

Teaching of Business Statistics in the Context of Big Questions of Meaning and Value

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ABSTRACT

Statistics can be one of the most daunting courses in the business curriculum. Known for its rigor it is not unusual for the study of statistics to be seen as monotonous by students, an experience often lacking in creativity. This paper chronicles the application, benefits and risks of an innovative way of teaching business statistics in the context of big questions of meaning and value.

INTRODUCTION

Despite its perceived relevance to many fields of study, it is not surprising that many students view the study of statistics as monotonous and rigorous, a potentially deadly combination from the perspective of any instructor. Usually lumped in with other quantitative courses in the business school curriculum such as finance, economics and operations, statistics tends to elicit a significant amount of anxiety, both anticipatory and actual (Onwuegbuzie and Wilson, 2003). Despite the steady increase in the recognition across a wide range of disciplines of its importance as a practical and intellectual skill set (Goudreau, 2012) statistics has a "face validity" problem, a professional inferiority complex that as counterintuitive as it may sound must be being reinforced by statisticians and quantitative methods teachers alike.

No doubt, how statistics has been taught historically may have something to do with its poor reputation. A quick scan of the research literature makes it clear that this has been considered with all seriousness by quantitative methods specialists, particularly in business schools. For decades, a number of broad-ranging general studies have considered the role and positioning of statistics in the business curriculum (Haskin and Krehbiel, 2011; Becker and Greene, 2001; Yilmaz, 1996; Strasser and Ozur, 1995; Gandhi, Sahai and Acevedo, 1991; Rose, Machak and Spivey, 1988). Other studies have addressed the teaching of statistics from the point of view of student perceptions of their experience within those classes (Whitworth, Price and Randall, 2002; McAlevev and Stent, 1999). Yet additional researchers have evaluated various classroom techniques as a way to break through the seeming barrier between subject and student (Smith and Martinez-Moyano, 2012; Martin, 2011; Shambare, 2011; Fairfield-Sonn et al., 2009; Lockwood, Ng, and Pinto, 2007; Basturk, 2005; Patel and Feinson, 2005; Johnson and John, 2003; Stork, 2003; McLean, 2000; Carlson, 1999; Hillmer, 1996; Ferris and Hardaway, 1994). Most recently, reflecting current trends in higher education, a group of scholars have set out to evaluate the use of leading edge technology and more progressive forms of content delivery (Dotterweich and Rochelle, 2012; Mills and Raju, 2011; Sebastianelli and Tamimi, 2011; Palocsay and Stevens, 2008; Grandzol, 2004).

Children naturally ask "big questions" without fear of being criticized as arcane or irrelevant. By the same token, college students typically ask such questions only under duress. What if one were to teach a statistics course in a much broader context, within a framework of a big question of meaning and value, piquing the interest of student and teacher alike? Is it

possible that a subject like statistics might be appreciated for more than just pragmatic reasons? Could students who view such material in non-traditional ways enhance their ability to transfer knowledge across hitherto impenetrable boundaries into unexpected domains?

This paper describes an unusual approach to teaching business statistics in a big questions framework. The primary objective is to suggest a way that this may be done. A more elusive objective is to argue that well beyond its obvious technical value statistics can be meaningful and evocative.

METHODS

It is important to be clear as to what is meant by a "big question" for the purpose of this study. Clearly, this is an elusive concept. However, Donaldson (2011) specifies a simple rubric for defining what qualifies as a big question: "In general, big questions of meaning and value (a) are of interest and importance for a large number of people (over long periods of time), (b) are of such a nature that answers have the potential for significant and lasting impact on human conceptions of meaning and value, and (c) subsume many smaller questions. For example, whereas "Who shall I marry?" is admittedly a very important question it is by its very nature limited in context and not what would be considered a big question. The big question chosen for use for the purposes of this study was, "Can there be purpose in a world of chance?" Whereas such a question has significant religious overtones it conjures up many important secular, scientific questions. Consider, for example, that many major scientific theories (e.g., evolution and natural selection, quantum mechanics, organizational development) are built around a core assumption of randomness or chance. This leads some to believe that there can be no purpose to our universe. On the other hand, humankind uses many forms of chance or stochastic processes to achieve various purposes. In fact, order emerges from randomness. A simple, though non-business example would be Boyle's Gas Law. Though molecular motion is random the behavior of the gas molecules in aggregate is very predictable: double the pressure on a gas at constant temperature and the volume is halved.

