

Data Science Project Scoping Worksheet

Updated: September 15, 2023

This worksheet is designed for social good organizations (government agencies, nonprofits, social enterprises, and others) to scope actionable data science projects. Additional resources, including the Data Science Project Scoping Guide, are available [here](#).

1. Project Title: Preventing re-entry of inmates to jail by early prediction through their mental health profile

2. Organization Name: Johnson County (KS) Mental Health Center

3. Problem Description

A **problem** is typically an observed, adverse outcome that is real, important, and has social impact. The problem should also be one that is prioritized by the organization and can be addressed using data the organization has access to.

3.1. What is the business or policy problem you are facing? (e.g. adverse health impacts among at-risk children due to low rates of vaccination, low graduation rates among high school students leading to un- or underemployment, etc.)

Untreated mental health problems are a major cause of incarceration for individuals in the United States. Because mental health services and healthcare more generally are inaccessible to a vast swath of US residents, many people's mental health conditions remain untreated. For many of those people, their untreated mental health conditions are a factor that causes them to commit offenses and end up incarcerated once again. If an organization was able to proactively identify individuals with mental health conditions who are at risk of becoming reincarcerated, they could deliver preventative care that would reduce the individual and societal harm associated with criminal recidivism.

3.2. Who or what is affected by this problem? (e.g. people of a certain type, organizations, neighborhoods, the environment, etc.)

- Jail Inmates
- Common people in Kansas City in particular
- The Johnson County Police Department
- Health Department of Kansas City

3.3. How many of these people/organizations/places/etc. are affected by the problem, and how much are they affected (order of magnitude is fine)? (e.g. only 90% of high school

students graduate on time, each organization loses \$1M each year to tax fraud, etc.)

3.4. Why is solving this problem a priority for your organization now?

The harms associated with incarceration are extreme both for individuals and for society, so reducing recidivism rates are always important. In the past, however, there likely has not been political will or the necessary resources available to try to address this problem. Thus, it is important to take advantage of this opportunity to prove that targeted preventative mental health treatment can make a meaningful impact in lowering recidivism rates.

3.5. How have you tried tackling this problem and what has been the outcome of your efforts?

The Johnson County Mental Health Center provides mental health care to the inmates who after an initial screening in jails show signs of mental health issues. This reactive intervention is not very helpful in dealing with the mental health issues of inmates because usually by the time such issues are screened and detected, any curative intervention gets too late to help such an inmate.

3.6. What other groups or stakeholders in your organization and outside need to be involved in scoping and implementing this project?

Typically, data science projects need involvement from stakeholders inside your organization (such as policymakers, managers, data owners, IT infrastructure owners, the people who will intervene such as health workers) as well as people and organizations from the outside (such as community groups that will be affected by this work).

One of the most important groups that we need to be involved with regarding project scope is the Johnson County Mental Health Center (MHC). They are the people who are going to be acting upon our analysis, and they are the most familiar with the constraints associated with this new program. Other groups that are important to be in communication with are all the other Johnson County organizations that are supplying us with inmate data. These include the Department of Health, the Department of Corrections (state-level), the Johnson County Jail System, and the Johnson County First Responders - including both ambulance operators and police departments. Finally, it is very important that we are involved with the affected parties and the interest groups that represent them. Vulnerable populations of Johnson County have limited resources to advocate for themselves, but nevertheless, we should be careful to try to understand their perspective and struggles by engaging with them and activist organizations that represent them as much as possible. Understanding their experiences with mental health and the criminal justice system will help us make sure that our analysis does not have any analytical blind spots that could bias our results.

4. Goals

A **goal** is a concrete, specific, measurable aim or outcome that the organization will accomplish by addressing the **problem**. Building a technical solution, such as a predictive model, dashboard, or map, **is not itself the goal of a data science project** even if one of these tools might help you achieve your goals.

