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Growth Strategies

The Importance of Pricing

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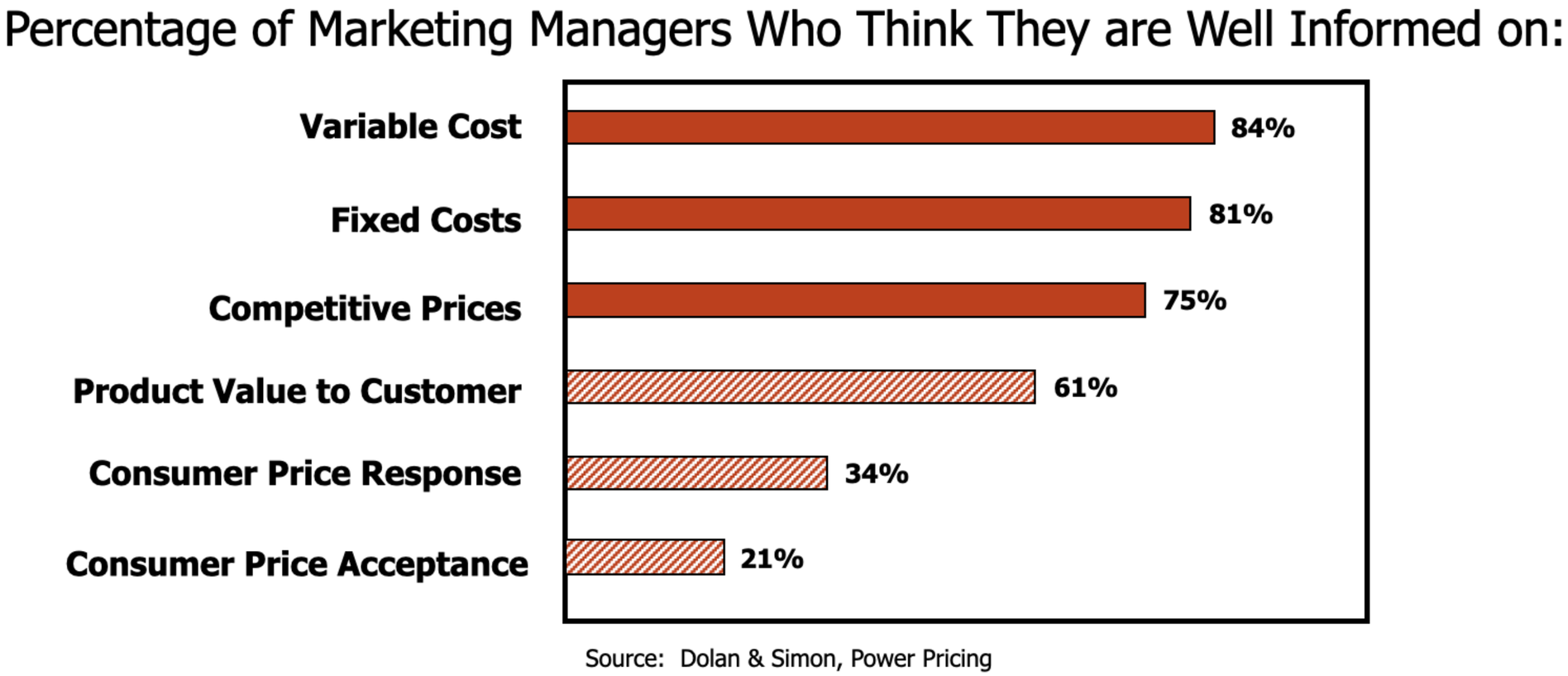
The Importance of Pricing

- Setting the price is probably one of the most important decisions an entrepreneur makes
- It is not just about setting the price, but more broadly thinking about what is the right revenue model, and price is just one part of that
- When you set the price, you should focus on both the numerator and the denominator
  - Price per what?
  - Will it be per unit of the product or per year?
  - People often think of just the numerator

The Importance of Pricing

- Pricing is important, but it's hard to do it well



The Four Inputs into Pricing

- Cost
  - What does it cost me to make the product?
  - In most cases, cost provides a floor, but not always
  - You might consider freemium pricing in some cases, just as Dropbox did
- The next factor that sets the upper bound is Maximum Willingness to Pay or WTP
  - Economists often refer to it is as the Reservation Price
  - We shall study three popular methods to measure willingness to pay