The course chosen for this study was a second semester statistics course in the general business curriculum; the course is required for all majors but accounting. The class was populated exclusively by juniors and seniors. Students were administered the sixteen item 'Can There be Purpose in a World of Chance? Perspectives Survey' (see Appendix A) on the first day of class and again on the last day of class. The survey took less than fifteen minutes to complete. The course was structured as lecture/discussion with brief periods of discussion on the 'big question' inserted as time permitted, usually at the end of a class period. In all respects, this class was structured and conducted as any other section of the course taught in recent years with the exception that this section would often end with a discussion about the various manifestations of chance and uncertainty in our world and its implications for meaning and value. The course text, readings and homework assignments (with exception of the Perspectives Survey and discussions) were the same as any other section of the class. The syllabus for the course provided a detailed class-by-class schedule for textbook readings and homework assignments; the course schedule was followed as outlined in the syllabus. Discussions of the role of chance or randomness in the physical world were lively and extensive with the author serving as facilitator. With the permission of the students in the class, all discussions were recorded and transcribed (without attribution to the identity of the speaker).

RESULTS

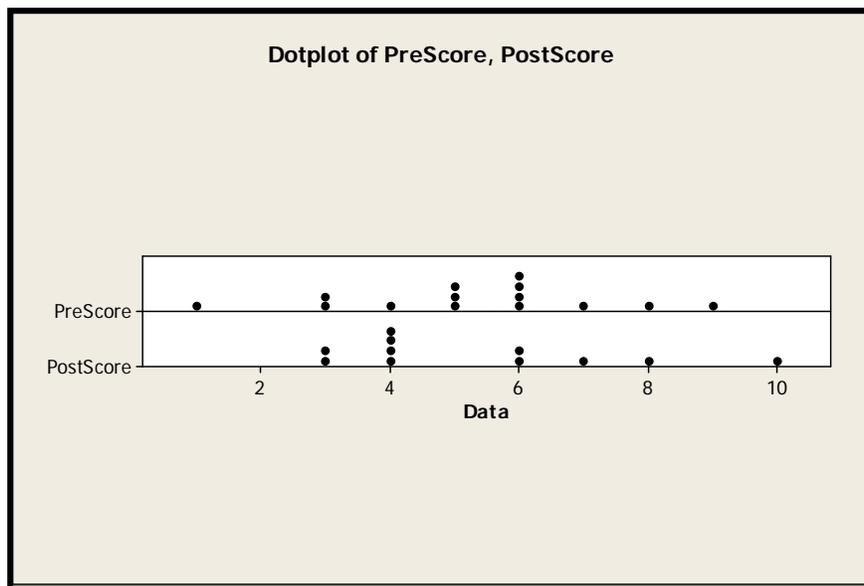
The sixteen items on the making up the Perspectives Survey were scored by summing the responses as 1 for 'Yes' and 0 for 'No;' a summated score of zero would indicate a free will perspective and a summated score of 16 would indicated a determinist perspective. Fourteen students completed the pretest whereas only eleven were present to complete the posttest. As a result usable pre/post data was available on eleven students. The pre and post survey data were analyzed using the Minitab Statistical Software (Release 15). Table 1 provides descriptive statistics for the pre and post Perspectives Survey scores:

Table 1. Descriptive Statistics of Perspectives Survey Summated Scores

<u>Variable</u>	<u>n</u>	<u>Median</u>
Pretest Score	11	5.5
Posttest Score	11	4.0

A Wilcoxon signed rank test on change in medians from pre- to posttest showed a statistically significant ($p = 0.014$) change away from a deterministic perspective and toward a more free will perspective. Figure 1 illustrates the distributions of the pre- and posttest scores:

Figure 1. Distributions of the Pre- and Posttest Perspectives Survey Summated Scores



Of note, mean aggregate student course evaluation were higher for this course than for the same course in either the preceding or following semester. In addition to the quantitative data a great deal of qualitative data was gathered via recorded discussions and written comments on the end-of-course student evaluation.

