Allocation of Charitable Resources: A Practical Illustration of Quantitative Literacy's Role in Ignatian Discernment

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As the Jesuit values of Xavier University were a significant factor in my decision to join the Xavier community, I was excited to participate in the Ignatian Mentoring Program (IMP) during the 2014-2015 academic year. In my first years at Xavier, I felt that I had imparted the Ignatian principles of discernment, compassion and care for the whole person primarily through one-on-one interactions with students. While I plan to continue to do so, the IMP has shed light on ways that I can incorporate Jesuit values directly into the classroom setting in a way that is genuinely connected to the mathematical aspects of a course. I would like to acknowledge my mentor, Richard Mullins, as I have benefitted greatly from his guidance and experience.

1 Project Setting

For my project, I attempted to incorporate Ignatian ideals into my Spring 2015, MATH 120: Elementary Functions course through an assignment and subsequent class discussion regarding charitable giving. MATH 120 is a freshman-level, non-major mathematics course that revisits the general idea of a function from high school and aims to give a deeper understanding of each of the major mathematical function types (e.g. linear, exponential, logarithmic, logistic, power and polynomials). Depending on mathematics placement scores, many Xavier students must take MATH 120 before progressing to Calculus or Statistics courses required for their major. The project was carried out in both of my MATH 120 sections, giving a total of 65 students.

2 Project Assignment

The project is best-described through the actual assignment description that was given to the students (included here between horizontal lines).

MATH 120 **D. Gerberry** **Charitable Giving Project**

As students (and a professor) at Xavier University, the Ignatian Tradition is a central theme of our environment. While Ignatian ideals are more prominent in some courses and less so in others,

it is my belief that all courses make a contribution to our spiritual development. Specifically, mathematical ideas can even make important contributions. This project is my idea of how to ensure that my students come out of MATH 120 knowing that this is so.

Charitable Giving

A practical, yet simple question that illustrates the relevance of the Gifts of Our Ignatian Heritage is the following:

"Which charities will I decide to support?"
"How much money will I give to each of these charities?"

The Gift of Discernment invites us to be open to God's spirit as we consider our feelings and rational thought in order to make decisions and take action that will contribute good to our lives and the world around us.

- Understand the complex motives that go into your charity decisions
  - Am I just going with the crowd?
  - Is this charitable contribution actually self-serving?
  - Am I afraid to be embarrassed for not giving?
  - What aspects of this decision are emotional and which are reasoned, scientific even?
- Do my decisions actually serve the "Greater Good"?
  - Most, if not all, charities are worthy causes, but how do we choose the greatest good?

The Gift of Reflection invites us to pause and consider the world around us and our place within it. It calls us to infuse a culture of attention, reflection and reverence throughout the University.

- Can we recognize new opportunities to do more good?
  - Will we simply continue a pattern of charitable giving indefinitely?
  - Will we embrace the causes that our parents have?
- What is really important to you and what is important to the world as a whole?

The Gift of Service Rooted in Justice and Love invites us to invest our lives into the well-being of our neighbors, particularly those who suffer injustice. This encourages and develops a culture of mutually beneficial community engagement as an expression of faith that promotes justice.

- Who do my charitable donations actually serve?
  - People like me (similar views and circumstances)?
  - People in my area, my state, my country, etc.?
  - Do they serve the people that are in the greatest need?

Assignment

Consider the following two scenarios:

Scenario 1: You graduate from Xavier, get a good job and have a reasonable amount of money per year that you can donate to charity. Let's assume you have $5,000 per year to donate.

Scenario 2: You graduate from Xavier, become the CEO of a company and have lots of money per year to donate to charity. Let's assume you have $10,000,000 per year to donate.

For both of the scenarios above, decide how you would allocate your pool of money to charities. Specifically, tell me the following:

1. Names of the charities you will donate to.
2. How much money you will give to each charity?
3. Explain why you have chosen this charity.

Some Guidance

You should include anything that you give money to:

- Sum up donations you might give to church for the year
- Donations to political campaigns
- Donations to organizations: Humane Society, Red Cross, Cancer Society, etc.
- Things you buy to donate (e.g. buy coats, blankets, food to give to homeless)

Don't include

- Fundraisers where you are buying a product (e.g. Girl Scout cookies, Boy Scout popcorn)
- Donations of old clothes or items to Goodwill or something similar

Directions

- Write this up in Word or something
- Turn in electronically through Canvas
- Due on Monday, March 30
- Email me if you have questions
- You just need to answer the 3 questions on this page, not everything I mentioned along with Ignatian Gifts. Those are simply there to get us thinking.

