

Running Head: SURVEY QUALITY

Using Rasch Measurement to Evaluate Survey Quality:

Examining Factors in Student College Choice

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Abstract

Surveys are administered everyday for a multitude of reasons. Data collected from these instruments are often used as the basis for decision making. However, the quality of the instrument is rarely evaluated, and therefore, the quality of both the data and the decisions made based on that data are often unknown. This study utilizes the Rasch measurement model to verify the quality of a survey administered by a small, private, liberal arts university to admitted students regarding important factors in their college decision-making process. The university that administers this survey uses the results to make changes in its recruitment and financial aid practices. Therefore, the quality of the data is crucial. While initial statistics showed the instrument to be adequate, further analysis showed item misfit and indicated several items need to be revisited.

Introduction

Problem Statement

Every year more students apply and enroll in post-secondary institutions. College admission is becoming more and more competitive-both for students and schools. While students strive to gain entrance into the nation's top colleges, colleges and universities constantly compete to attract the best and brightest students to their institutions. For colleges and universities that are dependent on tuition revenue to fund their institutions, the competition for students is even more intense. The difference between 320 and 325 students can have profound budgetary impacts. Therefore, institutions have a vested interest knowing what draws students to their campuses and what pushes students to choose other colleges.

Institutions often utilize surveys to collect information from students, including information about a student's college choice. These survey instruments are typically designed by university administrators, who have varying levels of methodological knowledge. The results from the surveys are typically used to make programmatic decisions. Little, if any, attention is given to determining the quality of the instrument used to collect the data, which is not responsible research. If the quality of the instrument being used to collect data is unknown, then the quality of the data, and therefore the analysis, is unknown as well. Programmatic decisions at an institution should not be made using data of unknown quality. Fortunately, practitioners and researchers can utilize the Rasch measurement model to assess the quality of the instrument and, in turn, the quality of the data collected from the instrument.

As an example of this phenomenon, this study examines a small, private, liberal arts college in the Midwest which administers a College Choice Survey that was designed to collect

information from students about what factors were important to them when making their college decision (see Appendixes A and B for complete surveys). The survey is disseminated each year to high school seniors who apply and are admitted to the university. The information aids the Office of Admissions, the Office of Financial Aid and the university administration in more effectively recruiting prospective students. Beyond summary statistics, no other analysis has been conducted on the instrument or the results, so the quality of the survey and the resulting data is unknown. The Rasch measurement model was applied to the instrument to determine its quality and assess the design of the rating scale. However, the purpose of this study is two-fold: 1) to utilize the Rasch measurement model to verify the quality of the College Choice Survey administered by this university to admitted students about important factors in their college decision-making process 2) to provide an example of the application of a sophisticated modeling technique to a practical, professional situation.

BACKGROUND

Rasch Measurement Theory and Classical Test Theory

Rasch Measurement Theory was first introduced by George Rasch in 1960 with his formulation of *Probabilistic models for some intelligence and attainment tests*. Central to the Rasch model is the ability to address this extremely simple question: “When a person with this ability (number of test items correct) encounters an item of this difficulty (number of persons who succeeded on the item), what is the likelihood that this person gets this item correct? Answer: The probability of success depends on the difference between the ability of the person and the difficulty of the item” (Bond & Fox, 2007, p.10). The Rasch model addresses many weaknesses of the Classical Test Theory and allows researchers to evaluate the quality of survey

instruments. This includes giving researchers the ability to determine whether or not the instrument is measuring the constructs of interest.

Fundamentally, Classical Test Theory focuses on the test/survey at hand, while latent-trait models, such as Rasch, attempt to examine the traits the survey is measuring, rather than the performance on the particular test. Because Classical Test Theory focuses on the test or survey as a whole, item statistics that are calculated can only be applied to the sample from which they were generated. With Rasch measurement, the focus on the trait, rather than the performance, allows the analysis to be used beyond the specific test administration. It is for this reason that Rasch is often referred to as sample-free measurement.

In its most basic form, the Rasch model can be applied to dichotomous data. However, extending the Rasch model allows us to apply it to polytomous data, such as the Likert scales, which are often used in survey instruments. This application of Rasch modeling allows researchers to go beyond traditional descriptive statistics (i.e., the reporting of statistics like averages) and discuss issues such as whether or not respondents are actually utilizing all of the choices on the rating scale provided. This type of information is exponentially more effective in utilizing a survey instrument to its fullest potential.

