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DISCRIMINATION TEST

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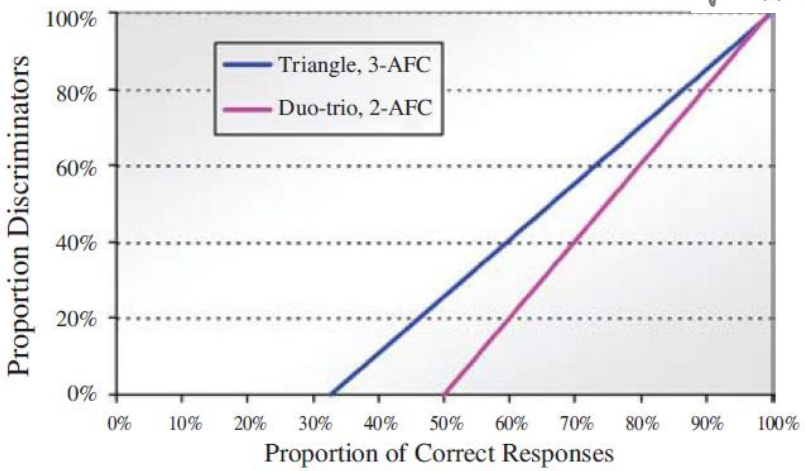
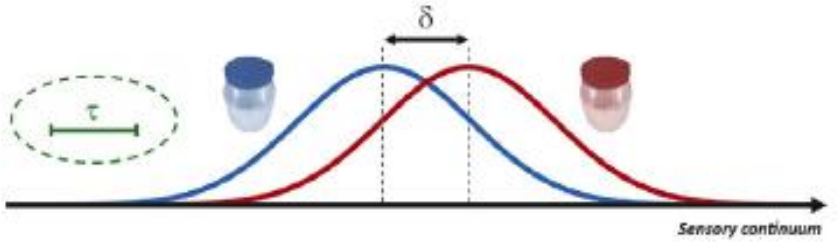




DIFFERENCES

Important or Not?

- **NOT IMPORTANT: OUT OF CONTROL**

  plant variability, hand-made bakery and etc..

- **IMPORTANT: UNDER CONTROL**

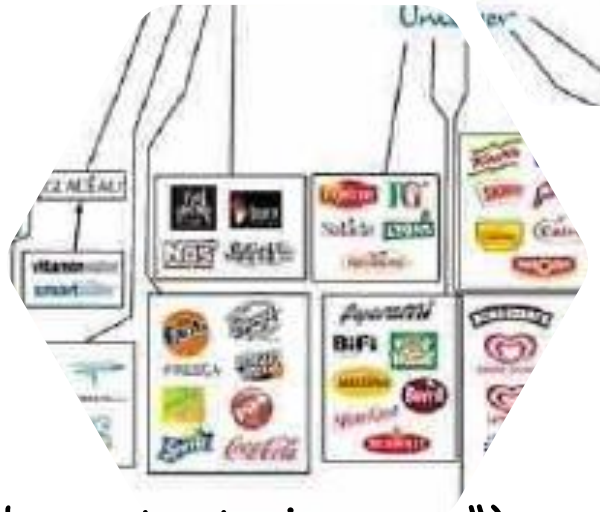
  processed products varying across batches, factories, chain stores and etc..

MORE HAPPEN TO…

Daily maintenance

- Quality control
- Ingredient sourcing
- Plant to plant variability
- Shelf life determination
- …

Intentional substitution



- Product upgrade
- Reformulation
- Ad claims ("bottle beer taste in a can")

How can we know whether consumers detect the differences?

Straightforward question:

- Can you tell a difference?
- Is the difference obvious?
- Is the difference confusable?

THERE ARE FOUR TYPES OF PEOPLE

Those Who Say:	Can They?	
"I Can Tell The Difference"	Yes, They Can	No Surprise
"I Cannot Tell The Difference"	No, They Cannot	No Surprise
"I Can Tell The Difference"	No, They Cannot	No Surprise
"I Cannot Tell The Difference"	Yes, They Can	Big Surprise!

FORCED CHOICE!

Discrimination Testing

- **Definition:** Discrimination test, also known as difference tests, are comparative procedures for use in the study of sensory discriminability of similar types of stimuli.

Key Strategy:

Which is the one we asked?

IF YOU CANNOT TELL, GUESS!

What can we obtain from Discrimination Testing?

- The difference between products is perceived at a previously established level of significance.

