Statistical Literacy – An Online Course at Capella University

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Abstract

Online education and statistical literacy are both relatively young concepts struggling to establish themselves. Combining these concepts into a single course represents the outcome of a unique experience that included the development and delivery of a three-credit quarter-course in Statistical Literacy online at Capella University. This paper will outline the core concepts of the statistical literacy along with details of the design and development of the course. Student feedback and evaluations are presented and compared with other general education offerings at Capella University. Key findings include evidence to support the successful achievement of the course description and learning goals. As a course, it stimulated learners to think critically and hypothetically about statistics and provided a relevant context for learning. Recommendations are provided for those considering development of similar courses.

Keywords: Critical Thinking, Hypothetical Thinking, Confounding, Assembly, Web Based Instruction

1. Background

The development and delivery of an online statistical literacy course at Capella University was the result of several different independent projects. In 2003, Capella University was developing its undergraduate general education program when it approached Augsburg College about a collaborative effort. Augsburg College is a small, private liberal arts institution in Minneapolis, MN which has traditionally taught courses to both traditional and adult learners in a classroom setting. At that time, Augsburg was the recipient of a W.M. Keck Foundation grant designed to "develop and deliver course-room materials for the teaching of Statistical Literacy". This grant provided the resources for the development of teaching strategies and methods employed in this course along with a Statistical Literacy textbook.

Through my work at Augsburg College, I was selected to participate in the collaboration between Capella University and Augsburg as a course designer for a traditional online introductory statistics course (MAT 2000). This experience allowed me to develop some understanding of benefits and pitfalls of online learning, especially as it related to more mathematical content.

As a result of my growing involvement in the Statistical Literacy program at Augsburg College and the traditional online introductory statistics course, I proposed the development of a three-credit quarter-course in Statistical Literacy (MAT 2050). Dr. Valerie Perkins, Dean - School of Undergraduate Studies at Capella University, reviewed and approved the development of this unique course.

With the assistance of the Capella University instructional designers, work began on a course designed to take advantage of the benefits of the online environment to develop the statistical literacy and critical thinking skills of undergraduates taking statistics to complete a general education requirement in mathematical and logical reasoning. For almost all of the students who would enroll in MAT 2050, this would be their only mathematical and logical reasoning course at Capella University. The resulting course description was the following:

> MAT 2050 Statistical Literacy: This course concentrates on the application of critical thinking skills to arguments involving statistics. Emphasis is placed on the learner as a consumer of statistics rather than a producer of statistical calculations. Course activities focus on the interpretation, evaluation, and communication of real-world situations and news stories.

In the development of any course, we established a list of important learning objectives. It was from this foundation that all of the readings, assignments, and electronic classroom activities were then built. MAT 2050 had the following learning objectives for a six week, three-credit quarter-course:

- Evaluate statistical information from a variety of sources as evidence in arguments.
- Analyze and interpret written statements and stories containing statistics that describe and compare.
- Evaluate whether descriptive statistics have been appropriately applied within a given context.
- Identify and analyze social construction of statistics used as evidence in arguments.
- Identify and analyze statements of association, and possible confounders, used as evidence in arguments.

Looking at the course description and learning objectives above, it is quite easy to see that this is not a traditional statistics course focused on descriptive

and inferential statistics. In this next section, I will describe more of the Statistical Literacy methodology and course content.

2. Statistical Literacy

The primary textbook for this course was a draft version of <u>Statistical Literacy: The Story behind the Statistics</u> by Milo Schield (2005). This text was written and edited based on the development of an undergraduate General Studies Statistical Literacy course taught at Augsburg College. See Schield 2004a and 2004b. The table of contents for the text used for MAT 2050 illustrates the range of topics:

1. The Story Behind the Statistics
2. Take CARE
3. Understanding Measurements
4. Describing Rates and Percentages
5. Comparing Rates and Percentages
6. Interpreting Rates and Percentages

While quite different in focus from many other introductory textbooks, it is most similar to the less formulaic approach of Utts (1999) or Moore (2000).

