DMAW
Direct Marketing Association of Washington

ADVANCED TOPICS

NEXT-LEVEL DIRECT MARKETING

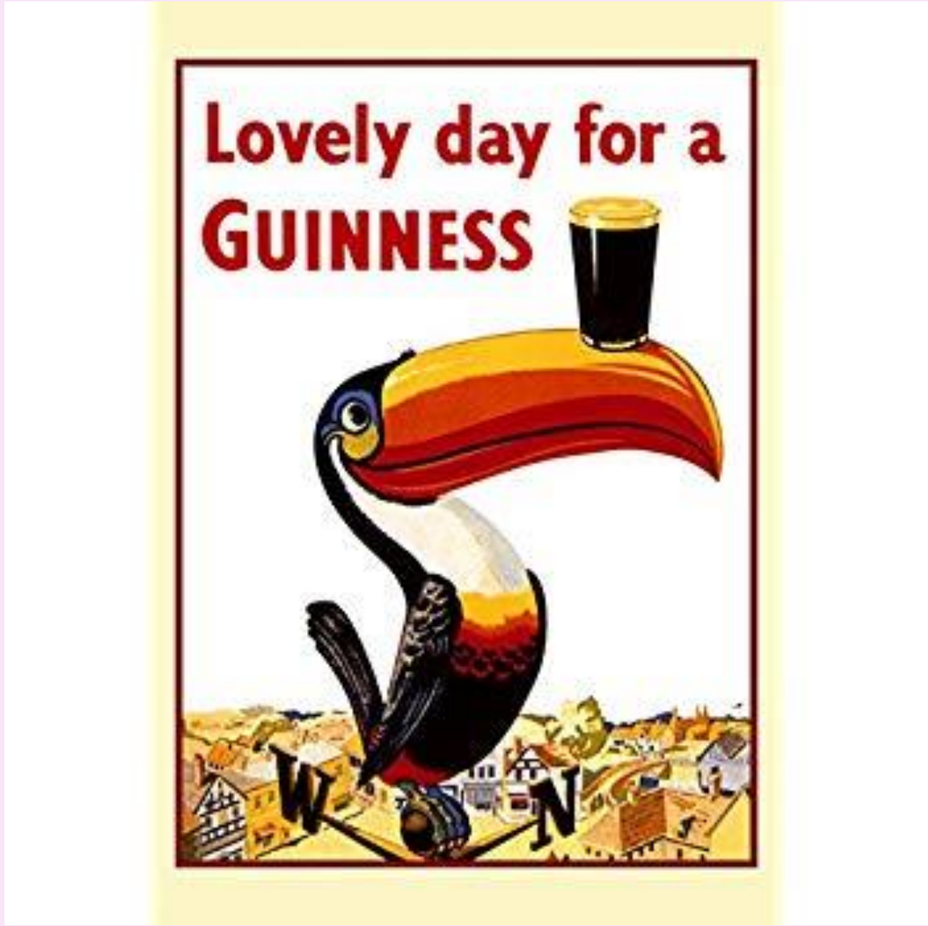
Table 3. Number of experimental runs (n_{exp}), maximum number of factors (n_f), levels (L_i) and maximum number of factors for specified levels ($\sum MF_i$)

n_{exp}	n_f	L_1	$\sum MF_1$	L_2	$\sum MF_2$	L_3	$\sum MF_3$
4	3	4	2	2	1		
		2	3				
6	3	6	1	3	2		
		3	3				
		2	1	3	2		
8	7	4	4	2	3		
		4	2	2	5		
		2	7				
	6	8	3	4	2	2	1
		8	1	4	3	2	2
		8	1	4	1	2	4
		4	6				
	5	8	3	2	2		
		8	2	2	3		
		8	1	4	3	2	1
		8	1	2	4		
	4	8	4				
9	5	3	5				
	4	9	4				
		9	2	3	2		
		9	1	3	3		
10	6	10	1	5	5		
	3	5	2	2	1		
12	11	2	11				
	10	4	1	2	9		
	9	4	2	2	7		
	7	4	4	2	3		
		4	3	2	4		
		3	7				
	6	4	6				
		4	3	3	1	2	2
		4	2	3	1	2	3
		3	4	2	2		
		3	3	2	3		

