Hypothesis Testing

- ✓ Basics Concept
- ✓ Null Hypothesis
- ✓ Alternate Hypothesis
- ✓ Type I and Type II Error
- ✓ Standard error of mean
- ✓ Hypothesis Testing Steps
- ✓ Z Test

Biostatistics & Research Methodology
B Pharm 8th Sem | M. Pharm. | PhD

Hypothesis

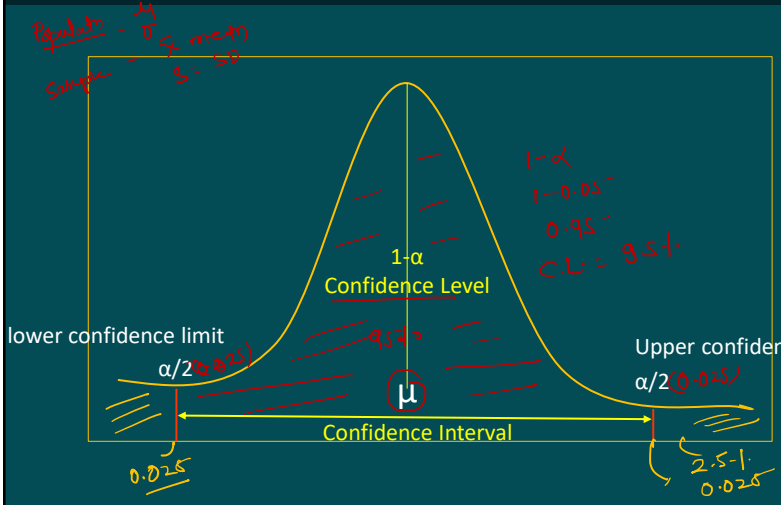
- A hypothesis is a proposed explanation for a phenomenon but has not yet been tested true or false.
- **Characteristics of Hypothesis**
  - It should be clear and precise to consider it to be reliable.
  - If the hypothesis is a relational hypothesis, then it should be stating the relationship between variables.
- **Sources of Hypothesis**
  - The resemblance between the phenomenon.
  - It should be proposed based on some scientific evidence or theory
  - Observations from past studies, present-day experiences and from the competitors.
  - General patterns that influence the thinking process of people.

Hypothesis

Hypothesis

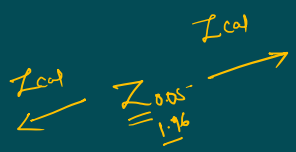
- **Simple** — A hypothesis that there exists a relationship between two variables
- **Complex** — A complex hypothesis is used when there is a relationship between the existing multiple variables.
- **Null (H0)** — there is no significant difference between the populations or samples specified in the experiments
- **Alternate (H1/Ha)** — there is significant difference between the populations specified in the experiments
- **Empirical** — An empirical hypothesis is formed by the experiments and based on the evidence
- **Statistical** — In a statistical hypothesis, the statement should be logical or illogical, and the hypothesis is verified statistically.

Hypothesis



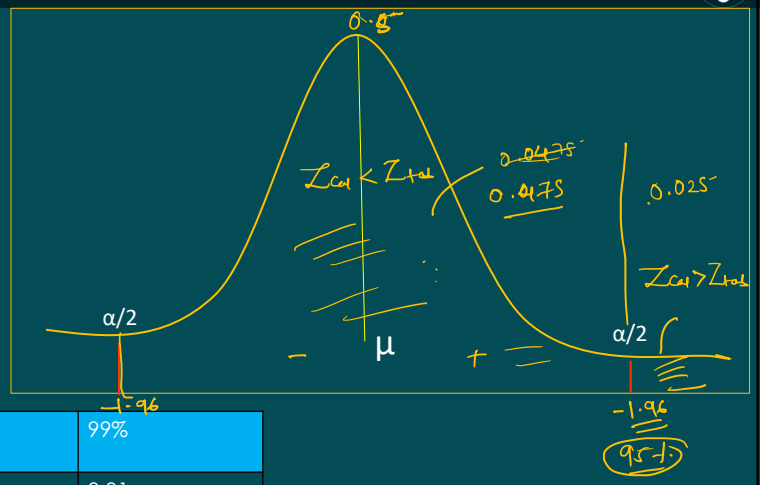
- ✓ a – threshold of significance
- ✓ a – 5% or p<0.05
- ✓ confidence level- 1-0.05 = 0.95 or 95%
- ✓ Two Tail – we used a/2

