

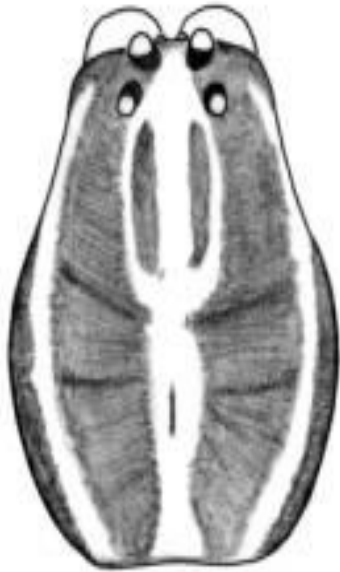
Identification of Family Lycosidae

- The family name and common name are derived from the Greek word "lycosa" meaning "wolf" due to the spiders' hunting method of ambushing and running down its prey.
- Research has shown that the Lycosidae are important in agriculture, as they are efficient controlling agents of insect pests. They are harmless to man.

Identification of Family Lycosidae

- Lycosids are often parasitized by wasps probably because they are free roaming and do not enjoy the protection of a web.

Identification of Family Lycosidae



- Centre of thoracic region is provided with fovea.
- Male has enlarged swollen palp
- Female genitalia is covered externally by heavy sclerotized plate called epigynal plate

https://www.google.com/search?q=fovea+in+lycosidae&sxsrf=ALeKk020bjj-vHKg9xn2OOMtsk0pchcuDg:1607331271899&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjEwf3Lv7vtAhXMN8AKHe2ADgMQ_AUoAXoECA8QAw&biw=1360&bih=600#imgsrc=---c7FIH2ulkqXM&imgdii=AlqodCv-Qo7AjM

Identification of Family Lycosidae

- Centre of thoracic region is provided with fovea.
- Male has enlarged swollen papl
- Female genetalia is covered externally by heavey sclerotized plate called epigynal plate
- Structure of genetalia is species specific.

Principles of Systematics

Module# 109

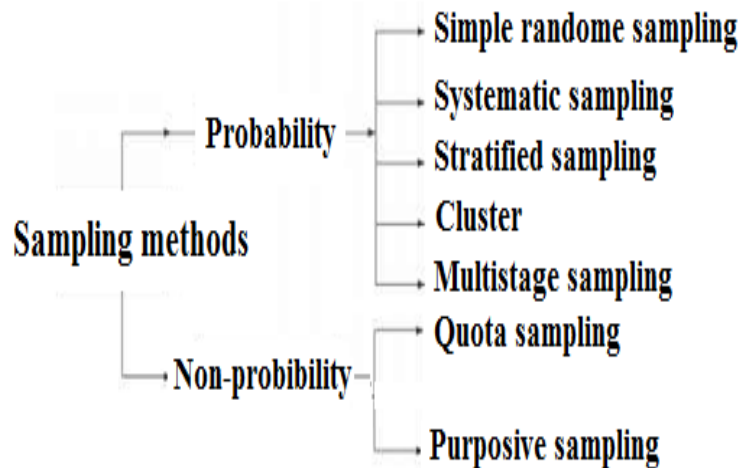
Principles of Systematics

**Sampling
Methods**

Sampling Methods

- Probability Sampling
- Non-Probability Sampling

Sampling Methods



Probability Sampling

- Random Sampling
- Systematic Sampling
- Stratified sampling
- Cluster Sampling
- Multistage Sampling

Sampling Methods

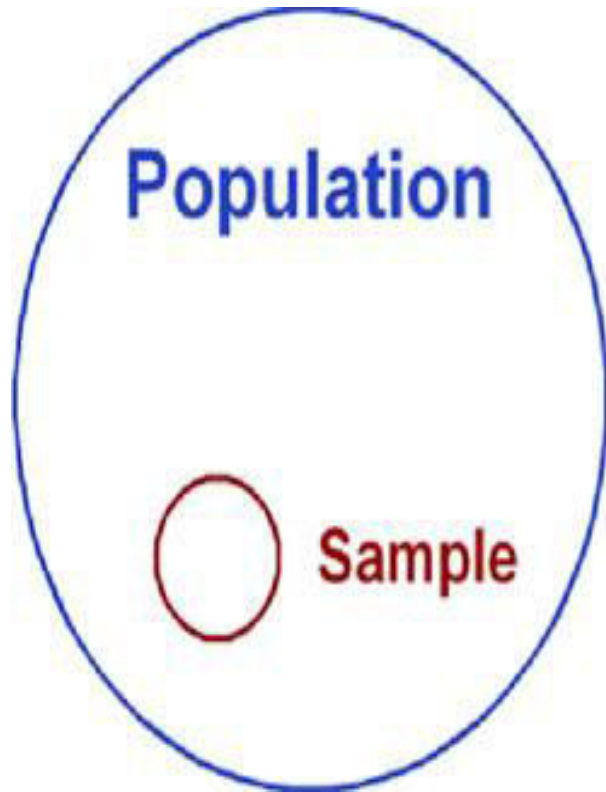
Non-Probability Sampling

- Purposive sampling
- Quota Sampling

Sampling Methods

- **Sampling:** It is the process of selecting a representative group from the population. The target population may be as broad as all humans but it may be a smaller group as people who are diabetics or only the teenagers.

Sampling Methods



- **Sample:** A sample is a group of units selected from a population by a defined procedure or simply a part of a statistical population.
- The sample should be representative of the general population. 5-10% portion of the sample size of total

Sampling Methods

- **Population:**

Population is the total group of individuals from which the sample might be drawn.

- All members of population possess the same basic and defined characteristics, but varying in amount or quality from one member to another. For

END

Principles of Systematics

Module# 110

Principles of Systematics

Random Sampling

Random Sampling

- If every individual of target population has an equal chance of selection then it will be called random sampling. Simple random sampling is the easiest form of probability sampling.
- No biasness and expert opinion is required in this method.

END

Random Sampling

- All the researcher needs to do is assure that all the members of the population are included in the list and then randomly select the desired number of subjects.

Examples:

- Selection of plants from rice fields
- Selection of students from class
- When carrying out a survey, it would be impractical to study a whole population.

Principles of Systematics

Module# 111

Principles of Systematics

Systematic Sampling

Systematic Sampling

- In this sampling method first sample from the population is taken randomly but after that samples are selected systematically at a regular interval.

Examples:

- Shopping centre
- Selection of plants
- Selection of soil sample

END

Principles of Systematics

Module# 112

Principles of Systematics

Stratified Sampling

Principles of Systematics

Module# 113

Principles of Systematics

Cluster Sampling

Cluster Sampling

- It is a sampling technique where the entire population is divided into groups, or clusters and a random sample of these clusters are selected.
- Members of one cluster have similarity with each other and also with other clusters; minor differences can be there between different clusters.
- Individual selection from each cluster is random.

Cluster Sampling

- Cluster of plants for study
- Cluster of animals

END

Cluster Sampling

- It is a sampling technique where the entire population is divided into groups, or clusters and a random sample of these clusters are selected.
- Members of one cluster have similarity with each other and also with other clusters; minor differences can be there between

END

Principles of Systematics

Module# 114

Principles of Systematics

Multistage Sampling

Multistage Sampling

- It is a complicated form of cluster sampling. In this type of sampling we divide our population into groups (clusters) and each group is further divided into sub-groups in such a way that each lower group is adjusted into a higher group.

Multistage Sampling

- For example in a survey of tuberculosis prevalence in world, if we divide whole world into continents, then select 10 countries from each continent randomly, then 10 districts from each country, 10 cities from each district, 10 villages from each city and finally 10 families from each villages randomly. This type of sampling is multistage sampling.

END

Principles of Systematics

Module# 115

Principles of Systematics

**Non-Probability
sampling**

Non-Probability Sampling

- **Quota sampling:** In this type of sampling we divide the population into different groups or strata based on some specific criterion but selection of individual from each group is not random.

Non-Probability Sampling

- **Purposive sampling:** In this technique researcher selects sample based on their knowledge and professional judgment. Purposive sampling can also be known as judgmental, selective or subjective sampling. For example purchase of car from market based on expert opinion or selection of staff for biology teaching in a college by a panel of subject experts.

