

# TESTS – I

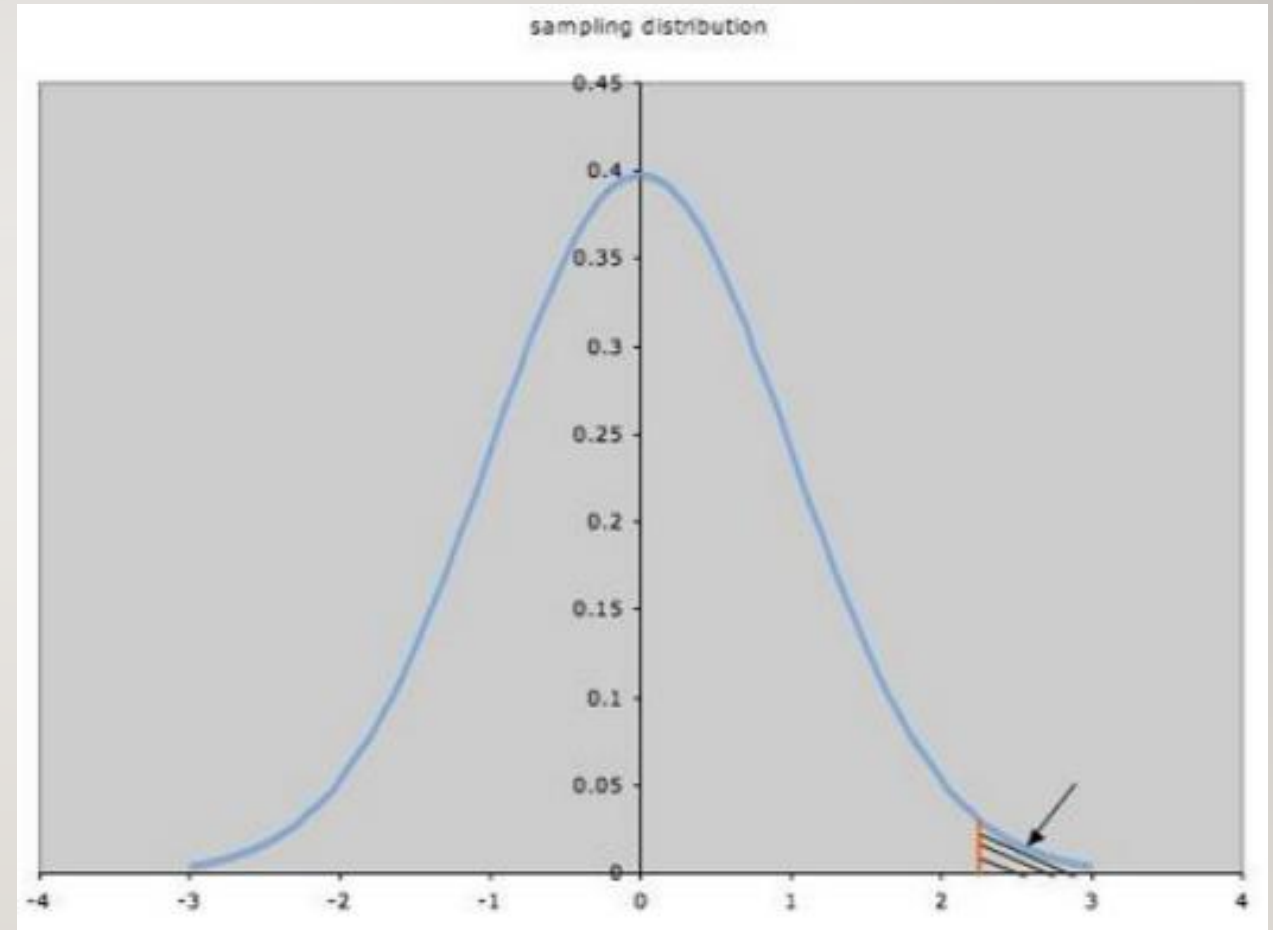
---

LAXMINARAYEN

# CRITICAL VALUE

---

A CRITICAL VALUE IS A LINE ON A GRAPH THAT SPLITS THE GRAPH INTO SECTIONS.

