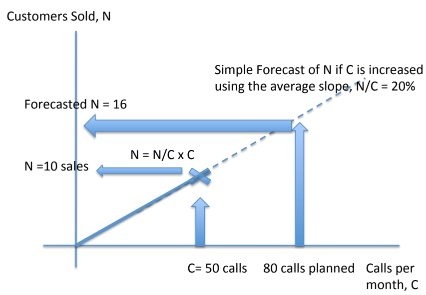
# Review
## Average and Incremental Changes

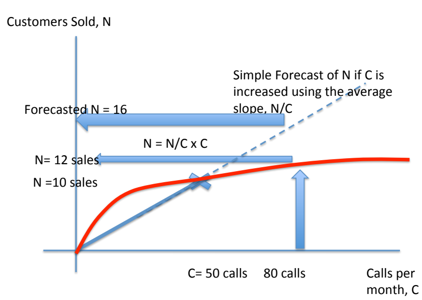
Ted Mitchell

## Using average Rates to forecast

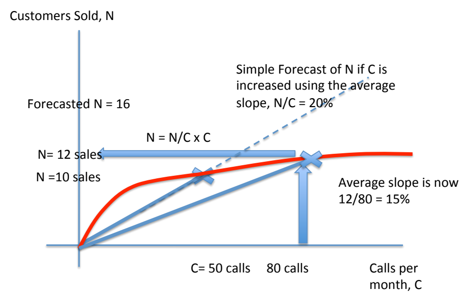
- Last month you made C=50 sales calls and made N=10 new customers
- Your average rate of sales per call is **N/C = 50/10 = 20%**
- If you made a simple prediction on the results of working harder and making 80 calls a month, then you should get 16 sales
- **N = (N/C) x C = 20% x 80 =16**




- We do not expect sales to continue in a straight line along the average sales to call rate
- Theory would suggest a curve of diminishing returns

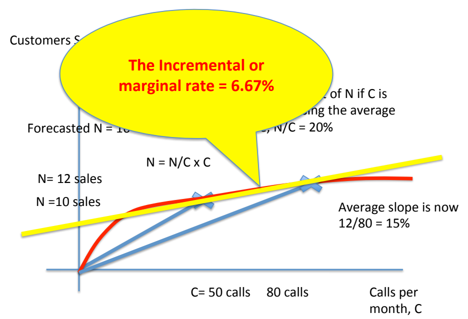



- The actual number of sales for making 80 calls a month is 12 sales (**NOT 18 as forecasted**)
- The average rate of sales per call is now N/C = 80/12 = 15%




Incremental rate is the ΔN/ΔC = 2/30 = 6.67%

The incremental rate of change from one point on the sales response curve to another is closer to 6.67%




- Marginal Rates are more accurate than Average rates
- Managers are more interested in Marginal or Incremental changes than they are in Average Rates of Change

# Impact Analysis of Working Harder and Smarter

Ted Mitchell

- The concept of 'Working Harder' is reflected in the idea of making more calls per month
- The concept of 'Working Smarter' is reflected in the idea of making each call more productive and improving the sales per call rate
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- Put the number of calls per month, C, on the x-axis
- Put the rate of sales per call, R = N/C on the Y-axis
- The number of sales is calculated as the area
- N = R x C
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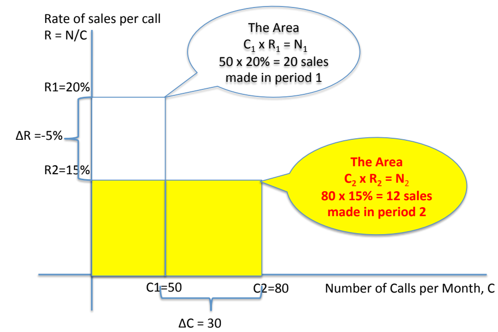
## Plotting the Impact of Two Changes



