Analytical Public Health

Using Data Analysis for Ethical Decisions Concerning
Contemporary Public Health Issues

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Description

I plan to study how to use data analysis as a tool for understanding and combating public health problems. To do this, I will develop a foundation in sufficient mathematics & statistics to be able to create a variety of visualizations and models and learn how to best analyze different types of data. In addition, I will how statistics can be used in the context of a variety of public health issues that range from affecting an individual to a community, and how data analysis can be used as a tool to reach out to people and promote working towards combating public health issues.

Some potential issues I might explore are how to slow or stop disease spread, improve quality of life & life expectancy, and how to ameliorate health inequities in the face of scarce resources. I plan to combine a variety of courses from departments such as MSCS, sociology, biology & chemistry, and philosophy to learn more about how these subjects can contribute to the previously listed issues. Specifically, the sociology/anthropology related courses would provide cultural context to these issues and the philosophy related courses would provide different methods of considering ethical dilemmas. The Center for Independent Research could also be a good tool for my exploration of these topics.

Guiding Questions

How does culture impact public health policy?
- ➢ How does it present unique barriers to public health efforts, and how can those obstacles be overcome while still being sensitive to the community's values?

How can statistics and other data gathering techniques guide and inform public health efforts?
- ➢ How does knowledge of biology help with data analysis, especially in the context of disease?
- ➢ How can statistics & data science be used to generate more public outreach and community involvement in public health issues?
- ➢ What are the ethical implications of using data for decision making that can affect the entire world?

What kind of data and technology is available for investigating how effective different public health campaigns are, or identifying potential public health concerns?
- ➢ How is technology and data science adapting to new problems we face?
- ➢ How can data and technology be used to guide the decisions of public health professionals and policy makers? How can it be used to guide medicine and individual's choices?

Experience & Class List

DATA ANALYSIS	EPIDEMIOLOGY & MEDICINE	ETHICAL DECISIONS – PEOPLE & COMMUNITIES
MATH 232 – Intro to Mathematical Reasoning	BIO 231 -- Microbiology	MSCS 396 – Just Data DUR
MATH 262 – Probability Theory	CHEM 360 – Medicinal Chemistry	ID 280 – Comparative Public Health: US/World
MSCS 341 – Algorithms for Decision Making	SOAN 267 – Medical Anthropology	PHIL 250 – Biomedical Ethics
STAT 316 – Advanced Statistical Modeling		FAMST 232 – Intro to Family Studies
STAT 302 – Biostatistics		SOAN 262 – Global Interdependence
OTHER SUPPORTING COURSEWORK & EXPERIENCES		
CHEM 247/248 – Organic Chemistry I & II	STAT 272 – Statistical Modeling	MATH 226 – Multivariable Calculus
CSCI 125 – Computer Science for Science/Math	MATH 220 – Elementary Linear Algebra	MATH 230 – Differential Equations
	MSCS 389 – CIR Research Fellow	
Summer experience 2018: CURI Research with Professor Ashley Hodgson: Developing a Patient-Level Measure of Medical Specialty Intensity for Use in Assessing Quality of Coordination in Health Care		

Explanations for Class Selections

<u>DATA ANALYSIS</u>

These courses are intended to provide a strong mathematical and statistical background for data analysis. They will give me the tools and experience to approach questions, especially in research, in a variety of ways and will enhance my quantitative reasoning skills.

MATH 232 Intro to Mathematical Reasoning (Fall, senior year)
  ➢ This course focuses on mathematical theories like number theory, graph theory, game theory, and combinatorics. Although I don't have a background in mathematical theory yet, game theory seems like it is a mathematical approach to considering conflict and resolution, which is a crucial and often difficult step in working towards resolving a public health issue with scarce resources.

MATH 262 Probability Theory (Fall, senior year)
  ➢ This class goes into more of the theory behind statistics. It will provide more of a solid background for me to understand how and why statistics works like it does. In turn, I will have a better understanding of how statistics can be applied to real-life questions.

