MODELLING VOLUME VIA MENU BASED CHOICE MODELS

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Ipsos

PRESENTATION

1 Measuring Choice behaviour

2 Modelling Volume via Menu Based Choice (MBC)

3 MBC Case Study

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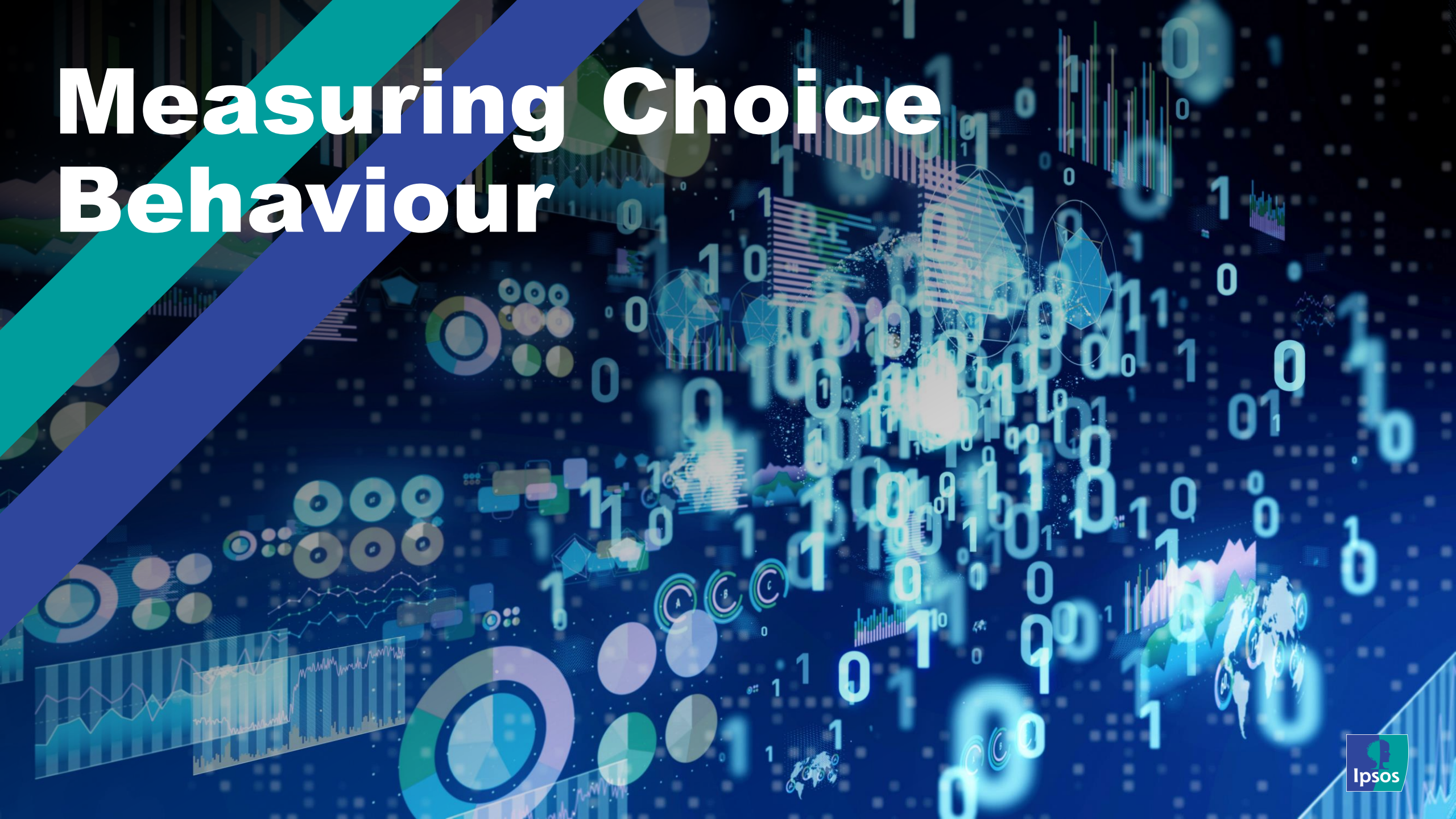
Measuring Choice Behaviour



MEASURING CHOICE BEHAVIOUR

Making choices can be complex!

What do consumers consider when deciding on what product to purchase?

