DOCUMENT RESUME

ED 479 367 TM 035 166

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TITLE Teaching Nonparametric Statistics Using Student Instrumental Values.

PUB DATE 2003-08-00

NOTE 10p.; Paper presented at the Annual Meeting of the American Psychological Association (Chicago, IL, August 2002).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS *College Students; Electronic Mail; Higher Education; *Nonparametric Statistics; Research Methodology; *Teaching Methods

IDENTIFIERS *Instrumental Values

ABSTRACT

Nonparametric statistics are often difficult to teach in introduction to statistics courses because of the lack of real-world examples. This study demonstrated how teachers can use differences in the rankings and ratings of undergraduate and graduate values to discuss: (1) ipsative and normative scaling; (2) uses of the Mann-Whitney U-test; and (3) the importance of statistical significance, protected t-tests, and effect sizes. Participants were 32 junior and senior undergraduates in a research methodology course and 29 first and second year doctoral students in an introduction to statistics course. They received an e-mail workbook that contained 20 instrumental values and were asked to rate them using a 5-point Likert-type scale. They also rated the importance of the values in their own lives and then returned the completed spreadsheets to the professor, who prepared the data for students to use in class to analyze the results of normative and ipsative data. Students were exposed to ordinal, ipsative scaling and the theoretical reasoning for its appropriateness. Students also saw how a combined data file is assembled. (Contains 1 table and 10 references.) (SLD)

Running head: Nonparametric Statistics Activity

Teaching Nonparametric Statistics Using Student Instrumental Values[1]

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Teaching Nonparametric Statistics Using Student Instrumental Values

Abstract

Non-parametric statistics are often difficult to teach in introduction to Statistics because of the lack of real-world examples. In this paper we demonstrate how teachers can use differences in the rankings and ratings of undergraduate and graduate values to discuss 1) ipsative and normative scaling; 2) uses of the Mann-Whitney U-test and 3) discuss the importance of statistical significance, protected t-tests and effect sizes.

Teaching Non-Parametric Statistics Using Student Instrumental Values

Nonparametric statistics are an important tool for analyzing ordinal data especially ipsative scaling associated with rank ordering. Nevertheless, there are few opportunities in introductory statistics and methodology courses for students to grapple with the differences between normative and ipsative scaling and their different statistical analysis, especially using the same construct. The purpose of this poster presentation is to demonstrate an activity for students to explore the theoretical and methodological issues that arise when using ipsative or normative scaling to measure personal values.

Values have been defined as "an enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (Rokeach, 1973, p. 5). Mode of conduct values are known as *instrumental values* (e.g. honesty, accountability), while end-state of existence values are known as *terminal values* (e.g. a comfortable or meaningful life).

Value researchers have often been divided on their use of normative or ipsative methods in measuring values (Meglino & Ravlin, 1998). *Normative* methods typically use a Likert-type scale and rate values independently of each other, (cf. Reynolds & Jolly, 1980; Singleton & Chen, 1996). *Ipsative* methods typically use a rank order or forced choice format and assess preferences between different values (cf. Meglino, Ravlin, & Adkins, 1989).

This activity gave undergraduate and graduate students the opportunity to rate and rank their own instrumental values. It also gave them the opportunity to identify and

use different statistical methods to compare value importance between their two groups. Four goals were associated with this demonstration.

1. Give students the opportunity to work with ipsative scaling.
2. Discuss aligning scaling choices to construct operationalization.
3. Introduce students to the nonparametric Mann-Whitney U test using the students' values as the data set.
4. Compare statistical results of instrumental value differences between undergrad and graduate students using both normative and ipsative scaling.

Method

Participants

Participants were 32 junior and senior undergraduates in a research methodology course and 29 first and second year doctoral students in an introduction to statistics course.

Materials and procedure

Participants received an excel workbook through e-mail which contained 20 instrumental values (Golden, 2001). Half the undergraduates and graduate students were asked to first rate the values using a 5-point Likert type scale, ranging from 1 = very unimportant to 5= very important. Next they were asked to rank the importance of the values in their own life; 1= most important, 20=least important. The other half of the participants were asked to rank the values first followed by the ratings. Participants returned the completed excel spreadsheet to the professor who combined the data and prepared the data file for the students to use in class. See Table 1 for a list of the 20 values.

Results

Students used a protected t-test with a $p<.0025$ (.05/20) to analyze the results of the normative Likert-scaling between undergrad and graduate results. There were no significant differences between graduate and undergraduate values. It should be noted that even with a less stringent *p* value cut-off there would have been no significant mean differences. More importantly, the effect sizes, shown in Table 1, are very small, with program (undergraduate vs. graduate) accounting, on average for less than 3% of the variance in mean value differences.