MSCS 341 Algorithms for Decision Making (Spring, senior year)

➢ One of the main focuses of this class is machine learning, which is quickly becoming a highly-valued subject in any statistics-related career field. The class focuses on machine learning algorithms using real-world data. Again, I do not have a deep understanding of machine learning yet, but I do know that it has been considered the future of statistics.

STAT 316 Advanced Statistical Modeling (Spring, junior year)

➢ This course expands on the methods learned in Stats 272 to teach more methods of data analysis. It will provide more ways of handling data and creating analyses and will allow me to expand my statistics background.

STAT 302 Biostatistics (Interim, junior year)

➢ According to the description, this course "investigates issues in health-related settings using a quantitative, research-oriented perspective. Course material focuses on global and public health issues, study design, methods for analyzing health data, and communication of research findings." This is a perfect combination of data analysis and public health for my major. It would also give me more experience with research and communicating findings.

ETHICAL DECISIONS FOR PEOPLE & COMMUNITIES

All of these courses consider some aspect of public health and how it impacts people around the world. They consider ways that different people may respond to a public health issue and how solutions to a public health issue may look different in different cultures or countries. They would give me different ways of viewing how individuals and communities might respond.

MSCS 396 Just Data DUR (Spring, sophomore year)

➢ The DUR focuses on statistical approaches to current social justice issues. Because it is a DUR, it gives me the opportunity to use my statistics background to better understand any issue of my choosing, in the context of an in-depth and independent research project. It will culminate in a final project using data to promote awareness for an issue of my choosing.

PHIL 250 Biomedical Ethics (Fall, senior year)

➢ Although statistics is often used to help people make decisions about public health issues, it cannot be used to examine the ethics behind these decisions. This class would give me a different lens with which to view how people make ethical choices when facing scarce resources, fast-paced emergencies, and cultural differences. It is important to not just blindly follow data, but to consider the implications behind the choices as well.

ID 280 Comparative Public Health: US/World (Interim, sophomore year)

➢ This class gave me exposure to a multitude of public health issues, presented by professionals who were experts in the field from the CDC, UN, and WHO. My final project consisted of using an existing data set to evaluate mental health in the workplace and identify what could be improved.

FAMST 232 Intro to Family Studies (Fall, junior year)

➢ As a class with a self-described interdisciplinary approach, it seems like a great way to examine public health issues through the lens of how it can affect a family. The class touches on socioeconomic challenges, one of the main problems at the root of many public health issues. It provides a personal view on how inequities can affect not just an afflicted individual, but their family as well, and why it is important to work to fix these.

SOAN 262 Global Interdependence (Fall, junior year)

➢ This class will offer an overview of the global nature of health, and how information and data fits into that global perspective. It dives into the information revolution and health inequities, especially in terms of low and high-income countries. This would allow me to learn more about how information impacts public health efforts all across the world.

EPIDEMIOLOGY & MEDICINE

These courses consider public health from a medicinal point of view. The biology and chemistry courses offer a scientific approach to disease and sickness, and the sociology course considers how disease and sickness impacts different people in different ways.

BIO 231 Microbiology (Fall, junior year)

➢ This class offers a microscopic approach to disease outbreak and control. It examines bacteria and viruses, how they impact humans and immune responses, and how microbes affect the environment. In order to understand disease outbreak, it's important to consider it from the microscopic level in addition to macroscopic.

CHEM 360 Medicinal Chemistry (Interim, senior year)

➢ As a complement to the microbiology class, Medicinal Chemistry investigates mechanisms of disease in the context of developing drugs to combat them. It is a different way to consider disease outbreak from the viewpoint of trying to develop a response. The class could also potentially touch on antibiotics and the current issues with anti-microbial resistance.

SOAN 267 Medical Anthropology (Spring, senior year)

➢ The course description starts by asking, "How do people understand illness and healing? How does social inequality shape health?". It also discusses diverse understandings of health and healing. Although it is easy to assume that everybody thinks of illness the same way and medicine as an inherent good, that is not always the case. When considering solutions to a medical crisis, it is important to be culturally sensitive, and that includes trying to understand how people may react to the method of aid.

