Characterizing a Group of AP Statistics Teachers' Beliefs and Practices

David J. Stokes - USCOTS 2021 - Posters & Beyond Session

Introduction

Purpose

The purpose of this study is to investigate the following questions:

1. What are the characteristics of a group of AP Statistics teachers?
2. What do these teachers believe and do; and how are these beliefs and actions related?

Data & Methods

The data consists of a sample of over 300 AP statistics teachers' responses to a survey from Fall, 2018. These teachers were teaching AP Statistics at the time of the survey. Seven items from a *Pedagogy* section, and 18 items from a *Beliefs* section are used in this analysis in order to address the questions of interest. Each of the items contain responses on a 6 point likert-scale (1 = strongly disagree … 6 = strongly agree) designed to measure the intensity of teacher beliefs and practices.

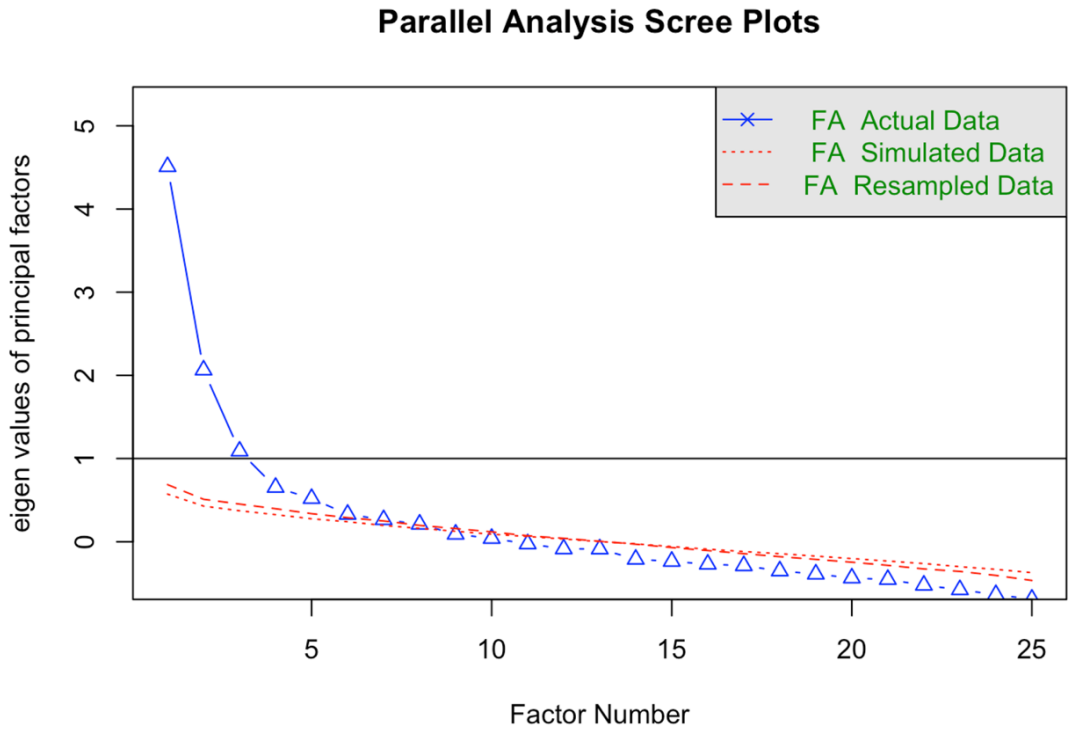
`Factor analysis` was used to derive constructs and `k-means clustering` was used for teacher grouping.

Summary

This presentation will describe interpretations of underlying constructs and the relationships between these constructs based on derived teacher groups, using the 25 beliefs and practices related survey items. Results are sample specific, but may be useful for future explorations.

Exploring the Dimensionality of the Data

To gain insight into the underlying constructs represented in this data, `Parallel Analysis` was used in order to determine a basis for choosing a number of factors. This method compares the observed data variation explained by the number of factors to (the average of) the variation explained by randomly generated datasets of the same size. Holgado-Tello et al. (2008), recommend using polychoric correlation for categorized continuous constructs (such as those measured by likert-scale items), and this is utilized here. From the graph it can be seen that the observed variation from 8 factors is larger than the (average) variance explained by 8 factors from random correlation matrices.