Available discrimination tests

Discrimination Testing

Class of test	Test	Samples: inspection phase	Samples: test phase	Task/instructions	Chance probability
Oddity	Triangle	(None)	A, A′, B (or A, B, B′)	Choose the most different sample	1/3
Matching	Constant reference duo–trio	Ref-A	A, B	Match sample to reference	1/2
	Balanced reference duo–trio	Ref-A, Ref-B	A, B	Match sample to reference	1/2
	ABX	Ref-A, Ref-B	A (or B)	Match sample to reference	1/2
	Dual standard	Ref-A, Ref-B	A, B	Match both pairs	1/2
Forced choice	Paired comparison	(None)	A, B	Choose sample with most of specified attribute	1/2
	3-AFC	(None)	A, A′,B	(Same)	1/3
	n-AFC	(None)	$A_1 - A_{n-1}$, B	(Same)	1/*n*
	Dual pair	(None)	A, B and A, A′	Choose A, B (different pair)	1/2
Sorting	Two out of five	(None)	A, A′, B, B′, B″	Sort into two groups	1/10
	4/8 "Harris–Kalmus"	(None)	$A_1 - A_4$, $B_1 - B_4$	Sort into two groups	1/70
Yes/no	Same–different	(None)	Pairs: A, A′ or A, B	Choose response: "Same" or "different"	N/A[a]
(Response choice)	A, not-A	Ref-A	A or B	Choose response: "A" or "not-A"	N/A[a]

How to choose the method?

Nature of difference between products

- A given attribute differ between samples
- Which one is stronger than the other one (2-AFC) or N-1 (N-AFC)?

- No given attributes differ between samples
- Which one is the “different” one from the others? (triangle, duo-trio)

Discrimination Testing

2-AFC

- For the below two tomatoes, which one is more red?

✓ The probability of correct guessing is p=1/2

Triangle test

- Two products are the same, one is different (odd sample)

✓ The probability of correct guessing is p=1/3

How to Interpret the data?

Example: 2-AFC

- Two different aged wines

  ⇨ Two glasses of wine

  (A is sweeter than B)

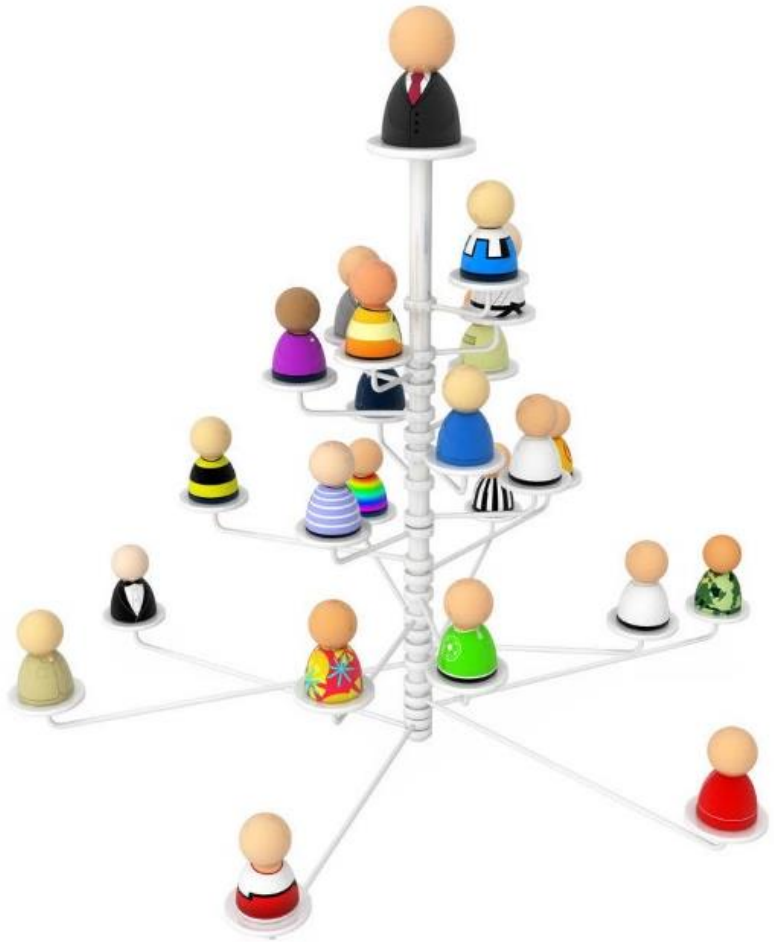
Participants were asked to select the one that is sweeter (A)

How many people Do we need?

