

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 within their own respective disciplines. Combining the two concepts into a single course represents the outcome of a unique experience that included the development and delivery of a three quarter credit course in Statistical Literacy at Capella University. We'll discuss the process from course development to online delivery, student / instructor feedback, as well as ideas for the future.

Keywords: Web Based Instruction, Confounding, Assembly

Background

The development and delivery of MAT2050, an online statistical literacy course, at Capella University was the result of several different independent projects. Capella University is one of the leaders in the online education marketplace. Founded in 1993, it has developed from a largely graduate institution into one offering a range of courses from undergraduate degree completion through PhD degrees. 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 from the W.M. Keck Foundation has provided the resources for the development of the first Statistical Literacy textbook.

Through my work at Augsburg College, I was selected to participate in the collaboration between Capella University and Augsburg. My first involvement in this activity was the development of a traditional online introductory statistics course (MAT2000). 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 MAT2000 traditional online introductory statistics course, I proposed the development of a 3 quarter credit course in Statistical Literacy (MAT 2050). 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 general education math requirements. For many of these students, this would be the only math or statistics course that they would take at Capella University. The resulting course description was the following:

MAT2050 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, but especially one taught in the online environment, it is especially important to have solid learning objectives. It is from these objectives that all of your readings, assignments, and electronic classroom activities must be based. MAT2050 had the following learning objectives for a 6 week, 3 quarter credit 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 descriptions and 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.

Statistical Literacy

The primary textbook for this course was a draft version of Statistical Literacy: The Story behind the

Statistics 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 as both a traditional classroom course as well as a hybrid course with significant online activities. The table of contents for the text used for MAT2050 illustrates the range of topics addressed:

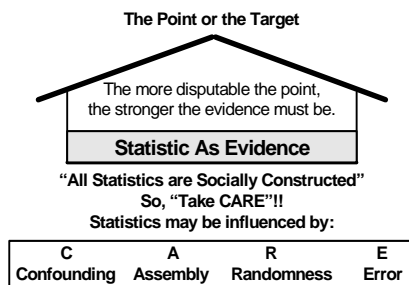
1. The Story Behind the Statistics
2. Take CARE
3. Understanding Measurements
4. Describing Rates and Percentages
5. Comparing Rates and Percentages
6. Interpreting Rates and Percentages

While quite different in focus from many other introductory textbooks in the market, it is most similar to the less formulaic approach of Seeing Through Statistics by Utts or Concepts and Controversies by Moore.

“Statistical Literacy is critical thinking about everyday arguments use statistics as evidence.” (Schield, 2005) This definition from the Schield textbook provides the basic framework from which the course was built. While most introductory statistics courses focus on the topics of data analysis, data production 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”.

In this acronym, each letter of CARE represents a possible source of influence on a given statistic used as evidence in an argument. Figure 1 below is a good graphical summary of the “Take CARE” methodology.

Figure 1: Four Influences on an Association



The premise of this Take CARE acronym comes from Joel Best’s book titled “Damned Lies and Statistics”. In this book, Best introduces the concept of social construction with regards to statistics. 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.

Confounding

The topic of confounding is one that rarely appears in a traditional introductory statistics course. 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 them are based on observational studies which are inherently weak at controlling for unknown factors that might be assumed away with random assignment. 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. By definition, confounding is the influence of related factors on a given statistic.

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 MAT2050 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.

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.

Randomness

In nearly all introductory statistics courses, the concept of random variation or chance 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 chance 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 reported 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.

Error

Like randomness, 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. Not only do they learn the terms and concepts but they also apply them by thinking hypothetically about the given situation and evidence.

COURSE DESIGN AND DELIVERY

The activities and assessments of the course are grouped into several different categories. First, there are the readings and presentations which form the majority of the material delivery in an online course. The reading assignments for the course include chapters from the draft of Milo Schield's textbook, as well as article by Joel Best which serves as an introduction to the course and topic. In addition, there were unit presentations which I wrote as the course designer. These are intended to help clarify and unify the course as the learners move from unit to unit within the course. As in any online course, it is imperative that the assigned reading materials and documents be very clear and concise regarding the subject matter. Without the presence of a lecturer to present and clarify materials, the written materials must be able to stand on their own with some facilitation from an online instructor.