One way of answering these questions is to determine the relative importance of the (product) features using a technique called

CONJOINT ANALYSIS

CONJOINT FORCES PEOPLE TO MAKE CHOICES BY TRADING OFF DIFFERENT ELEMENTS OF THE PRODUCT OR SERVICE PROPOSITION SO WE LEARN WHAT THEY TRULY VALUE

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MEASURING CHOICE BEHAVIOUR

Typical to ask respondents to make a single selection which represents their most preferred option out of the choices presented to them

Often the case that people can make **MULTIPLE PURCHASE DECISIONS**

VOLUMETRIC CONJOINT

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SINGLE CHOICE

Where respondents are only making a single choice between options the underlying interpretation is easy

40% consumers will purchase Option A

10% consumers will purchase Option B

30% consumers will purchase Option C

20% consumers will purchase Option D

Easy to build financial metrics such as revenue and profit

	Take-up
Option A	40%
Option B	10%
Option C	30%
Option D	20%
Sum	100%

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MULTI CHOICE

Standard methods are likely to be mis-leading as shares will sum to 100% - it doesn't consider VOLUME!!

At the aggregate level:

Preference share for Option C is twice that of Options A and B

Options A, B and D are equally preferred

At the respondent level:

Options A and B are chosen by as many respondents as Option C, and by twice as many respondents as Option D

Choices:

	Option A	Option B	Option C	Option D
Respondent 1	0	0	1	0
Respondent 2	0	0	0	1
Respondent 3	1	1	0	0
Respondent 4	1	1	0	0
Respondent 5	0	0	1	0

Shares:

	Option A	Option B	Option C	Option D
Respondent 1	0%	0%	100%	0%
Respondent 2	0%	0%	0%	100%
Respondent 3	50%	50%	0%	0%
Respondent 4	50%	50%	0%	0%
Respondent 5	0%	0%	100%	0%
Preference	20%	20%	40%	20%

Consumers	40%	40%	40%	20%

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SOME METHODS FOR VOLUMETRIC ANALYSIS

Maximum Expected Value

Identify the maximum volume across any single task (by respondent). Transform all other tasks to have the same volume by using the None option to capture residual volume

Joint Discrete / Continuous

2-step approach by modelling choice model data in the standard way. In the second step, use (log) utility estimates as predictors to create a general linear model

Economic Models

Uses demand theory to model volume. The model incorporates a common parameter for satiation of the good, and a parameter for the maximum budget spend

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Modelling Volume via Menu Based Choice (MBC)

WHAT IS MENU BASED CHOICE

Menu Based Choice allows us to **simultaneously** measure multiple **correlated** decisions in situations where the consumer can select multiple options

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MANY SITUATIONS IN WHICH CONSUMERS PICK MULTIPLE OPTIONS

Food / Drink

Restaurant / Coffee shop

Telecoms

Phone / Tariff / Additional bundles

FMCG

Purchasing of consumer goods

Tech

Buying add-on services in addition to a core product

Travel

Hotel / Flights / Car

Media

TV / Broadband / Phone

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MBC EXAMPLE SCREENS

Classic menu approach

Menu Scenario #1: Please imagine you pulled into a fast-food restaurant to order dinner for just yourself. If this were the menu, what (if anything) would you purchase?

❑ Deluxe Hamburger Value Meal -Deluxe Hamburger -Medium fries -Medium drink $3.99	❑ Chicken Sandwich Value Meal -Chicken Sandwich -Medium fries -Medium drink $5.59	❑ Fish Sandwich Value Meal -Fish Sandwich -Medium fries -Medium drink $3.99
(Only order sandwiches, fries or drinks from this area if you did not pick a value meal above.) **Sandwiches:** ❑ Deluxe Hamburger $1.99 ❑ Chicken Sandwich $3.59 ❑ Fish Sandwich $1.99 **Fries:** ❑ Small $0.79 ❑ Medium $1.49 ❑ Large $1.69 **Drinks:** ❑ Small $0.99 ❑ Medium $1.69 ❑ Large $2.19		**Salads:** ❑ Cobb dinner salad $4.79 ❑ Grilled chicken salad $4.39 **Healthy Sides:** ❑ Carrots/Celery with Ranch dressing $1.19 ❑ Apple slices/Grapes with dipping sauce $0.99 **Desserts:** ❑ Apple/Cherry/Berry pie $0.99 ❑Cookies $1.19 **Total Price:**_____
❑ I wouldn't buy anything from this menu. I'd drive to a different restaurant, or do something else for dinner.		

Base model + Multi Select

Which of the following would you buy? Select a Base Model, and then any add-on options you wish.