Students used a Mann-Whitney U-test to analyze the ipsative data (Marascuilo & McSweeney, 1977). Before computing the tests, students calculated the sum and average ranking for one value by hand. Next, the Mann-Whitney U-tests were calculated with SPSS using a stringent $p<.0025$ for statistical significance.

Undergraduates ranked *Order* as a significantly more important value than Graduate students. In addition, there were several values that did not meet the stringent *p* value but exceeded Cohen's (1988) small effect size (r=.30). Graduate students ranked *competency* and *knowledge* as more important while undergraduates ranked *obedience and order* as more important. See Table 1 for mean scale and rank scores, t-tests, Mann-Whitney U tests, and effect sizes for both tests.

Discussion

There were several benefits to this activity for advanced undergraduates and first year graduate students. First, students were exposed to ordinal, ipsative scaling and the theoretical reasoning for its appropriateness. After completing the data set, students and the professor discussed the construct of values and the issues surrounding its

operationalization. Both normative and ipsative scaling have their strengths and weaknesses. Normative scaling allows for measuring higher order factors. However, because normative scores are rated independently of each other, they are vulnerable to social desirability bias such that there is a tendency for artificially inflated relationships (Edward, 1990; Meglino & Ravlin, 1998). Probably the most important advantage of ipsative procedures lies in the conceptualization of the nature of values. Theoretically, values are thought to be unconsciously hierarchically ranked and reflect standards of preference such that individuals typically choose among values to guide their decision-making and behavior. This makes ipsative scaling a good conceptualization of the value construct (Rokeach, 1979). On the other hand, ipsative scaling does not capture absolute differences between values.

Secondly, the students generated the data themselves, were exposed to counterbalancing in data collection and saw how a combined data file is put together. Next, students were able to work with the nonparametric Mann-Whitney U-test with data that they generated. Fourth, students worked with protected *p* values and experienced the cost for adding variables to a data set. Fifth, the activity was a great discussion point for the different role and importance of statistical significance and effect sizes. Finally, the results generated good discussions with the graduate students on their expectations for their early graduate courses compared to their undergraduate courses and the usefulness of empirical data to shape that discussion.

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Table 1

Values, Scale and Rank Means, t-values and Effect Sizes

Value	UG mean	Grad mean	t-value	η	η^2		UG mean Rank	Grad mean Rank	Mann-Whitney U Z-score	η	η^2
Accountability	4.0	4.4	-2.03	0.26	7%		31.3	30.7	-0.12	0.02	0%
Affection	4.3	4.3	-0.35	0.05	0%		31.2	30.8	-0.08	0.01	0%
Autonomy	4.0	4.2	-1.13	0.15	2%		33.4	28.4	-1.09	0.14	2%
Competency	3.7	4.2	-2.26	0.29	8%		36.0	25.5	-2.33	0.30*	9%
Courage	3.6	4.1	-2.11	0.27	7%		35.7	25.8	-2.16	0.28	8%
Courtesy	4.1	4.0	0.33	0.04	0%		27.6	34.8	-1.60	0.21	4%
Creativity	3.7	3.9	-0.55	0.07	1%		33.9	27.8	-1.34	0.18	3%
Discipline	4.0	4.0	0.00	0.00	0%		30.7	31.3	-0.12	0.02	0%
Drive	3.8	3.9	-0.06	0.01	0%		31.5	30.5	-0.22	0.03	0%
Fairness	3.9	4.2	-1.55	0.20	4%		31.8	30.1	-0.38	0.05	0%
Forgiveness	4.7	4.4	1.78	0.23	5%		30.1	32.0	-0.41	0.05	0%
Honesty	4.8	4.8	0.15	0.02	0%		28.3	33.9	-1.26	0.17	3%
Humor	4.2	4.3	-0.37	0.05	0%		31.7	30.3	-0.30	0.04	0%
Knowledge	3.9	4.3	-1.88	0.24	6%		36.3	25.1	-2.46	0.31*	10%
Loyalty	4.3	4.1	0.79	0.11	1%		26.6	35.8	-2.02	0.26	7%
Obedience	3.2	2.8	1.22	0.16	3%		25.4	37.2	-2.64	0.33*	11%
Order	3.3	2.9	1.26	0.17	3%		24.0	38.8	-3.28**	0.40*	16%
Reason	3.7	3.7	-0.18	0.02	0%		28.9	33.4	-0.99	0.13	2%
Service	4.1	3.7	1.29	0.17	3%		29.2	33.0	-0.85	0.11	1%
Tolerance	3.9	4.1	-0.92	0.12	1%		34.1	27.6	-1.41	0.19	3%

**p. <.0025
* Effect size exceeds .3

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