Sample size

- IDEALLY, The Bigger, The Better

- PRACTICALLY, - (24-48)
  - Fixed panel
  - Casual consumers



N=36

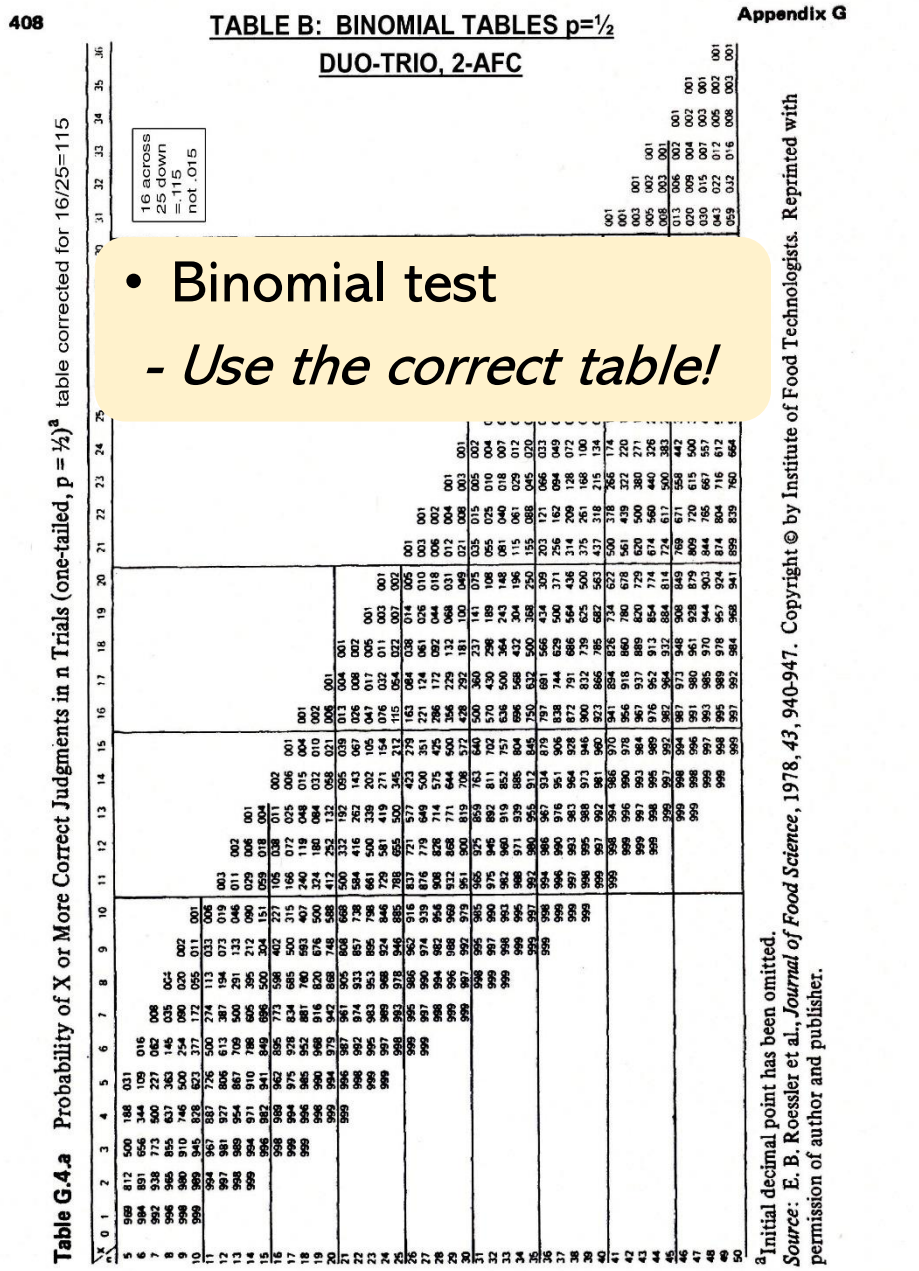
How to Interpret the data?

Example: 2-AFC test

Correct: 20 out of 36

SO is this proportion significantly higher than guessing probability (p=1/2)?

BINOMIAL TEST!



408 TABLE B: BINOMIAL TABLES p=½ Appendix G

DUO-TRIO, 2-AFC

16 across
25 down
=.115
not .015

Table G.4.a Probability of X or More Correct Judgments in n Trials (one-tailed, p = ½)[a] table corrected for 16/25=115

[a]Initial decimal point has been omitted.