"Statistical Literacy is critical thinking about everyday arguments that use statistics as evidence." (Schield, 2005) This definition provides the basic framework from which the course was built. While traditional introductory statistics courses focus on the topics of data production, data analysis, and statistical inference, statistical literacy is aimed primarily at consumers of statistical information. As a result, the text is built upon the admonition and acronym "Take CARE". Each letter of the CARE acronym represents a possible source of influence on a given statistic presented as evidence in an argument.

The premise of this Take CARE acronym comes from "Damned Lies and Statistics" by Joel Best (2001a). As he stated in a talk at Augsburg College,

> "Statistics are socially constructed: the products of social activities. There's a tendency in our culture to believe that statistics – that numbers – are little nuggets of truth. That we can come upon them and pick them up very much the way a rock collector picks up stones. A better metaphor would be to suggest that statistics are like jewels; that is, they have to be selected, they have to be cut, they have to be polished, and they have to be placed in settings so that they can be viewed from particular angles." (Best, 2002)

Many of today's students enter introductory statistics courses with this blind trust in numbers and statistics. Through the statistical literacy course, students learn to critically evaluate the statistical information presented to them. For many learners, this change in awareness and perspective is quite eye-opening and draws them into the course material and activities.

2.1. Confounding

The topic of confounding is one that rarely appears in a traditional introductory statistics course. By definition, confounding is the influence of related factors on a given statistic. With a focus on univariate descriptive and inferential statistics, most courses avoid the topic or save it for a later course in regression or multivariate analysis. On the other hand, learners live in a multivariate world filled not only with experiments. Many of the statistics surrounding learners are based on observational studies which are inherently weak at controlling for unknown factors. Without random assignment, the results of an observational study are not always neat and clean. One must think critically about the possibility of confounding and its' influence on the given results.

As consumers of statistical evidence, learners must have the ability not only to define a confounder but also identify those that might be critical influences on the stated statistical evidence. A large portion of the MAT 2050 course is focused on the identification of confounders in news stories, determining which have been accounted for in the research process and thinking hypothetically about the influence of other confounders not accounted for.

For many learners, the ability to think hypothetically about confounders is a challenging, yet vital task. If they are to think critically about evidence presented to them, they must have a working understanding of the factors that were or were not taken into consideration. The omission of relevant confounders can have a significant bearing on the resulting evaluation of a given piece of statistical evidence.

2.2. Assembly

The concept of Joel Best's social construction is captured in the Take CARE methodology in the influence of Assembly. While not frequently addressed in most traditional statistics courses, the concept of Assembly is likely the most commonly encountered of the four influence categories in Statistical Literacy. Assembly is defined as the influence of data definition and data presentation on a given piece of statistical evidence.

Many statisticians are familiar with the idea of operational definitions as used in the development of surveys and studies. For many introductory statistics students, their acceptance of statistics as presented may blind them from the idea that changes in operational definitions can result in significantly different statistics. In Statistical Literacy, students are exposed

to the concept of Assembly and asked to think about how alternative definitions might have lead to different statistical outcomes. Again, it is the hypothetical thinking about how things might have been done differently that challenges learners to think critically about the statistical evidence.

In addition to the idea of data definition, Assembly also includes the influence of data presentation on the critical evaluation of statistical evidence. In this aspect, students are asked to think critically about how the statistical data is presented within an argument. Through the study of mathematical comparisons and related grammar, they can evaluate a given statistic. In some cases, it is the omission of important information that is critical to evaluating a given statistical argument. For example, what if you were told that eating vitamin X reduced your risk of developing brain cancer by 10%? While this may sound important, the omission of the baseline risk gives us little information on the true benefit of vitamin X. If the risk was quite low to begin with, perhaps an additional 10% reduction isn't of much benefit.

2.3. Randomness

In nearly all traditional introductory statistics courses, the concept of random variation is a primary focus. It's an integral concept in the development of descriptive statistics, probability and inferential statistics. In the Take CARE methodology, random variation is one of the four primary influences on statistical evidence although it certainly not the focal point.

As learners encounter statistics as evidence in the news and other sources, typically issues of random variation due to sample size are not relevant. The surveys, studies, and experiments performed and reported today typically have sufficiently large sample sizes to minimize or rule out the influence of chance on a given statistic. That being said, it is still important that students be aware of the concept and vigilant in thinking critically about issues of sample size and random variation.