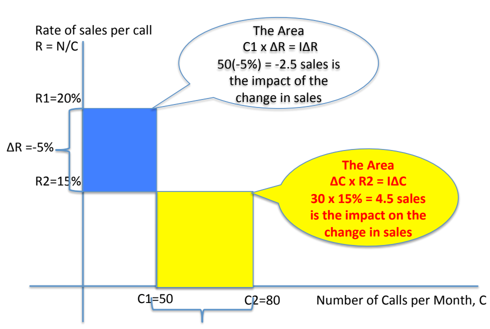

## Impact of Change on Sales

- The impact of the change in calls, ΔC, on the change in number of sales, ΔN, is
- $I\Delta C = R_{min1,2}(\Delta C) = R_{min1,2}(C_2\text{-}C_1)$
- The minimum of the two rates is 15%
- IΔC = 15%(80-50) = 15%(30) = 4.5 sales

## Impact of Change on Sales

- The impact of the change in sales per call rate, ΔR, on the change in number of sales, ΔN, is
- $I\Delta R = C_{min1,2}(\Delta R) = C_{min1,2}(R_2\text{-}R_1)$
- The minimum of the two call volumes is 50
- IΔC = 50(15%-20%) = 50(-5%) = -2.5 sales

## Plotting the Impact of Two Changes




## Impact of Change on Sales

- There is Zero Joint Impact
- The sum of the two impact must equal the change in sales
- IΔR + IΔC = ΔN
- –2.5 sales + 4.5 sales = +2 sales
- Sales increased because working harder had more impact on sales than the loss of sales efficiency.

# Change in Two Variables in The Operating Statement

Ted Mitchell

- A firm has had two changes in its operations from period 1 to period 2
- 1) It has a $10 reduction in variable cost per unit
- 2) It has a reduction in its marketing expenses (i.e., budget of $150)

Change in Marketing Expense and Variable Cost Reduces Gross Profit by $200 and Net Profit by $50

| | Period 1, P1 | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| Selling Price, P | $90 | $90 | $0 |
| Quantity Sold, Q | 100 | 80 | (20) |
| Revenue, R =P x Q | $9,000 | $7,200 | ($1,800) |
| Variable Cost, V | $40 | $30 | ($10) |
| $ Markup, D = P-V | $50 | $60 | $10 |
| COGS = V x Q | $4,000 | $2,400 | ($1,600) |
| Gross Profit, G = R-COGS | $5,000 | $4,800 | ($200) |
| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,950 | ($50) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $2,450 | ($50) |

Change in Marketing Expense and Variable Cost Reduces Gross Profit by $50

THE DROP OF $10 IN VARIABLE COST PER UNIT HAD A DIRECT IMPACT ON INCREASING THE DOLLAR MARKUP AND GROSS PROFIT

| | | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| | | $90 | $0 |
| | | 80 | (20) |
| Revenue, R =P x Q | $9,000 | $7,200 | ($1,800) |
| Variable Cost, V | $40 | $30 | ($10) |
| $ Markup, D = P-V | $50 | $60 | $10 |
| COGS = V x Q | $4,000 | $2,400 | ($1,600) |
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| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,950 | ($50) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $2,450 | ($50) |

Change in Marketing Expense and Variable Cost Reduces Gross Profit by $200 and Net Profit by $50

THE DROP OF $150 IN MARKETING EXPENSE HAD DIRECT IMPACT ON INCREASING THE NET PROFIT BY $150

| | | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| | | $90 | $0 |
| | | 80 | (20) |
| | | $7,200 | ($1,800) |
| | | $30 | ($10) |
| $ Markup, D = P-V | | $60 | $10 |
| COGS = V x Q | $4,000 | | ($1,600) |
| Gross Profit, G = R-COGS | $5,000 | | ($200) |
| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,950 | ($50) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $2,450 | ($50) |

Change in Marketing Expense and Variable Cost Reduces Gross Profit by $200 and Net Profit by $50