- ❍ Base Model 1 $200
- ⦿ Base Model 2 $275
- ❍ Base Model 3 $550

- ☑ Option A $12
- ❑ Option B $24
- ☑ Option C $7
- ❑ Option D $55
- ☑ Option E $3

Total Price of Selections: $297

Sawtooth Software examples

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BENEFITS OF MENU BASED CHOICE

Realistic environment where consumer chooses their own configuration

More accurate financial metrics

Identify item(s) that cannibalize each other

Understand which items consumers are picking together

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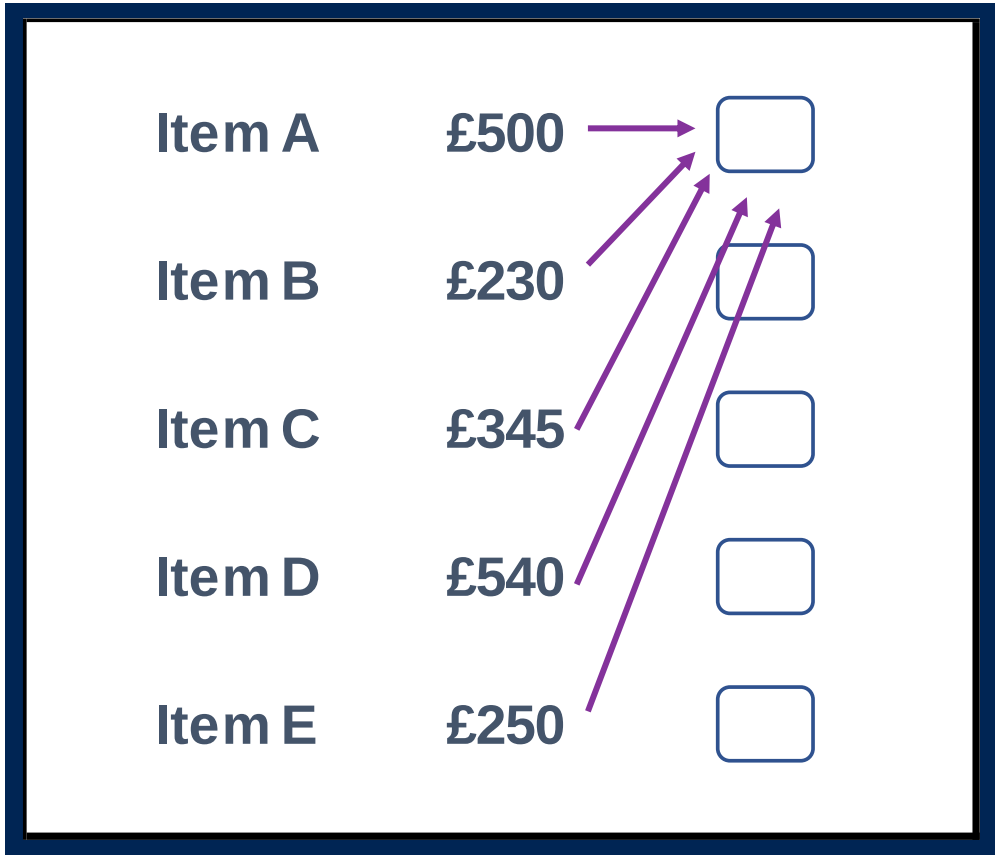
MBC ANALYTICAL APPROACHES

1. Serial cross-effects

Separate choice models are created for each item

Dependent variable is the choice of an item

Probability of choice for each item is some function of the desirability of the item, the price of the item and (potentially) the price of other items on the menu



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SERIAL CROSS EFFECTS

Base model

Cross-effect Model

No cross-effect

$$\text{Choice(Prod A)} = f(\text{Const} + \text{Price}_A)$$

Cross-effects

$$\text{Choice(Prod A)} = f(\text{Const} + \text{Price}_A + \text{Price}_B + \text{Price}_C)$$

