Manual of preparation and transformation of open data

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2017-05-03

Contents

Chapter 1

Overview

This manual describes through a methodology the activities of extraction, cleaning and integration of data bases prior to the processing and analysis phase. In addition to this manual and using a programming environment, automated scripts are developed for cleaning, integrating and transforming data.

Chapter 2

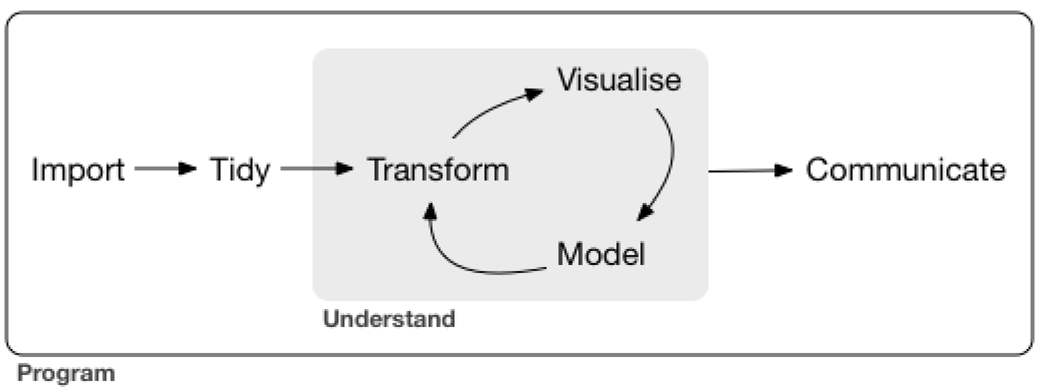
The Methodology

2.1 Introduction

In this chapter we present the methodology that we used to work with the data. We will explain each step individually and as part of the many subprocesses that are required to understand the databases present in datos.gob.mx.

2.2 General Model of the Methodology

The purpose of this methodology is to turn the raw databases found in the portal into understanding, insight and knowledge. To accomplish this, there is a need for using a computing system, for we will be using the statistical software R, which is free and open source.



2.2.1 Individual Steps of the Methodology

2.2.1.1 Import

First you must import your data into R. This typically means that you take data stored in a file, database, or web API, and load it into a data frame in R. In this step is where you usually deal with encoding, language, and formats issues.

2.2.1.2 Tidy

Once you've imported your data, it is a good idea to tidy it. Tidying your data means storing it in a consistent form that matches the semantics of the dataset with the way it is stored. In brief, when your data is tidy, each column is a variable, and each row is an observation. Tidy data is important because the consistent structure lets you focus your struggle on questions about the data, not fighting to get the data into the right form for different functions.

2.2.1.3 Transformation

Once you have tidy data, a common first step is to transform it. Transformation includes narrowing in on observations of interest (like all people in one city, or all data from the last year), creating new variables that are functions of existing variables (like computing velocity from speed and time), and calculating a set of summary statistics (like counts or means). Together, tidying and transforming are called wrangling, because getting your data in a form that's natural to work with often feels like a fight!

2.2.1.4 Visualisation and Modelling

Once you have tidy data with the variables you need, there are two main engines of knowledge generation: visualisation and modelling. These have complementary strengths and weaknesses so any real analysis will iterate between them many times.

Visualisation is a fundamentally human activity. A good visualisation will show you things that you did not expect, or raise new questions about the data. A good visualisation might also hint that you're asking the wrong question, or you need to collect different data. Visualisations can surprise you, but don't scale particularly well because they require a human to interpret them.

Models are complementary tools to visualisation. Once you have made your questions sufficiently precise, you can use a model to answer them. Models are a fundamentally mathematical or computational tool, so they generally scale well. Even when they don't, it's usually cheaper to buy more computers than it is to buy more brains! But every model makes assumptions, and by its very nature a model cannot question its own assumptions. That means a model cannot fundamentally surprise you.

2.2.1.5 Communication

The last step of the methodology is communication, an absolutely critical part of any data analysis project. It doesn't matter how well your models and visualisation have led you to understand the data unless you can also communicate your results to others.

