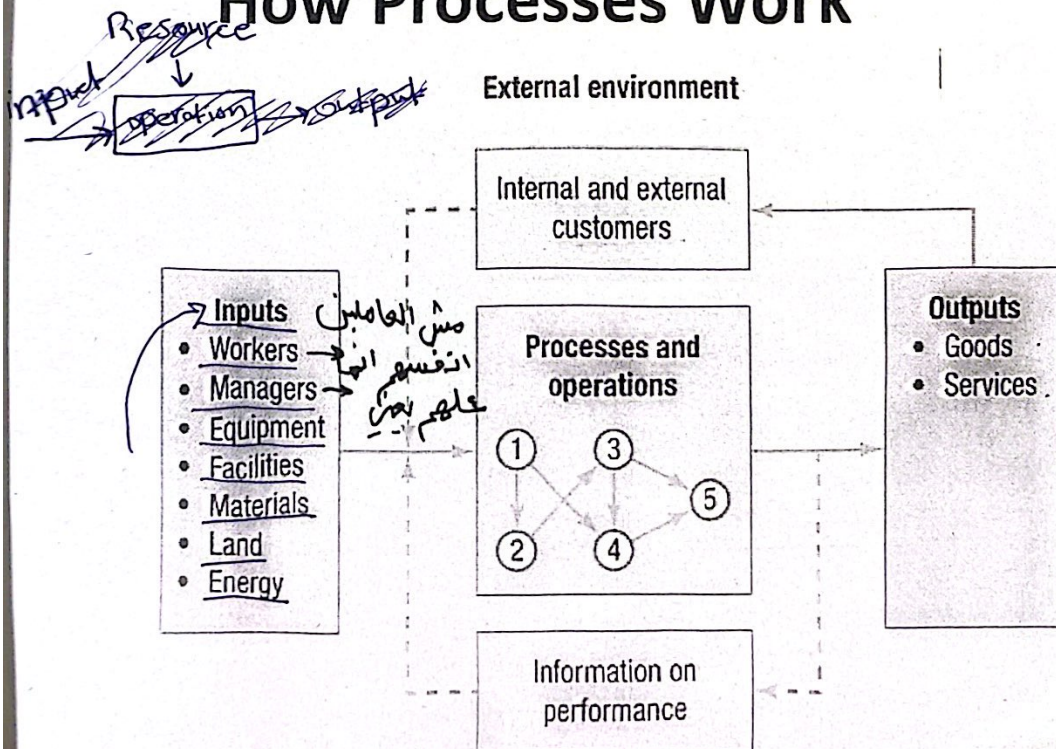


Figure 1.2

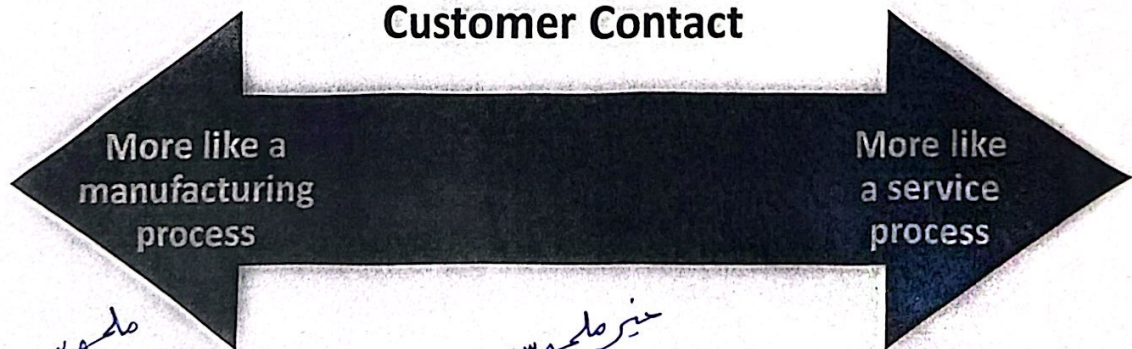


# How Processes Work

- Every process and every person in the organization has customers
  - External customers
  - Internal customers
- Every process and every person in the organization relies on suppliers
  - External suppliers
  - Internal suppliers
- Nested Process
  - The concept of a process within a process

## Service and Manufacturing Processes

Differ Across Nature of Output and Degree of Customer Contact



ملحوس

- Physical, durable output
- Output can be inventoried
- Low customer contact
- Long response time
- Capital intensive
- Quality easily measured

غير ملحوس

- Intangible, perishable output
- Output cannot be inventoried
- High customer contact
- Short response time
- Labor intensive
- Quality not easily measured

Kra

Figure 1.3



# Order Winners and Qualifiers

## Order Winners

A criterion customers use to differentiate the services or products of one firm from those of another.