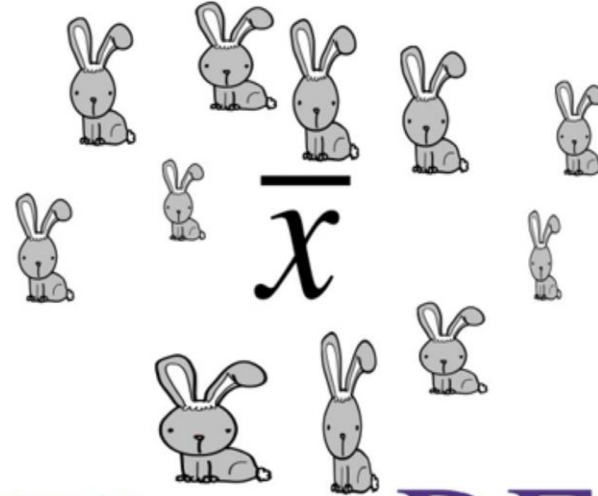


# DEGREES OF FREEDOM

---

YOU DON'T NEED TO FULLY  
UNDERSTAND THE MATHS

BUT HOPEFULLY  
WE CAN HELP!



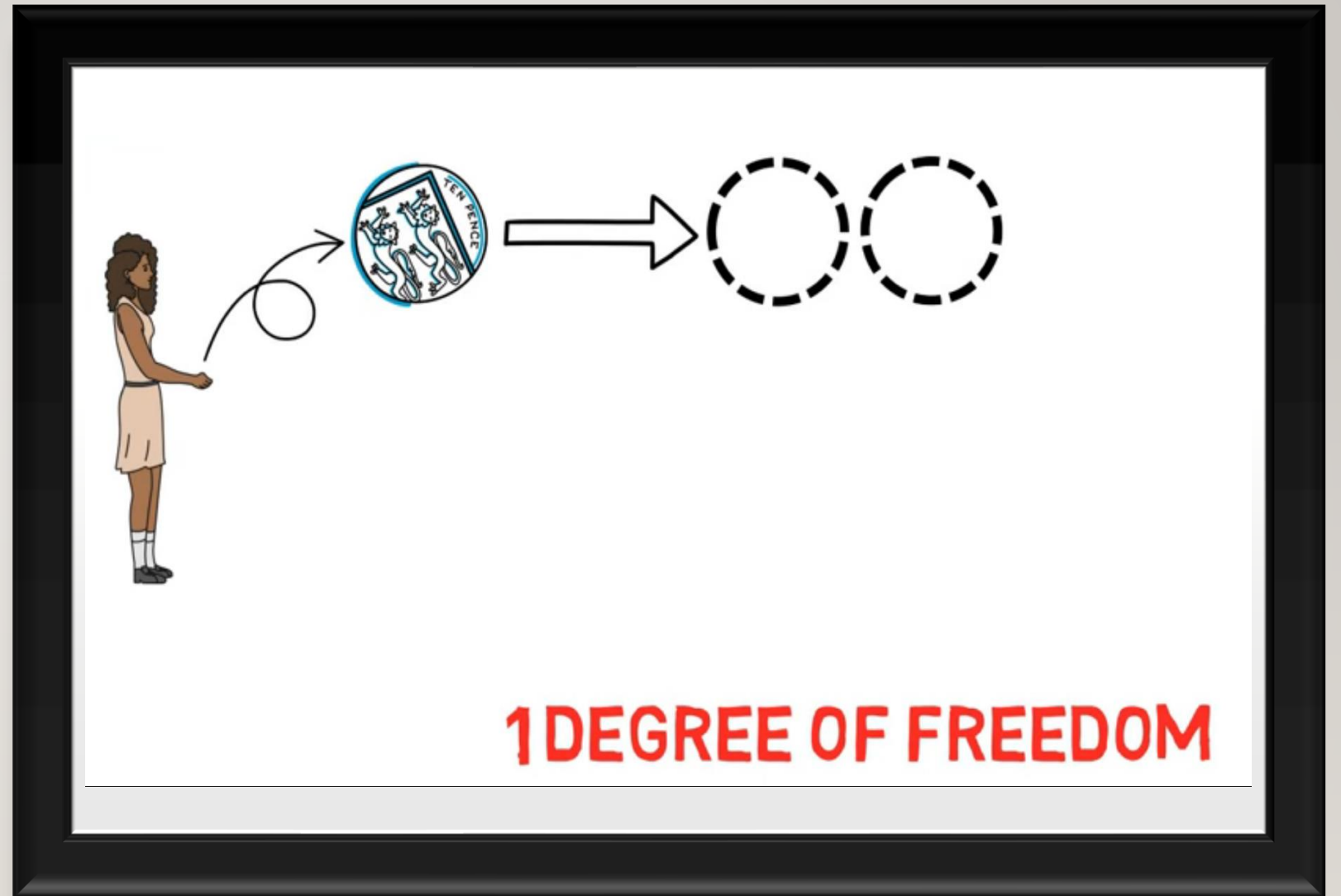
DEFINITION OF DF:

NUMBER OF INDEPENDENT  
PIECES OF INFORMATION

**BUT**  $DF \neq N$

# EXAMPLE FOR DEGREES OF FREEDOM

---



# HYPOTHESIS TESTING STEPS

---

1. State the Null Hypothesis ( $H_0$ ) and Alternate Hypothesis ( $H_1$ )
2. Choose the Level of Significance
3. Find Critical Values
4. Find test Statistic
5. Draw your conclusion



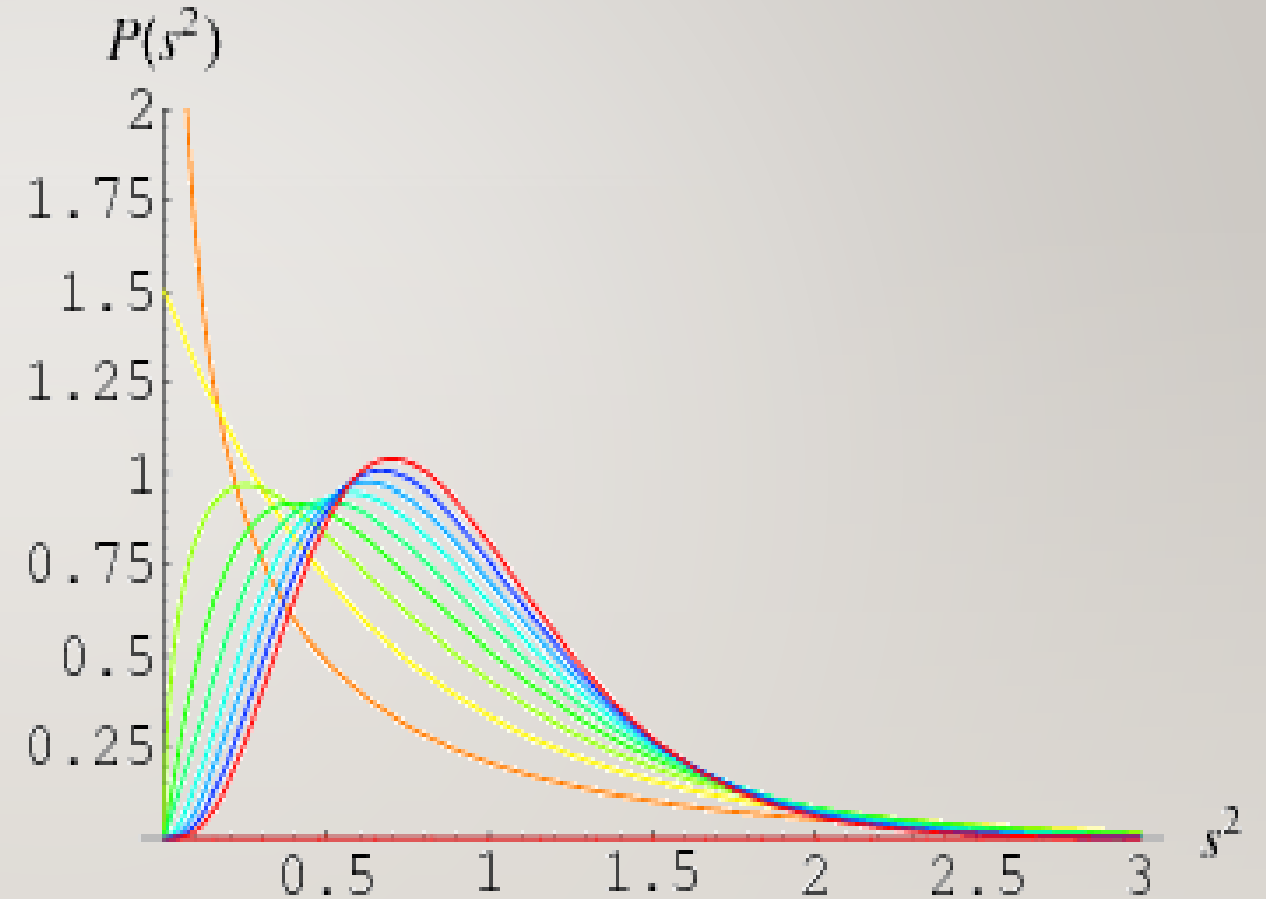
# ONE VARIABLE - TESTS

---

|                        |   |  |
|------------------------|---|--|
| $z$                    | } | Closely related to Sampling Distribution of <b>Means</b>       |
| $t$                    |   |  |
| $\chi^2$ (Chi-squared) | } | • Closely related to Sampling Distribution of <b>Variances</b> |
| $F$                    |   | • Derived from Normal Distribution                             |

# SAMPLING DISTRIBUTION OF VARIANCE

THE DISTRIBUTION OF SAMPLE VARIANCES,  
WITH ALL HAVING THE SAME SAMPLE SIZE  
N