n_{exp}	n_f	L_1	$\sum MF_1$	L_2	$\sum MF_2$	L_3	$\sum MF_3$
12	5	12	1	2	4		
		6	5				
		4	2	3	2	2	1
		4	1	3	2	2	2
		3	1	2	4		
	4	12	4				
	3	12	1	6	2		
14	6	7	5	2	1		
	5	14	1	7	4		
15	8	5	4	3	4		
	7	5	5	3	2		
		15	1	3	6		
		5	2	3	5		
		5	1	3	6		
		3	7				
	6	15	1	5	5		
		5	6				
		5	3	3	3		
16	15	2	15				
	14	4	1	2	13		
	13	8	1	2	12		
		4	2	2	11		
	12	16	1	2	11		
	10	16	1	8	1	2	8
	9	4	9				
		4	3	2	6		
	7	8	7				
	5	16	5				
		16	2	2	3		

n_{exp} = number of experimental runs
n_f = total number of factors
L_i = levels for associated number of factors *i*
$\sum MF_i$ = total number of maximum factors *i*

"Design of Experiments: Useful Orthogonal Arrays for Number of Experiments from 4 to 16". Sorana D. Bolboacă and Lorentz Jäntschi, Entropy 2009.


Lovely day for a
GUINNESS

William S. Gosset

- “Student”
- More like the (brew) Master
- Hoppy to see you
- Significant Other
- Rules are made to be broken

R.A. Fisher

- I, 95
- Do ya think (my son is) sexy?
- The Lady and the Tea

Muriel Bristol

- That’s no lady
- The most important issue of the day
- A lady with taste
- Trust but verify
- Socks would have been nice too

https://rss.onlinelibrary.wiley.com/doi/full/10.1111/j.1740-9713.2012.00620.x

R.A. Fisher

- Designing Experiments
- Not great, Ron
- A pun about Kolkata

Genichi Taguchi

- KimoNO
- Rao your boat
- OrthagonAlley
- You can drive my car
- Method Man

C.R. Rao

A/B Testing

Envelope Color	Message
 	*DMAW is Great!*
	DMAW is Really Great!

Test 1:  vs. 

(which message?)

Test 2: *DMAW is Great!* vs. *DMAW is Really Great!*

(which envelope color?)

Full Factorial Testing

Envelope Color	Message
 	*DMAW is Great!*
	DMAW is Really Great!