2.2.1.6 Programming

Surrounding all these tools is programming. Programming is a cross-cutting tool that you use in every part of the project. You don't need to be an expert programmer to be a data scientist, but learning more about programming pays off because becoming a better programmer allows you to automate common tasks, and solve new problems with greater ease.

2.2.2 Parts of the process

To accomplish this methodology, we will divide the whole process into several pieces that we explain next.

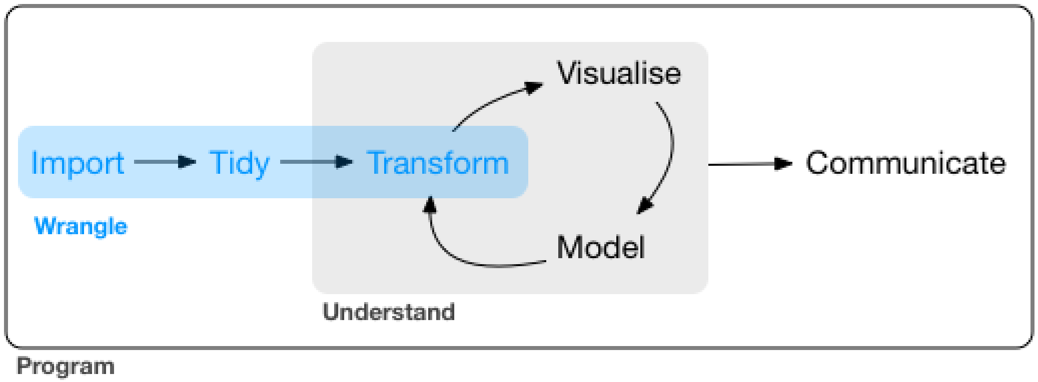


Figure 2.1:

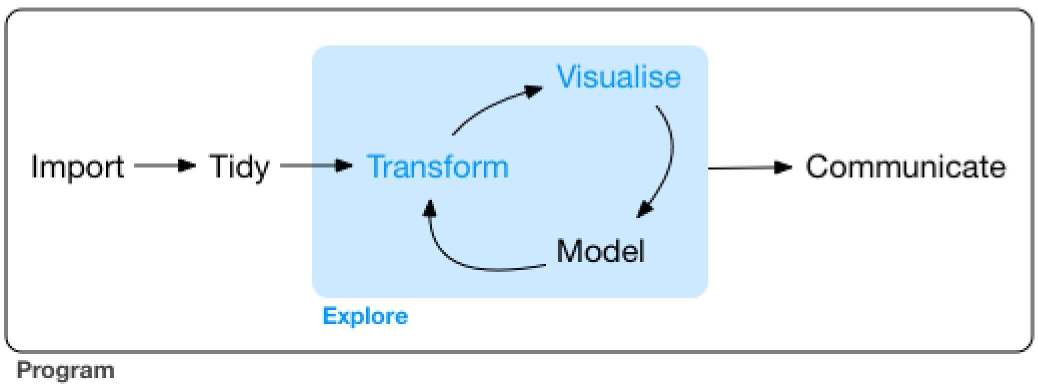


Figure 2.2:

2.2.2.1 Wrangling the Data

The objective of the wrangling phase of the method is to resolve all the informatical issues around the database. As mentioned before, the final goal to achieve is to tidy all the databases involved. For this task, R (and more specifically, the tidyverse package) supplies mostly of the tools you will need to get your data in a consistent form.

2.2.2.2 Exploring the data

When the data has already been tidied, the first step in the analysis is exploring the data. This means that you want to find as many relationships and irregularities as possible. For this, the main tools are visualisation and transformation which are generally applied in the following way:

1. You generate questions about your data.
2. Search for answers by visualising, transforming, and modelling your data.
3. Use what you learn to refine your questions and/or generate new questions.

2.2.2.3 Communicating

The final step in the methodology is to wrap up all the wrangling, exploration, and modelling in a single report. For this task is very useful recycle all the plots that you have already used to explore the data. As a technological tool, the R environment (in a very similar manner to the Python environment) allows us to put the plots, text and R code in a single document called Analysis Notebook.

