



Ewha Womans University

Tuesday June 12, 2012 • Seoul, South Korea

Five Key Experimental Factors for a Successful Sensory Discrimination Program

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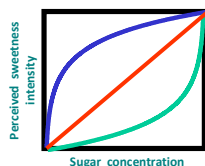


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Main Research Themes

Sensitivity (Thresholds)



Discrimination

Triangle



Which sample is different
from the other two?

Descriptive

1 2 3 4 5 6 7 8 9



• How sweet?



• How bitter?

• How fruity?

• How astringent?

Hedonic



Which sample do you prefer?

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Why Discrimination Testing?



- Measure the size of the difference between products
- Two main objectives
 - ❖ Prove products are different
 - “New and improved”, “Fresher, crisper taste”
 - ❖ Prove products are similar
 - Ingredient change, new supplier, government regulation (e.g., salt or sugar reduction)
- Use discrimination testing to measure small sensory differences



How Discrimination Testing?



- Get samples to be compared



“Which one is more bitter?”

- Get panelists



- Get results (e.g., $15/20$ correct)



Common Sensory Discrimination Methods

Information regarding the sample to be selected not required		
❖ Triangle		Which one is different?
❖ Duo-trio		Which one is the same as the reference ?
❖ Tetrad		Group the samples into 2 groups of 2 identical samples
❖ Method of triads		Which one is more similar to the reference ?
❖ Same-different		Are they the same or different ?
❖ ...		
Information regarding the sample to be selected required		
❖ 2-AFC		Which one is <i>more</i> ... ?
❖ 3-AFC		Which one of the three is the <i>most</i> ... ?
❖ m-AFC		Which <u>one</u> of the m is the <i>most</i> ... ?
❖ Specified tetrad		Which <u>two</u> are the <i>most</i> ... ?
❖ Identification		Is it A or B ?
❖ ...		

Sensory Discrimination Program

❖ 5 linked components:

α : Probability of a Type I error (wrongly concluding that a difference exists between the products)



β : Probability of a Type II error (wrongly concluding that no difference exists between the products = 1-power)



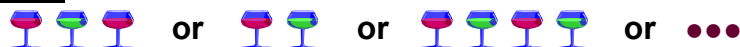
δ : Size of the difference of interest



N : Sample size



Testing Protocol

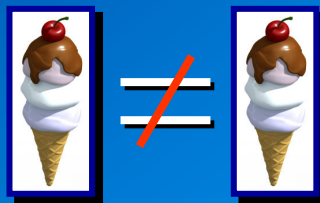




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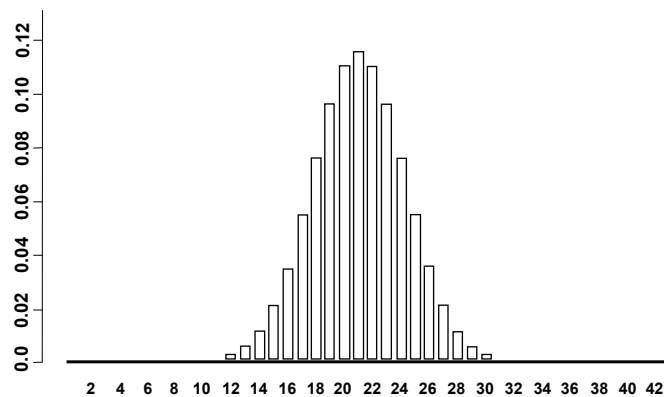
α : Type I Error