Grades

Obviously, I can't tell you that you picked bad charities and give you a bad grade. You are free to pick whatever you want. Basically, I see grades only going three ways:

- Bad grade: Obviously didn't take this project seriously and didn't put any time or thought into it.
- 100%: Did take it seriously. Put in a decent amount of time and thought and it shows.
- Above 100%: Took it very seriously. Obviously did some research, went above and beyond.

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3 Charities chosen by students

In Tables 1-4, I present the results of the students' allocations of charitable resources. Tables 1 and 2 give the number of donations made to specific charities whereas Tables 3 and 4 give the total dollar amount given to specific charities. My initial reactions to the students allocations were:

- I was impressed with Xavier students' experience in volunteering. Many students had first-hand experience working with the organizations that they would donate to.
- All student donations were to very worthy causes. Given my own immaturity at their age, I fully expected to see some answers that were nearly indefensible. To my surprise, not a single donation went to the Organization for Depressed Cats or something similar.
- Wounded Warrior Projects and other veteran-related causes were very popular with the students. Specifically, this helped me realize how much less impact the recent wars in Afghanistan and Iraq have had on me (someone in my mid-thirties) than on my students. This also led to classroom discussion about the role of government in particular causes. More specifically, how do we respond when we believe a cause should be funded by the government instead of charitable organizations? Should we not donate to this cause? Should we donate more?
- I was also surprised at how many students personally know someone that has benefited from the Make-A-Wish Foundation.

One very important aspect of quantitative literacy is being able to recognize when someone is using quantitative data in a deceptive way. When presenting the data in Tables 1-2 to the class, I labeled them simply as "Most Important Charities." In doing so, I implicitly defined "most important" as "receiving the greatest number of donations." We then moved on to consider "receiving the largest amount of money" as the definition as "most important" and to discuss other quantitative measures that we could use to measure importance. The takeaway message was something we discuss frequently in MATH 120:

The definitions that you choose and the assumptions that you make are incredibly important when using mathematics to model real-life issues,

and to be weary of quantitative data that is presented without precise definitions or descriptions of the data.

	Donations
Church	19
Food Bank	12
Make-a-Wish Foundation	6
Alzheimer's Associations	5
American Cancer Society	5
American Red Cross	4
Homeless	4
Ronald McDonald House	4
Wounded Warrior Project	4
Breast Cancer Research Foundation	3
Crayons 2 Computers	3
Xavier University	3
ASPCA	2
Catholic Charities	2
Feeding America	2
Habitat for Humanity	2
Pancreatic Cancer Research	2
politics	2
Salvation Army	2
School	2
Smile Train	2
St. Baldricks Charity	2
St. Jude Children Research Hospital	2
All others, 1 or fewer donations	

Table 1: Number of donations made to particular charities for Scenario 1 (i.e. $5,000 to donate).

	Donations
Church	16
Make-a-Wish Foundation	12
American Red Cross	9
Xavier University	9
American Cancer Society	8
St. Jude Children Research Hospital	8
School	6
Alzheimer's Associations	5
Food Bank	5
Ronald McDonald House	5
Breast Cancer Research Foundation	4
Humane Society	4
Salvation Army	4
Wounded Warrior Project	4
Action Against Hunger	3
Cancer Research Institute	3
Crayons 2 Computers	3
politics	3
Save the Children	3
Others, 2 or fewer donations	

Table 2: Number of donations made to particular charities for Scenario 2 (i.e. $10 Million to donate).

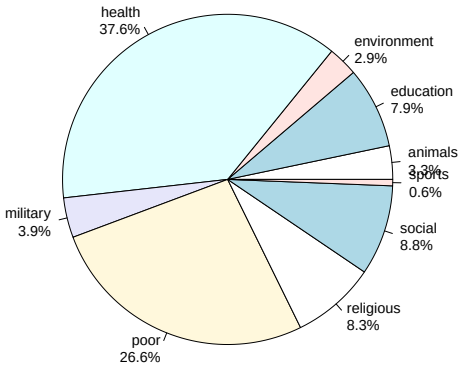
4 Categories of charities

We then moved on to examine how the resource allocations changed when the amount of charitable money went from $5,000 to $10,000,000.

