Mathematics, Social Justice & Sustainability

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Quick question: Which is a bigger long-term budget problem for the US government, Social Security or Medicare/Medicaid? Need more context? Social Security is in trouble because the baby boomers, a large group of people born shortly after World War II, are beginning to retire, meaning there are fewer workers per retiree to fund the system. The root cause of the government health programs' budget problems is that their costs (per enrollee) are rising at a rate faster than inflation. Politicians regularly argue that these programs are going bankrupt, but which is a more serious problem? Like Social Security and Medicare, nearly all social, political and economic issues have a mathematical component, and being an informed, responsible citizen of a democratic society requires understanding some of that mathematics.

When one thinks about issues of sustainability, environmental issues often come to the fore. But there are also economic and social dimensions to sustainability. A fundamental component of a sustainable society must be meeting human needs and respecting human dignity. Some government programs contribute to the social aspect of sustainability by improving quality of life – but the programs' positive social contributions will not last if the programs are not also economically sustainable.

What mathematics comes into play when talking about this area of sustainability? Critically examining numbers (including how very large ones are distributed), correctly interpreting statistics, and understanding how functions model different phenomena are just a few examples of the kinds of mathematical knowledge vital for responsible, sustainable living. Improving the mathematical education of everyone can help build a more just society – and with greater justice comes sustainability.

Numbers. How many times have you seen a broadcaster or politician insert the wrong letter, replacing "billion" with "million" or "trillion" as if a factor of 1000 hardly mattered? These are admittedly easy mistakes to make because of the linguistic similarities, but a numerically literate person in this age needs ways of bringing these monstrous numbers into clearer focus. For instance, one might use the fact that $1 billion of U.S. government spending corresponds to roughly $3 per resident. With that frame of reference – and a little arithmetic – we can have a more informed discussion of whether or not the $170 billion bailout of AIG was warranted, or how the $165 million in bonuses paid to AIG executives might be offensive, but isn't economically substantial (Andrews & Baker, 2009).

Of course as the Occupy movement pointed out, large numbers like these are rarely uniformly distributed, and mathematics helps us understand such distributions. When hearing that the top 1% control 35% of the wealth, but the bottom 40%

control just 1% of the wealth (Wolff, 2010), a mathematically adept citizen might mentally draw the Lorenz curve that connects these two points (Figure 1), a more complete view of the distribution of wealth. Or she might go further, using that graph to estimate the Gini Coefficient, the ratio of the area between the two curves to the area below the red “uniform distribution” line. Ranging between 0 (equal distribution) and 1 (complete concentration), the Gini index measures how unequally something is distributed (and is the subject of current mathematics research: Farris, 2010; Jantzen & Volpert 2012).