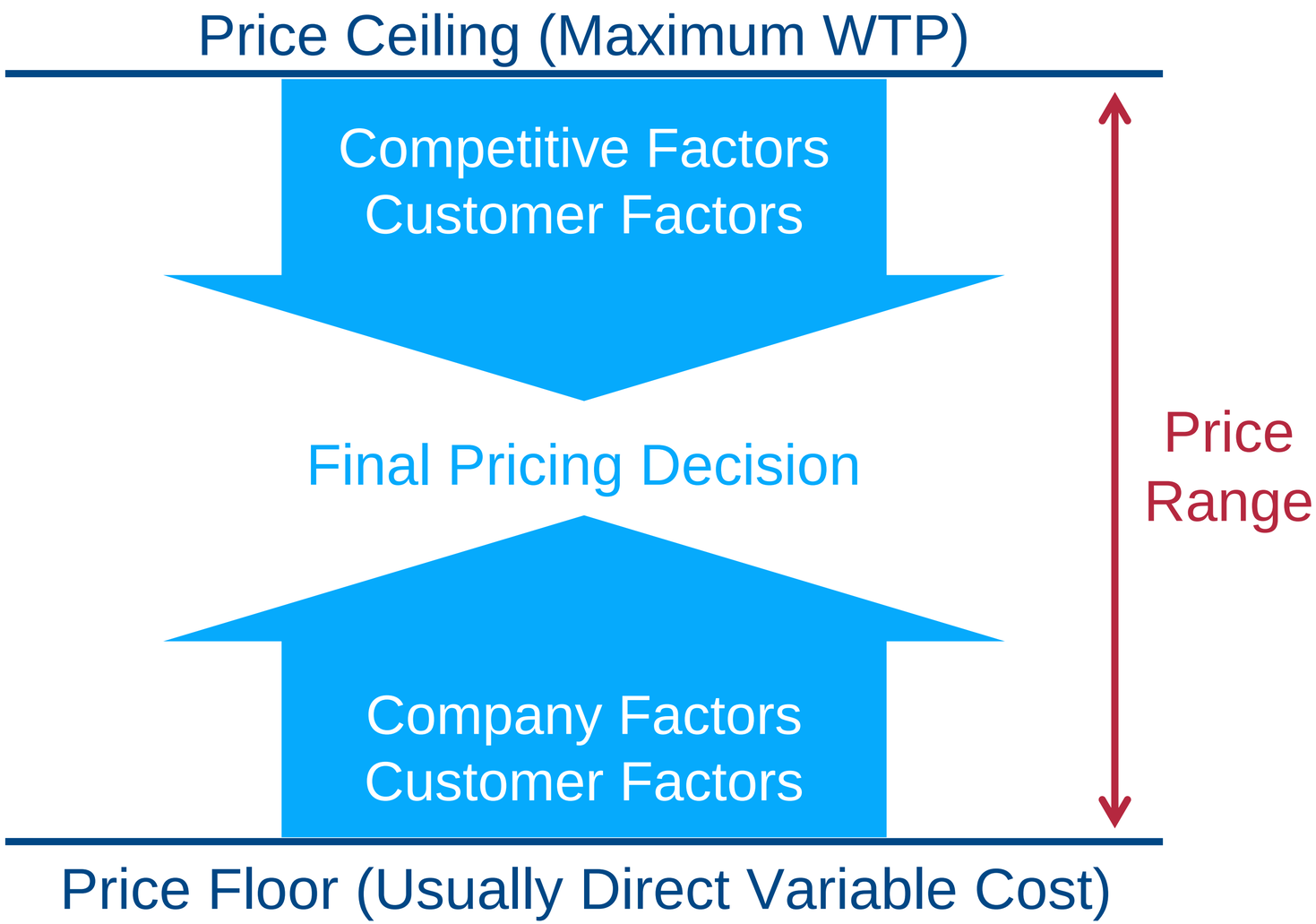
The Four Inputs into Pricing

- The next factor is competition
  - Competition forces us to charge less than the maximum willingness to pay
  - We may need to give some incentive to the potential customers to switch from what they are doing today to our product— accounting for switching costs

The Four Inputs into Pricing

- Finally, our channel partners and collaborators also influence our pricing decisions— usually pushing it higher because we have to make sure they also make some money and are rewarded for their efforts
  - Automobile companies charge a higher price to the consumer because the car dealers must also make some money from their efforts
- Many direct to consumer startups avoid using channel partners to save on this
  - Tesla sells directly to the customer and is changing the industry practice

Setting a Price



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Price Elasticity

Jagmohan Raju, Joseph J. Aresty Professor of Marketing

What is Price Elasticity?