An informal qualitative analysis of the comments gathered via in-class recordings of discussions as well as written comments on the end-of-course student evaluation reflect the same movement from a simple, deterministic worldview to one more reflective and tolerant of the possibility that chance is a fundamental element of the universe. A representative sample of

these student comments are provided in Appendix B. Note that the comments are offered in roughly chronological order. Comments are organized into three sections to indicate what the author perceived to be tangible shifts in the thinking of a nontrivial proportion of students in the class.

CONCLUSIONS

It can be particularly daunting to teach a technical subject within the context of big questions. Clearly, most instructors intend to cover a minimum corpus of material in any course and generally find little free time throughout the term. If one intends to only marginally address the issues related to the big questions (out of fear of slighting course content, for example) it will not be worth the investment of time nor can one expect to see much impact on student attitudes or perceptions.

The approach taken to incorporate a 'big question' into this course did not require as significant a redesign as might be expected though an instructor should expect additional prep time if discussions and other big questions related activities are to be meaningfully integrated into the course. Considering the proposed outcomes for using the the big questions format in the classroom,

1. improved faculty and student engagement;
2. enhancement of critical thinking skills;
3. improved relevance and retention of course content;
4. apprehension and appreciation of big questions outside the classroom;
5. increased faculty communication;
6. creation of a foundation for future contributions to the big questions dialogue; and
7. production of methods and materials that will allow ready duplication at other locations,

it appears clear to the author that the objectives were achieved. Student-to-student and student-to-faculty engagement increased, the classroom environment was livelier than is typical for this business statistics course, the students participated in a [surprisingly] high level of discussion and many concluded that the statistical content of the course was made more interesting in the context of the big question.

ACKNOWLEDGEMENTS

The author would like to thank the Teagle Foundation for a generous grant that made this study possible as well as to Dr. Steve Donaldson from whom the Perspectives Survey was obtained and modified. Any errors or ambiguities in the survey are strictly the responsibility of the author.

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APPENDIX A: SURVEY INSTRUMENT

Can There be Purpose in a World of Chance? Perspectives Survey

1. The tsunami that devastated Indonesia several years ago was
 - a) a random act of nature.
 - b) an act of God.
 - c) something that could be predicted well ahead of time if we could just process all of the relevant geothermal and tectonic data.

2. An infant born with a brain tumor represents
 - a) a random act of nature.
 - b) an act of God.
 - c) something that could be predicted well ahead of time if we could just process all of the relevant medical data.

Circle Yes or No for each question:

- | | | |
|--|---|---|
| 3. Do you think there is a particular person set aside for you to marry? | Y | N |
| 4. Do either of you have a choice in the matter? | Y | N |
| 5. Do you have control over the neurons firing in your brain? | Y | N |
| 6. Is God responsible for evil? | Y | N |
| 7. Are you always in control of your emotions and feelings? | Y | N |
| 8. Do humans have free will? | Y | N |
| 9. Are your days "numbered?" | Y | N |
| 10. Is "chance" simply a reflection of our ignorance? | Y | N |
| 11. Can random processes yield meaningful results? | Y | N |
| 12. Can chance and purpose co-exist in creation? | Y | N |
| 13. Are some things irreducibly uncertain? | Y | N |
| 14. Are all our choices predictable? | Y | N |
| 15. Can God act providentially in a world of chance? | Y | N |
| 16. Can we be truly free in a world in which all is controlled (by God)? | Y | N |

APPENDIX B: SAMPLE OF STUDENT CLASSROOM AND COURSE EVALUATION COMMENTS

EARLY WEEKS OF THE COURSE

"I personally do not believe that we live in a world of chance. I think everything happens for a reason and is a part of God's plan. I have to have faith that things, people, situations and circumstances all happen for a reason, and are all part of God's plan for me and my life. I believe that there can only be purpose in a world with a greater meaning than chance."