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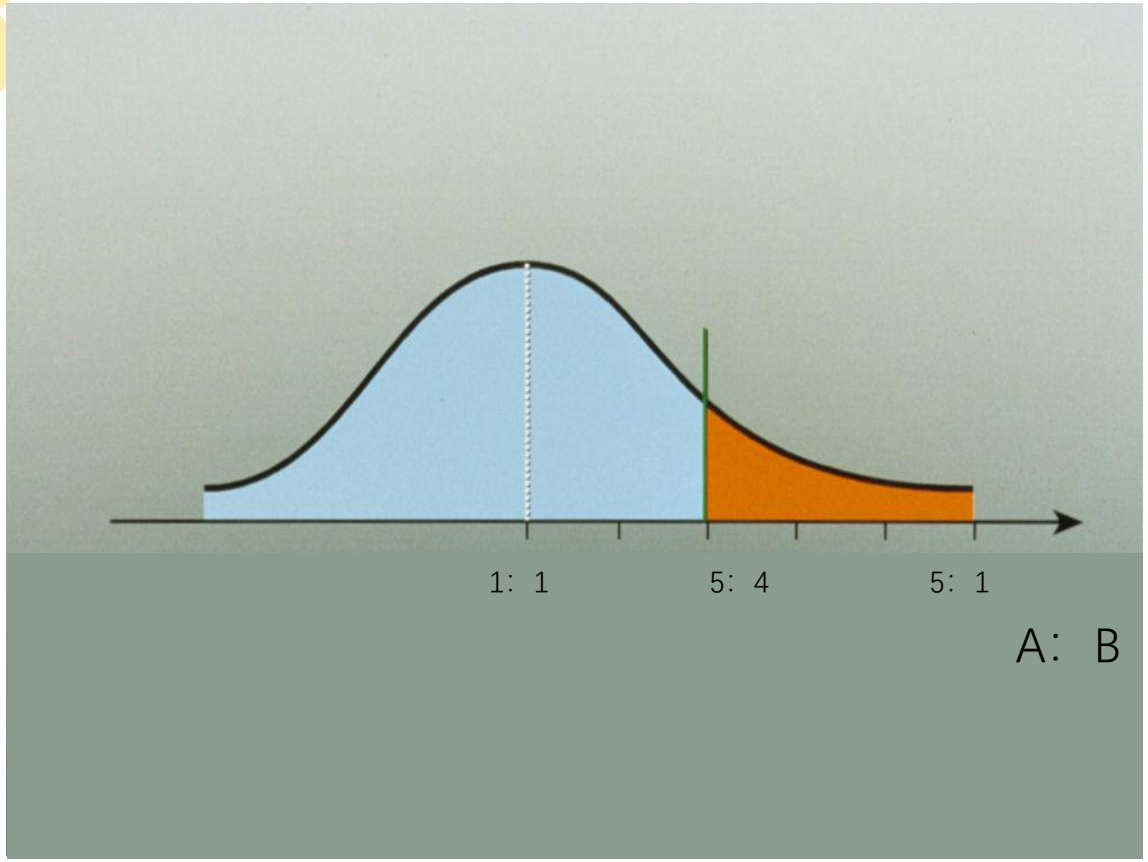
- Binomial test
  - *Use the correct table!*

Binomial test?

Null Hypothesis H_0: No significant difference between A and B (<u>18 select A & 18 select B</u>)

18 A	18 B	1:1	Most common on H_0
19 A	17 B		
20 A	16 B	5:4	
21 A	15 B		
22 A	14 B		
…	…		
30 A	6 B	5:1	
…	…		
36 A	0 B		Most rare on H_0

Binomial test?



- 36 participants, 36 selections, 36 events

$$(p+q)^{36}$$

p = probability of selecting A = 1/2

q= probability of selecting B = 1/2

Table G.4.a Probability of X or More Correct Judgments in n Trials (one-tailed, p = ½)[a]