2.4. Error

Many introductory courses do spend some time discussing the issues of error and bias as they pertain to the design of an experiment or study. Throughout the course, students learn to identify various aspects of study design and think critically about the influence of those choices on the statistical evidence.

3. Course Design and Delivery

The activities of MAT 2050 are grouped into several different categories. First, there are the various readings which form the majority of the material delivery in an online course. The reading assignments for the course include chapters from the selected textbook, as well as an article by Joel Best (2001b) which serves as an introduction to the course and topic. In addition, there are unit presentations which are intended to help clarify and unify the course as the learners move from unit to unit. As in any online course, it is imperative that the reading materials and documents be very clear and concise regarding the subject matter.

The use of asynchronous web-based discussions is an important element of many successful online courses. As a supplement to the assigned readings, they allow the instructor to further clarify and emphasize particular concepts for the learners. Discussions also allow for the important and necessary communication that takes place as learners explore the concepts of the course. In MAT 2050, discussion forums are used quite heavily to focus on particular concepts and allow for interaction amongst learners. The students in the course have been quite active in their participation. Typically, there are over 650 substantive postings by 15-20 learners during a six week course.

The single most important component of the course from both a learning and assessment perspective is the use of article evaluations which are performed on real-world news articles. In the course, learners are asked to evaluate 8 different articles as part of assignments and the course project. In each of these evaluations, the learners must apply the course concepts to an article which involves statistically based arguments heard or seen in the newspaper and television each day. Through the articles, learners are exposed to both observational studies and experiments like those found in everyday news media. Topics include music lessons and IQ, infant television viewing and links to ADD, smokers and increased divorce rates, etc.

These completed article evaluation worksheets (See Appendix 1) are then used as the basis for asynchronous web based discussions as well as individually graded assessments. The individualized feedback received from the instructor and multiple attempts at these article evaluations helps reinforce the concepts for the learners. With repeated uses of these article evaluations, learners can see their statistical literacy skills developing and gain greater confidence in their ability to think critically about the numbers they see and hear in the news.

In addition to the article evaluation assignments, the course project also reinforces the skill development. For three weeks, the learners are given a series of articles on a selected topic. The first is a short news transcript that one might hear on a 30 second radio news broadcast. This is followed up by a newspaper

article on the same topic. Lastly, they are provided with the published research journal article from which the first two news stories were written. In each of the project components, the learners evaluate the readings based on their developing knowledge of statistical literacy. Rather than using a worksheet format like the assignments, the students are required to write their evaluations in a more formal, traditional written paper. Within that paper, they are asked to evaluate the news story based on a checklist of items that resembles the article evaluation worksheet.

This continued repetition of the article evaluation process provides multiple opportunities for deeper understanding of the key concepts in Statistical Literacy. Rather than simply memorizing terms and definitions for a quiz, learners are forced to use and apply the concepts of the course to articles and real world situations. According to Larreamendy-Joerns et al (2004), "Authentic tasks – that is, tasks that require students to engage in intellectual moves that mirror those of professionals in the discipline or that resemble practices that will be meaningful to the students in their everyday life—foster transfer of learning and knowledge in use."

In addition to the work done with real-world articles, additional learner assessment involves assignments and two online quizzes which include a combination of hypothetical thinking and quantitative reasoning. One unique resource provided to learners for their own formative assessment is an online grammar checker (Burnham and Schield, 2005) which allows students to practice writing exercises using the grammatical rules presented in the text to describe and compare rates and percentages presented in different kinds of tables and receive immediate feedback without any instructor dependence. These activities provide learners with additional practice along with feedback on the terms and concepts as well as the grammatical and mathematical content of the course.

4.   Results

During the first six months, Capella University has offered five different sections of MAT 2050 with over 100 learners completing the course. In general, the course feedback from learners has been quite positive. At the end of the project, learners are asked to write a reflections statement on the course.

For many learners, this course is an awakening to the world of statistics. While they have lived in a world of increasing complexity, they viewed statistics in simple way prior to the course. Nearly all learners comment about the change in perspective that they have after taking this course. In a sense, they've

been given a new lens through which to view the statistics in their personal and professional lives.

