Using VITA service learning experiences to teach hypothesis testing and p-value analysis

Anne Drougas
Dominican University

Steve Harrington
Dominican University

ABSTRACT

This paper describes a hypothesis testing project designed to capture student interest and stimulate classroom interaction and communication. Using an online survey instrument, the authors collected student demographic information and data regarding university service learning experiences. Introductory statistics students performed a series of hypothesis tests on data from those respondents who had participated in a voluntary income tax assistance ("VITA") program as their exclusive service learning activity. Students then generated p-values using a predetermined α value to assess the impact of VITA service on variety of established service learning benefit categories. The class focused on the relative experience of males and females, and various sub-groupings.

Keywords: Business education, hypothesis testing, introductory statistics, statistical inference, service learning

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INTRODUCTION AND LITERATURE REVIEW

"The ability to correctly construct and interpret hypothesis tests is one of the most important skills an undergraduate business student can acquire" (Liu and Stone, 1999). Regrettably, most textbook examples frequently frame hypothesis testing within a series of mechanical steps requiring students to identify the hypotheses, graph regions of rejection, calculate test statistics, develop critical values, and then render a decision. While most introductory statistics students can solve the formulaic problems, many cannot apply the rationale developed in one problem to another (Gafield and Ahlgren, 1988; Pratt and Ainley, 2008; Sotos, Vanhoof, Van den Noortgate, and Onghena, 2007; Weinberg, Wiesner, and Pfaff, 2010). As such, statistics instructors need to place greater emphasis on developing pedagogical tools that help students enhance their inferential reasoning skills, as recommended by the National Council for Teachers of Mathematics (2009). While instructors recognize that the basic statistics course serves as a support component to the disciplines (Weinberg et. al., 2010) and are therefore tempted to quickly cover many topics, instructors also need to provide a pedagogical foundation, supporting students in their efforts to (1) make conjectures, (2) explain solutions, and (3) reflect on their results (Watson, 2002). Additionally, to prevent students from feeling overwhelmed, instructors need to "go slow" when introducing hypothesis testing terminology to students (McClave, Benson, and Sincich (2010)).

The limited business experience of most undergraduates represents an additional challenge for statistics instructors teaching hypothesis testing. As King and McConnell (2010) suggest, "one way to overcome the students' lack of experience is to use examples that can provide students a common framework." To hold student interest, Stork (2003) encourages instructors to use student-centered activities to test key concepts in statistics.

In this paper, the authors describe an assignment ("assignment") to teach hypothesis testing through p-value analysis. To provide a common framework and create "student-centered" activities, one of the authors (the "instructor") administered an online survey ("survey") between January and April 2010 to collect student demographic information and data on university service learning experiences. Introductory statistics students performed a series of hypothesis tests on data from those respondents who had participated in a voluntary income tax assistance ("VITA") program as their exclusive service learning activity. Based on the popularity of the VITA program, sample sizes from this group were significantly larger that those connected to other service learning activities. Students then generated p-values using a predetermined α value to assess the impact of VITA service on variety of established service learning benefit categories outlined below.

PROJECT GOALS

While the overarching objective in designing the assignment centered on developing a student-friendly framework for analyzing p-values and interpreting levels of significance, the authors hoped to achieve the following additional goals related to a first course in statistics:

- As the survey relates to a common experience (King & McConnell, 2010) shared by many of the statistics students (i.e., a service learning project), they will feel greater comfort discussing p-value results, the survey design, techniques for improving question construction (e.g., Likert scales, multiple choice, open-ended), and the grouping of respondents. Unfortunately, most introductory statistics textbooks do not include a discussion of survey design or relegate the topic to a web chapter.

- Students will gain an appreciation for the difference between quantitative and qualitative questions. More specifically, students will understand the importance of expressing quantitative question results as averages and the difficulty in measuring the value of qualitative responses.
- Students will learn how to measure and treat response "outliers" and eliminate the tendency to discard or discount responses that are different.
- As the authors' institution attracts a large percentage of first-generation college students, the assignment measures the direct impact of the service learning project on this group.
- Students will understand the importance of various spreadsheet techniques, including coding qualitative data (e.g., male =1.0, female =0.0; most important = 5.0, least important = 1.0) and sorting data by demographic category (e.g., gender).
- Given the size of the survey database, students will take responsibility for a specific portion of the assignment, reducing the probability of answer sharing and simulating a business environment where employees take individual responsibility for a portion of a team project. Stork (2003) encourages the use of large databases.
- Students will understand how to construct a comparison of means (Liu & Stone, 1999). In this assignment, for example, students may wish to interpret whether male respondents score the ability to resolve conflict as a more important outcome than female students.
- Students will appreciate the importance of protecting a respondent's identity when designing survey questions (McClave, Benson, & Sincich, 2010).
- Students will appreciate how the assignment differs from textbook examples that typically help students work through a single problem (e.g., if the p-value is less than 10%, reject the null). In this assignment, the clustering of 27 questions, grouped around 6 primary category benefits (civic engagement, etc.), will force the students to interpret data in a more robust fashion without any textbook guidance.

In considering a common experience when developing the assignment, the authors focused on the popularity of a Chicago-based VITA program promoted by one of the authors within his tax and accounting courses. 117 survey respondents at the authors' institution had completed the program, including some of the students enrolled in the instructor's introductory statistics course. Tying an assignment to a service learning project reinforces that: (1) service learning is an important pedagogical tool in statistics (Root, et. al., 2001) and accounting (Gujarathi, et. al., 2002; McCoskey, et. al., 2003; Still, et. al., 2004), (2) service learning activities, such as VITA, "balance instruction in the theoretical and practical while creating an environment that is conducive to learning." Drake (2000) and Strupeck (et. al., 2004), and (3) a VITA program provides faculty the rare opportunity to observe their students' work ethic, people skills, sense of responsibility and commitment (Clovey, 2008; Purcell, 2009).