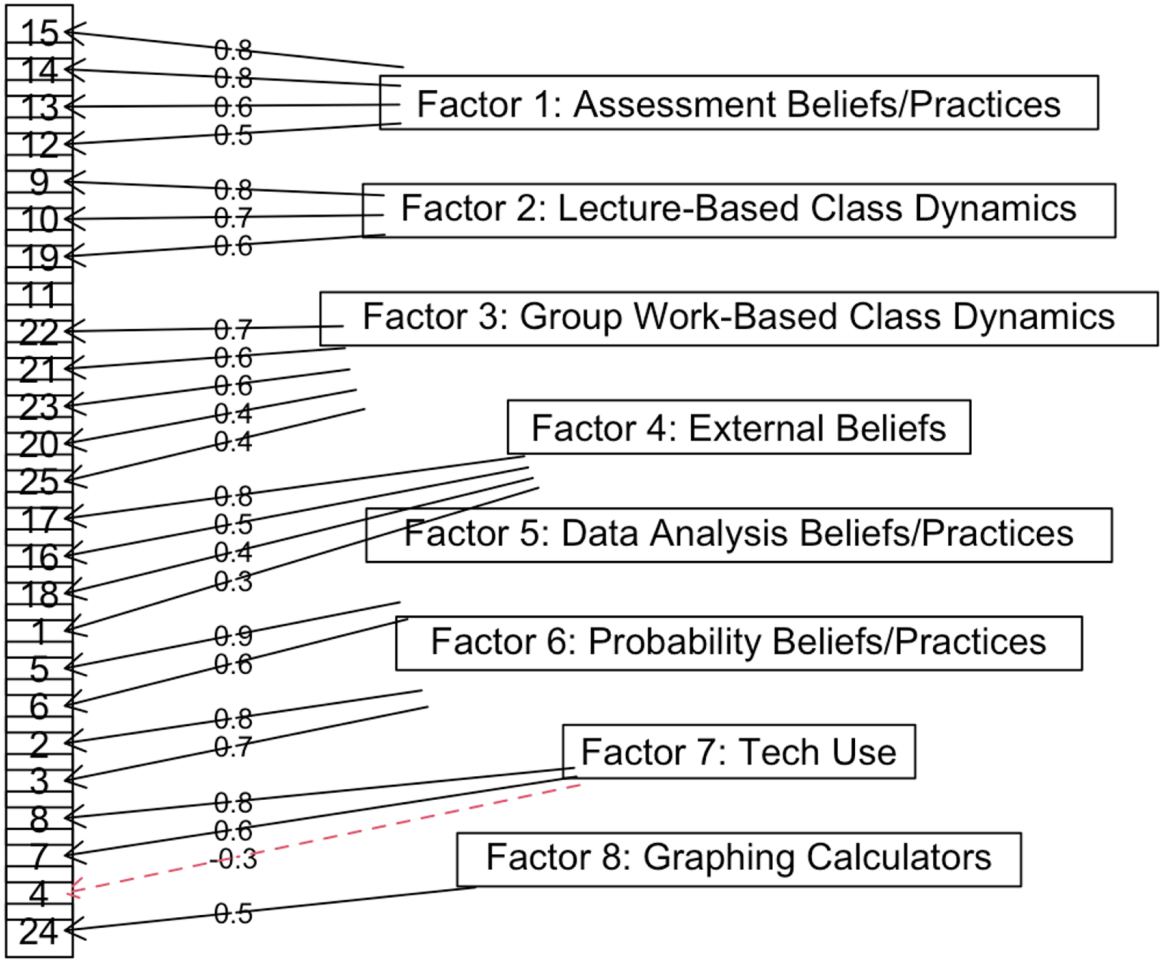
Interpreting the Factors

The table below has construct headings for the 8 factors. Each of the items within these factors are related to the construct title. AP Statistics teachers with high scores on a given construct/factor are associated with stronger agreement with the represented beliefs and/or practices.