END

Module# 116 Construction of Phenogram

- A tree diagram depicting taxonomic relationships among organisms based on overall similarity of many characteristics without regard to evolutionary history

Construction of Phenogram

Characters	A	B	C	D	E
No. of eyes	8	8	6	6	8
No. of spinnerts pairs	2	2	2	3	3
Shape of sternum	Heart shape	Heart shape	Heart shape	Oval	Oval
Size of Median eyes	Large	Small	Small	small	Large
size of chelicera	Small	small	Large	Large	Large

Construction of Phenogram

Characters	A	B	C	D	E
tail	+	+	-	+	-
Nail	-	+	+	-	-
fins	-	+	-	-	+
Wings	+	-	-	-	+
hairs	+	+	+	-	-

Construction of Phenogram

	A	B	C	D	E
A	x				
B	9	x			
C	5	2	x		
D	4	6	8	x	
E	3	5	7	6	x

Construction of Phenogram

Rules

- Start from lowest value
- Try to make maximum separate clusters
- Do not repeat
- In case of same number multiple time, you can choose any combination
- Value of previous similarity should be

Construction of Phenogram

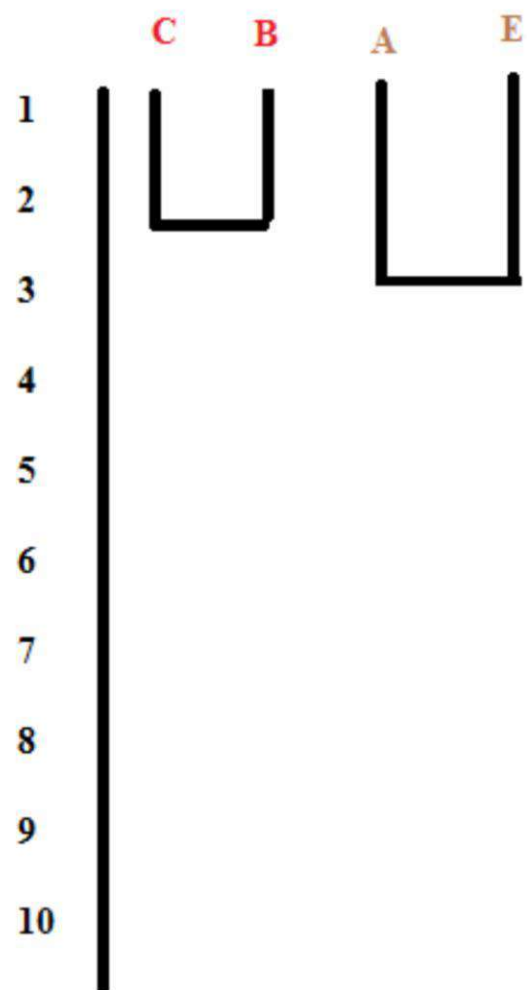
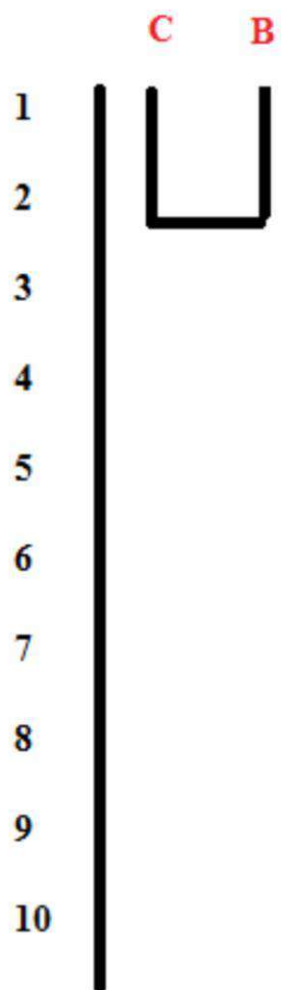
END

higher than afterwards

Construction of Phenogram

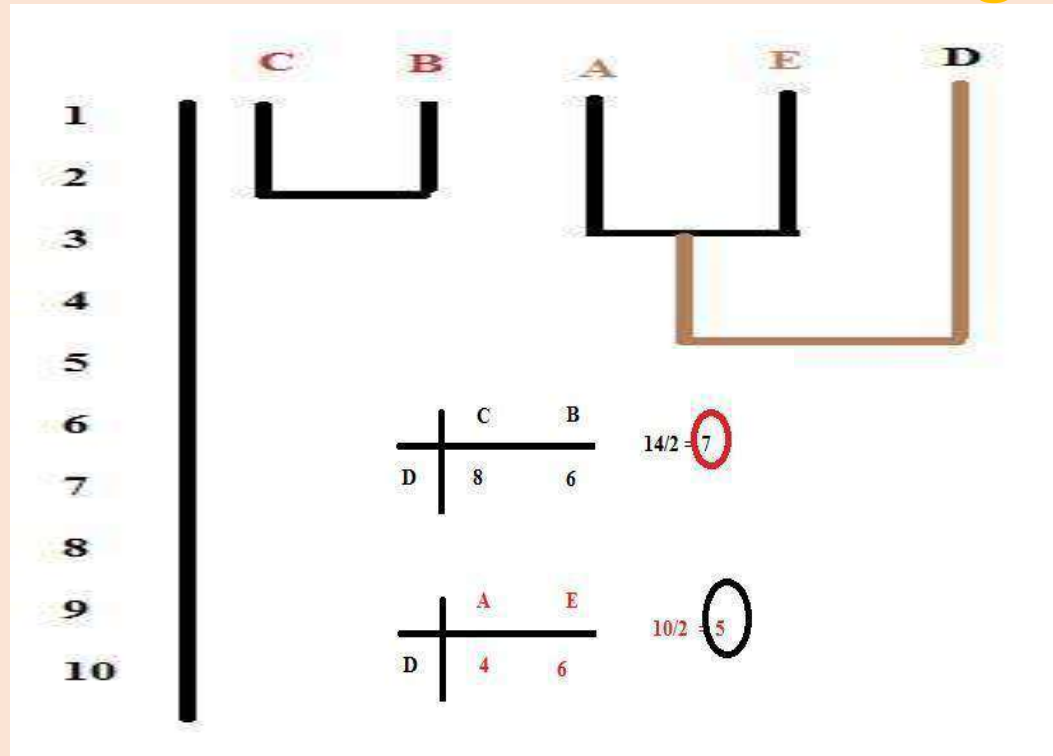
Module# 117 Construction of Phenogram

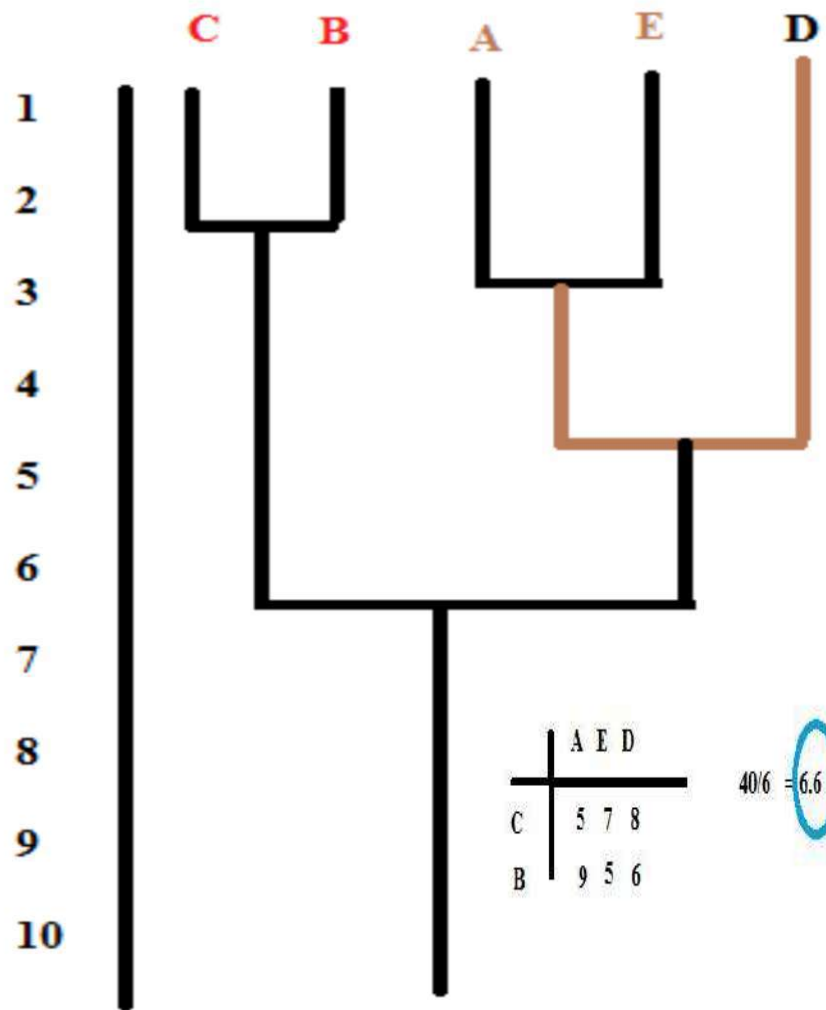
	A	B	C	D	E
A	x				
B	9	x			
C	5	2	x		
D	4	6	8	x	
E	3	5	7	6	x



Construction of Phenogram

Construction of Phenogram

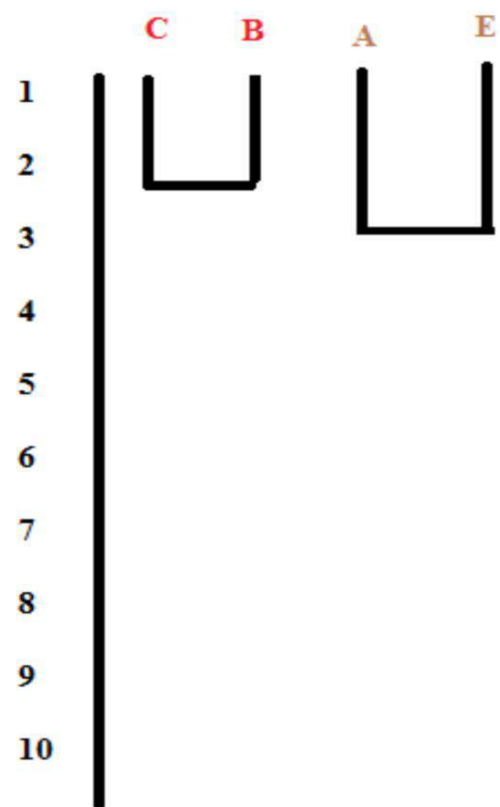
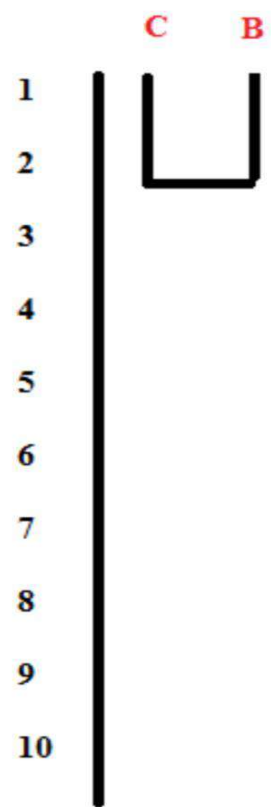