Adding in additional terms not related to product A

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MBC ANALYTICAL APPROACHES

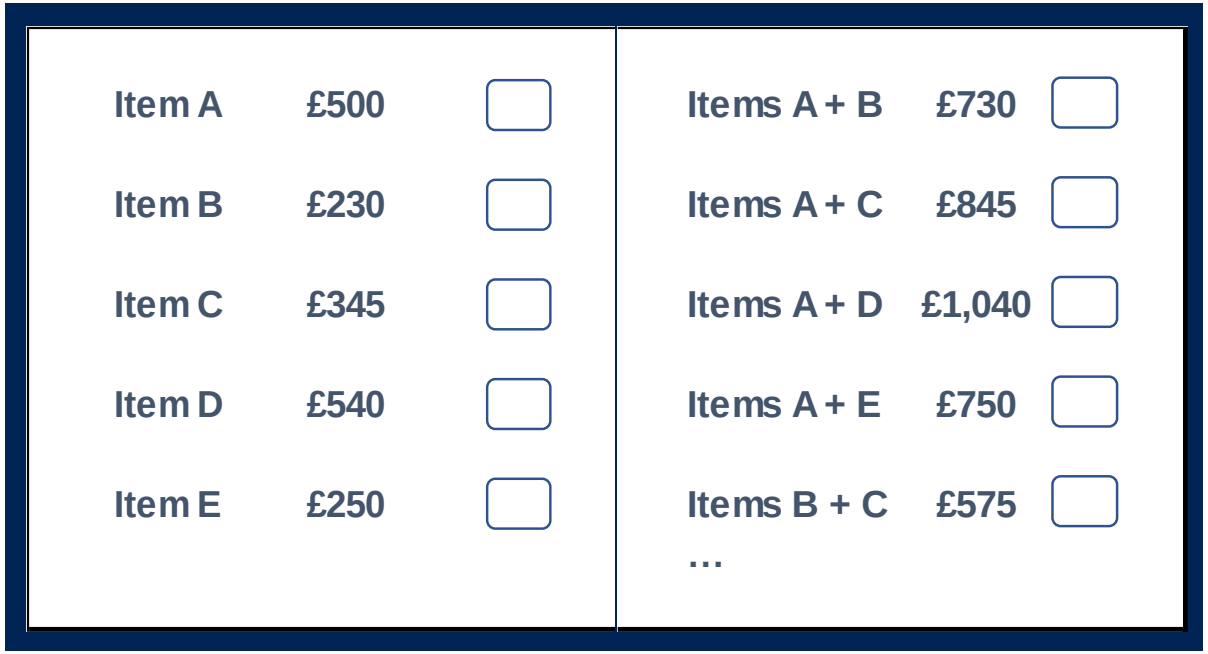
2. Exhaustive Alternatives

Treat each menu as a single choice from 2^n alternatives where n is the number of items

Pros: Single Model

Cons: Number of combinations becomes prohibitive the more items there are

Possible to do combination of cross-effects and exhaustive models in the same study



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3. Sampling of alternatives

Each item and its price coded as separate attributes

Considers only a random sample of all possible combinations (plus chosen combination)

Optionally… dummy tasks can be included to check if item chosen at a specific price

CASEID	Task#	**Concept#**	Core	Feature 1	Price1	Feature 2	Price2	...	**Response**
1	1	**1**	1	1	2	1	3	...	**0**
1	1	**2**	1	2	0	1	3	...	**1**
1	1	**3**	1	2	0	2	0	...	**0**
...	...	**...**	...	...	...	...	...	...	**...**
1	1	**33**	2	2	0	1	3	...	**0**

CASEID	Concept#	Core	Feature 1	Price1	Feature 2	Price2	Feature 3	Price3	...	**Response**
1	1	1	1	1	2	0	2	0	...	**1**
1	2	1	2	0	2	0	2	0	...	**0**
1	1	1	2	0	1	3	2	0	...	**0**
1	2	1	2	0	2	0	2	0	...	**1**
1	1	1	2	0	2	0	1	1	...	**0**
v	2	1	2	0	2	0	2	0	...	**1**

Each feature is either included in the combination (1) or not (2)
Option prices are alternative specific

Borghi et al, Sawtooth Software Conference 2012

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MBC ANALYTICAL APPROACHES

4. Probit models

Error terms are distributed differently and importantly can be correlated

Reveals substitution and complementary relationships by estimating covariance matrix of the error term

Despite theoretical advantage, it generally performs no better than logit models and takes significantly longer to estimate

	Multinomial Logit	Multivariate Probit
Utility Function	$U = X\beta^T + \epsilon$	$U = X\beta^T + \epsilon$
Error Terms	i.i.d. Gumbel	Multivariate normal (correlations allowed)
Model Structure	Separate models for each menu area	One single model
Interdependencies	Cross-price effects	Error term correlations
Likelihood	Closed-form expression	No closed-form expression

> **Multivariate probit would seem to provide a more theoretically complete model…**
> (Orme 2012, p. 6)

Neuerburg, Sawtooth Software Conference 2015

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MBC MEASURES VOLUME MORE ACCURATELY

Availability	Service subscription	Regular Price	Special Offer Through the XXX Platform	XXX Platform price	Take-up
	Entertainment				
☑	Subscription service 1	$5.99	40%	$3.59	10.9%
☑	Subscription service 2	$4.99	15%	$4.24	11.4%
☑	Subscription service 3	$6.99	0%	$6.99	13.2%
☑	Subscription service 4	$14.99	5%	$14.24	10.7%
☑	Subscription service 5	$5.99	40%	$3.59	17.2%
☑	Subscription service 6	$13.99	35%	$9.09	24.6%
☑	Subscription service 7	$4.99	20%	$3.99	6.5%
☑	Subscription service 8	$10.99	18%	$9.01	4.9%
☑	Subscription service 9	$8.99	40%	$5.39	5.3%
	Sports				
☑	Subscription service 10	$5.99	5%	$5.69	8.8%
☑	Subscription service 11	$24.99 *	5%	$23.74	2.9%
☑	Subscription service 12	$28.99 *	15%	$24.64	3.3%
☑	Subscription service 13	$8.75 *	50%	$4.38	3.4%
	Gaming				
☑	Subscription service 14	$6.99	40%	$4.19	4.4%
☑	Subscription service 15	$8.99	30%	$6.29	1.9%
☑	Subscription service 16	$7.99	10%	$7.19	2.5%
☑	Subscription service 17	$2.99	45%	$1.64	3.6%

