



## Mathematical Analytics and Modeling

Harvard University

**Keywords:** Statistics, Modeling, and Computation

**Recommendation:** This is a project-based program for students who are interested in and/or have a background in mathematics, data science, and market analysis. After the program, the students are encouraged to have some wonderful research outputs, such as a conference paper or a journal article.

**Abstract:** This is a project-based style program spanning transportation engineering and urban dynamics. The program focuses on mathematical analyses, including descriptive statistics, modeling construction, and numerical computation. Specifically, through hands-on quantitative real-world projects, various classical methods related to mathematical analytics in the decision-making process (e.g., weighting, aggregating, and grouping) will be detailly introduced, such as Entropy, AHP, TOPSIS, CA, PCA/CFA, BP Neural Network, etc. Whilst, some commonly used mathematical software tools, such as MATLAB and SPSS, will also be introduced during the program. Moreover, the research apprentices will learn the usage of EndNote, a reference management software package used to manage bibliographies and references when writing journal articles. In addition, AutoCAD, a computer-aided design (CAD) and drafting software, will be demonstrated for the applications in visualization and real design. Overall, by attending this program, the apprentices will have a significant improvement in discovering, analyzing, and solving practical problems from the mathematical perspective, which are closely related to their future studies and careers.

### Specific techniques and tools that would be delivered in this program:

- **Data collection:** Various databases at international, regional, and national levels
- **Data pre-processing:** Data cleaning and data normalization
- **Weighting:** Entropy Method and Analytic Hierarchy Process (AHP)
- **Aggregating:** TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution)
- **Robustness analyses:** Correlation analysis
- **Grouping:** RSR (Rank-Sum Ratio), Regressions, Clustering Analysis (CA),

and Multiple Correspondence Analysis (MCA)

- **Robustness analyses:** Principal Component Analysis (PCA) and Common Factor Analysis (CFA)
- Data decomposition and deconstruction
- **Neural Network:** BP Neural Network
- **Visualization:** AutoCAD Drawing
- **Coding:** MATLAB and SPSS
- **Reference Management:** EndNote
- **Paper Writing:** Journal article or Conference paper writing