While "proof" of service learning value is often anecdotal (e.g., faculty assigns a paper and reports qualitative quotes), the authors employ a survey instrument, similar to one first developed by Toncar (et. al., 2006), that focuses on student perceptions and clusters questions so that survey respondents are classified by characteristics (e.g., leadership, civic engagement). To conclude that a respondent viewed the project as most important from a leadership perspective, rather than one of five other characteristics, for example, helps students clarify and articulate the particular value of the program to various groups.

THE ASSIGNMENT

Introduction to the Survey, Variables, SELEB factors and Benefit Categories

The instructor introduced the assignment to her 30 introductory statistics students by describing how 117 student participants in a Chicago-based VITA program had completed an online survey between January and April 2010. The instructor then explained how she divided the VITA respondents into various sub-groupings (gender, first-generation college, primary language spoken at home) based on recommendations she received from former students. Students incorporated the language variable, for example, because many students simply assumed that English would not be the first language at home for most first-generation college students. Table 1 (Appendix) summarizes the variable nomenclature for the VITA respondents. After distributing Table 1 to the students, the instructor reinforced the importance of creating reader-friendly variable titles with short, descriptive terms that keep test reporting manageable. The use of $M_{GEN1,}$ for example, identifies a mutually exclusive group and works much better than what students frequently find in textbooks to describe a sample (i.e., $\mu_{SAMPLE1}$).

After a review of survey participants and variables, the instructor distributed Table 2 (Appendix) which reflects a breakdown of VITA participants by gender, first-generation college student, ad whether English or another language is primarily spoken in the home. As indicated in Table 2, Students noted that the category $M_{GEN1ENG0}$ only contained 3 respondents. After assuring students that a software package would calculate the appropriate statistics for hypothesis testing for the small sample, the instructor used the observation to discuss additional concerns regarding survey data, such as preserving the anonymity of the respondent.

The instructor next reviewed the survey instrument (Table 3) and explained that it reflects Toncar's (et. al., 2006) original 27 Service Learning Benefit ("SELEB") factors, designed to measure students' perception of their service learning experiences. As indicated in Table 4 (Appendix), these factor are classified within the following benefit categories: civic engagement ("civic"), critical thinking ("critical"), interpersonal communication skills ("interper"), knowledge-based learning ("knowledge"), leadership skills ("leader"), and life experiences ("life"). Using a five-point scale, "5" representing the most important and "1" representing not important, VITA respondents ranked the importance of each of the 27 factors to their service learning experience.

Table 4 (Appendix) presents the 27 benefit factors, the benefit category classification, and average responses for the groups listed in Table 2. Using the Table 4 data, the instructor challenged students to address some preliminary questions regarding the VITA participants (e.g., Does the very first factor, social responsibility and citizenship skills, appear to represent an important outcome for VITA participants?). These initial questions help students gain familiarity and comfort with the survey design and the results.

Generating the Research Questions

Using the variables contained in Table 1, the instructor created 20 test groups to serve as basis for hypothesis testing. Table 5 (Appendix) presents the test groups (e.g., $M_{GEN1ENG1}$ and $F_{GEN1ENG1}$).

The instructor randomly assigned each student a test group and a partial list of the 27 SELEB factors and instructed him/her to construct a meaningful research question for each factor. As an example, if a student was assigned test group one and the first SELEB factor from Table 4, he/she would have created the following research question: Do $M_{GEN1ENG1}$ assign a higher benefit to social responsibility and citizenship skills (e.g., one of the four factors assessing civic engagement) than $F_{GEN1ENG}$?

From an instructor perspective, the total number of potential research questions (20 groups multiplied by 27 factors) allows for the random assignment of questions within large classes, significantly reducing the opportunity for cheating.

Hypothesis Testing and Other Requirements

Students were then required to formulate a null and alternative hypothesis for each research question and to employ course software question (Excel, Minitab, or SPSS) to develop a hypothesis test of means using a 10% level of significance. The instructor advised students to sort survey data for each question to generate the tests (e.g., male=1, 0 otherwise; First-generation =1, 0 otherwise; English =1, 0 otherwise).

The instructor additionally required students to:

1. Interpret the mean of each sample in relation to the research question.
2. Explain the t-value and p-value results generated by the software.
3. Determine whether the null is rejected or not at the 10% level of significance and what type of error (e.g., Type I or Type II) may result.
4. Present a summary table of p-value results (using the format of the grid as indicated in Table 6).
5. Write a brief memo summarizing the results of the assigned test questions, cross-referencing statistically significant p-values against the benefit categories associated with the SELEB factors.

Table 7 (Appendix) presents a partial student solution to one of the research questions.

