# Inferential Statistics

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# Outlines

- Estimation
- Hypothesis Testing

# Overview

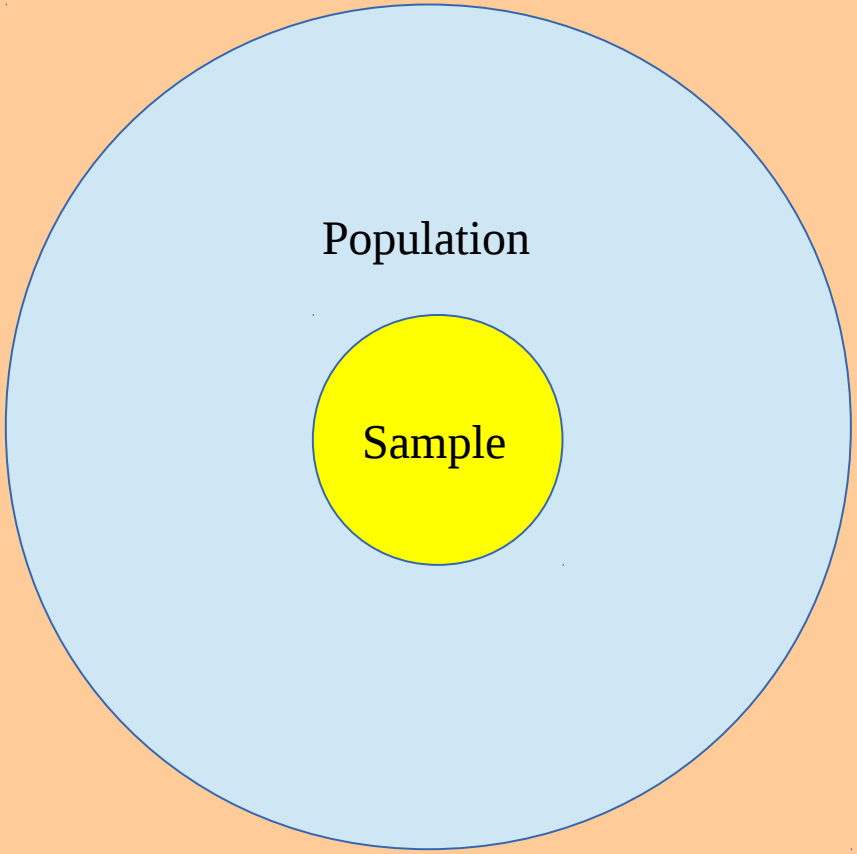
- Statistics?
- Population vs sample?
- Inference?

# Overview

- Statistics is a field of study dealing with (Daniel, 1995):
  1. Collection, organization, summarization and analysis of data.
  2. Making inference/conclusion about population data from sample data.