"I will definitely look at statistics in a different way after taking this class, especially reading them in magazines or newspapers. I will not be so naïve in believing everything that I read, and understand that some of the important facts could be missing in the story."

"The most valuable concept that I will take from the Statistical Literacy course is that we need to use and understand statistics in our daily lives. Whether personal or professional, statistics are part of the world we live in. We need to arm ourselves with the knowledge to use and decode them correctly to be successful."

For other learners, the idea of taking a quantitative college class to fulfill a general education graduation requirement is a daunting task. This is especially true given the nature of online courses and the fact that many of the MAT 2050 students are in degree completion programs as adult learners who have been away from any form of math education for years.

"I also want to thank you for helping to create a statistics class that was *possible* for a student who usually fails in math related areas. I was very afraid of this class before I knew what it would require, but it has been an awesome experience."

Lastly, learners are finding out that Statistical Literacy does not simply mean that this is a simpler, more elementary version of a traditional introductory statistics course. While the concept of a math course with fewer computations and calculations might appeal to those with some math anxiety, those learners quickly learn that the skills of critical thinking and Statistical Literacy are equally challenging.

"I expected this course to be a little easier than it was, but am glad that I actually learned something rather than going through the paces to get a grade. The course was challenging, but rewarding at the same time."

While the reflections from learners are nearly favorable in terms of the course, they are by no means unanimously positive. Of the negative feedback received, the principle complaint is the quantity and rigor of the material in a three-credit quarter-course.

"The material we covered should have been a six credit course. I did not have time to fully cover the material needed to do the best I could in this course. I think you should make this a 6 credit full quarter course or cover less material."

Capella University administers an online course evaluation shortly after the end of the course. Below,

Table 1 shows the average scores of all General Education courses, of MAT 2050 (Statistical Literacy) and of MAT 2000: the traditional introductory statistics course I designed for Capella University in 2004.

Table 1: Average Assessment Scores: Learner Evaluations: Quarters 2 and 3, 2005[1,]

Course Content and Course Benefits	Gen Ed.	MAT 2050	Rank[2] N=15		MAT 2000	Rank[2] N=15
1. I was challenged to think critically about subject matter of this course	4.42	4.62	2		3.91	15
2. I was able to apply what I learned to my work or professional activities	3.74	4.00	4		3.58	9
3. The course content provided relevant and useful knowledge	4.27	4.38	5		3.58	15
4. Course content promoted relevant and useful skill development	4.22	4.38	5		3.5	15
5. I would recommend this course to another learner	4.05	4.15	6		2.67	15
6. As a result of what I learned, I believe my value as a professional increased	3.87	4.00	6		3.00	15
7. I achieved the intended learning outcomes for this course	4.23	4.23	7		3.33	15
8. The course learning materials were relevant and useful	4.20	4.38	10		2.92	15
Course Design and Student Involvement						
9. The course was well-organized and sequenced	4.23	4.54	2		3.25	15
10. The learning objectives for each unit were relevant and appropriate	4.30	4.54	3		3.33	15
11. The discussion questions were relevant and engaging	4.27	4.46	3		3.25	15
12. I was frequently engaged with the instructor and other learners	4.12	4.31	4		3.08	15
13. The unit learning activities supported the learning objectives	4.28	4.46	5		3.58	15
14. The contributions and interactions of other learners made this course an enriching learning experience	4.15	4.15	5		2.83	15
15. About how many hours per week do you spend engaged in this course?	12.59	12.67	5		18.67	1

All scores for MAT 2050 are quite positive: at or above 4.0 on a 5 point scale and above the average scores for all 15 general education courses.

Compared to all general education courses, Statistical Literacy received its highest ranking (2nd place) in challenging students to think critically. PHI 1000 (Introduction to Philosophy) ranked in 1st place on this question. This result suggests that MAT 2050 is meeting the goals of the course description and learning objectives regarding thinking critically about statistics used in everyday arguments.