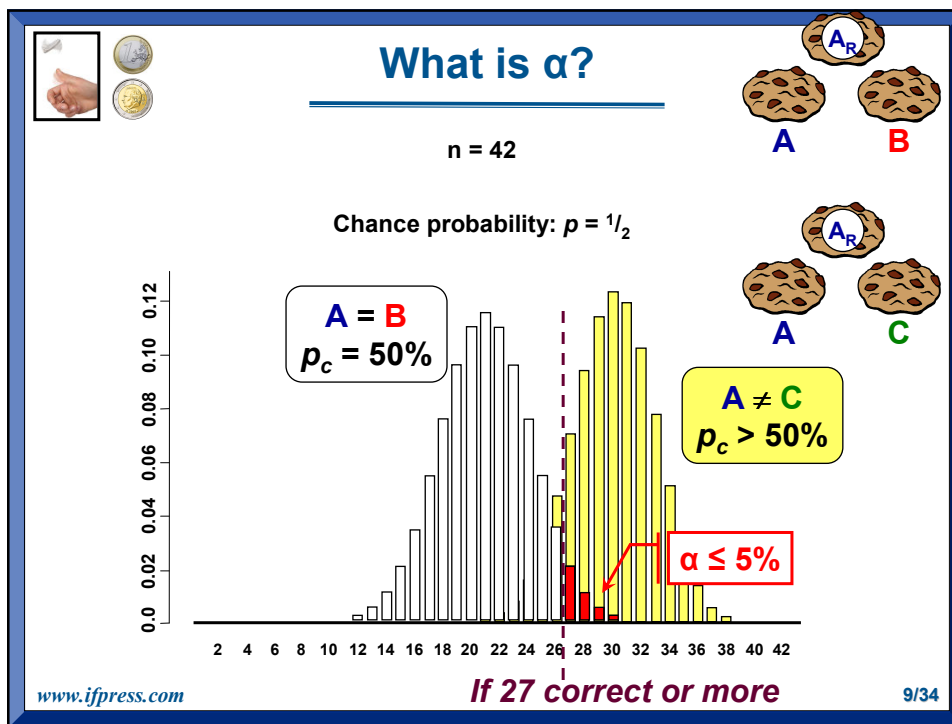


Binomial Theory

$$n = 42$$

Chance probability: $p = 1/2$





Binomial table for the Duo-Trio and 2-AFC Tests

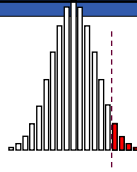
If sample size = 42

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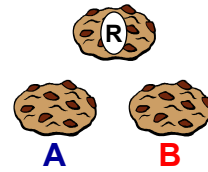
Number correct needed to be significant at $\alpha=5\%$

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n	0	1	2	3	4	5	6	7	8	9
10	9	9	10	11	12	12	13	13	14	
20	15	15	16	17	18	18	19	19	20	
30	21	21	22	23	23	24	24	25	26	
40	28	28	29	30	30	31	31	32	33	
50	35	35	36	37	37	38	38	39	40	
60	42	42	43	44	44	45	45	46	47	
70	49	49	50	51	51	52	52	53	54	
80	56	56	57	58	58	59	59	60	61	
90	63	63	64	65	65	66	66	67	68	
100	70	70	71	72	72	73	73	74	75	
110	77	77	78	79	79	80	80	81	82	
120	84	84	85	86	86	87	87	88	89	
130	91	91	92	93	93	94	94	95	96	
140	98	98	99	100	100	101	101	102	103	
150	105	105	106	107	107	108	108	109	110	
160	112	112	113	114	114	115	115	116	117	
170	119	119	120	121	121	122	122	123	124	
180	126	126	127	128	128	129	129	130	131	
190	133	133	134	135	135	136	136	137	138	
200	140	140	141	142	142	143	143	144	145	
210	147	147	148	149	149	150	150	151	152	
220	154	154	155	156	156	157	157	158	159	
230	161	161	162	163	163	164	164	165	166	
240	168	168	169	170	170	171	171	172	173	
250	175	175	176	177	177	178	178	179	180	
260	182	182	183	184	184	185	185	186	187	
270	189	189	190	191	191	192	192	193	194	
280	196	196	197	198	198	199	199	200	201	
290	203	203	204	205	205	206	206	207	208	
300	210	210	211	212	212	213	213	214	215	



Type I Error



- Falsely concluding that the products are different when they are not

- Consequence:

- ❖ Two main objectives

- Prove products are different
 - “New and improved”, “Fresher, crisper taste”
 - **Conclude a difference, but product was not improved**