Rationale for the Major

Just as practicing medicine is focused on the needs of individuals, a profession in public health focuses on the needs of entire populations or the entire world. Public health is an incredibly broad field, spanning from epidemics to making sidewalks safer and everything in between. Some of the vital work that public health officials are currently doing are battling HIV, protecting refugees, finding ways to prevent gun violence in schools, and trying to reduce practices that accelerate climate change. Paired with statistics, public health can be a powerful tool to not only prevent injury or illness but also to create lasting and positive change on an individual's life and a community's well-being. Data analysis provides the evidence of how public health efforts do or do not effectively impact a given health concern.

Pairing the ethics of public health with statistical modeling is an interdisciplinary approach to solving important issues that impact the entire world. This major is not just a mathematics major, a sociology/anthropology major, or a bio mathematics concentration, nor is it like any other traditional major offered at St. Olaf. Unlike any of the previously mentioned subjects, it is an effort to connect the cold, hard data with living & breathing people. It considers how to connect people who may not understand the ins & outs of a statistical analysis with the information they need to make ethical and appropriate health decisions. Public health permeates nearly every aspect of our lives and can be examined in so many contexts and through so many viewpoints. Not only does it examine health, an abstract concept in its own right, but it encapsulates problem solving, teamwork, creativity, public outreach, and data collection all in one topic. This major is suited for St. Olaf in particular because it fits in perfectly with the college's values and the mission statement. The major spans across a wide variety of subjects, will allow me to become a more globally engaged citizen, and will help me to examine values in a variety of different communities.

My proposed major starts with the background necessary to understand the data analysis, namely mathematics courses related to theory and decision making. It culminates in studying machine learning for complex algorithms for decision making, which is a modern approach to dealing with data. This is expanded by considering the ethics and implications of making decisions. The "Epidemiology and Medicine" portion compliments this by examining possible responses to public health issues, specifically for disease outbreaks and related illness, looking at the microscopic level and the global level. This is expanded by considering the ethics and implications of making decisions. Classes included in the "Ethical Decisions" portion discuss how individuals, communities, and the entire world respond to health crises, and how the people in charge of making the decisions that will impact people must consider more than just raw data.

Learning & Life Experience

When I began my education at St. Olaf, I did not have one specific career or future in mind. As a first year, my goal was to explore potential subjects and narrow down my interests. Although I had never taken a statistics class, I decided on taking Stats 212 on a whim in the fall semester. That class exposed me to a fascinating field that I have grown to truly enjoy. I love how statistics can be applied to nearly any other subject, ranging from testing new drugs to comparing public opinion on controversial political debates. I happened upon public health in a similar way. Public health was a topic I had never really explored before I took a class on it. That class was an interim abroad in Atlanta, Geneva, and Copenhagen to learn about a myriad of public health topics from officials at the CDC and UN. The experience allowed me to see how public health impacts the entire world and encompasses an incredibly broad range of possibilities for research.

My goal is to explore more about these two subjects, learn more about how they fit together, and discover what about public health and statistics I would be interested in pursuing in the future. I am hoping to learn much more about statistics/data science and the public health field by taking a variety of classes that will allow me to home in on my interests and develop the skills necessary to work with data. A major that incorporates data analysis as an approach to public health is the perfect blend of the problem solving I enjoy in science & mathematics classes and the opportunity to make a positive impact on peoples' lives.

Structure of Web Portfolio

I want to include the following sections of this proposal on my web portfolio: the description and guiding questions, the experience and class list, and a detailed explanation of my senior project. It may be beneficial to include my final project from the MSCS 396 course because it is a DUR that involves extensive data analysis on a social justice issue, which is an integral part of my major. A background section detailing what topics like biostatistics and epidemiology are, or how statistics works, could offer an accessible introduction to my major for those who may not be well versed in the area. Additionally, a section on links to important data/research others are currently pursuing in the field or how to get involved in local public health issues would be complementary to my major and senior project. Finally, I will include a section for an annotated bibliography with relevant material.