THE DROP OF $150 IN MARKETING EXPENSE HAD AN INDIRECT IMPACT ON DECREASING THE QUANTITY SOLD BY 20 UNITS

| | Period 1, P1 | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| Selling Price, P | $90 | $90 | $0 |
| Quantity Sold, Q | 100 | 80 | (20) |
| | | | ($1,800) |
| | | $30 | ($10) |
| | | $60 | $10 |
| | | $2,400 | ($1,600) |
| | | $4,800 | ($200) |
| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,950 | ($50) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $2,450 | ($50) |

Change in Marketing Expense and Variable Cost Reduces Gross Profit by $200 and Net Profit by $50

| | Period 1, P1 | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| Selling Price, P | $90 | $90 | $0 |
| Quantity Sold, Q | 100 | 80 | (20) |
| Revenue, R =P x Q | $9,000 | $7,200 | ($1,800) |
| Variable Cost, V | $40 | $30 | ($10) |
| $ Markup, D = P-V | $50 | $60 | $10 |
| COGS = V x Q | $4,000 | $2,400 | ($1,600) |
| Gross Profit, G = R-COGS | $5,000 | $4,800 | ($200) |
| [illegible] | [illegible] | [illegible] | ($150) |
| [illegible] | [illegible] | $2,950 | ($50) |
| [illegible] | [illegible] | $500 | $0 |
| [illegible] | [illegible] | $2,450 | ($50) |

**THE LOSS OF 20 UNITS IN SALES HAD DIRECT IMPACT ON DECREASING THE REVENUE, COST OD GOODS SOLD AND THE GROSS PROFIT**

## Classic Marketing Problem

- We can see that the reduction in marketing costs improved the net profit by $150
- We can see that the reduction in variable cost per unit had a dollar impact on gross profit
- BUT
- What was the dollar impact on the gross profit caused by the change in the quantity sold?

- The reduction in marketing effort caused a loss of 20 units in sales volume
- Can NOT directly compare quantity changes and dollar change
- What was the dollar impact of this loss in quantity sold on gross profit?

- Decomposing the $50 reduction in net profit into the two individual effects is best accomplished by first decomposing the $200 dollar reduction in gross profit into the impact on change in Gross Profit by
- 1) by change in variable cost ΔV
- Or change in dollar markup, ΔD
- 2) by change in quantity sold ΔQ

- Impact analysis has the big advantage of converting the impact of changing quantity sold into changing dollars of profit
- Dollars of Impact are Directly comparable with other direct dollar changes on profits

## Remember Impact Analysis Equation: $\Delta G = I\Delta Q + I\Delta D + J$

- ΔG = Change in Gross Profit
- IΔQ = Impact of Change in Quantity
- IΔD = Impact of Change in Dollar Markup
- J = the joint or Interactive Impact of the Two Changes (If any)

## Remember Impact Analysis Equation: ΔG = IΔQ+IΔD+J

- ΔG = Change in Gross Profit
  ΔG = $4,800 - $5,000 = -$200
- IΔQ = Impact of Change in Quantity
  IΔQ = Dmin1,2(Q2-Q1) = $50(80-100) =-$1,000
- IΔD = Impact of Change in Dollar Mark up
  IΔD = Qmin1,2(D2-D1) = 80($60-$50) =$800
- J = the joint or Interactive Impact of the Two Changes (If any)
  J = ΔG –IΔQ –IΔD = -$200 –(-$1,000) –$800 = 0

- **Why do I have to memorize this "Flaming Formula" for Impact Analysis?**

- I could just put one change at a time into the spreadsheet and see the impact of each individual change.
- Add up the individual changes and I get the total change to net profit

- If there is a single change in an operating statement from period to period then the impact of the change on the bottom line is often easy to measure and understand

- Let us Pretend That there was no change in the marketing Expense and sales remained at 100 units in period 2
- A Decrease in the Variable Cost per Unit by $10 Increases Gross Profit and the Net profit by $1,000