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 MAT2050, discussion forums are used quite heavily to focus on particular concepts and allow for interaction amongst learners. The students in this particular course have been quite active in their participation. Typically, there have been over a total of 650 substantive postings by a course including twenty 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 5 different articles through assignments as well as 3 more in course project. In each of these evaluations, the learners must apply the course concepts to an article which resembles the stories involving 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 similar to those found in everyday news media. Here are some

of the topics: music lessons and IQ, infant television viewing and links to ADD, smokers and increased divorce rates, etc.

These completed article evaluation worksheets 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, there is also a course project which further 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 an actual newspaper article on the same topic. Lastly, they are provided with the actual published research journal article from which the first two news stories were written. In each of the components of this project, the learners are asked to evaluate the stories 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 (See Appendix 1).

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 situations which they recognize as relevant and practical to their life beyond the end of the quarter. 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."

This combination of gained confidence through application and practical application has led to nearly all favorable comments in learner reflections and evaluations at the end of the term.

In addition to the work done with real-world articles, the remainder of the course assessment is done through a combination of assignments and two online quizzes. 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 numbers presented in a variety of different 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.

RESULTS

Since the launch of the course, Capella University has offered five different sections of MAT2050 with over one hundred learners completing the course. In general, the course feedback from learners has been quite positive. At the end of the course project, learners are asked to write a reflections statement regarding the course. The table below shows some of the most insightful learner evaluation feedback. Omitted questions listed in footnotes.¹

For many learners, this course is an awakening to the world of numbers and statistics. While they have lived in a world of increasing complexity, they still view reported numbers and statistics in simple way. One of the primary outcomes of this course is that 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 tool or lens through which to view and evaluate the statistics in their personal and professional lives. Generally, nearly all of the learners report at the beginning of the course that this is their only statistics course as an undergraduate. In several instances, a learner has commented on an increased interest in the subject to pursue additional coursework in statistical inference.

"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."

¹ The instructor provided clear expectations of course requirements (4.62, 0.51). The instructor provided timely feedback regarding postings to the unit assignments (4.62, 0.65). The instructor provided constructive feedback regarding course papers or projects (4.77, 0.44). The instructor encouraged learners to express their own ideas (4.54, 0.88). The instructor showed respect for learners (4.69, 0.48). The instructor showed commitment to learner progress (4.77, 0.44). Overall, how would you rate the quality of the instructor's online teaching activities? (4.69, 0.63). The online environment was easy to navigate (4.23, 0.93). Technical Support was responsive to my needs and concerns (4.00, 1.05).

| Learner Evaluation Questions | | Avg | Stdev |
|---|--|-------|-------|
| 1. | I was challenged to think critically about subject matter of this course | 4.62 | 0.51 |
| 2. | The course content provided relevant and useful knowledge | 4.38 | 0.65 |
| 3. | Course content promoted relevant and useful skill development | 4.38 | 0.65 |
| 4. | The course learning materials were relevant and useful | 4.38 | 0.65 |
| 5. | I achieved the intended learning outcomes for this course | 4.23 | 1.17 |
| 6. | I would recommend this course to another learner | 4.15 | 1.14 |
| 7. | I was able to apply what I learned in this course to my work or professional activities | 4.00 | 1.22 |
| 8. | As a result of what I learned from this course, I believe my value as a professional increased | 4.00 | 1.29 |
| COURSE DESIGN AND STUDENT INVOLVEMENT: | | | |
| 9. | The course was well-organized and sequenced | 4.54 | 0.52 |
| 10. | The learning objectives for each unit were relevant and appropriate | 4.54 | 0.52 |
| 11. | The discussion questions were relevant and engaging | 4.46 | 0.66 |
| 12. | The unit learning activities supported the learning objectives | 4.46 | 0.52 |
| 13. | I was frequently engaged in interactions with the instructor and other learners in this course | 4.31 | 0.95 |
| 14. | The contributions and interactions of other learners made this course an enriching learning experience | 4.15 | 1.07 |
| 15. | About how many hours per week do you spend typically engaged in this course? | 12.67 | 8.54 |
| n = 13 learners responding; All questions on 1 (low) to 5 (high) scale except #12 | | | |

Table 1: Learner Evaluations, Spring Quarter 2005

“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 college level mathematics 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 MAT2050 students are in degree completion programs as adult learners who have been away from any form of math education for several years or more.

“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 mathematical statistics course. While the concept of a math course with fewer computations and calculations might appeal to those with some form of 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 and evaluations, the principle complaint is the quantity and rigor of the material presented in a 3 quarter credit course.²

“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.”

Conclusions

After the experience of developing and delivering the MAT2050 course in Statistical Literacy. I have learned a number of valuable lessons which have aided me in both my approaches to teaching in both the online and classroom environments.