Hypothesis



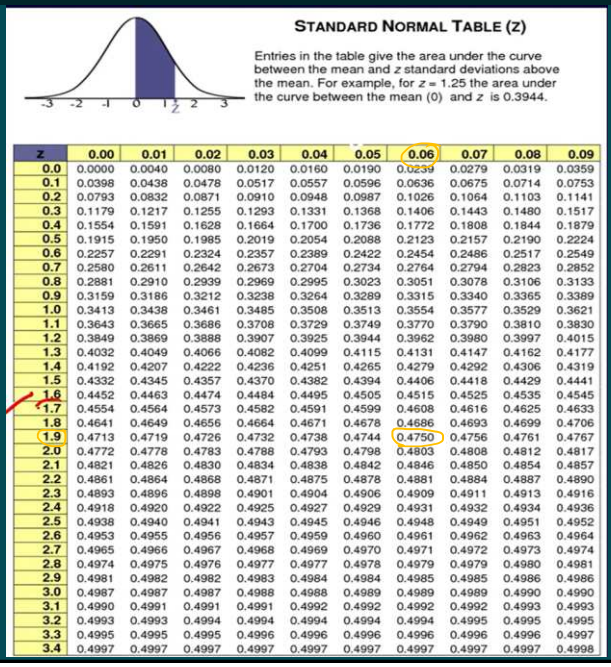
- ✓ For normal distribution data (N≥30) we used **Z Score** to check the level of significance or find out the critical value

$\alpha = 0.05 = 0.1$



Confidence level	90%	95%	99%
alpha for one-tailed CI (α)	0.1	0.05	0.01
alpha for two-tailed CI	0.05	0.025	0.005
z statistic	**1.64**	**1.96**	**2.57**

Hypothesis

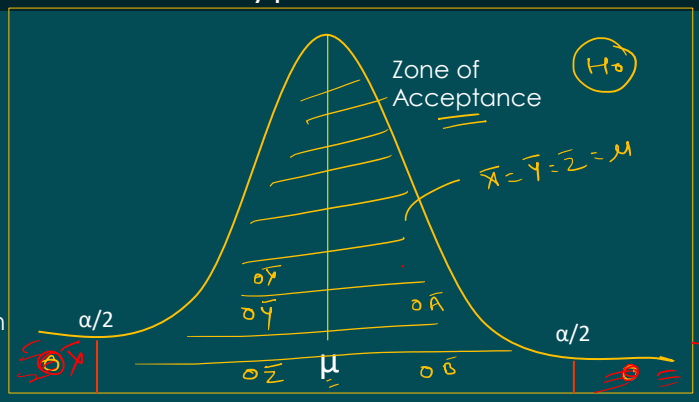


STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and *z* standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998

Hypothesis



Null Hypothesis (H0): there is No significant difference between the populations or groups specified in the experiments.

$\bar{X} = \bar{Y} = \bar{Z}$

$\mu = \bar{X}$

Alternate Hypothesis (H1/Ha): there is significant difference between the populations or groups specified in the experiments

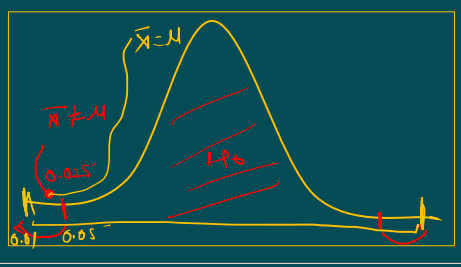
$\bar{X} \neq \bar{Y} \neq \bar{Z}$

$\mu \neq \bar{X}$

Type I & Type II error

$\alpha = 0.05$

$\alpha/2 = 0.025$



Type I Error (False Positive)

- The probability of type I error is called alfa (α)
- Zone of Acceptance is decrease
- Rejecting the H0, when its actually true
- Confidence level shift 0.05 to 0.1

Type I Error (False Negative)

- The probability of type II error is called beta (β)
- Zone of Acceptance is increase
- Accepting the H0, when its actually false
- Confidence level shift 0.05 to 0.01

	Accept H0	Reject H0
H0 is true	Correct design	Type I error
H0 is False	Type II error	Correct design

Hypothesis Testing Steps

Question: A company claim that the avg life of a thermometer is 60 month (N = 81) with SD 10 month, whether the 62 month is acceptable or not (at 5% significance level, Z tabulated = 1.96)

Step 1: Setup hypothesis, H0 or Ha

Step 2: Setup a Significance level

Step 3: Applied Appropriate Test

Step 4: Make Conclusion

Hypothesis Testing Steps

Question: A company claim that the avg life of a thermometer is 60 month (N = 81) with SD 10 month, whether the 62 month is acceptable or not (at 5% significance level, Z tabulated = 1.96)

Z = Difference of mean/ Standard error of mean

Z test = $|\bar{X}-\mu|$ / SEM

SEM = $\sigma/\sqrt{n}$

$Z = 62 - 60 / (10/\sqrt{81})$

$= 2/(10/9) = 2/1.11$

$= 1.8$

Zcal < Ztab

Means: H0 True & accepted

C L	90%	95%	99%
z stati stic	1.64	1.96	2.57

	Accept H0	Reject H0
H0 is true	Correct design	Type I error
H0 is False	Type II error	Correct design

Hypothesis Testing Steps

Question: A company claim that the avg life of a thermometer is 60 month (N = 81) with SD 10 month, whether the 62 month is acceptable or not (at 5% significance level, $Z_{tabulated}$ = 1.96)

Z = Difference of mean/ Standard error of mean

Z test = |X-μ| / SEM

SEM = $\sigma/\sqrt{n}$

Confidential Interval: Mean ± Z(0.05)xSEM

= 60 ± 1.96 (1.11)

= 60 ± 2.17

CI = 57.83 to 62.17