SAMPLE STUDENT OBSERVATIONS – TEST GROUP 1: $M_{GEN1ENG1}$ and $F_{GEN1ENG1}$

To keep classroom discussions manageable, the instructor focused student attention on Test Group 1 ($M_{GEN1ENG1}$ and $F_{GEN1ENG1}$). Students reached many thoughtful conclusions, including the following:

1. The first survey question asks survey participants to rate the VITA program's benefit in relation to developing social responsibility and citizenship skills. Within this test group, students correctly noted that using the 10% level of significance, a two-sample t test of means yielded a p-value of 0.8%. They therefore rejected the null hypothesis, concluding that that $M_{GEN1ENG1}$ viewed the development of social responsibility skills as more likely than $F_{GEN1ENG1.}$
2. P-values for all questions related to leadership (SELEB factors 14-17) were below 10%. Students concluded that $M_{GEN1ENG1}$ were more likely to gain leadership skills in comparison to $F_{GEN1ENG1}$.
3. Relative to the $M_{GEN1ENG1}$ population:

a. Students recognized that the following questions generated the highest mean scores:
   Question 9: Developing caring relationships (4.69/5.00)
   Question 12: Social action skills (4.83/5.00)
   Question 27: Bolster resumes (4.75/5.00)
   Of these three questions, students observed that only Question 12 was statistically significant (i.e., that $M_{GEN1ENG1}$ viewed the development of social action skills as more likely than $F_{GEN1ENG1}$).
b. Students recognized that the following questions generated the lowest mean scores:
   Question 18: Spiritual growth (2.63/5.00)
   Question 19: Personal growth (3.14/5.00)
   Question 22: Ability to assume personal responsibility (3.27/5.00)
   Of these three questions, students observed that only Question 18 was statistically significant (i.e., that $M_{GEN1ENG1}$ viewed the development of social action skills as more likely than $F_{GEN1ENG1}$).

4. Relative to the $F_{GEN1ENG1}$ population:
   a. Students recognized that the following questions generated the highest mean scores:
      Question 27: Bolster resume (3.88/5.00)
      Question 3: Service to people in need (3.80/5.00)
      Question 24: Having a stronger voice in the classroom (3.76/5.00)
      Of these three questions, students observed that only Questions 3 and 24 were statistically significant (i.e., that $F_{GEN1ENG1}$ viewed the development of these two skills as more likely than $M_{GEN1ENG1}$).
   b. Students recognized that the following questions generated the lowest mean scores:
      Question 18: Spiritual growth (2.28/5.00)
      Question 19: Personal growth (2.12/5.00)
      Question 22: Ability to assume personal responsibility (2.16/5.00)

      While observing that these same three questions generated the lowest means for $M_{GEN1ENG1}$, students also correctly observed that only Question 19, rather than Question 18, was statistically significant (i.e., that $F_{GEN1ENG1}$ viewed the development of personal growth skills as more likely than $M_{GEN1ENG1}$).

SUMMARY OBSERVATIONS

Student memos and class discussions reflected valuable summary conclusions regarding the assignment, including the following:

- This technology project helped me to understand the essentials of analyzing p-values. Since I am planning on pursuing a career in marketing, I feel confident that I will find this learning experience beneficial in my future. I specifically better understand how p-values can pertain to either just a sample or an entire population.

- Gaining experience in using the computer programs Excel and Minitab was helpful; I especially felt a sense of familiarity when using Excel, a fundamental tool in the business workplace.
- Being able to calculate and interpret p-values will hopefully be a useful skill in my future. I liked dealing with survey data based on the actual experience of my classmates. I feel that this project was an overall good learning exercise.

Overall, while the instructor did not require the current introductory statistics students to complete a service learning project within the semester, the student feedback suggested that they enjoyed being able to analyze the VITA experiences of classmates at their institution. End-of-semester surveys also reflected the ease with which students were able to perform the hypothesis testing and analyze p-values. Their command of the survey data and testing procedures enhanced their confidence levels and heightened their regard for how a meaningful division of samples into subgroups (e.g., males, females) contributes to better analysis.

CONCLUSION

In structuring an assignment that introduces two-sample hypothesis testing to introductory statistics students, the authors have addressed the recommendation of the National Council for Teachers of Mathematics (2009) that better pedagogical tools be developed to enhance student inferential reasoning skills. The assignment also provides students the "common framework" and student-centered activities recommended by King and McConnell (2010) and Stork (2003), respectively. Most important, the assignment provides introductory statistics students the opportunity to meaningfully review and discuss the individual conclusions generated by their p-value analysis.

REFERENCES

Batanero, C. (2000). Controversies around the role of statistical tests in experimental research. *Mathematical thinking and learning (An international journal), 2*(1 and 2), 75-97.

Ben-Zui, D. (2006). Scaffolding students' informal inference and argumentation. In A. Rossman and B. Chance (Eds.), *Working cooperatively in statistics education: Proceedings of the Seventh International Conference on Teaching Statistics*. Voorburg, The Netherlands: International Statistical Institute.

Clovey, R. and Oladipo, O. (2008) The VITA Program: A catalyst for improving accounting education. *The CPA Journal* 78(12), 60-65.

Drake, J.W. (2000) Uniting service-learning and PR at the University of Findlay. *Public Relations Tactics* September, 24-26.

Eyler, J., Giles, D., Stenson, C., and Gray, C. (2001) At a glance: What we know about the effects of service learning on college students, faculty, institutions, and communities, 1993-2000. Vanderbilt University, Nashville.

Gujarathi, M.R., and McQuade, R. J. (2002) Service-learning in business schools: a case study in an intermediate accounting course. *Journal of Education for Business* 70(3), 130-135.

Harrington, C., and Schibik, T. (2004) Methods for Maximizing Student Engagement in the Introductory Business Statistics Course: A Review, *Journal of American Academy of Business, Cambridge* 4(1), 360-365.

Liu, T. and C. Stone (1999) A critique of one-tailed hypothesis test procedures in business and economic statistics textbooks. *Journal of Economic Education* 30(1), 59 – 63.

