Collaborative Engineering

Morphological Measurements

- Anatomical Landmarks
- Measurement Techniques
- Statistics & Data Handling
- Graphical Analysis

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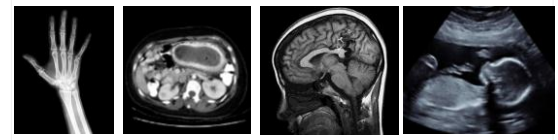
Where do we measure ?

Medical Imaging

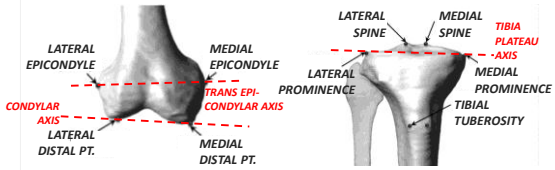
Hard Tissues		Soft Tissues	
X-Rays	CT	MRI	Ultrasound



What do we measure ?

Anatomical Landmarks :

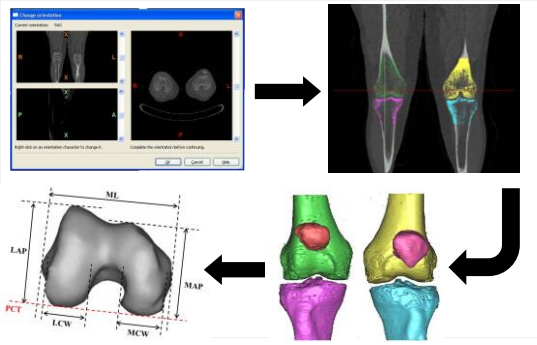
- biologically-meaningful points in an organism
- establish correspondences within the same species
- eg. distal femur and proximal tibia (part of the thigh bone and shin bone in the knee)



How do we measure (X-Rays) ?

- Disadvantages : rotational errors, resolution

How do we measure (CT / MRI) ?



Handling data (tabulate)

SR. NO	NAME	GENDER	AGE	LEFT ML	LAP	MAP	MAP/LAP	AP/ML	LCW	MCW	MCW/LCW	LCW/LAP	MCW/MAP
1	Dacira	F	72	78.33	62.69	57.62	0.92	0.77	29.31	33.86	1.16	0.47	0.59
2	Hegde Girija	F	64	81.68	66.73	64.76	0.97	0.80	34.19	35.59	1.04	0.51	0.55
3	Honavar Sudha	F	70	78.27	65.35	62.19	0.95	0.81	27.87	31.51	1.13	0.43	0.51
4	Khanna Neera	F	58	69.41	56.72	52.69	0.93	0.79	24.19	26.62	1.10	0.43	0.51
5	Kottiet Sunanda	F	58	67.41	51.91	48.61	0.94	0.75	21.17	22.34	1.06	0.41	0.46
6	Mathur Poornima	F	71	72.73	57.45	58.52	1.02	0.80	27.51	30.06	1.09	0.48	0.51
7	Molly Shanta	F	52	74.85	61.74	58.15	0.94	0.80	26.14	31.28	1.20	0.42	0.54
8	Verule Mudrikabai	F	70	71.22	58.03	56.30	0.97	0.80	23.28	25.08	1.08	0.40	0.45
9	Paryani Khimya	F	67	76.87	57.13	61.15	1.07	0.77	28.86	29.99	1.04	0.51	0.49
10	Punja Varanti	F	61	79.17	61.19	63.52	1.01	0.80	28.88	32.69	1.13	0.46	0.51
11	Rufus Muriel	F	74	80.86	60.74	57.68	0.95	0.73	25.66	26.32	1.03	0.42	0.46
12	Sharma Sushila	F	80	82.34	66.53	67.88	1.02	0.82	29.13	36.22	1.24	0.44	0.53
13	Shetty Chhayaja	F	56	78.76	63.66	68.92	1.08	0.84	27.57	32.13	1.17	0.43	0.47
14	Shetty Padmavathi	F	68	74.88	53.35	53.65	1.01	0.71	23.43	27.64	1.18	0.44	0.52
15	Shetty Indira	F	70	78.32	64.59	71.63	1.11	0.87	26.62	33.17	1.25	0.41	0.46
16	Banerjee Uma	F	78	76.77	61.71	59.27	0.96	0.79	26.10	30.99	1.19	0.42	0.52
17	Parashar Vibha	F	64	75.36	60.37	58.96	0.98	0.79	28.85	33.04	1.15	0.48	0.56
18	Sallan Sharda	F	75	76.75	60.11	58.03	0.97	0.77	23.62	30.04	1.27	0.39	0.52
19	Usha Tilku	F	63	76.04	56.37	58.59	1.04	0.76	24.94	30.70	1.23	0.44	0.52
20	Kaur Surinder	F	58	76.11	61.49	59.48	0.97	0.79	27.01	32.25	1.19	0.44	0.54
	Average	F	66.5	76.31	60.49	59.88	0.99	0.79	26.72	30.58	1.15	0.44	0.51
	Std. Dev.	--	7.69	3.86	4.13	5.52	0.05	0.04	2.90	3.50	0.07	0.03	0.04
	Min	--	52	67.41	51.91	48.61	0.92	0.71	21.17	22.34	1.03	0.39	0.45
	Max	--	80	82.34	66.73	71.63	1.11	0.87	34.19	36.22	1.27	0.51	0.59
	Halfwidth (95% CI)	--	3.6	1.81	1.93	2.58	0.02	0.02	1.36	1.64	0.03	0.02	0.02

Handling data (statistics)

Student t-test :

- establish basic information about entire data like mean, standard deviation, confidence interval etc.

Paired t-test :

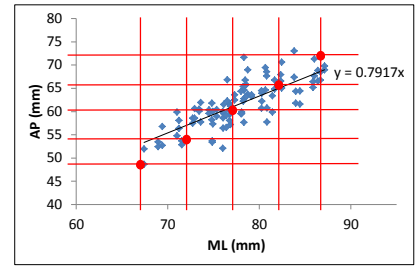
- compare two data sets with EQUAL number of samples (n)
- compare different dimensions within the SAME population

Welch t-test :

- compare two data sets with UNEQUAL number of samples (n_1 , n_2)
- compare different dimensions amongst DIFFERENT populations
- other statistical models like ANOVA etc.

Handling data (graphs)

- observe important / expected trends
- divide entire data into clusters – find local means



Summary

- Step 1: ACQUIRE DATA using medical imaging technologies like CT scans
- Step 2: LOCATE anatomical landmarks
- Step 3: MEASURE distances & angles relative to the selected landmarks
- Step 4: TABULATE results and find important population information
- Step 5: Employ STATISTICAL MODELS to establish / compare data
- Step 6: Visualize trends and clusters GRAPHICALLY