# Z – TEST

- A **z-test** is a **statistical test** used to determine whether means are different when the variance of population known and the sample size is large.



# ASSUMPTIONS FOR Z – TEST

---

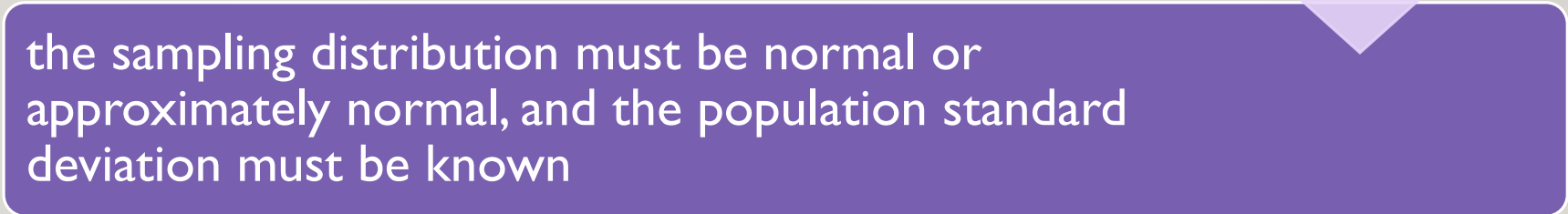
The sample size is large ( $n > 30$ )



The data were collected in a random way, each observation must be independent of the others



the sampling distribution must be normal or approximately normal, and the population standard deviation must be known



# FORMULA FOR Z – TEST

---

$$Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

$\bar{x}$  = sample mean

$\mu$  = population mean

$\sigma$  = population standard deviation

$n$  = sample size

## EXAMPLE FOR Z – TEST

---

- A principal at a certain school claims that the students in his school are above average intelligence. A random sample of thirty students IQ scores have a mean score of 112. Is there sufficient evidence to support the principal's claim? The mean population IQ is 100 with a standard deviation of 15.