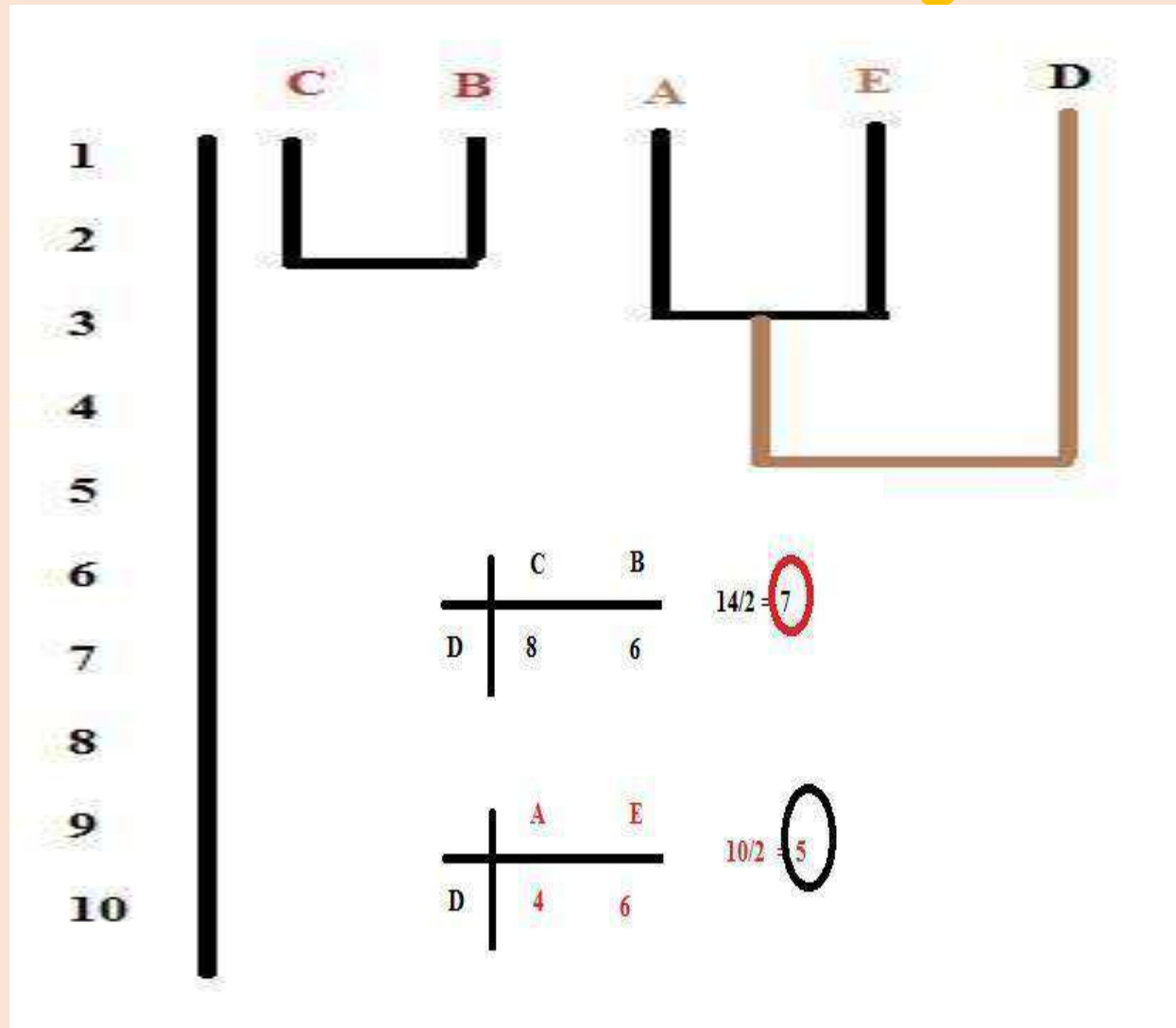
Construction of Phenogram

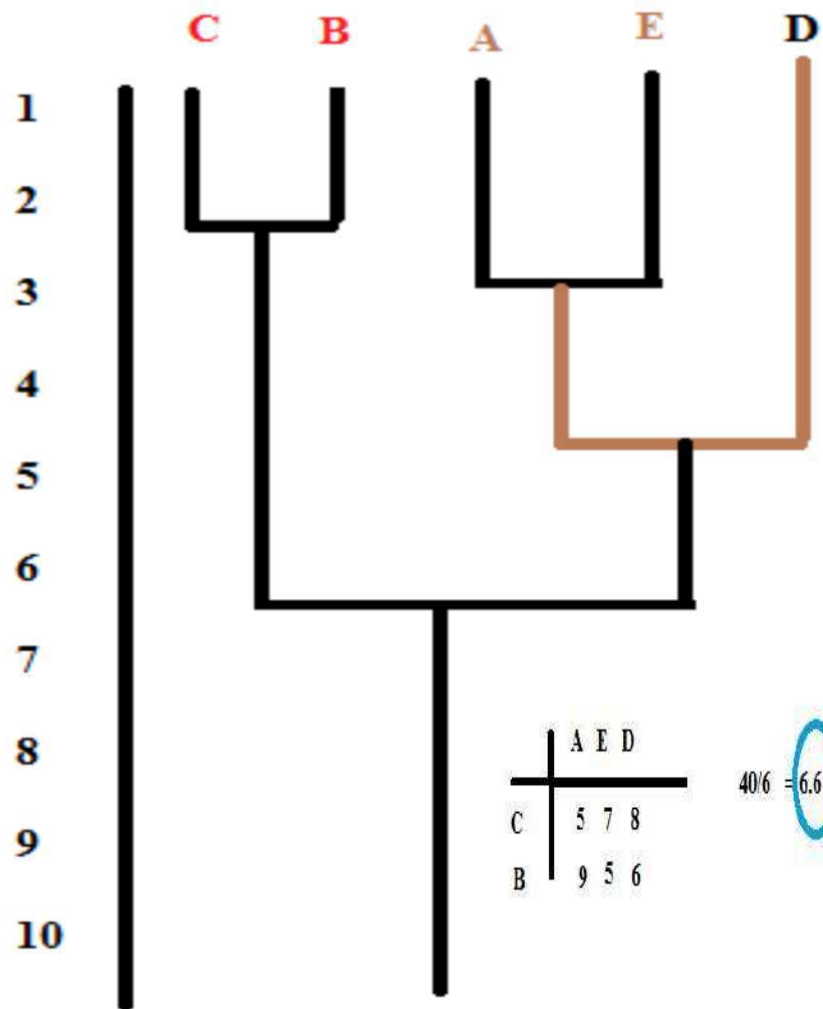
Module# 118 Construction of Phenogram

	A	B	C	D	E
A	x				
B	9	x			
C	5	2	x		
D	4	6	8	x	
E	3	5	7	6	x



Construction of Phenogram





Construction of Phenogram

Module# 119 Describing a New Species

- Describing new species is not something that is done by non-taxonomists.
- To describe a new species, you need to have the appropriate

credentials, experience,
and knowledge to do so.

- Assuming you have all

Describing a New Species

- Carrying out the necessary measurements (scales, size, morphological characteristics, etc.) needed in a description.

- Record location, habitat, and other info such as DNA

Describing a New Species

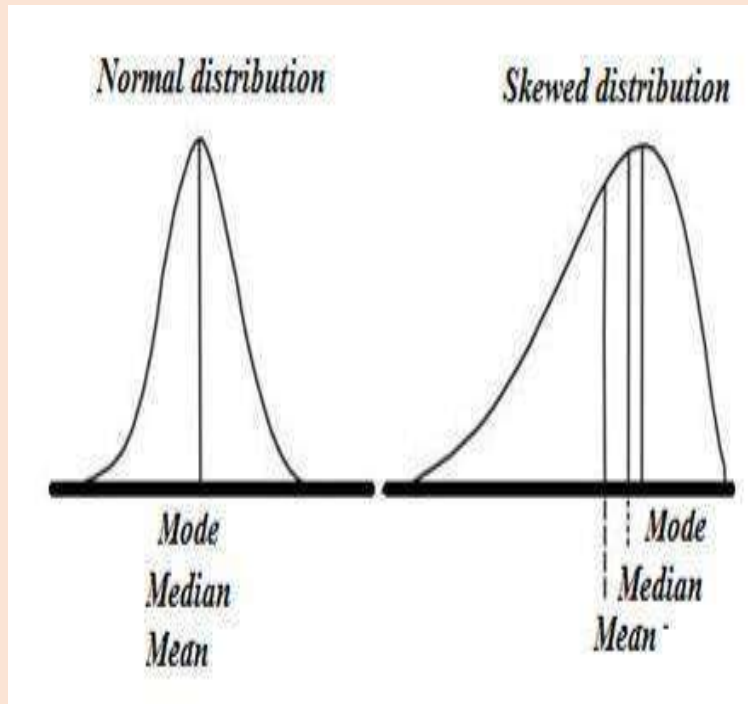
- Evidence of comparative studies demonstrating that your species is indeed new or undescribed (this can

take a long time to do properly.