Number of services purchased	
0	47.5%
1	16.2%
2	11.3%
3	6.8%
4	5.4%
5	4.1%
6	2.5%
7	2.0%
8	1.2%
9	0.8%
10+	2.2%

Average number services purchased
1.8

- Respondents can select from none to many subscription services
- Availability effects to model presence / absence of service
- Serial cross-effect model for each subscription service
- Calculate how many items respondent's buy

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MBC Case Study

Commissioned research to optimise the pricing of key dishes on their menu in order to maximise profit

In addition to individual dishes, Set menu deals which bundle together multiple courses also offered

Analysis needed to further take in to account cannibalisation to and from key competitors

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STUDY DETAILS

Sample

UK only

N = 1,490 (online panel)

Aged 16-35

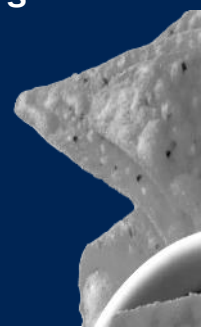
Young Adult / Family life stage

Eat out monthly or more in ‘branded’ restaurants serving alcoholic drinks and offering full table service

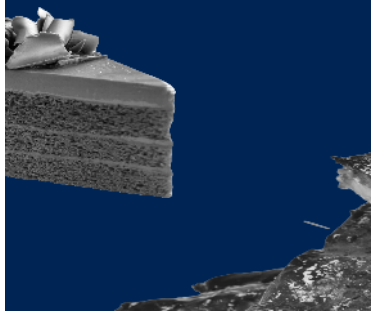
Must have a TGI Fridays in their ‘area’

Choice Design

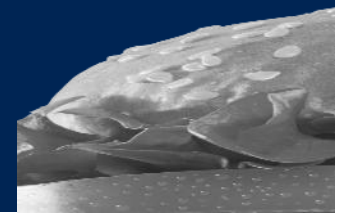
5 Starters



2 Bundled offers



10 Main courses



6 Desserts

5 Drinks

Desserts were collapsed in to Large and Small desserts and only one drink option (Cocktails) was analysed

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QUESTIONNAIRE FLOW

1. Screening

U&A demographic and screening questions

Most recent occasion

Satisfaction ratings

2. Stage 1 - CBC

Determine cannibalisation to/from TGI Fridays

Choose most preferred competitor menu (Fixed price – Single choice)

Choice Based Conjoint exercise with TGI Fridays menu vs. winning competitor menu

Only TGI Friday's prices changing

3. Stage 2 - MBC

Determine choice/price sensitivity within the TGI Fridays menu

MBC exercise with the price of all dishes varying each time

Option to choose none of the dishes and leave the restaurant

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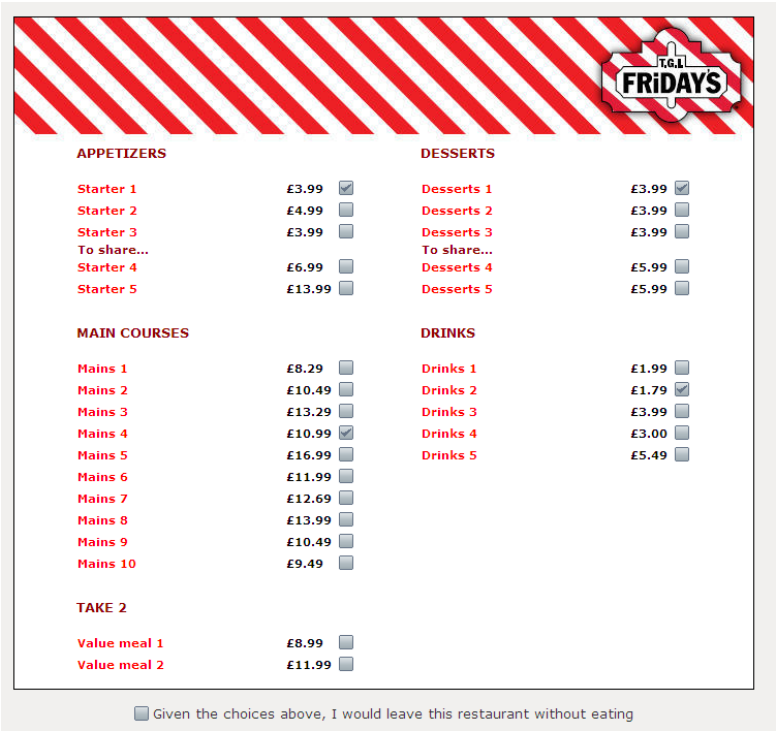
EXAMPLE SCREENSHOTS