## Order Qualifiers

Minimum level required from a set of criteria for a firm to do business in a particular market segment.

كيف افتح سريّة ناجحة؟ - الأسباب لبحاها؟  
 ① Quality ② time  
 ③ cost ④ Flexibility

# Order Winners and Qualifiers

COST	Definition	Process Considerations	Example
1. Low-cost operations	Delivering a service or a product at the lowest possible cost	Processes must be designed and operated to make them efficient	Costco
QUALITY			
2. Top quality	Delivering an <u>outstanding service</u> or product	May require a high level of customer contact and may require superior product features	<u>Rolex</u>
3. Consistent quality	Producing services or products that meet design specifications on a consistent basis	Processes designed and monitored to reduce errors and prevent defects	McDonald's

Table 1.3



# Order Winners and Qualifiers

TIME	Definition	Process Considerations	Example
4.Delivery speed	Quickly filling a customer's order	Design processes to reduce lead time	Netflix
5.On-time delivery	Meeting delivery-time promises	Planning processes used to increase percent of customer orders shipped when promised	United Parcel Service (UPS) <i>شركة</i>
6.Development speed <i>سرعة تطوير المنتج</i>	Quickly introducing a new service or a product	Cross-functional integration and involvement of critical external suppliers	Zara

Table 1.3

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# Order Winners and Qualifiers

FLEXIBILITY	Definition	Process Considerations	Example
7.Customization <i>حسب الطلبات التي يطلبها العميل</i>	Satisfying the unique needs of each customer by <u>changing service or product designs</u>	Low volume, close customer contact, and easily reconfigured	Ritz Carlton
8.Variety <i>نوع و تنوع</i>	Handling a wide assortment of services or products efficiently	Capable of larger volumes than processes supporting customization	Amazon.com
9.Volume flexibility	Accelerating or decelerating the rate of production of services or products quickly to handle large fluctuations in demand	Processes must be designed for excess capacity and excess inventory	The United States Postal Service (USPS)

Table 1.3

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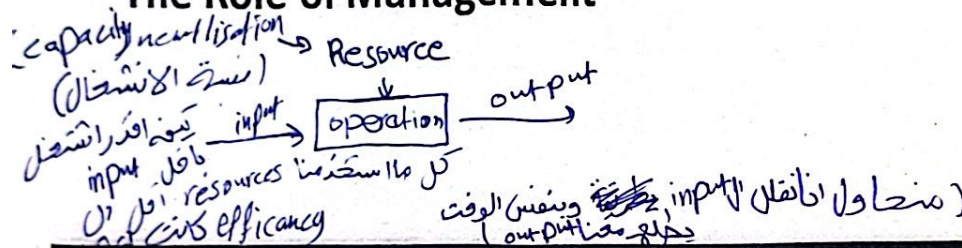


# Addressing the Trends and Challenges in Operations Management

## Measuring Productivity

$$\text{Productivity} = \frac{\text{Output}}{\text{Input}}$$

### The Role of Management



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\* جالاستحسان كفاءة و ال او سو البين حنة ال productivity

single productivity ادا كان واحد يكون productivity  
input ممكن يكون واحد و ممكن اكثر  
اذا كان اكثر من productivity  
متحول الى كل نفس الوقت  
وهي ال (حاسب)

### Example 1.1

Calculate the Productivity for the following operations:

a. Three employees process 600 insurance policies in a week. They work 8 hours per day, 5 days per week.

$$\text{Labor productivity} = \frac{\text{Policies processed}}{\text{Employee hours}}$$

$$= \frac{600 \text{ policies}}{(3 \text{ employees})(40 \text{ hours/employee})} = 5 \text{ policies/hour}$$

# Example 1.1

- b. A team of workers makes 400 units of a product, which is sold in the market for \$10 each. The accounting department reports that for this job the actual costs are \$400 for labor, \$1,000 for materials, and \$300 for overhead.

$$\text{Multifactor productivity} = \frac{\text{Value of output}}{\text{Labor cost} + \text{Materials cost} + \text{Overhead cost}}$$

$$= \frac{(400 \text{ units})(\$10/\text{unit})}{\$400 + \$1,000 + \$300} = \frac{\$4,000}{\$1,700} = 2.35 \rightarrow \text{unitless}$$