Statistical Literacy is different. While I was trained as an Industrial Engineer who took a great deal of math, statistics and quantitative courses, I have never encountered another course that captures the combination of critical thinking and statistical

² Other learner complaints involve technical online issues and difficulties searching online library databases.

awareness that is so practical to a wide audience of general education learners. While there are definitely more comprehensive introductory courses that appeal to those with a possible interest in pursuing further studies in statistics, they tend not to appeal to the general education student on either a practical or technical basis.

Statistical Literacy is more than just math. MAT2050 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 necessary documents through the Capella University online library introduces these general education students 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. For more details see the following hyperlink: <http://apps.carleton.edu/collab/quirk/>

Statistical Literacy requires hypothetical thinking. One of the most difficult skills for learners to master in MAT2050 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 given information within 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. While some subjects like traditional statistics tend to struggle with online courses due to technology requirements, MAT2050 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 around the evaluation of articles from the news media, learners find it very 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 statistics, this is a significant 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 MAT2050 would demonstrate an increased perception of value in statistics from the beginning to the end of the course.

Cautions and Pitfalls

Based on the experience of developing and teaching MAT2050 as online course in statistical literacy, I have observed and noted a number of issues which may be of value to others. The need for a clear and concise published textbook on the subject of Statistical Literacy is evident. Current versions of the course have been 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 stated earlier, materials used for an online class must be extremely clear and concise and not dependent on any instructor interpretation or clarification in the classroom. Based on feedback from initial sections of MAT 2050, work is currently underway on the current text by Milo Schield to streamline the presentation of concepts for the learner.

The fact that MAT2050 is such a different course does have a downside in terms of locating the appropriate faculty instructors. The lack of faculty 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 of them 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 potential teaching candidates is currently quite small.

MAT2050 also requires an increased commitment from the instructor. While this is true for all of the online instructors at Capella University, this course does require some additional effort. Since we are dealing with article evaluations and 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 statistics which have more definite correct / incorrect answers. For learners, the personalized feedback provided on article evaluations and other assessments is essential for their success but does require additional effort from the instructor.

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 significantly different from previous research on traditional statistics courses, I recommend that more empirical research be conducted on student attitudes in MAT2050 through the use of pre and post surveys.

Resources With the use of news articles, a course like MAT2050 is very prone to quickly becoming dated for learners. As a result, there is a continual need for additional resources to support future classes of MAT2050. Since this can be a time-consuming task for faculty, I recommend the development of additional instructor resources for Statistical Literacy including article evaluation databases, additional project topics, solution keys, etc.

Preparation For those considering developing a course similar to MAT2050, 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 significant learning curve for most faculty on either the mathematical topics or the hypothetical thinking aspects of the course. For MAT2050, I highly recommend that a teacher training course be developed to familiarize and train interested faculty to the course materials and content and prepare them for future facilitation of online course offerings.

Liberal Arts Approach While Capella University currently offers MAT2050 under the 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

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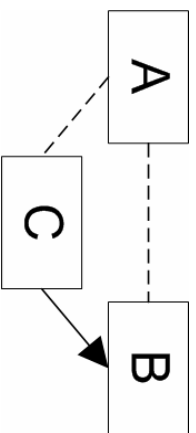
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APPENDIX 1: Statistical Literacy Argument Analysis Form (Fall, 2005)

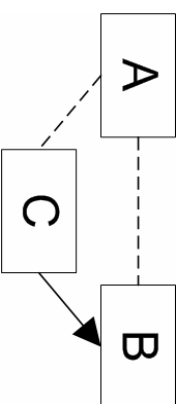
1. (2 pts) What is the point or “Target” of the news story?
2. (2 pts) State the association given in the article that supports the point of the argument. (Depending on the story this can be the same as item #1 above.)
3. (2 pts) State how the factors in the association are measured.
4. (2 pts) Is the 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).

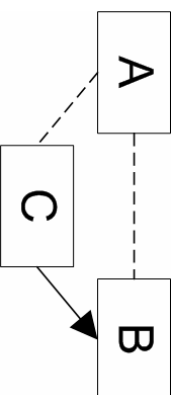
10. (5 pts) Identify a possible confounder for the observed relationship not accounted for in the story. Using the triangle diagram found below, explain how each alternate explanation is linked with both predictor and outcome. Confounder / Alternate Explanation #1:



Identify Box A:
Identify Box B:
Identify Box C:

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

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?