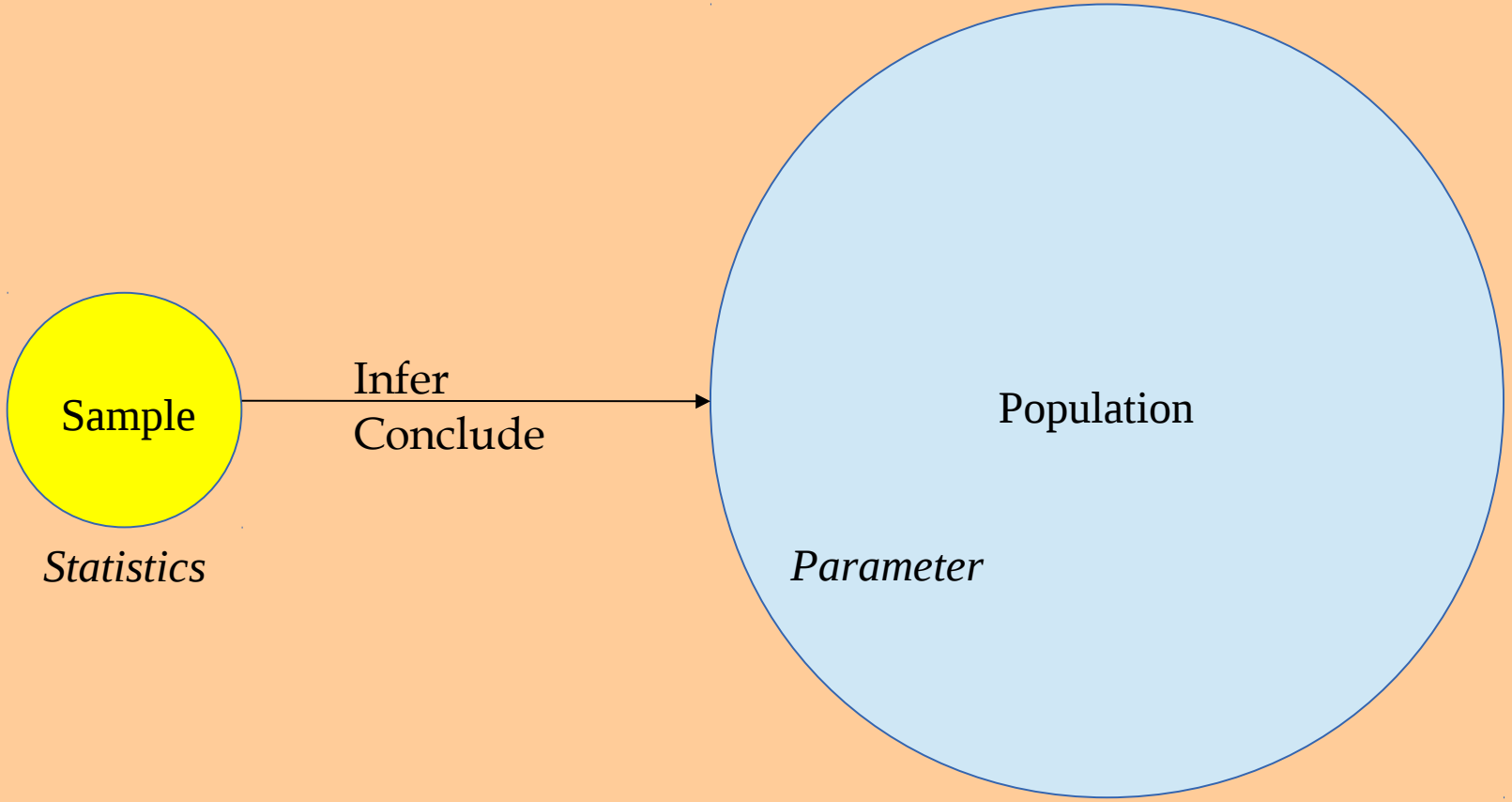
# Overview

- Population *vs* sample

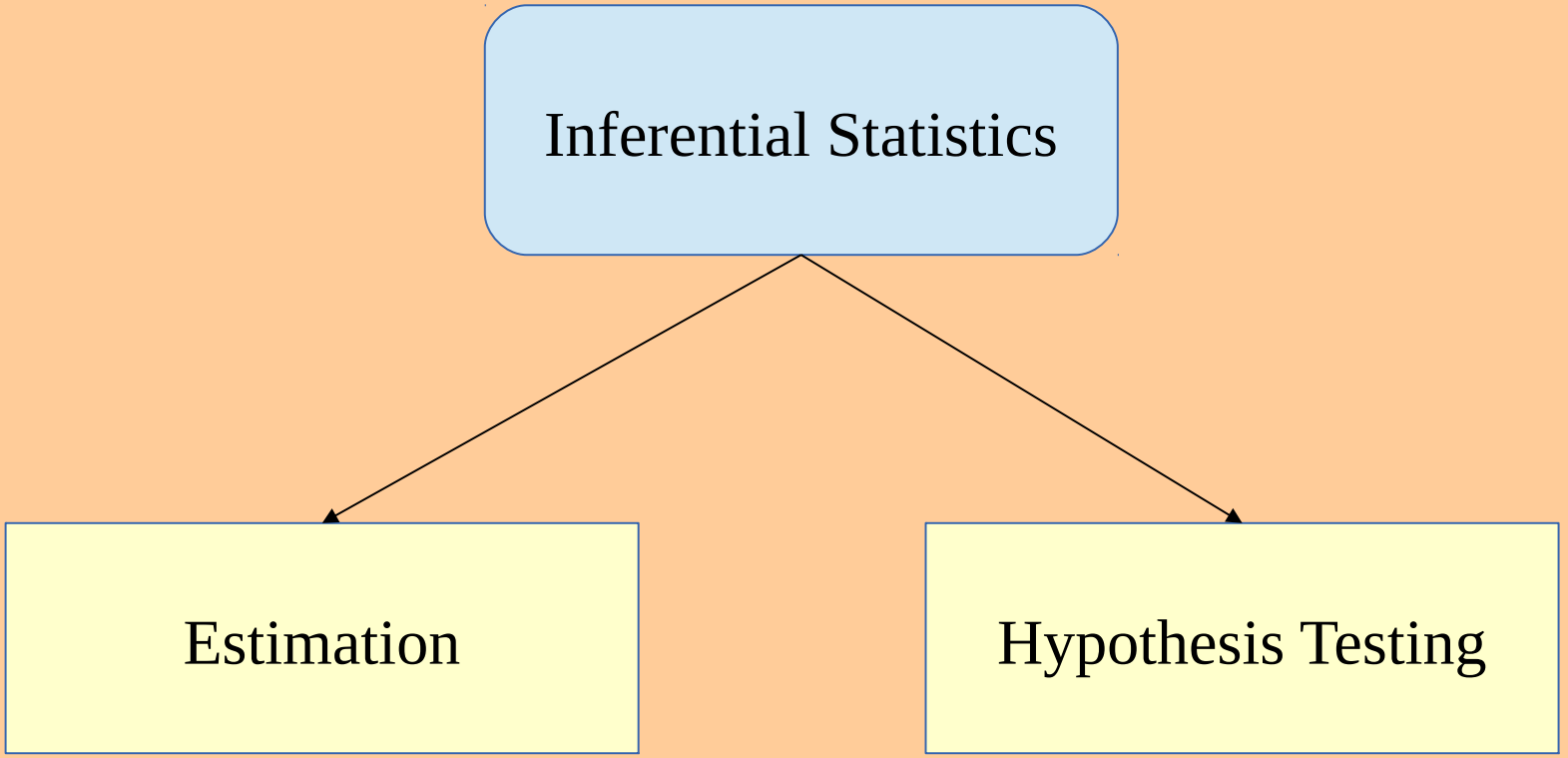


# Overview

- Inference:



# Overview



# 1. Estimation

