Working rules for Hypothesis testing:

Step 1: State the Null Hypothesis (H_0) and Alternative Hypothesis (H_1)

H_0: Select the claim that represents equal (=), greater-equal (≥) or less-equal (≤) relationship with the given population parameter value.

H_1: Select the claim that represents not equal (≠), less than (<) or greater than (>) relationship with the given population parameter value.

@remember : H_0 always contains the equal (=) sign.

Step 2: Collect the sample X_1, X_2, …, X_n.

Step 3: Calculate the **test** statistic $T_{cal} = f (X_1, X_2, …, X_n)$ depending on the problem statement.

Step 4: Set the level of significance α.

Step 5: Construct Acceptance / Rejection regions depending on α and H_1.

Step 6: Conclusion :

- i) Reject the null hypothesis: if T_{cal} falls under critical region,
- ii) Do not reject the null hypothesis: if T_{cal} does not fall under critical region.

Let us decide like a decision maker 😊

1. Suppose you want to check whether a coin is biased or unbiased with the following hypothesis.

   $$Ho : p = 0.5 \text{ vs } H_1 = 0.8$$

   where p is the probability of head in a single toss of a coin. You have decided that if you find more than 7 heads in 10 tosses, you will reject the null hypothesis.
   i)   What is Type-I error of your test ?
   ii)   What is the Type-II error ?
   iii)   What is the power of your test ?

2. Suppose a car manufacturer claims a model gets at least 25 mpg. A consumer group asks 10 owners of this model to calculate their mpg and the mean value was 22 with a standard deviation of 1.5. Is the manufacturer's claim supported at 95%confidence level.

3. An outbreak of Salmonella-related illness was attributed to ice cream produced at a certain factory. Scientists measured the level of Salmonella in 9 randomly sampled batches of ice cream. The levels (in MPN/g) were: *0.593 0.142 0.329 0.691 0.231 0.793 0.519 0.392 0.418.* Is there evidence that the mean level of Salmonella in the ice cream is greater than 0.3 MPN/g

4. 6 subjects were given a drug (treatment group) and an additional 6 subjects a placebo (control group). Their reaction time to a stimulus was measured (in *ms*). The outcome of both the group as follows

   Control = 91, 87, 99, 77, 88, 91

   Treat = 101, 110, 103, 93, 99, 104

   Test whether the drug has an effect or not (Assume higher reaction time is better) ?

5. A study was performed to test whether cars get better mileage on premium gas than on regular gas. Each of 10 cars was first filled with either regular or premium gas, decided by a coin toss, and the mileage for that tank was recorded. The mileage was recorded again for the same cars using the other kind of gasoline. Test to determine whether cars get significantly better mileage with premium gas
   Reg : 16, 20, 21, 22, 23, 22, 27, 25, 27, 28

   Prem : 19, 22, 24, 24, 25, 25, 26, 26, 28, 32

6. A national survey agency conducts a nationwide survey on consumer satisfaction and finds out the response distribution as follows:

Excellent:	8%
Good:	47%
Fair:	34%
Poor:	11%

A store manager wants to find if these results of customer survey apply to the customers of super market in her city. So, she interviews 207 randomly selected customers and asked them to rate their responses. The results of this local survey are given below. Determine if the local responses from this survey are the same as expected frequencies of the national survey, at 95% confidence level.

Response	Frequency
Excellent	21
Good	109
Fair	62
Poor	15

7. A survey is conducted by a gaming company that makes three video games. It wants to know if the preference of game depends on the gender of the player. Total number of participants is 1000. Here is the survey result

	Game A	Game B	Game C	Total
Male	200	150	50	400
Female	250	300	50	600
Total	450	450	100	1000

a. State the null hypothesis and alternate hypothesis.

b. Calculate the degrees of freedom.

c. Does men's preference is different from women's preference? Check with 0.05 level of significance.

8. Consider the hypothesis test of Ho : σ^2 = 0.01 against H1 : σ^2 ≠ 0.01. Sample size is 20 and sample variance is 0.0153. Test the hypothesis for α = 0.05.

9. laptop computer maker uses battery packs supplied by two companies, A and B. While both brands have the same average battery life between charges (LBC), the computer maker seems to receive more complaints about shorter LBC than expected for battery packs supplied by company B. The computer maker suspects that this could be caused by higher variance in LBC for Brand B. To check that, ten new battery packs from each brand are selected, installed on the same models of laptops, and the laptops are allowed to run until the battery packs are completely discharged. The following are the observed LBCs in hours.

Brand A = 3.2, 3.4, 2.8, 3, 3, 3, 2.8, 2.9, 3, 3

Brand B = 3, 3.5, 2.9, 3.1, 2.3, 2, 3, 2.9, 3, 4.1

Test, at the 10% level of significance, whether the variance of both the brands are similar.

10. A car crash research team wants to examine the safety of compact cars, intermediate and full size cars. Given below are the hypothetical values of the mean pressure applied to the drivers head during the crash test for each of the car types. Check whether means are equal for each type of these cars at 5% significance level.

Compact	643	655	702
Intermediate	469	427	525
Full size	484	456	402