4.1. What are your social, policy, or business goals, and what constraints do you have?

Goals should directly relate to the problem you've identified, and will typically *improve/maximize/increase* or *decrease/mitigate/reduce* a relevant outcome or metric (e.g. increase the percentage of high school students who graduate on time).

Goals often need to balance efficiency (e.g. help the most number of people in need with limited resources), effectiveness (e.g. maximize the total improvement in outcomes from the help you provide to people), and equity (e.g. allocate resources across groups to achieve equity in outcomes).

Common goal-related constraints are limited budget, people and/or time; legal restrictions or lack of political will; or lack of social license.

List goals below in order of priority.

	Goal	Goal Type : (Efficiency, Effectiveness, or Equity)	Constraints Around this Goal
1	To reduce re-incarceration rate, specifically by targeting people with treatable mental health conditions that otherwise would cause them to re-offend	Effectiveness	Only 100 individuals can be helped susceptible of committing crime again
2	Allow social workers to more efficiently target their care toward people who need it the most and at a time when it is most critical	Efficiency	Only 100 individuals can be helped, but perhaps in the future some resources from other programs could be directed toward this one
3	Ensure that there is an equitable distribution of mental health care services to the population of Johnson County	Equity	Certain populations may be more at risk than others - how do we balance equity and effectiveness? What dimensions do we want to

			consider in our equity calculations?
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4.2 What trade-offs exist across these goals?

Some of the goals above may be conflicting or have trade-offs across other goals. What are these tradeoffs? Which of these goals would you want to place more emphasis on to achieve a competing goal?

There may be an effectiveness/equity tradeoff. For example, assume that our model performs much better on men than women because men are overrepresented in our criminal justice system data. Would it be equitable if the vast majority of our model predictions are for men?

It may be the case that we are able to detect with the highest confidence recidivism for a subset of the population, and so the best way to lower recidivism would be to disproportionately focus on that group. Many policymakers would not be okay with this inequitable outcome, however, so we will need to take equity into account when training our model.

In general, we think that effectiveness is the more important goal to focus on subject to the fact that the people we are reaching out to have similar levels of overall need to other potential residents we will not be helping. There are going to be countless numbers of people who we can not provide appropriate care for, so as long as we are reaching some of the more disadvantaged people in the county, that is probably acceptable.

Finally, there are also potential tradeoffs between efficiency and equity/effectiveness. If we assume that some mental health conditions are easier to treat than others, it may be more efficient to target those specifically. If these easier to treat conditions have lower success rates of preventing recidivism, or if they introduce bias into who we treat, we will now have a tradeoff between efficiency and other goals.

5. Actions

An **action** is an activity, intervention, or program that your organization has, or will perform, to reach the **goal(s)** you've outlined. Actions are generally performed routinely and often involve allocating resources, such as providing preventative services, outreach attempts, or after-school programs to people, or prioritizing inspection of certain homes or facilities.

The data and the analysis in steps 6 and 7 should inform these actions to help achieve our

goals. **5.1. What actions will your organization take to address the problem?**

	Action 1
What is the action? <i>e.g. inspect a house for health hazards, enroll a child in an after-school program</i>	Provide proactive mental health help from Johnson County Mental Health Center for the individuals identified by our model to help them cope with their mental health issues.
Which goal does this action help achieve? <i>e.g. reduce rates of lead poisoning, increase graduation rates</i>	To reduce the incidents of inmates committing crime again after getting released from a jail.
Who is executing this action? <i>e.g. home health Inspector (Department of Inspections), school administrator (school district)</i>	Johnson County Mental Health Center
Who or what is the action being taken on? <i>e.g. house, child</i>	Inmates identified or predicted by our model susceptible of committing a crime again.
How often is the decision to take this action made? <i>e.g. weekly, quarterly</i>	The decision is made monthly
What channels are or can be used to take this action? <i>e.g. in person, digital channels</i>	In person intervention