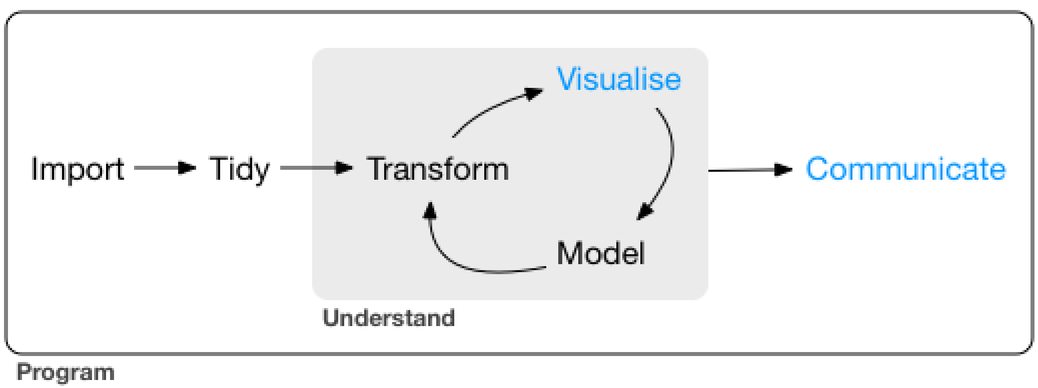

Visualise
Import
Tidy
Transform
Communicate
Model
Understand
Program

Figure 2.3:

Chapter 3

The Extraction Phase

3.1 Introduction

Even while the obtaining of the data is not part of the analysis methodology, we have to point out that it is no trivial matter to obtain data to begin working with. It is important to note also that this part of the process depends completely upon the structure and contents of the portal. There is no way to design a general method for obtaining data because each database is constructed and obtained in its own way. Even so, we will try to explain what have we done in this particular case(mexican open government data stored in datos.gob.mx) in order to clear the path for future investigations.

3.2 The CKAN system and its API

The data portal datos.gob.mx is built upon the design and functionalities of the CKAN system. To better explain how to use the portal, we first present a brief overview of CKAN, the definition of API and how it is related to our problem.

The first key concept is CKAN. Quoting from the CKAN website, "CKAN is a powerful data management system that makes data accessible – by providing tools to streamline publishing, sharing, finding and using data. CKAN is aimed at data publishers (national and regional governments, companies and organizations) wanting to make their data open and available".

The second key topic is the concept of API. An Application Programming Interface (API) is a set of subroutine definitions, protocols, and tools for building application software. In general terms, it is a set of clearly defined methods of communication between various software components.

Finally, we have to link these key ideas together:

The portal datos.gob.mx is an implementation of the CKAN system which is a platform to publish open data and make it accesible. CKAN has many tools in order to accomplish the accesibility of the data: it has a tag system, a query system, and a way of organizing the databases that makes it very easy to find the desired data. To make it possible for a program to access the site, CKAN has a set of functions (called API) which allows a program to make use of the all the functionality that the site has.

3.3 Keywords

The first step to obtain data is to try to guess the tags that are associated to the database. This a heuristic task for which we present a useful resource: list all the tags available in the site. This is most useful when you already know how to use the site (for which we mean knowing how to use the CKAN API), but you can use this tip querying on the search bar of the site.

3.4 Identifying the source of the data

After identifying

3.5 Discriminate the irrelevant entries

3.6 Download

3.7 Checking the data

Chapter 4

Prerequisites

4.1 Introduction

In this chapter we will present the preparation steps needed in order to be able to analyse a database of datos.gob.mx. The most important notion of this chapter is the concept of tidy data, which is a consistent form of arranging the data in a dataset that enables us to work more eficiently and stay focused analysing the data.

4.2 Software

4.2.1 What is R?

The software we chose to analyse the data contained in datos.gob.mx is called R. This is a programming language and ecosystem made for statistical analysis that is free and open source. We chose R because it is free software, which is a way of fulfilling the preconditions needed for anyone to make use of the free and open databases in datos.gob.mx.

4.2.2 R

The best source to install R is CRAN, the Complete R Archive Network https://cran.r-project.org/ . In this website there are many guides with the instructions needed to install R in a variety of operating systems, such as Windows, Mac and Linux. The basic tools that we used are already included in the Debian package named “r-base”.