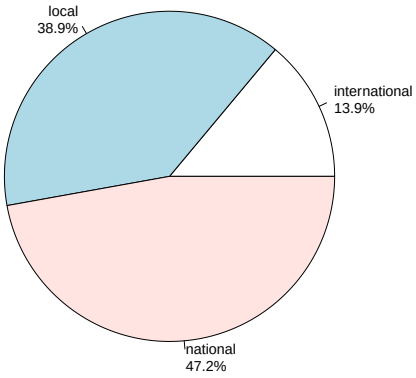
To do so, I categorized each charity according to its primary cause and primary geographic scope. Of course, significant overlap exists for several charities so assumptions needed to be made in order to categorize the data. As a class, we discussed that again, this is a point where someone with ill-intent could be deceptive in their presentation of the data. The categories we used are shown in Table 5. Charities were also grouped according to primary geographic scope: local, national or international.

With the data categorized, we were able to examine general trends in the students' charitable allocations. Specifically, we investigated if the allocations changed significantly when the amount of money to donate increased from $5,000 to $10,000,000 (see Figure 1) and came up with explanations why this should or shouldn't be the case.

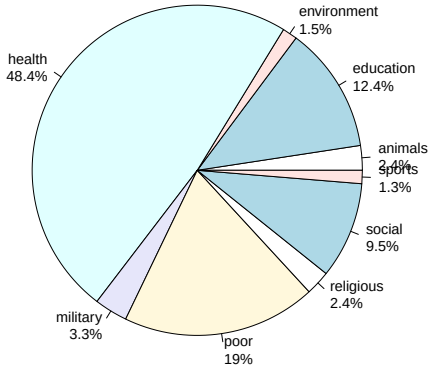
We also used the data from our charity allocations to determine if differences existed between the giving patterns of male and female students (see Figure 2). We noted that male students seemed to donate a larger percentage of money to religious organization and the poor while females donated more to military-related causes. I used this opportunity to briefly describe the field of statistics (which many students will go on to after MATH 120) and that statistics could be used to decide if our data is sufficient to conclude that female and male students actually do have different patterns of charitable giving.



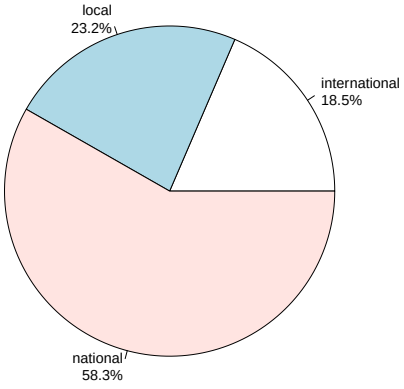
(a) Percentage of money donated to each category of charity. $5,000 scenario



(b) Percentage of money donated by geographic scope. $5,000 scenario



(c) Percentage of money donated to each category of charity. $10,000,000 scenario



(d) Percentage of money donated by geographic scope. $10,000,000 scenario

Figure 1: Resource allocations by charity type and geographic scope for the scenarios of $5,000 and $10,000,000 available to donate.

	$ amount
Food Bank	24894
Church	20492
American Cancer Society	14141
Make-a-Wish Foundation	11247
Alzheimers Associations	7920
Ronald McDonald House	6990
Homeless	6480
Catholic Charities	6000
Habitat for Humanity	5980
Wounded Warrior Project	5650
Crayons 2 Computers	5352
Backpack Tutoring	5000
Rainforest Foundation	5000
Trevor Project	5000
Youth Choral Theater of Chicago	5000
American Red Cross	4250
Pancreatic Cancer Research	4100
Our Daily Bread	4000
Compassion International	3648
Smile Train	3200
St. Jude Children Research Hospital	3200
Leukemia and Lymphoma Society	3000
Music Unites	3000

Table 3: Number of donations made to particular charities for Scenario 1 (i.e. $5,000 to donate).

	$ amount
Make-a-Wish Foundation	29499999
American Cancer Society	29333333
Xavier University	19926000
American Red Cross	19500000
Alzheimers Associations	17451000
St. Jude Children Research Hospital	15500000
School	15120000
Trevor Project	15000000
Ronald McDonald House	12700000
Church	12053300
Wounded Warrior Project	11500000
Feeding America	10000000
Jarretts Joy cart	10000000
Mission in Africa or Asia	10000000
Action Against Hunger	8875000
Save the Children	8000000
Cancer Research Institute	7000000
Susan G Komen Breast Cancer Foundation	7000000
Catholic Relief Services	6000000
Epilepsy Action	6000000
Leukemia and Lymphoma Society	6000000
Mental Health America	6000000

Table 4: Number of donations made to particular charities for Scenario 2 (i.e. $10 Million to donate).