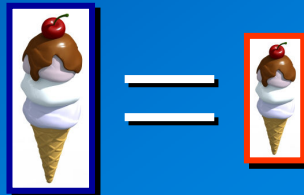
- Prove products are similar

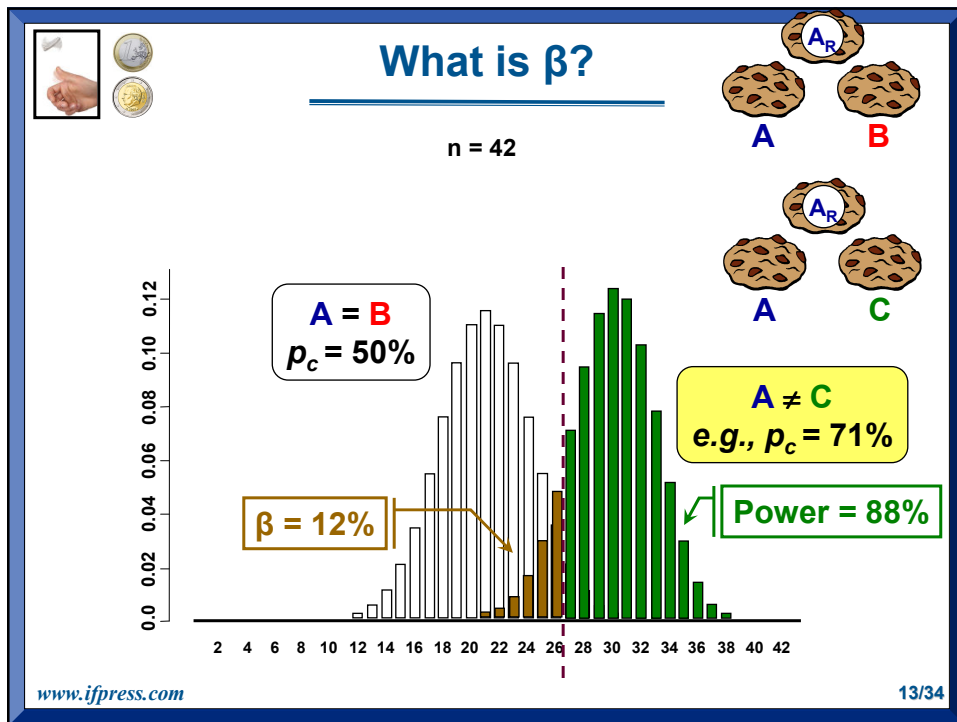
- Ingredient change, new supplier, government regulation (e.g., salt or sugar reduction)
 - **Conclude a difference**
 - **Missed an opportunity for change**



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β : Type II Error (1 – power)





Type II Error

- Falsely concluding that the products are not different when they are; failing to find a difference
- Consequence:
 - ❖ Two main objectives
 - Prove products are different
 - “New and improved”, “Fresher, crisper taste”
 - **Conclude similarity, missed an opportunity for change**
 - Prove products are similar
 - Ingredient change, new supplier, government regulation (e.g., salt or sugar reduction)
 - **Conclude similarity → Release on the market of a sensorially different product**

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Size of the Relevant Difference



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Comments on Sensory Differences