Label	Question	Loadings
Factor 1: Assessment Beliefs/Practices		
15	Students Should Be Assessed On Their Statistical Literacy e.g. Ability to Read a Graph Understand Common Statistical Words etc.	0.801
14	Students Should Be Assessed On Their Ability to Complete An Open Ended Statistical Problem	0.782
13	Formative Feedback Should Be Given On All Assessments In Order For Students to Improve Their Learning	0.601
12	All Assessments Should Be Regularly Reviewed to See that They Are Aligned With Student Learning Goals	0.451
Factor 2: Lecture-Based Class Dynamics		
9	Lectures Should Be The Primary Way For Students to Learn Statistical Content	0.841
10	Quizzes and Exams Should Be Used As The Primary Way to Evaluate Student Learning	0.650
19	The Content Was Presented Mostly Through Lectures	0.598
11	Alternative Assessments e.g. Projects Presentations Should Be Used to Provide Important Information About Student Learning	-0.262
Factor 3: Group Work-Based Class Dynamics		
22	The Content Was Presented Mostly Through Activities	0.698
21	The Course Frequently Required Students to Work Together	0.623
23	this Course Encouraged Students to Discover Ideas On Their Own	0.588
20	The Instructor Asked Challenging Questions that Made Students Think	0.387
25	this Course Often Used Technology Other Than Graphing Calculators to Help Students Understand Concepts	0.358

