

Week 1

Introduction

- What is a metric? Why is it important?
- What are marketing models?

What is a metric ?

- Metric is a measuring system that quantifies a trend, dynamic or characteristic
 - Grades/marks: measure a student's knowledge/comprehension of a subject
- Objective measures that facilitate comparison across regions, time periods, entities
 - Who among the students have a good understanding of marketing analytics?
- Vital in explaining phenomenon, diagnose causes, share findings and project future
 - Why do marks vary across students for an unit? What factors explain this variation?

Why do we need metrics ?

“If you can't measure it, you can't manage it”

“...when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind: it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science”

- Lord Kelvin

“First, marketers need to improve their metrics and measurement of the financial impact of their marketing activities and campaigns. Senior management is losing patience with marketing over the lack of marketing results measurement”

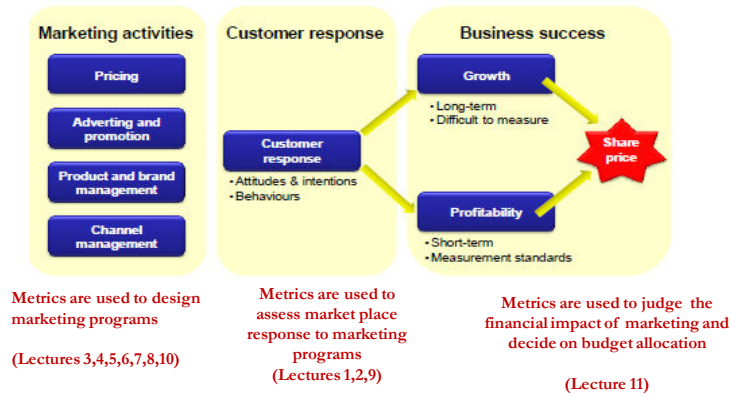
- Philip Kotler (2009)

Ability to measure marketing performance has a significant positive impact on firm performance

- Sullivan and Abela, Journal of Marketing (2007)

Metrics in Marketing

- Metrics are used to assess performance at each stage of marketing value chain



Models

- A model is a simplified representation of a phenomenon
 - E. g. The following linear regression model explains factors that affect students' marks in an unit

$$\text{Marks}_i = \alpha + \beta_1 \text{Attendance}_i + \beta_2 \text{In_semester_marks}_i + \beta_3 \text{Moodle_site_access_frequency}_i + \beta_4 \text{Time_spent_viewing_lecture_recordings}_i + \epsilon_i$$

- Models require us to specify the relationship between variables of interest
- Models capture the nature and strength of response to variables
 - E.g. What is the effect of missing one week's lecture/tutorial on the marks obtained?

Models

- Models help us to understand the drivers of a variable of interest
- Models enable us to predict future behaviour as well as changes in behavior in response to stimuli
- Models provide rationale for decision making and lead to greater consistency in decisions
- Key qualities that a model needs are validity, usability and the utility that it provides to the decision maker

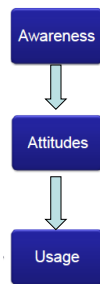
Market Share Analysis I

Business problems

1. How can firms measure their brand performance before it is reflected in their sales?
 1. How do consumers develop brand associations? What are the stages involved?
 2. How can a brand measure its performance in different stages?
2. How can a firm measure if its customers are satisfied?
 1. Why is customer satisfaction important?
 2. Measures of customer satisfaction
 3. Net promoter score

Hierarchy of Effects

1. Sequence of stages through which customers pass through in developing their brand association



- Consumer's knowledge and awareness of the brand's existence
- Doesn't mean that consumers prefer your brand

- Consumers form beliefs about the brand and develop attitudes towards the brand
- What is your attitude towards [Mac](#) vs. [PC](#)?

- Customers try your product and become its "users"

2. Understanding AAU helps us to answer why certain users prefer a certain type of brands
3. AAU are typically measured through survey of consumers. These measures are most useful when compared against a benchmark.

Awareness

1. Awareness: % of potential consumers who recognize the brand (aided or unaided)

Metric	Sample Questions
Top of mind brand recall within stated category	"What brand first comes to mind when you think of chocolate?"
Total unprompted brand recall	"What brands come to mind when you think of chocolate?" (record all mentions)
Unprompted brand recall	Do you recall the brand name for the TV ad which shows....?
Prompted brand recognition	Have you heard of brand X?

Awareness metrics: Examples

Brand	% of respondents listing the brand		
	What brand first comes to mind when you think of cars?	What brands come to mind when you think of cars?	Have you heard about a brand named...(Toyota, Ford, Nissan...)
Toyota	30%	80%	100%
Ford	10%	75%	100%
Nissan	15%	78%	100%
Honda	20%	57%	100%
Great Wall	1%	16%	50%

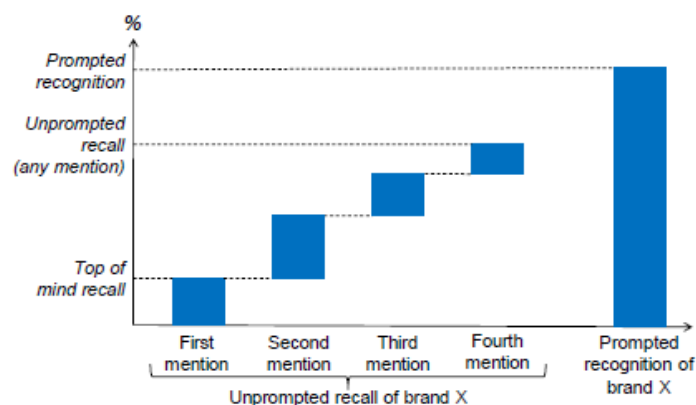
- What is the total unprompted brand recall measure for Honda?
- What is the top of the mind recall measure for Toyota?
- What is the prompted brand recognition for Great Wall?
- Which metric should Toyota and Great wall use?

Awareness Metrics: Comparison

% of respondents mentioning Toyota as the	List the top 4 brands that come to mind when you think of cars?
First brand	30%
Second brand	20%
Third brand	15%
Fourth brand	15%
	Have you heard about a brand named 'Toyota'
% of respondents	100%

- What is the top of the mind recall measure for Toyota?
- What is the unprompted brand recall (top 4 mentions) for Toyota?
- What is the prompted brand recognition for Toyota?

Awareness Metrics: Comparison



Attitude metrics

1. Attitude is a combination of consumers beliefs and their feelings towards a brand
2. Attitude has multiple dimensions, which can be captured using questionnaires

Construct	Metric	Sample Questions
Liking / Image	Relevance to consumer	"This is a brand for young people" "My Kind of brand"
Perceived value for money	Perceived value rating	"This brand represents good value for money"
Perceived quality / esteem	Quality perception rating	"How would you rate the overall quality of the brand"
Purchase Intentions	Likelihood of purchase	"It is very likely that I will purchase this product"

Usage

1. A measure of customer's self-reported purchase behaviour
2. What was purchased? How many units? When and where was it purchased? How many tried and adopted the product?

Metric	Sample Questions
Purchase frequency	"How often do you shop for...?"
Volume purchased on a shopping occasion	"When you last purchased...,how much did you buy?" "Of your total purchase of..., how much was brand X?"
Brands held	Which brands do you now have at home?

- What is the difference between purchase intention and purchase behaviour?

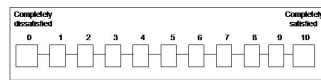
Customer satisfaction and its importance

$$\text{Satisfaction} = \text{Performance} - \text{Expectation}$$

- Customer satisfaction is a leading indicator of purchase intentions and loyalty
 - Sales and market share indicate current firm performance
 - Customer satisfaction indicate how likely a customer will purchase in the future and is therefore an indicator of long term performance
 - A satisfied customer tells a friend; an unhappy customer tells the world! (in reality, its 9-10 people....)
- Research has shown a strong link between customer satisfaction and profitability (Gupta and Lehmann 2008; Gupta and Ziethmal 2006; Aksoy et al. Journal of Marketing 2008)
 - Drop in satisfaction has twice the impact on ROI than increase in satisfaction

Measuring customer satisfaction

1. % of customers who are satisfied with your product
 - Can be simply measured from questionnaire using a Likert scale



- Or using sophisticated approaches like the American customer satisfaction index - <http://www.theacsi.org/about-acsi>
2. Willingness to recommend
 - % of customers who are willing to recommend your brand
 - 'Soft' loyalty metric – more precise than satisfaction
 3. Willingness to search
 - % of customers willing to search to avoid switching brands
 - 'Hard' loyalty metric

Challenges involved

- “Respondent bias” – Are you more likely to rate a good or a bad brand?
 - http://www.imdb.com/title/tt4016454/ratings?ref=tt_ov_rt
 - http://www.imdb.com/title/tt0361596/ratings?ref=tt_ov_rt
- Dissatisfied customers can defect over time, artificially inflating the satisfaction index
- Expectations may change over time. Increased expectations can affect product evaluations even if the product quality has improved!
- Satisfaction is correlated with other perceptual metrics such as loyalty, service quality and retention

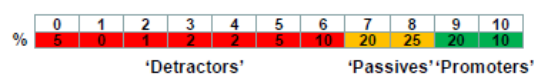
Net Promoter Score

- Degree to which current customers will recommend your product or service

Using a 0-10 scale, where 0 means not at all likely and 10 means extremely likely, how likely is it that you would recommend X to a friend or colleague?

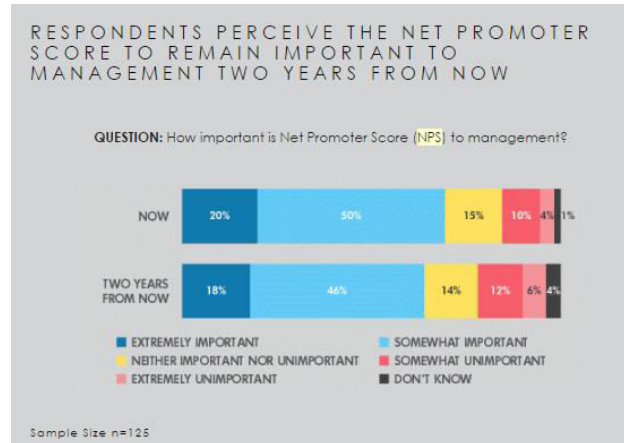
- Interpret 9 or 10 as 'Promoter'
- Interpret 0 – 6 as 'Detractor'
- Net promoters (%) = Promoters (%) – Detractors (%)

In example below, NPS = 5%



- <http://www.netpromotersystem.com/about/measuring-your-net-promoter-score.aspx>

NPS – Why should we care?



Net Promoter Score

- Can you solve the following question?

If NPS = -20 and 15% of customers are passives, what percentage are detractors?

Solution:

$$\text{NPS} = -20 \Rightarrow \% \text{ Promoters} - \% \text{ Detractors} = -20\% \dots (1)$$

$$15\% \text{ Passives} \Rightarrow \% \text{ Promoters} + \% \text{ Detractors} = 85\% \dots (2)$$

$$\begin{aligned} \text{Add (1) and (2)} &\Rightarrow 2 \times \% \text{ Promoters} = 65\% \\ &\Rightarrow \% \text{ Promoters} = 32.5\% \dots (3) \end{aligned}$$

$$\text{Substitute (3) into (1)} \Rightarrow 32.5\% - \% \text{ Detractors} = -20\%$$

$$\text{Rearranging} \Rightarrow \% \text{ Detractors} = 32.5\% + 20\% = 52.5\%$$

Net Promoter Score - Advantages

- Reichheld (2003, 2006) claim NPS as the
 - “most important customer feedback metric in predicting business performance”
 - “best predictor of growth”
- Ritson (2006) describes NPS as
 - “remarkably effective new method for measuring customer loyalty”
 - “accurately predict future revenue growth of a company”

http://www.tmiaust.com.au/downloads/NPS/Mark_Ritson_NPS_Survey.pdf
- Major corporations including GE, American Express, Telstra, Optus and Vodafone incorporate NPS into reporting

<http://www.youtube.com/watch?v=H6fnRpD3Y-Q>

<http://customergauge.com/news/2014-net-promoter-benchmarks/>

<http://www.insightsfromanalytics.com/blog/bid/324678/Top-10-U.S.-Net-Promoter-Scores-NPS-for-2013>

NPS in practice

20th March 2018

kogan.com

Would you recommend Kogan.com?

How likely are you to recommend Kogan.com to your friends or family?

Very unlikely Extremely likely

0 1 2 3 4 5 6 7 8 9 10

Seesaw
The Learning Journal

Based on your experience with the Mail Redirection / Mail Hold Service, how likely are you to **recommend** Australia Post to family and friends?*

Not at all likely Very likely

0 1 2 3 4 5 6 7 8 9 10

Your feedback helps us keep improving Seesaw. Help us gauge how we are doing (and what we can do better!) by answering two simple questions.

How likely are you to recommend Seesaw to a friend or colleague?

0 1 2 3 4 5 6 7 8 9 10

Not at all likely Extremely likely

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NPS in practice

Based on your experience with opening your account, how likely would you be to **recommend** AustralianSuper to a friend, family member or work colleague?

Not at all Likely Extremely Likely

0 1 2 3 4 5 6 7 8 9 10

How likely are you to recommend TerryWhite Chemmart as a health destination to a friend or colleague?

0 1 2 3 4 5 6 7 8 9 10

NOT AT ALL LIKELY EXTREMELY LIKELY

Tell us what you think for a chance to win a \$100 WISH Gift Card

Dear ,

Thanks for shopping at our Woolworths The Glen store on Thursday 17 May 2018!

We are committed to improving our service. The Store Manager Shane and the team at Woolworths The Glen would love to get your feedback through the below 5 - 7 minute survey.

To begin, thinking of your most recent experience, how likely are you to recommend Woolworths The Glen to your relatives, friends and colleagues? (Where 0 = Not at all likely and 10 = Extremely likely)

0 1 2 3 4 5 6 7 8 9 10

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Net Promoter Score - Limitations

- One of the key limitations of NPS is that the scale is not driven by theory / rationale
- Keiningham et al. (Journal of Marketing, 2007) found that NPS doesn't perform better than American Consumer Satisfaction Index
- Ehrenberg – Bass Institute of Marketing Science (2009) states “NPS does not predict growth – it's a fake science”
- If $NPS = 0$, then
 - Are there 50% promoters and 50% detractors? or
 - Is everyone passive?

Net Promoter Score - Limitations



NPS



Sales

- Suppose a firm has 100 customers
Promoters = 30 (30%) Passives = 40 (40%) and Detractors = 30 (30%), NPS = 0
- Suppose half of detractors leave the firm (85 customers), then,
Promoters = 30 (35%), Passives = 40 (47%) and Detractors = 15 (18%). What is the new NPS?
- Does an increase in NPS mean the company is growing?

Caution!!!



Review of topics discussed

1. How can firms measure their brand performance before it is reflected in their sales?
 1. How do consumers develop brand associations? What are the stages involved?
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2. How can a firm measure if its customers are satisfied?
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Marketing Decision Analysis

Week 2

Market Share Analysis 2

Business problems:

- How to measure the performance of a brand/product/firm?
- How to identify the reasons behind the performance and develop strategies to improve the performance?

What will you learn:

1. What is market share? Is it a good measure of performance?
2. Is market share a good performance goal for a company?
3. What are the drivers of market share?
4. Managerial implications

Market Share (MS)

$$\text{Unit Market Share of Brand A (\%)} = \frac{\text{Unit sales of Brand A (\#)}}{\text{Total Market Unit Sales (\#)}}$$

$$\text{Revenue Market Share of Brand A (\%)} = \frac{\text{Sales Revenue of Brand A (\$)}}{\text{Total Market Revenue (\$)}}$$

- Market share critically depends on market definition. Market definition should specify the category (or sub-category), time period and region adequately
 - Unit market share of Mercedes in the US in 2018: 2.02%*
 - Unit market share of Mercedes among luxury cars in the US in 2018: 14.7%*
- Market definition should be relevant to your objectives as well as the competitive environment of your brand
 - Is Sensodyne in toothpaste category (9.4% share) or sensitive toothpaste sub-category (61% share)?
- Too broad market definition may dilute the focus and may lead to unrealistic goals. Too narrow focus may lead to missed opportunities
 - Is Union Pacific a railway or logistics company?

Market Share

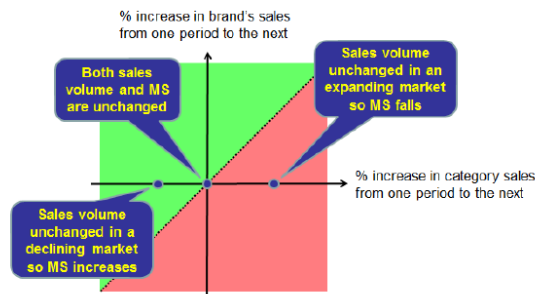
Brand	Units Sold (000)	Avg. Price (\$ 000)	Revenue (\$M)	Unit MS (%)	Revenue MS (%)
Nippy	50	15	750	25%	25%
Zippy	45	20	900	22.5%	30%
Squeez	40	10	400	20%	13.3%
Gecko	35	10	350	17.5%	11.7%
Jubilee	30	20	600	15%	20%
Total	200	15	3000		

$$\text{Relative Price Index of Brand A} = \frac{\text{Avg. price paid of Brand A}}{\text{Weighted avg. price across all brands}} = \frac{\text{Revenue market share of A}}{\text{Unit market share of A}}$$

- When will relative price index be > 1?

Market Share Vs. Sales

- Can a company's market share increase when there is no change in its sales?



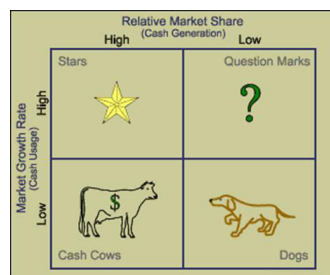
- Eagle Boys pizza chain (market share < 10%) closed in May 2016 (Australian Financial Review, July 2016). Closure of Eagle Boys increased the market shares of its competitors – Dominos (50%), Pizza Hut (20%) and RFG (25%). Does it mean their performance has improved?
- TDK is the worlds largest CD-R manufacturer: Does it mean TDK is doing really well?

How to measure a brand's relative position in a category?

- Is 20% market share good, bad or average?

$$\text{Relative Market Share (\%)} = \frac{\text{Focal Brand's Market Share}}{\text{Largest Competitor's Market Share}}$$

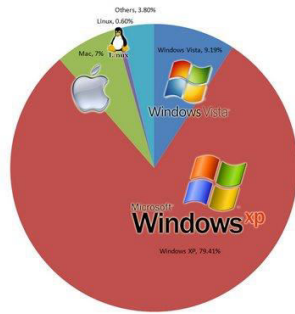
- Benchmarks performance against leading competitor; enables comparison across product categories
- Used in BCG matrix



How to measure the competitive intensity in a category?

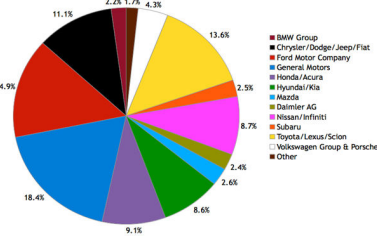
3 (or 4) Firm concentration ratio (%) = sum of MS of top 3 or 4 firms in the market

Herfindahl Index = sum of squared MS of all brands = $\sum_{i=1}^n MS_i^2$ where n = no. of firms



CR = .956
HFI = .654

Auto Manufacturer Market Share In America January 2012



CR = .469
HFI = .115

Is Market share a good performance goal for a company?

- Apple accounted for 32% of smart phone revenues, but 66% of total industry profits in 2019
- Samsung accounted for 21% of smartphones revenues and 17% of the total industry profits in 2019
- All other players together accounted for the remaining 13% of industry profits

Source: Forbes

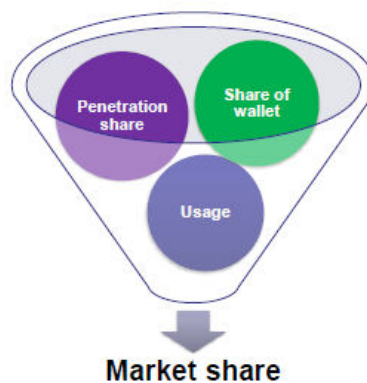
<https://www.forbes.com/sites/johnkoetsier/2019/12/22/global-phone-profits-apple-66-samsung-17-everyone-else-unlucky-13/#7ddabcf22ff3>



Can too much emphasis on market share hurt profitability? (listen to the podcast below to find out...)

<http://knowledge.wharton.upenn.edu/article/the-myth-of-market-share-can-focusing-too-much-on-the-competition-harm-profitability/>

Identifying the reasons behind the performance: drivers of market share



Penetration Share

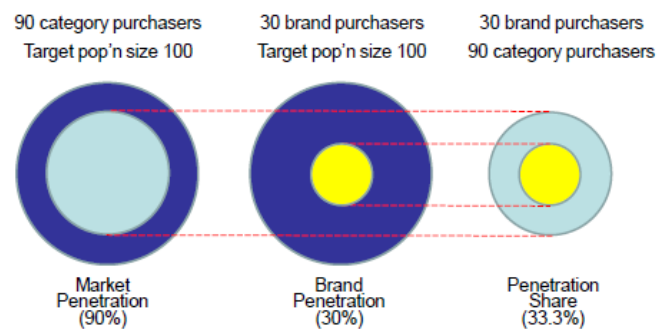
$$\text{Market penetration} = \frac{\text{No. of customers who purchased in the category at least once}}{\text{Total No. of customers}}$$

$$\text{Brand penetration} = \frac{\text{No. of customers who purchased the brand at least once}}{\text{Total No. of customers}}$$

$$\text{Penetration share} = \frac{\text{No. of customers who purchased the brand}}{\text{No. of customers who purchased in the category}} = \frac{\text{Brand penetration}}{\text{Market penetration}}$$

- Market penetration captures the reach of a category, brand penetration captures the popularity of a brand and penetration share measures the brand's popularity (or reach) within its category
- Penetration shares are defined for a specific period

Penetration Share - Illustration



- When will penetration share be equal to unit market share?