**Two different products
will never be identical**

**A lack of significance difference does not
mean that two products are identical/similar**

**A significant difference can always be found,
provided that the sample size is large enough**

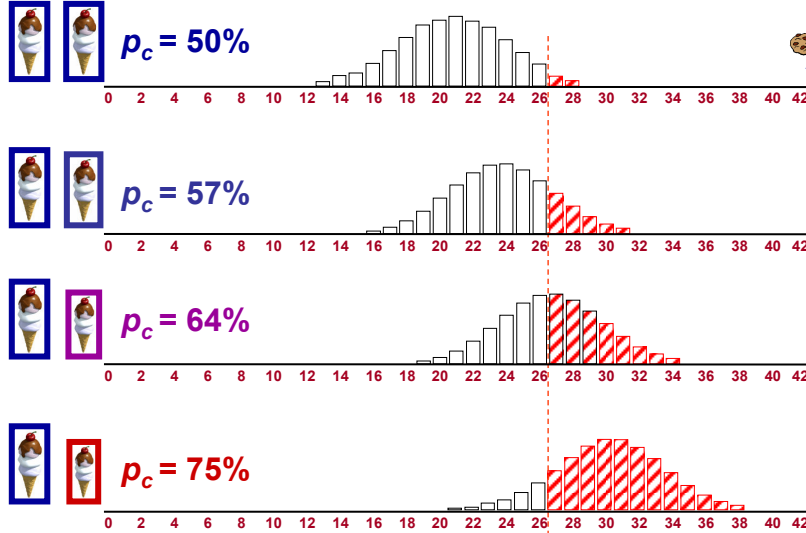


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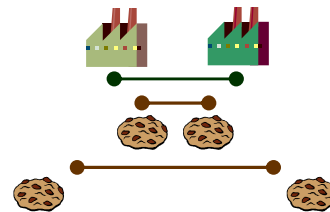
Increasing the Size of the Difference

N=42



Estimating the Size of a Relevant Difference

- No universal answer
- Research is necessary
- Various options
 - ❖ *Measuring inter factory differences*

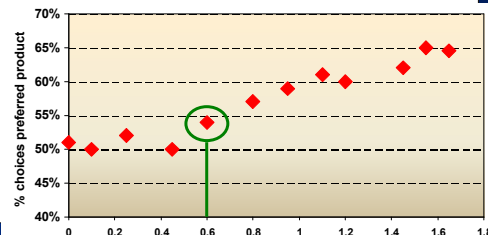


- ❖ *Use the same-different test*
 - Estimate the size of the sensory difference above which consumers call the products 'Different'



"Are they the same or different?"

- ❖ *Build a relationship between perceived differences and consumer preferences*





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Sample Size



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Effect of Sample size on Discrimination

- Greater sample sizes provide greater statistical power
- Example: One study, no significance difference found
 - ❖ 5 panelists  performing one triangle 

vs.

- ❖ 500 panelists  performing one triangle 

- Larger sample sizes are less likely to miss sensory differences
- The sample size is a function of α , β , the **size of the difference** of interest and the **test methodology**

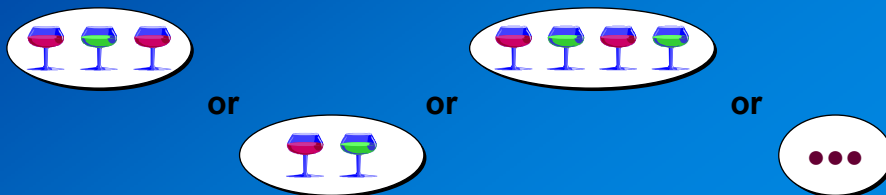
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Test Protocol

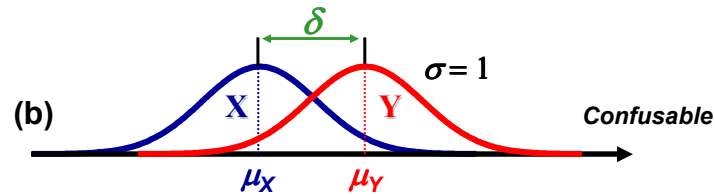
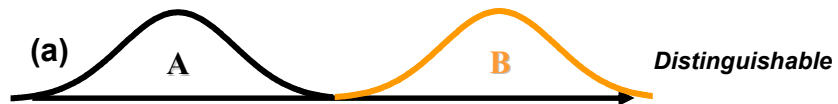


Common Sensory Discrimination Methods

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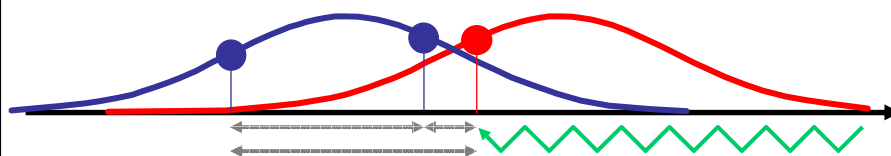
Sensory Differences