McClave, J., Benson, P., and Sincich, T. (2010) Statistics for Business and Economics, 11th edition, Pearson Prentice Hall: New York.

King and McConnell (2010). Using a common experience to teach introductory managerial accounting. *Journal of Instructional Pedagogies*. Retrieved from: http://www.aabri.com/manuscripts/10473.pdf.

National Council for Teachers of Mathematics (2009). *Focus in High School Mathematics: Reasoning and Sense Making in Statistics and Probability*. Reston: Author

Pratt, D., and Ainley, J. (2008, November). Introducing the special issue on informal inferential reasoning. *Statistics Education Research Journal,* 7(2), 3-4. Retrieved from: http://www.stat.auckland.ac.nz/~iase/serj/SERJ7(2)_Pratt_Ainley.pdf.

Purcell, T. (2009) Service learning and tax: More than VITA. *The Tax Adviser* 40(8), 550-553.

Root, R. and Thorme, T. (2001). Community-Based Projects in Applied Statistics: Using Service-Learning to Enhance Student Understanding. The American Statistician. Vol. 55, No 4. 326-331.

Rossman, A. J. and Chance, B. (2004). Anticipating and addressing student misconceptions. Presented at ARTIST Roundtable Conference, August, 2004.

Sotos, A., Vanhoof, S., den Noortgate, W., and Onghena, P. (2009) How confident are students in their misconceptions about hypothesis tests? *Journal of Statistics Education* 17(2). Retrieved from: http://www.amstat.org/publications/jse/v17n2/castrosotos.html

Stork, D. (2003). Teaching statistics with student survey data: A pedagogical innovation in support of student learning. *Journal of Education for Business* 78(6), 335 – 339.

Strupeck, C. and Whitten, D. (2004) Accounting service-learning experiences and the IRS volunteer income tax assistance programme: a teaching note. *Accounting Education* 13(1), 101-112.

Toncar, M., Reid, J., Burns, D., Anderson, C., and Nguyen, H. (2006). Uniform assessment of the benefits of service learning: The development, evaluation, and implementation of the SELEB Scale. *Journal of Marketing Theory and Practice* 14(3), 223 – 238.

Weinberg, A., Wiesner, E., and Pfaff, T. (2010) Using informal inferential reasoning to develop formal concepts: Analyzing an Activity. *Journal of Statistics Education* 18(2). Retrieved from: http://www.amstat.org/publications/jse/v18n2/weinberg.pdf.

APPENDIX

Table 1: List of Variables

Variable	Description
Males	Male who completed VITA
Females	Female who completed VITA
$\mathbf{M_{GEN1}}$	Male, 1st generation college student
$\mathbf{M_{GEN0}}$	Male, non 1st generation college student
$\mathbf{M_{ENG1}}$	Male, who primarily speaks English at home
$\mathbf{M_{ENG0}}$	Male, who does not primarily speak English at home
$\mathbf{M_{GEN1ENG1}}$	$M_{GEN1,}$ who primarily speaks English at home
$\mathbf{M_{GEN1ENG0}}$	$M_{GEN1\ ,}$ who does not primarily speak English at home
$\mathbf{M_{GEN0ENG1}}$	$M_{GEN0,}$ who primarily speaks English at home
$\mathbf{M_{GEN0ENG0}}$	$M_{GEN0,}$ who does not primarily speak English at home
$\mathbf{F_{GEN1}}$	Females, 1st generation college student
$\mathbf{F_{GEN0}}$	Female, non 1st generation college student
$\mathbf{F_{ENG1}}$	Female, who primarily speaks English at home
$\mathbf{F_{ENG0}}$	Female, who does not primarily speak English at home
$\mathbf{F_{GEN1ENG1}}$	$F_{GEN1,}$ who primarily speaks English at home
$\mathbf{F_{GEN1ENG0}}$	$F_{GEN1,}$ who does not primarily speak English at home
$\mathbf{F_{GEN0ENG1}}$	$F_{GEN0,}$ who primarily speaks English at home
$\mathbf{F_{GEN0ENG0}}$	$F_{GEN0,}$ who does not primarily speak English at home