Penetration share: Example

- The following table shows the weekly grocery spending of 5 customers across three major Australian supermarkets

Customer	Coles	Woolworths	Aldi
1		\$50	
2	\$50		
3	\$100	\$100	
4			\$90
5		\$50	

Share of Wallet (Requirements)

$$\text{Revenue Share of Wallet} = \frac{\text{Brand Purchases (\$)}}{\text{Total Category Purchases by Brand buyers (\$)}}$$

$$\text{Unit Share of Wallet} = \frac{\text{Brand Purchases (\#)}}{\text{Total Category Purchases by Brand buyers (\#)}}$$

- SOW at individual consumer level is widely used as measure of their loyalty
 - How many times do you choose Coke when you buy a soft drink?
- SOW is the market share of a brand among its buyers
- Unit SOW is also referred to as 'share of customer'
 - Revenue SOW = Unit SOW * Relative price index

SOW vs. Market Share

- The following table shows the weekly grocery spending of 5 customers across three major Australian supermarkets

Customer	Coles	Woolworths	Aldi	Total customer spending
1		\$50		\$50
2	\$50			\$50
3	\$100	\$100		\$200
4			\$90	\$90
5		\$50		\$50
Total store sales	\$150	\$200	\$90	\$440

Total spending at Coles = Total spending of Coles' customers =

Total spending across the three major Australian supermarkets =

SOW at Coles = MS of Coles =

- SOW is the market share of a brand among its buyers

Heavy Usage Index

$$\text{Heavy Usage Index} = \frac{\text{Avg. total purchases in the category by brand customers (\# or \$)}}{\text{Avg. total purchases by all customers in that category (\# or \$)}}$$

- Measures relative intensity of usage
 - Australians consume 3 litres of Cola per week on an average*. How much do you consume? Are you a heavy or light user?
- Heavy usage index > 1 implies that customers of the focal brand purchase more from the category than customers of all other brands, on average
- It doesn't necessarily mean that they buy more of the focal brand or are loyal to it

*Euromonitor GMID database

Heavy Usage Index

- The following table shows the weekly grocery spending of 5 customers across three major Australian supermarkets

Customer	Coles	Woolworths	Aldi	Total customer spending
1		\$50		\$50
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3	\$100	\$100		\$200
4			\$90	\$90
5		\$50		\$50
Total store sales	\$150	\$200	\$90	\$440

Total spending of Coles' customers =

Avg. spending of Coles' customers =

Avg. spending across all customers =

HUI at Coles =

Market Share Decomposition

*Market Share = Penetration share * Share of Wallet * Heavy usage index*

- This decomposition formula can be used to deduce any one variable (MS, penetration share, SOW, usage index) from the other 3
 - E.g. If MS of a brand is 16%, penetration share is 0.2 and share of wallet is 0.4, then usage index is.....

$$0.16 / (0.2 * 0.4) = 2$$

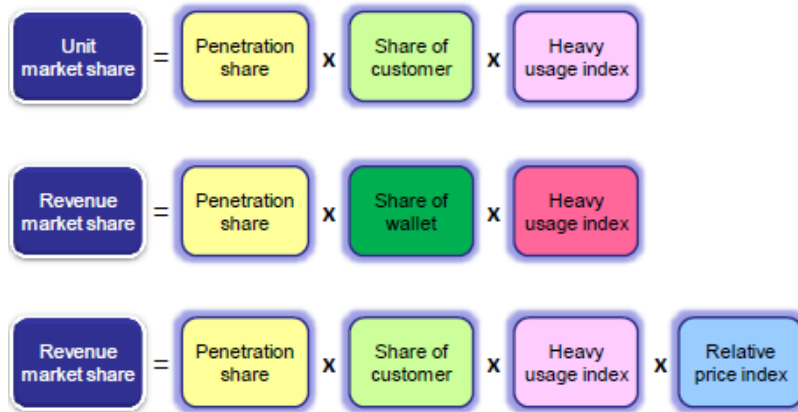
Example

Table on left shows the weekly grocery spending of 5 customers across three major Australian supermarkets (discussed earlier)

Cust_id	Coles	Woolworths	Aldi	Totals
1		\$50		\$50
2	\$50			\$50
3	\$100	\$100		\$200
4			\$90	\$90
5		\$50		\$50
Totals	\$150	\$200	\$90	\$440

	Coles	Woolworths	Aldi
MS	34%	45%	20%
Penetration share	40%	60%	20%
Total spending	\$250	\$300	\$90
SOW	60%	67%	100%
Avg. spending	\$125	\$100	\$90
HUI	1.4	1.1	1
PS * SOW * HUI	34%	45%	20%

Summary of Market Share Decomposition



Strategic Consideration

Decomposition of market share enables marketers to understand the underlying causes for any changes in market share (e.g. why did Market share of a brand grow?)

- > Are more consumers now using the brand?
- > Has their loyalty to the brand increased?
- > Do users of the brand now consume more in the category than the average user?

Metric	Consideration	Strategic response
Penetration share	Coverage	Awareness and promotion; distribution; product development
Share of wallet	Depth of relationship	Cross-sell to existing customers; price; product development
Heavy usage index	Usage intensity	Target customers with higher usage; product development; price promotion

Business problems addressed:

- How to measure the performance of a brand/product/firm?
- How to identify the factors behind (reasons for) the performance and develop strategies to improve the performance?

What we discussed:

1. What is market share? Is it a good measure of performance?
2. Is market share a good performance goal for a company?
3. What are the drivers behind market share?
4. Managerial implications

Intuition behind the decomposition of market share

1. We know that, Revenue Market Share of a store A = $\frac{\text{Sales Revenue of Store A}}{\text{Total Market Revenue}}$ (1)

2. Now, what is the sales revenue of a store?

Sales Revenue of store A (\$) = [How many people visit store A] * [How much does a store A customer spends at store A]

3. Multiplying and dividing by the same term (total spending of a store A customer) doesn't affect the results; so,

$$\begin{aligned} \text{Sales Revenue of store A (numerator in eqn (1))} \\ &= [\text{How many people visit}] * \left[\frac{[\text{How much does a store A customer spends at Store A}]}{[\text{How much does a store A customer spends overall}]} \right] \\ &\quad * [\text{How much does a store A customer spends overall}] \quad (2) \end{aligned}$$

4. Now, let's look at the denominator of the revenue market share (the first equation),

$$\text{Total market revenue} = [\text{Total number of people in the market}] * [\text{How much does a customer spends on average overall}] \quad (3)$$

5. Substituting (2) and (3) in to (1), we get,

$$\begin{aligned} \text{Market Share} \\ &= \left[\frac{[\text{How many people visit store A}]}{[\text{Total number of people}]} \right] * \left[\frac{[\text{How much does a store A customer spends at Store A}]}{[\text{How much does a store A customer spends overall}]} \right] \\ &\quad * [\text{How much does a customer spends on average overall}] \end{aligned}$$

which is nothing but, Market share = Penetration share * share of wallet * Heavy usage index

Marketing Decision Analysis

Week 3

Product Management 1

Predicting consumer choices & market shares of existing products

Business problems:

1. How to predict which brand a customer will choose and thereby, a brand's market share?
2. How to identify what factors (e.g. price) drive consumer choices?
3. How to predict what happens if you change a marketing mix variable?

What will you learn:

1. The concept of attraction or utility
2. Multi-attribute framework for determining brand attractions
3. Calculating market shares from purchase probabilities
4. Models to predict purchase probabilities
5. Choice models: identifying factors that drive consumer choices

How do we predict a consumer's choice?

- Suppose you are choosing one among the following three brands

Brand	Brand A	Brand B	Brand C
Price	\$5	\$5	\$5
Avg. user rating (1-10 scale)	6.6	9.2	4.8

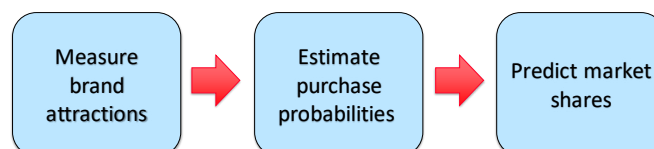
Which of these three brands will you choose and why?

- The underlying theory is that human beings are rational decision makers and choose the option which maximises their utility
- Therefore, if we can measure the utility that a consumer gets from different options, then we can predict that consumer's choices!

Concept of Attraction or Utility

- Attraction or utility is the total benefit or satisfaction that a consumer derives from a product
- Attraction measures the extent to which a brand's benefits and price are perceived to match a consumer's needs
- Assertions:
 - Each brand has its own attraction
 - Attractions are non-negative
 - Attractions depend on the marketing effort
 - Increasing attraction increases purchase probability and hence the market share

Market share prediction



Brand attractions can be measured using

- Multi-attribute framework (from survey data)
- Conjoint analysis

Multi-attribute framework

- Consumers evaluate a product as a bundle of attributes
E.g. When buying a car, John looks for brand name, safety and price
- They have different evaluations about how important different attributes are to them
E.g. John values price the most, followed by brand name and safety
- They form beliefs about relative strengths/attractiveness of different products in each attribute
E.g. John believes that a Volvo car has better safety than a Ford car
- The total utility or attraction of a brand to a consumer is the weighted sum of attribute strengths of that brand across all attributes, where the weights are the importances of attributes to that consumer

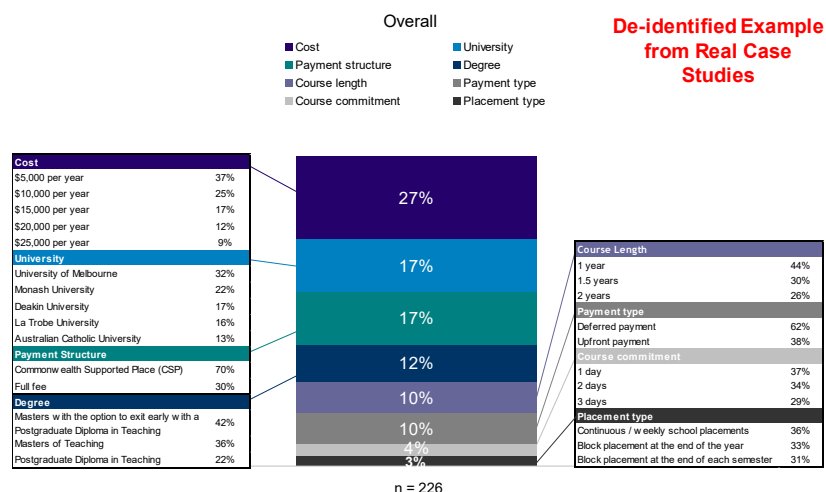
Multi-attribute framework illustration

- John's evaluations of importances of different attributes and his beliefs about the strengths of three car brands in those attributes are given below

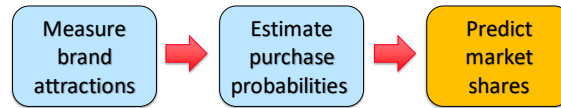
Attribute	Attribute importances	John's beliefs about strengths/attractiveness of brands in different attributes		
		Ford	Volvo	Toyota
Brand name	0.3	4	8	6
Safety	0.2	5	7	5
Price	0.5	8	3	6
Attractions		6.2	5.3	5.8

- Note that attribute importances should sum to one or 100%
- Stated attribute importances and beliefs about attribute strengths of brands can be obtained using surveys

Example case : University choice



Predicting market shares



- Market shares can be predicted from purchase probabilities:
 - If purchase probabilities are at individual customer level, or at customer segment level and segment sizes are same, then,

$$\text{Market share of a brand} = \text{Average purchase probability of the brand across all customers or customer segments}$$
 - However, if segment sizes are different,

$$\text{Market share of a brand} = \text{Weighted average purchase probability of the brand across all customers segments}$$
- Note that when predicting market shares from purchase probabilities, we have assumed that all consumers/segments buy the same quantity

Market share from purchase probabilities

The following tables show the purchase probabilities of three brands for four customer segments

When segments are of equal sizes						
Segment	No. of customers	Segment sizes	Purchase probabilities (%)			Total (across brands)
			Brand 1	Brand 2	Brand 3	
C1	50	25%	0	30	70	100
C2	50	25%	45	5	50	100
C3	50	25%	80	15	5	100
C4	50	25%	25	50	25	100
Market Share			37.5	25	37.5	100

Market share from purchase probabilities

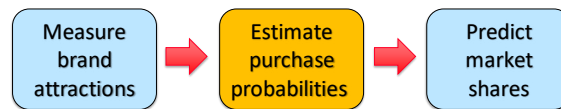
The following tables show the purchase probabilities of three brands for four customer segments

When segments are of unequal sizes						
Segment	No. of customers	Segment sizes	Purchase probabilities (%)			Total (across brands)
			Brand 1	Brand 2	Brand 3	
C1	20	10%	0	30	70	100
C2	60	30%	45	5	50	100
C3	80	40%	80	15	5	100
C4	40	20%	25	50	25	100
Market Share			50.5	20.5	29	100

$$\text{Size of segment 1} = 20 / (20+60+80+40) = 10\%$$

$$\text{Brand 1's market share} = (10\% \times 0 + 30\% \times 45 + 40\% \times 80 + 20\% \times 25) = 50.5\%$$

Estimating purchase probabilities



Purchase probabilities can be estimated from brand attractions in several ways

1. Maximum attraction
 - Consumers choose the brand with the highest attraction
2. Share of attraction
 - Brand's purchase probability is equal to its share of total attraction
3. Multinomial Logit model

Maximum Attraction

- Each consumer chooses the brand which has highest attraction
- Suitable for high involvement, infrequent purchases such as cars and houses

Brand	Attractions	Purchase probabilities
B1	4	0
B2	5	0
B3	6	100

- Limitations:
 - Predicts extreme market shares (more 0s and 1s)
 - Market shares are very sensitive to small changes in attractions

Share of Attraction

- Purchase probability of a brand is equal to its share of the total attraction of all available brands

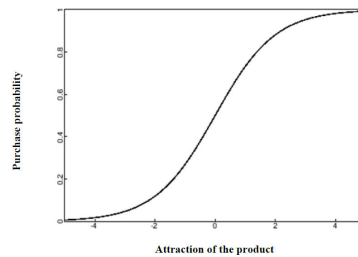
$$\text{Probability of choosing brand 1, } \Pr(B1) = \frac{\text{Attraction of B1}}{(\text{Att. of B1} + \text{Att. of B2} + \text{Att. of B3})}$$

Brand	Attractions	Purchase probabilities
B1	4	26.7
B2	5	33.3
B3	6	40
Totals	15	100

- Can be used for low involvement, frequently purchased products
- Purchase probabilities increase linearly with utilities

Issues in these simplistic approaches

- Research has shown that probability of choosing a product doesn't increase linearly with utilities; rather the relationship is 'S' shaped



- These simple models do not take into account the uncertainty in consumer choices
- They have low predictive power

Multinomial Logit Model

- Brand's purchase probability is equal to its share of exponentials of brand attractions

$$\text{Probability of choosing brand 1, } \Pr(B1) = \frac{\exp(\text{Attraction of B1})}{(\exp(\text{Att.of B1}) + \exp(\text{Att.of B2}) + \exp(\text{Att.of B3}))}$$

- Logit model assumes that utilities as well as choice probabilities are stochastic (have a random component)

Note: $\exp(X) = e^X$ where $e = 2.71828$

Brand	Attractions	exp (attractions)	Purchase probabilities
B1	4	54.6	9
B2	5	148.41	24.5
B3	6	403.43	66.5
Totals		606.44	100

Multinomial Logit Model (MNL)

- Trivia: MNL was developed by Prof. Daniel McFadden who was awarded 2000 Nobel Prize in Economics for his work on choice models (Actually it is The Sveriges Riksbank Prize in Economic Sciences!)
- MNL is the most widely used choice model and has three properties that better reflects the actual choice behaviour,
 - Probabilities are never zero
 - Probabilities are invariant under translation of attractions (It doesn't matter if you add or subtract a constant to attractions. Only differences in attractions matter and not their absolute values)
 - Each brand's choice probability has a 'S' shaped relationship with its attraction (while other attractions are held fixed). 'S' shaped curve implies that incremental increases in attractions have little effect on choices for products that have very low or very high utilities (extremes).

MNL invariance property

- Only differences in attractions affect choices. Adding or subtracting a constant (same number) to all attractions does not change purchase probabilities.

Brand	Attractions	exp (attractions)
B1	4	54.6
B2	5	148.41
B3	6	403.43
Totals		606.44

Brand	Attractions	exp (attractions)
B1	0	1
B2	1	2.72
B3	2	7.39
Totals		11.4

Brand	Purchase probabilities
B1	9
B2	24.5
B3	66.5
Totals	

- Attractions in the top and bottom tables differ by same constant '4'. Check if MNL gives same purchase probabilities.

Example: predicting market share of a new Store using MNL

- A survey was conducted to determine the share of shoppers that a new store would attract
- In a pre-test, shoppers indicated that variety, quality and value are the three factors that they consider when deciding which store to pick; importances of these three attributes were collected
- Respondents rated existing stores A and B, and the proposed store (based on a written concept statement) on these 3 attributes on a 1-10 scale
- Calculate:
 - Market shares of the two existing stores before and after the new store entry
 - Market share of the new store
 - Market shares lost by the two existing stores

Example: predicting market share of a new Store using MNL

Attribute	Attribute importance	Avg. beliefs about attribute strengths/attractiveness		
		A	B	New
Variety	0.33	8.7	5.3	7.6
Quality	0.22	5.5	9.5	4.4
Value	0.45	7.7	4.8	8.2
Attraction		7.546	6	7.166
exp(attraction)		1893.2	403	1294.7
Pre-entry market share		82.4%	17.6%	
Post-entry market share		52.7%	11.2%	36.1%
(Pre-entry MS – Post-entry MS)		29.7%	6.3%	
Post-entry MS / Pre-entry MS		63.9%	63.9%	

Attraction of store A = $0.33 * 8.7 + .22 * 5.5 + .45 * 7.7 = 7.546$

Pre-MS of store A = $1893.2 / (1893.2 + 403) = .824$ or 82.4%

Post-MS of store A = $1893.2 / (1893.2 + 403 + 1294.7) = .527$ or 52.7%

Fair share draw property

- Major limitation of share of attraction and MNL models:

A new brand draws the same proportion of share from each of the existing brands
In the example before, Post-entry MS = 63.9% * Pre-entry MS

- This is unrealistic if the new brand is in direct competition with only one of the existing brands. Consider the following scenario:

Suppose if a shopping centre has Kmart and Myer stores. Suppose if David Jones opens a new store in that shopping centre. Will Kmart and Myer be equally affected by David Jones' entry?

- How do we overcome this limitation in the example problem?

<https://www.youtube.com/watch?v=ZfMnbgH6DQ0>

The other side of the equation...

- If we observe individual consumers' choices, can we find out what factors influenced their choices and to what extent?
- Example: Scanner-panel data from Coles on consumer purchases of 1L orange juice

Customer	Brand	Price	Display ad	Purchase outcome
1	Berri	\$2.50	1	1
1	Daily juice	\$2	0	0
1	Coles	\$1	1	0
2	Berri	\$2.25	0	0
2	Daily juice	\$2	0	1
2	Coles	\$1	1	0

- Such scanner-panel data track consumer purchases, marketing mix variables (e.g. price), consumer demographics and even situational variables (e.g. holiday, weather)
- 'Choice models' allow us to study what factors influenced a consumer's choices among alternatives

Logit choice model

- Similar to a regression model, choice models allow us to estimate the effects of independent variables (e.g. price, promotions etc.) on the outcome/dependent variable (consumer choices)
- The key difference here is that the dependent variable in a choice model is a discrete variable (one choice among available alternatives); whereas in a regression model, it is a continuous variable
- For the orange juice example in the previous slide, the purchase probabilities of the three brands can be estimated using a logit model. For example, the purchase probability of brand Berri is:

$$\Pr(\text{Berri}) = \frac{\exp(\text{Utility}_{\text{Berri}})}{(\exp(\text{Utility}_{\text{Berri}}) + \exp(\text{Utility}_{\text{Daily}}) + \exp(\text{Utility}_{\text{Coles}}))}$$

- Here we observe the purchase probabilities (i.e. purchase outcomes), but we don't know the utilities

Logit choice model

- Following multi-attribute framework, let us define the utilities as a function of marketing mix - price and advertising (i.e. whether the brand was advertised). So,

$$\begin{aligned} \text{Utility}_{\text{Berri}} &= \alpha_{\text{Berri}} + \beta_{\text{price}} \text{Price}_{\text{Berri}} + \beta_{\text{adv}} \text{Adv}_{\text{Berri}} \\ \text{Utility}_{\text{Daily}} &= \alpha_{\text{Daily}} + \beta_{\text{price}} \text{Price}_{\text{Daily}} + \beta_{\text{adv}} \text{Adv}_{\text{Daily}} \\ \text{Utility}_{\text{Coles}} &= \alpha_{\text{Coles}} + \beta_{\text{price}} \text{Price}_{\text{Coles}} + \beta_{\text{adv}} \text{Adv}_{\text{Coles}} \end{aligned}$$

Differences compared to multi-attribute framework:

- Here, we use observed brand attributes (e.g. price, display advertisement) instead of a consumer's stated beliefs about brand attributes
- β_{price} and β_{adv} are consumers' sensitivities (analogous to attribute importances in multi-attribute framework) to price and advertising
- α s are intercepts (note that there is one per brand); they capture the intrinsic attraction or equity of brands which arise from factors such as taste and quality that are not accounted in the model
- α s and β s are estimated from the model (similar to coefficient estimates in a regression model)

Logit choice model

- How does this differ from predicting choice?
 - Here, we (marketers) observe purchases, and so the probability of choosing different brands is known
 - Instead of asking consumers what attributes (e.g. price) are important, marketing manager/analyst chooses them based on theory/practice/experience (e.g. it is well established that prices influence choice and therefore, price is included as a predictor)
 - Strengths or levels of attributes in different brands are observed by the marketer. For example, price of Berri is observed (and so, we don't ask how attractive price of Berri is using survey)
 - Consumers' sensitivities to attributes (equivalent to importance weights) are not known and are obtained by estimating the model
- These sensitivities (similar to regression coefficient estimates) tell us which attributes influence choices (i.e. are significant) and to what extent (i.e. the magnitude of effect)
- Choice models can be estimated by software tools like SPSS, SAS, R etc.

Choice model illustration

- Suppose if we get the following estimates when run the model for orange juice (assume that all estimates are significant)

$$\alpha_{\text{Berri}} = 2 \quad \alpha_{\text{Coles}} = 0 \quad \alpha_{\text{Daily}} = 1.2 \quad \beta_{\text{price}} = -1.1 \quad \beta_{\text{adv}} = 1.8$$

Note: In a logit model, only relative differences in utilities affect choices, not their absolute values (invariance property). So, the intrinsic attraction of one of the alternatives has to be set to 0 for identification (intrinsic attractions of other brands are measured relative to this brand).

- Which factors (marketing mix variables) affect choice in this example?
- What can you say about brand equities of the three brands in this example?
- Can you predict what happens to Berri's market share if its price is reduced by 20%?