- The most common answer I get is “it’s an indicator of how sales change when you change price”
  - While this answer is not wrong, it is not accurate either
- The word sales means different things to different people and we need to be precise
- Price elasticity is about how unit sales are affected by price changes, but even that is not precise enough

Price Elasticity of Demand

$$\text{Price Elasticity} = \frac{\%\ \text{Change in unit sales}}{\%\ \text{Change in price}} = \frac{\Delta Q/Q}{\Delta P/P}$$

- Why do we make our life complicated by dealing with percentages?
  - You do not want a concept or its measurement to change just because you measure quantities in 1000's or 100's, or tons or pounds, or price in dollars or cents
- Elasticity is a "pure" number, and it does not matter whether we are talking about meters, pounds, gallons, tons, dollars, or euros

Elastic or In-elastic

- We often hear business people use the phrase “my demand is elastic” or “my demand is in-elastic”
- What do we mean by elastic or in-elastic?
  - The typical answer I get is “it is about whether demand changes with price or not”
  - Once again, it is good to be more precise
- When we talk about elastic or inelastic, our conversation shifts from unit sales to revenues
  - Revenue elasticity

Relationship Between Quantity and Revenue Elasticity

$$\text{Revenue Elasticity} = \frac{\%\ \text{Change in revenue}}{\%\ \text{Change in price}} = \frac{\Delta R}{\Delta P}\frac{P}{R}$$

- Using the chain rule from calculus we can show that:

$$\text{Revenue Elasticity} = 1 + \text{Quantity Elasticity}$$

- Inelastic: (revenue decreases when price is cut), 0 > elasticity > -1
- Elastic: (revenue increases when price is cut), elasticity < -1

Concept 3: Break-Even Profit Elasticity

- What is the price elasticity needed for profits to break even?
- Helps us link cost structure to elasticity and profits

Break-Even Profit Elasticity: Example

- Admiral Electric has 3 different products (business groups)
- It is thinking about changing the prices for these products
- Contribution margins for the three products are 85%, 55%, and 15%
- The company is considering lowering prices by 5%
- Will such a price change work out?
  - What will be the potential impact of such a price change on profits?

Break-Even Profit Elasticity: Example

p_0 = initial price $\qquad$ p_1 = new price

q_0 = initial demand $\qquad$ q_1 = new demand

c = initial variable cost = new variable cost **(no change in cost)**

Break-even profit condition: $(p_1 - c)q_1 = (p_0 - c)q_0$

$$\Rightarrow \quad \frac{q_1}{q_0} = \frac{(p_0 - c)}{(p_1 - c)}$$

$$\Rightarrow \quad \frac{q_1}{q_0} - 1 = \frac{(p_0 - c)}{(p_1 - c)} - 1$$

$$\Rightarrow \quad \frac{q_1 - q_0}{q_0} = \frac{(p_0 - c) - (p_1 - c)}{(p_1 - c)} = \frac{-(p_1 - p_0)}{(p_1 - p_0) + (p_0 - c)}$$

$$\Rightarrow \quad \frac{q_1 - q_0}{q_0} = \frac{-(p_1 - p_0)/p_0}{(p_1 - p_0)/p_0 + (p_0 - c)/p_0}$$

$$\Rightarrow \quad \frac{(q_1 - q_0)/q_0}{(p_1 - p_0)/p_0} = \frac{-1}{(p_0 - c)/p_0 + (p_1 - p_0)/p_0}$$

$$\Rightarrow \text{Elasticity needed to Breakeven} = \frac{-1}{\%\text{ initial contribution margin} + \%\text{ price change}}$$

Break-Even Profit Elasticity: Admiral Electric Example

- If the original gross margin is 15% and we are planning to decrease prices by 5% then break-even profit elasticity:
  - -1/(0.15-0.05) = -1/(0.1) = -10
- If the original gross margin is 25% and we are planning to decrease prices by 5% then break-even profit elasticity:
  - -1/(0.25-0.05) = -1/(0.2) = -5
- If the original gross margin is 55% and we are planning to decrease prices by 5% then break-even profit elasticity:
  - -1/(0.55-0.05) = -1/(0.5) = -2