هو معنى هذا الرقم؟  
مفادها: - الدولار الواحد الذي ينفق على input تم به إنتاج output؟

## Application 1.1

هناك تيسر تراجعي السؤال الذي حظه الدكتور بالحاضرة  
سؤال سنوات وموجود بالكتاب

	This Year	Last Year	Year Before Last
Factory unit sales	2,762,103	2,475,738	2,175,447
Employment (hrs)	112,000	113,000	115,000
Sales of manufactured products (\$)	\$49,363	\$40,831	—
Total manufacturing cost of sales (\$)	\$39,000	\$33,000	—

- Calculate the year-to-date labor productivity:

	This Year	Last Year	Year Before Last
$\frac{\text{factory unit sales}}{\text{employment}}$	$\frac{2,762,103}{112,000} = 24.66/\text{hr}$	$\frac{2,475,738}{113,000} = 21.91/\text{hr}$	$\frac{2,175,447}{115,000} = 18.91/\text{hr}$

- Calculate the multifactor productivity:

	This Year	Last Year
$\frac{\text{sales of mfg products}}{\text{total mfg cost}}$	$\frac{\$49,363}{\$39,000} = 1.27$	$\frac{\$40,831}{\$33,000} = 1.24$





ELEVENTH EDITION  
ajewski ■ Malhotra ■ Ritzman

## Forecasting

### Chapter 8

PEARSON

PEARSON

التوقعات والتنبؤات  
عادة تكون فيه  
نسبة خطأ  
What is a Forecast?  
Tools  
planning  
supply = Demand  
ما يطلبه الزبائن  
قد يسأل المنتج؟

### Forecast

A prediction of  
future events used  
for planning  
purposes.

الأنماط

# Demand Patterns

- A *time series* is the repeated observations of demand for a service or product in their order of occurrence
- There are five basic time series patterns
  - Horizontal
  - Trend → برید او بقل
  - Seasonal
  - Cyclical
  - Random