In addition to critical thinking, the course also received high rankings on a number of other questions regarding course content and benefits. It is interesting to note that while this was a liberal arts general education requirement, the learners also saw a great deal of application for the course content in their work or professional lives (4th place rank). This was certainly not a course objective but does demonstrate the wide range of applications for statistical literacy.

Comparing Statistical Literacy (MAT 2050) to Introductory Statistics (MAT 2000) on course content and benefits, the difference is quite striking. With one exception (course learning materials), statistical literacy ranks in the top seven, while traditional statistics ranks last or near-last in all questions.

In addition to course content and benefits, MAT 2050 also received high marks for many of the course design and student involvement questions. While this may be a compliment to the designer, it is also important to contrast these scores with the scores for MAT 2000 which I also designed. Obviously, there is something besides the course designer which might explain the sizable difference in assessment scores between the Statistical Literacy course and Introductory Statistics. While it is difficult to know the exact cause some possible explanations for the lower scores in MAT 2000 could include the lack of a math prerequisite / placement program at Capella University, the more abstract concepts of mathematical statistics and the challenge of teaching and learning mathematical computation online.

5. Conclusions

After developing and delivering MAT 2050, I have reached some conclusions about this new course.

Statistical Literacy is different. While I was trained as an Industrial Engineer who took a wide range of quantitative courses, I have never encountered an-

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[1] For calculation of question averages: n=521 for Gen Ed Courses; n=12 for MAT 2000 (Introductory Statistics), n = 28 learners responding for MAT 2050, All questions on 1 (low) to 5 (high) scale except #12.

[2] Rank is based on average score among 15 currently offered general education courses

other course that captures the combination of critical thinking and statistical awareness that is so practical to a wide audience of general education learners. This difference is obvious in the student evaluation scores (Table 1). While Statistical Literacy is not a replacement for traditional statistics, it does offer a viable alternative for fulfilling a quantitative reasoning requirement in general education.

Statistical Literacy is more than just math. MAT 2050 has ancillary benefits besides those associated with the critical evaluation of statistics presented as evidence in news stories. With a focus on and the use of real-world news articles, the retrieval of documents through the online library introduces these learners to the world of bibliographic searches and the data literacy skills important for those living in today's electronic world. In addition, the integration of article evaluations with writing is an important opportunity to develop multiple skills for the general education learner. This connection between quantitative reasoning skills and writing across the curriculum is one of the key components of a current FIPSE grant at Carleton College in Northfield, MN[3].

Statistical Literacy requires hypothetical thinking. One of the most difficult skills for learners to master in MAT 2050 is hypothetical thinking. In the study of articles requiring critical evaluation, one must not only evaluate the given information but also consider hypothetical scenarios for what is not described. This ability to think beyond the information given in the context of the news article is not something commonly tested in other college courses even though it is a critical skill necessary in today's data rich world.

Statistical Literacy is not easy. As mentioned previously, some learners mistakenly believe that the lack of focus on formulaic computations in this course somehow makes it easier than other math or statistics courses. What learners fail to realize is that many of them have not had much opportunity to test or develop their critical and hypothetical thinking skills. In the evaluation of news articles, a learner may have to interpret and analyze what is not in the text as much as what is actually stated. This analysis of what is not in a news story and what that might mean is very different territory for many undergraduate students who have been trained to look only at the information presented in textbooks and other sources.

Statistical Literacy is well suited online. As the learner evaluation data shows, some subjects like traditional math and statistics courses tend to struggle with the online format, MAT 2050 is very well suited to the online environment. With the availability of a suitable text, appropriate news articles and a structured course design, learners can pursue the content at their own pace with the flexibility of the internet. The use of the asynchronous discussion boards allows for frequent interaction with the instructor and fellow classmates while allowing each student to form their skills through repeated article evaluations.

Statistical Literacy is valued. With all of the course materials and learning activities centered on the evaluation of articles from the news media, learners find it easy to see the value in what they are learning. By changing their perspective on the role and importance of statistics in the world around them, nearly all of the learners express a greater appreciation for the statistical literacy skills learned in the course. Compared to other traditional introductory statistic courses, this is a major accomplishment. Previous research (Schau, 2003) has demonstrated a decrease in student appreciation for statistics following the completion of a traditional introductory statistics course. While no empirical research has been completed, I believe that learners completing MAT 2050 would demonstrate an increased perception of value in statistics from the beginning to the end of the course.