Break-Even Profit Elasticity: Admiral Electric Example

- If the original gross margin is 15% and we are planning to decrease prices by 5% then break-even profit elasticity:
  - -1/(0.15-0.05) = -1/(0.1) = -10
- What does it mean that we need a price elasticity of -10
  - Does it mean demand must go up 10 times?
  - No, it means demand must go up 10 times the contemplated change in price which is 10 x 5% = 50%
  - If this does not seem likely, then such a price change will not work out and lead to lower profits
  - For higher margin businesses it may work out
  - Important to keep in mind that break even profit elasticity increases non-linearly with margins going down

Summary

- Three important foundation concepts
  - Price elasticity or simply demand elasticity
  - Revenue elasticity
  - Break-even profit elasticity

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Measuring Price Elasticity: Part 1

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Price Sensitivity: Overview

- Measuring price elasticity
  - Surveys
  - Controlled experiments
  - Analysis of historical data
  - A/B testing
- What does price elasticity mean in different contexts?

Price Elasticity: Contexts

Are we talking about response to a permanent price change or a temporary or short-term price change?

- By and large, consumer response is much higher for short term price changes than it is to long term price changes
  - Often an order of magnitude higher
- When short term price discounts are offered, consumers switch brands, buy early or sometimes even stockpile or consumer more

Price Elasticity: Contexts

Are we talking about response to a permanent price change or a temporary or short-term price change?

- In some cases, short term price changes lead to no change in demand
  - For example, demand is not very elastic to price of gasoline in the short run
  - But if consumers were to know with certainty that gasoline prices will go up and remain at say $5/gallon or even higher, they will shift to EV's more readily

Price Elasticity: Contexts

Are we talking about the response of the entire market (segment) level or an individual level price response?

- Market level responses to price are usually smoother
  - It is aggregated over many consumers
- At the individual level, because we often buy in discrete units (say one toothpaste, or two tubes of toothpaste), the response can be discrete, and we need different types of statistical methods when response is discrete

Measuring Price Elasticity

- Surveys
- Controlled experiments
- Analysis of historical data
- A/B testing

Measuring Price Sensitivity: 2x2 Summary of Methods

Variable Measured	Conditions of Measurement: Natural Setting	Conditions of Measurement: Controlled
Actual Purchase	Aggregate sales data	In-store experiments A/B Testing
Preferences or Intentions	Buyer response surveys	Lab experiments Tradeoff analysis (conjoint)

Measuring Price Sensitivity: 2x2 Summary of Methods

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Using Surveys to Measure Price Sensitivity

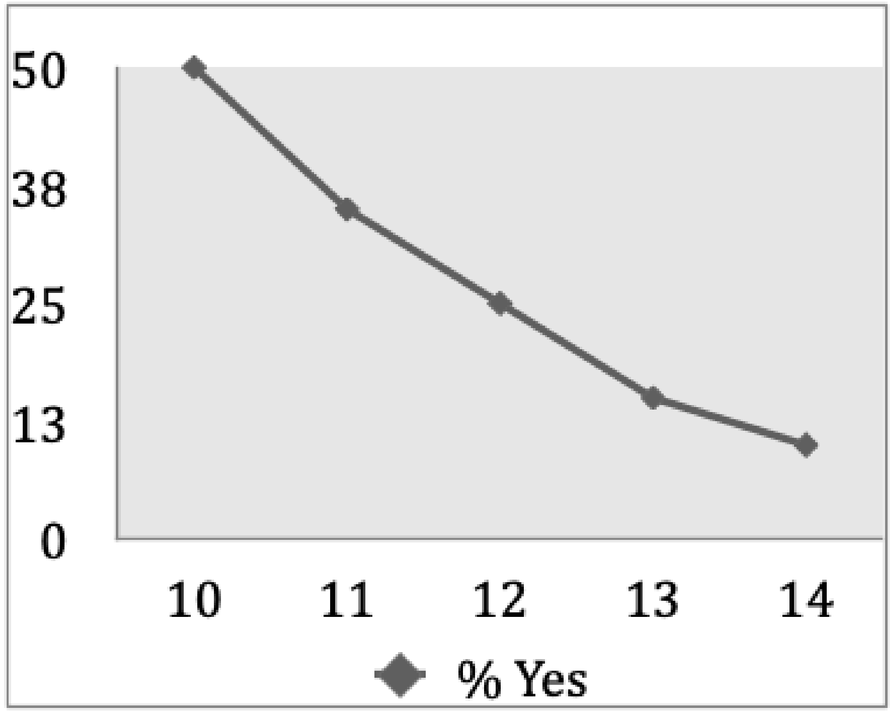
- Let us assume that FedEx is trying to determine how consumers will respond to the price of a new delivery service
- Start with a representative sample of 150 buyers
- Administer the survey to 5 randomized groups of 30 representative consumers
- To each group, describe the product in depth, state potential competitive offerings and their prices, and provide additional useful information

