Chapter12: Quantum Erratum Demonstratum

Introduction

Many good natured, well meaning people set out to make the world a better place. They dig in, get their hands dirty and work passionately hard at the task. How do they know if they have succeeded?

As discussed in chapter 4, in order to determine whether we have solved a problem, we need to clearly define the problem. Once we have further defined the problem we want to solve, we need to figure out how we will measure whether or not our goal has been achieved. In figuring out how to measure our success, we may find that we need to further define what we are attempting to effect.

Once we have a means for determining whether or not our goal has been achieved, not only can we determine whether we have met the goal we set out to achieve, but we can use the same metrics to help us better improve our approach to the problem and to potentially solve other problems. These statistics on our problem can be used to figure out other related problems. Some of which we may not have known of, some of which we may have caused and finally some that we may not have thought to solve, but are well situated to solve.

Operationalization

When we set about to solve a problem, we typically focus on some negative consequence in the world that we are hoping to eliminate or at least mitigate by way of a particular manipulation. In order to determine whether the negative aspect has in fact been reduced as a result of our manipulation, we need to identify both the variables we are manipulating and the variable we are hoping to effect. In science the manipulated variable is called the independent variable (the change that is introduced) and the effected variable is called the dependent variable.

Many variables of interest are originally conceived of in vague terms. Such variables are considered fuzzy variables[1]. Consider the goal of reducing cyber bullying by adding a censoring tool onto social media posts. Both of these variables are vague. Although everyone intuitively understands the general nature of what is intended, we need to further define “censoring,” “cyber bullying” and “reduce” in order to definitively state anything about this problem let alone claims to solving it. When we use quantitive terms such as “reduce” we have to have some metric of comparison. Almost every time we set out to solve a problem, we will be using a term of comparison. We want to make things

better, to reduce harm, increase joy, etc. Operationalization is the process of translating a complex real world, fuzzy and often qualitative variable into something that can be measured, a quantitative variable. In this chapter we will discuss how to go about operationalizing a variable.

The first step to operationalizing a variable often involves further defining what the important dependent variable is. The idea here is to make sure the correct thing is being measured so that accurate statements about the research can be reported and compared to other research. Two different products may claim to scientifically decrease the risk of heart disease. However, one study measured cholesterol levels, which are often associated with heart disease and the other measured calcium build up around the heart, which is also associated with heart disease. Comparing these two studies could be difficult as they targeted different metrics. Defining "decreasing heart disease" here would make sure that studies that are the same are compared on the same metric and studies that are different are compared on different metrics.

In some instances further definition of an ambiguous term may not be necessary if what we care about is not the definition itself, but instead what is important is how each participant/user feels. Consider a common fuzzy variable that has been studied all around the world for a variety of purposes: happiness or wellbeing. Such studies often ignore trying to come to a consensus regarding the definition of happiness and instead have relied upon subjective responses of users regarding each person's own life and implicitly using each participants own definition of happiness or well being. What matters to many of these researchers is how the person feels not a precise scientific definition[2]. On the other hand, I might care about an objective measure of happiness such as activity in the brain that has been associated with pleasure or satisfaction.

Consider again our cyber bullying example. What constitutes cyber bullying could be measured either subjectively (does the target feel cyber bullied) or objectively. If we want to measure this objectively we are going to have to get a lot clearer on what we mean by cyber bullying. The able below further defines are variables..

Defining the Variables

Cyber	Occurring through electronic communications such as text message, instant message, email, chat rooms, online posting forums. Note: there may still, even in this definition be ambiguity. Does up or down voting count as an electronic communication? What about sharing? Not allowing someone to see a group's conversations? One could argue whether these are communications. If we think these things count as a communication for cyber bullying, we probably want to be clear that these things are in fact communications

Defining the Variables

Bullying	influence by means of threat of harm or actual harm to get a desired reaction. We may decide this is too narrow to get at what we want to target, but this is a good start.
Censoring	Blocking certain messages from being sent/read/shared or redacting portions of the message

Once we are clear about what dependent variable is of concern, we can better determine an effective means for operationalizing that variable into something measurable. If the variable we care about is subjective, like a feeling, it is common to use a likert type scale for measuring the subjective experience and other similar self-report measures such as surveys regarding frequency of behaviors and emotions. A likert scale is rating system that is designed to measure people's attitudes perceptions and opinions. It is named after Rensis Likert, who came up with the approach in 1932[3]. If the variable is an objective one, our definitions can guide us towards a quantitative variable. Some variables will be measurable in their own right, such as blood sugar level or number of logins, others will be measured as the presence or absence of something(s). If our goal is to reduce or increase something, these are comparisons that must be measured against a baseline. The table below expresses how we will operationalize our cyber bullying reduction.