Test 1:  *DMAW is Great!*

Test 2:  *DMAW is Really Great!*

Test 3:  *DMAW is Great!*

Test 4:  *DMAW is Really Great!*

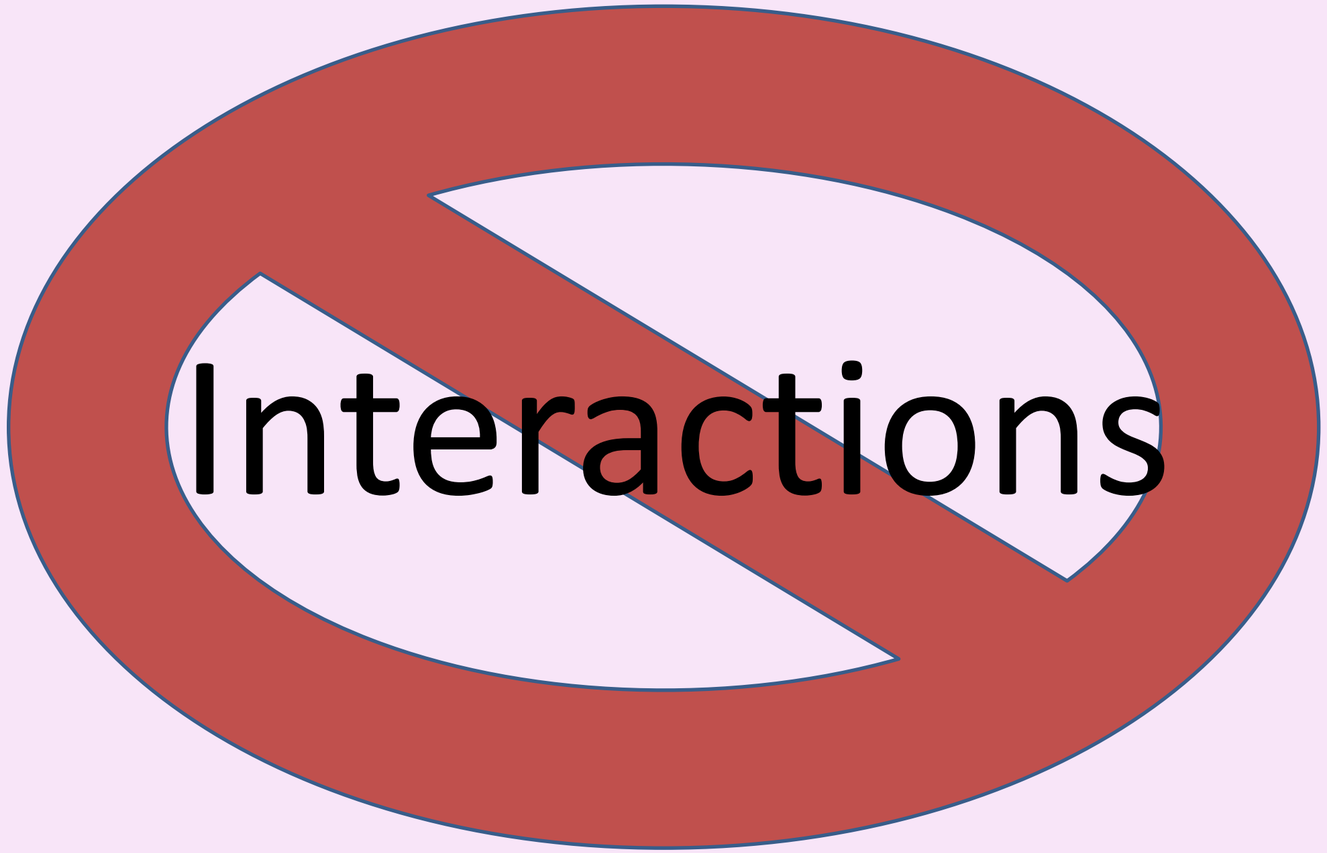
Terms to Know

Factor – The groups of things to be tested. (e.g. Envelope Color or Messaging)

Level – The different values within a factor. (e.g.: Red or Blue; DMAW is Great! or DMAW is Really Great!

Qualitative/Quantitative – Describes the factors and levels we are testing. Most are qualitative (color, messaging, etc.) Continuous numeric values are quantitative

Interaction – Two or more factors having a multiplicative impact (e.g. pouring sugar AND stirring tea)


Interactions

Full Factorial Testing

Envelope Color	Message
 	*DMAW is Great!*
	DMAW is Really Great!

Test 1:  *DMAW is Great!*

Test 2:  *DMAW is Really Great!*

Test 3:  *DMAW is Great!*

Test 4:  *DMAW is Really Great!*

Full Factorial Testing

Envelope Color	Message
 (1)  (2)	*DMAW is Great!* (1) *DMAW is Really Great!* (2)

	Envelope Color	Message
Test 1:	1	1
Test 2:	1	2
Test 3:	2	1
Test 4:	2	2

Full Factorial Testing

Envelope Color	Message	Font
 (1)  (2)  (3)	*DMAW is Great!* (1) *DMAW is Really Great!* (2)	Arial (1) Times New Roman (2)

Test #	Envelope Color	Message	Font
1	1	1	1
2	1	1	2
3	1	2	1
4	1	2	2
5	2	1	1
6	2	1	2
7	2	2	1
8	2	2	2
9	3	1	1
10	3	1	2
11	3	2	1
12	3	2	2

Full Factorial Testing – Number of Tests Required

Envelope Color: 3	Message: 2	Font: 2
 (1)  (2)  (3)	*DMAW is Great!* (1) *DMAW is Really Great!* (2)	Arial (1) Times New Roman (2)

3 X 2 X 2
= 12

AARP Test from 2015

Envelope	Letter	Reply	RAE	Ask
Pre-Renewal Monarch OE	Pre-Renewal Letter	Pre-Renewal Reply	Pre-Renewal RAE	$12
#10 OE	Double Reply Letter	Double Reply Faux NCR Format	3 ways to give on back of RAE	3 ask test
Brownkraft	Faux NCR Letter	Pre-Renewal Reply Redesign	Note pushing for online gift	$12.50
Respond by Date	Remove BBB Logo	Double Reply Format		
4	4	4	3	3

Control

4 x 4 x 4 x 3 x 3 = ???

