

Sales of Automated External Defibrillators and State Regulations

Background

Automated external defibrillators (AEDs) are devices that can save lives when used to provide an electric shock to the heart of a person undergoing cardiac arrhythmia (heart beats that are irregular, too fast, or too slow). This condition leads to cardiac arrest, when the heart stops beating. Cardiac arrhythmia arises when the electrical signals that control the beating of the heart are not functioning properly and differ from a heart attack which is caused by a blockage of blood to the heart. Survival of a person undergoing cardiac arrest is improved substantially if treatment begins within a few minutes of the onset of the episode. AEDs are designed to be easy to use for untrained people as the units include spoken and visual commands that direct the steps that the user needs to take to apply the device correctly. The machines are also equipped with safeguards that measure the victims heart rhythm so that they will not discharge a shock if it is not needed.

While AEDs are sold and used throughout the country, regulations on their use can vary a great deal from state to state. These regulations, or “Good Samaritan” laws, are intended to provide legal protection to people who provide reasonable aid to others they believe to be injured or in peril, but restrictive provisions with regard to AED use could limit their acceptance or use. Some states require one to be a physician or to have received special training before using an AED device while other states have more lax regulations. It is of interest to understand how the laws and regulations in states are associated with AED sales.

Allied 100 is a company headquartered in northern Wisconsin that is one of the largest distributors of AEDs in the United States. We will be examining sales data from the company since the beginning of 2013 to examine patterns and relationships with demographic data in the regions where units are sold and relationships with state regulations. In addition, we will examine some limited data on saves for interesting patterns.

Questions

Here are a list of potential questions. More questions of interest will arise during the first interview with the client.

1. Adjusted for population, what regions or states are purchasing the most AEDs?
2. What are some of the demographic characteristics of the areas where AEDs are sold and how do these differ from the rest of the country?
3. Are there regional differences among the types of institutions that purchase AEDs?
4. How are AED sales impacted by state regulations?
5. Do areas with more AEDs experience higher save rates?
6. Is there an association between AED industries and saves?

Data

There are several large data sets associated with this project. One file contains information about each sale of an AED by Allied 100 since January, 2013 including the zip code of the address where the device was delivered. Other files contain demographic and population information for all zip code regions (or the related ZCTAs) in the US. ZCTA is an acronym for ZIP Code Tabulation Area and is a trademark of the US Census Bureau. ZIP codes are used by the US Postal Service. We will ignore any potential differences between them. Demographic information is based on ZCTA. Sales addresses use zip codes.

In addition, there are files for the states and territories with data on regulations and population. Furthermore, the R package `zipcode` contains a function `clean.zipcodes()` which is useful for processing data frames with zip code information and a data frame accessed with the command `data(zipcode)` that contains the city, state, latitude, and longitude of all US zip codes. The `as.Date()` function can be useful when working with dates within R.

The sales data is proprietary and may only be used for the purpose of this course. You may not distribute it without the express permission of its owner. When you are finished with the data at the end of the semester, you should delete all copies of it. The data will be accessible through the Learn@UW course page. The population and income data is from public sources and may be used freely.

Here are the specific files and their contents.

`aed-sales.csv` contains a single row for each AED device sold by Allied 100 since January 1, 2013. There are 34,229 rows of data.

- Date — the date of the sale.
- Model — the code (Model A through Model U) of the model of the unit.
- ZIP — the zip code of the address where the unit was sold.
- Software — TRUE or FALSE if the unit is sold with a specific software.
- Classification — The classification of the buyer; one of Fortune 500, Small Business, Non Profit Entity, Personal/Home, Government, and State/Local Government.

`saves.csv` contains limited information on the number of saves made using devices that were sold with the software over some period of time. This data is only available for cases reported to the company.

- ZIP — ZIP code.
- Industry — type of location that used the AED.
- Saves — number of saves made with unit.
- Model — model code of the unit.

`aed-laws.csv` contains a row for each state plus the territory Puerto Rico and the District of Columbia.

- id — the row index.

- `state_code` — two letter code for each state or territory.
- `country_code` — US for the United States (you should not need this).
- `url` — web address where information is found (you should not need this).
- `physician_required` — Is a physician required to use the AED? yes=1, no=0.
- `training_required` — Is training required to use the AED? yes=1, no=0.
- `registration_required` — Is registration of the AED required? yes=1, no=0.
- `enacted_law_count` — the number of laws about AED use enacted in the state.

`income.csv` contains information from the American Community Survey through the Census Bureau. Statistical methods are used to estimate the number of households and median income per household by ZCTA. There are 33,120 ZCTAs in the data set.

- ZCTA — ZIP Code Tabulation Area.
- Households — Estimated total number of households (2013).
- Income — Estimated median household income (2013) in dollars. Note, these values are censored both left (\$2500) and right (\$250,000).

`population.csv` contains information from the Census Bureau that includes estimates of the 2010 population, the area, and the population density for all ZCTAs. Some ZCTAs with population 0 are not accurate. There are 33,144 ZCTAs in this data set.

- ZCTA — ZIP Code Tabulation Area.
- Population.2010 — Estimated Population from 2010 US Census.
- Area — Area (square miles).
- Density — Number of people per square mile (with absurd precision).

`state-population.csv` contains the 2014 estimated population of all states and some territories.

- State — name of state.
- Population — 2014 estimated population.