Stage 1 - CBC

Stage 2 - MBC



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MODELLING CONSIDERATIONS

Imposed limitations

1 Respondents can select a maximum of one dish per menu area

2 Cannot select the same dish multiple times

3 If a Take 2 meal is selected then the respondent cannot select any other dish (and vice versa)

4 If the last occasion was a Friday – Sunday then the Take 2 option was not available (mimicked real life situation)

Note: Survey data on last occasion suggested c.96% chose a main course

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ANALYSIS STAGE 1 (CBC)

Total Sample N=1490

- Filter
- Menu Prices
- Importance Summary
- Importance Chart
- Set Band A/B Prices
- Filter Summary
- Competitor Elasticity
- Menu Analysis
- Help Guide
- Export Chart

Starters	Price
Starter 1	£7.99
Starter 2	£3.99
Starter 3	£5.59
Starter 4	£3.99
Starter 5	£13.29

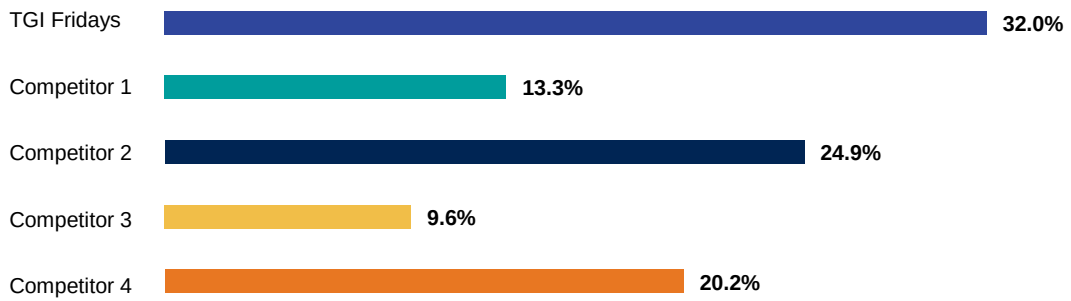
Value meals	
Value meal 1	£9.99
Value meal 2	£12.99

Mains	Price
Main 1	£7.99
Main 2	£10.29
Main 3	£12.99
Main 4	£8.99
Main 5	£14.99
Main 6	£12.99
Main 7	£12.99
Main 8	£12.69
Main 9	£9.49
Main 10	£8.99

Desserts	Price
Dessert 1	£3.99
Dessert 2	£5.99

Drinks	
Drink 1	£4.49

Simulation Results



CBC model to gauge change in footfall as a result of changes in menu price

At the base case TGI Fridays obtained 32% preference share

Changes to this value would alter the number of customers that would go in to a TGI Fridays in an average month – which then feeds in to profit calculation

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ANALYSIS STAGE 2 (MBC)

Total Sample N=1490 ▼

- Filter
- Menu Prices
- Importance Summary
- Importance Chart
- Set Band A/B Prices
- Filter Summary
- Competitor Elasticity
- Menu Analysis
- Help Guide
- Export Chart

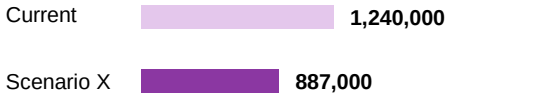
Starters	Price	% of choice
Starter 1	£7.99	3.3%
Starter 2	£3.99	11.3%
Starter 3	£5.59	11.0%
Starter 4	£3.99	6.4%
Starter 5	£13.29	5.0%
Value meals		
Value meal 1	£9.99	13.1%
Value meal 2	£12.99	1.0%

Mains	Price	% of choice
Main 1	£7.99	18.4%
Main 2	£10.29	10.1%
Main 3	£12.99	10.8%
Main 4	£8.99	3.9%
Main 5	£14.99	3.8%
Main 6	£12.99	6.6%
Main 7	£12.99	6.3%
Main 8	£12.69	4.5%
Main 9	£9.49	6.5%
Main 10	£8.99	7.1%

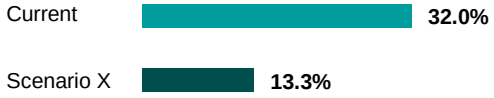
Desserts	Price	% of choice
Dessert 1	£3.99	9.7%
Dessert 2	£5.99	5.3%
Drinks		
Drink 1	£4.49	9.0%

TGIF covers

Net profit



% share



Gross profit (£ per 1000 Total)

MBC model to gauge change in preference for the different menu items as price changes