Fractional Factorial

Test #	Envelope	Letter	Reply	RAE	Ask
1	1	1	1	1	1
2	2	1	1	1	0
3	3	1	1	0	3
4	4	1	4	3	1
5	1	2	4	3	1
6	2	2	4	2	1
7	3	2	4	2	2
8	4	2	3	3	2
9	1	3	3	1	3
10	2	3	3	2	3
11	3	3	1	2	1
12	4	3	2	3	3
13	1	4	2	3	3
14	2	4	3	1	2
15	3	4	2	2	2
16	4	4	2	1	2

	Full Factorial	Fractional Factorial
Tests	576	16
Measure Interactions?		
Test all combinations?		

Packages	Qty	Response	RR%	Income	Cost	Net/Donor
Pre-Ren Rem No Prem Offer #10 OE No BBB Ltr DR Rep 3 ways RAE MV Tst #4	30,000	428	1.43%	$ 5,974.00	$ 6,280.24	$ (0.71)
Pre-Ren Rem No Prem Offer Faux NCR Ltr DR Rep Onl Push RAE MV Tst #2	30,000	399	1.33%	$ 5,523.99	$ 5,611.56	$ (0.22)
Pre-Ren Rem No Prem Offer #10 OE Faux NCR Ltr DR NCR Rep 3 ways RAE 3 Ask MV Tst #15	30,000	366	1.22%	$ 5,650.00	$ 7,282.24	$ (4.38)
Pre-Ren Rem No Prem Offer Resp by OE DR Rep 3 Ask MV Tst #12	30,000	366	1.22%	$ 5,114.00	$ 5,298.06	$ (0.50)
Pre-Ren Rem No Prem Offer #10 OE DR Ltr MV Tst #1	30,000	354	1.18%	$ 5,319.00	$ 6,558.82	$ (3.46)
Pre-Ren Rem No Prem Offer 3 ways RAE $12.50 Ask MV Tst #10	30,000	353	1.18%	$ 5,193.30	$ 5,016.06	$ 0.50
Pre-Ren Rem No Prem Offer Resp by OE DR Ltr DR NCR Rep 3 ways RAE $12.50 Ask MV Tst #11	30,000	343	1.14%	$ 5,008.00	$ 11,283.65	$ (18.19)
Pre-Ren Rem No Prem Offer DR Ltr DR NCR Rep 3 Ask MV Tst #13	30,000	334	1.11%	$ 4,820.00	$ 11,283.65	$ (18.90)
Pre-Renewal Reminder w/ No BE Offer Ctrl	30,000	330	1.10%	$ 4,649.00	$ 5,016.06	$ (1.09)
Pre-Ren Rem No Prem Offer Resp by OE Faux NCR Ltr Rep Redsgn 3 ways RAE MV Tst #5	30,000	310	1.03%	$ 4,529.00	$ 5,702.75	$ (3.76)
Pre-Ren Rem No Prem Offer BK OE DR NCR Rep Onl Push RAE MV Tst #3	30,000	306	1.02%	$ 4,336.00	$ 7,411.08	$ (9.95)
Pre-Ren Rem No Prem Offer BK DR Ltr DR Rep Onl Push $12.50 Ask MV Tst #8	30,000	292	0.97%	$ 4,111.50	$ 6,229.67	$ (7.23)
Pre-Ren Rem No Prem Offer BK OE Faux NCR Ltr $12.50 Ask MV Tst #6	30,000	289	0.96%	$ 4,321.50	$ 6,169.08	$ (6.33)
Pre-Ren Rem No Prem Offer No BBB Ltr Rep Redsgn $12.50 Ask MV Tst #7	30,000	284	0.95%	$ 4,067.00	$ 5,016.06	$ (3.31)
Pre-Ren Rem No Prem Offer #10 OE Rep Redsgn Onl Push RAE $12.50 Ask MV Tst #9	30,000	270	0.90%	$ 4,508.00	$ 6,283.24	$ (6.50)
Pre-Ren Rem No Prem Offer Resp by OE No BBB Ltr Onl Push RAE 3 Ask MV Tst #14	30,000	204	0.68%	$ 3,586.00	$ 5,016.06	$ (6.88)
Pre-Ren Rem No Prem Offer BK OE DR Ltr Rep Redsgn 3 ways RAE 3 Ask MV Tst #16	30,000	127	0.42%	$ 2,200.00	$ 6,850.36	$ (36.33)