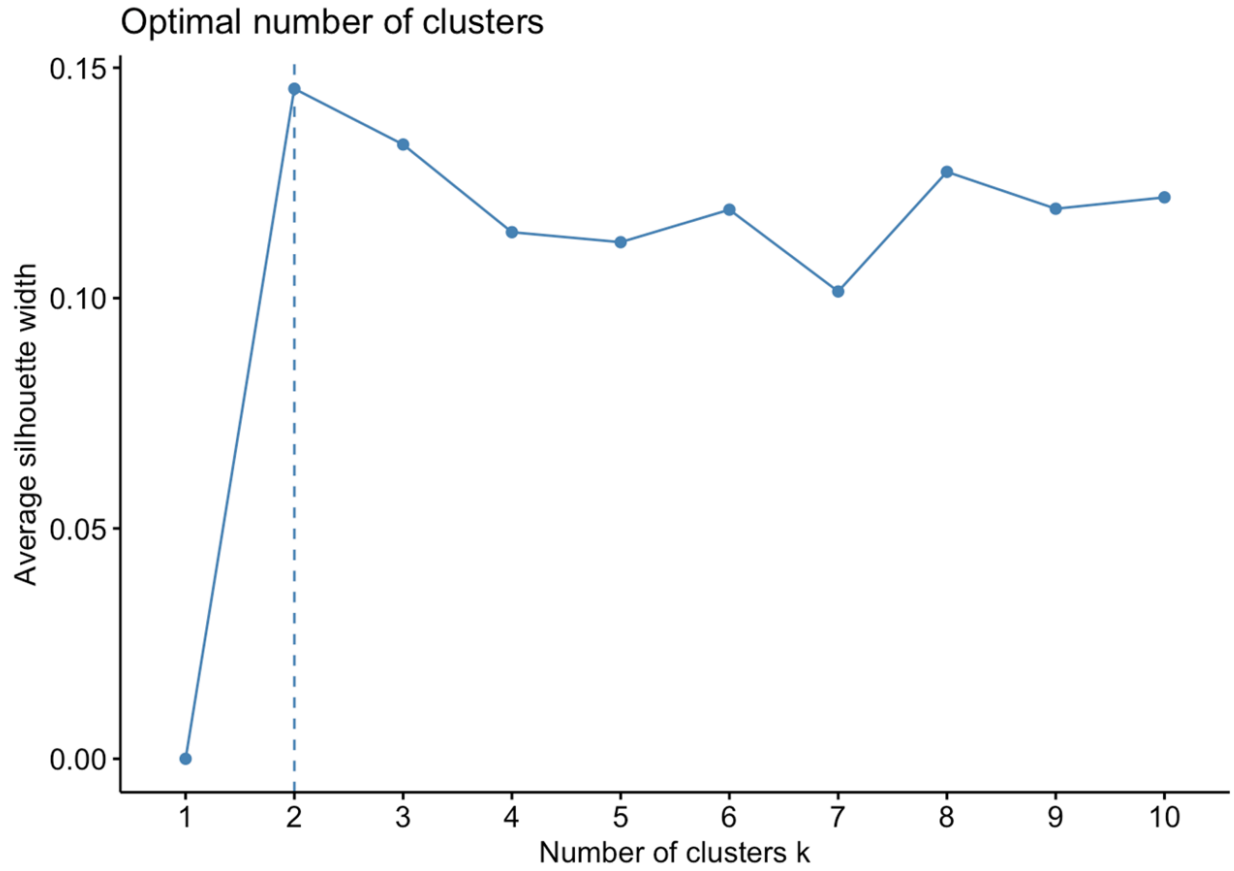
Factor 4: External Beliefs		
17	Statistics Courses Should Be Updated Continually In Response to Recommendations Such As Common Core	0.765
16	Statistics Courses Should Be Updated Continually to Keep Up With Advances In Technology	0.508
18	Statistics Instructors Should Be Actively Engaged In The Statistics Education Community	0.416
1	Students Should Learn Fewer Topics In Greater Depth Instead of Learning More Topics In Less Depth In An Introductory Statistics Course	0.343
Factor 5: Data Analysis Beliefs/Practices		
5	Students Should Learn The Importance of Using Appropriate Methods For Collecting Data	0.878
6	Students Should Learn Connections Between The Qualityture of The Data and Inferences that Are Made	0.612
Factor 6: Probability Beliefs/Practices		
2	Basic Rules of Probability Should Be Included In An Introductory Statistics Course	0.808
3	The Topic of Theoretical Probability Distributions e.g. The Binomial Distribution Should Be Included In An Introductory Statistics Course	0.707
Factor 7: Tech Use		
8	Students Should Analyze Data Primarily Using Technology	0.766
7	Technology Tools Should Be Used to Illustrate Most Abstract Statistical Concepts	0.584
4	Students Should Learn How to Read Statistical Tables of Probability Distributions e.g. T Table Z Table	-0.329
Factor 8: Graphing Calculators		
24	Students Use Graphing Calculators Regularly In this Course	0.539

Factor Analysis



Determining How to Group Teachers?