کلمه معوم  
Random behavior

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## Demand Patterns

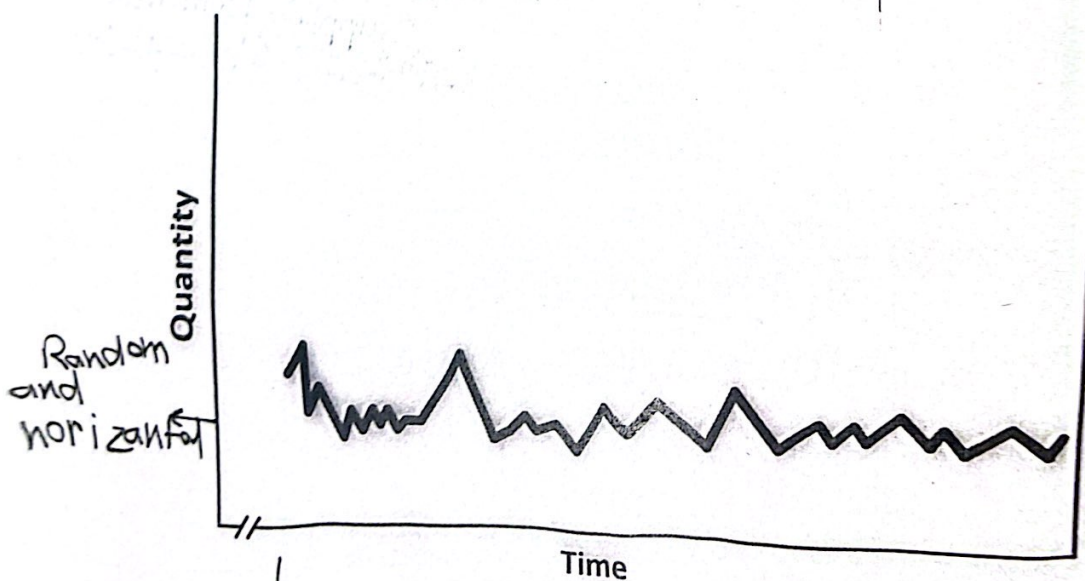


Figure 8.1

(a) Horizontal: Data cluster about a h



# Demand Patterns

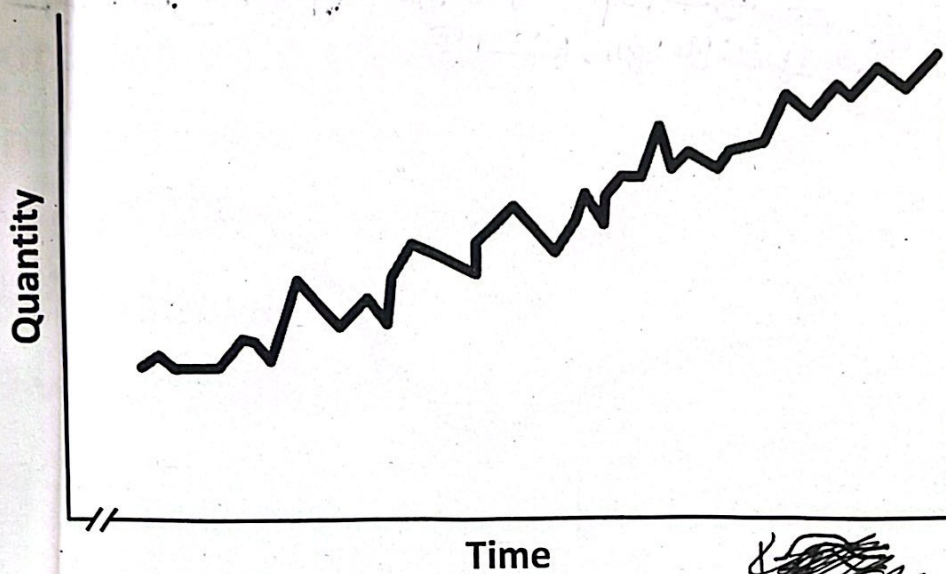


Figure 8.1

(b) Trend: Data consistently increase or decrease

# Demand Patterns

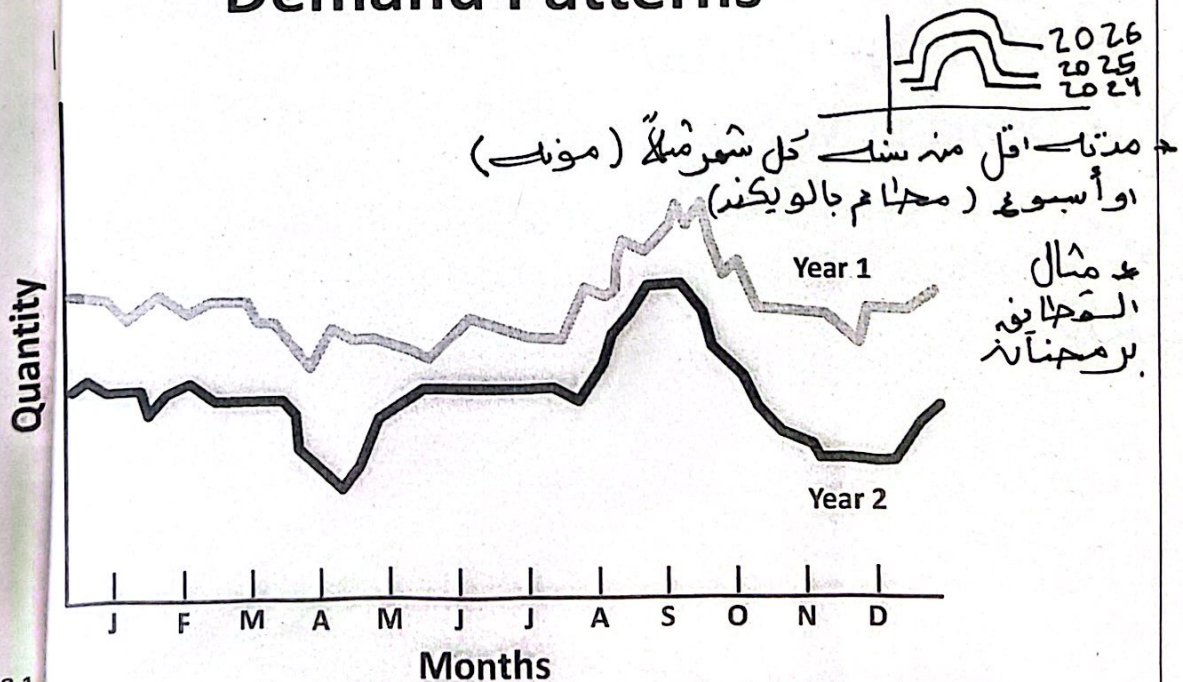


Figure 8.1

(c) Seasonal: Data consistently show peaks and valleys

# Demand Patterns

شروط أكثر من عامين مثل كأس العالم (٦ سنوات)  
 أشياء لها علاقة بالمواسم

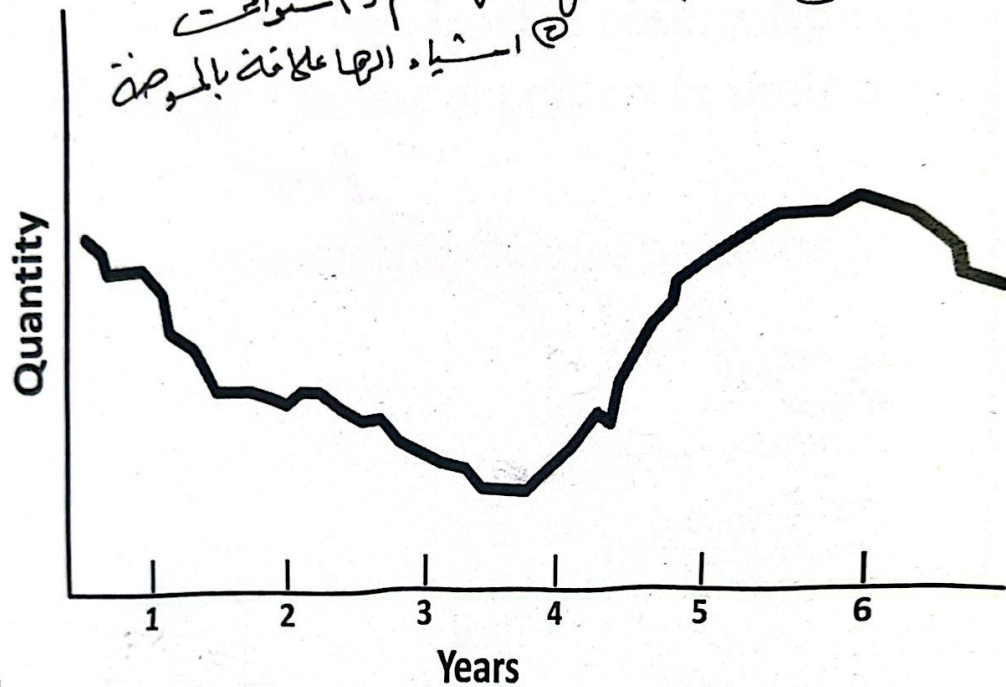


Figure 8.1

(d) Cyclical: Data reveal gradual increases and decreases over extended periods

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## Demand Management Options

لحاولة التغيير على شكل الطلب

• Demand Management

– The process of changing demand patterns using one or more demand options

الطلب  
 الموسمي  
 الي  
 متغير



# Demand Management Options

- Complementary Products منتج تكميلي
- Promotional Pricing اسعار ترويجية