	RAE		
Package	Pre-Renewal RAE	Note pushing for online gift	3 ways to give on back of RAE
1	1.18%		
2		1.33%	
3		1.02%	
4			1.43%
5			1.03%
6	0.96%		
7	0.95%		
8		0.97%	
9		0.90%	
10			1.18%
11			1.14%
12	1.22%		
13	1.11%		
14		0.68%	
15			1.22%
16			0.42%
control	1.10%		
Maximum	1.22%	1.33%	1.43%
Minimum	0.95%	0.68%	0.42%
Mean	**1.09%**	**0.98%**	**1.07%**
Rank	1	3	2

Step 1 – Isolate packages containing each element

Step 2 – Calculate mean response rate for each element

Step 3 – Determine “statistical significance” of best mean response rate to every other mean response rate

Step 4 – Analyze Maximum – Minimum (small difference suggests factor has big impact on response rate)

Step 5 – Analyze spread of mean response rates (big difference suggests big impact on response rate)

Winners and Retest

	Winner #1	Winner #2
Envelope	#10 OE	Pre-Renewal Monarch OE
Letter	Faux NCR Letter	Pre-Renewal Letter
Reply	Double Reply Format	
RAE	Pre-Renewal RAE	3 ways to give on back of RAE
Ask	$12	

Winning package generated 26% lift in income, 18% lift in response, and cut Net/Sent and Net/Donor in half

Package	Envelope	Letter	Reply	RAE	Ask
1	#10 OE	Faux NCR Letter	Double Reply Format	Pre-Renewal RAE	$12
2	#10 OE	Faux NCR Letter	Double Reply Format	3 ways to give on back of RAE	$12
3	#10 OE	Pre-Renewal Letter	Double Reply Format	Pre-Renewal RAE	$12
4	#10 OE	Pre-Renewal Letter	Double Reply Format	3 ways to give on back of RAE	$12
5	Pre-Renewal Monarch OE	Faux NCR Letter	Double Reply Format	Pre-Renewal RAE	$12
6	Pre-Renewal Monarch OE	Faux NCR Letter	Double Reply Format	3 ways to give on back of RAE	$12
7	Pre-Renewal Monarch OE	Pre-Renewal Letter	Double Reply Format	Pre-Renewal RAE	$12
8	Pre-Renewal Monarch OE	Pre-Renewal Letter	Double Reply Format	3 ways to give on back of RAE	$12
Control	Pre-Renewal Monarch OE	Pre-Renewal Letter	Pre-Renewal Reply	Pre-Renewal RAE	$12

Example Taguchi Designs

Run	X_1	X_2	X_3	X_4
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

Taguchi, $P=2$, $L=3$			
Run #	a	b	X
1	1	1	X_1
2	1	2	X_2
3	1	3	X_3
4	2	1	X_4
5	2	2	X_5
6	2	3	X_6
7	3	1	X_7
8	3	2	X_8
9	3	3	X_9

Taguchi, $P=3$, $L=3$				
Run #	a	b	c	X
1	1	1	1	X_1
2	1	2	2	X_2
3	1	3	3	X_3
4	2	1	2	X_4
5	2	2	3	X_5
6	2	3	1	X_6
7	3	1	3	X_7
8	3	2	1	X_8
9	3	3	2	X_9

Experiment Number	Column 1	2	3	4	5	6	7
1	1	1	1	1	1	1	1
2	1	1	1	2	2	2	2
3	1	2	2	1	1	2	2
4	1	2	2	2	2	1	1
5	2	1	2	1	2	1	2
6	2	1	2	2	1	2	1
7	2	2	1	1	2	2	1
8	2	2	1	2	1	1	2

When to Use Fractional Factorial Tests

- ❑ Have the test quantity/package availability to support it
- ❑ Want to test a lot of different things
- ❑ Don’t care about interactions
- ❑ Have someone who can design/evaluate responsibly