# Comparing means

## **Notations**

|  |  |
| --- | --- |
| **Population statistics** | |
| Population mean |  |
| Population variance |  |
| Population standard deviation |  |
| Standard error of a population mean |  |
| **Sample statistics** | |
| Sample mean |  |
| Sample variance |  |
| Sample standard deviation |  |
| Standard error of the sample mean |  |
| **Independent two samples** | |
| Mean of the difference between samples | or |
| Variance of the difference between samples |  |
| Standard deviation of the difference between samples |  |
| Standard error of the difference between samples |  |
| Distribution of the difference between two sample means |  |

## **Hypothesis testing**

|  |  |
| --- | --- |
| **Two independent samples t-test** | |
| Equal variances, Unequal sample sizes | |
| test statistic |  |
| pooled standard deviation |  |
| Standard error |  |
| degrees of freedom |  |
| Equal variances, Equal sample sizes | |
| test statistic |  |
| pooled standard deviation |  |
| Standard error |  |
| degrees of freedom |  |
| Unequal variances (Welch’s test) | |
| test statistic |  |
| degrees of freedom | or Welch–Satterthwaite equation |
| Standard error |  |
| distribution of test statistic |  |
| **One sample t-test** | |
| test statistic |  |
| Standard error |  |
| degrees of freedom |  |
| distribution of test statistic |  |

## **Sample size calculation**

|  |  |
| --- | --- |
| **Two samples** | |
| Effect size |  |
| Critical value condition |  |
| Equal variances, Equal sample sizes | |
| Critical value condition |  |
| Minimum sample size | Multiplier   |  |  |  |  | | --- | --- | --- | --- | | / |  |  |  | | 0.8 | 11.7 | 7.9 | 6.2 | | 0.9 | 14.9 | 10.5 | 8.6 | | 0.95 | 17.8 | 13.0 | 10.8 |   So for and , , |
| Rule of thumb | shows the number of standard deviations the means are away from each other. 16 is the numerator.  When   |  |  |  |  | | --- | --- | --- | --- | |  | Power |  | | | One sample | Two sample | | 0.5 | 0.5 | 4 | 8 | | 0.2 | 0.8 | 8 | 16 | | 0.1 | 0.9 | 11 | 21 | | 0.05 | 0.95 | 13 | 26 | | 0.025 | 0.975 | 16 | 31 | |
| Detectable difference |  |
| Equal variances, Unequal sample sizes | |
| Minimum sample size |  |
| Unequal variances, Unequal sample sizes | |
| Critical value condition |  |
| Minimum sample size |  |
| **One sample** | |
| Effect size |  |
| Critical value condition |  |
| Minimum sample size |  |

# Comparing proportions

## **Notations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Success** | **Failure** | **Total** |
| *Control (group 1)* |  |  |  |
| *Treatment (group 2)* |  |  |  |
| *Total* |  |  |  |

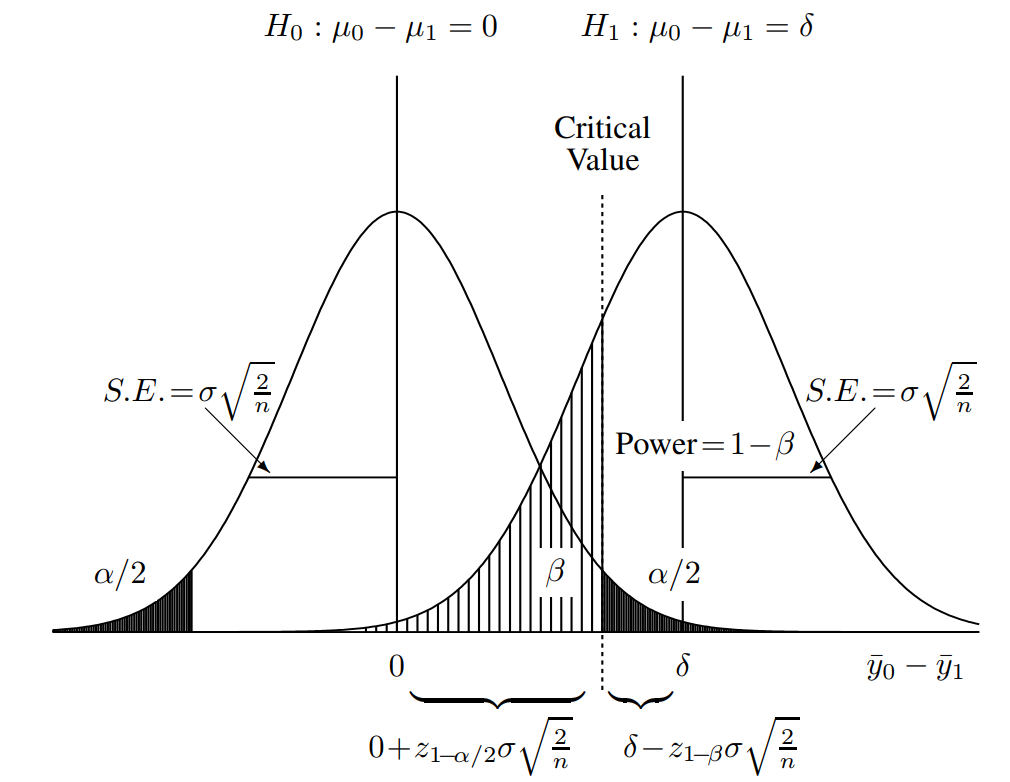
## **Hypothesis testing**

|  |  |
| --- | --- |
| **Two samples** | |
| Z Test (or Chi-Square Test) | |
| test statistic |  |
| Standard error (**unpooled version**) | where |
| Standard error (**pooled version**)  Satterthwaite approximation for pooled standard error | where |
| distribution of test statistic |  |
| T-Test | |
| test statistic |  |
| Degrees of freedom |  |
| distribution of test statistic |  |
| **One sample** | |
| test statistic |  |
| Standard error |  |

## **Sample size calculation**

|  |  |
| --- | --- |
| **Two samples** | |
| Unequal variances, Unequal sample sizes | |
| Minimum sample size |  |
| Unequal variances, Equal sample sizes | |
| Minimum sample size |  |
| **One sample** | |
| Critical value condition |  |
| Minimum sample size |  |

# Graphs



# Table of t values

|  |  |  |  |
| --- | --- | --- | --- |
|  | Confidence |  |  |
| 0.0005 | 99.9% | 3.291 |  |
| 0.001 | 99.8% | 3.090 | 3.291 |
| 0.005 | 99% | 2.576 | 3.090 |
| 0.01 | 98% | 2.326 | 2.576 |
| 0.025 | 95% | 1.960 | 2.326 |
| 0.05 | 92% | 1.645 | 1.960 |
| 0.1 | 80% | 1.282 | 1.645 |
| 0.15 | 70% | 1.036 | 1.282 |
| 0.2 | 60% | 0.842 | 1.036 |
| 0.25 | 50% | 0.674 | 0.842 |