- Prescheduled Appointments اعادة ترتيب المواعيد
- Reservations حجز
- Revenue Management نحدد قد يش العائد من المنتج
- Backlogs هذا  
عس اكبر  
صدا طلب او در بخته  
بنا المكنون  
كلعوهم
- Backorders and Stockouts ما عندي للمنتج وما صيوفر  
طلبوهم  
منه الكناس  
بجبر  
ما عندي بين الما يوفر  
كلعوهم

عشانه اعرفه اعل Forecasting كازم اعرفه ال behavior

## Key Decisions on Making Forecasts

- Deciding What to Forecast
  - Level of aggregation تجميع  
محل سيارات
  - Units of measurement وحدة القياس: عدد السيارات  
وحدة القياس: طن  
حشون
- Choosing the Type of Forecasting Technique
  - Judgment methods ما فيه اعادة ارقام  
اراد صبر
  - Causal methods Forecasting  
بعضه استنتاجي (علامة بيانية)  
بازد مسوعان العقالية  
لما ينفذ بغيره  
مفان بانه
  - Time-series analysis بشره مبيحان الرجعية
  - Trend projection using regression Time



## Example 8.1

The following table shows the actual sales of upholstered chairs for a furniture manufacturer and the forecasts made for each of the last eight months.

Calculate CFE, MSE,  $\sigma$ , MAD, and MAPE for this product.