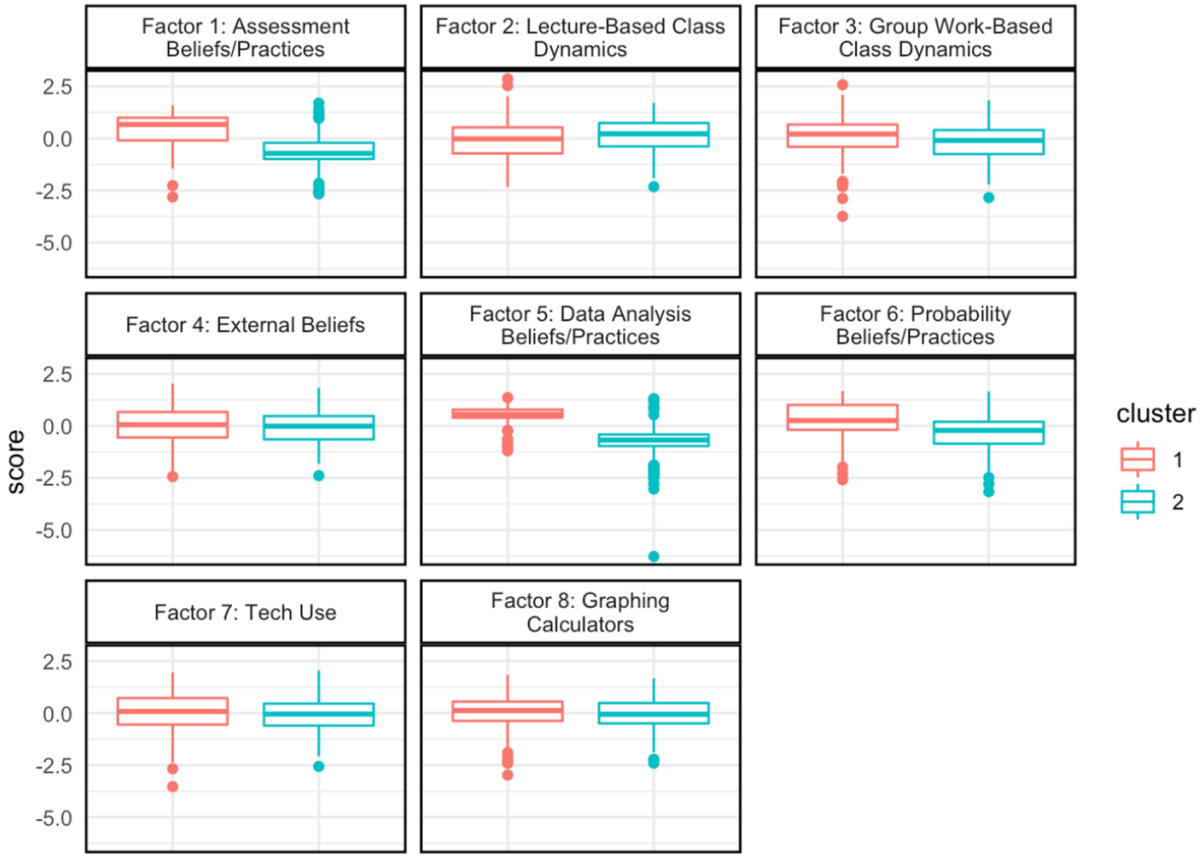
The plot below is a visual representation of the `silhouette method` which is a measure of average distance between points within a cluster compared to average distance between points across clusters. The number of clusters (2) was chosen from this criterion and is denoted by the maximum in the graph at the dashed line.



Describing Teacher Types

Below are boxplots of factor construct by cluster group. The purpose of this graph is to visually gain insight into the relationship between teacher beliefs and practices across constructs with respect to the cluster groups.

What do you notice in the graph?