Predicting a binary outcome

- So far we discussed a multinomial choice situation (i.e. which brand is purchased among a set of brands)
- Similar framework can also be used to study the drivers of a binary choice situation (e.g. whether a customer buys or not)
- E.g. Coffee purchase decision of a customer

Day	Weather	Queue	Purchased coffee?
Mon	Severe cold	Moderate	1
Tue	Mild cold	Long	0
Wed	Warm	Short	1

- In the above example, the outcome is binary (whether or not coffee was purchased by a customer)

Logit choice model

- To model this, we assume that utility of not making a purchase is 0. Utility of making a purchase is defined as before,

$$\text{Utility}_{\text{buy}} = \alpha_{\text{coffee}} + \beta_1 \text{Day} + \beta_2 \text{Weather} + \beta_3 \text{Queue_length}$$

$$\text{Utility}_{\text{no_buy}} = 0 \quad (\text{note that } \exp(0) = 1)$$

- Using logit model, probability of purchasing coffee can be specified as,

$$\Pr(\text{buy}) = \frac{\exp(\text{Utility}_{\text{buy}})}{\exp(\text{Utility}_{\text{buy}}) + 1}$$

- By estimating this model, we can study what factors makes a person buy coffee
- In the above example, note that all the explanatory variables are categorical...we will discuss more about how to handle these variables in the next lecture!

Some applications of choice models

1. Compare the effectiveness of different marketing mix variables. Simulate the effect of marketing actions and identify the best strategy to pursue (e.g. should Berri reduce price or advertise?)
2. Segmentation: Segment consumers on the basis their preferences and sensitivities
3. Study how consumer preferences and sensitivities vary across different regions/time periods, change in response to internal & external events /marketing environment (e.g. product changes, labeling legislation, competitor entry) and develop marketing responses
4. Choice models can be used to model other decisions like purchase quantity decisions, store choice decisions etc. and in many other contexts where a choice is made (e.g. election voting, choice of university/degree etc.)

Business problems addressed:

1. How to predict which brand a customer will choose and thereby, a brand's market share?
2. How to identify what factors (e.g. price) drive consumer choices?
3. How to predict what happens if you change a marketing mix variable?

What you learnt this week:

1. The concept of attraction or utility
2. Multi-attribute framework for determining brand attractions
3. Calculating market shares from purchase probabilities
4. Models to predict purchase probabilities
5. Choice models: identifying factors that drive consumer choices

Marketing Decision Analysis

Week 4

Product Management 2

Utilities and Consumer Preference

Business problems:

- How to measure consumers' preferences for different product features and identify the best product configuration to offer?
- How to measure consumers' willingness to pay for a product

What will you learn:

1. Conjoint analysis
2. Regression with categorical variables
3. Calculating relative importances of product attributes

Conjoint Analysis Overview

- Aim is to understand how consumers develop preferences for products or services
- Underlying premise of conjoint analysis is that consumers arrive at the overall value or worth of a product/service by combining the separate amounts of value (called part-worths) provided by each of its attributes
- Rather than directly asking people about how important an attribute is, conjoint analysis asks them to choose between products with different levels of attributes. Based on the tradeoffs that consumers make, part-worths of each attribute can be determined

<http://www.youtube.com/watch?v=86iiQjPaVSI>

Conjoint Analysis Overview

- Product profiles or bundles are constructed by varying the levels of different attributes of the product
E.g. Pizza with thin crust vs. thick crust
- Consumer's preferences for different product profiles are obtained by asking them to rate or rank order the bundles to indicate their degree of preference
- In this evaluation process, consumers are forced to make trade-offs between attributes
E.g. Do you prefer a thin crust pizza for \$10 or a thick crust pizza for \$12
- This preference data enables us to determine part-worths of different attributes and the overall utility of a bundle to customers

Conjoint Analysis Application

- Conjoint analysis is widely used tool for designing new product offerings
- Conjoint analysis can be used to
 - Identify consumers' preferences for different product combinations, even for those that are not evaluated by customers!
 - Identify the relative importance of different attributes to consumers
 - Identify consumers' willingness to pay for different attributes as well as for a product
 - Develop forecasts of sales and market share

Intuition behind conjoint analysis

- A conjoint analysis was conducted by a GPS manufacturer to determine the importance that customers assign to different attributes and their willingness to pay for these attributes
- The company has identified 3 attributes – accuracy (3m vs. 15m), battery life (12 hours vs. 32 hours) and price (\$250 vs. \$350) as the main features of a GPS
- By varying the 3 attributes, the company came up with $2 \times 2 \times 2 = 8$ different product combinations and asked customers to rate their preferences for these 8 products on a scale of 1-100

* Adopted from MIT opencourseware

Intuition behind conjoint analysis

- Following is sample data from the conjoint analysis for a GPS with 3 attributes from one of the respondents. Her preferences for different levels of these attributes are collected on a 100-point scale*

Profile	Accuracy	Battery life	Price	Preference rating (1-100)
1	15m	12 hours	\$350	4
2	3m	12 hours	\$350	11
3	15m	32 hours	\$350	33
4	15m	32 hours	\$250	74

* Adopted from MIT opencourseware

Intuition behind conjoint analysis

- Comparing profiles 1 and 2 (which are identical except for the accuracy), the additional utility (utils) in a 3m GPS compared to a 15m GPS is 7
- Similarly, additional utils from battery life (32 vs. 12 hours) is 29 (comparing 1 and 3) and from price (\$250 vs. \$350) is 41 (comparing 3 and 4)
- **Dollar worth of utility:** Because the respondent gets 41 'utils' when the price is reduced by \$100, the dollar worth of each util is '\$2.44' ($\$100 / 41$)
- **Willingness to pay:** Since a more accurate GPS gives '7' additional utils to the respondent, her willingness to pay for accuracy is $7 \times 2.44 = \$17.07$
- **Relative importances of attributes:** By comparing the 'utils' we can also compare the relative importances of different attributes. For instance, battery life is 4 times more important than accuracy for this respondent
- Of course, in this example, we just compared two product options at a time. Conjoint compares all product options and computes average change in utility when an attribute is changed (e.g. avg. change in utility when accuracy is improved)

*Note that part-worth values computed here are approximate (for illustration). This is because we haven't considered all configurations.

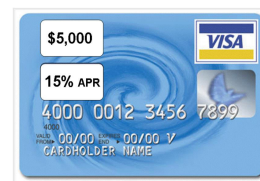
Steps in Conjoint Analysis

1. Identify product profile
 - Identify attributes and their levels
 - Develop product bundles to be evaluated
2. Collect data
3. Obtain part-worths and compute utilities
4. Evaluate product options
 - Estimate market shares and identify prospective products
 - Segment customers based on part-worths

Step 1: Product Profile

- The first step in conjoint analysis is to profile the product in terms of its attributes and the levels that the attributes can take
 - Attributes can be identified through focus groups, descriptive research, exploratory research, expert judgment etc.

Attribute*	Levels
Brand	Amex, Visa, Mastercard
Interest rate	15%, 20%, 25%
Credit limit	\$5k, \$10k, \$15k



* Example adopted from Prof. Wagner Kamakura's teaching resources

Step 1: Product Bundles (Full factorial)

- By varying the levels of these attributes, develop possible product combinations with varying levels of utility to consumers
 - Also known as treatment combination
- If number of attributes is large, including all possible combinations of attribute levels (called as Full-factorial design) will result in 100's of products!
 - Suppose, if we are developing a new design for a pizza with 5 attributes – crust (thin, thick, pan), toppings (veggie, pepperoni, sausage and pineapple), cheese (mozzarella, romano and mixed), size (small, medium, large) and price (\$10,\$12,\$14)

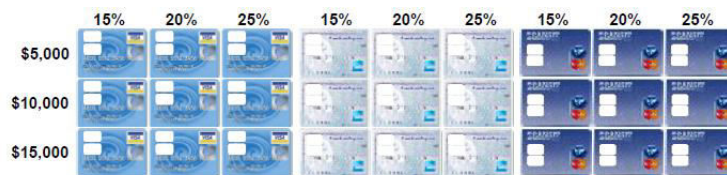
We will end up with $3*4*3*3*3 = 324$ pizza combinations!

Step 1: Product Bundles (Fractional factorial)

- To avoid participant fatigue, full factorial designs are rarely used in practice. Instead, only a fraction of treatment combinations (called fractional factorial design) are used
- Combinations are selected in such a way that each attribute level appears same number of times (balanced)
 - For pizza example in previous slides, all attribute-level combinations can be captured using only 16 ($3+4+3+3+3$) pizza combinations instead of 324!
- However, interaction effect of attributes cannot be captured through fractional factorial design
 - E.g. A consumer might prefer utility car over a sporty car and blue color over red color, but might prefer a red sporty car over a blue sporty car

Step 1: Full factorial design example

- For conjoint study on credit cards with 3 attributes - credit limit (\$5k, \$10k, \$15k), interest rate (15%, 20%, 25%) and brand (Visa, American Express, Mastercard), full factorial design will yield $3 \times 3 \times 3 = 27$ product combinations to evaluate



Step 1: Fractional factorial design example

- For conjoint study on credit cards with 3 attributes - credit limit (\$5k, \$10k, \$15k), interest rate (15%, 20%, 25%) and brand (Visa, American Express, Mastercard), fractional factorial design will yield $3+3+3 = 9$ product combinations to evaluate*



Step 2: Data collection

- Customer evaluations of selected product bundles are obtained by presenting the products verbally, visually (using pictures) or physically (product samples or prototypes)
- Data can be collected in several ways
 - Pair-wise comparisons: Products are presented two at a time and respondents allocate 100 points between the two or choose their preferred option
 - Rank ordering: Respondents rank the products in the order of their preference (1 being most preferred)
 - Rating scale evaluation: Respondents evaluate product on a rating scale (e.g. 0-100)

Step 3: Obtaining Part-worths

- The rank or rating that a respondent gives to a product bundle is a measure of its overall worth or utility to that respondent
- This total utility is the sum of part-worths of each of the attribute of the product

For the credit card example,

Utility of a credit card profile = part-worth of interest rate + part worth of brand + part-worth of credit limit

- Part-worths can be derived using regression analysis

Quick Review of Linear Regression

- Dependent variable (Y) and independent or explanatory variables (X's) are related in a linear model through coefficients (β 's) which capture the strength of the relationship between Y and the X's.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots \beta_n X_n + \xi$$

E.g. $\text{Marks} = \beta_0 + \beta_1 \text{Hours_worked} + \beta_2 \text{Attendance} + \xi$

β_1 captures the effect of hours worked on your total marks.

- How do we test if Girls tend to have higher marks than boys?

Quick Review of Dummy Variable Regression

- When the independent variable is a categorical variable (e.g. gender, brand name etc.), dummy variables (1,0) are used to capture the relative effects of one level over another
 - For example, to see if girls score higher than boys, we set the gender variable to 1 for girls and 0 for boys

$$\text{Marks} = \beta_0 + \beta_1 \text{Hours_worked} + \beta_2 \text{Attendance} + \beta_3 \text{Gender_girl} + \xi$$

β_3 captures the avg. marks of girls relative to that of boys

Regression Model for Credit Card Example

We know that, Utility of a credit card profile

= Part-Worth (PW) of interest rate + PW of brand + PW of credit limit

This is a regression equation, where Y is the preference ranking of credit cards (measure of utility) and Xs are dummy variables representing credit card profiles,

$$Y = \beta_0 + \beta_{\text{amex}} D_{\text{amex}} + \beta_{\text{mc}} D_{\text{mc}} + \beta_{15\%} D_{15\%} + \beta_{20\%} D_{20\%} + \beta_{\$5k} D_{\$5k} + \beta_{\$10k} D_{\$10k} + \xi$$

where D_{amex} is a dummy variable which is set to 1 for an Amex credit card and 0 otherwise

- The regression coefficients directly gives us the part-worths for the levels of each attribute
 - $\beta_{\$5k}$ gives us the part-worth of \$5k credit limit
- Why did we eliminate D_{visa} , $D_{25\%}$ and $D_{\$15k}$ from the model?

Regression Model for the Credit Card Example

$$Y = \beta_0 + \beta_{\text{amex}} D_{\text{amex}} + \beta_{\text{mc}} D_{\text{mc}} + \beta_{15\%} D_{15\%} + \beta_{20\%} D_{20\%} + \beta_{\$5k} D_{\$5k} + \beta_{\$10k} D_{\$10k} + \xi$$

- Regression requires the independent variables to be linearly independent
But, $D_{\text{visa}} + D_{\text{mc}} + D_{\text{amex}} = 1$ (since, the card has to be one of the three!)
- By not including D_{visa} in the regression equation, we have set the part-worth of Visa (β_{visa}) to 0 and consequently the part-worths of Amex and MC (β_{amex} and β_{mc}) are measured **relative to the part-worth of Visa**
E.g. If the regression analysis estimates β_{amex} as 1.2, it means that part-worth of Amex card is 1.2 more than that of Visa card
- So, the estimated utility of a **Visa** card with **15%** interest and **\$5k** credit limit is given by,

$$U = 0 + \beta_{15\%} + \beta_{\$5k}$$

Regression Model for Credit Card Example

Here is a sample of data for the credit card example.

Profile	Independent variables						Dependent variable
	D _{Amex}	D _{MC}	D _{15%}	D _{20%}	D _{\$5k}	D _{\$10k}	Preference
1	0	0	1	0	1	0	7
2	1	0	1	0	0	0	9
3	0	1	1	0	0	1	8
4	1	0	0	0	0	1	5
5	0	1	0	1	0	0	3
6	1	0	0	1	1	0	6
7	0	0	0	1	0	1	4
8	0	1	0	0	1	0	2
9	0	0	0	0	0	0	1

'X matrix' 'Y vector'

Note: When a respondent ranks product profiles, the most preferred product (which gives highest utility) gets a rank of 1 (lowest rank). So, ranks have to be reverse-coded and replaced by preferences (in this example, rank 1 has been recoded as a preference of 9 for product profile 2) and so on).

Regression Model for Credit Card Example

Suppose if the regression model gives the following estimates,

$$Y = 1 + 2.7D_{\text{amex}} + 0.3D_{\text{mc}} + 5.3D_{15\%} + 1.7D_{20\%} + 0.7D_{\$5k} + 1.3D_{\$10k}$$

- **Relative to Visa (part-worth of 0)**
Amex increases utility by 2.7
Master card increases utility by 0.3
- **Relative to 25% interest rate (part-worth of 0)**
15% rate increases utility by 5.3
20% rate increases utility by 1.7
- **Relative to \$15k credit limit (part-worth of 0)**
\$5k increases utility by 0.7
\$10k increases utility by 1.3

Utility of a Visa card with 15% interest and \$5k limit = $0 + 5.3 + 0.7 = 6$

Attribute Importances from Part-worths

Attribute	Level	Estimated PWs	Importance	
			Range of PWs	Relative Importance
Brand	Visa	0	2.7	2.7/9.3=29%
	Amex	2.7		
	MC	0.3		
Interest rate	15%	5.3	5.3	5.3/9.3=57%
	20%	1.7		
	25%	0		
Credit Limit	\$5K	0.7	1.3	1.3/9.3=14%
	\$10K	1.3		
	\$15K	0		
Total range			9.3	

Range of PWs = Maximum PW – Minimum PW
So for brand name, Range = $2.7 - 0 = 2.7$

Note: PWs can be negative and range calculation needs to take that into account.
Suppose if PWs are (-2, 1 and 0), then, range of PWs = $1 - (-2) = 3$

Step 4: Evaluating Product Options

- Market share prediction
 - Utility of a product offering can be computed if we know the part-worths of all its attributes
 - Once we know the utilities, choice probability and market share can be computed using one of the attraction models (e.g. share of attraction, logit model)
 - Firms can thus find out which product bundles will get higher market shares and consider which would be the most viable to release on the market
- Segmentation
 - Part-worths of different attributes indicate consumer's preference for those attributes
 - Consumers can be grouped in to different segments on the basis of their part-worths

Limitations

- Regression model considers main effects only. It assumes no interactions between attributes
- Ranking of profiles from best to worst is not necessarily an easy task
- Ranking task is not the same as real choice situation that consumers face when choosing a product from a set of alternatives
 - Choice based conjoint analysis overcomes this limitation. Here respondents choose a product among a set of alternatives in a simulated choice task. Using a choice model (such as logit model), part-worths of different attributes is then computed.

Conjoint in Practice – An example



Objectives of the Research

- What role does brand play?
- What is the most important product feature in a purchasing decision?
- What role do fees, price and interest rates play in relation to other important product features?
- What trade-offs will potential customers be willing to make?

Research Design



- Respondents:
 - n = 1, 500 those with a credit card for personal use in their own name (or held jointly with a partner);
 - those aged under 25 or over 60;
 - **MYER one** members and Non **MYER one** members
- Data Collection Methodology:
 - Self administered online questionnaire

Conjoint Design

Attribute	Attribute Level
Card Type/Brand	Brand A Brand B Brand C
Points earned	0.5pt for every \$1 spent 1pt for every \$1 spent 2pts for every \$1 spent No points earned
Bonus Point	2 bonus point for every \$1 spent 1 bonus point for every \$1 spent No bonus points
Redemption of points	2,000pts earns \$20 voucher 3,000pts earns \$35 voucher 4,000pts earns \$50 voucher No loyalty program
Annual fees	\$120 \$90 \$60 \$30 No annual fees
Interest Rate	12.99% 15.99% 18.99% 21.99%
Application reward	Double points for the first month 10% off on the first purchase Annual fee waived for the first month

The Concept Card

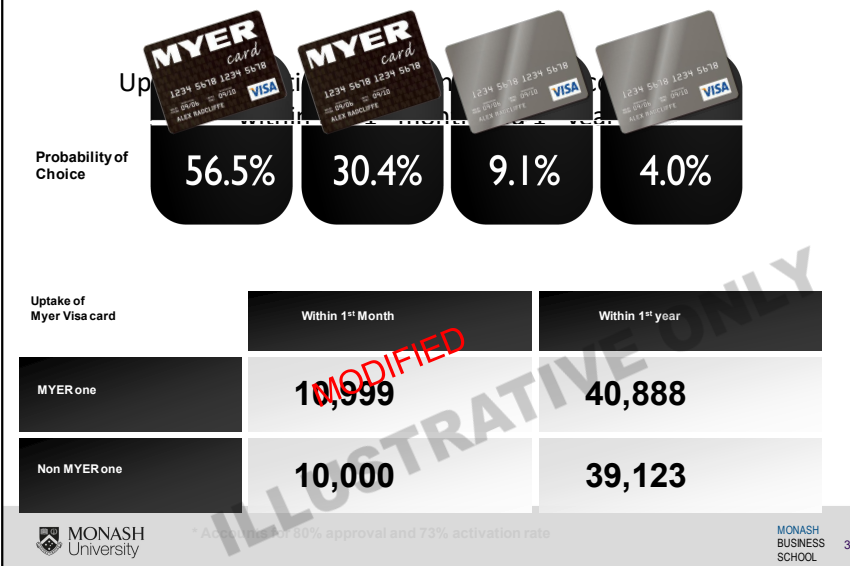
This is the card that was presented to respondents and has been used as the basis of uptake.



Relative importance of attributes

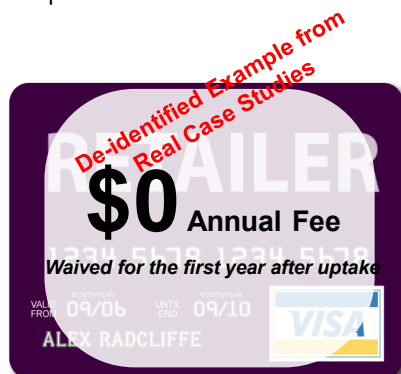


Estimated choice probabilities



The final product.....

This is the card that the business produced after the research...



Summary of Key Findings...

- The brand on the loyalty based credit card was not a barrier to uptake
- The loyalty program and redemption process was a powerful carrot for uptake (in a cluttered market) and ongoing use

Management Implications

- Use conjoint analysis when
 - New concept involves important trade-offs affecting production, marketing etc.
 - Product is decomposable into set of attributes
 - High involvement product
 - Alternatives can be described easily verbally or pictorially
- Cautionary note: “The greatest potential error.....would be to exclude meaningful attributes from theanalysis” (Text, P. 151)

Business problems addressed:

- How to measure consumers' preferences for different product features and identify the best product configuration to offer?
- How to measure consumers' willingness to pay for a product

What you learnt this week:

1. Conjoint analysis
2. Regression with categorical variables
3. Calculating relative importances of product attributes

Marketing Decision Analysis

Week 5

Product Management 3

Forecasting new product sales

Business problems

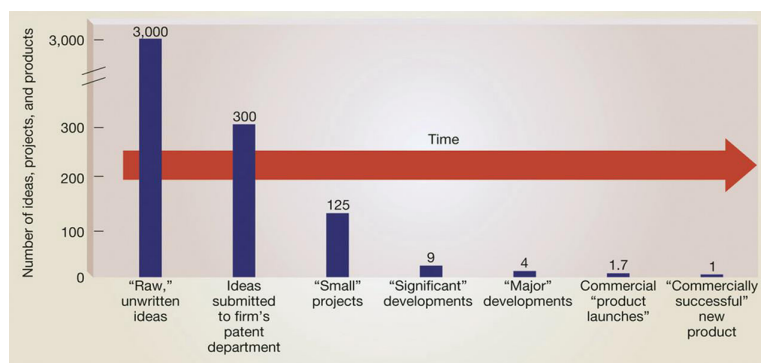
Business problems:

1. How to forecast sales of new products?
2. How to forecast adoption of entirely new product categories?

What will you learn this week:

1. Trial and repeat model
2. Bass diffusion model

How successful are new products?



Source : *Winning at New Products*, p.9

Test Market

- Marketers sample customer purchase intentions on a small scale in test markets and project it to the whole population to predict product success
<https://www.youtube.com/watch?v=7wx5B2p8qyg>
- Product prototype, positioning strategy, product packaging, advertising and marketing mix (price, promotion) need to be completed before market testing
<http://smallbusiness.com/product-development/best-u-s-cities-to-test-market-a-national-product/>
- Key questions:
 - How many people are likely to try the product?
 - How many will re-purchase the product?
 - How often will they buy and how many units will they buy?

