UNIVERSITÀ DEGLI STUDI DI BERGAMO | Dipartimento di Ingegneria Gestionale, dell'Informazione e della Produzione

22059 – APPLIED TOPICS IN MANAGEMENT ENGINEERING

Excel, Access and Matlab

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AGENDA

Lecture IV

- DEVIATION ANALYSIS

  - Theoretical background

  - Example

  - Final conclusion

  - Brief explanation of 5-Factor Model

  - Summary

DEVIATION ANALYSIS

THEORETICAL BACKGROUND

- The Deviation Analysis is part of company's feedback control activities.

- The firm defines the budget (it is not a forecast) and compares it with the final data:

  - The direct comparison between budget and final data does not provide accurate information.

- The Deviation Analysis allows to identify whether the responsibility for a given result is due to a factor inside or outside the company.

- The difference between budget and final data is exploded in several factors, considering a specific variation at each step.
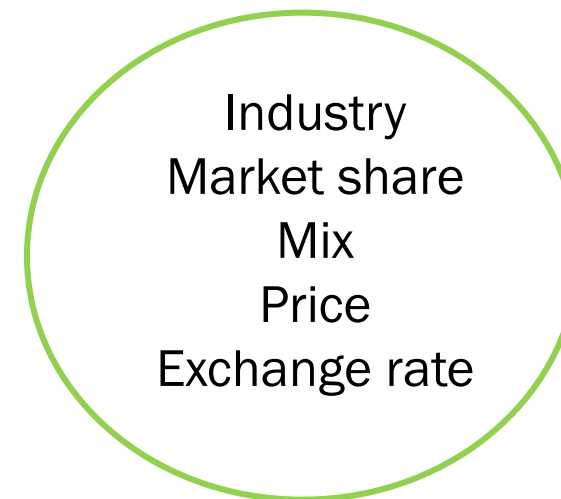
How can you assess each deviation?

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DEVIATION ANALYSIS

- The analysis can be carried out at:

3 Factors

Quantity
Mix
Price

5 Factors

Industry
Market share
Mix
Price
Exchange rate

- The performance control can be done considering different elements:

1. Turnover
2. Direct material cost
3. Direct Labour cost

DEVIATION ANALYSIS

Example "comparison between budget and final data only considering the **turnover**"

- Company X has budgeted to sell:

Product	Quantity	Price ($)
A	150	30
B	50	40

- In the final analysis, Company X has actually sold

Product	Quantity	Price ($)
A	200	27
B	40	45

DEVIATION ANALYSIS - Example

- Calculation of the turnover on budget and final data:

	A	B	C	D
1		**Budget**		**Final data**
2	Qa	150		200
3	Qb	50		40
4	Pa	30		27
5	Pb	40		45
6	**Turnover**	6500	**700**	7200

Fig.1: Actual turnover and budget turnover

- The difference between final data turnover and budget turnover (Total deviation) is **+700**

What does it mean? → The turnover increased.

Why?

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DEVIATION ANALYSIS - Example

- In order to understand what this deviation is due to, a "3-Factor model" can be used in the first analysis.

- Three deviations related to quantity, mix and price should be highlighted.

> How do you do it?
>
> You have to vary each factor in different steps!

$$\sum_{i=1}^{N} Q * Q_{vi} * P_i \quad \rightarrow \quad \sum_{i=1}^{N} q * Q_{vi} * P_i \quad \rightarrow \quad \sum_{i=1}^{N} q * q_{vi} * P_i \quad \rightarrow \quad \sum_{i=1}^{N} q * q_{vi} * p_i$$

Legend:
- $P_i \rightarrow$ selling price of the i-th product
- $Q \rightarrow$ Total quantity of products sold
- $Q_{vi} \rightarrow$ % of output related to the i-th product (mix)

N.B.
In capital letters, budget values.
In lowercase, final values.

DEVIATION ANALYSIS - Example

F	G	H	I	J	K	L	M
	Budget	**EFF Q**	**Flex Mix Stnd**	**EFF MIX**	**Flex mix Eff**	**EFF PRICE**	**Final data**
Qa	150		180		200		200
Qb	50		60		40		40
Pa	30		30		30		27
Pb	40		40		40		45
Q	200		240		240		240
Mix A	75%		75%		83%		83%
Mix B	25%		25%		17%		17%
Turnover	6500	1300	7800	-200	7600	-400	7200

Fig.2: Deviation analysis with «3-Factor model»

- The macro deviation previously seen can be better commented now:
1. Quantity Effect is **positive** (+1300) → The quantity sold has increased.
2. Mix Effect is **negative** (-200) → The quantity sold of product A, which is the cheapest, has increased.
3. Price Effect is **negative** (-400) → The selling price of product A, which is the best-selling, has decreased.

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FINAL CONCLUSION

	Budget	EFF Q	Flex Mix Stnd	EFF MIX	Flex mix Eff	EFF PRICE	Final data
Turnover	6500	1300	7800	-200	7600	-400	7200

Fig.2: Turnover deviation with «3-Factor model»

Overall, turnover increases because the positive effect on sold
quantities more than offsets the decrease in turnover due to the
general decrease in prices and the shift towards the lower-priced mix.

DEVIATION ANALYSIS

- In order to make a more detailed deviation analysis, considering available data, a "5-Factor model" can be introduced. It decomposes "3-Factor model" deviations in sub-deviations.

- In detail, 3-Factor quantity deviation can be split into:
  1. Industry deviation ($Q_{industry}$)
  2. Market share company deviation ($MS_{company}$)

So, quantity deviation

$$\sum_{i=1}^{N} Q * Q_{vi} * P_i \quad \rightarrow \quad \sum_{i=1}^{N} q * Q_{vi} * P_i$$

becomes:

$$\sum_{i=1}^{N} Q_{industry} * MS_{company} * Q_{vi} * P_i * ER \rightarrow \sum_{i=1}^{N} q_{industry} * MS_{company} * Q_{vi} * P_i * ER \rightarrow \sum_{i=1}^{N} q_{industry} * ms_{company} * Q_{vi} * P_i * ER$$

DEVIATION ANALYSIS

- Also 3-Factor price variation can be split into:
1. Price variation (P_i)
2. Exchange rate variation (ER)

So, price deviation:

$$\sum_{i=1}^{N} q * qvi * Pi \quad \rightarrow \quad \sum_{i=1}^{N} q * qvi * pi$$

becomes:

$$\sum_{i=1}^{N} q_{industry} * ms_{company} * q_{vi} * P_i * ER \rightarrow \sum_{i=1}^{N} q_{industry} * ms_{company} * q_{vi} * p_i * ER \rightarrow \sum_{i=1}^{N} q_{industry} * ms_{company} * q_{vi} * p_i * er$$

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SUMMARY

- Budget is a tool through which the results of the different centers of responsibility are coordinated.

- The Total deviation can be assessed using "3-Factor" or "5-Factor" Model. The choice of the model depends on the available data.

- The performance control can be done considering:

  1. Turnover
  2. Direct material cost
  3. Direct material employment
  4. Direct labour cost
  5. Labour force employment