Are there any resource or capacity constraints with this action? <i>e.g. only 100 inspections can take place every month, or only 50 children can be enrolled in a support program at any time</i>	Yes, only 100 interventions can take place each month
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<p>What are the ethical issues associated with this action?</p> <p><i>Will acting on someone who does not need this intervention have adverse consequences? Are there ethical issues around excluding someone?</i></p>	<p>Our model will influence which people receive mental health care and which people do not. Is it fair to assign health care based on probability of success instead of other factors, such as time spent waiting for people with greatest need? We will need to carefully consider these questions so that we are not unintentionally advantaging other groups at the expense of others.</p>
<p>Can you provide any other useful information about this action?</p> <p><i>Has it been tested to be effective? Are there any approvals necessary before an action can be taken? How long does it take for an action to have an effect?</i></p>	<p>It will be hard to evaluate the counterfactual for the people we treat. If they end up reoffending despite the treatment, is that because our model was inaccurate or because of factors outside of our control? We will have to think carefully about how to evaluate this</p>

6. Data

Data, coupled with **analysis**, should inform the **actions** you will use to achieve your **goals**.

Many data science projects in governments and non-profits use administrative data as a primary data source, augmented by secondary, publicly available data sources (e.g. the US Census). Partnering with a private sector or nonprofit organization is a way to obtain data you might not have internally.

6.1. What data sources do you have internally?

The data you use to perform your analyses should be updated frequently and granular enough to reliably inform the actions you've identified. For example, if your actions prioritize individuals for help, your data should be at the individual level.

<p>What is the name of the data source?</p> <p><i>e.g. hospital admissions database</i></p>	<p>JIMS - Justice Information Management System: County-level jail and inmate information</p>	<p>JCDHE - Johnson County Department of Health encounter data</p>	<p>JCMHC - Johnson County Mental Health Center data</p>	<p>MED-ACT - First responder data, including ambulance runs</p>	<p>PD - Police department arrest data</p>

<p>What does it contain?</p> <p>Describe the attributes included in the data source. <i>e.g. admission and discharge records for hospitals nationwide, including patient sociodemographics, insurance type, and physician information.</i></p>	<p>Case data (including status, closed date), jail inmate data (demographic info and MH screen answers), inmate charges (charge type, court and sentence dates), bails data, pre-trial assessment and LSIR screening data.</p>	<p>Encounter records with patient's demographic, residential and insurance data.</p>	<p>Data on calls, patients' demographics, income and job, services and outcomes.</p>	<p>Data on medical emergency incidents, including client's demographics, residence, complaint and impressions of the first responders.</p>	<p>Arrests data, including time, charge type and description.</p>
<p>What level of granularity/detail is the data?</p> <p><i>e.g. inspection level, student level, patient visit level</i></p>	<p>Case and inmate level.</p>	<p>Patient level.</p>	<p>Patient level.</p>	<p>Incident level</p>	<p>Arrested person level..</p>
<p>How far back does the data in this data source go?</p> <p><i>Is it sufficient for the problem being scoped?</i></p>	<p>The earliest booking date is from 1989.</p>	<p>The earliest encounter date is from 2003.</p>	<p>The earliest call date is from 1993 and admission date from 1967.</p>	<p>The earliest incident is from 2010.</p>	<p>The earliest arrest is from 2010.</p>