- Finding the right journal for publishing your description.
- Zootaxa, ZooKeys

END

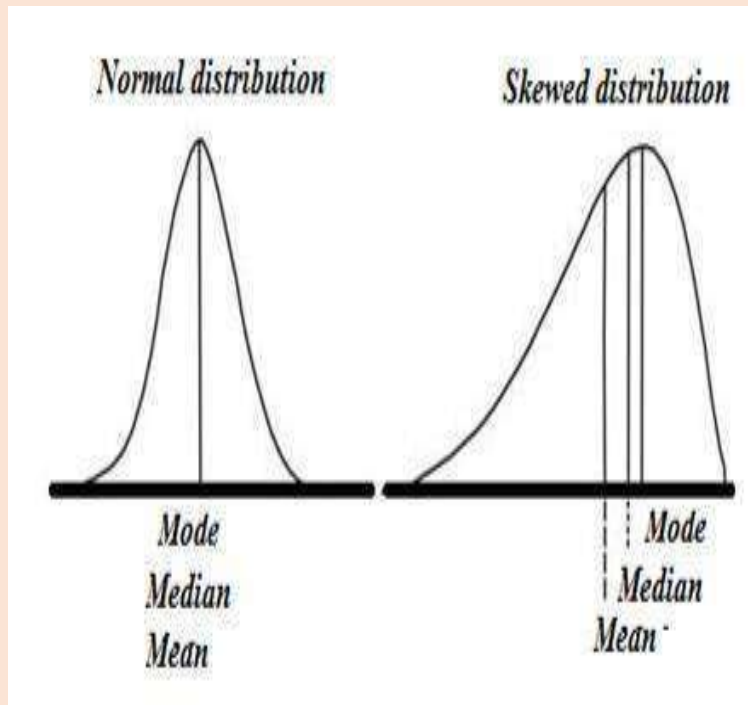
Module# 120 Normal and Skewed Data



- In normal data values of means, median mode are equal but this not the case for asymmetric or skewed data.
- Normal data follow a bell shape curve. In skewed

distribution one tail is
larger than other as in
above figure.

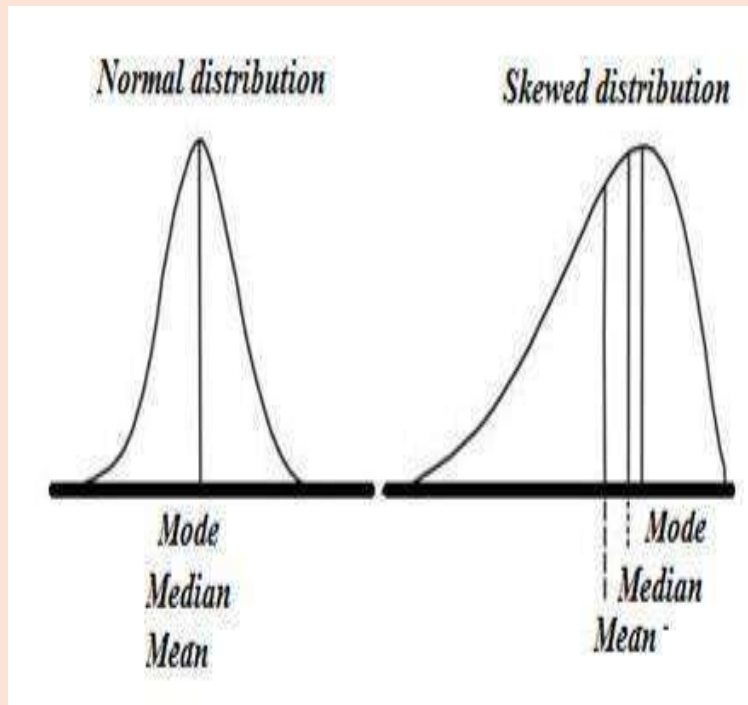
Normal and Skewed Data



- In normal data most of the individual values are close to the mean of the data. However, in skewed that the difference between individual values and mean values is higher.

- Extreme values are almost negligible in normal data but higher

Normal and Skewed Data



- Values of standard deviation are less for normal data compared to skewed data.
- Measure of central tendency for normal data

is mean but it is median
for skewed data.

Module# 121 Parametric Vs Non-Parametric Tests

- Parametric tests are used for Normal data
 - T-test
 - Z-test
 - F-test

- ANOVA
- Regression
- Correlation

Parametric Vs Non-Parametric Tests

- Non-parametric tests for skewed data.
- Wilcoxon Signed Rank Test

- Mann Whitney U Test
- Kruskal-Wallis test
- Principal Component Test
- Friedman Tests

Parametric Vs Non-Parametric Tests

Parametric Test	Non-Parametric test
Make assumptions about the population	Does not make assumptions
Uses normal probabilities	Distribution is arbitrary
Uses mean value for central tendency	Uses median value for central tendency
Require previous knowledge about the population	Does not require previous knowledge about the population

- For measuring the degree of association between two quantitative variables, **Pearson's coefficient of correlation** is used in the parametric test, while **Spearman's rank correlation** is used in the nonparametric test.

Module# 122 Types of data Distribution

- Normal Distribution
- Binomial Distribution
- Poison Distribution

Types of data Distribution

- **Normal Distribution**
- Data which is normally distributed and follow the normal curve is called normal data. It can be continuous and discrete in value.
- **Binomial Distribution**
- Data in which there are only two outcomes from an event and numbers of events are

Types of data Distribution

predecided is called binomial distribution. For example in five test match series, outcomes of each match are two i.e. to win or lose. Outcome of the event is a discrete number.

- **Poisson Distribution**
- The data distribution in which total numbers are not predetermined and some time there number can reach to infinite. These events

Types of data Distribution

occur in nature rarely. Outcome of such events is complete discrete value not in decimal points. For example number of deaths in

END

Lahore per hour. Number of deaths can be infinite if some unusual event occurs.

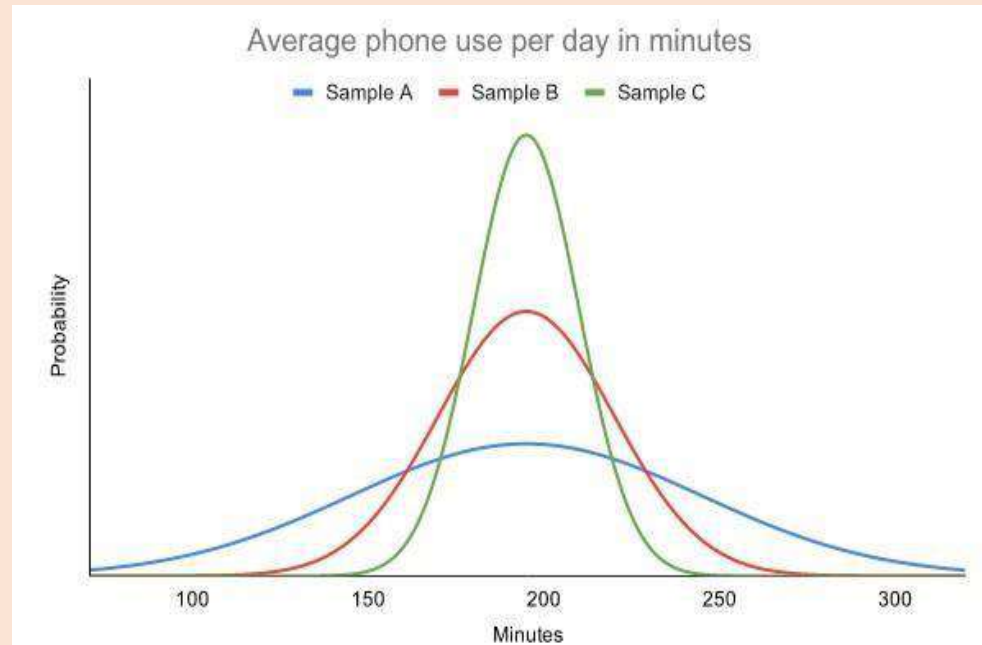
Module# 123 Measure of Central Tendency and Measure of Variability

Measure of central tendency

- It provide information about average value of a data set.
- Mean, Median and Mode are commonly used measures of central tendency.

- Data set has only one and only one Mean.
- Value of mean is influenced by all ^{BS} ZOOLOGY observations in the data set.