n \ X	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
5	968	812	500	188	031																																
6	984	891	656	344	109	016																															
7	992	938	773	500	227	062	008																														
8	996	965	855	637	363	145	035	004																													
9	998	980	910	746	500	254	090	020	002																												
10	999	989	945	828	623	377	172	055	011	001																											
11		994	967	887	726	500	274	113	033	006																											
12		997	981	927	806	613	387	194	073	019	003																										
13		998	989	954	867	709	500	291	133	046	011	002																									
14		999	994	971	910	788	605	395	212	090	029	006	001																								
15			996	982	941	849	696	500	304	151	059	018	004																								
16			998	989	962	895	773	598	402	227	105	038	011	002																							
17			999	994	975	928	834	685	500	315	166	072	025	006	001																						
18			999	996	985	952	881	760	593	407	240	119	048	015	004	001																					
19				998	990	968	916	820	676	500	324	180	084	032	010	002																					
20				999	994	979	942	868	748	588	412	252	132	058	021	006	001																				
21				999	996	987	961	905	808	668	500	332	192	095	039	013	004	001																			
22					998	992	974	933	857	738	584	416	262	143	067	026	008	002																			
23					999	995	983	953	895	798	661	500	339	202	105	047	017	005	001																		
24					999	997	989	968	924	846	729	581	419	271	154	076	032	011	003	001																	
25						998	993	978	946	885	788	655	500	345	212	015	054	022	007	002																	
26						999	995	986	962	916	837	721	577	423	279	163	084	038	014	005	001																
27						999	997	990	974	939	876	779	649	500	351	221	124	061	026	010	003	001															
28							998	994	982	956	908	828	714	575	425	286	172	092	044	018	006	002															
29							999	996	988	969	932	868	771	644	500	356	229	132	068	031	012	004	001														
30							999	997	992	979	951	900	819	708	572	428	292	181	100	049	021	008	003	001													
31								998	995	985	965	925	859	763	640	500	360	237	141	075	035	015	005	002													
32								999	997	990	975	945	892	811	702	570	430	298	189	108	055	025	010	004	001												
33								999	998	993	982	960	919	852	757	636	500	364	243	148	081	040	018	007	002												
34									999	995	988	971	939	885	804	696	568	432	304	196	115	061	029	012	005	007											
35									999	997	992	980	955	912	845	750	632	500	368	250	155	088	045	020	008	003	001										
36									999	998	994	986	967	934	879	797	691	565	434	309																	
37										999	996	990	976	951	906	838	744	629	500	371	256	162	094	049	024	010	004	001									
38										999	997	993	983	964	928	872	791	686	564	436	314	209	128	072	036	017	007	003									
39										999	998	995	988	973	946	900	832	739	625	500	375	261	168	100	054	027	012	005									
40											999	997	992	981	960	923	866	785	682	563	437	318	215	134	077	040	019	008	003	001							
41											999	998	994	986	970	941	894	826	734	622	500	378	266	174	106	059	030	014	006	002	001						
42												999	996	990	978	956	918	860	780	678	561	439	322	220	140	082	044	022	010	004	001						
43												999	997	993	984	967	937	889	820	729	620	500	380	271	180	111	063	033	016	007	003	001					
44												999	998	995	989	976	952	913	854	774	674	560	440	326	226	146	087	048	024	011	005	002	001				
45													999	997	992	982	964	932	884	814	724	617	500	383	276	186	116	068	036	018	008	003	001				
46													999	998	994	987	973	948	908	849	769	671	558	442	329	231	151	092	052	027	013	006	002	001			
47													999	998	996	991	980	961	928	879	809	720	615	500	385	280	191	121	072	039	020	009	004	002	001		
48														999	997	993	985	970	944	903	844	765	667	557	443	333	235	156	097	056	030	015	007	003	001		
49														999	998	995	989	978	957	924	874	804	716	612	500	388	284	196	126	076	043	022	012	005	002	001	
50															999	997	992	984	968	941	899	839	760	664	556	444	336	240	161	101	059	032	016	008	003	001	

[a]Initial decimal point has been omitted.

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20 out of 36

30.9%

Example: Triangle test

- **Binomial distribution:**

To determine whether the result of the study was due to chance alone or whether the panelists actually perceived a difference between the samples.

$$P(y) = \frac{n!}{y!\,(n-y)!} p^y p^{n-y}$$

n = total number of judgments;

y = total number of correct judgments;

p = probability of making the correct judgment by chance

n!= n*(n-1)*(n-2)…*2*1; P=1/3 for triangles

Table G.5.a. Minimum Numbers of Correct Judgments to Establish Significance at Various Probability Levels for Paired-Comparison and Duo-Trio Tests (one-tailed, p = ½)