Month $t$	Demand $D_t$	Forecast $F_t$	Error $E_t$	Error <sup>2</sup> $E_t^2$	Absolute Error $ E_t $	Absolute % Error $( E_t /D_t)(100)$
1	200	225	-25			
2	240	220	20			
3	300	285	15			
4	270	290	-20			
5	230	250	-20	400	20	8.7
6	260	240	20	400	20	7.7
7	210	250	-40	1,600	40	19.0
8	275	240	35	1,225	35	12.7
Total			-15	5,275	195	81.3%

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1	200	225	-25	625	25	12.5%
2	240	220	20	400	20	8.3
3	300	285	15	225	15	5.0
4	270	290	-20	400	20	7.4
5	230	250	-20	400	20	8.7
6	260	240	20	400	20	7.7
7	210	250	-40	1,600	40	19.0
8	275	240	35	1,225	35	12.7
Total			-15	5,275	195	81.3%

t	D	F	E	E <sup>2</sup>	E /D
1	100	100	0	0	0
2	110	100	10	100	10/110
3	105	100	5	25	5/105
			MAD = 15/3		MAPE = 44
					MAPE = 41

TOS  
MAPE = 41



## Example 8.1

- A CFE of  $-15$  indicates that the forecast has a slight bias to overestimate demand.
- The MSE,  $\sigma$ , and MAD statistics provide measures of forecast error variability.
- A MAD of 24.4 means that the average forecast error was 24.4 units in absolute value.
- The value of  $\sigma$ , 27.4, indicates that the sample distribution of forecast errors has a standard deviation of 27.4 units.
- A MAPE of 10.2 percent implies that, on average, the forecast error was 10.2 percent of the actual demand.

These measures be per

	$E_1$	$E_2$	$E_3$
$R_1$	100	100	50
$R_2$	120	150	70
$R_3$	120	115	100

number of

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8-17

البيانات المتوقعة  
البيانات الفعلية  
الخطأ  
المتوسط

## Judgment Methods

- Other methods (casual, time-series, and trend projection using regression) require an adequate history file, which might not be available.
- Judgmental forecasts use contextual knowledge gained through experience.

- Salesforce estimates → قيم المبيعات
- Executive opinion (التقدير)
- Market research → آراء العملاء
- Delphi method → منهجية مختلفة (التقدير)

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# Causal Methods: Linear Regression

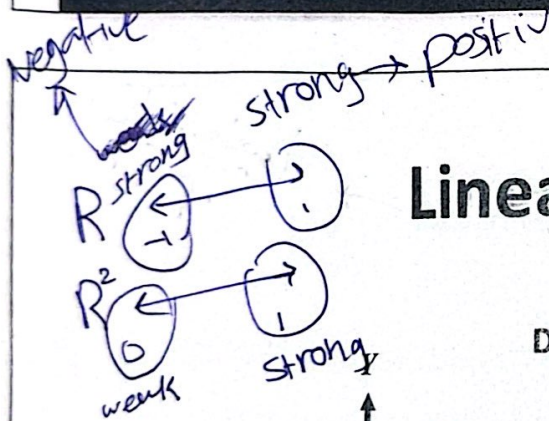
- A dependent variable is related to one or more independent variables by a linear equation
- The independent variables are assumed to "cause" the results observed in the past
- Simple linear regression model is a straight line

dep ←  $Y = a + bX$   
 where intersect stop

$R^2$

$\underline{Y}$  = dependent variable  
 ←  $\underline{X}$  = independent variable  
 $a$  = Y-intercept of the line  
 $b$  = slope of the line