Table 2: Category Responses

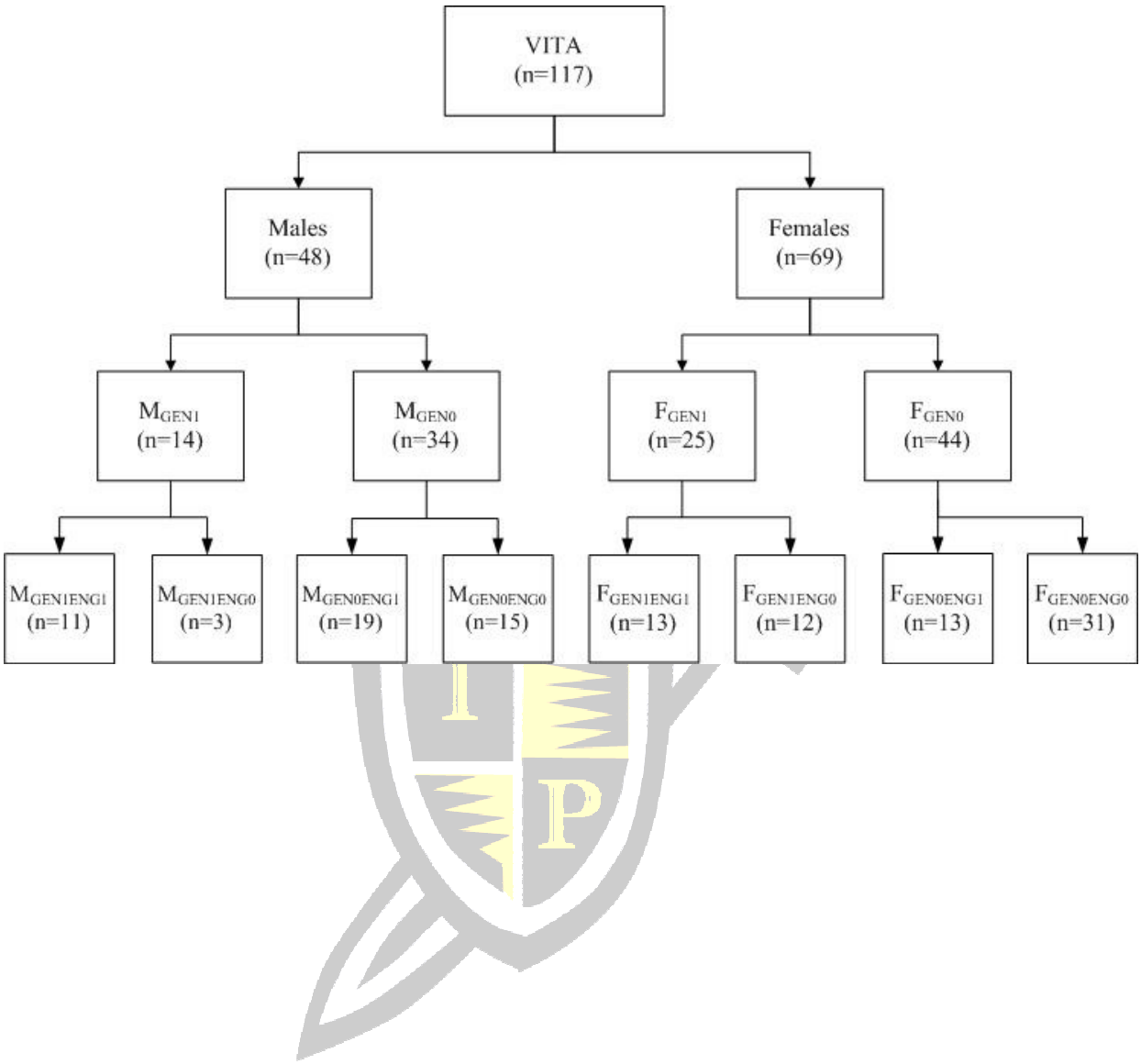

Table 3 – Survey Instrument

Please answer these questions to the best of your ability. The survey will only take about 15 minutes to complete. Any information that you supply will be ANONYMOUS and CONFIDENTIAL. Your willingness to complete this survey indicates your consent to participate in the study. If you do not want to take part in this project you have the right not to participate. Also, if at any time you want to stop or if you do not want to answer a particular question, you are free to do so.

In 2006, Toncar (et. al., 2006) designed a survey to help assess what undergraduate students learned from their service learning experiences. Here is a subset of attributes from that survey. On a scale of 1 (not important) to 5 (most important), rank how important/unimportant are each of the following factors within your university service learning experience.

1. Social responsibility and citizenship skills
2. Community involvement
3. Service to people in need
4. Ability to make a difference in the community
5. Problem analysis and critical thinking
6. Communication skills
7. Understanding cultural and racial differences
8. Social self-confidence
9. Developing caring relationships
10. Empathy and sensitivity to the plight of others
11. Applying knowledge to the "real" world
12. Social action skills
13. Connecting theory to practice
14. Ability to work well with others
15. Leadership skills
16. Being trusted by others
17. Ability to relate to people from different backgrounds
18. Spiritual growth
19. Personal growth
20. Professional relationships with faculty
21. Conflict resolution
22. Ability to assume personal responsibility
23. Development of workplace skills
24. Having a stronger voice in the classroom
25. Skills in learning from experience
26. Organizational skills
27. Bolster resume

Please answer the following demographic questions

1. Are you (check one): Male Female
2. Are you a 1st generation college student (check one): Yes No
3. Do you speak English primarily in the home (check one): Yes No