METHOD

Apparatus

The survey was drafted and field tested with a nonprobability sample, more specifically a convenience sample, of current students at the university. Ten students were asked to complete the survey and were interviewed individually to discuss the survey. Their feedback and reactions resulted in revisions to the survey.

The final instrument was comprised of 74 items, including 10 demographic questions and one open-ended question. It was distributed both in a paper format and via email to all admitted students. Printed copies of the instrument were mailed to all admitted students upon receipt of their college decision (to accept or decline their admission to the university). As a follow-up, all non-responders were sent an electronic version of the survey (using Survey Monkey). The correspondence was sent using the email address given at the time of application. This two-pronged approach was an attempt to increase the response rate. 41 additional surveys were collected from matriculated students and 73 additional surveys from non-matriculated students via the electronic mailing. All survey responses were entered into Survey Monkey and then imported into other software packages (Microsoft Excel and Winsteps) for analysis.

Only twenty of the survey items were appropriate for use with Rasch measurement. Question 3 from both surveys included 20 different factors that could affect a student's college choice. Each of the factors was treated as an item for this analysis. Respondents were asked to rate each factor in terms of its role in the student's decision to accept or decline his/her admission to the university. The items addressed issues ranging from academic reputation to social atmosphere and location of the university to the amount of scholarship money offered to the student. These twenty items used a three point Likert-scale labeled "Not a factor", "Somewhat a factor" and "Very important factor".

Participants

A census sample was used, and all first-time freshmen students admitted to the fall 2009 class of a small, private, liberal arts college in the Midwest (n=1,145) were included. Two versions of the survey were created: one for students who matriculated to the university and one version for those who chose to attend another university. The two versions of the survey were

almost identical in nature. Slight changes were made in the wording of some questions to reflect the decision of the recipients and make the questions relevant (see Appendixes A and B for complete surveys). A total of 358 (170 matriculated and 188 non-matriculated) students responded to the survey for an overall response rate of 31%. The response rate for matriculated students and non-matriculated students was 52% and 22% respectively.

Procedure

Analysis was conducted using a one-parameter Item Response Theory model, or Rasch Model. The analysis was executed using Winsteps software (Linacre, 2004, version 3.51). Because items in this analysis have more than two response categories, an extension of the dichotomous Rasch model had to be used. The Andrich Rating Scale Model or a polytomous model was used. The algebraic representation of this model reads: $\log(P_{nik}/1-P_{nik}) = B_n - D_i - F_k$, where P_{nik} is the probability of person n encountering item i in category k , B_n is the person ability, D_i is the item difficulty and F_k is the difficulty of endorsing the k th threshold. (Bond & Fox, 2007). The response categories were coded as follows: “Not a factor”, 1, “Somewhat a factor”, 2, and “Very important factor”, 3. It is important to note that categories were not collapsed for this analysis.

The Rasch measurement model allows researchers to go beyond simple descriptive statistics. Rasch models an interval measurement scale that allows “comparisons [that can be] interpreted as how much difference exists between any two locations in probabilistic terms” (Bond and Fox, 2007, p.48) by looking at two facets: person ability and item difficulty. In the case of rating scale data, this translates to a respondent’s willingness to or the likelihood of endorsing an item in a positive way. As researchers, these aspects of Rasch modeling allow us to not only say that two things are different (persons or items), but gives us the tools to make

statements about the magnitude of the differences. The results of Rasch analysis can also aid researchers in evaluating the quality of the instrument by examining output, such as item misfit.

A person and item map was generated and can be seen in Figure 1. A person and item map displays both persons and items on the same interval scale. The Rasch model “has the distinct advantage of applying the same analytical logic, and therefore the same logic of interpretation, to persons as it does to items” (Bond and Fox, 2007, p. 60). Both are displayed on a logit, scale which not only allows one to discern the order of items and persons, but also how much more difficulty/ability one item/person has when compared to another item/person. In this study, the item difficulty indicates how difficult it was for a respondent to endorse that particular item. Those items toward the top of the scale (e.g. Item 20: Faculty or staff diversity and Item 19: Student Diversity and Item 11: Varsity athletic) were more difficult for respondents to endorse, while those at the bottom of the scale (e.g. Item 17: Cost of tuition” and Item 16: Amount of scholarship) were easier for respondents to endorse.