Using Surveys to Measure Price Sensitivity

- Then ask the question: Would you buy the new service if its price were $10 [$10; $11; $12; $13; $14]?
  - Yes
  - No
- Different groups are responding to a different price — one group to $10, another to $11, and so on
- Examine the % of yes answers in each group and plot a demand function

Example: Fraction of Consumers Saying Yes

Price	% yes
$14.00	10%
$13.00	15%
$12.00	25%
$11.00	35%
$10.00	50%



Strengths and Weaknesses of This Approach

Strengths

- Easy to do
- Inexpensive
- Fast
- Gives a demand function — may not be great, but we get something

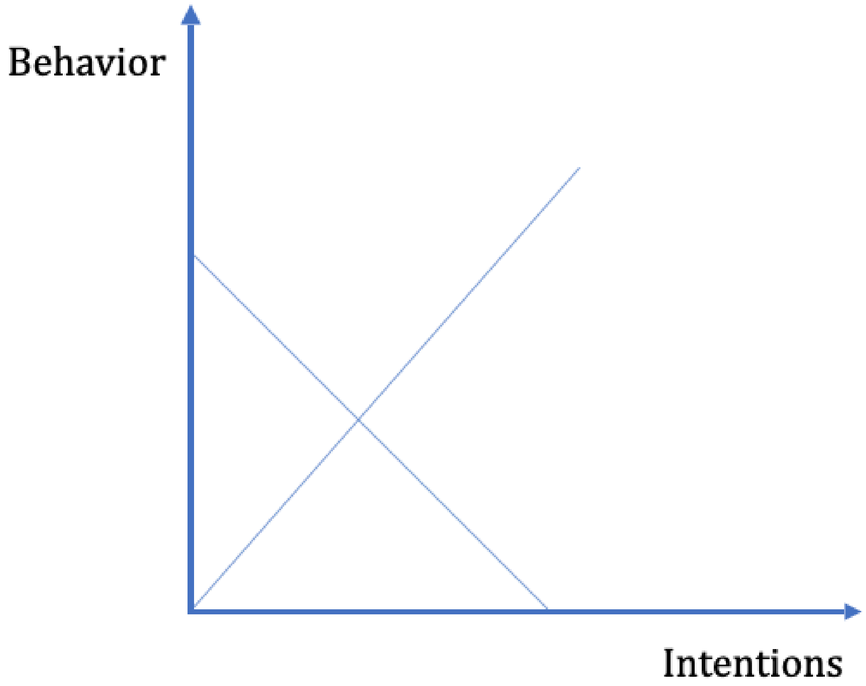
Weaknesses

- Does not account for competition — what if competition changed their prices?
- Does not account for how many units people will buy, only whether or not they will buy
- It is measuring intent to buy, not actual purchase behavior

How do we create a better relationship between intent to buy and actual purchases?

Ideal Relationship Between Intentions and Behavior

- What is the ideal relationship between intentions and behavior?
  - Most will say it is a 45 degree line, pointing upwards
  - Does it have to be a 45 degree line — suppose it is exactly the opposite?
- You have a friend, and every time when he/she says a stock will go up, it goes down, and every time he/she says a stock with go down, it goes up
  - Is he/she a good friend?
- What we are looking for is a stable, predictable relationship and not necessarily a 45 degree line



Improving Intentions as a Predictor of Behavior

- A major manufacturer of routers is thinking of launching a new G-class router
- The company conducts a survey of 100 potential buyers and asks them to state their intention to purchase on a 1-5 scale

	Intent to Purchase G-Class Router (1-5)	# of Consumers
	1	15
	2	20
	3	40
	4	15
	5	10
		100

Improving Intentions as a Predictor of Behavior

- The company launches the G-class router — what did people actually do?

	Intent to Purchase G-Class Router (1-5)	# of Consumers	Actually Bought
	1	15	0
	2	20	2
	3	40	5
	4	15	3
	5	10	3
		100	

Improving Intentions as a Predictor of Behavior

- The company launches the G-class router — what did people actually do?