4.2.3 RStudio

When facing a programming language, it is often useful to have a IDE (short for Integrated Development Environment). An ideal IDE makes it more eficient to write programs because it saves the user a lot of typing and also may have many useful functions such as browsing files, show dependencies between the programs, highlighting the code (which makes easier to spot the structure of the program), variable browser, etc. The IDE we chose for using with R is called RStudio, which is made for statistical analysis and also is free and open source, like R. The ecosystem of R and RStudio makes it possible to analyse the data in many different ways, printing plots and making complete reports of the analysis among many others. All these functionalities make it ideal to analyse the datasets in the portal. RStudio can be downloaded in https://www.rstudio.com/

4.2.4 The tidyverse

The R ecosystem is very extensible and customizable via something called **packages**. An R package is a collection of functions, data, and documentation that extends the capabilities of base R. The tidyverse is a wrapper around many packages that work consistently with data and have as a whole almost any tool needed in order to analyse a database. The tidyverse includes packages to do almost all the steps in the methodology: making plots about a dataset, transform the variables of a dataset, importing a dataset and resolving its encoding issues, fitting a mathematical model to a variable, among many others. As all these packages are linked together, the tidyverse implements a set of consistent names, functions and tools to make it easier to have all its parts work together on a single dataset.

4.3 Tidy data

4.3.1 Why would we "tidy" the data?

The final prerequisite to begin working with the databases in the portal is to understand what means that a dataset is tidy. The tidy data is a way to resolve all the differences between the many formats, structures, and encodings that databases can have. It also allows us to work the database with the tidyverse, saving us the time to put the database in a different form for plotting, transforming or modelling. It also makes it easier for R to work with the database because the inherent variable that R uses is a **vector**, (which is a ordered tuple of data of the same kind) and every column in a tidy dataset is a vector.

4.3.2 Variables

The basis of the concept of tidy data is the idea of a measurable feature of something. For example, the speed of a car, the height of a person and the date of an event are all measurable features of the respective objects. The way in which this concept leads to the tidying of a dataset is that because a variable is a measurable thing, maybe it is a number or date o category, so we can make the computer understand it. As R uses vectors as its basic blocks, we want variables to be encoded in vectors. This is the reason why we are going to put all the variables in columns, which makes the first step in the tidying of a dataset.

4.3.3 Observations

As variables make the measurable aspects of something, we can speak of the "instant" in which we measured the data of the something. For example, if we are studying diseases in country, we can talk about the number of diseased people, the country and dead people, all of which are linked together by the variable year, which is the moment in which all the other variables happened in the way we are trying to study. Putting together all the values of the measured variables, we can think of a concrete situation, so it makes sense to put all this data together in a way. This is the reason why we are going to put the observations as the rows of the dataset, which is the final step in the tidying of a dataset.

4.3.4 Definition and Example

Having all these ideas at hand, we finally define tidy data:

- All the variables in the dataset have its own column.

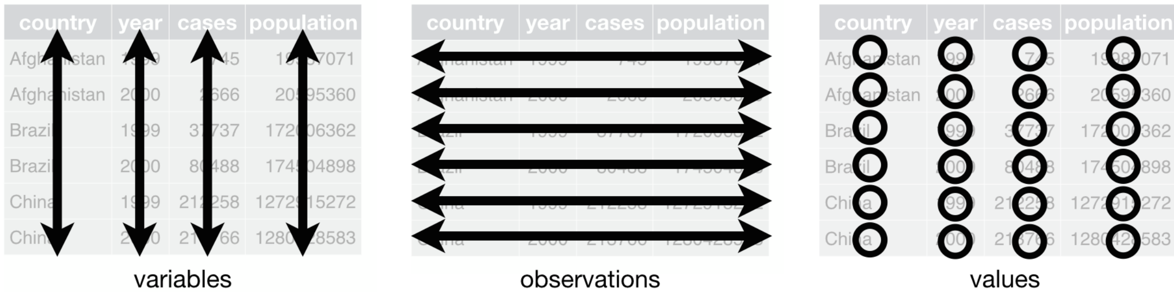


Figure 4.1:

- All the observations of the variables have its own row.

In a picture, this is what we call tidy data:

Chapter 5

Applications

Some *significant* applications are demonstrated in this chapter.

5.1 Example one

5.2 Example two

Chapter 6

Final Words

We have finished a nice book.

Bibliography