# STUDENT'S T-DISTRIBUTION

---

Developed by William Sealy Gossett  
while he was working at Guinness  
Brewery





# GOAL OF STUDENT'S T-DISTRIBUTION

- Goal was to select the best barley from small samples



|    |          |          |          |          |         |         |         |        |
|----|----------|----------|----------|----------|---------|---------|---------|--------|
| 8  | 0.261921 | 0.706367 | 1.396815 | 1.859548 | 2.30600 | 2.89646 | 3.35539 | 5.0413 |
| 9  | 0.260955 | 0.702722 | 1.383029 | 1.833113 | 2.26216 | 2.82144 | 3.24984 | 4.7809 |
| 10 | 0.260185 | 0.699812 | 1.370181 | 1.812481 | 2.22211 | 2.76377 | 3.16927 | 4.5869 |
| 11 | 0.259556 | 0.697445 | 1.363430 | 1.795885 | 2.20099 | 2.71808 | 3.10581 | 4.4370 |
| 12 | 0.259033 | 0.695483 | 1.356217 | 1.782288 | 2.17881 | 2.68100 | 3.05454 | 4.3178 |
| 13 | 0.258591 | 0.693829 | 1.350171 | 1.770332 | 2.16031 | 2.65121 | 3.01222 | 4.2208 |
| 14 | 0.258213 | 0.692417 | 1.345020 | 1.761310 | 2.14479 | 2.62449 | 2.97684 | 4.1405 |
| 15 | 0.257885 | 0.691197 | 1.340606 | 1.753050 | 2.13145 | 2.60248 | 2.94671 | 4.0728 |
| 16 | 0.257599 | 0.690132 | 1.336757 | 1.745884 | 2.11991 | 2.58349 | 2.92078 | 4.0150 |
| 17 | 0.257347 | 0.689195 | 1.333375 | 1.739607 | 2.10982 | 2.56693 | 2.89823 | 3.9651 |
| 18 | 0.257123 | 0.688364 | 1.330391 | 1.734064 | 2.10092 | 2.55238 | 2.87844 | 3.9216 |
| 19 | 0.256923 | 0.687621 | 1.327728 | 1.729133 | 2.09302 | 2.53948 | 2.86093 | 3.8834 |
| 20 | 0.256743 | 0.686954 | 1.325341 | 1.724718 | 2.08596 | 2.52798 | 2.84534 | 3.8495 |
| 21 | 0.256580 | 0.686352 | 1.323188 | 1.720743 | 2.07961 | 2.51765 | 2.83136 | 3.8193 |
| 22 | 0.256432 | 0.685805 | 1.321237 | 1.717144 | 2.07387 | 2.50832 | 2.81876 | 3.7921 |
| 23 | 0.256297 | 0.685302 | 1.319483 | 1.713873 | 2.06863 | 2.50005 | 2.80654 | 3.7676 |

## PURPOSE OF T-TEST

• Using the t-table, the Student's t-test determines if there is a significant difference in means between two sets of data

# ASSUMPTIONS FOR T – TEST

---

The sample size is not large ( $n < 30$ )

The data were collected in a random way, each observation must be independent of the others,

The sampling distribution must be normal

# ONE SAMPLE T-TEST CALCULATION

---

- The t-statistic:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

$\bar{x}$  = sample mean

$\mu$  = population mean

$s$  = sample standard error

$n$  = sample size

GUESS WHAT THE DEGREE OF FREEDOM IS FOR T –TEST!

---





# GUESS WHAT THE DEGREE OF FREEDOM IS FOR T –TEST!

---

- Degrees of Freedom  $df = N - 1$



## EXAMPLE FOR T – TEST

---

- Your company wants to improve sales. Past sales data indicate that the average sale was \$100 per transaction. After training your sales force, recent sales data (taken from a sample of 25 salesmen) indicates an average sale of \$130, with a standard deviation of \$15. Did the training work? Test your hypothesis at a 5% alpha level.