Trial and Repeat model

- Used to predict new product sales in an existing category
- Sales of a product depends on
 - Proportion of target population that purchases the product for the first time in a given period (“trial rate”)
 - Timing of the first purchase
 - Repeat purchase rate
 - Repeat purchase frequency
 - Quantity (number of units) purchased

Trial rate and Repeat rate

- Trial rate is the proportion of target population that purchases the product for the first time in a given period

Trial rate = Number of first time buyers / Target population size

- Repeat rate is the proportion of trial population that will re-purchase the product

Repeat rate = Number of triers who re-purchase the product / Trial population size

- Trial rates are estimated by asking potential customers about their likelihood of purchasing the product (typically on a five point scale as shown below)

Definitely will buy	Probably will buy	May or may not buy	Probably won't buy	Definitely won't buy
------------------------	----------------------	-----------------------	-----------------------	-------------------------

Trial rate adjustment

Follow-through adjustment

- Not all respondents follow through on their stated purchase intentions
- 80% of respondents stating they will “definitely buy” and 30% stating they will probably buy typically end up purchasing the product
- Purchases of remaining respondents are negligible

Awareness adjustment

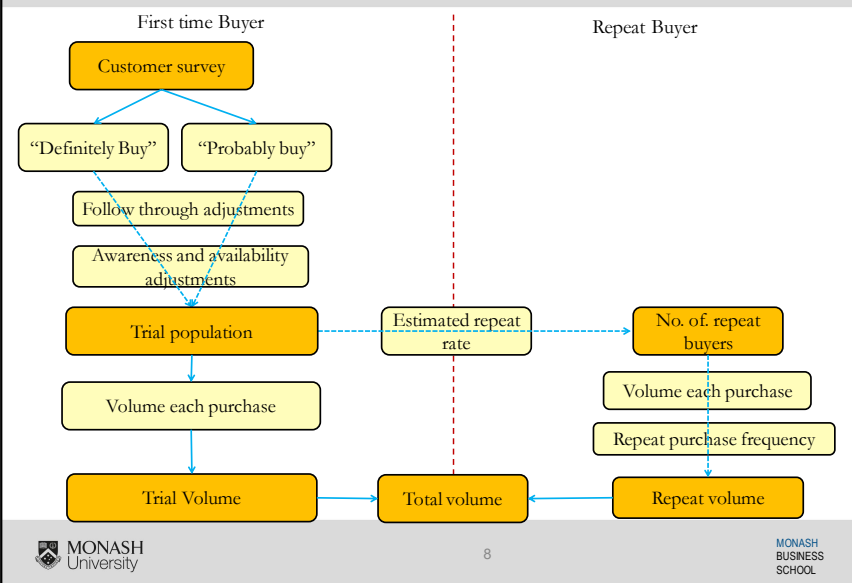
- Not all consumers might be aware of the product in the target market
- Awareness refers to the proportion of customers who “know” the product

Availability adjustment

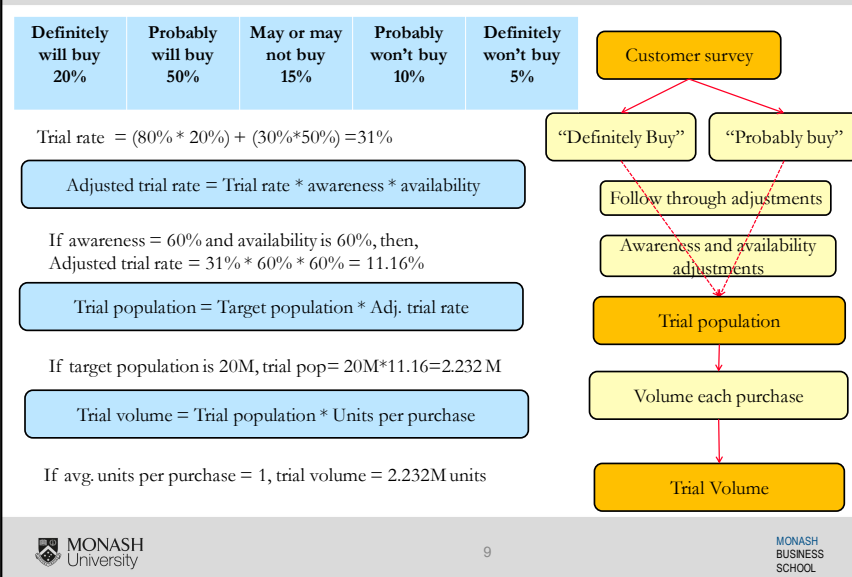
- Product might not be available / accessible (distributed) for the entire target market
- Measured using proportion of stores that carry the product

Adjusted Trial rate = Trial rate * Awareness * Availability

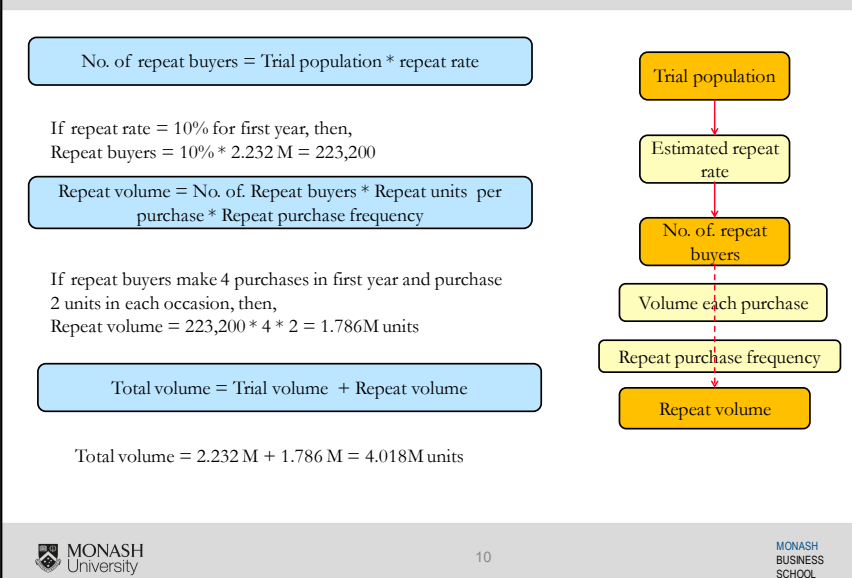
Trial and repeat volumes



Trial volume calculation



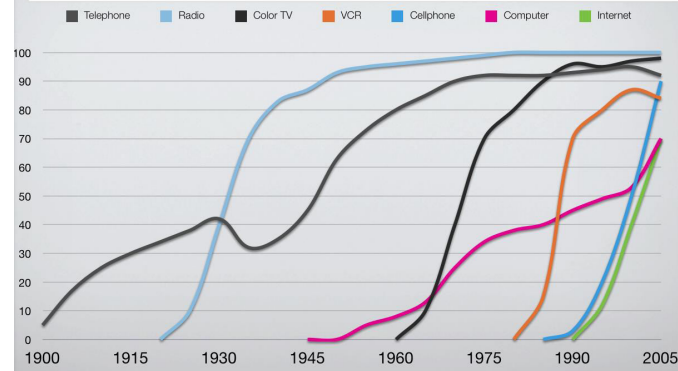
Repeat volume calculation



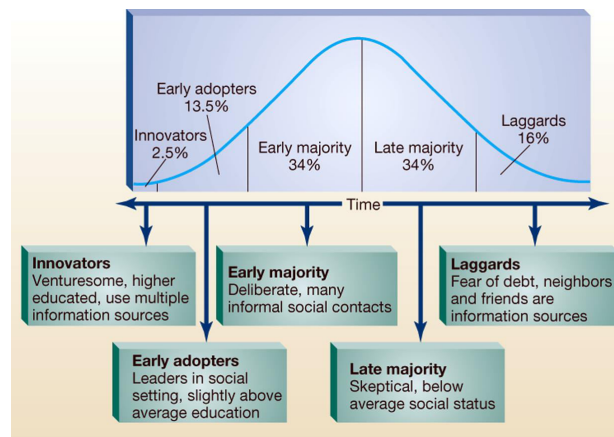
New Product Diffusion

Tech Adoption

Historical adoption rates of communication technologies



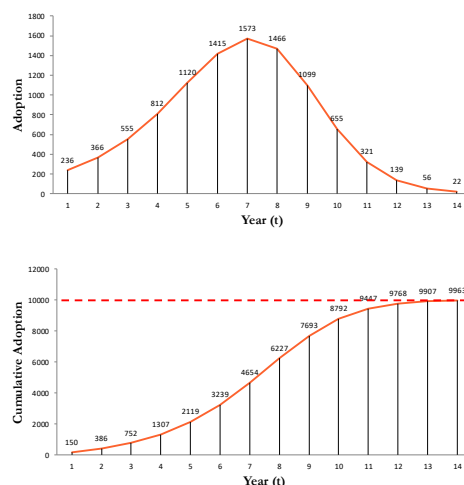
New Product Diffusion Curve



Adoption and cumulative adoption

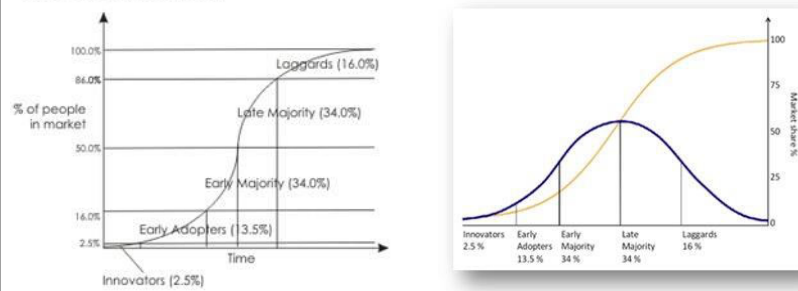
Total market size = 10,000

Year	Cumulative adopters	Adopters
1	150	150
2	386	236
3	752	366
4	1307	555
5	2119	812
6	3239	1120
7	4654	1415
8	6227	1573
9	7693	1466
10	8792	1099
11	9447	655
12	9768	321
13	9907	139
14	9963	56
15	9985	22



Adoption and cumulative adoption

The Product Diffusion Curve



<https://www.youtube.com/watch?v=kxVeLITEgtU>

Bass Diffusion Model (BDM or Bass model)

- Bass model is used to predict how many people will adopt a new product in each time period
- It is typically used to predict the adoption behavior of a new category (e.g. smartphones)
 - It can also be used for brand level forecasting when no close alternative exists in the market
 - Doesn't take repeat purchases into account
 - Doesn't take competitive behavior into account
 - More suitable for durable goods

Bass Diffusion Model

- Basic premise of BDM is that there are two types of consumers in the market

Innovators:

- Those who adopt the product on their own (based on their intrinsic tendency to adopt) without any external influence.
- Adoption behaviour of innovators does not depend on the product's penetration or time since introduction (constant throughout)

Imitators

- Those whose adoption behaviour is influenced by prior adopters through word-of-mouth or "social contagion", network externalities etc.
- Adoption behaviour of imitators depends on the product's penetration (what proportion of consumers have adopted the product)

Bass Diffusion Model

Nomenclature of model variables and parameters

M = total size of the target population

A_t = no. of adopters in time period t (typically in years)

Q_t = Cumulative no. of adopters up to and including time period t

p = coefficient of innovation (proportion of innovators in the market)

q = coefficient of imitation (influence of prior adopters)

Residual consumers

At any given year ' t ', number of "residual" consumers who are yet to adopt the product = $(M - Q_{t-1})$

Bass Diffusion Model

- Number of innovators who adopt the product in year $t = p * (M - Q_{t-1})$
- Number of imitators who adopt the product in year $t = q * \left[\frac{Q_{t-1}}{M} \right] * (M - Q_{t-1})$
where $\left(\frac{Q_{t-1}}{M} \right)$ the proportion of people who have already adopted the product

- Therefore, total adopters in time period t ,

$$A_t = (M - Q_{t-1}) \left[p + q \frac{Q_{t-1}}{M} \right]$$

- In this equation, $(M - Q_{t-1})$ is the number of consumers available to adopt (residuals) and $\left[p + q \frac{Q_{t-1}}{M} \right]$ is the probability that a consumer who has not adopted the product yet will adopt in year t

Bass model - Example

- Let $M = 10,000$ $p = 0.015$ or 1.5% $q = 0.6$

No. of. People adopting in the first year = $10,000 * 0.015 = 150$

Year	M	Q(t-1)	A(t)
2	10,000	150	236
3	10,000	386	366
4	10,000	752	555
5	10,000	1307	812
6	10,000	2119	1120
7	10,000	3239	1415
8	10,000	4654	1573
9	10,000	6227	1466
10	10,000	7693	1099
11	10,000	8792	655
12	10,000	9447	321
13	10,000	9768	139
14	10,000	9907	56

Year 2:

Residual consumers = $M - Q(1) = 10000 - 150 = 9850$

$$\Lambda(t) = 9850 * (0.015 + 0.6 * (150 / 10000)) = 236$$

$$Q(t) = 236 + 150 = 386$$

Year 3:

Residual consumers = $M - Q(2) = 10000 - 386 = 9614$

$$\Lambda(t) = 9614 * (0.015 + 0.6 * (386 / 10000)) = 366$$

$$Q(t) = 366 + 386 = 752$$

Bass model - Estimation

- To apply the Bass model, we need to know the value of p , q and M . There are two ways of obtaining these values
 - Imputation
 - Regression
- Imputation: In this simple method, we impute the values of p , q and M from the estimates for a closely related product or region (based on our judgment)

Examples:

- p and q values for CRT TVs can be used for LCD TVs. Entire population of Australia can be taken as M since we expect everyone to own a TV
- p , q and M values for China can be used for India since India typically follows China in product adoption
- Surveys of managers can be used to estimate p , q and M values
- This method is crude and approximate, but can still be used to predict initial adoption

Bass model - Estimation

- If we have the adoption data for the first 4 time periods (years), we can compute the value of p , q and M using the following regression equation

$$A_t = a + bQ_{t-1} + c(Q_{t-1})^2$$

where A_t is the adoption in year t , Q_{t-1} is the cumulative adoption till year $t-1$, and parameters a , b & c are regression coefficients

- From these regression coefficients, p , q and M can be calculated as follows.

$$q = \frac{b + \sqrt{(b^2 - 4ac)}}{2}$$

$$p = q - b \quad M = \frac{a}{p}$$

Bass model estimation – Intuition behind the regression analysis

- Here is how the regression works

According to Bass model,
$$A_t = (M - Q_{t-1}) \left[p + q \frac{Q_{t-1}}{M} \right]$$

Rearranging this equation,

$$A_t = (M - Q_{t-1}) \left[p + q \frac{Q_{t-1}}{M} \right] = Mp + qQ_{t-1} - pQ_{t-1} - q \frac{(Q_{t-1})^2}{M}$$

$$A_t = Mp + (q - p)Q_{t-1} - \left(\frac{q}{M}\right) (Q_{t-1})^2$$

Let $a = Mp$, $b = q - p$, $c = (-q/M)$,

$$A_t = a + bQ_{t-1} + c(Q_{t-1})^2$$

which is the regression equation used in the previous slide!

- What is the minimum number of observations needed to estimate parameters a , b and c in the above equation?

Some insights about Bass model

- Why does Bass model give 'S' shaped cumulative adoption curve?
 - It is the net result of two opposing effects
 - Imitation probability increases over time as the proportion of people who have already adopted the product increases
 - Market size (residual consumers) decreases over time
- Are the parameters p , q and M constant?
 - Rate of diffusion varies with factors like marketing mix variables, macro-economic climate, target population size, technological evolution etc.
 - These parameters can be incorporated into Bass model by making p , q and M as functions of different factors

E.g. If population size increases by $x\%$ per period, then $M(t) = M(t-1) * (1 + x\%)$
- **Caution!**
 - Bass model doesn't predict the success of product. It just projects future adoption based on observed adoption patterns in the first few years

Some applications of Bass model

- Plan marketing, manufacturing and distribution activities based on adoption curve (e.g. when should a firm ramp up its production capacity)
- For product categories with limited repeat purchases (e.g. insurance, movies), Bass model can be used to predict sales and revenues (e.g. Self Managed Super Fund adoption in Australia)
- Bass model can also be used to predict brand sales if estimates of market share and repeat purchase probabilities are available
- Plan marketing strategy based on the type of consumers adopting the product (e.g. word-of-mouth / social media promotions when a market has high imitation coefficient)

Some insights from academic research using Bass model

- Speed of diffusion is increasing over time
- Countries with collectivistic culture (e.g. China, Japan) have higher imitation coefficient than countries with individualistic culture (e.g. USA, Australia)
- Countries with higher purchasing power have higher p values
- Products which exhibit network effects or require investments in complementary infrastructure (e.g. cell phones, fax machines) have higher q values
- What does it mean when a market has low p and high q value?

Business problems

Business problems:

1. How to forecast sales of new products?
2. How to forecast adoption of entirely new product categories?

What you learnt this week:

1. Trial and repeat model
2. Bass diffusion model

Marketing Decision Analysis

Week 6

Communication 1

Promotion

Business problems:

- How to evaluate the outcome of a price promotion?

What you will learn this week:

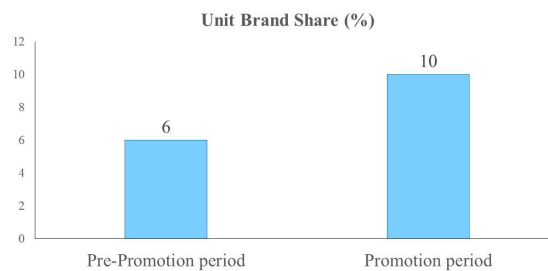
1. Objectives of short term price promotions
2. Evaluating incremental sales
3. Evaluating the profitability of price promotions
4. Long term effects of price promotions
5. Evaluating price promotions in practice

Price promotions

- Short-term promotional objectives
 - To induce trial and acquire new customers
 - Increase appeal to price-sensitive segments
 - To accelerate purchase rates of existing customers and increase loyalty (encourage customers to “load up” and thereby blunt competitor marketing efforts)
 - To introduce new skus to the trade
 - To clear inventories and smooth production in seasonal categories
 - To increase shelf space
 - To gain new trade accounts



Price promotion scenario



Was this promotion successful?

(Assume both pre-promotion and promotion periods are of same duration)

Baseline vs. incremental Sales

Baseline sales

- Expected sales in the absence of marketing programs (e.g. promotion)
- Baseline sales can be determined from historical data or using control groups

Incremental sales or Promotional lift

- Lift or increase in sales in response to promotion
- Total sales less baseline sales

$$\text{Total sales (\#, \$)} = \text{Baseline sales (\#, \$)} + \text{Incremental sales (\#, \$)}$$

$$\text{Lift from promotion (\%)} = \frac{\text{Incremental sales (\#, \$)}}{\text{Baseline sales (\#, \$)}}$$

Price promotion scenario

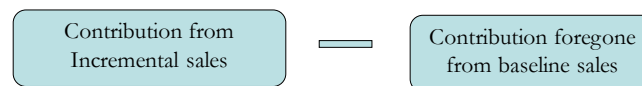
	Pre-promotion period	Promotion period
Brand's unit market share	6%	10%
Category sales (#)	1,000,000	1,000,000
Brand sales (#)	60,000	100,000
Baseline sales (#)	60,000	
Incremental sales (#)	$100,000 - 60,000 = 40,000$	
Lift from promotion (%)	$40,000 / 60,000 = 66.67\%$	

Brand sales = Unit market share * Category sales (units) = $6\% * 1,000,000 = 60,000$ units

* Note that all periods are of same duration (e.g. 1 week)

Evaluating the outcome of a price promotion

- Profit contribution due to promotion



Result of:

- Increased sales during the promotion period
- Any increase in sales during the post promotion period

Result of:

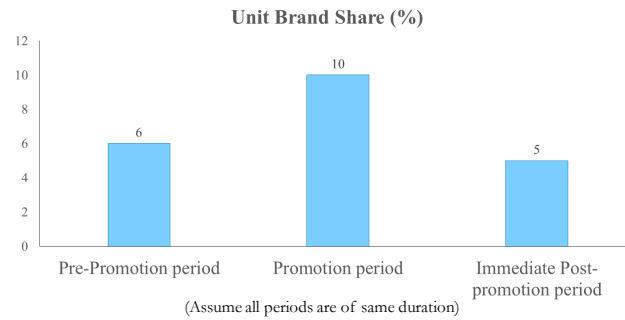
- Reduced contribution from baseline sales during the promotion period
- Any sales shortfall during the post-promotion period

Case 1: Price promotion scenario with no post-promotion effect

	Pre-promotion period	Promotion period
Brand unit market share	6%	10%
Category sales (#)	1,000,000	1,000,000
Brand sales (#)	60,000	100,000
Variable cost per unit (\$)	\$50	\$50
Selling price per unit (\$)	\$150	\$120
Contribution per unit (\$)	$\$150 - \$50 = \$100$	$\$120 - \$50 = \$70$
Baseline sales (\$)	60,000	
Incremental sales (\$)	$100,000 - 60,000 = 40,000$	
Contribution from Incremental sales (\$)	$40,000 * \$70 = 40,000 * 70 = 2,800,000$	
Contribution foregone from baseline sales (\$)	$60,000 * (\$70 - \$100) = 60,000 * -30 = -1,800,000$	
Net contribution to profit (\$)	$\$2,800,000 - \$1,800,000 = 1,000,000$	

* Note that all periods are of same duration (e.g. 1 week)

Case 2: Immediate post-promotion period



- Sales shortfall in the post-promotion period can occur due to customers stocking up the product and/or advancing their purchases

Case 2: Price promotion scenario with post-promotion effect

	Pre-promotion period	Promotion period	Immediate post-promotion period
Brand unit market share	6%	10%	5%
Category sales (#)	1,000,000	1,000,000	1,000,000
Brand sales (#)	60,000	100,000	50,000
Variable cost per unit (\$)	\$50	\$50	\$50
Selling price per unit (\$)	\$150	\$120	\$150
Contribution per unit (\$)	\$100	\$70	\$100
Baseline sales (#)	60,000		
Incremental sales (#)		40,000	
Sales shortfall (#)			-10,000

* Note that all periods are of same duration (e.g. 1 week)

Case 2: Price promotion scenario with post-promotion effect

	Pre-promotion period	Promotion period	Immediate post-promotion period
Brand sales (#)	60,000	100,000	50,000
Contribution per unit (\$)	\$100	\$70	\$100
Baseline sales (#)	60,000		
Incremental sales (#)		40,000	
Sales shortfall (#)			-10,000
Contribution from incremental sales (\$)		40,000 * \$70 = \$2,800,000	
Contribution foregone from baseline sales (\$)		60,000 * (70 - 100) = - \$1,800,000	-10,000 * \$100 = - \$1,000,000
Net contribution to profit (\$)	\$0		
Net unit impact (#)	40,000 - 10,000 = 30,000		

* Note that all periods are of same duration (e.g. 1 week)

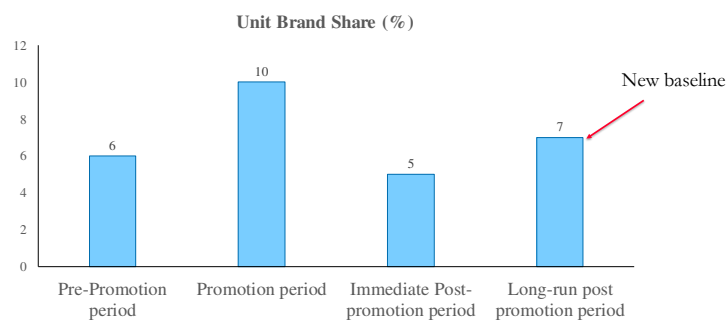
Case 3: What if the three periods are of different durations?