Measure of Central Tendency and Measure of Variability



https://www.google.com/search?q=measure+of+variability&tbm=isch&ved=2ahUKEwjF9d_6-cntAhVV4oUKHTygC0MQ2-cCegQIABAA&oeq=measure+of+variability&gs_lcp=CgNpbWcQAzIECAAQQzICCAAYAggAMgIIADICCAAYAggAMgIIADICCAAYBggAEAUQHjIGCAAQBRAeULa-NFim1DRg7dY0aABwAHgAgAHnAogB_xKSAQcwLjQuNi4xmAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=B4LVX4XWItXElwS8wK6YBA#imgsrc=Xcszu3CdSMBXLM

jF9d_6-cntAhVV4oUKHTygC0MQ2-
cCegQIABAA&oeq=measure+of+variability&gs_lcp=CgNpbWcQAzIECAAQQzICCAAYAggAMgIIADICCAAYAggAMgIIADICCAAYBggAEAUQHjIGCAAQBRAeULa-NFim1DRg7dY0aABwAHgAgAHnAogB_xKSAQcwLjQuNi4xmAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=B4LVX4XWItXElwS8wK6YBA#imgsrc=Xcszu3CdSMBXLM

Measure of variability

- Mean deviation
- Variance
- Standard deviation
 - Standard error of mean

- Range

BS ZOOLOGY • Less vs high value

Module# 124 Z-test

- Z-test is used to compare the means of two samples when sample size is greater than 30 ($n > 30$).

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

- This test like t-test assume a normal distribution of the data.

Z =

- This test is most useful when the standard deviation is known.

Z-test

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

- Test the hypothesis that there is no difference in the calculated sample mean with given population means.

- Population mean: $\mu = 100$, $n = 55$,
Sample mean: $\bar{x} = 12$
- By putting the values in formula:
- Z-calculated = -2.7

Z-test

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

- Critical value at 95% confidence interval for Z -test is ± 1.96 . Zcalculated is not within the acceptable range so our null hypothesis is rejected.

Module# 125 ANOVA

- Analysis of variance (ANOVA) is a technique used to compare means of more than two samples.
- This technique can be used only for numerical data as it is a parametric test.”

ANOVA

Assumptions

- Number of samples must be more than two.
- Data should be normally distributed.
- Samples must be independent.

- Homogeneity of variances.

ANOVA

Examples

- A group of psychiatric patients are trying three different therapies: counseling, medication and biofeedback. You want to see if one therapy is better than the others.
- Students from different colleges take the same exam. You want to **END** see if one college outperforms

the other.

Module# 126 ANOVA

Source of variation	SS	DF	MS	F-value
Between group variation				
Within group variation				
Total				

ANOVA

Source of variation	SS	DF	MS	F-value
Between group variation				
Within group variation				
Total				

- $SS \text{ (total) [Sum of square]} = (\text{Each observation} - \text{Grand mean})^2$
- $SS \text{ (within)} = ((\text{Each observation} - \text{Group mean})^2$
- $SS \text{ (between)} = (\text{Group mean} - \text{Grand mean})^2 \times \text{Number of observation in each group}$
- $DF \text{ (between)} = \text{Total number of Groups} - 1$

END

- $DF \text{ (within group)} = \text{Total number of Observations} - \text{Total number of Groups}$

Module# 127 One-Way ANOVA

- A one-way ANOVA uses one independent variable, while a Two-way ANOVA uses two independent variables.

- As a crop researcher, you want to test the effect of three different fertilizer mixtures on crop yield. You can use a one-way ANOVA to find out if there is a difference in crop yields between the three groups.

- You are interested to compare the effectiveness of three medicines in treating cancer patients
- Comparison of four feeds on weight of fish

One-Way ANOVA

One-Way ANOVA

Replicates	Lahore	Sialkot	Sargodha
1	8	10	8
2	14	14	6
3	3	11	5
4	7	9	1
Mean	8	11	5

Grand Mean = $8+11+5/3 = 8$

SS (total) [Sum of square] = (Each observation – Grand mean)²

- **SS(Total)** = $(8-8)^2 + (14-8)^2 + (38)^2 + (7-8)^2 + (10-8)^2 + (14-8)^2 + (118)^2 + (9-8)^2 + (8-8)^2 + (6-8)^2 + (6-8)^2 + (5-8)^2 + (1-8)^2$

- **SS (Total) = 174**

One-Way ANOVA

Replicates	Lahore	Sialkot	Sargodha
1	8	10	8
2	14	14	6
3	3	11	5
4	7	9	1
Mean	8	11	5

- **SS (within)** = ((Each observation – Group mean)²
- **SS(within)** = $(8-8)^2 + (14-8)^2 + (3-8)^2 + (7-8)^2 + (10-11)^2 + (14-11)^2 + (11-11)^2 + (9-11)^2 + (8-5)^2 + (6-5)^2 + (5-5)^2 + (1-5)^2$
- **SS (with in)** = 102

Module# 128 One-Way ANOVA

Replicates	Lahore	Sialkot	Sargodha
1	8	10	8
2	14	14	6
3	3	11	5
4	7	9	1
Mean	8	11	5

- **SS (between)** = (Group mean - Grand mean)² × Number of observation in each group
- $SS \text{ (between)} = [(8 - 8)^2 \times 4] + [(11 - 8)^2 \times 4] + [(5 - 8)^2 \times 4] = 72$

One-Way ANOVA

Source of variation	SS	DF	MS	F-value
Between group variation	72	2	36	3.17
Within group variation	102	9	11.33	
Total	174	9+2= 11	-	

- **DF (between)** = Total number of groups – 1
- $DF (\text{between}) = 3 - 1 = 2$
- **DF (within group)** = Total number of observation – Total number of groups
- $DF (\text{within group}) = 12 - 3 = 9$

One-Way ANOVA

Source of variation	SS	DF	MS	F-value
Between group variation	72	2	36	3.17
Within group variation	102	9	11.33	
Total	174	9+2= 11	-	

MS (between)

- It can be calculated by dividing the SS (between group) with DF (between group)
- $72/2 = 36$

MS (within)

It can be calculated by dividing the SS (within group) with DF (within group)

- $102/9 = 11.33$

One-Way ANOVA

Source of variation	SS	DF	MS	F-value
Between group variation	72	2	36	3.17
Within group variation	102	9	11.33	
Total	174	9+2= 11	-	

F-calculated

- 3.11

F- Tabulated

- Comparison of both
- Decision about hypothesis

Module# 129 Two-Way ANOVA

- In two-way ANOVA there are two independent variables and one dependent variable.
- In one-way ANOVA there was only one independent variable

Two-Way ANOVA

Assumptions

- The population must be close to a normal distribution.
- Samples must be independent.
- Population variances must be equal.

Two-Way ANOVA

- Groups must have equal sample sizes.
- One could use a **two-way ANOVA** to understand whether there is an interaction between gender and educational level on test anxiety amongst university students, where gender (males/females) and education level

Two-Way ANOVA

(undergraduate/postgraduate)
are your independent variables,
and test anxiety is your
dependent

- For example, a two -way ANOVA allows a company to compare worker productivity based on two independent variables, such as department and gender.

Two-Way ANOVA

- It is utilized to observe the interaction between the two factors. It tests the effect of two factors at the same time.
- The effective life (in hours) of batteries is compared by material type (1, 2 or 3) and operating temperature: Low (-10°C), Medium (20°C) or High (45°C).

Two-Way ANOVA

END

- Twelve batteries are randomly selected from each material type and are then randomly allocated to each temperature level.

Module# 130 T-test

- T-test is appropriate whenever you want to compare the means of two samples.
- This test is used to find out whether the means of two samples are statistically different from each other or not.

T-test

- Data should be normally distributed.
- Samples should be taken randomly from the population
- Sample size should be 30 or less than 30.
- All randomly collected samples should have the same variances

(within the limits of sampling error).

- Standard deviation may or may not be known.

T-test

- Independent t -test/two sample ttest
- Paired t-test

Module# 131 Independent t-test

- For two sample t -test, the two populations must be
independent
- It is not necessary that sample size should be same for both samples.

- **Examples:** Test the hypothesis that means heights (cm) of plants randomly selected from two wheat fields are same.

Independent t-test

Data of field I (X_1)= 10, 15, 20, 25 and 30.

Data of field II (X_2)= 4, 8, 10, 15 and 10.

Null hypothesis: $\bar{X}_1 = \bar{X}_2$

Alternative hypothesis is $\bar{X}_1 \neq \bar{X}_2$.

Formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

- For two sample t-test, the two populations must be independent
- It is not necessary that sample size should be same for both samples.

Independent t-test

- **Examples:** Test the hypothesis that means heights (cm) of plants randomly selected from two wheat fields are same.

Independent t-test

X_1	X_2	X_1^2	X_2^2
10	4	100	16
15	8	225	64
20	10	400	100
25	15	625	225
30	10	900	100
$\sum X_1 = 100$	$\sum X_2 = 47$	$\sum X_1^2 = 2250$	$\sum X_2^2 = 505$

Independent t-test

$$\begin{aligned}\sigma_1^2 &= \frac{\sum (X_1 - \bar{X}_1)^2}{n-1} \\ &= \frac{\sum X_1^2 - \frac{(\sum X_1)^2}{n}}{4} = \frac{2250 - 2000}{4} = 62.5\end{aligned}$$

$$\begin{aligned}\sigma_2^2 &= \frac{\sum (X_2 - \bar{X}_2)^2}{n-1} \\ &= \frac{505 - \frac{(47)^2}{5}}{4} = \frac{505 - 441.8}{4} = \frac{63.2}{4} = 15.8\end{aligned}$$

$$\begin{aligned}t &= \frac{20 - 9.4}{\sqrt{\frac{62.5}{5} + \frac{15.8}{5}}} \\ &= \frac{10.6}{\sqrt{12.5 + 3.6}} = \frac{10.6}{\sqrt{15.66}} = \frac{10.6}{3.95} = 2.68\end{aligned}$$

Independent t-test

Null hypothesis: $\bar{X}_1 = \bar{X}_2$

$t = 2.68$ (calculated value)

As both samples are independent so degree of freedom will be $n-1$ (from sample X_1) and $n-1$ (from sample X_2).

