Students' forward thinking – an analysis of cultural divides

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Introduction

- This work presents an analysis of data collected using an initial attmept at crowdsourcing.
- The data show the preferences of students from different countries (mainly Poland and Romania) regarding teaching methods at their universities and future career plans.
- These data were processed using the reverse clustering method to determine the impact of the cultural background on students' expectations.
- The reverse clustering technique, developed by the authors, tries to reconstruct an initially given partition of the set of observations, using the clustering algorithms with tuned parameters.

The characteristics of collected students' responses

1. The questionnaire was conducted in March 2020 in Romania and Poland.
2. About 50 responses have been obtained.
3. The questionnaire contains 61 distinct items, organised into seven domains. In the responses:
   - 5 university-level schools are represented,
   - not less than 7 directions of study are represented,
   - respondents belong to 4 nationalities
   - the sample contains both intramural and extramural students
   - the respondents currently are at all the years of study, from 1 to 4
   - the gender balance among respondents is almost perfect.
   - the age of respondents ranges from 18 to 37.

The questionnare description

The questionnaire contains the following groups of items:

- Basic data on the respondents (the school, the study direction, the intra- or extramural studies, the year of study, nationality, gender, age).
- Expected nature of employment after studies.
- Attitude towards studying (attending lectures and exercises, superfluous lectures, relation to life problems, excess theory in the curriculum, teamwork of students).
- Use of the web (university website, use by lecturers, use by oneself – and for what purposes, use of social media).
- Learning and teaching and the kinds of resources used (with a suggestion of an "appropriate mix" of various kinds of media to be used).
- Necessity of changes in teaching, with indication of particular domains (lectures, lecture materials, exercises,…) and the potential tools or instruments.
- Student contribution to the potential change (can students contribute? how? do you have your own idea?).

The overview of responses

The respondents answers can be summarized as follows:

1. Gender: female 49%, male 51%.
2. Nationality: Romanian: 51%, Polish: 43%,Ukrainian: 4%, other: 2%.
3. School:
   - WSISIZ/WIT in Warsaw: 49%,
   - Bucharest University of Economic Studies: 40%,
   - Polytechnic University of Bucharest: 6%,
   - Babes Bolyai University: 2%
   - National University of Political Studies, Bucharest: 2%.
4. Time spent a week by students on own study:
   - less than 10 hours: 38% (9 Polish and 9 Romanian students),
   - more than 10 hours: 62% (11 Polish, 15 Romanian and 3 other nationality students).

The overview of responses

5. Future employment plans (do not sum up to the number of respondents):

- Programmer: 31
- Designer/developer: 34
- Manager: 21
- Project manager: 23
- Clerk: 8
- Self-employed/business person: 29
- Sales person: 9
- Other: 14.

The overview of responses

6. The responses to the question as to whether the students have their own idea on the tools and methods for improving the teaching process and its outcomes:
   - No: 66%,
   - Yes: 34%.
7. All students answered positively to the question: “Can students contribute to the change?”, meaning change in the way teaching is done, with special emphasis on new media and the web, with importance assigned ranging from 3 to 5 (0 – unimportant, 5 -absolutely necessary).

The reverse clustering approach

Therefore, the question arises whether the obtained answers are influenced by the cultural context (nationality, university, etc.)?

It is possible to investigate this question using the reverse clustering method.

The reverse clustering approach

1. Assume we dispose of a data set, denoted X, composed of n observations x_i, $i = 1,\ldots,n$, each of which is characterised by a vector of m values, x_{ik}, $k = 1,\ldots,m$.

2. We also dispose of a partition of this set of observations, denoted P_A.

3.The set of observations (or of their indices i, their set being denoted I, $I = \{1,\ldots,n\}$) is divided up into a certain number, say p_A, of subsets, call them A_q, $q = 1,\ldots,p_A$, in such a manner that $\cup_q A_q = I$ and $A_q \cap A_{q'} = \varnothing$.

4. The task is to determine a clustering procedure that will produce, when applied to the data set X, a partition P_B that is as close to P_a as possible (this partition P_B being composed of the subsets, or clusters, B_q, $q = 1,\ldots,p_B$), and this task is called reverse clustering.