This perceived value is also shown in Table 1 where MAT 2050 ranked 5th among all 15 general education courses in promoting "relevant and useful skill development" Comparatively, PHI 1000 (Intro Philosophy) ranked 11th on this same question. Thus, while PHI 1000 challenged learners to think critically (1st place rank), they did not see the relevant and practical applications which are evident to students of Statistical Literacy. MAT 2050 stimulated learners to think critically and hypothetically and also provided a relevant context for authentic learning.

5.1. Cautions and Pitfalls

After developing and teaching MAT 2050 as an online course in statistical literacy, I have observed and noted a number of issues which may be of value to others in developing a similar course. The need for a clear and concise published textbook on the subject of Statistical Literacy is evident. Current versions of the course are offered using a draft copy of Schield's Statistical Literacy textbook. While this has been functional, the text could use some additional refinement for use in teaching online. As seen in Table 1, the student evaluation of the learning materials received the lowest rank comparison for all the questions. While the average score of 4.38 on a 5 point scale is not unfavorable, there is still room for improvement on a tenth place ranking.

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[3] For more details, see http://apps.carleton.edu/collab/quirk/

The fact that MAT 2050 is such a different course does have a downside in terms of locating the appropriate instructors. The lack of instructors with experience in the topic of statistical literacy as defined by this course could be an issue. While statisticians have the skills to handle the statistical content, many are unfamiliar or uncomfortable with the critical thinking elements of the course. At the same time, those instructors with an interest in the areas of critical thinking may not have the desire or interest to teach the statistically based content. As a result, the pool of instructors is currently quite small.

MAT 2050 also requires an increased commitment from the instructor. Since article evaluations involve critical thinking with the possibility of multiple correct answers and no master solutions key, the time for grading and feedback of coursework is much greater than in other more traditional math and statistics courses which have more definite correct / incorrect answers. For learners, the personalized feedback provided on article evaluations and other assessments is essential for their success.

5.2. Recommendations

Student Attitude Assessment: As mentioned earlier, the subjective feedback received through learner evaluations and reflective writing assignments is quite positive. Since this impression is considerably different from previous research on traditional introductory statistics courses, I recommend that empirical research be conducted on student attitudes in MAT 2050 through pre and post surveys.

Resources: With the use of news articles, a course like MAT 2050 is very prone to quickly becoming dated for learners. As a result, there is a continual need for resources to support future classes of MAT 2050. Since this can be a time-consuming task for faculty, I recommend the development of additional resources for Statistical Literacy including article evaluation databases, additional project topics, solution keys, etc.

Preparation: For those considering developing a course similar to MAT 2050, I would strongly suggest some advance preparation of potential faculty members. Because Statistical Literacy is quite different from other mathematically based courses, there will be a substantial learning curve for most faculty on either the mathematical topics or the hypothetical thinking aspects of the course. For MAT 2050, I highly recommend that a teacher training course be developed train interested faculty to the course materials and content and prepare them for future facilitation of online course offerings.

Liberal Arts Approach: While this course is currently offered as a graduation requirement for Mathematical and Logical Reasoning, a similar course might also be suited as a first year seminar at a liberal arts college. This course could draw upon the current course and include further integration of the concepts of Statistical Literacy, writing skills, quantitative reasoning and critical thinking. Such a course might be both a practical and enjoyable experience for new college students

Acknowledgments

References

Best, Joel (2001a) *Damned Lies and Statistics*, University. of California Press

Best, Joel (2001b). *Telling the Truth About Damned Lies and Statistics*. Chronicle of Higher Education; Vol 47 Issue 34, p. B7

Best, Joel (2002) Transcript of Talk at Augsburg College W. M Keck Statistical Literacy gathering. www.statlit.org/PDF/2002BestAugsburg.pdf

Burnham, Tom and Milo Schield (2005). *An On-line Grammar Parsing Program that Decodes Ordinary English Descriptions and Comparison of Percentages and Rates.* 2005 ASA Proceedings of the Section on Statistical Education. "2005BurnhamSchieldASA.pdf"

Larreamendy-Joerns, J.,Leinhardt G. and Corredor J. *Six Online Statistics Courses: Examination and Review, The American Statistician, 59, 240-251.*

Moore, David (2000). *Statistics: Concepts and Controversies.* 5th Edition. W. H. Freeman.