Change in Variable Cost per Unit Improves profit by $1,000

| | Period 1, P1 | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| Selling Price, P | $90 | $90 | $0 |
| Quantity Sold, Q | 100 | 100 | 0 |
| Revenue, R =P x Q | $9,000 | $9,000 | $0 |
| Variable Cost, V | $40 | $30 | ($10) |
| $ Markup, D = P-V | $50 | $60 | $10 |
| COGS = V x Q | $4,000 | $3,000 | ($1,000) |
| Gross Profit, G = R-COGS | $5,000 | $6,000 | $1,000 |
| Marketing Expense, ME | $2,000 | $2,000 | $0 |
| Marketing Profit, M | $3,000 | $4,000 | $1,000 |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $3,500 | $1,000 |

- Let us pretend that the change in variable cost did NOT happen and The marketing expense was reduced by $150

- The decrease in quantity sold of 20 units results in an decrease in Gross profit of $1,000 and a decrease in Net profit of $850

Change in Marketing Expense Reduces profit by $850

| | Period 1, P1 | Period 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| Selling Price, P | $90 | $90 | $0 |
| Quantity Sold, Q | 100 | 80 | (20) |
| Revenue, R =P x Q | $9,000 | $7,200 | ($1,800) |
| Variable Cost, V | $40 | $40 | $0 |
| $ Markup, D = P-V | $50 | $50 | $0 |
| COGS = V x Q | $4,000 | $3,200 | ($800) |
| Gross Profit, G = R-COGS | $5,000 | $4,000 | ($1,000) |
| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,150 | ($850) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $1,650 | ($850) |

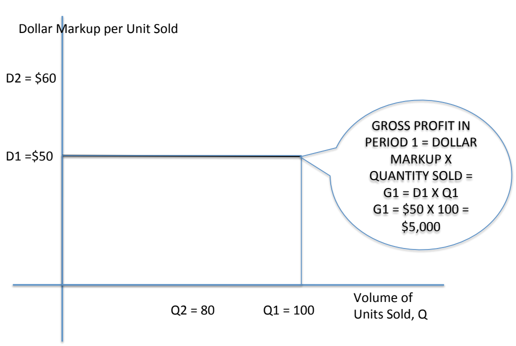
…able Cost Reduces profit by $50

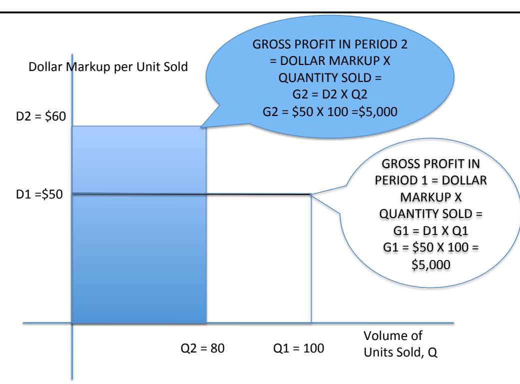
**The original Operating Statement has a $200 reduction in gross profit which is the same as we get adding the individual impacts together!!!**

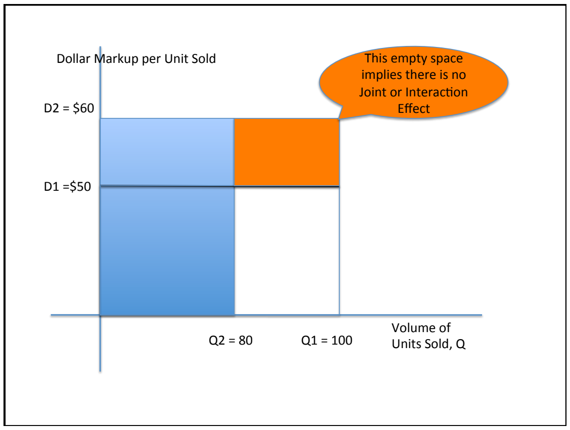
| [illegible] | [illegible] | …eriod 2, P2 | Δ=P2 –P1 |
|---|---|---|---|
| [illegible] | [illegible] | $90 | $0 |
| [illegible] | …00 | 80 | ($20) |
| Revenue, … | [illegible] | $7,200 | ($1,800) |
| Variable Cost, V | $4… | $30 | ($10) |
| $ Markup, D = P-V | $50 | $60 | $10 |
| COGS = V x Q | $4,000 | $2,4…0 | ($1,600) |
| Gross Profit, G = R-COGS | $5,000 | $4,800 | ($200) |
| Marketing Expense, ME | $2,000 | $1,850 | ($150) |
| Marketing Profit, M | $3,000 | $2,950 | ($50) |
| General Overheads, OH | $500 | $500 | $0 |
| Net Profit, Z | $2,500 | $2,450 | ($50) |