The distribution for both persons and items can also be revealing. Ideally, both persons and items will be distributed in a bell-shaped curve across the scale. This distribution indicates a well-matched person/item sample. A distribution with a disproportionate number of persons toward the top would indicate a relatively easy instrument for the sample. Conversely, a disproportionate number of persons toward the bottom of the map would show the instrument was relatively difficult for the sample.

Results

It would appear from the initial statistics, the survey is an acceptable measurement instrument. The person reliability index is 0.89, while the item reliability is 0.98. Both statistics are interpreted on a scale of 0 to 1. The person reliability index describes the likelihood that the

ordering of respondents would be similar if this same group was given “another parallel set of items measuring the same construct (Wright & Masters, 1982)” (Bond & Fox, 2007, p. 40). The item reliability index indicates that if another group were given these same items, they would perform similarly.

The variable map generated (see Appendix C, Figure 1) displays some valuable information. First, it is important to notice that the mean for survey items and the mean measure for respondents are approximately equal (the mean for persons is slightly below survey items). This indicates the survey items are just slightly more difficult for respondents to endorse. The person and item map also reveals something interesting about the sample. In a well-matched sample, there is typically a bell-shaped distribution of persons and items with one peak. However, in this sample, there are two peaks for both persons and items. Perhaps this is a reflection of analyzing both the matriculated and non-matriculated students in the same analysis. In this case, there could be Differential Item Functioning or an instance in which items perform differently for different groups (i.e., matriculated and non-matriculated, men and women, different racial/ethnic groups, etc.). Further analysis would be needed to make this determination.

To evaluate the fit of items, Z scores are used in this study. University administrators and faculty are familiar with the use of Z scores, and therefore, the understandability and utility of this study will be greater if this statistic is reported. Several items have extremely large INFIT and OUTFIT ZSTD scores. The large INFIT scores indicate there is more variance than the model would predict and the item is not measuring the construct. This is often labeled item misfit. The traditional range of acceptable values for Z scores is -2 to +2 for both INFIT and OUTFIT. Those “greater than +2 or less than -2 [are] generally interpreted as having less

compatibility with the model than expected... Positive values indicate more variation than modeled” (Bond & Fox, 2007, p.239) and negative values less variation.

Four items show extremely high INFIT ZSTD scores (see Appendix C, Table 2). The largest value is for Item 17: Cost of tuition, which has both an INFIT and an OUTFIT of 9.9. This is followed by Item 16: Amount of scholarship/financial aid offered at Transylvania, which has an INFIT of 7.1 and an OUTFIT of 5.3. Next is Item 11: Varsity athletic programs, with an INFIT of 4.1 and an OUTFIT of 4.9. Finally, there is Item 15: Distance from home, with an INFIT of 4.8 and an OUTFIT of 5.9. The magnitude of the INFIT ZSTD scores signifies all four of these items show misfit, and therefore, are not measuring the construct of interest. The OUTFIT ZSTD scores indicate there are unexpected responses and irregularity in the responses. The two items with the highest OUTFIT ZSTD scores are Item 17: Cost of Tuition and Item 16: Amount of scholarship offered at the university. For these items, the high OUTFIT ZSTD scores could be a result of the way the question is worded and being interpreted by the respondents. For instance, Item 17: Cost of tuition could be interpreted in different ways. A respondent could be interpreting the question as referring to the cost of tuition after scholarships, while another student could be interpreting “cost of tuition” to mean the actual published cost of attendance. Both the INFIT and OUTFIT statistics indicate several items should be reviewed and revised.

Several items had OUTFIT ZSTD less than -2 indicating, less variance than the model would predict. This finding is not surprising since respondents applied to the same small, private, liberal arts college. The college fills a specific niche, and often students admitted to this university have similar values when selecting a college. These statistics support this theory.

All items have positive correlations, as shown in the Item Polarity table (see Appendix C, Table 3). The category function output (see Appendix C, Table 4) displays that the thresholds do

increase across the rating scale and are therefore not considered disordered. However, the distances between the measures are of interest as well. The distances should “increase by at least 1.4 logits, to show distinction between categories, but not more than 5 logits, so as to avoid large gaps in the variable” (Bond & Fox, 2007, p. 224). Table 4 shows an increase of less than 1.4 logits between categories 2 and 3. This lack of difference indicates the categories might not aid much in distinguishing various points on the variable (Bond and Fox, 2007). This finding warrants further investigation.