	Pre-promotion period	Promotion period	Immediate post-promotion period
Brand sales per week (#)*	60,000	100,000	50,000
Contribution per unit per week (\$)	\$100	\$70	\$100
Duration	4 weeks	2 weeks	1 weeks
Baseline sales (#)	60,000		
Incremental sales per week (#)		40,000	
Sales shortfall per week (#)			-10,000
Contribution from incremental sales (\$)		$40,000 * \$70 * 2 = \$5,600,000$	
Contribution foregone from baseline sales (\$)		$60,000 * \$30 * 2 = -\$3,600,000$	$-10,000 * \$100 * 1 = -\$1,000,000$
Net contribution to profit (\$)	\$1,000,000		
Net unit impact (#)	$40,000 * 2 - 10,000 * 1 = 70,000$		

Case 4: What if the category expands?

	Pre-promotion period	Promotion period	Immediate post-promotion period
Brand unit market share	6%	10%	5%
Category sales (#)	1,000,000	1,200,000	1,100,000
Brand sales (#)	$6\% * 1M = 60,000$	$10\% * 1.2M = 120,000$	$5 * 1.1M = 55,000$
Contribution per unit (\$)	\$100	\$70	\$100
Baseline sales (#)	60,000		
Incremental sales (#)		60,000	
Sales shortfall (#)			-5,000
Contribution from incremental sales (\$)		$60,000 * \$70 = \$4,200,000$	
Contribution foregone from baseline sales (\$)		$60,000 * \$30 = -\$1,800,000$	$-5,000 * \$100 = -\$500,000$
Net contribution to profit (\$)	\$1,900,000		
Net unit impact (#)	$60,000 - 5,000 = 55,000$		

Case 5: Price promotion with long-run benefit



- If the price promotion induces brand trial or increases usage of existing customers

Evaluating the long run effect

- Calculate the net contribution to profit from promotion till the immediate post-promotion period (as shown earlier)
- Contribution per period (from increase in baseline sales) in the long-run = (New baseline sales – Old baseline sales) * Contribution per unit

For the example in case 2, if the brand unit market share increases from 6% to 7% in the long-run, then,

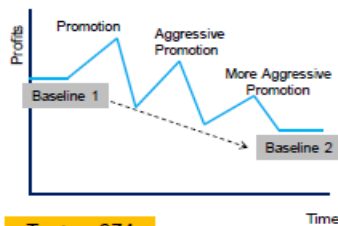
Contribution per week in the long-run = $(7\% - 6\%) * 1,000,000 * \$100 = \$1,000,000$

- Managerial judgement: is the increase in contribution in the long-run sufficient to offset any negative contribution to profit from promotion?

Long term effects of promotion

Downward Spiral

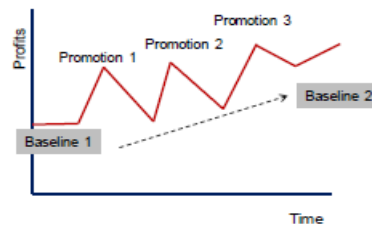
- Competitors react
- Size of price-offs increase
- Customers learn to wait for deals



Text, p. 274

Successful Promotion Cycle

- Customers try product
- Trade stock the successful product
- Repeat purchases
- Customers become loyal



Promotional gains: Retailers' vs. Manufacturers' perspectives

	Brand manufacturer (brand sales)	Retailer (category sales)
Incremental sales	• Switching from competing brands during the promotional period (within the focal retailer as well as from other retailers) • Switching from competing brands from the future time periods (within the focal retailer as well as from other retailers) • Higher consumption rate and new brand users	• Switching from competing retailers during promotional period (from the focal brand as well as from competing brands) • Switching from competing retailers from the future time periods (from the focal brand as well as from competing brands) • Higher consumption rate and new category users

Promotional gains: Retailers' vs. Manufacturers' perspectives

	Brand manufacturer (brand sales)	Retailer (category sales)
Sales shortfall in immediate post-promotion period	Switching from the focal brand from the future time periods (within the focal retailer as well as from other retailers)	Switching within the focal retailer from the future time periods (from the focal brand as well as from competing brands)
Long term gain in sales	From higher consumption rate and new brand users	From higher consumption rate and new category users

Evaluating promotions in practice

- What is the baseline sales, incremental sales and sales-shortfall in this example?

Week	Quantity sold
1	100
2	100
3	100
4	100
5	100
6	200
7	80
8	100
9	100
10	100

Regression for evaluating price promotions

- Promotion outcome can be evaluated using a regression with dummy variables (for promotion & post-promotion period)

$$Unit_sales_t = a + b D_{promo} + c D_{post_promo}$$

a (intercept) – baseline sales

D_{promo} - Dummy variable which is set to 1 for promotion weeks

b - Incremental sales

D_{post_promo} - Dummy variable which is set to 1 for post-promotion (sales shortfall) weeks

c – Sales shortfall in the post-promotion period

- What if the promotion and post-promotion dip last for multiple weeks?

Regression for evaluating price promotions

- Number of periods for the post promotion effect is decided based on product purchase frequency
- Dummy variables simply capture the average sales during a period. A regression framework allows us to control for other variables (e.g. competitor actions) which is not possible when we just take average
- In this simple model, we assumed that price discount is the same. What if price discount is not always same and the regular price also varies?
- Similar (but more complex) regression framework can be used to identify switching and halo effects, and evaluate the promotion from retailer's or manufacturer's perspectives.

Business problems:

- How to evaluate the outcome of a price promotion?

What you learnt this week:

1. Objectives of short term price promotions
2. Evaluating incremental sales
3. Evaluating the profitability of price promotions
4. Long term effects of price promotions
5. Evaluating price promotions in practice

Marketing Decision Analysis

Week 7

Communication 2

Advertising media metrics

Business problems:

- How to evaluate the outcomes of advertising campaigns?

What you will learn this week:

1. Advertising metrics: Impressions, Reach, Frequency, GRPs and TARPs
2. Evaluating cost effectiveness of advertisements
3. Frequency response functions
4. Advertising elasticity of demand, carry-over effects and optimal advertising spending

Reach and Frequency

- Key media objectives
- **Reach**
 - # or % of population exposed to advertising at least once
 - Needs to be defined for a specific period and target audience
- **Frequency**
 - Average number of times those reached are exposed to advertising
- Media planners must decide how much advertising spending is needed to meet these objectives

Reach and Rating points

- Examples for reach:
 - Readership (newspapers & magazines)
 - Number of viewers (TV) (e.g. <http://www.oztam.com.au/LatestAvailableReports.aspx>)
 - Number of listeners (Radio)
 - Number of passers-by (outdoor)
 - Number of page-views (internet)

<http://www.dailytelegraph.com.au/entertainment/sydney-confidential/the-2015-winners-and-losers-in-australias-tv-ratings-war/news-story/d91b7e701bab21d898e23598ee43d633>
- Reach of a media vehicle (e.g. newspaper) is expressed in terms of rating points
Rating points of a media vehicle is calculated as the proportion of individuals in a target population reached by that media vehicle, expressed in points that represent the resulting percentage
 - E.g. 70 rating points for TV implies 70% of the population is reached by a TV Ad

$$\text{Rating points} = 100 * \frac{\text{Reach (\#)}}{\text{Population size}}$$

Impressions

- The number of times a specific advertisement is available to be seen or otherwise exposed to media audiences
 - An impression is generated each time an advertisement is available to be viewed

$$\text{Impressions (\#)} = \text{Reach (\#)} * \text{Average frequency (\#)}$$

- Impressions are also known as 'exposures' or opportunities to see/hear
- Impressions is an estimate of audience for a media 'insertion' (one time ad) or a campaign

Gross Rating Points

- The rating points of all the media vehicles that deliver an advertisement or campaign can be summed to yield a measure of aggregate reach of the campaign, known as GRP

E.g. If a newspaper ad is shown on 5 different newspapers, each with an average rating of 30, then $\text{GRP} = 5 * 30 = 150$

$$\text{GRPs} = 100 * \frac{\text{Impressions (\#)}}{\text{Population size}} = 100 * (\text{Reach (\%)}) * \text{Avg. frequency (\#)}$$

- GRPs is an important determinant of media price

Ad campaign metrics calculation

Insertion	Individual				
	A	B	C	D	E
1	1	1	0	0	1
2	1	1	0	0	1
3	1	1	0	1	0
4	1	1	0	1	0
5	1	1	0	1	0
6	1	0	0	1	0
7	1	0	0	1	0
8	1	0	0	0	0
9	1	0	0	0	0
10	1	0	0	0	0
Totals	10	5	0	5	2

- A-E represents the viewing population
- 1 represents an opportunity to see
- Calculate these campaign metrics
 - Reach (#)
 - Reach (%)
 - Impressions (#)
 - Average frequency (#)
 - GRPs

Ad campaign metrics calculation

Insertion	Individual				
	A	B	C	D	E
1	1	1	0	0	1
2	1	1	0	0	1
3	1	1	0	1	0
4	1	1	0	1	0
5	1	1	0	1	0
6	1	0	0	1	0
7	1	0	0	1	0
8	1	0	0	0	0
9	1	0	0	0	0
10	1	0	0	0	0
Totals	10	5	0	5	2

- Reach (#) = 4
- Reach (%) = $4/5 = 80\%$
- Impressions (#) = $10+5+0+5+2 = 22$
- Average frequency (#) = $22/4 = 5.5$
- GRPs = $100 * (22/5) = 440$

Ad campaign metrics calculation

Insertion	Individual					Impressions	Reach	Rating points
	A	B	C	D	E			
1	1	1	0	0	1	3	60%	60
2	1	1	0	0	1	3	60%	60
3	1	1	0	1	0	3	60%	60
4	1	1	0	1	0	3	60%	60
5	1	1	0	1	0	3	60%	60
6	1	0	0	1	0	2	40%	40
7	1	0	0	1	0	2	40%	40
8	1	0	0	0	0	1	20%	20
9	1	0	0	0	0	1	20%	20
10	1	0	0	0	0	1	20%	20
Totals	10	5	0	5	2	22		440

GRPs is the sum of rating points of all the media vehicles that deliver an advertisement

Advertising Media Metrics

- Media planners would like high reach and frequency; but campaigns with high reach and frequency are costly
- Media planners often need to trade-off between reach and frequency. Consider a media plan with a given GRPs figure:
 - It could have high reach and low frequency (“runs the danger of being lost in a noisy advertising environment”)
 - It could also have a low reach and high frequency (“can over-expose some audiences and miss others entirely”)
 - Neither is desirable, so media planners need to balance both reach and frequency (depending on effective frequency, product type, ad purpose etc.)

Target Audience Analysis

- Most advertisements are intended only for selective potential buyers or “target audience”

TARPs (TRPs in text) denote target audience rating points. A specific segment of the audience (target audience) is used as the base for all calculations.

- Reach, average frequency, impressions, rating points and TARPs are calculated for target audience only (same definition as before, but for a subset of total audience)

Target audience campaign metrics calculation

Insertion	Individual				
	A	B	C	D	E
1	1	1	0	0	1
2	1	1	0	0	1
3	1	1	0	1	0
4	1	1	0	1	0
5	1	1	0	1	0
6	1	0	0	1	0
7	1	0	0	1	0
8	1	0	0	0	0
9	1	0	0	0	0
10	1	0	0	0	0
Totals	10	5	0	5	2

- A-C represents the target audience
- Calculate these campaign metrics for the target audience
 - Reach (#)
 - Reach (%)
 - Impressions (#)
 - Average frequency (#)
 - TARPs

Target audience campaign metrics calculation

Insertion	Individual				
	A	B	C	D	E
1	1	1	0	0	1
2	1	1	0	0	1
3	1	1	0	1	0
4	1	1	0	1	0
5	1	1	0	1	0
6	1	0	0	1	0
7	1	0	0	1	0
8	1	0	0	0	0
9	1	0	0	0	0
10	1	0	0	0	0
Totals	10	5	0	5	2

A-C represents the target audience

- Reach (#) = 2
- Reach (%) = $2/3 = 66.7\%$
- Impressions (#) = $10+5+0 = 15$
- Average frequency (#) = $15/2 = 7.5$
- TARPs = $100 * (15/3) = 500$

Target audience campaign metrics calculation

Insertion	Individual					Impressions	Reach	Rating points
	A	B	C	D	E			
1	1	1	0	0	1	2	66.7%	66.7
2	1	1	0	0	1	2	66.7%	66.7
3	1	1	0	1	0	2	66.7%	66.7
4	1	1	0	1	0	2	66.7%	66.7
5	1	1	0	1	0	2	66.7%	66.7
6	1	0	0	1	0	1	33.3%	33.3
7	1	0	0	1	0	1	33.3%	33.3
8	1	0	0	0	0	1	33.3%	33.3
9	1	0	0	0	0	1	33.3%	33.3
10	1	0	0	0	0	1	33.3%	33.3
Totals	10	5	0	5	2	15		500

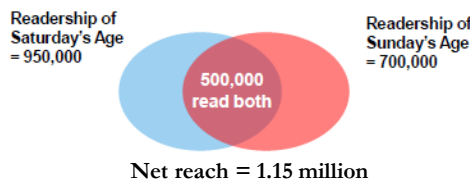
TARPs is the sum of rating points of all the media vehicles that deliver an advertisement among target audience

Net Reach

- An advertisement through different media (e.g. TV and internet) can end up reaching the same audience

Example:

An Advertisement is placed in both Saturday and Sunday editions of The Age newspaper. Suppose if 950,000 readers read Saturday edition and 700,000 read Sunday edition and 0.5 million read both editions, then the net reach is.....



- Net reach and reach are essentially same. The qualifier 'net' is used to emphasize that only unduplicated audience of individuals who have been exposed at least once to the advertisement in question are taken into consideration

Frequency Response Models

- Frequency response functions capture the relationship between advertising outcomes (unit sales or revenues) and advertising frequency

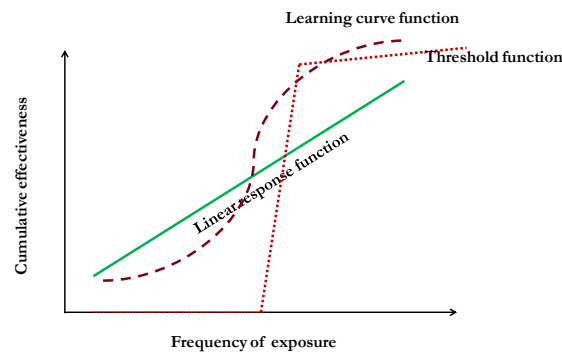
Linear response: Effectiveness increases linearly with each exposure. Each exposure is equally valuable, regardless of preceding exposures

Learning curve response: Audience response follows a 'S' shaped curve

- Initial few exposures do not register with audience and have meagre effect
- Further exposures rapidly increase the effectiveness as audience absorb the message
- As exposures keep increasing, diminishing returns sets in due to message saturation and the effectiveness declines

Threshold response: Advertising has no effect until the exposure reaches a certain level or threshold. At this point the message becomes fully effective and further advertising has no effect

Frequency Response Models



Frequency response functions help marketers decide how many times an advertisement should be shown to the target audience

Effective Frequency

- Each advertisement requires a minimum number of impressions (called effective frequency) before being able to influence an audience member
- Effective frequency depends on,
 - Audience level of awareness of the brand
 - Their loyalty to the brand
 - Message creativity
 - Level of influence sought by the marketer
- **Wear-in:** The frequency required before a given advertisement or campaign achieves a minimum level of effectiveness
- **Wear-out:** The frequency at which a given advertisement or campaign begins to lose effectiveness or even yield a negative effect

Effective Reach

- Effective reach is the # or % of audience that receives an advertising message with a frequency equal to or greater than the effective frequency

Example:

The following table shows the distribution of population across different exposure frequencies. If the effective frequency is 3, calculate the effective reach.

Number of exposures	Population
0	140,000
1	102,000
2	64,000
3	23,000
4+	11,000
Total	340,000

If effective frequency is 3, then the effective reach is 34,000 (23,000 + 11,000) or 10% of the population

Share of Voice

- Measure of the “presence” that a specific brand or product enjoys
- Defined as either brand’s ad spend relative to total market ad spend, or # of impressions or GRPs relative to market total

$$\text{Share of voice (\%)} = \frac{\text{Brand advertising (\$, \#)}}{\text{Total Market advertising (\$, \#)}}$$

- Share of voice web/social media is defined in terms of share of conversations about a brand relative to the total market (i.e. all brands in the category)

Comparing Advertising Costs

$$\text{Cost per 1000 impressions (\$)} = \frac{\text{Cost of advertising (\$)}}{\text{Impressions generated in 1000's}}$$

- CPI is useful in comparing the relative efficiency of different advertising opportunities or media and in evaluating the cost of overall campaigns
- Not all impressions are equally valuable. Consequently, it can make good business sense to pay more for impressions from some sources than others

Media Alternative	Cost of Ad	Audience Size	Cost per Thousand Impressions
<i>USA Today</i> (newspaper)	\$411,500	2,524,965	\$163
<i>Sports Illustrated</i> (magazine)	\$302,680	3,150,000	\$96
<i>Super Bowl</i> (television)	\$2,600,000	91,000,000	\$29

Advertising Elasticity of Demand

$$\text{Advertising Elasticity of Demand} = \frac{\text{Change in quantity demanded (\%)}}{\text{Change in advertising spending (\%)}}$$

Example

Period 1: Advertising spending (A1) = \$10,000 Quantity demanded (Q1)=300,000

Period 2: Advertising spending (A2) = \$10,500 Quantity demanded (Q2)=303,000

$$\text{Advertising elasticity of demand} = ((Q2-Q1)/Q1) / ((A2-A1)/A1) = 0.2$$

Thus, every 1% increase in ad spending leads to 0.2% increase in sales.

Advertising Elasticity of Demand

- Advertising elasticity of demand captures the change in consumer demand due to change in advertising spending
- Helps in determining how much to spend on advertising, which products to advertise, which medium to use etc.
- Typically calculated from historical data
- Will advertising elasticity of demand be positive or negative?
- Will you advertise more or less if AED is small?

Calculating Advertising Elasticity of Demand

- From longitudinal and/or cross-sectional sales and advertising spending data using the following linear regression model

$$\ln(\text{Sales}_t) = \alpha + \beta \ln(\text{Advertising spending}_t) + \varepsilon_t$$

The coefficient β gives the advertising elasticity. Note that we have assumed that this elasticity is constant (β is same for different spending levels) in this regression

- When calculating AED, it is important to control for price and other variables that affects sales. Omitting variables will bias the estimated AED if the omitted variables are correlated with advertising spending

Carry-over effects of advertising*

- Effect of advertising on current-period demand is typically much lower than that of price. However, advertising affects future demand for a product as well (through building awareness, brand equity etc.)
- This 'carry-over' effect of advertising can be accounted in different ways

Koyck model:

$$\ln(\text{Sales}_t) = \alpha + \lambda \ln(\text{Sales}_{t-1}) + \beta \ln(\text{Ad_spend}_t) + \varepsilon_t$$

Here, β is the current effect of advertising and $\beta \left[\frac{\lambda}{1-\lambda} \right]$ is the carry-over effect.

* Adopted from the "The Cutting-Edge Marketing Analytics" book by Venkatesan, Farris and Wilcox (2015)

Carry-over effects of advertising

Adstock model:

- The accumulated advertising capital (i.e. Advertising stock) is calculated as,

$$\text{Ad_stock}_t = \text{Ad_stock}_{t-1} + \lambda \ln(\text{Ad_spend}_t)$$

$$\ln(\text{Sales}_t) = \alpha + \beta \text{Ad_stock}_t + \varepsilon_t$$

- Advertising stock is calculated from an initialization period and is then updated every period
- Carry-over effect ' λ ' can be imputed from existing research/managerial knowledge or can be estimated

Optimal Advertising Spending

- According to Dorfman – Steiner theorem,

$$\frac{\text{Advertising (\$)}}{\text{Sales (\$)}} = \frac{\text{Price (\$)} - \text{Cost to Produce (\$)}}{\text{Price (\$)}} * \text{AED} = \text{Contribution Margin (\%)} * \text{AED}$$

Example (P. 322 in the Text book)

Selling price = \$10 Variable cost = \$7.50 AED = 0.204 Sales = \$300k

Contribution margin = $(10 - 7.5) / 10 = 25\%$ or 0.25

Optimal advertising (\$) = $0.25 * 0.204 * \text{Sales (\$)} = 5.1\% * \text{Sales (\$)}$

In this example, optimal advertising spending is 5.1% of sales (note that sales at optimal ad spending will be higher than \$300k and has to be estimated using methods like numerical maximization)

- Flat-maximum principle
 - Profits are often similar over wide range of advertising spending
 - So, a firm will not lose much as long as its advertising spending is not very far from optimal level

Business problems revisited:

- How to evaluate the outcomes of advertising campaigns?

What you learnt this week:

- Advertising metrics: Impressions, Reach, Frequency, GRPs and TARPs
- Evaluating cost effectiveness of advertisements using Cost per Thousand Impressions (CPM)
- Frequency response functions
- Advertising elasticity of demand, carry-over effects and optimal advertising spending

Week 8

Communication 3

Online advertising and social media metrics

Business problems:

- How to evaluate the outcomes of online advertising campaigns?

What you will learn this week:

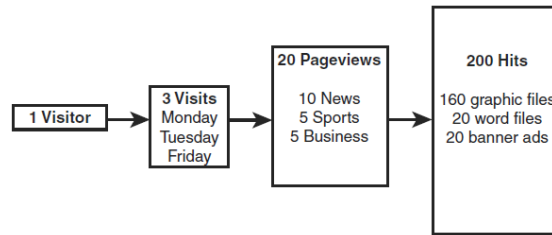
- Web analytics metrics
- Banner/display advertising metrics
- Paid search advertising metrics
- Social media metrics
- Share of Voice & consumer sentiment

Web analytics

“Web analytics is the measurement, collection, analysis and reporting of Internet data for the purposes of understanding and optimizing web usage”
- Digital Analytics Association

- What are some of the metrics that marketers would like to track for their websites?
 - Website reach or traffic (relevant to all websites)
 - Website engagement (relevant to all websites)
 - Customer purchase conversion metrics (specifically for electronic retailers)

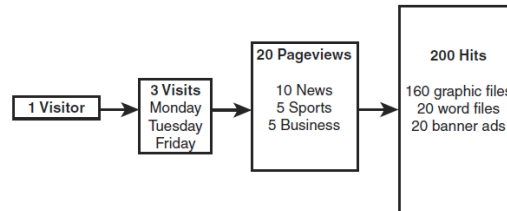
Web analytics: Reach (traffic)



Visitors

- # of unique users visiting the site
- Typically captured using cookies and/or user logins
- Visitors are more difficult to measure than visits as consumers often browse from different devices, browsers, clear cookies etc.