Cause	Examples
animals	ASPCA, Human Society, Animal Shelters
education	Primary schools, High Schools, Universities, Crayons 2 Computers, Scholarships
environment	Greenpeace, Rainforest Int'l, World Resource Institute, Conservation Int'l
health	American Cancer Society, St. Jude, American Red Cross, Ronald McDonald House Make-a-Wish, Alzheimer's Associations, Susan G. Komen
poor	Homeless shelter, Feeding America, Salvation Army, Catholic Relief Services, Save the Children, Food Banks
religious	Church donations
social	Boys and Girls Club, Trevor Project, Global Fund for Women, NAACP, political donations, Boy Scouts, United Way
sports	Special Olympics, Ball for All, Youth Sports, Make a Splash
veterans	Wounded Warrior Project, Homes for Troops, US Veterans Initiative, Hope for the Warriors

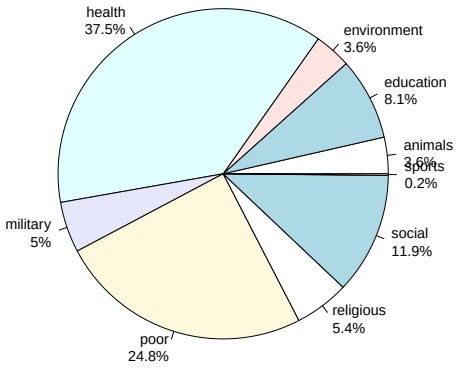
Table 5: Categorization of charities by cause.

5 Connections to MATH 120 course material

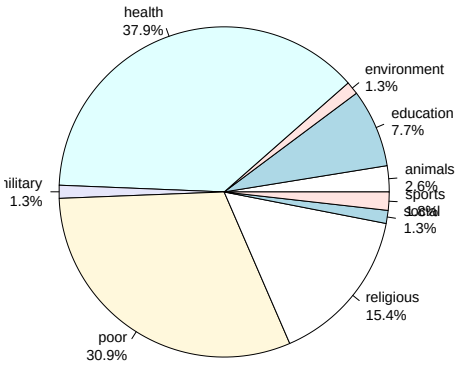
At this point, I attempted to make connections between our charitable giving project and the material we had been covering in MATH 120. Specifically, for each charity we realized that the amount of "good" (e.g. meals delivered, lives saved, DALY's, etc.) that an organization can do will depend on the amount of money available.

Therefore, we could imagine a function where

- Input of function is amount of money available to a charity
- Output of function is amount of "good" (e.g. meals delivered, lives saved, DALY's, wishes granted, etc.) that can be done with that money.



(a) Percentage of money donated by female students to each category of charity. $5,000 scenario



(b) Percentage of money donated by male students to each category of charity. $5,000 scenario

Figure 2: Comparison between resource allocations of female and male students for the scenario of $5,000 available to donate.

We realized that any such function should be increasing (i.e. more money should imply more "good"). We considered the multiple function types that we have studied through the semester (see Figure 3) and discussed which would make the most realistic mathematical model. We also discussed how the efficiency of the organization could be measured by the rate of change of the function and that the best places on the graph to donate would be at the points where the slope is largest (i.e. at inflection points).

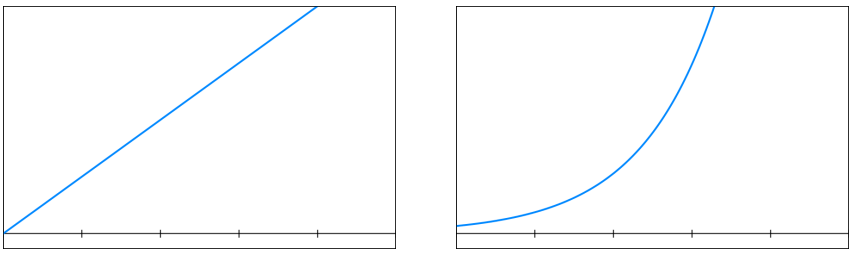
Linear regression, another important course topic for MATH 120, was used to discuss whether or not it is a possible for a worthwhile charity to actually be *over*-funded? Specifically, we examined the data in Figure 4 that shows the levels of National Cancer Institute research funding for different forms of cancer as a function of the percentage Disability-adjusted Life Years (DALYs) lost to each form of cancer. The quantitative data seems to indicate that certain forms are overfunded (e.g. breast, prostate, leukemia) while others are underfunded (e.g. lung, colorectal). We discussed reasons why this might be the case.

6 Further questions for in-class discussion

Our charitable giving project concluded with a discussion of several more general questions that could be a part of our discernment process for choosing charities.

