## Exercise 1:

Let $T : \mathbb{R}^2 \to \mathbb{R}^2$ be the linear transformation represented by the matrix

$$A = \begin{pmatrix} 4 & 1 \\ 2 & 3 \end{pmatrix}.$$

1. Find the matrix of the linear transformation $T$.

2. Find the eigenvectors associated with each eigenvalue.

3. Calculate the image of the vector $v = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ under $T$.

## Exercise 2:

The following table displays the distribution of individuals across two professions and two gender categories:

|  | Profession 01 | Profession 02 | Σ |
|---|---|---|---|
| Men | 20 | 15 | 35 |
| Women | 30 | 25 | 55 |
| Σ | 50 | 40 | 90 |

1. What is the nature or classification of these values?

2. What are the key purposes of applying Correspondence Analysis (CA) to this dataset?

Assuming independence between the variables "profession" and "gender," Determine the table of theoretical frequencies in the case of independence.

1. Calculate the Chi-Square statistic and compare it with the critical value at a significance error level of $\alpha = 0.05$. What can you conclude about the relationship between profession and gender?

2. Deduce the inertia, interpret the results.

3. Calculate the row-profile matrix $L$ and the column-profile matrix $C$. Discuss these matrices.

4. Calcule the diagonal matrix $D_r$.

Take the covariance matrice on Ligne profiles is:

$$\Sigma_r = Y_r^t D_r Y_r = \begin{bmatrix} 0.014 & 0.02 \\ 0.02 & 0.039 \end{bmatrix}.$$

1. Compute the total inertia of the row profiles $L$. interprete the result.

On Exercise 2 part 2; we recall that The correspondence analysis is essentially based on the two matrices $\Sigma_r D_c^{-1}$ and $\Sigma_c D_r^{-1}$, Where:

- $\Sigma_r$ and $\Sigma_c$ are the covariance matrices of row profiles and column profiles, be the centered matrices of the row profiles and column profiles.

- $D_r$ and $D_c$ Povide the diagonal matrices of row profiles and column profiles.

## Problem Statement

Population consisting of 4 individuals, where we are interested in studying 3 statistical variables: $x$ and $y$. These individuals represent 4 families, each with 5 children, living on the same salary. The three statistical variables are defined in hundreds of dinars, as follows:

3. $x$: the salary received for the year (in 100s of dinars).
4. $y$ the expenses allocated for consumption this month (in 100s of dinars).

Here is the data table:

| Family | Salary (x) | Consumption Expenses (y) |
|--------|------------|--------------------------|
| Family 1 | 35 | 10.7 |
| Family 2 | 8 | 2.5 |
| Family 3 | 12 | 3.8 |
| Family 4 | 25 | 7 |

1. Calculate the statistics of the above data variables.
2. Calculate the covariance matrix.
3. Calculate the correlation matrix, and then comment on it.
4. Calculate the variances (eigenvalues) of the principal components for this problem statement.
5. What is the percentage of variance explained by each principal component?
6. . Find the normalized eigenvector corresponding to the first principal composant.
7. Calculate the individuals components.

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