$5-1 = 4$ (X_1) and $5-1 = 4$ (X_2)

Degree of freedom: $4+4 = 8$

Tabulated value/standard value/critical value = 2.3

Result: As our calculated value is lower than tabulated value so our null hypothesis is accepted.

Module# 132 Paired t-test

X	Y	d	d^2
9	12	-3	9
12	14	-2	4
13	19	-6	36
20	25	-5	25
5	10	-5	25
		$\sum d = -21$	$\sum d^2 = 99$

Paired t-test

$$t = \frac{\bar{d}}{\sqrt{\frac{\sigma^2_d}{n}}}$$

$$\sigma^2_d = \frac{\sum (d - \bar{d})^2}{n - 1}$$

$$= \frac{\sum d^2 - (\bar{d})^2}{n - 1}$$

$$= \frac{99 - 17.64}{4} = \frac{81.36}{4} = 20.34$$

Paired t-test

$$\bar{d} = \frac{-21}{5} = -4.2$$

$$t = \frac{-4.2}{\sqrt{\frac{20.34}{5}}} = \frac{-4.2}{\sqrt{4.068}} = \frac{-4.2}{2.016} = -2.08$$

T calculated: -2.08

T tabulated $= 2.77$

As observation were paired so degree of freedom $(n-1) = 4$.

Our null hypothesis is rejected as T- calculated is smaller than T-tabulated.

Module# 133 Standard Deviation

Data of field I (X_1)= 10, 15, 20, 25 and 30.

Data of field II (X_2)= 4, 8, 10, 15 and 10.

Null hypothesis: $\bar{X}_1 = \bar{X}_2$

Alternative hypothesis is $\bar{X}_1 \neq \bar{X}_2$.

Formula:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

- It is positive square root of variance.
- Standard deviation "provides a sort of average of the differences of all scores from the mean.
- It is a measure of the dispersion of scores around the mean.
- Generally, a low standard deviation means that a set of scores is not very widely dispersed around the mean.

Standard Deviation

- While a high standard deviation indicates that the scores are more widely dispersed

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

- Its advantage over variance is that its physical unit are same as that of individual observations

Standard Deviation

- The standard error is also a measure of spread.

$$SE = \frac{\sigma}{\sqrt{n}} \quad \text{or} \quad SE = \frac{SD}{\sqrt{n}}$$

- It is represented by SE.
- Higher value of SE indicates higher spread of the data.
- The difference in the standard error and standard deviation is that standard error uses sample data but standard deviations use population data.
- SE tells us that how far our sample mean deviate from

Standard Deviation

$$SE = \frac{\sigma}{\sqrt{n}} \quad \text{or} \quad SE = \frac{SD}{\sqrt{n}}$$

population means.

Module# 134 Standard Deviation

The **sample standard deviation** formula is:

$$s = \sqrt{\frac{\sum(X - \bar{X})^2}{n - 1}}$$

where,

s = sample standard deviation

$\sum$ = sum of...

$\bar{X}$ = sample mean

n = number of scores in sample.

- The standard deviation is a measure of the spread of scores within a set of data.
- Usually, we are interested in the standard deviation of a population.
- However, as we are often presented with data from a sample only, we can estimate the population

Standard Deviation

standard deviation from a sample standard deviation.

The **population standard deviation** formula is:

$$\sigma = \sqrt{\frac{\sum(X - \mu)^2}{n}}$$

where,

σ = population standard deviation

$\sum$ = sum of...

μ = population mean

n = number of scores in sample.

- The standard deviation is a measure of the spread of scores within a set of data.

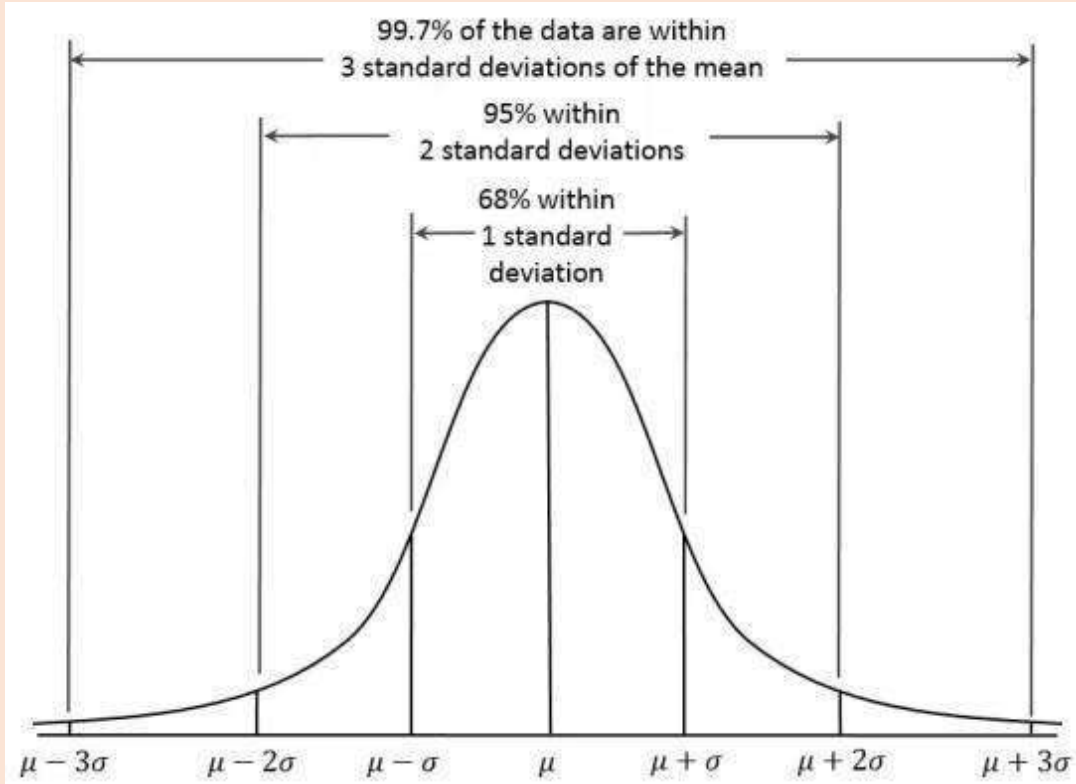
- A **sample standard deviation** is a statistic. This means that it is calculated from only some of the individuals in a **population**.

- The **population standard deviation** is a parameter, which is a fixed value calculated from every individual in

Standard Deviation

the **population**.