CONCLUSIONS

Based on the results of this analysis, the College Choice Survey should be reviewed and revised before being disseminated again. Several items had extremely high INFIT ZSTD scores, which indicate the items are not measuring the construct of interest. This can most likely be attributed to the ambiguity in the wording of the questions. The items that were identified referred to issues such as Item 17: Cost of Tuition and Item 16: Amount of scholarship/financial aid offered. The question, as it is currently posed, could be interpreted in many different ways. To eliminate confusion, perhaps the administration might consider asking students if the cost of tuition was too high rather than simply asking if the cost of tuition was a factor in their decision-making process. Ultimately, the administration needs to determine exactly what they want to know about these topics and ask the questions more specifically. With the recent economic downturn, this information is an area of critical interest for the institution. Anecdotally, students cite this as a common reason for not attending this university. Improving this question would lead to better quantitative data in regards to exactly how financial considerations affect a student’s college choice.

Another question that needs to be revisited is Item 15: Distance from home. Currently, a respondent could indicate that this was an important factor in their college decision, but the administration cannot determine whether the respondent is indicating the institution was too far from home, too close to home or an acceptable distance from home. While the university can do nothing about the physical location of the campus, accurate knowledge of how students perceive the university's location can help better inform the staff working to recruit students. Again, restructuring the question for future surveys could help improve the information garnered from this survey.

Another area for further study is the response categories used in this survey. The results show the categories "Somewhat a Factor" and "Very Important Factor" do not distinguish various points on the variable. Perhaps the administration should consider collapsing the categories and running the analysis again. Another possibility would be to consider a dichotomous response where respondents choose from "Not a factor" and "A Factor." The next step for the administration is a more in-depth discussion to determine what information they hope to glean from this survey. The results from that discussion will guide the redesign of the survey questions. A final recommendation would be to run the analysis for matriculated students and for non-matriculated students separately since the variable map showed dual peaks. This step could demonstrate whether or not the items function differently for these two sub-populations.

This study utilizes very basic Rasch statistics, and the analysis could be carried out even further to learn more about the survey and its quality. However, the purpose of this study is to show how a sophisticated statistical technique, such as Rasch measurement, can be applied to an instrument currently being used by a practitioner in the field. Currently, the university utilizes the information collected by this survey to help inform recruitment and financial aid decisions. This

basic analysis indicates the instrument can be improved and, with improvements, better inform decision-making at the university. However, even in its current state, valuable information was collected. Beyond what has already been discussed, it is of note to mention that items regarding, Item 20: Faculty and Staff Diversity, Item 19: Student Diversity, Item 4: Quality of Labs and Item 11: Varsity Athletics were more difficult for respondents to endorse when compared to other items on the survey. This information could be interpreted different ways, but because of the vague wording used in the questions, it is unclear how to interpret these findings. Perhaps, these areas are not as important to students in their college selection process, or perhaps, the questions need to be clarified. If it was determined students did not find this information important in their selection process, the information emphasized to students and families during campus visits and in university publications could be altered.

EDUCATIONAL SIGNIFICANCE

The importance of this study is two-fold. First, the application of the Rasch measurement model offers more information and analysis of the instrument than was previously available to those utilizing the survey. In the past, only descriptive data was extracted from the survey results. There was no indication about the quality of the instrument, the data or whether or not the instrument was measuring those constructs the administration sought to measure.

Second, it is an example of the application of a sophisticated modeling technique to a practical, professional situation. In an age of data-driven decision making, surveys are administered everyday across college campuses, and programmatic decisions are made based upon the data collected by those instruments. The decisions made based on these surveys can have significant impacts across the university—both programmatic and financial. In this case, the administration was using this data to make adjustments to their recruitment and financial aid

strategies, both of which have major cost implications. The fact that the data derived from this survey may not truly represent students' opinions, but yet, is being used to make changes at the university is troubling.

The issue of data quality can easily be addressed, but most practitioners are unaware of the methods available to determine the quality of the instrument they are administering. Researchers and practitioners often operate in silos at the same institution. This paper shows an example of the work of the two groups can be integrated. Even a very simple application of the Rach model can aid practitioners in increasing the quality of their data by increasing the quality of the instrument used in data collection. Ultimately, these improvements will result in more informed decision making. This study brings together research and practice, and illustrates the value of evaluating a programmatic survey instrument.