Web analytics: Reach (Traffic)



Visits (or sessions in Google analytics)

- # of (browsing) sessions in a site (hits for a website)
- A session is initiated when a customer opens a website and terminates when the browser is closed or after a period of inactivity

Pageviews

- Number of times a web page was viewed
- A session can consist of single or multiple pageviews

Web analytics: Engagement

- Return visits – e.g. average sessions per user
- Interaction depth – e.g. average pageviews per user, average time spent per session

Bounce rate:

- Measures a website's effectiveness in encouraging visitors to continue visit

$$\text{Bounce Rate (\%)} = \frac{\text{Visits that accessed only a single page (\#)}}{\text{Total visits to the site (\#)}}$$

- High bounce rate could imply that the site is not relevant to the visitors
 - So, money spent on generating traffic has been wasted
- Bounce rates can be determined for individual pages and content experiments (showing difference pages to different visits) can be used to identify the best pages to show

Web analytics: Example

- What are the strengths/weaknesses of the three websites whose weekly reach & engagement metrics are given below.

Website	A	B	C
Unique visitors	1,000,000	500,000	100,000
Total sessions	5,000,000	15,000,000	200,000
Total pageviews	5,000,000	30,000,000	1,000,000
Average sessions per user	5	30	2
Avg. pageviews per session	1	2	5

- Which website has high reach but low engagement?
- Which website is doing well in terms of return visits?
- Which website is performing well in terms of interaction depth?
- Which website is performing well overall?

Web analytics: Purchase conversion

Conversion rate:

- Conversions (or shopping conversions) refers to visitors who have been converted to purchasers

$$\text{Conversion Rate (\%)} = \frac{\text{Number of Consumers who Purchase (\#)}}{\text{Number of Visitors (\#)}}$$

- If conversion rate is low, we can analyse the bounce rate, abandonment rate and engagement to understand the underlying reasons

Abandonment rate:

- Abandonment refers to unfinished shopping carts (that don't result in purchase)

$$\text{Abandonment Rate (\%)} = \frac{\text{Carts Not Completed (\#)}}{\text{Customer Baskets Initiated (\#)}}$$

Web analytics: Clickstream data

Clickstream data

- Sequence of pages that a user browses through in a website
- Has information on visitors, sessions, pageviews and purchases (for e-retailers)
- Path analysis of clickstream data can be used to predict users' browsing and purchasing behaviours

Example:

Suppose an online retailer's web pages can be classified into five types – home page (H), category page (C), product pages (P), shopping cart/checkout page (S) and account & payment page (A).

A user's clickstream path data could look like this: HCPPCPPPSA

By analysing browsing paths and purchase outcome (i.e. whether a product was purchased or not), we can predict whether a customer will purchase given her browsing path (and offer custom deals to induce the purchase)

Web analytics: Google analytics

- Web analytics metrics that we discussed could be obtained using tools like Google analytics
- Google analytics: Free web analytics tool to track website performance
<http://www.google.com.au/analytics/>
 - A “page tag” (JavaScript code) is added onto every page of a website and it collects visitor data and sends back to Google for processing
 - Tracks visitors from all referrers such as search engines, ads, emails, links within documents etc.

http://www.youtube.com/watch?v=Hdsb_uH2yPU

Display advertising metrics

- Display ads are typically in the form of banner advertisements on third party websites
- Their predominant objective is to lead users to the brand website; sometimes they directly lead to a product page
- Often difficult to track reach & frequency, but impressions can be calculated as follows

Impressions: Number of opportunities presented to people to see an advertisement

**# of impressions = % of times an ad is displayed on a web page (%) *
Pageviews for the web page (#)**

E.g. If Pageviews = 20,000 and if an ad is displayed 10% of times, then the impressions generated by the ad = 10% * 20,000 = 2000

Note that impression captures only opportunities-to-see and doesn't capture whether an ad was actually seen

Display ads: Clickthroughs

- Display ads are typically evaluated using number of clickthroughs they generate.
- Clickthrough (or simply click) is when a user clicks on an advertisement's link

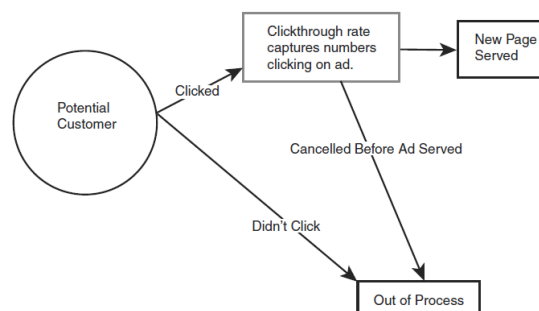


Figure 10.1 Clickthrough Process

Display ads: Clickthrough rate

$$\text{Clickthrough rate (\%)} = \frac{\text{Clickthroughs (\#)}}{\text{Impressions (\#)}}$$

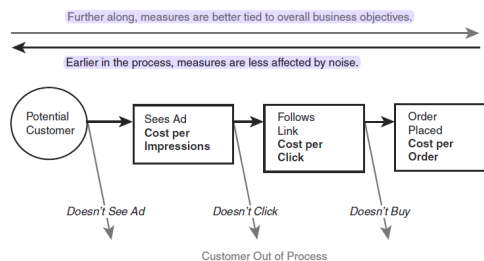
- Captures initial response to websites
- High clickthrough rate is desirable, but it doesn't necessarily mean that an ad is successful

<https://www.youtube.com/watch?v=kKjiDZcZ5I4>

- Click is a weak signal of interest
 - People can click on an ad by mistake
 - People can move on before page is loaded
 - People can click on an ad several times

“Unless a user clicks on a “Buy Now” button, clickthroughs measure only one step along the path towards a final sale” Text p. 336

Display ads: calculating costs



$$\text{Cost per Impression (\$)} = \frac{\text{Advertising Cost (\$)}}{\text{Number of Impressions (\#)}}$$

$$\text{Cost per Click (\$)} = \frac{\text{Advertising Cost (\$)}}{\text{Number of Clicks (\#)}}$$

$$\text{Cost per Order (\$)} = \frac{\text{Advertising Cost (\$)}}{\text{Orders (\#)}}$$

Display ads: calculating online advertising cost

- Example: (Text, P. 341)

An Internet retailer spent \$24,000 on online advertising and generated 1.2 million impressions, which led to 20,000 clicks, with 1 in 10 clicks resulting in a purchase. Find the cost per impression, cost per click and cost per order.

Display ads: calculating online advertising cost

- Example: (Text, P. 341)

An Internet retailer spent \$24,000 on online advertising and generated 1.2 million impressions, which led to 20,000 clicks, with 1 in 10 clicks resulting in a purchase. Find the cost per impression, cost per click and cost per order.

Answer

Cost per impression = $24,000 / 1,200,000 = \$0.02$ or 2 cents

Cost per click = $24,000 / 20,000 = \$1.20$

Number of orders = 10% of 20,000 = 2000

Cost per order = $24,000 / 2000 = \$12$

- Is this ad worth it if the contribution margin from an order is \$20?
- How will you evaluate the effectiveness of ads which are intended to build awareness/brand loyalty or generate leads or bring in contractual customers?

Paid Search Advertising (PSA)*

- Displaying advertisements when consumers search for specific keywords in search engines such as Google and Bing
- By paying and displaying advertisements at prominent positions (typically before organic search results), brands can generate more clicks than from simply relying on organic search (where they could get lost in the volume of information displayed)
- Unique feature of PSA is that it targets customers who face a need, right at the moment they express an interest on a product (by searching for the product)
- Unlike traditional (push) advertisement, PSA (pull) don't have to generate need and consumer demand. As a result return on investment would be high when a company that has the right product and can deliver the right advertisement
- However, PSA can capture only existing demand and may not generate new demand. So, it will be less effective for totally new products

* Adopted from "Cutting Edge Marketing Analytics" by Venkatesan, Farris and Wilcox (2015)

Paid search advertising – Cost Per Click bid

- Paid search advertising works on the basis of cost-per-click (CPC) bid, in which advertisers bid for the highest amount they are willing to pay for a click
- Search engine will assign a rank to each advertisement based on the CPC bid and the quality score of the ad (an estimate of how likely an ad will generate a click, based on how relevant the keywords, ad and the landing page are)
- Advertisers can set limits on how much they want to spend on a day
- Success of PSA (i.e. high click through rate and conversion) depends on targeting the right key words, delivering the right ad (which will generate interest and is relevant to the user's search) to the right customer at right time (e.g. weekends when people are more likely to buy)
- Right customers can be identified based on the customer life time value, profitability, conversion rate etc. and targeted based on what they search for

Paid search advertising – Cost Per Click bid*

- The key decision in PSA is determining how much to bid - Google has an enhanced system which allows advertisers to have a base bid (e.g. \$1), which can be increased/decreased by a factor (e.g. 50%) based on the device (e.g. \$1.50 for mobile searches), location (e.g. \$1.20 for customers close to the store), customer type (e.g. \$1.30 for high value customers) and day/time (e.g. \$0.8 for weekday late nights)
- Google search engine bidding algorithm:

Brand	CPC bid	Quality score	Rank score	Rank	Actual CPC
JB Hi-Fi	\$0.50	2	1.00	1	0.31
Harvey Norman	\$0.60	1	0.60	2	0.51
Kogan	\$1	0.5	0.50	3	0.01

Rank score = CPC bid * Quality score. Rank is assigned to ads based on their rank score
 Actual cost per click = (Rank score of the next highest rank ad) / Quality score + 0.01

* Adopted from "Cutting Edge Marketing Analytics" by Venkatesan, Farris and Wilcox (2015)

Social media metrics

What is social media?

"Group of internet based applications that build on the ideological and technological foundations of web 2.0 and that allow the creation and the exchange of user-generated content"

Kaplan and Haenlein (2010)

- The key difference between social media marketing and other forms of online media is user participation and 'user generated content'
- Web 2.0 enabled internet to become a two way medium allowing users to participate

E.g. social community (Facebook, Twitter), social publishing (blogs, YouTube), social entertainment (Second Life, MySpace), social commerce (TripAdvisor, Ozbargain)

Social media metrics

- What to measure?
 - Goals should drive your metrics
- What are your social media goals?
 - Increase awareness/reach - Awareness metrics
 - Build brand equity/loyalty - Engagement metrics & consumer sentiment
 - Improve customer satisfaction - Consumer sentiment
 - Competitive position - Share of voice
 - Market research/identify trends - Monitoring trends and listening to online conversations



Social media: Awareness (reach) metrics

- Reach of a brand in social media
 - No. of followers, friends, page views etc. for a brand's social media page
 - Easy to measure: most social sites have analytics which allow users to track these metrics
- **Caution!**
 - Awareness metrics such as no. of followers etc. are indicative of popularity and not content consumption
 - Engagement metrics such as likes, re-tweets etc. are stronger measures of consumption, but are also dependent on content quality (not just on the brand)

Social media: Engagement metrics

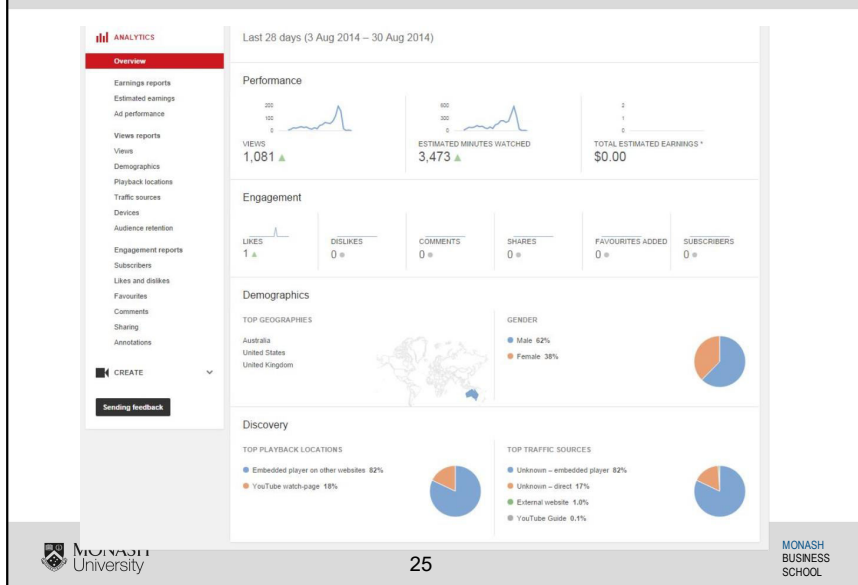
- Extent to which a consumer has a meaningful brand experience when exposed to a marketing message
- Engagement occurs when somebody cares and interacts
- Basic engagement metrics (for campaigns)
 - Likes / comments / shares / re-tweets / clicks / ratings / views
- Reach and engagement metrics are particularly useful when compared against a benchmark such as competitors' performance or past performance



Social media: Awareness and engagement in Facebook



Social media: Awareness and engagement in YouTube



Social media: Consumer sentiment

- **Sentiment:** an attitude, thought, or judgment prompted by feeling
- Each piece of discussion (comment/thread/tweet) is given a quantitative rating based on its
 - Polarity (positive, neutral, negative)
 - Intensity (degree of emotion)
- <https://www.danielsoper.com/sentimentanalysis/default.aspx>
- Sentiment is a measure of relative extent of positivity and negativity in the discussions
- Caution: automated sentiment analysis may not decipher human emotions (e.g. sarcasm) accurately (although tools are becoming better)

Social media: Share of voice

- Total brand conversations in social media relative to competitors
- Several online tools allow users to measure brand mentions, trends, sentiment etc. for range of topics/products
 - This allows brands to calculate their share of online discussions relative to competitors
 - Note that several social sites and metrics can be accessed only by the 'owner' of the content (e.g. YouTube demographics, audience engagement etc. are not public)

Social media: Share of Voice through Google trends

- Captures interest on a topic on the basis of Google searches for it
<https://www.google.com/trends/>
- Can be used to capture brand searches/mentions (a measure of awareness)
 - Index which indicates the proportion of searches for a term in Google relative to the highest proportion of searches for the term (doesn't give the actual proportions, but an index relative to the maximum)
- Allows comparison of up to 5 terms or regions, and available since 2004
- Useful in comparing interest for brand/brands across regions, over time and for analysing changing trends over time
- Caution: Popularity doesn't mean it is positive!

Social media listening

- **Trend monitoring**
 - Monitoring trends in reach, engagement and sentiment etc.
- **Observational research** (passive approach)
 - Recording residual behaviour from comments / discussion threads etc.
- **Netnography (online Ethnography)**
 - Unobtrusive systematic observation of online consumer behaviour using ethnographic approaches (typical sources include forums, bulletin boards, chat rooms)
- **Content analysis**
 - Search for themes / concepts in online discussions
- **Caution!**
 - Online sample is essentially a convenience sample. Findings will not be meaningful if the online community is not representative of the brand consumer demographics

Business problems:

- How to evaluate the outcomes of online advertising campaigns?

What you learnt this week:

- Web analytics metrics
- Banner/display advertising metrics
- Paid search advertising metrics
- Social media metrics
- Share of Voice & consumer sentiment

Marketing Decision Analysis

Week 9

Marketing and Finance

Why is understanding the financial impact of marketing actions important?

<http://www.youtube.com/watch?v=q9qptiwsUi0>

Business problems:

- How to calculate the return on investment?
- How to identify the optimal level of marketing investment?

What you will learn this week:

1. Return on Marketing Investment (ROMI)
2. Incremental ROMI
3. Optimal Investment Theory
4. Profitability Comparisons

Profit (\$) and ROS (%)

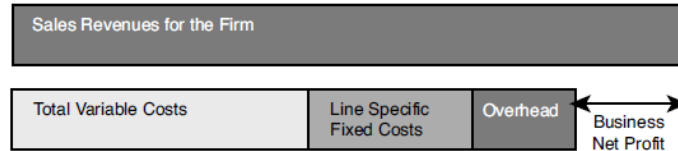
$$\text{Net Profit (\$)} = \text{Sales revenue (\$)} - \text{Total costs (\$)}$$

- Net profit is also referred to as 'net earnings', 'net income' and 'bottom line'

$$\text{Return on Sales (\%)} = \frac{\text{Net Profit (\$)}}{\text{Sales Revenue (\$)}}$$

- ROS is simply the % of sales revenue that gets "returned" to the company as profits
- It can be viewed as a measure of "profitability" and "efficiency" of a firm
- ROS is typically measured at firm level, and is particularly useful for financial reporting when a firm has multiple divisions

Return on Sales



Simple View of Business – Revenues and Costs

- For firms with multiple divisions (lines), overheads associated with the overall firm (e.g. headquarters staff) cannot be directly tied to any one specific division
- Size of different divisions could also differ widely; division level profitability might not give a clear picture of overall firm profitability (particularly to investors!)
 - E.g. Coles supermarket vs. Target vs. Officeworks vs. Kmart
- So, how does a firm like Wesfarmers report its overall performance to its investors?
 - ROS captures the overall performance of a firm, taking different divisions and overheads into account

<http://www.wesfarmers.com.au/investor-centre/company-performance-news/reports>

Profitability Comparison using ROS

- ROS is an indicator of profitability and it allows us to compare the profitability of firms of different sizes and with multiple divisions

The Coca-Cola company

Sales = \$44.3 billion
Net profit = \$7.3 billion
ROS (%) = 16.5%

PepsiCo

Sales = \$63.06 billion
Net profit = \$5.4 billion
ROS (%) = 8.6%

- Which of these two firms is operating more efficiently?
- What can a firm do to increase its ROS?
- What are some of the limitations of ROS?
 - ROS doesn't take the capital investment into account
 - It doesn't account for future performance (e.g. ROS may be lower for a firm like Facebook till its penetration reaches a critical mass)

EBITDA (\$)

- Earnings Before Interest, Taxes, Depreciation and Amortization

$$\text{EBITDA} = \text{Net Profit (\$)} + \text{Interest Payments (\$)} + \text{Taxes (\$)} + \text{Depreciation and Amortization Charges (\$)}$$

- A rough measure of operating cash flow
 - Tries to reverse effect of accounting, financing & tax policies on profits
 - Used to assess the operating profit of a business
 - Reduces managers' ability to change reported profits by choice of accounting rules
 - Popular measure of financial performance

Return on Investment (ROI)

$$\text{ROI (\%)} = \frac{\text{Net Profit (\$)}}{\text{Investment (\$)}}$$

- ROI measures profitability adjusted for total investment
- Marketing decisions influence both the numerator (net profit) as well as the denominator (e.g. through new plants and equipments, inventories etc.) in the ROI formula
- Other related metrics such Return on Assets (ROA), Return on Capital (ROC) etc. differ slightly from ROI in terms of how investment (denominator) is defined

<https://www.stock-analysis-on.net/NASDAQ/Company/Apple-Inc/Ratios/Profitability>

Evaluating Multi-period investments

- ROI doesn't account for future returns from an investment
- Evaluation of investments that produce returns over multiple time periods should consider both the magnitude and timing of the returns

Payback (#): # of periods required to “pay back” (i.e., return) the initial investment

Net Present Value, NPV (\$): The discounted value of future cash flows minus the initial investment

Internal Rate of Return, IRR (\$): The discount rate that results in an NPV of zero

Payback

- Years (time) required to generate the (undiscounted) cash flow to recover the initial investment
- Shorter payback periods have less uncertainty around receiving returns, allow resources to be re-used/re-invested quickly and are generally recorded more favourably
- Payback period ignores all cash flow after payback period - projects that produce benefits for a longer term tend to appear less valuable than they are using this measure

Example: Harry is considering buying a small chain of hair dressing salons for \$50,000. He estimates that the salons will produce a cash flow of \$15,000 a year for at least 5 years.

$$\text{Harry's payback period} = \$50,000 / \$15,000 = 3.33 \text{ years}$$

Net Present Value (NPV)

- NPV is the present (discounted) value of future cash flows associated with an investment minus the present value of the investment

$$\text{Net Present Value (\$)} = \sum_{t=1}^n \frac{\text{Cash Flow (\$)}}{(1 + \text{Discount Rate (\%)})^t} - \text{Initial investment where } t \text{ is the number of periods}$$

- Thus, NPV accounts for the fact that future cash flow is less valuable than money received today and there is an inherent risk in future cash flows

Example: Harry invests \$50,000 in a small chain of hair dressing salons which are expected to produce a cash flow of \$15,000 per year for the next 5 years. He decides that 10% discount rate is appropriate for this investment. What is his NPV?

$$\text{NPV} = (\$15,000 / (1+0.1)) + (\$15,000 / (1+0.1))^2 + (\$15,000 / (1+0.1))^3 + (\$15,000 / (1+0.1))^4 + (\$15,000 / (1+0.1))^5 - \$50,000 = \$6,862$$

Internal Rate of Return (IRR)

- The discount rate for which the NPV of an investment is zero
- IRR is the percentage return made on an investment over a period of time
- Firms typically have an internal threshold rate of return (called 'Hurdle rate'). If IRR > Hurdle rate, then they would go ahead with that investment
- IRR can be calculated using a software package (e.g. Excel has IRR function)

Example: Harry invests \$50,000 in a small chain of hair dressing salons which are expected to produce a cash flow of \$15,000 per year for the next 5 years. He decides that 10% is the hurdle rate for his investment. Should he go ahead with this investment?

Using Excel, IRR = 15.24%. This is higher than the hurdle rate and so, he should go ahead with the investment.

Return on Marketing Investment (ROMI)

$$\text{ROMI (\%)} = \frac{\text{Gross margin} - \text{Marketing investment}}{\text{Marketing investment}}$$

Gross margin = Revenue – Cost Of Goods Sold (COGS)



- Here, revenue refers to the additional revenue generated as a result of marketing investment
- Gross margin should capture other costs such as promotional discounts, customer service expenses etc. if they are incurred
- Note that future impact of marketing investments is not included in this formula

Return on Marketing Investment

Example:

- A company is considering whether to invest in a customer acquisition initiative costing \$1 million.
- The first stage of the initiative is to develop technology to identify prospects at a cost of \$500,000.
- The second stage is to implement marketing campaign at a cost of \$500,000. It is projected that the gross margin from the initiative will be \$1.4 million.

a) What is the ROMI for this initiative?

$$\text{ROMI} = (1,400,000 - 1,000,000) / (1,000,000) = 40\%$$

b) If the ROMI threshold or the hurdle rate at which the company makes investments is 25%, should the investment be funded?

Return on Marketing Investment

- ROMI can be used to compare investment options against one another (to identify the best option) and against hurdle rate (to decide whether to go ahead with an investment)
- The other way to evaluate an investment would be to calculate the gross margin needed to meet the hurdle rate and see if the investment can meet that gross margin
- Gross margin that is needed to meet target ROMI (hurdle rate) can be calculated using

$$\text{Gross Margin} = \text{Marketing Investment} * (\text{ROMI} + 1)$$

Example:

What gross margin is needed to meet a 25% hurdle rate on a \$60,000 budget for a promotional campaign?

$$\text{Gross margin} = \$60,000 * (0.25 + 1) = \$75,000$$

Example continued

- A company is considering whether to invest in a customer acquisition initiative costing \$1 million.
- The first stage of the initiative is to develop technology to identify prospects at a cost of \$500,000. The second stage is to implement marketing campaign at a cost of \$500,000.
- It is projected that the gross margin from the initiative will be \$1.4 million. Assume that the hurdle rate is 25%.
- Suppose the first stage was completed on budget, however new projections estimate a revised gross margin of only \$800,000
 - Should they invest in the second stage?
 - Does your answer change if expected cost of second stage increased to \$700,000?