<p>How frequently is the data collected or updated after it is captured?</p> <p><i>e.g. immediately (real-time), daily, weekly, monthly, yearly, ad hoc</i></p>	The data is not updated.	The data is not updated.	The data is not updated.	The data is not updated.	The data is not updated.
<p>Does the data have reliable and unique identifiers that can be linked to other data sources?</p> <p><i>e.g. SSN, national identifier, patient identifier, insurance number</i></p>	mni_no, booking_no are unique identifiers to link to other data sources.	Patient_no is a unique identifier to link.	Patid is a unique identifier to link.	hash_rcdid is a unique identifier to link	Arre_id is a unique identifier to link.
<p>Who is the internal owner of the data?</p> <p><i>e.g. Sacred Heart hospital</i></p>	The data is owned by the Johnson County JIMS Department.	Johnson County Department of Health	Johnson County Mental Health Center	Johnson County	Johnson county Police Department
<p>How is the data stored? <i>e.g. in a database, in pdfs, in excel, in a SAS data store</i></p>	The data is stored in the database.	The data is stored in the database.	The data is stored in the database.	The data is stored in the database.	The data is stored in the database.
<p>What are the ethical issues associated with using this data source? <i>e.g. do you need consent from the people in the data to use their data? are there security protocols that need to be in place? does the data collection process systematically result in any type of known collection biases?</i></p>	Sensitive data is hidden, so privacy is not a concern.				Police data can be reported with a bias, which may bias results

Can you provide any other useful information about this data source?					
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6.2. What data can you get from external private or public sources?

	Data source 1	Data source 2
What is the name of the data source? <i>e.g. air quality database</i>	US Census Information - i.e. ACS surveys	
What does it contain? Describe the attributes included in the data source. <i>e.g. particle concentration of each type of pollution in the air</i>	Lots of demographic, economic and living situation data	
What level of granularity is the data? <i>e.g. zip code level, daily records.</i>	Depending on the survey, it can be accessed on various levels of census tract levels.	
How frequently is the data collected or updated after it is captured? <i>e.g. daily</i>	Also depends on the granularity. Highly granular data is collected less frequently, every couple years, while more aggregated data is collected yearly I believe	
Does it have unique identifiers that can be linked to other data sources? <i>e.g. sensor identifier number</i>	Census tract / block group IDs, etc.	

Who is the internal owner of the data? <i>e.g. NOAA</i>	US Gov	
How is it stored? <i>e.g. API endpoint from an open data portal</i>	https://www.census.gov/data.html with API access	
What are the ethical issues associated with using this data source?	Spatial aggregates are very coarse approximations for individual's characteristics	
Can you provide any other useful information about this data source?	There are many APIs/Packages available to conveniently retrieve this data	

6.3. In an ideal world, what additional data would you want to have that is relevant to this problem? (e.g. survey results, CCTV videos, phone records, DNA, currently available data more frequently updated or at a different level of granularity, etc.)

One of the biggest challenges we are facing is not great information about people's mental health status. In an ideal world, we would have a detailed and timely picture of every person's mental health status. Although we have ambulance encounter data, mental health center data, and mental health survey data, this data is missing for many people. Additionally, we often only discover people's mental health status after they are already incarcerated. If inmates were released from prison and routinely checked on to have their mental health needs evaluated, that would be very useful. Additionally, the more granularity we had into people's mental health status, the more we could target individuals with our intervention that would benefit the greatest amount. Some mental health conditions are more treatable than other, and some are more likely to lead to criminal behavior.

Another useful set of data would be more detailed information about the success of previous interventions. If clinicians ran some kind of randomized control trial on released inmates to see what the effects were of mental health interventions on various kinds of conditions/people, we could use that information to better target our interventions.

7. Analysis

The objective here is to specify a set of **analysis** the project will do that use the **data** we have to inform the **action(s)** that will achieve our **goals**.

The analysis is **not the goal of a data science project**. Data science projects typically include a combination of analysis types, such as description, detection, prediction, optimization, and/or causal inference.

This section is typically not filled out in the earlier iterations of the scoping process until the problem, goals, actions, and data have been figured out.

7.1. What analyses will you complete to inform your actions?

An analysis can involve 1) better understanding and describing the past, 2) detecting new events as they're happening, 3) predicting future outcomes, 4) selecting among various strategies using optimization techniques, or 5) influencing or changing future behavior.

Each set of analysis will likely need to be validated. Initially, this may be through historical data, and eventually, through some type of a field trial.