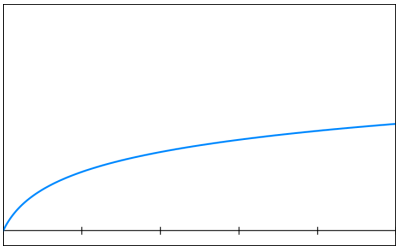
- Are all lives worth the same? Is a life in Cincinnati worth more than one in Florida? Is an American life worth more than others? Is a child's life worth more than a 95 year-old's?

  For the most part, the students agreed that making such statements sounds and feels terrible. Looking at our data though, we realized that our allocations do reflect this in some ways. Moreover, we discussed that governments, NGO's and public health policymakers make these judgements everyday and that quantitative metrics even exist for these decisions such as Disability-Adjusted Life Year (DALY), Quality-Adjusted Life Year (QALY).

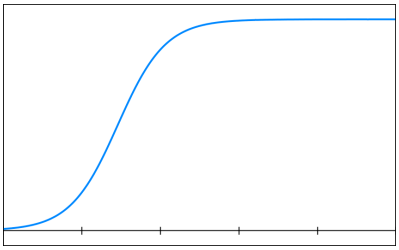


(a) Linear

(b) Exponential



(c) Logarithmic



(d) Logistic

Figure 3: Sample of function types studied in MATH 120. Horizontal axis would represent the amount of money available to a charitable organization. Vertical axis would denote the amount of "good" (e.g. meals delivered, lives saved, DALY's, etc.) that an organization can do will depend on the amount of money available

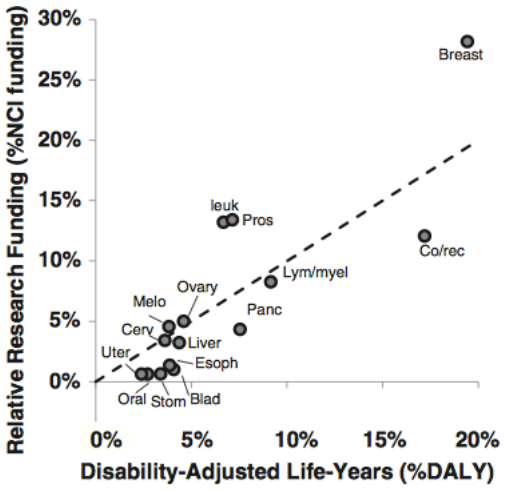


Figure 4: NCI research funding relative to societal health cost as measured by DALYs (Disability-adjusted Life Years). Dashed lines indicates funding if resources are equitably shared according to burden imposed by DALY, cancers above the line receive more funding relative to DALY than expected whereas cancers below the line receive less. Due to its extremely large %DALY (approx. 30%) and relatively low funding (approx. 10%), lung cancer is excluded from this plot. *NOTE: Figure currently used from [1] without permission!*

- Should our charitable donations go to organizations with specific goals or to more general causes?

  Again, students agreed that specific goals certainly sound better on the surface. In our data we noticed that a large portion of students' donations went to cancer research. While many donated to fight specific forms of cancer, there were also many donations to the American Cancer Society in general. We discussed the benefit of allowing experts at the American Cancer Society allocate funds to different cancers to achieve the greater good but also realized that our personal connection to specific forms of cancer is an important factor.

- Does donating \$1 million to Charity X and \$3 million to Charity Y mean that Y is 3 times as important to me?

  Students resoundingly said "Of course not!" However, when looking at our data we see that many students divided their charitable resources equally among causes. We discussed why this might be the case only to conclude that psychological factors were at play.

- What's better, donating all of our money to one charity or less to many charities?

  Again, we concluded that psychological factors make donating to several charities feel more satisfying. On the other hand, I presented an economic argument for donating larger amounts to fewer charities based on overhead costs. Specifically, each credit card transaction or bank transfer costs money and takes away from the amount of "good" that an organization can accomplish. Moreover, an opportunity cost exists for the amount of time and effort a charity spends attracting donors.

7 Conclusion

My original objective was to use charitable giving to illustrate the role that quantitative data and objective aspects can play in the discernment process of a decision that is often dominated by personal, emotional, moral and other subjective aspects. While certainly successful in doing so, the project had unexpected benefits for me personally and my teaching. In the course of describing why they had chosen particular charities, many students shared personal stories and experiences with me that left me feeling much closer to the students and helped me to see them as more than the single dimension that is "student in a math class." Later in the semester, I was able to use the knowledge of my students' experiences to tailor example problems to topics that I knew aligned with their interests. Moreover, the project introduced me to multiple excellent programs and charities in our community. As Xavier students are already actively involved with many of these programs, I see a natural path for my own expanded involvement in both our local community and the Xavier community.