Table 4: Average (Mean) Scores of SELEB Factors by Subgroup

A	B	C	D	E	F	G	H	I	J	K
No.	SELEB	Category	MGEN1ENG1	MGEN1ENG0	MGEN0ENG1	MGEN0ENG0	FGEN1ENG1	FGEN1ENG0	FGEN0ENG1	FGEN0ENG0
1	Social responsibility and citizenship skills	Civic	3.71	3.19	4.21	3.50	2.78	2.13	2.87	2.77
2	Community involvement	Civic	3.85	4.00	3.93	3.82	2.60	3.23	3.11	3.09
3	Service to people in need	Civic	4.35	4.61	4.21	4.41	3.80	3.50	3.59	3.22
4	Ability to make a difference in the community	Civic	4.25	4.29	3.93	4.38	2.88	3.52	2.77	2.99
5	Problem analysis and critical thinking	Critical	4.19	4.04	4.14	4.21	2.64	3.27	3.66	3.42
6	Communication skills	Interper	3.94	3.65	3.86	3.97	2.56	2.71	2.67	2.50
7	Understanding cultural and racial differences	Interper	3.58	3.38	3.93	3.44	2.44	2.34	2.76	2.55
8	Social self-confidence	Interper	4.23	4.57	4.14	4.26	3.36	3.68	3.79	3.66
9	Developing caring relationships	Interper	4.69	4.67	4.36	4.82	3.60	3.70	3.70	3.64
10	Empathy and sensitivity to the plight of others	Interper	4.38	4.44	3.79	4.62	3.40	3.45	3.77	3.66
11	Applying knowledge to the "real" world	Knowledge	3.92	4.09	4.14	3.82	3.20	3.02	3.22	3.10
12	Social action skills	Knowledge	4.83	4.54	4.71	4.88	3.56	3.52	3.45	3.36
13	Connecting theory to practice	Knowledge	4.02	3.41	4.07	4.00	3.44	3.39	3.47	3.86
14	Ability to work well with others	Leader	4.22	3.64	3.21	3.71	2.72	2.59	2.62	2.61
15	Leadership skills	Leader	4.46	3.84	4.57	4.41	2.64	2.95	3.11	3.00
16	Being trusted by others	Leader	4.08	4.41	3.79	4.21	3.36	3.43	3.55	3.43
17	Ability to relate to people from diff. backgrounds	Leader	3.92	3.84	3.64	4.03	3.20	2.64	3.11	2.95
18	Spiritual growth	Life	2.63	2.19	2.71	2.59	2.28	2.14	2.55	2.12
19	Personal growth	Life	3.14	3.02	3.43	3.03	2.12	1.95	3.00	2.97
20	Professional relationships with faculty	Life	4.29	4.39	4.29	4.29	3.48	3.44	3.48	3.11
21	Conflict resolution	Life	3.50	3.36	3.57	3.47	2.44	2.32	2.29	2.10
22	Ability to assume personal responsibility	Life	3.27	3.25	3.21	3.29	2.16	2.29	2.77	2.65
23	Development of workplace skills	Life	4.29	4.30	4.00	4.41	3.40	3.25	3.45	3.30
24	Having a stronger voice in the classroom	Life	4.52	4.78	4.36	4.59	3.76	3.79	3.88	3.22
25	Skills in learning from experience	Life	3.69	4.09	3.29	3.85	2.96	3.16	2.45	2.77
26	Organizational skills	Life	3.98	4.20	3.93	4.00	3.36	3.11	3.40	3.33
27	Bolster resume	Life	4.75	4.99	4.57	4.82	3.88	4.05	3.77	3.64
	Sample Size		11	3	19	15	13	12	13	31