	Analysis 1	Analysis 2
What is the type of analysis? <i>e.g. description, prediction, detection, causal inference</i>	Data analytics of the criminal justice system as it relates to mental health	Predict which people will recidivate AND also have untreated mental health conditions
What is the purpose of this analysis? <i>e.g. understand historical behavior of individuals, estimate risk of disease, identify which actions will increase graduation rates amongst students</i>	Better understand the nature of the problem we are trying to address, which can inform project scope and expansion	Using these predictions, JOCO mental health center can strategically reach out to individuals and intervene by providing mental health treatment. This is done with the hopes of avoiding recidivism, which is painful to individuals and society

<p>Which action will this analysis inform?</p> <p><i>eg. inspections of compliance regarding handling of hazardous materials</i></p>	<p>Project scoping, expansion, project write up, etc</p>	<p>Mental health outreach targeting</p>
<p>How will you validate this analysis using existing data?</p>	<p>We will compare our row counts before and after joins to make sure we aren't losing data during any intermediate cleaning steps</p>	<p>We will train a machine learning model that will only be trained on data up until time t-1 to make predictions at time t, then we will check our accuracy by looking at status at time t</p>
<p>What methodology and what metrics will you use?</p> <p>How will you compare against existing baselines?</p> <p><i>e.g. creating multiple train and test sets based on time, using precision or positive predictive value at top 10% as a metric, and comparing against random and "existing system" baselines</i></p>	<p>We can use census data to compare our dataset to baseline population statistics. For example, what is our incarceration rate compared to the national average?</p>	<p>Accuracy, precision, recall</p> <p>We can also evaluate the model by not intervening and then seeing if our predictions were correct. I.e. what percent of people generally recidivate in 1 year, and then out of our model's predictions, how many of the top 100 people recidivate? If our percentage is much higher than the baseline, then it will be successful</p>

<p>What are some ethical issues associated with conducting this analysis?</p>		<p>If we compare our model against business as usual, we are potentially sacrificing the ability to help people in the short term in order to evaluate our model in the long term.</p>
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8. Ethical Considerations

Ethical issues should be considered continuously, in every part of the scoping process as well as during the project. This section provides a set of questions to answer as a starting point for those discussions through the project scoping, design, and execution phases.

8.1. Privacy, Confidentiality, and Security

Are you working with personal and/or sensitive data that is individually identifiable? What are the legal as well as ethical considerations for privacy and confidentiality with the data being used? What type of protections need to be in place? How are these data protections being audited, and how often?

We have personal data, but all PII is hashed and thus it would be hard to recover individual identities in the data. Additionally, we have a secure computing environment so no members of the public should be able to access the data at any time. As this is a project, our data protections will not be audited but will be supervised/informed by our teacher.

8.2. Transparency

Which aspects of the project do different stakeholders need to be informed about? Stakeholders typically include policymakers, frontline workers, people who will be affected by the actions, the general public, etc. What should each of them know about this project? Do the people who “own” the data know how you’re using it? Do the people being prioritized for intervention know why they’re being prioritized?

In general, it will be important for staff from the MHC who are conducting the pilot and relevant policy stakeholders to understand what our model is doing and how it functions at a high level. If they don’t understand what data we are using and how predictive analytics work broadly, they may not trust the model and disregard its suggestions. They may also be unaware of the bias and blind spots a model like this could have. They should also understand the challenges associated with scaling a model like this from a pilot of 100 people to the broader population.

The people who “own” the data may benefit from knowing that their data is being used in the model, but it may be difficult to inform them all because there are so many people in our dataset. Additionally, they likely already realize that their data is collected and utilized by Johnson County, and our model is an extension of Johnson County’s work, so it is likely not a large transgression that we are using their data at all. People may object,

however, to the manner in which we are using their data. If they realize that they were not selected for mental health treatment because of a predictive model which is not interpretable, they may reasonably become upset.

8.3. Discrimination/Equity

For which specific groups do you want to ensure equity of outcomes (e.g. groups of interest defined by gender, age, location, social class, educational level, urban or rural residency, ethnicity, etc.)? How might each of these groups define equity in outcomes in this context? How will you detect biases in your system and reduce them or mitigate their impacts? How should you take into account any broader sources of inequities that affect the outcomes you're seeking to improve?