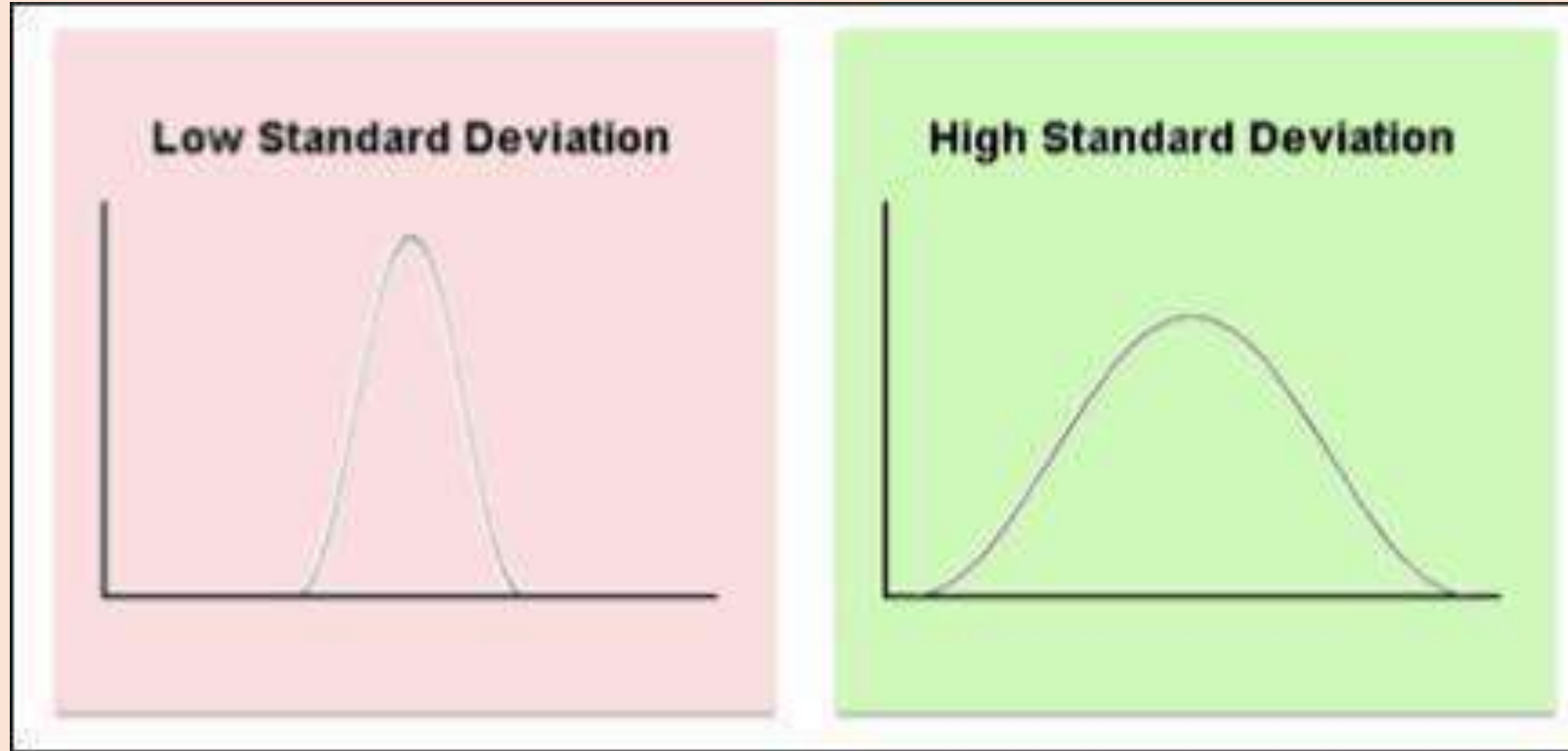
Standard Deviation



Relationship between Variance and SD

- The **standard deviation** is the square root of the **variance**. The **standard deviation** is expressed in the same units as the mean is, whereas the **variance** is expressed in squared units,

Standard Deviation



Module# 135 Introduction to Spiders

- Most abundant natural predators

(Maloney et al., 2003)

Ranked 7th in animal diversity

(WSC, 2018)

- More than 46000 species
- Strictly carnivorous

Standard Deviation

- Cause wasteful killing
- Show functional and numerical response

Introduction to Spiders



https://www.google.com/search?q=spiders+eating&tbm=isch&ved=2ahUKEwi0ybiUp9vtAhUBRBoKHWkMA0IQ2-cCegQIABAA&oeq=spiders+eating&gs_lcp=CgNpbWcQAzICCAAyAggAMgIIADICCAAyAggAMgIIADICCAAyAggAMgIIADICCA6BAgjECc6BAGAEENQ6SNYvTJg6jVoAHAAeACAAa4CiAGZDJIBBzih=657&biw=1360#imgsrc=WaGecw9pWIST7M

A

uMS41LjGYAQCgAQGqAQtn3Mtd2l6LWltZ8ABAQ&sclient=img&ei=IJveX7S5JIGlaemYjJAE&

b

- Best survivors under food shortage
- Prey switching
- Cannibalistic
- Top down effect
- Indirect killing

Module# 136 Introduction to Spiders



- Ground runners • Stalkers

<https://www.google.com/search?q=spiders+eating&tbm=isch&ved=2ahUKEwi0ybiUp9vtAhU>

cCegQIABAA&oq=spiders+eating&gs_lcp=CgNpbWcQAzICCAyAggAMgIIADICCAyAggAMgIIADICCAyAggAMgIIADICCA6BAgjECc6BAgAEENQ6SNyVTJg6jVoAHAAeACAAa4CiAGZDJIBBZAuMS41LjGYAQCgAQGqAQtd3Mtd2l6LWltZ8ABAQ&sclient=img&ei=IJveX7S5JIGlaemYjJAE&b

- Web builders

Introduction to Spiders



- Bio-control agents



- Model organism for research



- Spiders silk

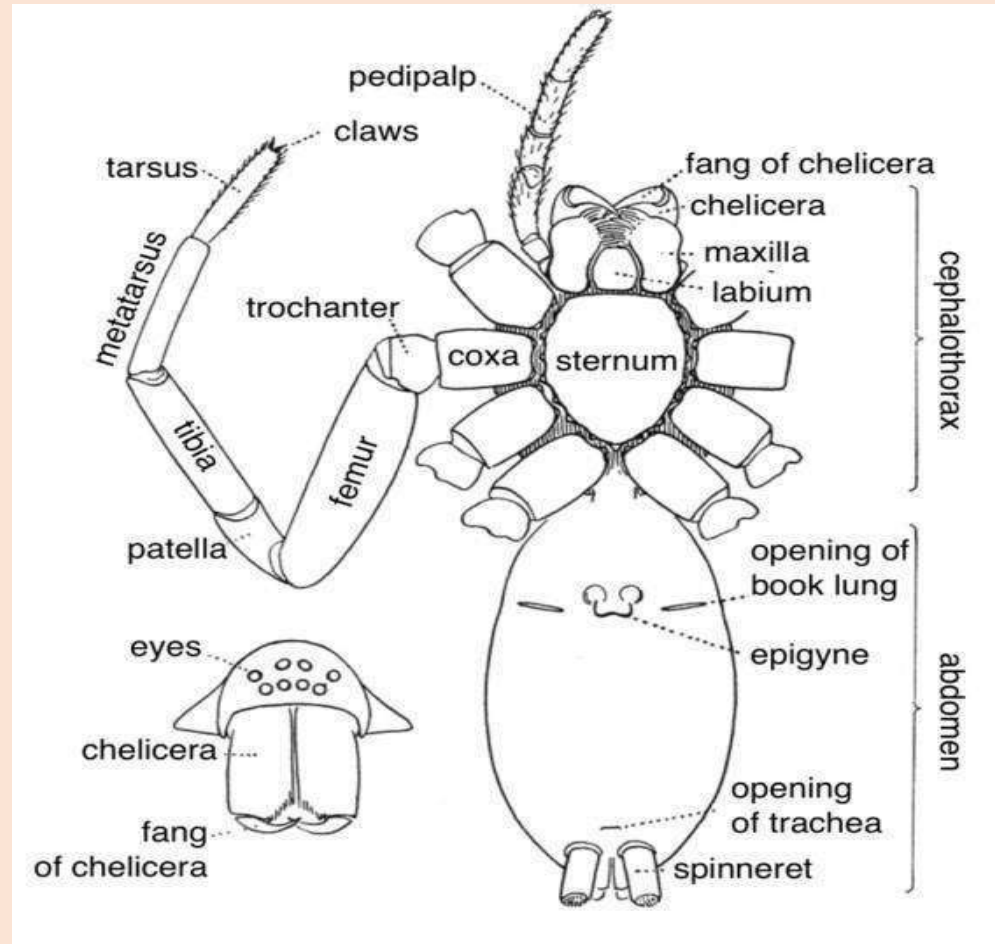
<https://www.google.com/search?q=spiders+eating&tbm=isch&ved=2ahUKEwi0ybiUp9vtAhUBRBoKHWkMA0IQ2->

cCegQIABAA&oq=spiders+eating&gs_lcp=CgNpbWcQAzICCAAyAggAMgIIADICCAAyAggAMgIIADICCAAyAggAMgIIADICCAA6BAgjECc6BAgAEENQ6SNYvTJg6jVoAHAAeACAAa4CiAGZDJIBBzAuMS41Lj