Table 5: Hypothesis Tests

Test	Sample 1	Sample 2	Null Hypothesis	Alternative Hypothesis
1	$M_{GEN1ENG1}$	$F_{GEN1ENG1}$	Ho: $\mu_{MGEN1ENG1} \leq \mu_{FGEN1ENG1}$	Ha: $\mu_{MGEN1ENG1} > \mu_{FGEN1ENG1}$
2	$M_{GEN1ENG1}$	$F_{GEN1ENG0}$	Ho: $\mu_{MGEN1ENG1} \leq \mu_{FGEN1ENG0}$	Ha: $\mu_{MGEN1ENG1} > \mu_{FGEN1ENG0}$
3	$M_{GEN1ENG1}$	$F_{GEN0ENG1}$	Ho: $\mu_{MGEN1ENG1} \leq \mu_{FGEN0ENG1}$	Ha: $\mu_{MGEN1ENG1} > \mu_{FGEN0ENG1}$
4	$M_{GEN1ENG1}$	$F_{GEN0ENG0}$	Ho: $\mu_{MGEN1ENG1} \leq \mu_{FGEN0ENG0}$	Ha: $\mu_{MGEN1ENG1} > \mu_{FGEN0ENG0}$
5	$M_{GEN1ENG0}$	$F_{GEN1ENG1}$	Ho: $\mu_{MGEN1ENG0} \leq \mu_{FGEN1ENG1}$	Ha: $\mu_{MGEN1ENG0} > \mu_{FGEN1ENG1}$
6	$M_{GEN1ENG0}$	$F_{GEN1ENG0}$	Ho: $\mu_{MGEN1ENG0} \leq \mu_{FGEN1ENG0}$	Ha: $\mu_{MGEN1ENG0} > \mu_{FGEN1ENG0}$
7	$M_{GEN1ENG0}$	$F_{GEN0ENG1}$	Ho: $\mu_{MGEN1ENG0} \leq \mu_{FGEN0ENG1}$	Ha: $\mu_{MGEN1ENG0} > \mu_{FGEN0ENG1}$
8	$M_{GEN1ENG0}$	$F_{GEN0ENG0}$	Ho: $\mu_{MGEN1ENG0} \leq \mu_{FGEN0ENG0}$	Ha: $\mu_{MGEN1ENG0} > \mu_{FGEN0ENG0}$
9	$M_{GEN0ENG1}$	$F_{GEN1ENG1}$	Ho: $\mu_{GEN0ENG1} \leq \mu_{FGEN1ENG1}$	Ha: $\mu_{GEN0ENG1} > \mu_{FGEN1ENG1}$
10	$M_{GEN0ENG1}$	$F_{GEN1ENG0}$	Ho: $\mu_{GEN0ENG1} \leq \mu_{FGEN1ENG0}$	Ha: $\mu_{GEN0ENG1} > \mu_{FGEN1ENG0}$
11	$M_{GEN0ENG1}$	$F_{GEN0ENG1}$	Ho: $\mu_{GEN0ENG1} \leq \mu_{FGEN0ENG1}$	Ha: $\mu_{GEN0ENG1} > \mu_{FGEN0ENG1}$
12	$M_{GEN0ENG1}$	$F_{GEN0ENG0}$	Ho: $\mu_{GEN0ENG1} \leq \mu_{FGEN0ENG0}$	Ha: $\mu_{GEN0ENG1} > \mu_{FGEN0ENG0}$
13	$M_{GEN0ENG0}$	$F_{GEN1ENG1}$	Ho: $\mu_{GEN0ENG0} \leq \mu_{FGEN1ENG1}$	Ha: $\mu_{GEN0ENG0} > \mu_{FGEN1ENG1}$
14	$M_{GEN0ENG0}$	$F_{GEN1ENG0}$	Ho: $\mu_{GEN0ENG0} \leq \mu_{FGEN1ENG0}$	Ha: $\mu_{GEN0ENG0} > \mu_{FGEN1ENG0}$
15	$M_{GEN0ENG0}$	$F_{GEN0ENG1}$	Ho: $\mu_{GEN0ENG0} \leq \mu_{FGEN0ENG1}$	Ha: $\mu_{GEN0ENG0} > \mu_{FGEN0ENG1}$
16	$M_{GEN0ENG0}$	$F_{GEN0ENG0}$	Ho: $\mu_{GEN0ENG0} \leq \mu_{FGEN0ENG0}$	Ha: $\mu_{GEN0ENG0} > \mu_{FGEN0ENG0}$
17	$M_{GEN1ENG1}$	$M_{GEN0ENG1}$	Ho: $\mu_{GEN1ENG1} \leq \mu_{MGEN0ENG1}$	Ha: $\mu_{GEN1ENG1} > \mu_{MGEN0ENG1}$
18	$M_{GEN0ENG1}$	$M_{GEN0ENG0}$	Ho: $\mu_{MGEN0ENG1} \leq \mu_{MGEN0ENG0}$	Ha: $\mu_{MGEN0ENG1} > \mu_{MGEN0ENG0}$
19	$F_{GEN1ENG1}$	$F_{GEN1ENG0}$	Ho: $\mu_{FGEN1ENG1} \leq \mu_{FGEN1ENG0}$	Ha: $\mu_{FGEN1ENG1} > \mu_{FGEN1ENG0}$
20	$F_{GEN0ENG1}$	$F_{GEN0ENG0}$	Ho: $\mu_{FGEN0ENG1} \leq \mu_{FGEN0ENG0}$	Ha: $\mu_{FGEN0ENG1} > \mu_{FGEN0ENG0}$