	Intent to Purchase G-Class Router (1-5)	# of Consumers	Actually Bought	% Bought
	1	15	0	0
	2	20	2	10%
	3	40	5	12.5%
	4	15	3	20%
	5	10	3	30%
		100		

Improving Intentions as a Predictor of Behavior

- Now this company is launching an N-Class router
- It again conducts a survey of 100 potential buyers and asks their intentions to buy on 1-5 scale

Intent to Purchase G-Class Router (1-5)	# of Consumers	Actually Bought	% Bought	Intent to Purchase N-Class Router
1	15	0	0	10
2	20	2	10%	20
3	40	5	12.5%	30
4	15	3	20%	20
5	10	3	30%	20
	100			100

Improving Intentions as a Predictor of Behavior

- Now this company is launching an N-Class router
- It again conducts a survey of 100 potential buyers and asks their intentions to buy on 1-5 scale

Intent to Purchase G-Class Router (1-5)	# of Consumers	Actually Bought	% Bought	Intent to Purchase N-Class Router	% Conversion
1	15	0	0	10	0
2	20	2	10%	20	10%
3	40	5	12.5%	30	12.5%
4	15	3	20%	20	20%
5	10	3	30%	20	30%
	100			100	

Improving Intentions as a Predictor of Behavior

- Now this company is launching an N-Class router
- It again conducts a survey of 100 potential buyers and asks their intentions to buy on 1-5 scale

Intent to Purchase G-Class Router (1-5)	# of Consumers	Actually Bought	% Bought	Intent to Purchase N-Class Router	% Conversion	Forecast
1	15	0	0	10	0	0
2	20	2	10%	20	10%	2
3	40	5	12.5%	30	12.5%	3.75
4	15	3	20%	20	20%	4
5	10	3	30%	20	30%	6
	100			100		15.75

Improving Intentions as a Predictor of Behavior

- This helps improve the relationship between intentions and behavior
- We are codifying our past experience
- More details are in a paper by Professors Jamieson and Bass

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Measuring Price Elasticity: Part 2

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Using Historical Data on Actual Purchases

- Package delivery company case
- The data in the case are adapted from an HBS case study on Fedex when they launched a document delivery service called Courier Pak
- They had data on prices and unit sales for the first 29 weeks
- The company used a penetration pricing strategy (start low… slowly increase price)
- Should the company raise price one more time, this time by $1?
- As we do not have access to cost data, we can focus on the impact of price changes on revenues

Price and Unit Sales History Over 29 Weeks

Week	Sales	Price
1	140	5.00
2	195	5.00
3	268	5.00
4	481	5.00
5	411	5.00
6	481	5.00
7	525	8.50
8	527	8.50
9	547	8.50
10	502	8.50
11	511	8.50
12	534	8.50
13	559	10.00
14	575	10.00
15	592	10.00
16	661	10.00
17	764	10.00
18	794	10.00
19	805	11.50
20	745	11.50
21	859	11.50
22	982	11.50
23	987	11.50
24	1034	11.50
25	1090	11.50
26	1156	11.50
27	1194	12.50
28	1370	12.50
29	1304	12.50