References

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Appendix A-College Choice Survey for matriculated students

College Choice Survey
2009

You are receiving this survey because you plan to enroll in the Fall 2009 class at ██████████ University. While the process is still fresh in your mind, we would like to know what factors were important to you in selecting ██████████. Your responses will enable us to improve our services and procedures.

This survey is completely voluntary and all questions are optional. This survey should take approximately 20 minutes to complete. This survey asks some basic questions about you, and your admissions experience with ██████████ University. Please be candid in your responses. All responses will be kept confidential.

Please complete and return this survey, using the enclosed envelope, within one week of receiving it. If you have any questions, please do not hesitate to email us at admissions@████████.edu. Again, we appreciate your time in completing this survey.

1. How did you first learn of ██████████ University? (Please choose the first thing that comes to mind.)

- Friend/family member
- Teacher
- Guidance/high school college counselor
- Transylvania admissions counselor
- Transylvania alumni
- Mailings
- College fair
- Transylvania web site
- College search websites (Peterson's, CollegeView, etc.)
- U.S. News and World Report
- College guidebooks (Princeton Review, Barron's, etc.)
- General knowledge
- Don't remember
- Other (please specify _____)

2. What information did you find useful during your decision process? (Please check one for each row.)

	Not useful	Somewhat useful	Useful	N/A
Brochures, catalogs, other print materials				
Emails from admissions staff				
Individual campus day visit				
Overnight campus visit				
Open Houses				
Letters/emails from faculty				
████████ web site				
Other resources (U.S. News, Princeton Review Guides, etc.)				

3. Please rate each of the following factors in terms of their role in your decision to attend [redacted] University. (Please check one for each row.)

	Not a factor	Somewhat a factor	Very important factor	N/A
Academic reputation				
Quality of faculty				
Academic majors/programs				
Quality of laboratory facilities				
Study abroad opportunities				
Rates of graduate/professional school attendance				
Amount of personal attention				
Social atmosphere				
Quality of residence halls				
Extra-curricular activities				
Varsity athletic programs				
Size of student body				
Attractiveness of campus				
Size of [redacted]				
Distance from home				
Amount of scholarship/financial aid offered at [redacted]				
Cost of tuition				
Academic support programs				
Student diversity				
Faculty/staff diversity				

4. Using the factors listed in the previous question, please indicate the top three factors (in order) you considered when making your college decision.

1. _____
2. _____
3. _____

5. Please rate the frequency of each of the listed types of communications in terms of how they compared to the contact you received from the other colleges/universities to which you applied. (Please check one for each row.)
Compared to the other colleges/universities to which I applied, I received:

	Less frequent contact from [REDACTED]	About the same frequency from [REDACTED]	More frequent contact from [REDACTED]	N/A
In-person contact with admissions staff				
In-person contact with current students				
In-person contact with faculty				
In-person contact with alumni				
Email communication from admissions office				
Email communication from faculty				
Email communication from alumni				
Telephone contact from admissions staff				
Telephone contact from current students				
Brochures, viewbooks, other print materials				
Off-campus receptions in your hometown				
On-campus open houses				
Individual campus visits (day or overnight)				

6. Please rate the quality of each of the listed types of communications from [redacted] in terms of how they compared to the same things you received from the other colleges/universities to which you applied. (Please check one for each row.)

Compared to other colleges/universities to which I applied, the quality of [redacted] contact was:

	Less frequent contact from [redacted]	About the same frequency from [redacted]	More frequent contact from [redacted]	N/A
In-person contact with admissions staff				
In-person contact with current students				
In-person contact with faculty				
In-person contact with alumni				
Email communication from admissions office				
Email communication from faculty				
Email communication from alumni				
Telephone contact from admissions staff				
Telephone contact from current students				
Brochures, viewbooks, other print materials				
Off-campus receptions in your hometown				
On-campus open houses				
Individual campus visits (day or overnight)				

7. Did you apply for need-based financial aid [by completing the Free Application for Federal Student Aid (FAFSA)] at [redacted]?
 Yes
 No
 Prefer not to answer

8. Was [redacted] timely with a financial aid package (compared to the other schools from which you received aid offers)?
 Yes
 No
 Prefer not to answer

9. Please rate the following factors related to financial aid and your decision to attend [REDACTED].
 (Please check one for each row.)