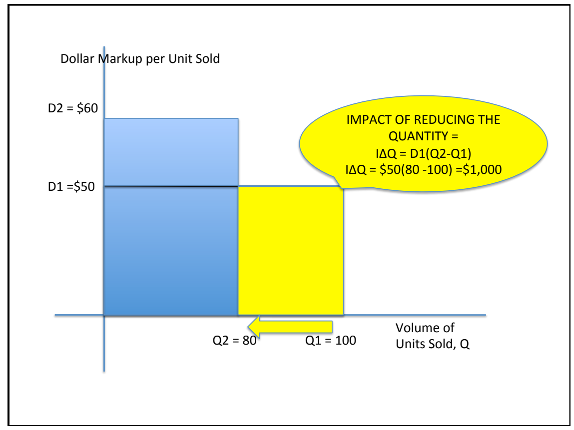
- If I add up the impact **I think** I should get the actual change in gross profit and net profit when both changes are made.
- Change in Gross Profit due to change in Variable Cost was +$1,000
- Change in Gross profit due to change in Volume sold was -$1,000
- Net Change in Gross Profit is predicted to be $1,000 - $1,000 = 0
- The actual change in Gross profit was -$200

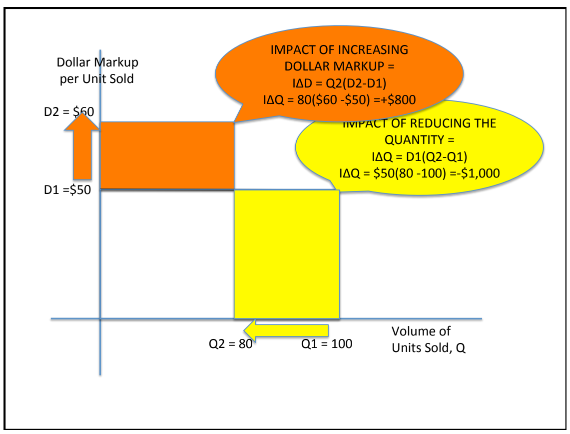
- The Reason you don't just add up the changes on spreadsheet from making changes one at time is
- Because you can get the **WRONG ANSWER!**

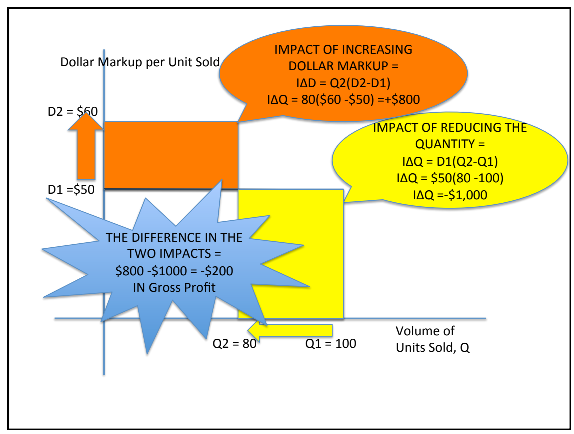





## Identifying and Measuring the Joint Impact of Changing Two Variables

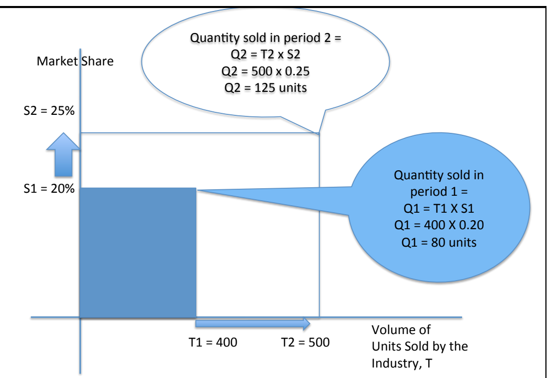
Ted Mitchell

- In Theory There are Three Steps in The Process of Working With a Potential Joint Impact
- 1) Identifying the Existence of a Joint Impact
- 2) Measuring the Size of the Joint Impact
- 3) Allocating the Joint Impact to the Two Independent impacts