Table 6: Presentation of p-values for all 20 Subgroups

SELEB	Category	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12	Test 13	Test 14	Test 15	Test 16	Test 17	Test 18	Test 19	Test 20	Sum
1	Civic	0.8%	2.5%	29.9%	0.8%	7.3%	0.1%	24.3%	21.6%	1.7%	8.6%	1.7%	5.1%	31.9%	2.3%	6.1%	33.5%	4.4%	10.9%	3.7%	25.8%	13
2	Civic	26.0%	37.8%	1.1%	15.0%	8.8%	17.0%	22.9%	9.7%	27.7%	6.4%	20.5%	42.1%	19.7%	27.5%	27.8%	8.9%	5.0%	1.2%	7.0%	24.4%	8
3	Civic	5.8%	22.6%	4.9%	1.1%	33.1%	9.2%	5.3%	41.3%	7.9%	16.3%	7.2%	16.7%	22.1%	7.3%	20.6%	12.9%	18.5%	17.7%	21.8%	6.8%	9
4	Civic	42.7%	9.5%	2.8%	45.2%	28.5%	4.5%	6.7%	25.3%	36.9%	30.3%	37.7%	40.1%	45.9%	44.2%	9.6%	9.8%	7.5%	8.2%	9.1%	8.5%	10
5	Critical	2.5%	4.3%	0.8%	9.3%	39.7%	35.8%	2.4%	0.2%	41.7%	7.3%	0.1%	2.2%	5.6%	26.2%	7.9%	4.4%	12.9%	43.3%	39.4%	3.9%	13
6	Interper	6.0%	36.6%	25.8%	18.5%	11.9%	31.2%	5.2%	4.6%	29.9%	39.6%	1.9%	2.9%	38.9%	7.5%	26.6%	15.8%	8.5%	1.9%	21.2%	6.7%	9
7	Interper	16.6%	9.2%	35.1%	9.4%	34.5%	4.6%	49.9%	1.9%	13.1%	29.8%	2.2%	17.1%	2.8%	18.1%	12.8%	38.7%	13.0%	38.1%	8.2%	51.4%	7
8	Interper	4.7%	35.9%	12.9%	27.9%	4.0%	4.7%	38.0%	48.7%	3.1%	16.1%	8.0%	21.8%	19.5%	6.2%	25.9%	2.9%	17.9%	6.1%	5.3%	39.5%	9
9	Interper	44.2%	2.9%	31.8%	19.8%	21.8%	6.4%	17.3%	5.0%	48.4%	19.9%	8.5%	12.4%	25.2%	45.7%	2.9%	5.7%	6.2%	1.1%	7.8%	18.8%	9
10	Interper	38.5%	1.6%	40.3%	4.7%	25.6%	3.9%	17.2%	11.0%	15.9%	46.1%	36.5%	7.4%	10.5%	40.0%	1.6%	1.8%	2.7%	3.6%	4.1%	18.7%	9
11	Knowldg	24.6%	21.6%	28.2%	44.3%	26.2%	37.1%	14.4%	14.2%	24.9%	6.3%	29.1%	44.6%	26.1%	26.1%	11.6%	18.2%	34.3%	16.2%	27.1%	15.9%	1
12	Knowldg	9.3%	33.3%	45.4%	35.9%	9.2%	31.5%	15.3%	0.7%	48.8%	42.7%	1.4%	0.2%	42.1%	10.8%	21.3%	33.4%	23.9%	2.1%	19.5%	16.8%	6
13	Knowldg	2.4%	43.4%	45.5%	10.0%	5.9%	6.6%	11.3%	6.4%	36.8%	11.6%	3.9%	0.4%	23.4%	3.9%	31.4%	33.5%	3.1%	8.6%	5.1%	12.8%	11
14	Leader	3.8%	14.6%	33.0%	14.7%	33.3%	20.4%	48.2%	9.2%	32.7%	15.4%	6.0%	24.4%	9.0%	38.8%	4.6%	23.0%	4.7%	23.3%	10.4%	49.7%	6
15	Leader	0.1%	3.3%	9.2%	0.9%	2.1%	4.3%	0.2%	1.2%	3.3%	11.3%	0.0%	0.1%	22.5%	1.6%	22.8%	0.8%	9.1%	7.9%	5.1%	1.7%	17
16	Leader	7.5%	17.9%	38.2%	10.1%	19.5%	7.3%	29.1%	28.1%	46.8%	10.5%	23.8%	3.9%	8.1%	9.0%	21.6%	22.9%	17.4%	19.8%	27.2%	14.4%	5
17	Leader	3.7%	4.8%	3.3%	6.1%	10.9%	49.2%	30.4%	29.0%	35.3%	41.8%	40.7%	40.6%	26.9%	5.2%	2.8%	8.8%	5.9%	2.6%	5.9%	31.9%	10
18	Life	2.0%	37.6%	28.6%	14.2%	3.8%	6.8%	14.5%	0.3%	39.5%	37.9%	0.1%	0.1%	49.0%	3.1%	27.6%	18.6%	4.2%	6.1%	3.1%	16.0%	10
19	Life	25.7%	16.5%	24.9%	22.9%	37.2%	9.9%	36.6%	1.4%	30.4%	15.7%	3.6%	4.6%	6.4%	4.1%	6.5%	14.9%	12.9%	27.2%	0.9%	38.1%	8
20	Life	31.0%	49.1%	27.6%	29.7%	42.4%	43.5%	25.6%	42.7%	39.0%	27.0%	48.5%	39.6%	37.8%	32.5%	39.1%	17.6%	19.7%	32.4%	33.5%	27.1%	0
21	Life	27.0%	40.5%	33.4%	37.8%	28.9%	26.8%	45.9%	41.3%	40.7%	18.5%	48.4%	36.1%	29.4%	28.5%	30.5%	23.4%	27.8%	18.9%	16.8%	47.4%	0
22	Life	45.6%	42.0%	30.9%	44.5%	49.8%	41.7%	31.8%	17.4%	38.6%	23.9%	25.7%	32.8%	36.9%	47.1%	32.0%	20.9%	34.5%	39.8%	31.7%	33.3%	0
23	Life	47.5%	4.9%	24.7%	15.1%	24.3%	24.4%	48.3%	8.9%	40.1%	11.7%	4.7%	28.3%	4.1%	49.0%	4.9%	4.9%	4.2%	4.1%	4.6%	49.8%	9
24	Life	4.0%	25.3%	37.6%	11.3%	10.4%	9.3%	16.0%	23.9%	18.1%	14.5%	7.8%	6.5%	42.3%	5.5%	14.5%	12.1%	13.9%	11.2%	14.1%	17.5%	5
25	Life	4.1%	4.3%	22.7%	1.3%	15.6%	0.2%	36.2%	26.3%	2.9%	9.4%	13.0%	30.5%	20.6%	5.6%	4.3%	5.7%	3.6%	4.9%	4.8%	37.7%	12
26	Life	25.2%	45.1%	28.2%	22.9%	39.4%	37.5%	19.8%	6.8%	13.0%	13.8%	33.3%	29.2%	46.0%	26.7%	33.1%	16.2%	10.9%	27.4%	25.5%	21.3%	1
27	Life	19.7%	28.6%	30.9%	23.6%	26.6%	12.8%	44.0%	2.5%	11.2%	5.1%	15.1%	27.2%	30.1%	21.2%	16.6%	18.9%	11.6%	14.6%	0.8%	45.5%	3
Sum		14	10	6	9	7	14	5	14	5	6	15	11	6	12	10	10	13	13	15	5	

Table 7: Sample Solution for Question 1 (Subgroup 1)

Sample Solution

Step 1: Develop the Null and Alternative Hypothesis:

Ho: $\mu_{MGEN1ENG1} \leq \mu_{FGEN1ENG1}$
Ha: $\mu_{MGEN1ENG1} > \mu_{FGEN1ENG1}$

Step 2: Develop the Research Question

Do $M_{GEN1ENG1}$ assign a higher benefit to social responsibility and citizenship skills based upon their VITA experience when compared to $F_{GEN1ENG1}$?

Step 3: Using Minitab software, derive the p-value

Two-Sample T-Test and CI

Sample	N	Mean	StDev	SE Mean
1	11	3.71	1.02	0.31
2	13	2.78	0.71	0.20

Difference = mu (1) - mu (2)
Estimate for difference: 0.930
95% lower bound for difference: 0.322
T-Test of difference = 0 (vs >): T-Value = 2.63 P-Value = 0.008 DF = 22
Both use Pooled StDev = 0.8648

Step 4: Answer the Research Question using a 10% level of significance

The p-value is 0.8% (0.008). At the 10% level of significance, it appears that $M_{GEN1ENG1}$ assign a higher benefit to social responsibility and citizenship skills based upon their VITA experience when compared to $F_{GEN1ENG1}$.