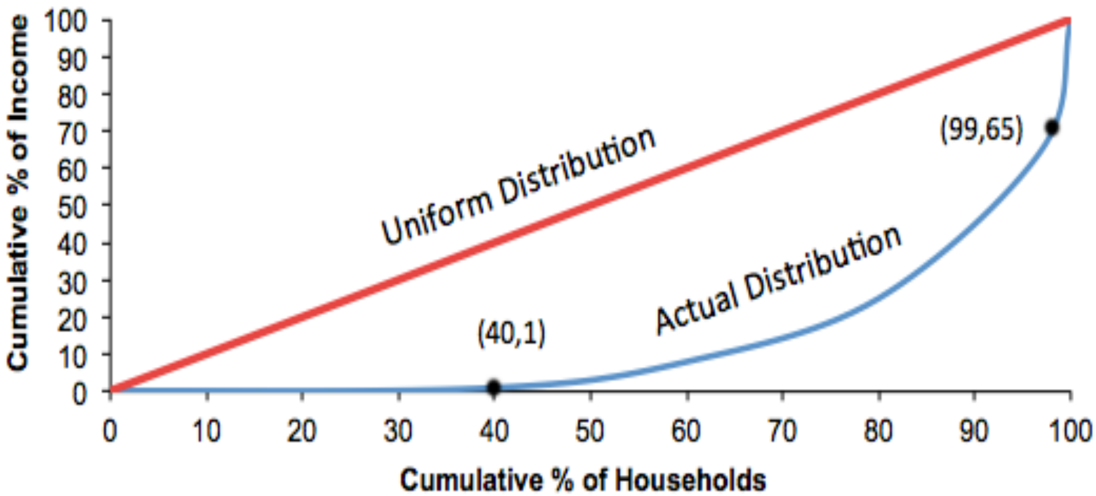

Figure 1. Approximate Lorenz Curve for US Wealth

What does this have to do with sustainability? Having such a large population with so few resources means that healthy food and adequate medical care are out of reach for many. History suggests that high Gini coefficients, showing greater concentration of income or wealth, that relegate so many to a large underclass are unsustainable and tied to social and political unrest (Muller & Seligson, 1987).

Statistics. Numbers are quoted in nearly every story you read about the long-term fiscal challenges we face. Are the nation’s programs for the poor sustainable? The political arguments surrounding so-called “entitlement” programs are rife with statistics, manipulated by both sides.

Take the problem of uninsured children as an example. Are these kids living without health insurance for a long time, or do they typically drop out for only a short period? If you wanted to know, you might look at two different statistics:

- At any particular time, what percentage of the uninsured have been without insurance for at least one year?
- At any particular time, what percentage of those who are just now joining the ranks of the uninsured will stay uninsured for at least one year?

These two different numbers might be used to paint this one issue in different shades, depending on one's perspective. Want to blame the long-term uninsured for using too much government support? The first statistic (the "stock", in social science parlance) includes people who became uninsured on many different dates, and have stayed uninsured for a long time. Want to minimize the impact of the long-term uninsured? The second statistic (the "flow") only includes one group of those long-term uninsured. How big a difference does it make? The department of Health and Human Services estimated that at one point, the first statistic was 46% while the second was 21% (Czajka, 1999).

Understanding the difference between these two statistics is only the first step. An engaged citizen who thinks critically about numbers might read one number in an article and then search out the other to gain a more complete understanding of the issue. Only when citizens have the mathematical tools to understand the arguments being made – about health insurance, unemployment, or food stamps – can we have a truly informed debate about how such programs might contribute to, or threaten, the sustainability of our society.

Functions. Lost somewhere in middle and high school math classes is the main use of so much mathematics: to model phenomena and predict the future. While some of the models used are incredibly complex – the most powerful computers in the world are used to understand climate change – understanding the differences among linear, quadratic, and exponential growth helps make sense of everything from cell phone pricing schemes to the amount of oil we expect to discover. Improving people's knowledge of functional behaviors in the context of social issues could potentially help us make more sustainable choices, both personally and collectively.

If we think back to the problems with Social Security versus those with Medicare and Medicaid, this type of functional literacy shows us that the latter is a much greater long-term problem. While the bulge of baby boomers will eventually pass, leaving Social Security on stable footing, the exponential growth of the nation's health care programs (about 6%) is simply unsustainable (Holahan & McMorrow, 2012). Solutions to Social Security's problems are mathematically easy to find, even if those solutions are politically difficult. On the other hand, if the trends for Medicare and Medicaid continue, they will eventually eat up more than 100% of the government's budget – the ultimate in unsustainability – and the real problem is health care spending more broadly, since the government programs beat private health insurance in terms of efficiency. (Holahan & McMorrow, 2012; Reich, 2013; Schoen, Davis & Collins, 2008)

Understanding the mathematics of social and economic issues is key to our living in a just democratic society, from the issues above to things like racial bias in traffic stops (Khadjavi, 2006), school funding formulas (Kozol, 2012), and tax issues (Tax Policy Center, 2013). Equipping future generations with this type of knowledge is one of the keys to building a sustainable future.

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