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## Linear Regression

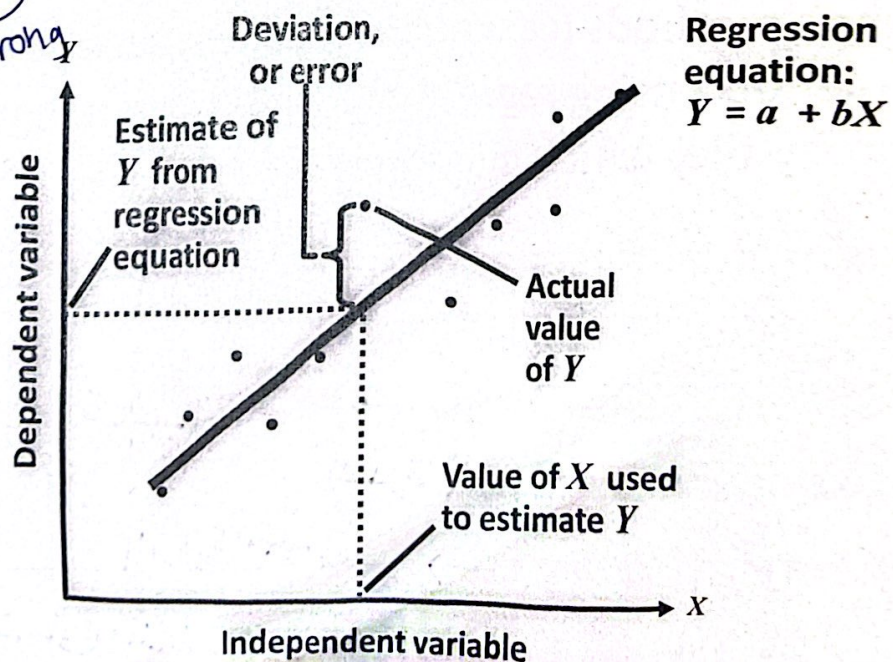


Figure 8.3



# Linear Regression

- The sample correlation coefficient,  $r$ 
  - Measures the direction and strength of the relationship between the independent variable and the dependent variable.
  - The value of  $r$  can range from  $-1.00 \leq r \leq 1.00$
- The sample coefficient of determination,  $r^2$ 
  - Measures the amount of variation in the dependent variable about its mean that is explained by the regression line
  - The values of  $r^2$  range from  $0.00 \leq r^2 \leq 1.00$
- The standard error of the estimate,  $s_{yx}$ 
  - Measures how closely the data on the dependent variable cluster around the regression line

## Example 8.2

The supply chain manager seeks a better way to forecast the demand for door hinges and believes that the demand is related to advertising expenditures. The following are sales and advertising data for the past 5 months:

$y = a + bx$

Month	Sales (thousands of units)	Advertising (thousands of \$)
1	264	2.5
2	116	1.3
3	165	1.4
4	101	1.0
5	209	2.0

The company will spend \$1,750 next month on advertising for the product. Use linear regression to develop an equation and a forecast for this product.



## Example 8.2

We used POM for Windows to determine the best value of  $a$ ,  $b$ , the correlation coefficient, the coefficient of determination, and the standard error of the estimate

$$a = -8.135$$

$$b = 109.229X$$

$$r = 0.980$$

$$r^2 = 0.960$$

$$s_{yx} = 15.603$$

المتغير المستقل (X) له علاقة إيجابية مع المتغير التابع (Y)

The regression equation is

$$Y = -8.135 + 109.229X$$

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## Example 8.2

The  $r$  of 0.98 suggests an unusually strong positive relationship between sales and advertising expenditures. The coefficient of determination,  $r^2$ , implies that 96 percent of the variation in sales is explained by advertising expenditures.

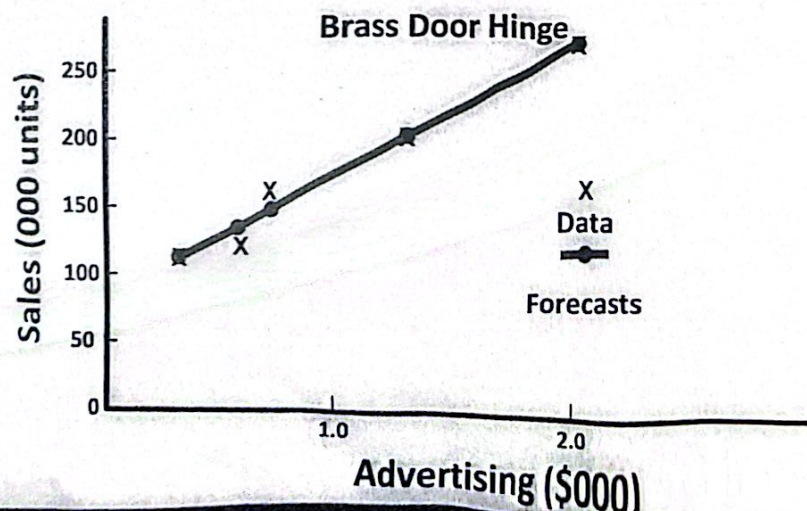


Figure 8.4



# Time Series Methods

## ① Naïve forecast

- The forecast for the next period equals the demand for the current period (Forecast =  $D_t$ )

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

t	D
1	100
2	105
3	100
4	95
5	

## ② Horizontal Patterns: Estimating the average

- Simple moving average
- Weighted moving average
- Exponential smoothing

t	D	$F_t$	$F_{t+1}$	$F_{t+2}$
1	100			
2	105			
3	100			
4	95			
5		95	105	95

$$w_1 = 0.5$$

$$w_2 = 0.3$$

$$F_{t+1} = w_1 D_t$$

$$w_1 + w_2 = 1$$

# Trend Patterns: Using Regression

$$X = \text{Time}$$

- A trend in a time series is a systematic increase or decrease in the average of the series over time

$$y = -a + bt$$

- The forecast can be improved by calculating an estimate of the trend
- Trend Projection with Regression accounts for the trend with simple regression analysis.