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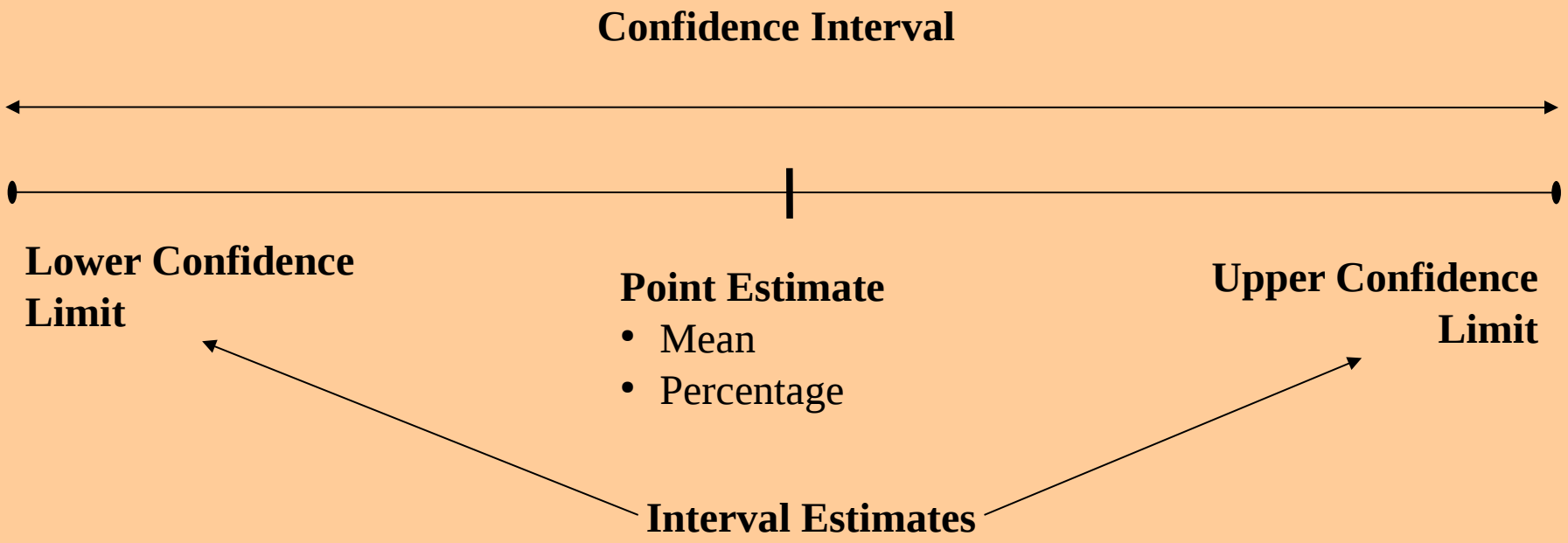
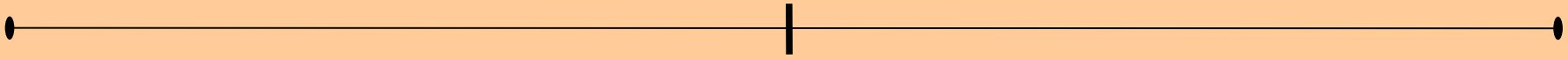
- Usually for <u>One Sample</u> → <u>One Population</u>
- Estimate *parameter* by