The reverse clustering approach

5. The metric $D(P_A,P_B)$, which is quite natural, and which is actually largely used in the approach outlined, is the classical Rand index of similarity of two partitions. In this approach we minimize:

$$(b + c)/(a + b +c + d)$$

where:

a – the number of pairs of observations which are in the same cluster in both partitions (no matter how we designate this cluster),

b – the number of pairs of observations, which are in the same cluster in one partition, but in different clusters in the second partition,

c – the number of pairs that are in different clusters in one partition, but are in the same cluster in the second partition,

d – the number of pairs of observations that are in different clusters in both partitions.

The reverse clustering approach

- The clustering algorithm used as clustering procedure in presented further results was the k-mens algorithm, we also tried DBSCAN and hierarchical agglomeration algorithms in our investigations, but they appeared to be too slow and not as exact as k-means.
- The parameters of the clustering methods (called the vector Z) tuned to obtain the closest are quite different for different methods, for the k-means algorithm are:
  - the number of clusters,
  - initial values of cluster centres,
  - variable weights,
  - the exponent in the Minkowski formula for computing the distance between observations – $d(x_i,x_j)$.
- The optimization procedure for finding the best parameter vector Z and hence the partition P_B is an evolutionary algorithm.

Obtained results of computer simulations

Table 1. Results from the “reverse clustering” exercise based on the initial partition according to nationalities

Clusters assumed	Clusters obtained	
	Cluster 1	Cluster 2
Romanians	24	0
Poles	0	21
Ukrainians	0	2
Other	0	1

Obtained results of computer simulations

Table 2. Results from the “reverse clustering” exercise based on the initial partition according to nationalities with exclusion of the variable indicating the school attended

Clusters assumed	Clusters obtained	
	1 (Romanians)	2 (non-Romanians)
Romanians	23	1
Poles	1	20
Ukrainians	0	2
Other (Turks)	0	1

Obtained results of computer simulations

Table 3. Results from the "reverse clustering" exercise based on the initial partition according to higher schools, case 1

Clusters assumed	Clusters obtained	
	Cluster 1	Cluster 2
Romanian schools: BUES, UPB, NUPSPA, BBU	24	0
Polish school: WIT	0	24

Obtained results of computer simulations

Table 4. Results from the "reverse clustering" exercise based on the initial partition according to higher schools, case 2

Clusters assumed	Clusters obtained		
	Cluster 1	Cluster 2	Cluster 3
Romanian school: BUES	19	0	0
Romanian schools: UPB, NUPSPA, BBU	0	5	0
Polish school: WIT	0	0	24

Obtained results of computer simulations

Table 5. Results from the "reverse clustering" exercise based on the initial partition according to higher schools, case 1, without the nationality variable

Clusters assumed	Clusters obtained	
	Cluster 1	Cluster 2
Romanian schools: BUES, UPB, NUPSPA, BBU	20	4
Polish school: WIT	1	23

Obtained results of computer simulations

Table 6. Results from the "reverse clustering" exercise based on the initial partition according to higher schools, case 2; without the nationality variable

Clusters assumed	Clusters obtained		
	Cluster 1	Cluster 2	Cluster 3
Romanian school: BUES	19	0	0
Romanian schools: UPB, NUPSPA, BBU	1	2	2
Polish school: WIT	1	3	20

Obtained results of computer simulations

Table 7. Results from the “reverse clustering” exercise based on the initial partition according to gender

Clusters assumed	Clusters obtained	
	Cluster 1 (Females)	Cluster 2 (Males)
Females	20	3
Males	2	23

Conclusions

- The results from the “reverse clustering” demonstrate that it is possible to devise a regular partition of the given set of objects into subsets, by appropriately selecting the elements of the vector of parameters (Z), characterising the clustering procedure.
- The clusters obtained using “reverse clustering” show that people from different countries and different cultural backgrounds (like associated with gender) have different expectations, according to their mind-set, local traditions and cultural profile of the environment they come from.
- According to obtained results many aspects of the educational process should be reconsidered in order to preserve the quality and face the challenges of webinars, tutorials and other resources available on the internet. The cultural backgrounds of the target audience ought definitely to be taken into account explicitly.

Thank you !