Incremental ROI

- “Ideally, ROMI calculations measure the return generated by the incremental marketing investment” (Lenskold, 2003)
- View each investment decision on its own merits, irrespective of the consequences of earlier decisions
 - In the example, we should consider the returns from the second stage of the investment only
- Why is this approach suited to marketing?
 - Marketing decisions are often scalable
 - Marketing decisions require flexibility

Example continued

- Suppose the first stage was completed on budget, however new projections estimate a revised gross margin of only \$800,000
 - Should they invest in the second stage?
 - Does your answer change if expected cost of second stage increased to \$700,000?

Answer:

a) Incremental ROMI = $(\$800,000 - \$500,000) / \$500,000 = 60\%$

The company should invest in the second stage as incremental ROMI > hurdle rate

b) Incremental ROMI = $(\$800,000 - \$700,000) / \$700,000 = 15\%$

Since this is less than the hurdle rate, the investment should not be funded

Scalability of Marketing Investment: Example

	Investment levels		
	A	B	C
Marketing investment (\$'000)	500	1,000	1,500
Gross margin (\$'000)	725	1,350	1,875

- Consider a campaign which could have three investment levels with the above projections
- Assume that the hurdle rate is 25%
- Should you invest 500K (level A) or 1M (level B) or 1.5M (level C)?

Scalability of Marketing Investment: Example

- Let's first calculate which of these levels meet the hurdle rate

	Investment levels		
	A	B	C
Marketing investment (\$'000)	500	1,000	1,500
Gross margin (\$'000)	725	1,350	1,875
Return (\$'000)	225	350	375
ROMI	45%	35%	25%

- All three investment levels meet 25% hurdle rate, so we cannot eliminate any
- However, notice that returns are decreasing as we invest more and more money
- So, let's consider the returns from incremental (additional) investments instead of total investments

Scalability of Marketing Investment: Example

- Let's consider the investment sequentially and calculate return from every \$500k increment investment

	Investment increments		
	A	B-A	C-B
Incremental investment (\$'000)	500	500	500
Gross margin (\$'000)	725	625	525
Incremental Return (\$'000)	225	125	25
Incremental ROMI	45%	25%	5%

- So, after investing 1M dollars, the subsequent 500k investment produces only 5% incremental return (which is less than the hurdle rate)

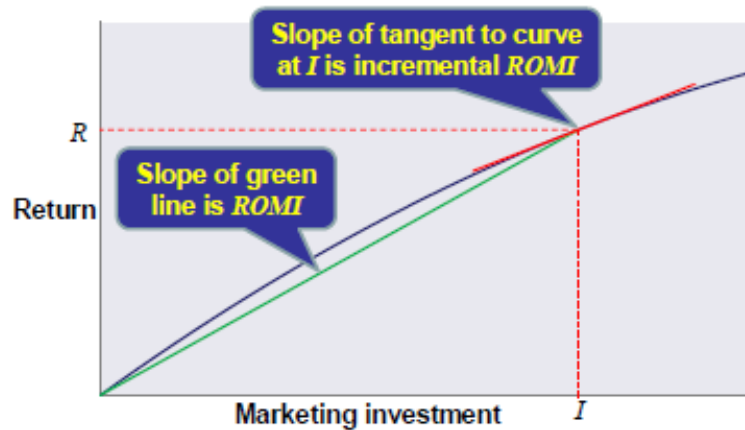
Decision: Scale up to investment level B (i.e. invest 1M dollars)

- If we refine our investment, is there an optimal investment level?

Optimal Investment Theory

- As the example suggests, with every \$ invested, the return on investment increases at a diminishing rate
- In other words, the incremental ROMI associated with each additional \$ invested will decrease
- For an investment level (e.g. \$1M), incremental ROMI (associated with a small increase in investment around that level- \$1k) is given by the slope of the tangent to the Investment-Return curve at that investment level (\$1M)

ROMI Versus Incremental ROMI



Optimal Investment Theory

- At optimal investment level, incremental ROMI will just be equal to hurdle rate
At optimal investment level, Incremental ROMI = H (hurdle rate)
- If ROMI increases linearly with investment I, e.g. $ROMI = a + bI$, then

Optimal investment: $I = (H - a)/2b$

ROMI at optimal investment: $ROMI = (H + a)/2$

Return at optimal investment : $R = (H^2 - a^2)/4b = ROMI * I$

Rationale behind optimal investment level

At optimal investment level, Incremental ROMI = H (hurdle rate)

Incremental ROMI = $\frac{dR}{dI}$ (slope of the Return – Investment curve at I)

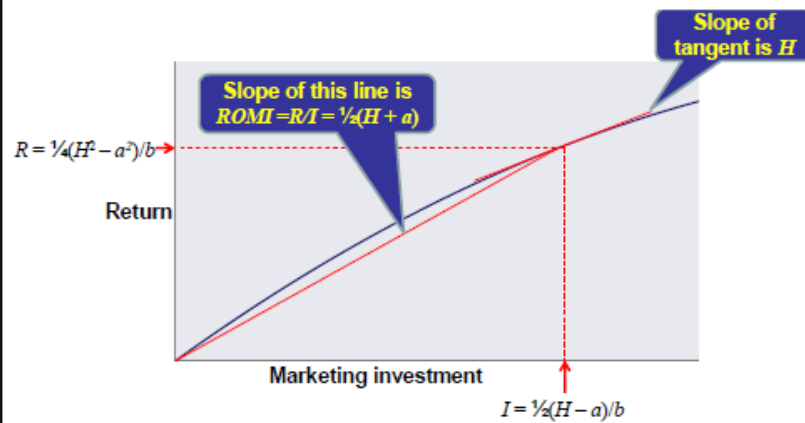
Since $ROMI = a + bI$, $R = I * ROMI = aI + bI^2$

So, incremental ROMI = $a + 2bI$

At optimal level, $a + 2bI^* = H$, so, $I^* = (H - a)/2b$

- ROMI at optimal investment level can be obtained by substituting I^* in $ROMI = a + bI^*$
- Return at optimal investment level can be obtained by multiplying I^* to ROMI at optimal investment level

Optimal Investment – Graphical illustration



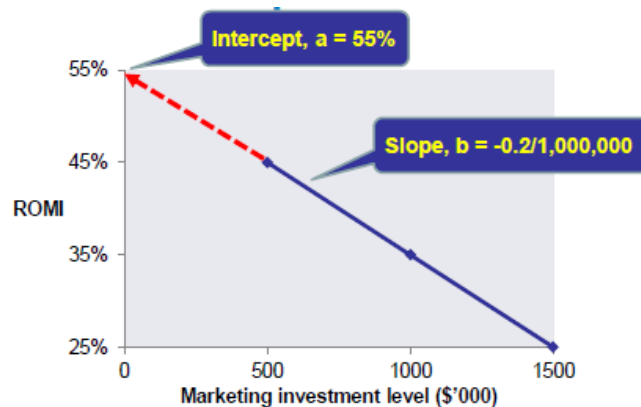
Scalability example revisited

- Find the optimal investment level

	Investment levels		
	A	B	C
Marketing investment (\$'000)	500	1,000	1,500
Gross margin (\$'000)	725	1,350	1,875
Return (\$'000)	225	350	375
ROMI	45%	35%	25%

- The relationship between ROMI and I in this example is linear, i.e., $ROMI = a + bI$
- Intercept 'a' and slope 'b' can be obtained from regression of ROMI on I

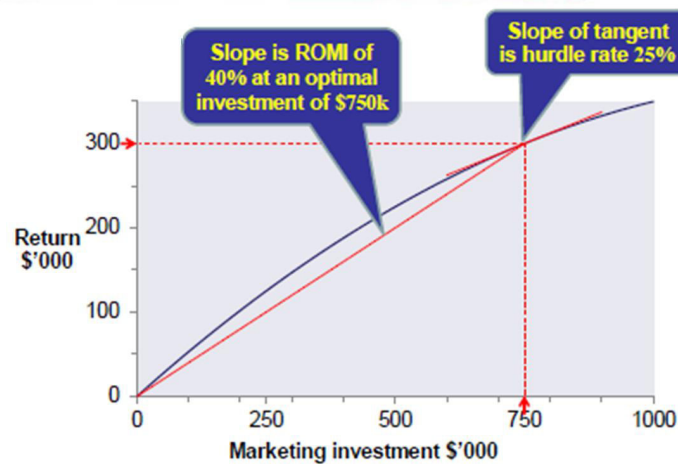
Scalability example



Optimal Investment for the example

Given, $H=0.25$, $a=0.55$, $b=-0.2/1,000,000$

- Optimal investment: $I = (H-a)/2b = (0.25 - 0.55) / (2 \cdot -0.2) = \$0.75M$
- $ROMI = (H+a)/2 = (0.25 + 0.55) / 2 = 40\%$
- Return, $R = I * ROMI = 0.4 * \$0.75M = \$0.3M$



Profitability Comparison

- Scalability example illustrates benefit of making optimal investments
- If we invested all \$1.5M in this campaign, we would generate a return of \$375,000
- But, if we invested \$750,000 in the campaign and the balance in another project that met the hurdle rate, the return would be at least,
$$= \$300K + 0.25 * (\$1,500K - \$750K) = \$487.5K$$

And so add \$112.5K or more to total contribution

Management Implications

- Investment decisions for marketing are best made incrementally (where possible)
- Assessment of each incremental investment should be independent of prior decisions
- Marketers should seek optimal investment levels, as these will result in additional profits
- ROMI methodology can be used by marketers to counter proposed budget cuts

Business problems:

- How to calculate the return on investment?
- How to identify the optimal level of marketing investment?

What you learnt this week:

1. Return on Marketing Investment (ROMI)
2. Incremental ROMI
3. Optimal Investment Theory
4. Profitability Comparisons

Marketing Decision Analysis

Week 10

Profitability and Pricing 1

Customer Profitability

Business problems:

- How to determine the value of a customer?

What you will learn this week:

1. Segmenting customers on the basis of profitability
2. How to measure the dollar value of a customer relationship?
3. How to measure the dollar value of a prospective customer?
4. Acquisition vs. Retention: Determining the right strategy

Customer level profitability

1. From aggregate profitability to more granular measurements



2. Some customer relationships are more profitable than others

Customer level metrics

1. Customers: Number of customers that a firm has during a specified time period

E.g. In June 2014, Vodafone Australia had 5.2 million customers compared to 9.43 million at Optus and 15.8 million at Telstra

2. RFM

Recency: Length of time (e.g. how many months) since a customer last purchased

Frequency: How often does a customer visit the store?

Monetary value: How much does a customer spend in the store?

Insights from RFM metrics

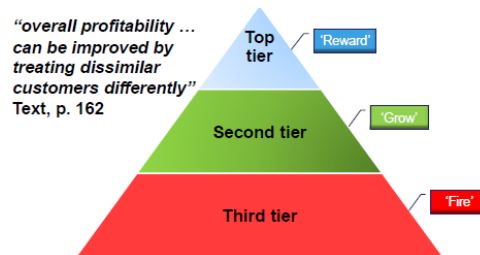
- What can we learn from tracking changes in RFM metrics over time?

% change over time		
Recency	Frequency	Monetary value
↓	0	0
0	↓	0
0	0	↓

Why distinguish customers?

- “Some customers are more equal than others” - Don Peppers and Martha Rogers
- Customer profitability: The difference between the revenues earned from and the costs associated with the customer relationship during a specified period

Customer profitability pyramid



Customer Profitability

- E.g. A catalog retailer has grouped its customers into 10 deciles based on their profitability

Customer decile	Total profits (\$m)	% of total profits	Cumulative profits
0-10%	100	60%	60%
10-20%	50	30%	90%
20-30%	25	15%	105%
30-40%	10	6%	111%
40-50%	5	3%	114%
50-60%	3	2%	116%
60-70%	2	1%	117%
70-80%	0	0%	117%
80-90%	-8	-5%	112%
90-100%	-20	-12%	100%

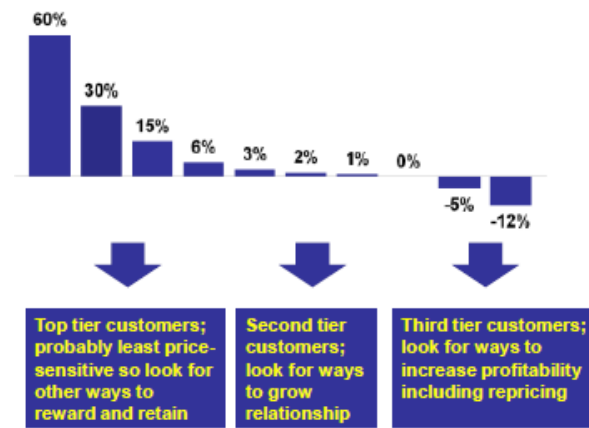
Total Profits = $100 + 50 + 25 + \dots + (-20) = \167 Million

% of Total Profits = $(\text{Profits} / \text{Total Profits}) = 100/167 = 60\%$

Cumulative profits = Sum of profits of deciles = $60\% + 30\% = 90\%$

Customer Profitability

Customer profitability pyramid for the catalog retailer



Customer Lifetime Value (CLV)

- CLV is the present (dollar) value of the projected future cash flows attributed to the customer relationship
- “Whereas customer profit is a metric that summarizes the past financial performance of a customer relationship, CLV looks forward in an attempt to value existing customer relationships”
- It encourages firms to shift their focus from quarterly profits to long term health of their customer relationships and enables marketers to better plan and justify their marketing investments

CLV is becoming more and more important in today's world

- A survey of 255 CMOs and marketing directors from Australia & New Zealand found that those who always measured the lifetime value of customers received 16% increase in their marketing budget (y-o-y), compared to 0% for those who did not
<https://www.cmo.com.au/article/602843/report-sharper-customer-lifetime-value-measurements-attract-bigger-marketing-budgets/>
- A growing number of companies are using CLV to show their firm value to financial markets

<https://www.xero.com/au/about/investors/financial-info/annual-report-2018/the-xero-journey/>

<https://www.asx.com.au/asxpdf/20190221/pdf/442t641s7tvj9j.pdf>

Retention and Attrition rate

- Retention rate is the ratio of number of customers retained (at period's end) to number of consumers at risk (at start)
- Attrition rate = 1 - retention rate
Attrition rate can also be thought of as the probability that a customer will leave a firm

Example		Retention rate = 7000/10,000 = 0.7 or 70%
Number at risk at start of period	10,000	Attrition rate = 1 - 0.7 = 0.3 or 30%
Number of those at risk who are retained at end of period	7,000	
Retention rate	70%	
Attrition rate	30%	

Expected customer lifetime

- For how many years will a customer patronize a firm?
- Assuming a constant retention rate,

$$\text{Expected customer lifetime} = \frac{1}{\text{Attrition rate}} = \frac{1}{1 - \text{retention rate}}$$

Example calculations

Metric	Firm A	Firm B	Firm C	Expected customer Lifetime = 1/(1-0.9) = 10 years
Annual retention rate	90%	80%	50%	
Expected customer lifetime	10 years	5 years	2 years	

Discount rate

- Value of money decreases over time due to inflation and lost interest. Thus, receiving \$10 today is worth more than receiving the same \$10 next year.
- Therefore, value of future money (i.e. money which will be received in the future) should be discounted to find its present value

$$\text{Value of money in year (t)} = \text{value of money in year (t+1)} / (1 + \text{discount rate})$$

Examples

- If the discount rate per year is 10%, getting \$10 next year is equivalent to getting \$9.09 [$10 / (1 + 0.1)$] this year.
- Conversely, a \$10 this year is equivalent to \$11 ($\$10 * (1 + 0.1)$) next year.

$$\text{Present (2020) value of money that will be received in 2022} = (\text{money received in 2022}) / (1 + \text{discount rate})^2$$

Customer Lifetime Value (CLV) over 'n' years

- CLV is the present (dollar) value of the projected future cash flows attributed to the customer relationship
- If 'c' is the contribution (margin) from a customer, 'r' is the retention rate and 'd' is the discount rate, then the CLV of that customer over 'n' years is given by,

CLV over n years = contribution in year 1 + discounted future contribution in year 2 + + discounted future contribution in year n

$$\text{CLV over n years} = c + c * [r / (1+d)] + c * [r / (1+d)]^2 + c * [r / (1+d)]^3 + \dots + c * [r / (1+d)]^{(n-1)}$$

- We adjust for retention rate because every year the customer has (1 – retention rate) probability of leaving the company

Customer Lifetime Value (CLV) over 'n' years

- Note that we have assumed that payments are received at the start of the contract period (e.g. year), and hence discounting starts from period 2.
- If payments are received at the end of the contract period, then,

$$\text{CLV over n years} = c * [r / (1+d)] + c * [r / (1+d)]^2 + c * [r / (1+d)]^3 + \dots + c * [r / (1+d)]^n$$

- CLV represents the upper limit on spending to acquire new customers as well as the upper limit on the amount firms will be willing to pay to avoid losing a customer
- Value of a firm = Number of customers * CLV

CLV – Example

- Melbourne based marketing consultancy firm Melcon offers annual consumer insight analysis to its clients. It charges a service fee of \$30,000, paid at the start of a year, and has 200 clients. The company spends \$20,000 on average on servicing each client. If Melcon's retention rate is 97.5% and the discount rate is 10%, calculate the CLV of Melcon's customers over a period of 4 years.

Soln: Retention rate = 0.975 Discount rate = 0.1
Avg. Margin per client = \$30,000 - \$20,000 = \$10,000

Margin in year 1 = \$10,000

Margin in year 2 = \$10,000 * (0.975/(1+0.1)) = \$8863

Margin in year 3 = \$10,000 * (0.975/(1+0.1))² = \$7856

Margin in year 4 = \$10,000 * (0.975/(1+0.1))³ = \$6964

CLV over 4 years = \$10,000 + \$8863 + \$7856 + \$6964 = \$33,684

CLV over the entire lifetime of a customer

- CLV over the entire lifetime of a customer (infinite time period instead of finite period) is given by,

$$CLV = \text{Margin} * \frac{\text{retention rate}}{1 + \text{discount rate} - \text{retention rate}}$$

- We assume here that payments are made in arrears i.e. at the end of a contract term (year)
- If we payments are made in advance (at the start of a contract term) or if there is an initial margin (e.g. margin from sign-up fee), then,

$$CLV = \text{Initial margin} + \text{Margin} * \frac{\text{retention rate}}{1 + \text{discount rate} - \text{retention rate}}$$

- CLV = Margin/discount rate when 100% retention

CLV – Assumptions

- Constant margins
 - Do all customers have same margins?
 - Do margins remain same over time?
- Constant retention rate
 - How will the retention rate change when consumers “try” and “evaluate” a new product?
- Constant discount rate
 - What if the economy changes?
- If a customer is not retained, then that customer is lost for good
 - What if customers come back?

Prospect Lifetime Value (PLV)

- PLV is the expected value of a prospect i.e. a new customer to a firm
 $PLV = \text{Profit expected from the prospect} - \text{Cost of prospecting}$

Acquisition rate: Proportion of targeted customers that the firm expects to acquire

Acquisition spending: Expenditure associated with acquiring a prospect

$$PLV = \text{Acquisition rate} * CLV - \text{Acquisition spending per prospect}$$

- If $PLV > 0$, acquisition spending is a profitable investment; if < 0 , it is not a wise investment
- Note that acquisition spending is the acquisition expenditure **per customer prospect** (targeted for prospecting, not every customer acquired)

Acquisition vs. Retention

$$\text{Average acquisition cost} = \frac{\text{Acquisition spending (\$)}}{\text{Number of customers acquired (\#)}}$$

$$\text{Average retention cost} = \frac{\text{Retention spending (\$)}}{\text{Number of customers retained (\#)}}$$

Example:

During the past year, a regional pest control service firm spent \$1.4 million and acquired 64,800 new customers. Of the 154,890 past customers, 87,957 remained with the firm after an investment of \$500,000 for retention. Calculate the acquisition vs. retention cost.

$$\text{Avg. Acquisition cost} = 1400000 / 64800 = \$21.60$$

$$\text{Avg. Retention cost} = 500000 / 87957 = \$5.68$$

CLV with retention costs

$$\text{CLV} = (\text{Margin} - \text{retention cost}) * \frac{\text{retention rate}}{1 + \text{discount rate} - \text{retention rate}}$$

Comparing acquisition vs. retention strategies:

Total firm value under retention strategy = No. of existing customers * updated CLV
(i.e. CLV with updated retention cost and margin)

Total firm value under acquisition strategy = No. of customer targeted * PLV + No. of existing customers * CLV (original)

Business problems:

- How to determine the value of a customer?

What you learnt this week:

1. Segmenting customers on the basis of profitability
2. How to measure the dollar value of a customer relationship?
3. How to measure the dollar value of a prospective customer?
4. Acquisition vs. Retention: Determining the right strategy

Week 11

Profitability and Pricing 2

Pricing Strategy

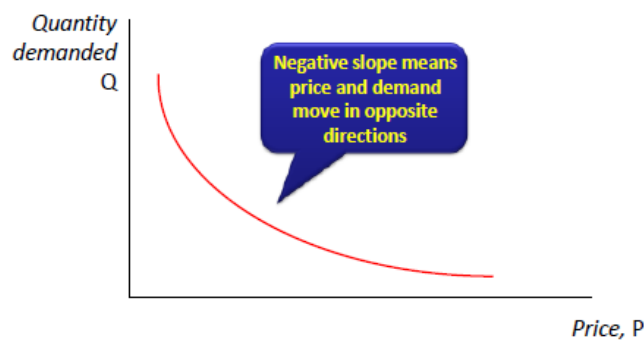
Business problems:

- How to estimate the sales outcome of a price change?

What you will learn this week:

1. How to estimate the change in demand when a firm changes its price?
 - Demand curve
 - Price elasticity
 - Linear demand model
 - Constant elasticity demand model
2. How to estimate the change in demand when competitors react to the firm's price change?
 - Residual price elasticity

Demand curve



$$\text{Slope of the demand curve} = \frac{dQ}{dP}$$

Reservation price and consumer surplus

- Reservation price is the maximum price at which a customer will buy the product
 - Each customer has their own price ceiling for a product, beyond which they will not buy the product
 - Reservation price represents the maximum willingness to pay for a customer
 - A consumer's reservation price is an approximation of the total utility or benefit that a good offers to that consumer
- Consumer surplus is the difference between a consumer's reservation price and the price paid by that consumer
- Total surplus in a market is the sum of surpluses of all consumers in the market

Demand curve from reservation price

- If we know the reservation prices, we can find the quantity that will be demanded at different prices and plot it to get demand curve

Example: Suppose if there are 5 customers (1,2,3,4,5) in the market with reservation prices of \$20, \$30, \$50, \$60 and \$80 respectively. Then how many units will a firm sell at different prices?