Data weighted by how often they go to TGI Fridays

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CHECKING RESULTS

Sensitivity of each item as other items change price

Effect on dish

Changing price of dish from low to high price	S1	S2	S3	S4	S5	VM1	VM2	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	D1	D2	DR1
S1		0.7	0.1	1.1	0.0	-.0.5	-0.3	-0.6	0.0	-0.1	0.0	-0.1	0.1	0.0	-0.1	-0.2	0.0	0.1	-0.4	-0.1
S2	0.4		1.0	2.8	0.1	-0.9	-0.5	-0.8	-0.4	0.1	-0.3	0.1	0.1	0.0	0.1	0.1	0.0	-0.4	0.2	0.8
S3	0.1	1.2		0.9	0.0	0.5	0.7	-0.6	-0.1	-0.2	-0.1	0.1	0.1	0.0	-0.2	-0.3	-0.2	0.0	0.1	-0.2
S4	0.7	0.7	0.8		0.2	-0.4	0.3	-0.7	-0.4	0.1	-0.4	-0.1	-0.1	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1
S5	0.0	0.1	0.0	0.2		0.0	-0.3	-0.2	0.0	0.1	0.0	-0.2	0.0	-0.1	0.2	0.0	-0.3	-0.5	0.7	1.1
VM1	0.3	0.5	0.2	0.4	0.5		2.9	1.3	0.1	0.1	0.5	0.3	0.1	0.0	0.3	0.5	0.4	0.8	0.6	0.5
VM2	0.0	0.3	0.1	0.1	-0.1	4.1		-0.1	0.0	0.0	0.2	-0.1	-0.1	0.0	-0.1	0.0	0.1	-0.5	-0.1	-0.6
M1	-0.2	-0.8	-0.1	-0.5	0.0	1.9	0.3		1.8	0.2	1.4	0.1	0.1	0.1	0.3	0.8	0.9	-0.9	-0.9	0.2
M2	-0.1	-0.1	-0.1	0.1	0.0	0.2	0.2	2.2		0.1	0.9	0.1	0.2	0.1	0.5	0.5	0.8	-0.8	-0.5	0.5
M3	-0.1	-0.3	0.0	0.4	0.0	0.0	-0.2	0.1	0.0		0.1	0.1	0.0	0.0	0.1	0.0	0.0	1.0	0.3	0.3
M4	0.1	-0.3	-0.2	0.1	0.0	0.2	0.3	0.9	0.5	0.3		0.2	0.1	0.1	0.2	0.3	0.4	0.1	0.0	-0.4
M5	0.2	0.4	0.1	-0.1	0.1	0.1	-0.2	0.0	0.0	0.1	0.2		0.0	0.0	0.1	0.0	0.0	0.7	-0.1	0.1
M6	0.2	0.1	0.0	0.4	0.0	-0.4	-0.1	0.1	0.1	0.0	0.3	0.1		0.2	0.2	0.2	0.0	-0.4	-0.3	0.0
M7	-0.1	-0.6	0.0	-0.6	0.2	-0.9	-0.5	0.1	0.2	0.0	0.2	0.0	0.2		0.4	0.2	0.0	0.4	-0.1	-0.8
M8	0.0	0.4	0.1	0.1	0.0	-0.2	0.1	0.2	0.4	0.0	0.2	0.1	0.1	0.3		0.2	0.2	0.0	0.0	0.8
M9	0.1	-0.4	-0.1	-0.9	0.0	1.6	0.0	0.8	0.4	0.0	0.5	0.1	0.1	0.2	0.4		0.7	-1.4	-0.9	-0.3
M10	0.3	0.3	0.1	1.1	0.4	0.2	-0.5	0.7	0.5	0.0	0.4	0.0	0.1	0.0	0.1	0.5		0.9	0.9	1.2
D1	-0.1	-0.3	0.0	-0.4	0.0	0.6	0.4	1.0	-0.5	-0.2	-0.4	-0.1	-0.1	0.0	0.0	-0.4	-0.3		3.0	0.0
D2	0.1	0.4	0.2	0.7	-0.2	-1.6	0.0	-0.2	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0	-0.2	3.7		0.0
DR1	-0.1	0.3	0.0	0.4	0.0	0.7	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.6	-0.1	

Within category all cross-effects should be positive

Cross-effects outside category should be a mixture of positive and negative effects

Correlated items have greater sensitivity (M1 and M2 are both burger options)

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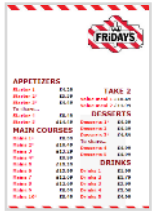
PROFIT OPTIMISATION

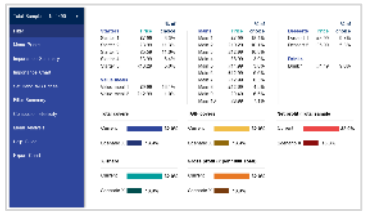
Ultimate goal of the project was to increase net profit so analysis needed to show best combination of prices