δ = distance between the means (μ_X and μ_Y) of the distributions measured in terms of their standard deviation (σ)

d' = Experimental estimate of δ

Decision Rules

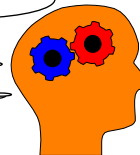


❖ Triangle: **Wrong**

Comparison of distances

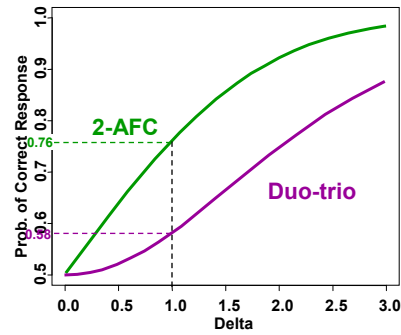
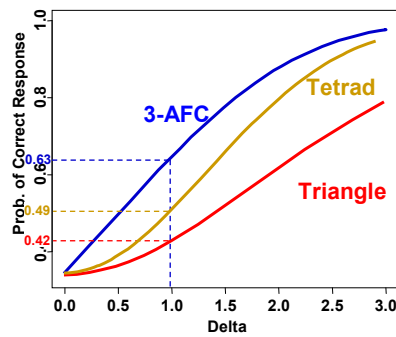
❖ 3-AFC: **Correct**

Magnitudes



Comparison of distances	Magnitudes
Triangle, Duo-trio, Tetrad	2-AFC, 3-AFC, m -AFC,

Proportion Correct vs. δ

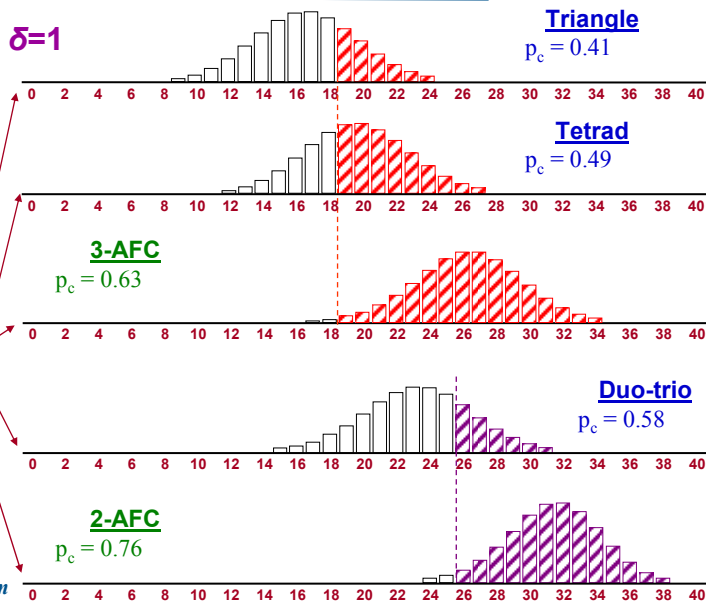


Relative Discrimination Power, N=40



$\delta=1$

Number
of tests
correct





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Establishing a Successful Sensory Discrimination Program



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Sensory Discrimination Program

❖ 5 linked components:

α : Probability of a Type I error (wrongly concluding that a difference exists between the products)



β : Probability of a Type II error (wrongly concluding that no difference exists between the products = 1-power)