Translating to measurable variable

Cyber	This is measured in a boolean fashion with either a true (for this occurring through electronic means) or false (not occurring in electronic means). There was an electronic communication or there wasn't. Furthermore, we can track which type of electronic communication it was if we wish to.			
Bullying	Boolean variable of whether their was a requested action	Boolean variable of whether the requested action was completed or not	Boolean variable was there a communication made to the reader	Boolean variable was the requested action completed after the communication
Censoring	Boolean variable was there negative remark removed by our software			

In the cyber bullying example above, we have attempted to create an objective measure to test whether or not our censoring tool has an effect on cyber bullying. The censoring tool is our independent variable, the variable we are changing or manipulating and cyber bullying is our dependent variable, the variable that we hope will be positively effected by our tool. Cyber is defined and operationalized because we may choose to

measure whether or censoring tool has an effect on school bullying in the future and want to distinguish from cyber bullying. We are measuring our tool removed the negative remark or not to test both if the tool is working as intended (there could be a malfunction that we don't want to affect or test oft he tool) and to make a comparison between the control group (where there was not censoring) and the test group. Bullying is objectively measured above by first determining whether all of the aspects we defined as bullying are present and if so, how many times this happens. We could also have made bullying a subjective term instead and used a survey of our users regarding whether they feel bullied.

In figuring out how to operationalize your variables, think about what numbers you will have at your disposal or what ones you could have. Are there quantitative metrics that are linked with the variable of concern? For example if I am measuring the effect of a new product on stress. I might be able to measure the use of my product for the independent variable and the behaviors of my user that can be indicative of stress, such as not sleeping, abnormal eating patterns, drug/alcohol use, increased negative interactions with others. I might put these questions into a survey rather than ask directly about stress.

Measuring Success

Once we have implemented our solution and collected data on our target problem we are ready to determine to what extent we were successful. Success, like our fuzzy variables is an intuitive but not necessarily definitive thing. Whether or not the solution is a success is dependent upon what stakeholder you ask. Each may use a different metric, but all will measure the success or failure against some metric. Some may measure the success of a project based upon its completion, its having helped contribute to knowledge about the problem, its having actually solved or ameliorated the problem, its monetary success, its contribution or application to other problems or some combination of these things.

Those Who May Not Care if the Problem Is Solved

Apart from those who actually want the project to fail because they are gaining from the problem continuing, there are certain stakeholders who will call the project a success even if it fails to solve the problem. Most obviously, any of those who stand to gain regardless of whether the problem is solved.

From a project management perspective, the project may be viewed as successful even if it doesn't solve the intended problem. This may be the view of workers on the team

and management who are responsible only for the on time, on budget deliverable that meets the design specs. These stakeholders may feel that they “win” because they did the job and presumably got paid for the job that they were asked to do. For these stakeholders the metric, is dates, budgets and a yes/no of how many specs were met.

Similarly, investors may gain regardless of whether the project succeeds. Their metric is return on investment rather than successful problem solving. This can be the case if the investor was an early investor who already got paid, one who is guaranteed to get paid or one who can sell his stake for at least the price of investment.

Any project member who views himself as a pure scientist will feel that something was gained even if the problem is not solved so long as the data collected about the solution’s implementation and effects were carefully measured and there is confidence in the data collected. This is because they will have learned from the project regardless. For scientists the project’s success metric is a strong data set with statistical significance either positively or negatively.

Similarly, anyone who gained valuable experience by doing the project will see this as a success. This persons metric is whether they expanded their skill set, knowledge base or made good contacts. All of which they can carry forward into new projects.

Sometimes a problem is seen as successful because you stumbled upon a solution to a different problem. If this is the case, success is simply a matter of shifting focus to announcing and providing awareness for the problem that was solved. Consider someone trying to give free education to everyone in the world. The education may turn out to be not as good as what is available in a classroom, but they may have found away to increase internet access to more of the world and to close the digital divide. This result may shift focus to discussing education on use of computers rather than general education.