# 1. Estimation

**Mean SBP for Normal population**

**95% Confidence Interval**



***115mmHg*** **120mmHg** ***125mmHg***

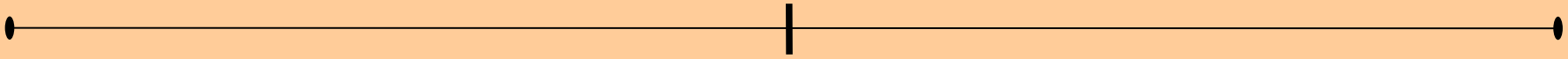
**Interpretation:** Based on a *sample* of 30 subjects, I am 95% sure that mean SBP of normal *population* is between 115mmHg to 125mmHg. The sample mean is 120mmHg.

**Reporting:** 120mmHg (95% CI: 115mmHg, 125mmHg)

# 1. Estimation

**Percentage of Obesity among University Students' population**

**95% Confidence Interval**



***28%*** **38%** ***48%***

**Interpretation:** Based on a *sample* of 100 subjects, I am 95% sure that **percentage of obesity** of university students' *population* is between 28% to 48%. The sample percentage is 38%.

**Reporting: 38%** (95% CI: 28%, 48%)

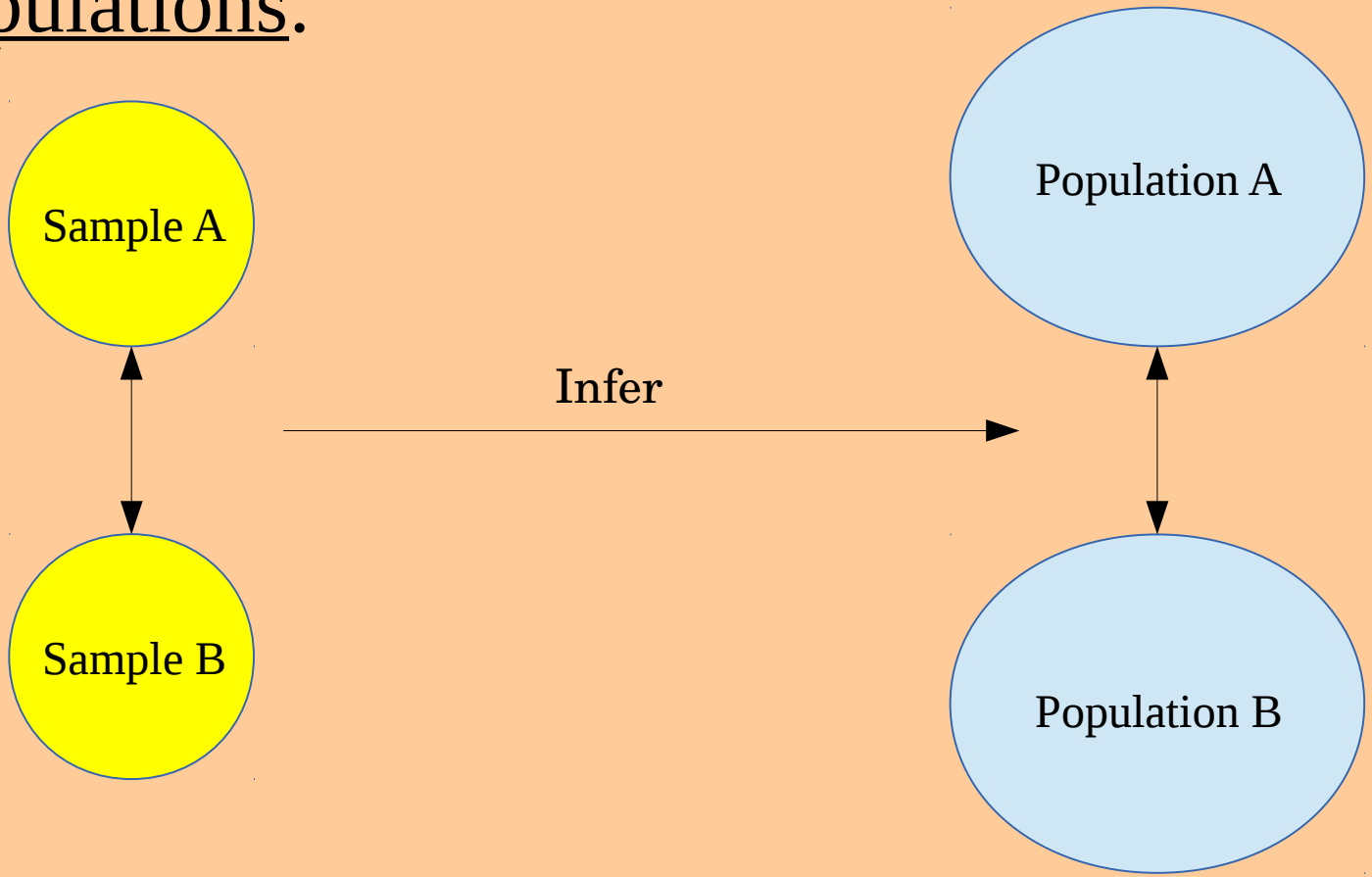
# 1. Estimation

- **Interval estimates** values depend on ***Confidence level*** (90%, **95%**, 99%), ***sample size*** and ***standard deviation*** → Precision.
- Calculation*? Given in SPSS output. It is important to know the interpretation.

# 2. Hypothesis Testing

# 2. Hypothesis Testing

- Usually for comparison of samples → comparison of populations.



# 2. Hypothesis Testing

- Stated in form of **Statistical Hypothesis** → Can be tested with statistical test.

Alternative Hypothesis:
Population A is different from Population B

Null Hypothesis:
Population A is similar to Population B

# 2. Hypothesis Testing

- **P-value –** Probability that the difference is merely by chance → Calculated from statistical test.
- Set acceptable level so called “chance” → **Significance level**, **α** (**<u>0.05</u>**, 0.01, 0.001)

<u>Alternative Hypothesis</u>:
P-value ≤ **0.05**

<u>Null Hypothesis</u>:
P-value > **0.05**

# 2. Hypothesis Testing

Alternative Hypothesis:
Population A is different from Population B

Null Hypothesis:
Population A is similar to Population B

Statistical Test →

Alternative Hypothesis:
P-value ≤ **0.05**

Null Hypothesis:
P-value > **0.05**

# 2. Hypothesis Testing

Comparing **Mean SBP** of **Medical Students' population** vs **Lecturers' population**

Alternative Hypothesis:
Mean SBP of MS population is different from L population

Null Hypothesis:
No difference in Mean SBP between the populations

Statistical Test

Alternative Hypothesis:
P-value ≤ **0.05**

Null Hypothesis:
P-value > **0.05**

Independent t-test

# 2. Hypothesis Testing

Comparing **Obesity %** of **Medical Students' population** vs **Lecturers' population**

Alternative Hypothesis:
Obesity % among MS population is different from L population

Null Hypothesis:
No difference in Obesity % between the populations

Statistical Test

Alternative Hypothesis:
P-value ≤ **0.05**

Null Hypothesis:
P-value > **0.05**

Chi-square test

# Outcomes

- Understand basic concept of confidence interval.
- Able to interpret confidence interval.
- Understand basic concept of hypothesis testing.
- Able to interpret P-value.
- Understand concept of significance level.

# Reference

Daniel, W. W. (1995). Biostatistics: A foundation for analysis in the health sciences (6th ed.). USA: John Wiley & Sons.

# *1. Estimation

- Interval estimates (mean):

Standard deviation

$$\text{Lower confidence limit} = \text{Point Estimate} - \text{Reliability Coeffient} \times \frac{SD}{\sqrt{n}}$$

Number of subjects

$$\text{Upper confidence limit} = \text{Point Estimate} + \text{Reliability Coeffient} \times \frac{SD}{\sqrt{n}}$$

# *1. Estimation

- Interval estimates (mean):

Percentage

Lower confidence limit = Point Estimate − Reliability Coeffient $\times\sqrt{\frac{p(1-p)}{n}}$

Number of subjects

Upper confidence limit = Point Estimate + Reliability Coeffient $\times\sqrt{\frac{p(1-p)}{n}}$

# *1. Estimation

- Reliability Coefficient:

| Confidence level | Reliability coefficient |
|---|---|
| 90% | 1.65 |
| 95% | 1.96 |
| 99% | 2.56 |