	Not a factor	Somewhat a factor	Strong factor	N/A
Amount of total financial aid package (scholarships and need-based aid)				
Amount of scholarship award				
Terms of scholarship award (maintenance of good academic standing)				
Timeliness of notification of the award				
Estimated debt burden upon graduation				

10. From which school did you receive your best financial aid offer? _____

11. I am a:
 Parent
 Student
 Prefer not to answer
 Other (please specify: _____)

12. What is your state of permanent residence? _____

13. From which high school did you graduate? _____

14. To how many colleges/universities did you apply? _____

15. Are you:
 Male
 Female
 Prefer not to answer

16. I identify myself as:
 American Indian or Alaskan Native
 Asian/Asian American
 Black/African American
 Caucasian/White
 Hispanic/Latino
 Native Hawaiian or Other Pacific Islander
 Prefer not to answer
 Other (please specify : _____)

17. High School GPA: _____

18. ACT/SAT Score: _____

19. Name(Optional): _____

20. Please provide any information you think might be helpful for improving the admissions process at [REDACTED].

**Thank you for completing our survey! We appreciate the feedback you have provided.
If you have any questions, please feel free to email us at admissions@[REDACTED].**

We wish you the best this fall!

**Sincerely,
The Admissions Staff
[REDACTED] University**

Survey # _____

***Please note the aesthetics of the survey have been altered for inclusion in this paper. Due to the nature of the original proof, it was not publishable in this format. The content had to be reformatted for this text. The content of the survey has not been altered.**

Appendix B-College Choice Survey for non-matriculated students

**College Choice Survey
2009**

You are receiving this survey because you applied to ██████████ University for admission to our Fall 2009 class. We know you have decided to attend college elsewhere this fall and we wish you the best! We would like to know what factors were important to you in selecting a college or university. Your responses will enable us to improve our service and admissions procedures.

This survey is completely voluntary and all questions are optional. This survey should take approximately 20 minutes to complete. This survey asks some basic questions about you, your admissions experience with ██████████ University, and your future plans. Please be candid in your responses. All responses will be kept confidential. Your participation in this survey is completely voluntary.

Please complete and return this survey, using the enclosed envelope, within one week of receiving it. If you have any questions, please do not hesitate to email us at admissions@█████████.edu. Again, we appreciate your time in completing this survey.



1. How did you first learn of ██████████ University? (Please choose the first thing that comes to mind.)

- Friend/family member
- Teacher
- Guidance/high school college counselor
- Transylvania admissions counselor
- Transylvania alumni
- Mailings
- College fair
- Transylvania web site
- College search websites (Peterson's, CollegeView, etc.)
- U.S. News and World Report
- College guidebooks (Princeton Review, Barron's, etc.)
- General knowledge
- Don't remember
- Other (please specify _____)

2. What information did you find useful during your decision process? (Please check one for each row.)

	Not useful	Somewhat useful	Useful	N/A
Brochures, catalogs, other print materials				
Emails from admissions staff				
Individual campus day visit				
Overnight campus visit				
Open Houses				
Letters/emails from faculty				
█████████ website				
Other resources (U.S. News, Princeton Review Guides, etc.)				

3. Please rate each of the following factors in terms of their role in your decision NOT to attend [redacted] University. (Please check one for each row.)

	Not a factor	Somewhat a factor	Very important factor	N/A
Academic reputation				
Quality of faculty				
Academic majors/programs				
Quality of laboratory facilities				
Study abroad opportunities				
Rates of graduate/professional school attendance				
Amount of personal attention				
Social atmosphere				
Quality of residence halls				
Extra-curricular activities				
Varsity athletic programs				
Size of student body				
Attractiveness of campus				
Size of Lexington				
Distance from home				
Amount of scholarship/financial aid offered at [redacted]				
Cost of tuition				
Academic support programs				
Student diversity				
Faculty/staff diversity				

4. Using the factors listed in the previous question, please indicate the top three factors (in order) you considered when making your college decision.

- a. _____
- b. _____
- c. _____

5. Please rate the frequency of each of the listed types of communications from [redacted] in terms of how they compared to the same things from the college/university you will attend in the fall. (Please check one for each row.)
Compared to the college/university I will attend this fall, I received:

	Less frequent contact than I received from [redacted]	About the same frequency of contact as I received from [redacted]	More frequent contact than I received from [redacted]	N/A
In-person contact with admissions staff				
In-person contact with current students				
In-person contact with faculty				
In-person contact with alumni				
Email communication from admissions office				
Email communication from faculty				
Email communication from alumni				
Telephone contact from admissions staff				
Telephone contact from current students				
Brochures, viewbooks, other print materials				
Off-campus receptions in your hometown				
On-campus open houses				
Individual campus visits (day or overnight)				

6. Please rate the quality of each of the listed types of communications from [redacted] in terms of how they compared to the same things from the college/university you will attend in the fall. (Please check one for each row.)