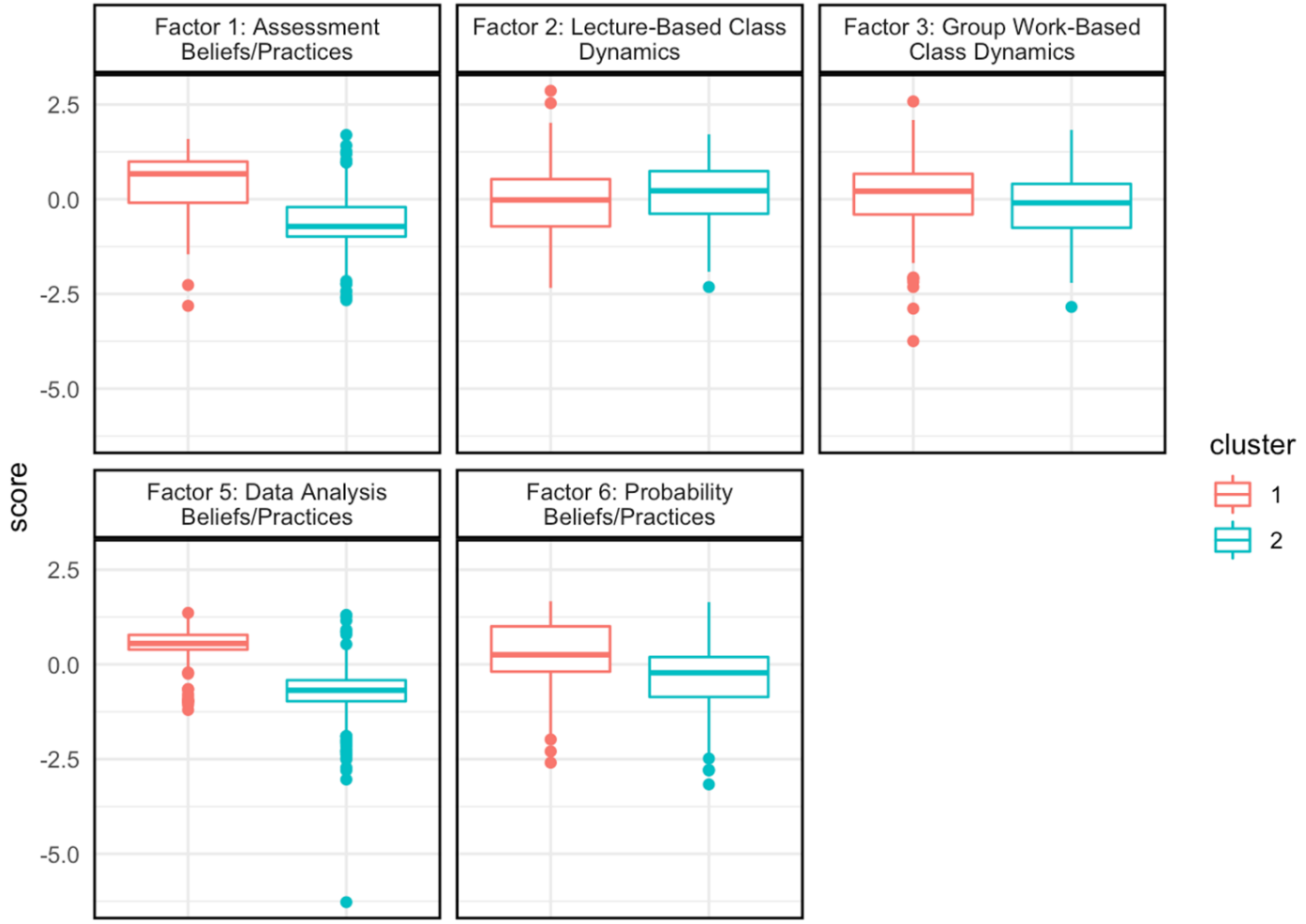
Exploring significant differences

ANOVA Results for Factor Score Cluster Differences

Factor	F value	Pr(>F)
Factor 1: Assessment Beliefs/Practices	148.47	<0.0001*
Factor 2: Lecture-Based Class Dynamics	9.35	0.0024*
Factor 3: Group Work-Based Class Dynamics	13.42	0.0003*
Factor 4: External Beliefs	2.80	0.0949
Factor 5: Data Analysis Beliefs/Practices	393.71	<0.0001*
Factor 6: Probability Beliefs/Practices	57.31	<0.0001*
Factor 7: Tech Use	1.46	0.2271
Factor 8: Graphing Calculators	1.86	0.1732

Note:
* indicates significant difference

Five Significant Differences



Interpretation

Teachers who tend to emphasize aspects of Lecture-Based Class Dynamics (factor 2) tend to de-emphasize Assessment Beliefs/Practices (factor 1), Group Work-Based Class Dynamics (factor 3), Data Analysis Beliefs/Practices (factor 5), and Probability Beliefs/Practices (factor 6). From this perspective, based on the two types of teachers, it can be said that those categorized in the manner of cluster 2 tend to be lecture-focused, more traditional teachers. These Group 2-like teachers are less concerned about course updates and aspects of teaching that go beyond the lecture method. They tend to assess students in a static manner.

On the other hand, teachers in Group 1 appear to take a more holistic approach to statistics in their beliefs and practices, and emphasize group dynamics, and components of data analysis and probability that have strong relationships with the AP statistics curriculum.

Next Steps

- Are there differential student outcomes across the two teacher groups/types?
- How does professional development look for different teacher groups/types?

Other Considerations

- Exploring different groups (number or method)
- Exploring score correlations
- Exploring/revising/eliminating different items, or those with weaker loadings
- Obtaining teacher demographics