- Consider the how a firm's sales volume can be impacted by changes in the firm's market share and the size of the total market Assume a firm had an increase
- 1) in its market share from 20 to 25%
- 2) in the size of the total market of 400 to 500 units sold by the industry
- Both Events will increase the firm's sales
- Classic Problem: How much of the increased sales was due to the improved market share?

Table with Changes in Share, Size and Sales

| | Period 1, P1 | Period 2, P2 | Δ=P2-P1 | |
|---|---|---|---|---|
| Total market Size, T | 400 units | 500 units | ΔT = 100 units | |
| Market Share, S | 0.20 | 0.25 | ΔS = 0.05 | |
| Joint Impact, J | | | | |
| Firm's Sales Volume, Q =S x T | 80 units | 125 units | ΔQ = 45 units | |



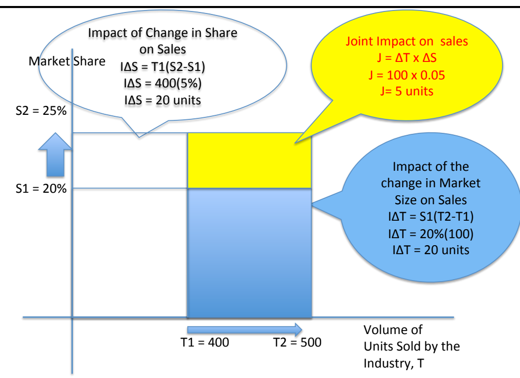




Table with measuring the Impact of IΔT, IΔS and J on ΔQ

| | Period 1, P1 | Period 2, P2 | Δ=P2-P1 | Impact of Change, IΔ |
|---|---|---|---|---|
| Total market Size, T | 400 units | 500 units | ΔT = 100 units | IΔT = S1(ΔT) = 0.2(100) = 20 |
| Market Share, S | 0.20 | 0.25 | ΔS = 0.05 | IΔS = T1(ΔS)= 400(0.05) = 20 |
| Joint Impact, J | | | | J = ΔQ –IΔT-IΔS<br>J = 45 -20-20<br>J= 5 |
| Firm's Sales Volume, Q = S x T | 80 units | 125 units | ΔQ = 45 units | ΔQ = IΔT+IΔS+J<br>ΔQ = 20+20+5<br>ΔQ= 45 units |

## Rules for Identification and Measurement of Joint Impact

1) If the ΔT x ΔS is a positive number, then a joint impact exists, J ≠ 0
2) If the ΔT x ΔS is a negative number, then the joint impact is zero, J = 0
3) The size and direction of the Joint Impact, J is measured as
   J = ΔQ –IΔT –IΔS
   (This will equal zero if there is no joint impact)

## Allocating Joint Impact

- For the purposes of calculating and awarding bonuses or blame for the impact of changes, it is sometimes necessary to allocate the joint impact between the independent impacts

## For example

- The Marketing manager has been promised a bonus for increasing the firm's market share
- The calculation of the bonus is to based on the change in sales due to the change in market share
- The total change in sales is the independent impact of the change in market share and a proportional amount of of the joint impact

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- The change in sales due to the impact of of the change in market share was 20 units
- The change in sales due to the impact in market size was 20 units
- The two impacts were in a 1-to-1 proportion and the joint impact of 5 units is divided in the same proportion as the independent impacts
- The marketing manager gets credit for increasing the sales volume by 20 + 50%(5) = 22.5 units