Compared to the college/university I will attend this fall, the quality of [redacted]'s contact was:

	Less frequent contact than I received from [redacted]	About the same frequency of contact as I received from [redacted]	More frequent contact than I received from [redacted]	N/A
In-person contact with admissions staff				
In-person contact with current students				
In-person contact with faculty				
In-person contact with alumni				
Email communication from admissions office				
Email communication from faculty				
Email communication from alumni				
Telephone contact from admissions staff				
Telephone contact from current students				
Brochures, viewbooks, other print materials				
Off-campus receptions in your hometown				
On-campus open houses				
Individual campus visits (day or overnight)				

7. Did you apply for need-based financial aid [by completing the Free Application for Federal Student Aid (FAFSA)] at [redacted]?

- Yes
- No
- Prefer not to answer

8. Was [redacted] timely with a financial aid package (compared to the school you are attending)?

- Yes
- No
- Prefer not to answer

9. Please rate the following factors related to financial aid and your decision NOT to attend [REDACTED]. (Please check one for each row.)

	Not a factor	Somewhat a factor	Strong factor	N/A
Amount of total financial aid package (scholarships and need-based aid)				
Amount of scholarship award				
Terms of scholarship award (maintenance of good academic standing)				
Timeliness of notification of the award				
Estimated debt burden upon graduation				

10. From which school did you receive your best financial aid offer? _____

11. I am a:

- Parent
- Student
- Prefer not to answer
- Other (please specify: _____)

21. What is your state of permanent residence? _____

22. From which high school did you graduate? _____

23. To how many colleges/universities did you apply? _____

24. What college/university will you attend this fall? _____

25. Are you:

- Male
- Female
- Prefer not to answer

26. I identify myself as:

- American Indian or Alaskan Native
- Asian/Asian American
- Black/African American
- Caucasian/White
- Hispanic/Latino
- Native Hawaiian or Other Pacific Islander
- Prefer not to answer
- Other (please specify: _____)

27. High School GPA: _____

28. ACT/SAT Score: _____

29. Name: _____

30. Please provide any information you think might be helpful for improving the admissions process at [REDACTED].

**Thank you for completing our survey! We appreciate the feedback you have provided.
If you have any questions, please feel free to email us at admissions@[REDACTED].edu.**

We wish you the best this fall!

**Sincerely,
The Admissions Staff
[REDACTED] University**

Survey # _____

***Please note the aesthetics of the survey have been altered for inclusion in this paper. Due to the nature of the original proof, it was not publishable in this format. The survey had to be reformatted for this text. The content of the survey has not been altered.**

