# MCDM (Multi-Criteria Decision Making) Models

## 1. Introduction

Multi-Criteria Decision Making (MCDM) helps decision makers evaluate and rank alternatives when multiple, often conflicting criteria are present. It is widely used in supplier selection, project prioritization, location analysis, and many engineering and business problems.

## 2. Popular MCDM Methods

- Weighted Sum Model (WSM): Sum weighted normalized scores for each alternative.
- Weighted Product Model (WPM): Multiply criteria raised to their weights.
- Analytic Hierarchy Process (AHP): Pairwise comparisons to derive weights and consistency checks.
- TOPSIS: Rank alternatives based on distance to ideal and anti-ideal solutions.
- ELECTRE and PROMETHEE: Outranking methods for complex decision contexts.

## 3. Basic Steps

1. Define the decision problem and the set of alternatives.
2. Identify evaluation criteria.
3. Assign weights to criteria (subjective or computed).
4. Score alternatives against criteria.
5. Apply chosen MCDM method to rank alternatives.
6. Perform sensitivity analysis to test robustness.

## 4. Applications

- Supplier selection and evaluation
- Project prioritization and portfolio selection
- Investment decisions and portfolio screening
- Location selection for facilities
- Environmental and sustainability trade-offs

## 5. Advantages and Limitations

Advantages:

- Structured approach to multi-criteria problems
- Can combine qualitative and quantitative criteria

Limitations:

- Weight assignment can be subjective
- Sensitivity to normalization and scale
- Some methods are computationally intensive for large problems

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