δ : Size of the difference of interest

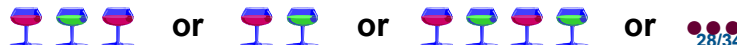


N : Sample size



Testing Protocol

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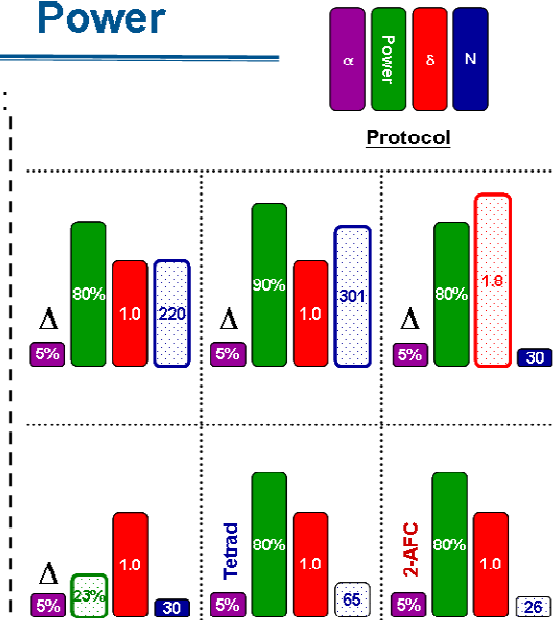
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Power

❖ 5 linked components:

- α : Probability of a Type I error (wrongly concluding that a difference exists between the products)
- β : Probability of a Type II error (wrongly concluding that no difference exists between the products = **1-power**)
- δ : Size of the difference of interest
- N : Sample size

Protocol



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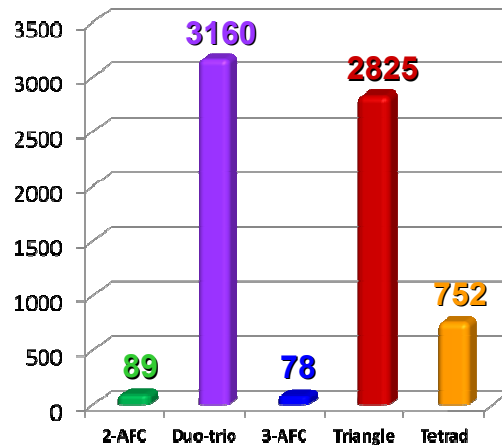
Conclusions

The Cost of Decision Rules (1)

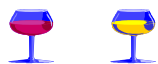


Scenario 1

- **Size of the difference:**
64:36 in a 2-AFC (δ of 0.5)
- **Power:** 80% chance of detecting the difference
- **α level:** 5%
- **Sample size needed** ➡

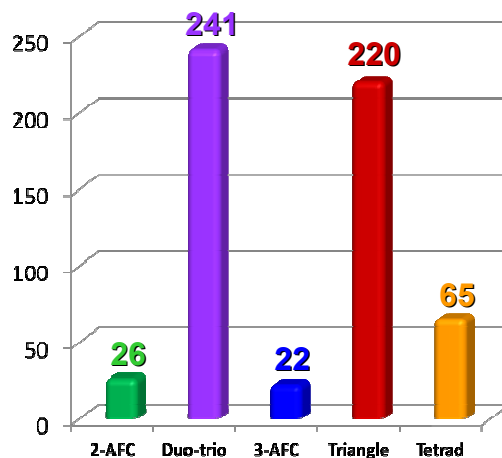


The Cost of Decision Rules (2)



Scenario 2

- **Size of the difference:**
76:24 in a 2-AFC (δ of 1)
- **Power:** 80% chance of detecting the difference
- **α level:** 5%
- **Sample size needed** ➡





Discrimination Testing



➤ Two main objectives

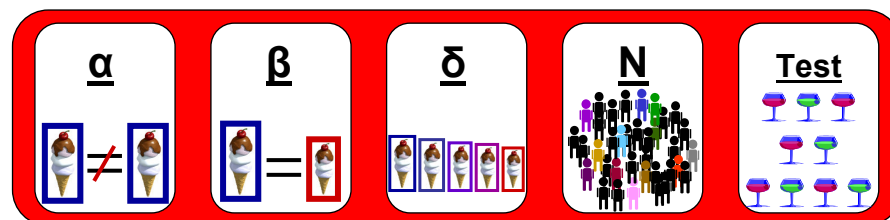
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Thank You Very Much
Any Questions?

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