## Example 8.6

The manager of the Stanley Steemer carpet cleaning company needs a quarterly forecast of the number of customers expected next year. The carpet cleaning business is seasonal, with a peak in the third quarter and a trough in the first quarter. Following are the quarterly demand data from the past 4 years:

The manager wants to forecast for each quarter of year 5, based on a total year 5 demand of 2,600.

السؤال الى هنا بالعراقي

ترتيب  
البيانات  
300  
والنتيجة  
377  
وبنهاية بطولها وبياناتها

$$= F - AD$$

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AD	F <sub>1</sub>	E	F <sub>2</sub>
100	110	-10	101
105	100	5	106
95	100	-5	96
100	90	10	102
		$\Sigma E = 0$	$\Sigma E = 5$

البيانات

	F <sub>1</sub>	E	E	F <sub>2</sub>	E	E
YEAR 2	110	-10	10	101	-1	1
	100	5	5	106	-1	1
	100	-5	5	96	-1	1
	90	10	10	102	-2	2
		$\Sigma E = 0$			$\Sigma E = 5$	

Seasonal  
Factor (2)

Q	Demand	Seasonal Factor (2)
1	45	45/250 = 0.18
2	335	335/250 = 1.34
3	520	520/250 = 2.08
4	100	100/250 = 0.40
Total	1,000	

Average 1,000/4 = 250

1,200/

$E^2$	$E^2$
100	1
25	1
100	1
62.5	4
$\Sigma E^2$	$\Sigma E^2$
	1.75

البيانات

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# Seasonal Patterns: Using Seasonal Factors

## Multiplicative seasonal method

A method whereby seasonal factors are multiplied by an estimate of average demand to arrive at a seasonal forecast.

## Additive seasonal method

A method in which seasonal forecasts are generated by adding a constant to the estimate of average demand per season.

	2022	2023	2024
Q1	200	$\frac{100}{58.7} = 1.7$	350
Q2	100	$\frac{100}{58.7} = 1.7$	150
Q3	50	$\frac{50}{58.7} = 0.85$	5
Q4	50	$\frac{60}{47} = 1.28$	40
	350		545
			2025
			$F_1 = 0.7$
			$F_2 = 0.85$
			$F_3 = 1.28$
			$F_4 = 0.7$
			54.9

لو كانه مقسم على 3  
مقسم على 3 ماض فم  
حسب التقسيم

- season by dividing annual demand by the number of seasons per year.
2. For each year, divide the actual demand for each season by the average demand per season, resulting in a seasonal factor for each season.
3. Calculate the average seasonal factor for each season using the results from Step 2.
4. Calculate each season's forecast for next year.



# Choosing a Time-Series Method

- Using Statistical Criteria:

- For more stable demand patterns, use lower  $\alpha$  values or larger  $n$  values to emphasize historical experience.
- For more dynamic demand patterns, use higher  $\alpha$  values or smaller  $n$  values.

# Choosing a Time-Series Method

- Holdout sample

- Actual demands from the more recent time periods in the time series that are set aside to test different models developed from the earlier time periods.

t	D	F	E	MAD	TS
1	100	100	0	0	0
2	105	100	5	2.5	2
3	100	105	-5	3.3	0
4	20	100	-80	22.5	-3.5

أكثر دقة  
 ± 4  
 أفضل طرية  
 ↓  
 ± 8  
 هذا هو  
 أفضل  
 الحد الأدنى



# Tracking Signals

- A measure that indicates whether a method of forecasting is accurately predicting actual changes in demand.

$$\text{Tracking signal} = \frac{\text{CFE}}{\text{MAD}} \quad \text{or} \quad \frac{\text{CFE}}{\text{MAD}_t}$$

**Each period, the CFE and MAD are updated to reflect current error, and the tracking signal is compared to some predetermined limits.**