1. Stage 1
Determine # monthly covers



2. Stage 2
Determine volume of each dish

3. Client data
Provided all fixed and variable costs



Optimisation analysis done via Oracle Crystal Ball software

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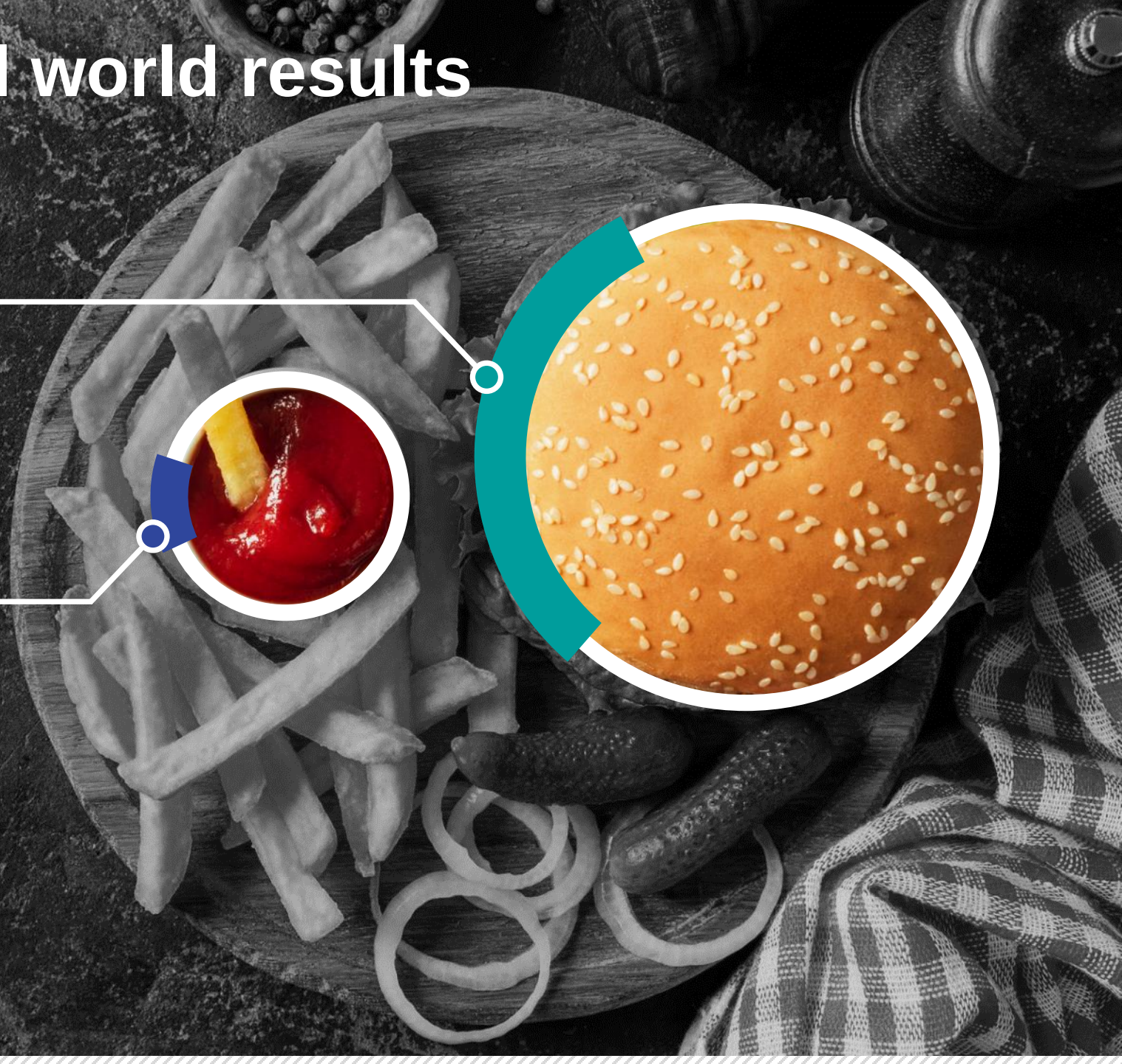
Real world results

IN 3 MONTHS, TGI FRIDAY NET PROFIT INCREASED BY

31%

VS. PREVIOUS YEAR WHERE NEW MENU IMPLEMENTED, AND SIGNIFICANTLY HIGHER THAN IN THE CONTROL RESTAURANTS (12%)



Moore, Sawtooth Software Conference 2010

SUMMARY

Simpler models i.e. less cross-effects tend to work better. Only include significant effects

Establish all the choice rules up front e.g. Choice patterns, availability, context,…. Be PRAGMATIC !

MBC is very flexible but don't expect it to solve every possible problem e.g. complex pricing, dynamic bundling

MBC is very data hungry in order to model cross-effects. N = 1000 is a good starting point

If optimising for revenue/profit do not rely on the None option

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Questions?

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