Mixed Reactions to the Problem not being Solved

Those who remain invested in the problem after the project will be mixed about the proposed solution not solving the problem. Like scientists, the designers, long-term investors and those passionate about solving the problem will see the project as an opportunity to learn, regroup and try again with the hope of success later. Essentially these stakeholders are delaying measuring the success until a later date when the problem has been solved or deemed not solvable.

Determining if the Problem is Solved

Whenever we are dealing in the real world rather than in an environment subject to our complete control, we must measure our success or failure at solving the indented problem on statistical terms. In the real world there are generally too many additional variables that could be effecting the dependent variable for us to definitely say that our solution could be the only explanation. If statistically speaking it is unlikely that the improvement we have seen in the problem we are attempting to solve happened by chance, we are inclined to pay attention to our proposed solution. This is what is referred to as statistical significance. Statistical significance helps us to rule out the possibility that the result happened by chance[4].

In order to have results that are statistically significant, one must have a strong enough sample size to draw conclusions. If your sample size is too low you may have more room for error. Generally speaking the larger your sample size the more likely you are to have statistically significant results. Similarly if your sample size is not representative of the population you are testing, you have more room for error.

Even results that are not statistically significant can provide important information about the problem that one is trying to solve. A trend can bolster enough energy and support for a larger implementation that may later prove to be statistically significant. Even a project team that is motivated to continue and who can prove able to deliver onetime can garner the attention of additional supporters for future projects.

Improving Your Design

Whether or not your project was deemed successful, after implementing a solution, one often has insights into how to improve the solution, to apply it to another problem or simply to narrow in more specifically on the problem.

When operationalizing a variable in order to determine the effects that a particular solution has on the targeted problem, one is often required to define the variable more narrowly than desired. In our operationalization example above, we defined an instance of bullying when there was a request, a performance of the requested action, after there had been a negative statement made to the reader. We recognized that negative statement would be further defined by specific words. This may have led us to miss the mark on the variable we are really trying to measure: bullying. We may have cast our net too narrowly or too broadly. Perhaps negative statements are not always used in bullying and perhaps bullying occurs with sarcasm that cannot be captured by our

definition. The operationalization can often be improved by trying to make the metric more narrowly tailored to the variable one is addressing.

Once we begin measuring our solution, we may very naturally find additional variables that we would like to test. These may come about by a different operationalization of the same dependent variable, by wanting to look at a related dependent variable or by making tweaks to our independent variable.

Sometimes we can even manipulate the data we already collected for a different purpose. For example, if we kept track of all of the statements involved in our cyber bullying project, then we would likely be able to change the operationalization without having to start over. We may even notice that there seemed to be a correlation between our manipulation and another variable that we happened to collect data on. Similarly we may find that our solution did not have a significant effect on the total population we looked at, but it may have on a subset of the population. For this reason it is important to collect information about the population beyond your target population.

Conclusion

In is important for every project leader to have an understanding of the various metrics involved in determining his or her project successful. Success is a sign of a good leader. At times strong leaders are tasked with projects that are difficult to solve or whose solutions are uncertain. Perseverance is a characteristic of a good leader. It is much easier to persevere if one can maintain a positive attitude about projects that were undertaken. Furthermore, the inspirational leader can rally his team again and again by pointing to actual successes and the real possibility of future ones.

Past successes can be by way of knowledge, personal pride in doing a good job, meeting investor expectations or having a promising new direction that is based on lessons learned from the past.

1. Shuttleworth, Martyn (n.d.) Operationalization. explorable.com. Retrieved from https://explorable.com/operationalization.
2. Pavot, W. (2018). The cornerstone of research on subjective well-being: Valid assessment methodology. In E. Diener, S. Oishi, & L. Tay (Eds.), Handbook of well-being. Salt Lake City, UT: DEF Publishers. DOI:nobascholar.com
3. Likert Scale. Encyclopedia Britannica. https://www.britannica.com/topic/Likert-Scale.

4. Gallo, Amy (2016) A Refresher on Statistical Significance. Harvard Business Review. Retrieved from https://hbr.org/2016/02/a-refresher-on-statistical-significance.