Price	Quantity Sold (Demanded)
\$20	5
\$30	4
\$40	3
\$50	3

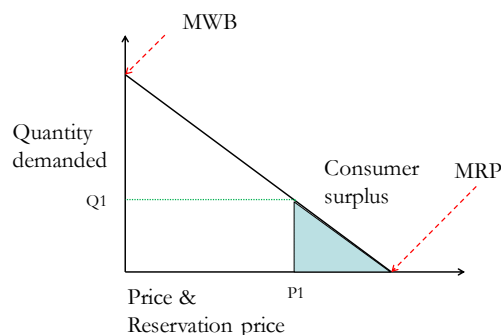
If the price is \$30, then all consumers whose reservation prices are $\geq \$30$ (2,3,4,5) will buy the product.

If the product's price is \$30, then, the surplus of consumer 4 is $\$60 - \$30 = \$30$

Total surplus in this market = $(\$20) + (\$30) + (\$50) = \100

Demand curve from reservation price

- Maximum Reservation Price (MRP): Least price at which demand is zero
- Maximum Willingness to Buy (MWB): Expected demand if the product is free



Price elasticity

- Measure of market reaction to price change
- Price elasticity is the % change in demand relative to a small % change in price

Example: If a 1% increase in current price produces a 2% decrease in demand, the elasticity is then -2

- Product is price elastic if the price change has a relatively large effect on demand. E.g. Jewelry
- Product is in-elastic if the price change has little or no effect on demand. E.g. Petrol

Price elasticity

$$\text{Price elasticity} = \frac{\% \text{ Change in quantity}}{\% \text{ Change in price}}$$

- Price elasticity is negative for all products other than Giffen (inferior) and Veblen (status-seeking) goods

If, $|PE| < 1$, then the demand is price inelastic

$|PE| = 1$, then the demand is unitary elastic

$|PE| > 1$, then the demand is price elastic

Where $|PE|$ is the absolute value (magnitude) of price elasticity

- Price elasticity depends on the current price or the point at which it is calculated (except in the case of constant elasticity model)
- Therefore, defined for a “small” % change at current prices

Example

- Current price of a product is \$3 and the demand is 60,000 units. If the price elasticity is -2.5, what is the demand expected when the price is increased to \$3.18

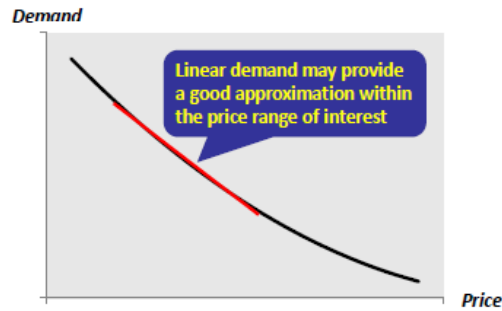
$$\% \text{ change in price} = (\$3.18 - \$3) / \$3 = 6\%$$

$$\begin{aligned} \% \text{ change in Quantity} &= \text{Price elasticity} * \% \text{ change in price} \\ &= -2.5 * 6 = -15\% \end{aligned}$$

$$\text{Change in quantity} = -15\% * 60,000 = -9,000 \text{ units}$$

$$\text{New quantity} = 60,000 - 9,000 = 51,000 \text{ units}$$

Linear demand

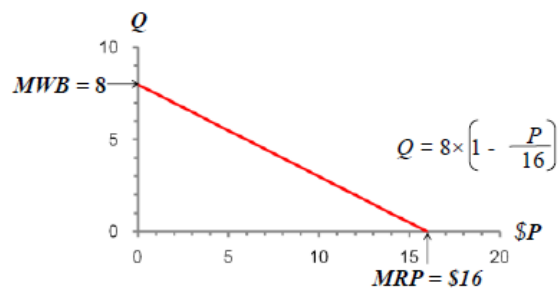


- “Locally linear” approximation: Even non-linear demand curves can be approximated with a straight line within a small region or neighborhood (for a limited range of prices)

Linear demand

- Quantity sold (Q) at any given price (P) in a linear demand curve is given by,

$$Q = (MWB) * \left[1 - \frac{P}{MRP} \right]$$



Linear Demand

- Quantity sold (Q) at any given price (P) in a linear demand curve is given by,

$$Q = (MWB) * \left[1 - \frac{P}{MRP} \right] = MWB - \left(\frac{MWB}{MRP} \right) * P$$

This relationship is same as the linear equation: $Q = a + b * P$

Here $a = MWB$ (Intercept)

and $b = -(MWB / MRP)$ (Slope)

Example:

Erin sells 10 units of Coke at \$0. Demand falls to zero when the price is \$5. How many units will be sold at \$3?

Linear demand

- We can determine the entire demand curve from just two prices and the corresponding quantities
- This is because a straight line has the same slope at every point, and if we know two points, we can extrapolate and get the whole line!

$$MWB = Q_1 - \left[\frac{Q_2 - Q_1}{P_2 - P_1} \right] * P_1$$

$$MRP = P_1 - \left[\frac{P_2 - P_1}{Q_2 - Q_1} \right] * Q_1$$

Example:

If a firm sells 5 units at \$90 and 3 units at \$110 and the demand is linear then,

$$MWB = 5 - (-2/20)*90 = 14$$

$$MRP = \$90 - (20/-2)*5 = \$140$$

$$Q = 14 * [1 - (P/140)]$$

Price elasticity of linear demand

- Elasticity at price P_1 is given by,

$$\text{Elasticity}(\epsilon) = \frac{(\frac{\Delta Q}{Q})}{(\frac{\Delta P}{P})} = \left[\frac{Q_2 - Q_1}{P_2 - P_1} \right] * \frac{P_1}{Q_1}$$

$$\epsilon = \text{slope} * \frac{P_1}{Q_1} = - \left[\frac{MWB}{MRP} \right] * \frac{P_1}{Q_1}$$

Price elasticity of linear demand

- Example: Suppose the slope of demand curve is -20, then

Price	Quantity Sold (Demanded)	Price/Quantity	Slope	Elasticity
\$8	100	0.08	-20	-1.6
\$9	80	0.11	-20	-2.25
\$10	60	0.17	-20	-3.33

$$\text{Elasticity} = \text{slope} * (\text{price} / \text{quantity}) = -20 * 0.08 = -1.6$$

Optimal price for linear demand

- Optimal price is the most profitable price for a product i.e. the price that will generate the maximum contribution by the product after deducting its variable costs
- If a product is priced too low, then we lose revenues from customers who are willing to pay more for the product i.e. we lose the consumer surplus
- If the price is set too high, then we risk facing low demand and losing people who could have been served profitably

Optimal price for linear demand

- Suppose, variable cost (v) = \$1 MRP = \$5 MWB = 5
- For every dollar decrease in price, 1 additional unit is demanded

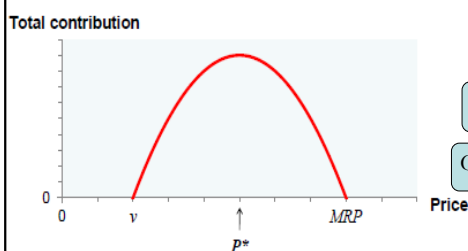
Price	Quantity Sold (Demanded)	Variable cost	Contribution on per unit	Total contribution to profit
\$0	5	\$1	-\$1	-\$5
\$1	4	\$1	\$0	\$0
\$2	3	\$1	\$1	\$3
\$3	2	\$1	\$2	\$4
\$4	1	\$1	\$3	\$3
\$5	0	\$1	\$4	\$0

Contribution per unit = Price - VC
= \$0 - \$1 = -\$1

Total contribution = Contribution per unit * Quantity
= -\$1 * 5 = -\$5

Optimal price for linear demand

$$\text{Total contribution} = (P - VC) * Q$$



$$P^* = [MRP + \text{variable cost}] / 2$$

$$\text{Gross Margin}(\%) = -1 / \text{Elasticity at } P^*$$

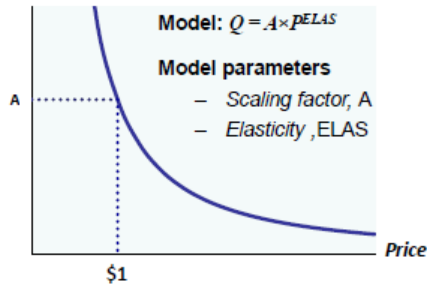
$$\text{Contribution}^* = (MWB / MRP) * (P^* - VC)^2$$

Optimal price is the mid-point between maximum reservation price (MRP) and variable cost

Constant Elasticity Demand

- In this demand model, elasticity is constant while the slope changes at every point
 - A small % change in price will cause the same % change in quantity regardless of the price

Demand



$$\text{Elasticity} = \frac{\ln(\frac{Q_2}{Q_1})}{\ln(\frac{P_2}{P_1})}$$

Impact of a price change

- With a constant elasticity demand curve, when the price changes from P_1 to P_2 , the new quantity demanded (Q_2) will be,

$$Q_2 = \left(\frac{P_2}{P_1}\right)^{ELAS} * Q_1$$

Example:

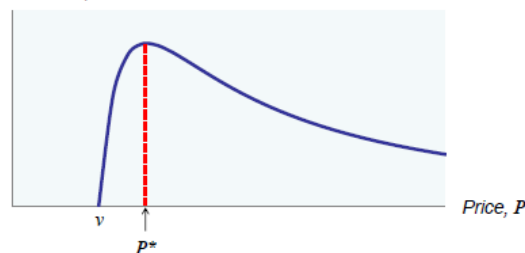
Suppose the current demand is 60,000 units at a price of \$3. What will be the new demand if the price is increased to \$3.18. Assume a constant elasticity of -2.5.

$$Q_2 = (3.18/3)^{-2.5} * (60000) = 51,866$$

Optimal pricing when elasticity is constant

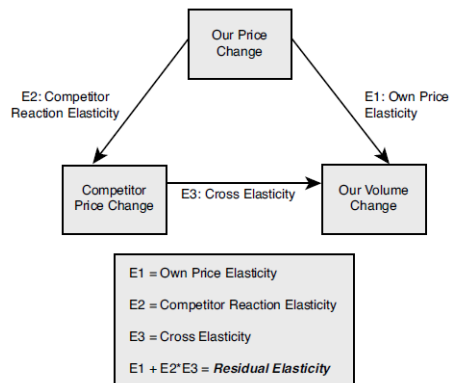
$$P^* = \text{variable cost} * \frac{ELAS}{1 + ELAS}$$

Total contribution, TC



Residual price elasticity

- Customer's price response in the market place is influenced not just by our own price, but also by that of our competitors



Competitor reactions might **amplify, diminish or reverse** the direction of change in sales that was expected from the initial price change

Residual price elasticity

- Own price elasticity (E1): Change in units sold due to changes in a firm's own price (when there is no change in competitor's price)

$$E1 = \frac{\% \text{ change in quantity sold}}{\% \text{ change in own price}}$$

- Competitor reaction elasticity (E2): Change in competitor's price due to changes in a firm's own price

$$E2 = \frac{\% \text{ change in competitor's price}}{\% \text{ change in own price}}$$

- Cross elasticity (E3): Change in units sold by the firm due to changes in its competitor's price (when there is no change in own price)

$$E3 = \frac{\% \text{ change in quantity sold}}{\% \text{ change in competitor's price}}$$

Residual price elasticity

$$\text{Residual Price Elasticity} = \text{Own price elasticity} + [\text{Competitor reaction elasticity} \cdot \text{Cross elasticity}]$$

$$\text{Change in sales (\%)} = \text{Own price change (\%)} \cdot \text{Residual price elasticity}$$

Example:

A company decides to reduce the price by 10%. Its own price elasticity is -2, competitor reaction elasticity is 1 and the cross-price elasticity is 0.7. By how much % will its sales increase?

$$\text{Residual elasticity} = -2 + (1 \cdot 0.7) = -1.3$$

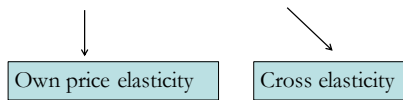
$$\text{Sales increase (\%)} = -10\% \cdot -1.3 = 13\%$$

If there were no competitors, then, sales increase = $-2 \cdot -10\% = 20\%$

Computing elasticities using regression

- Own price, cross price and reaction elasticities can be computed using logarithmic regression analysis.

$$\log(\text{sales}) = \beta_0 + \beta_1 \log(\text{own price}) + \beta_2 \log(\text{competitor's price}) + \xi$$



$$\log(\text{competitor's price}) = \beta_0 + \beta_1 \log(\text{own price}) + \xi$$

Reaction elasticity

Some insights...

- Knowledge of price elasticity can help marketers make better pricing decisions
- Linear demand curve may be reasonable approximation to actual price-demand curve. If so, there is a simple rule for finding the optimal price
- Constant elasticity demand curve has an optimal price when the magnitude of elasticity > 1
- Residual price elasticity incorporates competitor response to own price changes and is likely to give a more realistic estimate of eventual impact of own price changes

Business problems:

- How to estimate the sales outcome of a price change?

What you learnt this week:

1. How to estimate the change in demand when a firm changes its price?
 - Demand curve
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2. How to estimate the change in demand when competitors react to the firm's price change?
 - Residual price elasticity

Week 12

Profitability and Pricing 3

Margins and Profits

Business problems:

- How to find out whether a business will make profits (break-even) and if so, when?

What you will learn this week:

1. Margins
2. Fixed and Variable costs
3. Break-even and contribution analysis
4. Target volume and revenue

Margin

Unit margin (\$) = Selling price per unit (\$) – Cost per unit (\$)

$$\text{Margin(\%)} = \frac{\text{Unit margin (\$)}}{\text{Selling price per unit (\$)}}$$

Example:

Cost per unit of Ipad2 = \$333*

Unit margin = \$500-\$333 = \$167

Selling price of Ipad2 = \$500

% Margin = 33.4%

- Will a firm sell below its cost price?

- Amazon Kindle Fire's cost price = \$210

- Unit margin = -\$11

Selling price = \$199

% Margin = -0.5%

- Why does a firm sell below its cost price?

*Bloomberg news

Average Sales Margin

- Firms use average % margin when selling multiple products

$$\text{Avg. Margin(\%)} = \frac{(\text{Total sales(\$)} - \text{Total cost (\$)})}{\text{Total sales (\$)}}$$

- Example:

	2 litre Coke bottles	1.25 litre coke bottles	Total
Unit sales	240	600	
Selling price (\$)	2.50	1.50	
Total sales (\$)	600	900	1500
Cost price (\$)	1	0.50	
Total cost (\$)	240	300	540
Dollar margin (\$)	360	600	960
% Margin	60%	67%	64%

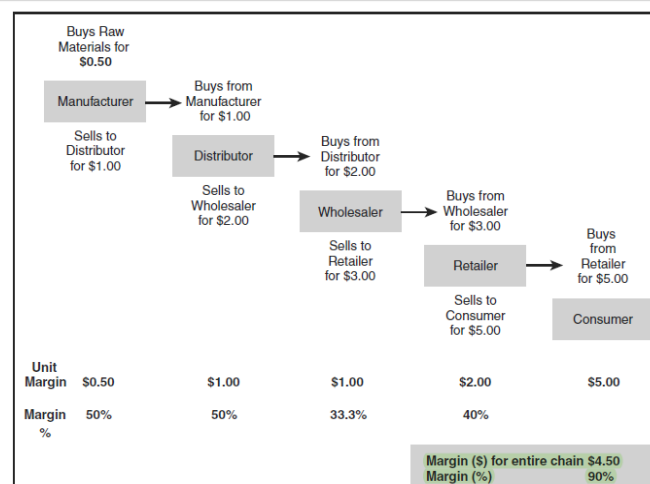
Markup vs. Margin

- Markup is a % added to the cost price to arrive at selling price. Typically used in retail industry.

$$\text{Markup(\%)} = \frac{(\text{Selling price (\$)} - \text{Cost Price (\$)})}{\text{Cost Price (\$)}}$$

- Retail prices are typically 'marked up' as a % of cost price but 'marked down' as % of selling price during promotions!
 - A markup of 50% on a cost price of \$10 implies the product is sold for \$15
 - A markdown of 50% on a selling price of \$15 implies the product is sold for \$7.50

Channel Margins



Margin Pricing (working forward)

- To find the selling price when cost and % margin are given

$$\text{Selling price (\$)} = \frac{\text{Item cost (\$)}}{1 - \text{Margin (\%)}}$$

- Example:



Suppose a retailer wants 40% margin for a product that costs them \$3.
Then the selling price should be.....

$$SP = 3 / (1 - 0.4) = \$5$$

Margin Pricing (working backward)

- To find the cost when the selling price and %margin are given

$$\text{Cost (\$)} = \text{Selling price (\$)} * [1 - \text{margin (\%)}]$$

- Example:



Suppose a retailer believes that a product should be sold at \$5 to be competitive and wants to make a 40% margin, then it should pay the wholesaler no more than.....

$$CP = 5 * (1 - 0.4) = \$3$$

- Can a retailer determine the whole sale price?

Channel Price

- In a vertical channel, a higher order member's (e.g. manufacturer) selling price is lower order member's (e.g. retailer) cost price

Manufacturer's selling price

$$= \text{Retailer's selling price} * (1 - \text{retailer margin}) * (1 - \text{wholesaler margin}) * (1 - \text{distributor margin})$$

Or,

Retailer's selling price

$$= \frac{\text{Manufacturer's selling price}}{[(1 - \text{retailer margin}) * (1 - \text{wholesaler margin}) * (1 - \text{distributor margin})]}$$

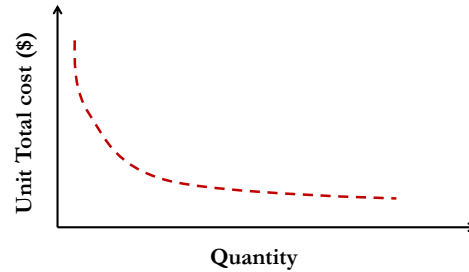
- For the example in slide 6,

$$\text{Cost of raw material} = \$5 * (1 - 0.4) * (1 - 0.33) * (1 - 0.5) * (1 - 0.5) = \$0.5$$

Fixed and Variable costs

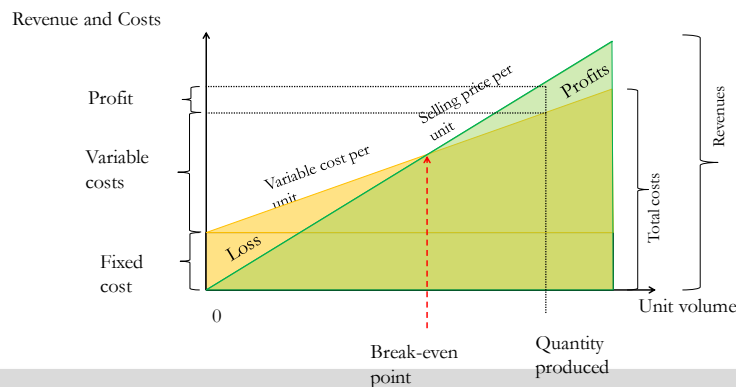
$$\text{Total cost (\$)} = \text{Variable cost per unit (\$)} * \text{Quantity (\#)} + \text{Fixed costs (\$)}$$

$$\text{Total cost per unit (\$)} = \text{Total cost (\$)} / \text{Quantity (\#)}$$



Break-Even: Costs vs. Revenue

- Break-even point represents the revenue or units required to cover total costs (both fixed and variable)



Break-Even

- Profit at break-even is zero
- Break-even is only possible when a firm's prices are higher than its variable costs
- Break-even analysis also helps in estimating when a firm would start earning profits
- Each unit sold higher than the variable cost generates a "contribution" which is then used to cover the fixed costs. The firm starts gaining profits after all the fixed costs are covered.

Contribution Metrics

$$\text{Contribution per unit (\$)} = \text{Selling price per unit (\$)} - \text{Variable cost per unit (\$)}$$

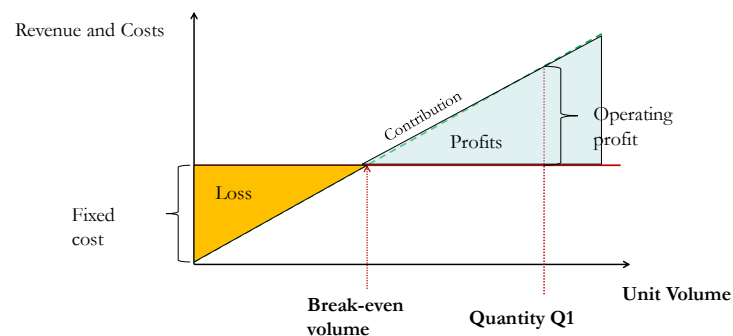
- Think of it as unit contribution to profit

$$\text{Contribution margin (\%)} = \text{Contribution per unit (\$)} / \text{Selling price per unit (\$)}$$

- Think of it as percentage of sales revenue that contributes to profit

Break-Even: Contribution perspective

- Each unit sold higher than the variable cost generates a “contribution” which is then used to cover the fixed costs. The firm starts gaining profits after all the fixed costs are covered.



Break-even volume

At Break-even point,

Total cost = Total revenue

Fixed cost + Unit variable cost * quantity sold = Selling Price * quantity sold

Fixed cost = quantity sold * (Selling price - Unit variable cost)

$$\text{Break-even volume (\#)} = \text{Fixed costs (\$)} / \text{Contribution per unit (\$)}$$

$$\text{Break-even revenue (\$)} = \text{Fixed costs (\$)} / \text{Contribution margin (\%)}$$

Profit based Sales Targets

- Break even analysis can be extended to find target revenue, target volume or even the price that needs to be charged to reach a certain profit level
- To achieve a profit target, a firm's revenues should cover both the costs (break-even) as well as the target profit

$$\text{Target volume (\#)} = (\text{Fixed costs (\$)} + \text{Profits (\$)}) / \text{Contribution per unit (\$)}$$

$$\text{Target revenue (\$)} = (\text{Fixed costs (\$)} + \text{Profits (\$)}) / \text{Contribution margin (\%)}$$

- Can you calculate the price that you have to charge to achieve a target profit level if you know the number of units that you can sell?

Break-even analysis: Advantages and Limitations

- Advantages
 - Simplistic
 - Break-even pricing and target pricing strategies
 - Target sales volume and revenues for break-even and target profits
- Limitations
 - Simplistic fixed and variable costs assumptions
 - Can you handle Non-linear pricing?
 - How to incorporate economies of scale?

Business problems:

- How to find out whether a business will make profits (break-even) and if so, when?

What you learnt this week:

1. Margins
2. Fixed and Variable costs
3. Break-even and contribution analysis
4. Target volume and revenue