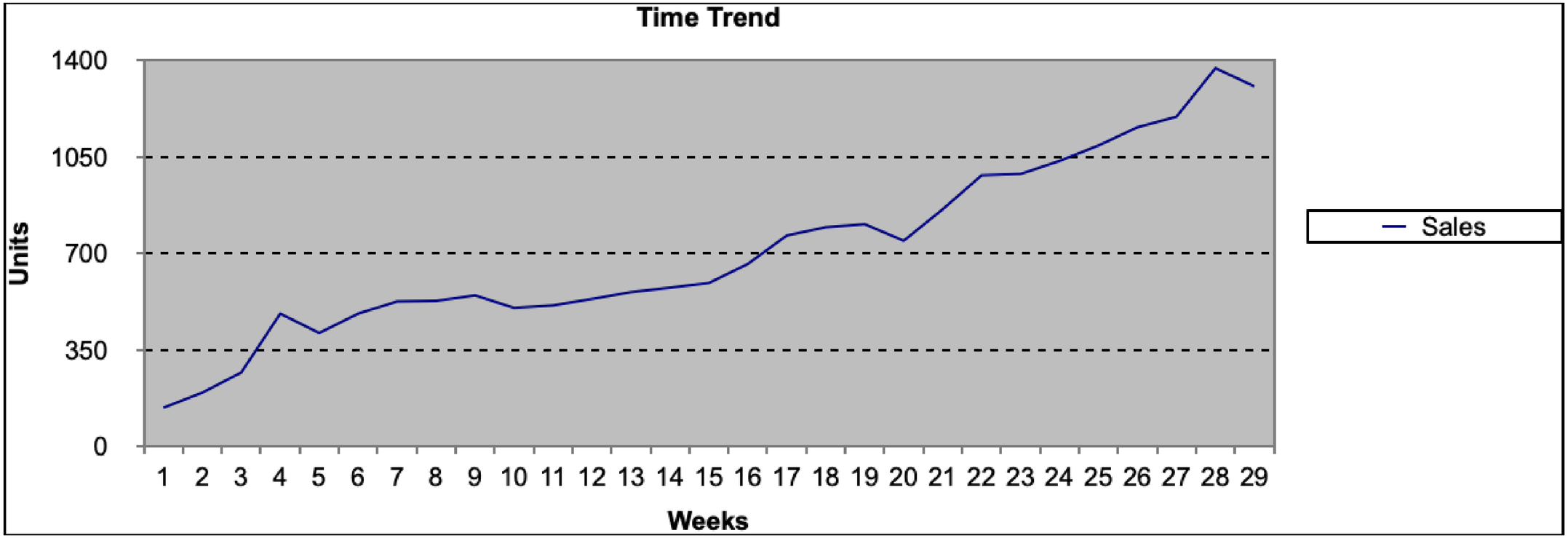
Start By Regressing Units Against Price

Regression Statistics	
Multiple R	0.874
R Square	0.765
Adjusted R Square	0.756
Standard Error	159.218
Observations	29

- We observe a positive price coefficient that is statistically significant
- Does it imply price increases result in demand increases?
- What else is going on while prices are increasing:
  - More advertising?
  - More word of mouth? Diffusion effects?

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-306.951	112.517	-2.728	0.011064
Price	109.037	11.639	9.368	5.65E-10

Use Time (Weeks) as a Surrogate for Changes in Other Variables



Regressing Units Against Price and Weeks

Regression Statistics	
Multiple R	0.974
R Square	0.948
Adjusted R Square	0.944
Standard Error	76.145
Observations	29

	Coefficients	*t Stat*	*P-value*
Intercept	383.075	4.265	0.000234
Price	-44.151	-2.611	0.014788
Weeks	49.256	9.594	4.99E-10

Start by Computing Elasticity

- Week 29:
  - Unit sales = 1304, Price = 12.50
- Elasticity:
  - % change in sales = -44.15/1304 = -0.0339 = -3.39%
  - % change in price = 1/12.50 = 0.08 = 8%
  - Elasticity = -3.39/8 = -0.42
- Therefore demand is in-elastic
  - Raising price will raise revenues
  - Can this go on forever?

	Coefficient	*t Stat*
Intercept	383.075	4.265
Price	**-44.151**	-2.611
Weeks	49.256	9.594

Start by Computing Elasticity

- Is elasticity computed from past data valid going forward?
- Compute elasticity at different points on the curve
- Another approach would be to see how well a constant elasticity model fits the data (Log Log is a constant elasticity model)

Regressing Log Units Against Log Price and Log Week

Regression Statistics	
Multiple R	0.966
R Square	0.933
Adjusted R Square	0.928
Standard Error	0.144
Observations	29

- A log-log model fits quite well
- Data so far exhibit more or less constant elasticity
- Therefore, there is more confidence in recommending that another price increase will be fine

Log-Log Model fits quite well!

Demand is inelastic!

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	5.443	0.312	17.426	7.353E-16
Price	-0.378	0.230	-1.643	1.124E-01
Weeks	0.744	0.088	8.436	6.453E-09

Measuring Price Sensitivity: Summary of Methods

Variable Measured	Conditions of Measurement: Natural	Conditions of Measurement: Experimental/Controlled
Actual Purchase	Aggregate sales data	In-store experiments Laboratory experiments A/B Testing
Preferences/Intentions	Buyer response surveys	Tradeoff analysis (conjoint) Rank order preference data

Comparison of Methods

- Historical data, if analyzed carefully, can give quite good measures of price elasticity
  - Good estimates within existing range of operation
  - Must institute good controls
- Estimates of price elasticity computed in experiments invariably result higher than actual numbers

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