Potential Senior Integrative Projects

First Potential Project

I could imagine doing a project involving data analysis about a particular public health issue, which could even expand upon the research I am currently doing in MSCS 396. I would use existing data sets (such as CDC data like YRBS & BRFS, the European Health Gateway, UN Data Explorer, GSS, etc.) to explore an

issue that perhaps does not yet have a lot of research or could be looked at in a new way. Some potential broad issues that are of particular interest to me are injury & violence, mental health, vaccines, health inequity, and communicable disease. Most data sets related to this should be open access, but if not, I could apply for access. I would most likely use R, although SAS might be useful for a larger data set. The CIR might be helpful for getting ideas for analysis options. My final project might turn out in the form of a research paper or informational poster that could be displayed.

Second Potential Project

Similar to the first project idea, I believe that data analysis would be an intensive and integrative senior project. However, instead of using existing data, it would be interesting to look at a particular public health issue (for example, mental health resources/access) on a more local level. To this end, I could collect my own data at the community level and either analyze that as a stand-alone piece or compare those local results to larger populations, like Minnesota or the entire country. One possible route to explore is collaborating with the Northfield HealthFinders clinic. I would need to make sure that whatever data I collected is done so ethically and meets St. Olaf guidelines, which would entail consulting with the St. Olaf Institutional Review Board.

Consultations

Summary of Consultation with Reference Librarian

On May 3rd, 2018, I met with Maggie Epstein to discuss research strategies and resources for my individual major. She suggested several databases for not only my senior project, but also any projects or research I may do in my future classes. Specifically, she showed me BrowZine, a database for browsing scholarly journals by subject, Credo Reference, a site for encyclopedia entries, and Social Science Premium Collection, a database spanning the sociology/anthropology fields. Credo Reference would be especially helpful for the section of my web portfolio where I want to give some background information on subjects like biostatistics, and it links to resources such as *Gale Encyclopedia of Public Health*. She also mentioned strategies for finding information related to my interests. In general, I can search in the subject or content drop-down menus from the databases tab of Catalyst for different databases like in the nursing, sociology/anthropology, family studies/social work, and philosophy subjects, or search in the data/statistics content area. For locating data to use in projects, she recommended searching for organization's websites that might have relevant data instead of simply performing a search for data itself.

Summary of Peer Review Session

On April 18th, 2018, I met with Anna McWilliams, a current senior who created an independent major similar to mine. She provided helpful feedback on both my writing and the content. For writing, she helped

fix passive sentences and suggested several format changes. In terms of content, she gave me multiple suggestions on people with whom I could meet, as well as possibilities for local options in the senior project session. In particular, Anna and I had a conversation about reaching out to HealthFinders Collaborative in Northfield and how I could potentially work with them.

Summary of Conversation with Faculty Member(s)

My advisor, Julie Legler, offered several important comments on my ideas about my major. She suggested different ways for me to consider how public health work can actually be used, like how it may influence policy makers or other health professionals. She also made several suggestions for my coursework, including the interim biostatistics class. I also plan on discussing ideas with Ashley Hodgson, who will be my supervisor for CURI research in the summer.

Four Year Course Grid

	Fall	Interim	Spring
Freshman Year	AmCon 101	ChBi 126	Amcon 102 (FYW, HWC)
	ChBi 125 (IST)		ChBi 227 (SED)
	French 232 (FOL, MCG)		Religion 121 (BTS-B)
	Stat 212 (AQR)		Stat 272 (WRI)
			ESAC 190 (SPM)
Summer	QC internship at Prolitec, Inc.		
Sophomore Year	Chem 247	ID 280 (HBS)	AmCon 202 (ALS-A, HBS, ORC, WRI)
	AmCon 201 (ALS-L, MCD, WRI)		Chem 248
	Bio 150		CS 125
	Phil 247 (BTS-T)		MSCS 396
Summer	CURI research with Prof. Ashley Hodgson on patient care coordination		
Junior Year	Math 220	Stat 302	Math 230
	Soan 262		Stat 316
	Bio 231		Math 226
	Famst 231		HWC
	MSCS 389 – CIR		MSCS 389 – CIR
Summer	Research/internship experience		
Senior Year	Math 232	Chem 360	MSCS 341
	Phil 250 (EIN, WRI)		Soan 267
	Math 262		IS 392
	SPM		Elective

Key	
	Supporting course
	Course in major
	GE requirement