MSMS 308 : Practical 01

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🎯 **Question** Estimate $\underset{\sim}{\mu}$ and Σ from the data given below.

Head Length First Son (X_1)	Head Breadth First Son (X_2)	Head Length Second Son (X_3)	Head Breadth Second Son (X_4)
191	155	179	145
195	149	201	152
181	148	185	149
183	153	188	149
176	144	171	142
208	157	192	152
189	150	190	149
197	159	189	152
188	152	197	159
192	150	187	151
179	158	186	148
183	147	174	147
174	150	185	152
190	159	195	157
188	151	187	158
163	137	161	130
195	155	183	158
186	153	173	148
181	145	182	146
175	140	165	137
192	154	185	152
174	143	178	147
176	139	176	143
197	167	200	158

Theory

$$\underset{\sim}{\mu}_{MLE} = \frac{1}{n}\sum_{\alpha=1}^{n} \underset{\sim}{x}_{\alpha}$$

$$\hat{\Sigma} = \frac{A}{n}$$

where $A = ((a_{ij}))$ with $a_{ij} = \sum_{\alpha=1}^{n}(x_{\alpha i} - \bar{x}_i)(x_{\alpha j} - \bar{x}_j)\ \forall i, j = 1(1)4.$

R Program

```
df <- read.csv('https://raw.githubusercontent.com/sakunisgithub/data_sets/refs/heads/master/msc_semester_3/multivariate_practical_1.csv')
```

```
colnames(df) <- c("X1", "X2", "X3", "X4")
```

```
mu_hat <- apply(df, 2, mean)
mu_hat
```

```
##       X1       X2       X3       X4
## 185.5417 150.6250 183.7083 149.2083
```

```
n <- dim(df)[1]; n
```

```
## [1] 24
```

```
sigma_hat <- cov(df) * ((n-1)/n)
sigma_hat
```

```
##          X1       X2        X3       X4
## X1 94.49826 50.66146  69.07465 45.97049
## X2 50.66146 48.23438  49.68229 34.66146
## X3 69.07465 49.68229 100.37326 56.43576
## X4 45.97049 34.66146  56.43576 44.99826
```