No. of trials (n)	Probability levels						
	0.05	0.04	0.03	0.02	0.01	0.005	0.001
7	7	7	7	7	7		
8	7	7	8	8	8	8	
9	8	8	8	8	9	9	
10	9	9	9	9	10	10	10
11	9	9	10	10	10	11	11
12	10	10	10	10	11	11	12
13	10	11	11	11	12	12	13
14	11	11	11	12	12	13	13
15	12	12	12	12	13	13	14
16	12	12	13	13	14	14	15
17	13	13	13	14	14	15	16
18	13	14	14	14	15	15	16
19	14	14	15	15	15	16	17
20	15	15	15	16	16	17	18
21	15	15	16	16	17	17	18
22	16	16	16	17	17	18	19
23	16	17	17	17	18	19	20
24	17	17	18	18	19	19	20
25	18	18	18	19	19	20	21
26	18	18	19	19	20	20	22
27	19	19	19	20	20	21	22
28	19	20	20	20	21	22	23
29	20	20	21	21	22	22	24
30	20	21	21	22	22	23	24
31	21	21	22	22	23	24	25
32	22	22	22	23	24	24	26
33	22	23	23	23	24	25	26
34	23	23	23	24	25	25	27
35	23	24	24	25	25	26	27
36	24	24	25	25	26	27	28
37	24	25	25	26	26	27	28
38	25	25	26	26	27	28	29
39	26	26	26	27	28	28	30
40	26	27	27	27	28	29	30
41	27	27	27	28	29	30	31
42	27	28	28	29	29	30	32
43	28	28	29	29	30	31	32
44	28	29	29	30	31	31	33
45	29	29	30	30	31	32	34
46	30	30	30	31	32	33	34
47	30	30	31	31	32	33	35
48	31	31	31	32	33	34	36
49	31	32	32	33	34	34	36
50	32	32	33	33	34	35	37
60	37	38	38	39	40	41	43
70	43	43	44	45	46	47	49
80	48	49	49	50	51	52	55
90	54	54	55	56	57	58	61
100	59	60	60	61	63	64	66

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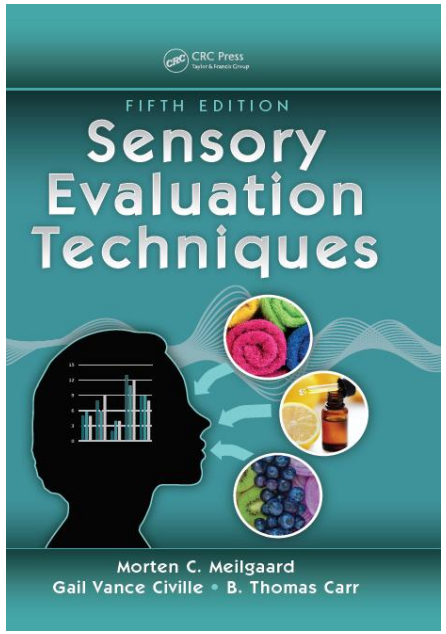
So, according to the current result (20 out of 36 correct), can we say A and B are significantly different from each other (REJECT H_0)?

$p < 0.05$ 5% level

$p < 0.01$ 1% level

$p < 0.001$ 0.1% level

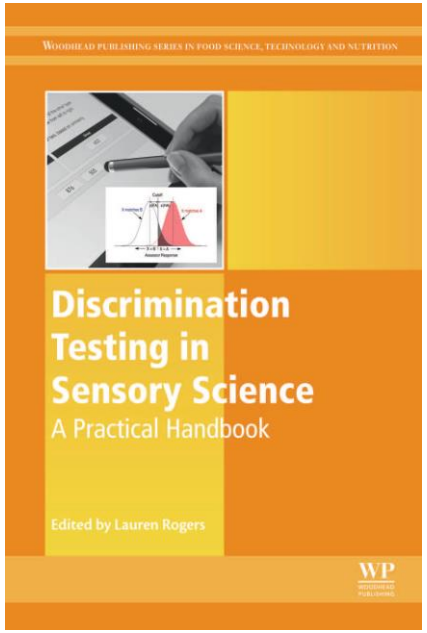


Issues:

–Limited information; only find out if there is a perceptible difference

–External clues

–Power (need many judges); *tables do not account for subjects pre-screened for their sensory acuity in the category of interest.*



Discrimination testing is widely used in sensory science today.

■Small panel procedure.

■Subjects screened for sensory acuity.

■Triangle and Duo-Trio are most common and are equally sensitive. Less fatigue with Duo-Trio

■Can two ‘Control products’ pass?

■New methods are introduced; keep up with literature.