# EXAMPLE FOR T – TEST

---

- A car company claims that their Super Spiffy Sedan averages 31 mpg. You randomly select 8 Super Spiffies from local car dealerships and test their gas mileage under similar conditions.
- You get the following MPG scores:
- MPG: 30      28      32      26      33      25      28      30
- Does the actual gas mileage for these cars deviate significantly from 31 ( $\alpha = .05$ )?

# $\chi^2$ TEST (CHI SQUARE TEST)

THE CHI SQUARE STATISTIC IS COMMONLY USED FOR TESTING RELATIONSHIPS BETWEEN CATEGORICAL VARIABLES.

---

## TYPE I: GOODNESS OF FIT



Set up the hypothesis for Chi-Square goodness of fit test:



**Null hypothesis:** In Chi-Square goodness of fit test, the null hypothesis assumes that there is no significant difference between the observed and the expected value.



**Alternative hypothesis:** In Chi-Square goodness of fit test, the alternative hypothesis assumes that there is a significant difference between the observed and the expected value.

# FORMULA FOR GOODNESS OF FIT

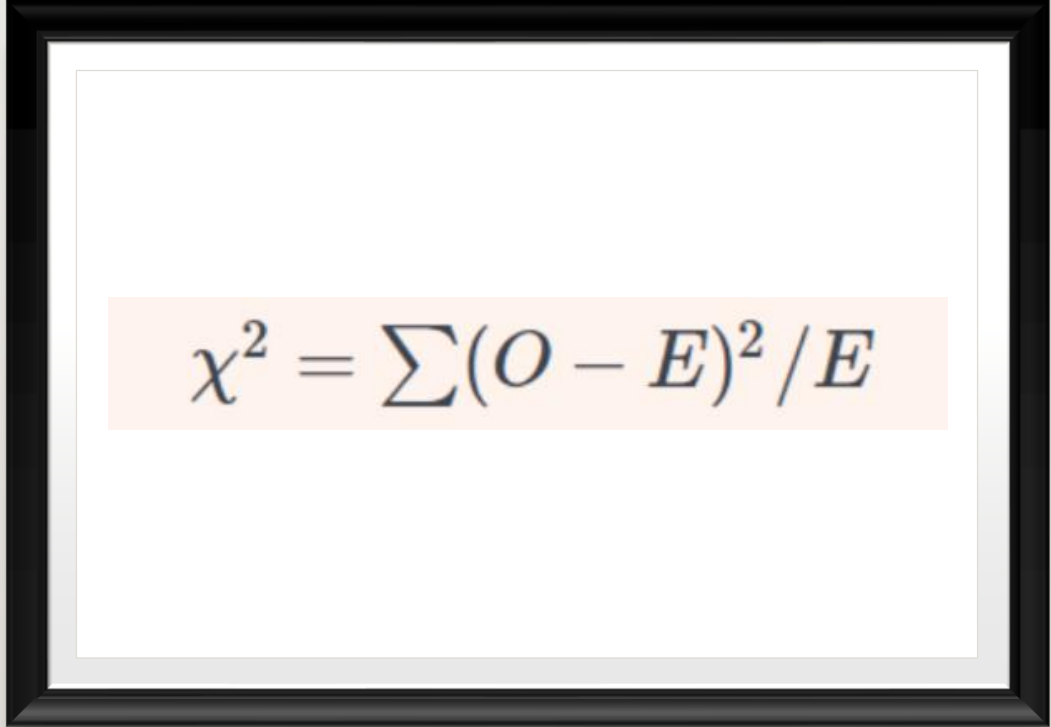
---

And fail to reject the null hypothesis if our test statistic > Chi square value

Here

O – stands for observed value and

E – Stands for expected value

A rectangular box with a thick black border and a white background, containing the Chi-square formula. The formula is centered and written in a black serif font. The background of the formula itself is a light pink color.
$$\chi^2 = \sum (O - E)^2 / E$$



# EXAMPLE FOR CHI SQUARE TEST

---

- If we flip a coin 18 times and observe that it comes up heads 12 times, can we say that this is due to chance, or do we assume that our coin is biased?