APPENDIX C-Output for students

Figure 1

Variable map for students

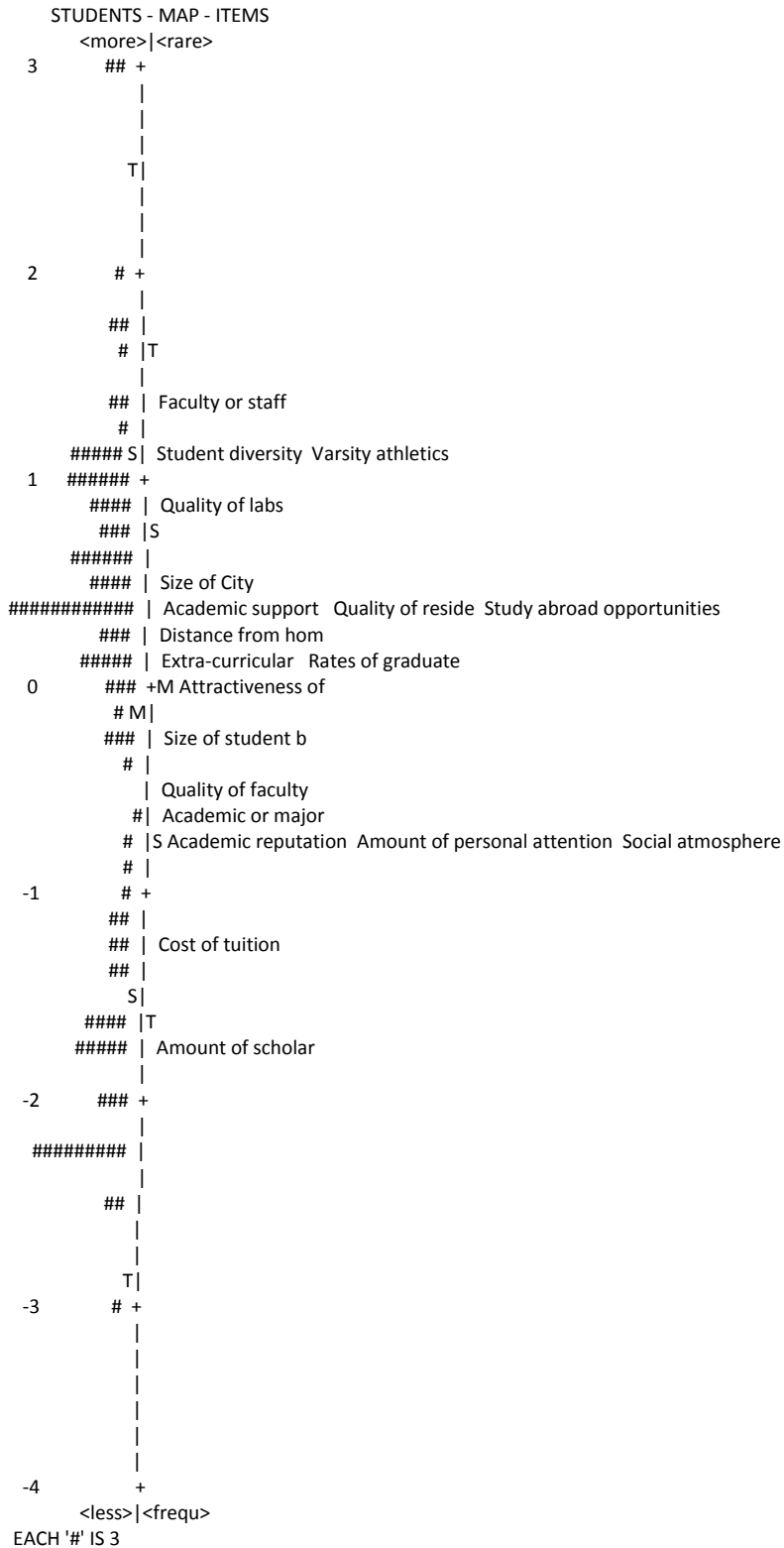


Table 1
Summary Statistics

	Measure	Infit ZSTD	Outfit ZSTD
Person			
M	-0.2	-0.1	1.24
S.D.	1.03	1.2	1.2
Item			
M	0.00	-0.7	-0.4
S.D.	0.81	4.2	3.9
Real Person reliability .89			
Real Item reliability .98			

Table 2

Misfitting items

Entry Number	Infit ZSTD	Outfit ZSTD	Item
17	9.9	9.9	Cost of Tuition
16	7.1	5.3	Amount of scholarship offered at Transylvania
11	4.1	4.9	Varsity athletic programs
15	4.8	5.9	Distance from home
20	-4.3	-2.7	Faculty or staff diversity
10	-4.2	-3.2	Extra-curricular activities
18	-5	-3	Academic support programs
13	-3.9	-3.4	Attractiveness of campus
1	-4	-4.1	Academic reputation
7	-4.7	-4	Amount of personal attention
2	-5.6	-5.8	Quality of faculty

Table 3

Item Polarity

Entry Number	Pt. Measure Correlation	Item
17	0.09	Cost of Tuition
16	0.37	Amount of scholarship offered at Transylvania
11	0.46	Varsity athletic programs
15	0.51	Distance from home
19	0.56	Student diversity
4	0.58	Quality of laboratory facilities
14	0.62	Size of City
20	0.62	Faculty or staff diversity
5	0.65	Study abroad opportunities
9	0.66	Quality of residence halls
12	0.67	Size of student body
1	0.69	Academic reputation
2	0.69	Quality of faculty
7	0.69	Amount of personal attention
3	0.71	Academic or major offerings
10	0.72	Extra-curricular activities
8	0.73	Social atmosphere
18	0.73	Academic support programs
6	0.74	Rates of graduate or professional school acceptance
13	0.74	Attractiveness of campus

Table 4

Category function for students

Category Label	Category Measure
1	-3.66
2	-0.52
3	-0.16