"...everything has a purpose; chance is just a game of numbers, knowing the percent chance of something happening or not happening - being true or false does not affect the outcome."

"Because of our faith, we believe that God is in control of everything and he left nothing up to chance including creation. Therefore, I believe there was a purpose for creation and no room was left for chance."

"Ultimately, I believe God knows all and it can be hard for humans, even Christians, to fathom this. With God knowing all, he has the capability of letting humans discover information in a timeline necessary for their survival with the advances they've made. Therefore, a purpose in a world of chance could only be seen as something guided by God."

MIDTERM COMMENTS

"The first question to ask here, is to whom is chance pertaining? I believe that if chance is pertaining to humans (people as opposed to God, then, yes, there can be purpose in a world of randomness. This is because, randomness is relative based on those who are encountering it. For instance, years ago, hair color was random. Today we know that hair, in general, (color, length, type) is based upon the mother."

"I think purpose and predestination are different things. We all live in a world of chance happenings, chance encounters, accidents in essence. We are here to accomplish something, we are here for a reason, a goal. This purpose does not mean we have to do it or will do it, but we have a goal. God put us here for a reason, to accomplish things, not to be his robots who unwillingly do his bidding. In a world that is full of questions, we must hold on to our goal to stay focused."

"...there can be purpose in a world of chance. If there were no purpose then there would be no purpose of me taking this [class], going to school, breathing, or living. We may not be able to prove what exactly the purpose is, but we can prove that there is purpose. Like Popper's quote we cannot completely prove our purposes, but only fail to disprove them. It is all part of a larger, more complex plan."

"There is a slight chance for almost anything in today's time, however comparing it to creation's purpose, there is no similarity. A world of chance has no meaning because there is no certainty

for anything, nothing set in stone. How can there be meaning and purpose for anything that is not factual or certain? I realize this may be bias (although this is a Baptist college); so, for example, if one person decides to chance it and goes against what is written to be true (such as faith) what purpose does that serve then in the end? As sad and frightening as it is to think about it, a life of chance has no purpose or reward to them in the end..."

"I think that everyone has a purpose in this world. However, I don't think everyone fulfills that purpose. They are left to follow life's journey and sort out the various decisions, or chances, we have to make. We take chances every day, but not all of them are part of our overall purpose. So, yes, there can be purpose in a world of chance. It's up to us to figure out how to take the right chances to fulfill our purpose."

"I believe there is purpose in a world of chance, because at the root of everything (even chance) there is a purpose. Just by the fact that something happens randomly and not mapped out. I believe that everything happens for a reason, though it may not be evident at the time, eventually it all comes together in the end."

"While we live in a world of chance the mere existence of earth is statistically improbable so there must be purpose. We can better reveal that purpose by using the tools we have to analyze the chance in the world."

"There can be purpose in a world of chance because there is a possibility that at the core of creation it has randomly chosen/become/designed to be for purpose."

LATTER WEEKS OF THE COURSE

"As a Christian, I believe that an infinite creator can orchestrate a world of both purpose and chance. Because my mind cannot fathom a universe that does not elevate either purpose or chance above the other, who am I to limit my God by the confines of my imagination and understanding?"

"It would involve a tremendous degree of arrogance to claim that there is a zero percent chance of purpose derived from randomness. However, I do not believe that there will ever be a justifiable means of defining the actual purpose that drives this ever present randomness. For that reason, the general impossibility to prove a purpose in creation spawns a personal belief that randomness is most likely nothing but random. Although there are countless scientific phenomena that remain unexplained, leading some, even agnostics, to conclude a purpose in creation, I believe that there will never be a way of proving a driving force. And, failing to disprove doesn't work in this circumstance."