VALIDATING A PSYCHOLOGICAL RESILIENCE SCALE USING EXPLORATORY FACTOR ANALYSIS IN PYTHON

1. Background

A psychology department at a U.S. research university developed a 25-item self-report scale intended to measure emotional resilience among undergraduate students. Before formal adoption, the team required statistical validation to determine if the scale measured distinct underlying constructs such as optimism, adaptability, and emotional regulation.

We were commissioned to perform Exploratory Factor Analysis (EFA) using Python to identify latent dimensions, assess item loading consistency, and refine the instrument for future use in academic and clinical contexts.

2. Objective

- To perform exploratory factor analysis in Python on survey response data to uncover underlying dimensions of emotional resilience
- To determine the number of valid factors to retain using statistical criteria
- To identify and eliminate weak or cross-loading items for psychometric refinement
- To deliver a detailed, structured validation report suitable for peer-reviewed publication

3. Data Used

Source: Online survey responses collected from psychology undergraduates (n = 368)

Variables:

- 25 Likert-scale items (rated 1–5) measuring different aspects of resilience
- No missing data (all fields mandatory in survey)
- Fields: Q1 to Q25 with reverse-coded items adjusted during preprocessing

4. Methodology

4.1 Preprocessing

- Checked internal consistency using **Cronbach's alpha**

- Reverse-coded 5 items using pandas
- Standardized all responses using StandardScaler from sklearn

4.2 Suitability Tests

- **Kaiser-Meyer-Olkin (KMO)** = 0.87 (good)
- **Bartlett's Test of Sphericity** = $p < 0.001$ (significant)

4.3 Factor Extraction

- Applied **EFA using the factor_analyzer package**
- Determined number of factors using:
    - **Eigenvalues > 1 rule**
    - **Scree plot inspection**
    - **Parallel Analysis**
- Rotation method: **Varimax** (orthogonal)

4.4 Factor Interpretation

- Suppressed loadings < 0.4 for clarity
- Dropped 3 items due to weak or cross-loading behavior
- Named resulting factors based on grouped item semantics

5. Factor Extraction Results

Factor	Description	Number of Items	Sample Items
F1	Optimism & Positivity	7	"I believe things usually work out well"
F2	Adaptability	6	"I adjust quickly to new challenges"
F3	Emotional Self-Regulation	5	"I stay calm when facing problems"

- Cumulative Variance Explained: **61.3%**
- All factors had **Cronbach's alpha > 0.78**

6. Interpretation and Use

- The original 25-item tool was refined to a **3-factor, 18-item validated scale**
- Provided **item-to-factor mapping table** for scoring interpretation
- Suggested scoring framework:
    - Each factor scored on a 1–5 average basis
    - Composite resilience index = mean of three factor scores
- Scale deemed appropriate for future research on college mental health, coping, and intervention studies

7. Reporting Output

- **Python Script (Jupyter Notebook)**:
    - EFA pipeline with KMO, Bartlett's test, scree plot, and factor extraction
    - Automated factor labeling and export of rotated component matrix
- **PDF Report (15 pages)**:
    - Overview of methodology
    - Tables: Factor loadings, eigenvalues, item retention decisions
    - Charts: Scree plot, parallel analysis, variance explanation
    - Recommendations for future survey deployment
- **Excel Output**:
    - Final 18-item tool with item labels and corresponding factor
    - Summary metrics: factor loadings, item-total correlation, reliability scores

8. Research Impact

- Tool now being used in a **larger NIH-funded mental health resilience project**
- Results formed the **appendix of a published peer-reviewed study**
- Faculty now use the validated tool in course-based mental wellness assessments
- The Python EFA notebook is used in ongoing survey-based graduate research