Schau, Candace (2003). *Students Attitudes: The "Other" Important Outcome in Statistics Education.* ASA Proceedings of the Section on Statistical Education, Pg. 3673 - 3681.

Schield, Milo (2004a). *Statistical Literacy Curriculum Design*. Curriculum Design Roundtable, International Association of Statistical Educators in Lund Sweden. "2004SchieldIASE.pdf"

Schield, Milo (2004b). *Statistical Literacy and Liberal Education at Augsburg College*. Peer Re-

view, Sept. 2004. American Association of Colleges & Universities. "2004SchieldAACU.pdf"

Schield, Milo (2005). *Statistical Literacy: The Story Behind the Statistics.* Draft of textbook.

Utts, Jessica (1999). *Seeing Through Statistics*. Duxbury Press

APPENDIX 1: Statistical Literacy Argument Analysis Form (Fall, 2005)

1. (2 pts) What is the point or "Target" of the news story?

2. (2 pts) State the association given in the article that supports the point of the argument. (Depending on the story this can be the same as item #1 above.)

3. (2 pts) State how the factors in the association are measured.

4. (2 pts) Is the study involved an experiment or an observational study? Explain your reasoning.

5. (2 pts) Is the study involved cross-sectional or longitudinal? Explain your reasoning.

6. (2 pt) Is the study a controlled study? Explain your reasoning.

7. (1 pt) If there are groups, are the subjects randomly assigned to the groups?

8. (4 pts) Identify a possible mechanism that would explain the association as causal. Explain how the mechanism helps explain the association shown in the triangle diagram. Be sure to identify what items should appear in boxes A, B and C in the diagram..
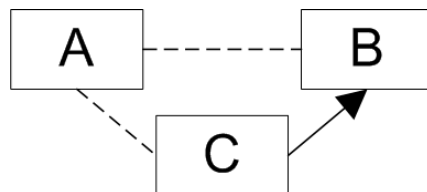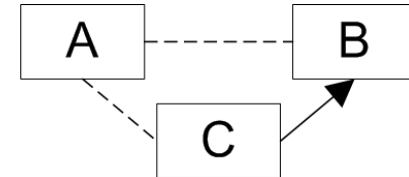
    Box A:

    Box B:

    Box C:

    Explain mechanism:

9.   (2 pts) Name all the factors taken into account in this story (if any).

10. (5 pts) Identify a possible confounder for the observed relationship not accounted for in the story. Using the triangle diagram found below, explain how each alternate explanation is linked with both predictor and outcome. Confounder / Alternate Explanation #1:
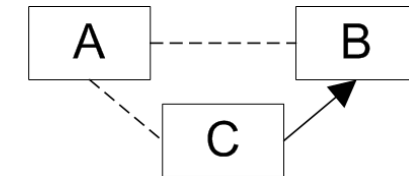
    Identify Box A:

    Identify Box B:

    Identify Box C:

    Explain how the Alternate Explanation is linked with both the predictor and outcome:

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11. (5 pts) Identify a second possible confounder for the observed relationship not accounted for in the story. Using the triangle diagram found below, explain how each alternate explanation is linked with both predictor and outcome.   Confounder / Alternate Explanation #2:

    Identify Box A:

    Identify Box B:

    Identify Box C:

    Explain how the Alternate Explanation is linked with both the predictor and outcome:

Answer the next three questions with relation to the Take CARE methodology,

12. (2 pts) Considering what is stated or not stated in the article, comment on the potential for **Error** or Bias to influence the stated association or statistic?

13. (2 pts) Considering what is stated or not stated in the article, comment on the potential for **Randomness** to influence the stated association or statistic

14. (2 pts) Considering what is stated or not stated in the article, comment on the potential for **Assembly** to influence the stated association or statistic?