The exact group definitions we care about depend partially on what our collaborators in Johnson County value. Some initial ideas would be gender, age, location, income/education levels, and race. Each of these groups might define equity as receiving the correct amount of mental health services proportional to their groups' needs. For example, low income people struggle to afford mental health care in the US, so they have a higher need relative to people with higher incomes. They would likely define an equitable outcome as receiving disproportionately more resources than other groups. Our data science group will struggle to determine how much need exactly every group should receive in relation to other groups, as this is largely a matter of politics, ethics and moral judgements.

As an alternative, we could strive for an approach that distributes resources in equal quantities proportional to the number of people in each group. This would be an equal distribution system, but not necessarily an equitable one. For many, it will not be preferable to an equitable distribution, but it will avoid the worst case scenario of distributing more resources to relatively advantaged groups at the expense of treating disadvantaged groups.

One way we could measure discrimination and equity in our modeling efforts is to look at accuracy/precision/recall rates by demographic group and see if our model performs equally well across different groups. It could be possible that our model underperforms for certain groups (i.e. women) because they are underrepresented in the data. This poor performance might lead to women receiving fewer resources than they should because we are unable to detect women with greatest need/potential to treat. We could potentially alleviate this by resampling our dataset to include more women.

8.5. Accountability

Who is responsible for ensuring that each of the above ethical considerations are made? What accountability lies with the people building the data science system, the people acting on them, and the policymakers defining the goals and objectives? If there are data leaks, misuses of the system, unintended consequences, or other harms arising from this work, who is accountable?

It is our (the data science team's) job to ensure that our model performs well across different demographic groups and to rebalance our training data and choose model parameters as necessary to ensure this occurs. When these equity concerns collide with efficiency/effectiveness goals, we will need to consult with the MHC and other policymakers to decide what the appropriate tradeoff is.

It will be up to policymakers and the MHC to decide which demographic groups of interest we should make equity considerations for.

The data science team will be accountable for any data leaks, assuming the county has delivered the data to us in an originally secure format. It is up to the data science team to properly inform the MHC and policymakers about the potential issues of bias and unintended consequences that may arise from use of the system. Assuming that has been done, it will be the responsibility of the county to fully consider those factors and take accountability in case the public takes issue with their decisions.

8.4. Social License

If the entire population of the country finds out about your project, will they be ok with it? Why? Are there any specific groups who might object, and what concerns would they raise? If it was on the front page of the newspaper, would the headline be positive or negative?

In general, we believe that the public would likely accept the concept of a pilot program that uses a model to predict mental health needs and offers services accordingly. However, concerns may arise if this system were to operate on a larger scale beyond just a pilot phase. The primary concern, we anticipate, would revolve around how policymakers prioritize effectiveness, equity, and efficiency in the program.

More specifically, people may question whether prioritizing effectiveness and efficiency over equity is justified. They may wonder how much efficiency is gained at the expense of equity and whether groups that are disadvantaged by our model's biased output are adequately assisted through other means.

To address these concerns, we could provide a comprehensive spectrum of potential outcomes based on different weightings of equity and efficiency. This approach would allow the public and policymakers to understand the full range of possibilities and make more informed decisions about the trade-offs they are comfortable with regarding the program's priorities and actions.

8.6. Are there any other ethical considerations that should be made prior to or during the data science project?

e.g. legal issues, informed consent, etc.

We may need to consider getting informed consent for people to study their outcomes and use their data in the model evaluation process.

This worksheet is currently being maintained at Carnegie Mellon University.
Please email dssg+scoping@cmu.edu for any questions or suggestions.

This worksheet was originally developed by the Center for Data Science and Public Policy at the University of Chicago and has been extended through a collaboration with GobLab at Adolfo Ibanez University.