GYAQCgAQGqAQtn3Mtd2l6LWltZ8ABAQ&sclient=img&ei=IJveX7S5JIGlaemYjJAE&b

- Spider venom peptides

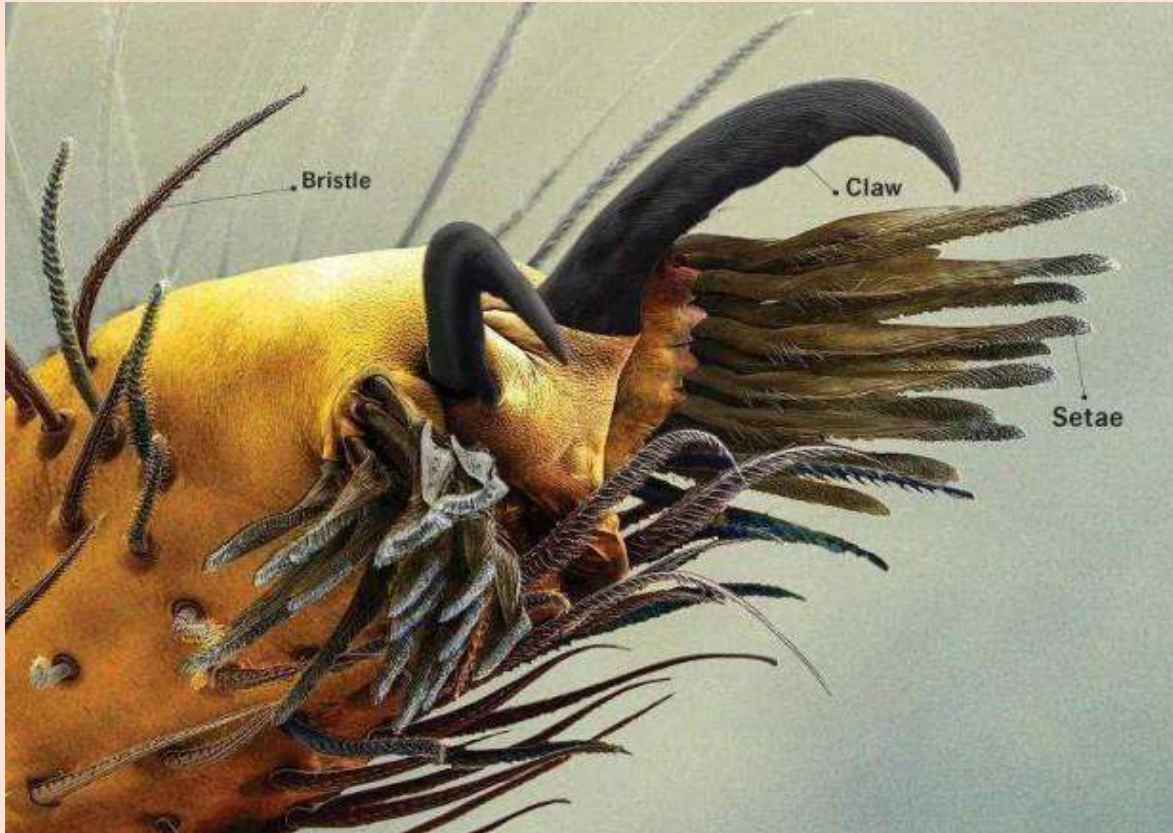
Module# 137 Morphology of spider Leg



- Spiders typically have eight walking legs (insects have six)
- They do not have antennae
- the pair of appendages in front of the legs are the pedipals(or just palps)
- Spiders' legs are made up of

Morphology of spider Leg

https://en.wikipedia.org/wiki/Spider_anatomy#/media/File:Spider_external_anatomy_en.png



seven segments

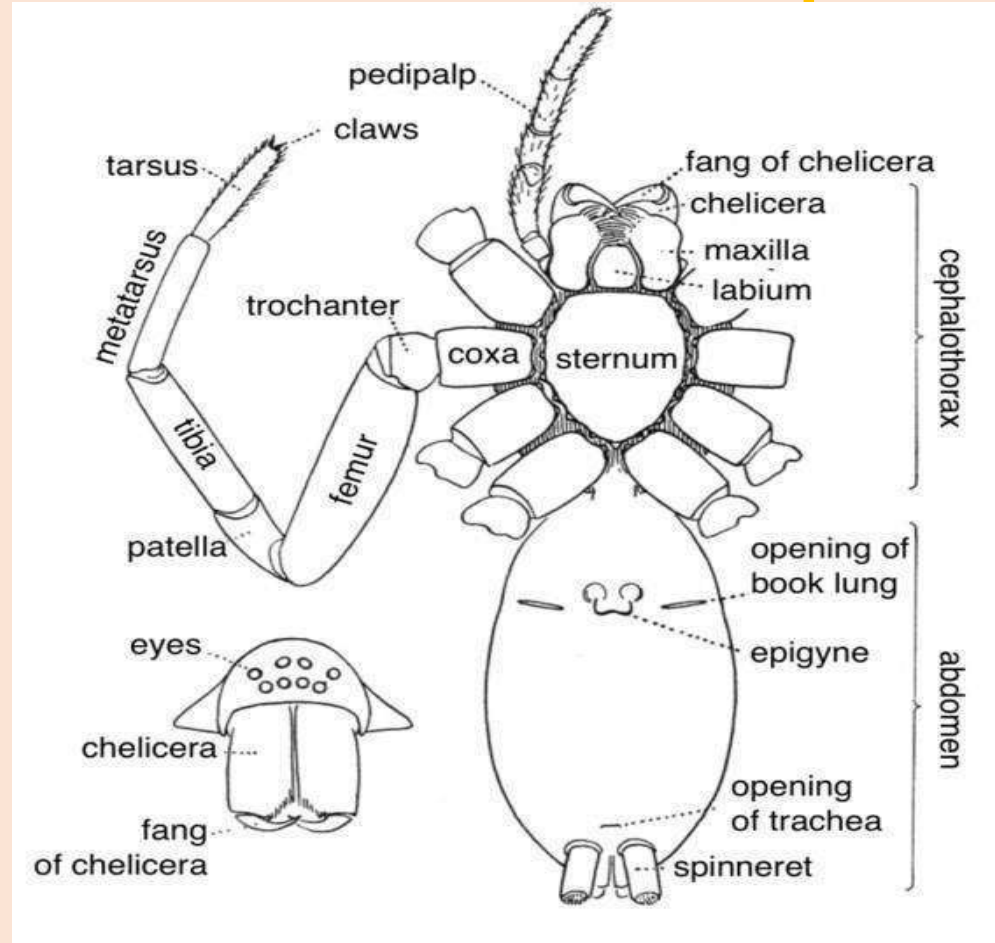
- The tip of the tarsus bears claws, which vary in number and size
- Spiders that spin webs typically have three claws, the middle one being small
- Hunting spiders typically have

Morphology of spider Leg

only two claws

https://www.google.com/search?q=claws+on+spider+legs&sxsrf=ALeKk0060j_KdLtgm-6hkwrG7Ye5YSDcbw:1608429989309&source=lnms&tbm=isch&sa=X&ved=2ahUKEwillalRvNvtAhVhs3EKHXUQBY4Q_AUoAXoECBQQAw&biw=1360&bih=657#imgsrc=288GAYKO3bRCM

Morphology of spider Leg



- Starting from the body end, these are the:

- Coxa
- Trochanter
- Femur
- Patella • Tibia

Morphology of spider Leg

https://en.wikipedia.org/wiki/Spider_anatomy#/media/File:Spider_external_anatomy_en.png

• Metatarsus •

Tarsus.

Morphology of spider Leg



- Since they do not have antennae, spiders use specialized and **sensitive** **setae** on their legs to pick up scent, sounds, vibrations and air currents.
- Some spiders, such as

Morphology of spider Leg

https://www.google.com/search?q=claws+on+spider+legs&sxsrf=ALeKk0060j_KdLtgM6hkwrG7Ye5YSDcbw:1608429989309&source=Inms&tbm=isch&sa=X&ved=2ahUKEwillaLRvNvtAhVhs3EKHXUQBY4Q_AUoAXoECBQQAw&biw=1360&bih=657#imgsrc=288GAyKO3bRCM

not have claws.

the
Australia
crab
spiders,
do

Morphology of spider Leg



palpal

- The pedipalps have only six segments: the metatarsus is missing.
- In adult males, the tarsus of each palp is modified for mating (variously called a palpal pulb, organ or copulatory bulb)

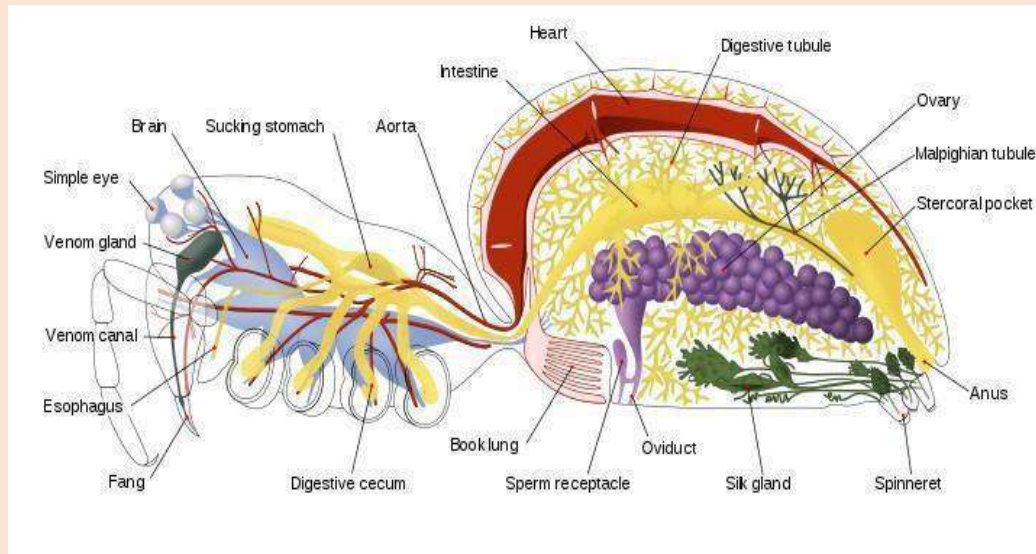
<https://www.google.com/search?q=palpal+bub+in+spiders&tbm=isch&ved=2ahUKEwjypqXYvNvtAhVLHBoKHTcdDzsQ2->

cCegQIABAA&oq=palpal+bub+in+spiders&gs_lcp=CgNpbWcQAzoECCMQJzoICAAQsQMgQgw

A

QE&sclient=img&ei=tLHeX_L8Acu4aLe6vNgD&bih=657&biw=1360#imgsrc=HeEJxStweWNH

Module# 138 Morphology of spider's Abdomen



- The abdomen is also known as the **opisthosoma.**
- On the ventral side of the abdomen
are two hardened plates covering
the book lungs.

cCegQIABAA&oq=palpal+bub+in+spiders&gs_lcp=CgNpbWcQAzoECCMQJzoICAAQsQMqgw

A

QE&sclient=img&ei=tLHeX_L8Acu4aLe6vNgD&bih=657&biw=1360#imgsrc=HeEJxStweWNH