Communicating With Census Data: Data Visualization

Select Topics in International Censuses[1]

Released June 2017

INTRODUCTION

This technical note will demonstrate effective data presentation and visualization practices for census and survey data produced by National Statistical Offices (NSOs).

Data visualization can help NSOs reach a broader audience, more effectively communicate high priority information, and discover hidden patterns. Visuals can be created easily using common office productivity software, but constructing professional and well-designed visuals requires additional effort. Ultimately, the added effort is worthwhile since useful visuals will substantially improve the effectiveness of statistical products.

As data authorities, NSOs should prioritize the production of effective visuals in both existing analytical products and as standalone products to improve accessibility to official statistics for data users, decision-makers, and the public.

Terminology used:

Visual (noun): a collection of graphics and text used to convey information, such as a chart, map, or table

Visualize (verb): the act of creating a visual

This technical note is part two of a two-part series on *Communicating With Census Data*. This series illustrates the importance of conveying census results to a wide audience through the production of relatable and engaging data products.

The first part of this technical note discusses important concepts associated with data visualization, such as the value of visuals, how to produce a visual, and good practices. The second part includes examples of good practices for three types of data visualization: tables, charts, and maps.

CREATING VISUALS

Data are presented in a variety of visual formats and mediums, all of which are complementary. For instance, while tables of data are important, providing only tables without accompanying charts or maps is limiting to the value of the overall data presentation.

Most static visuals are produced with standard office productivity software, while others require advanced tools and skills.

Data visualization

People naturally form **visuals** in their minds (Few 2012, p. 65). Whether reading a novel, dreaming while asleep, or going about daily tasks, the human brain is capable of compressing large amounts of information into a visual representation of a phenomenon. A visual is "a tool for your eyes and brain to perceive what lies beyond their natural reach" (Cairo 2013, p. 10).

The act of **data visualization** uses this innate ability to provide context to large amounts of data with graphics. By definition, "data graphics visually display measured quantities by means of the combined use of points, lines, a coordinate system, numbers, symbols, words, shading, and color" (Tufte 1983, p. 9).

[1] This technical note is one in a series of "Select Topics in International Censuses" exploring matters of interest to the international statistical community. The U.S. Census Bureau helps countries improve their national statistical systems by engaging in capacity building to enhance statistical competencies in sustainable ways.

United States Census Bureau
U.S. Department of Commerce
Economics and Statistics Administration
U.S. CENSUS BUREAU
census.gov

USAID
FROM THE AMERICAN PEOPLE

Technological advances and the proliferation of free and open data have improved our ability to visualize data (Cairo 2011, p. 14). Specifically, visualizing **census and survey data** can add value for several reasons:

- **Showing patterns that are otherwise obscured**. Even if the underlying data are large or complex, a well-designed visual will highlight the most important patterns. These patterns are difficult to identify without the assistance of visuals.
- **Transmitting information quickly**. Most readers cannot meaningfully interpret a table of data without extensive analysis. Visuals can turn a data table into a graphic that can be quickly interpreted.
- **Providing compelling evidence**. Data visualizations strengthen the author's narrative by easing the transfer of knowledge to the audience.

Subject matter experts may use visuals during the exploratory data analysis stage (see the exploratory data analysis section in Part 1 of this series). However, this technical note will focus on the use of data visualization when presenting findings to another audience.

Visual types and mediums

One of the earliest decisions when producing a visual is to determine the dissemination or publication medium. **Paper** products have different requirements than Web products. For instance, paper requires attention to the weight, thickness, coating, and brightness of the paper itself. Conversely, **electronic** products typically require a reliable Internet connection and should be viewable across multiple devices (such as personal computers, smartphones, and tablets).

A visual can be either **static** or **interactive**. Static visuals are the most common since they are the simplest to produce. Many static visuals can be created using common desktop productivity software.

Interactive visuals are typically associated with Internet products. If well designed, an interactive visual can display a greater amount of information and engage the audience for a longer period. However, interactive visuals demand greater technical ability to design and may require external consultancy.

Due to their ease to adopt and usefulness for national statistical offices, this technical note will focus on static visuals.

Static visuals

Analytical products from national statistical offices provide information about major trends and patterns over time and space. For most national census and survey analytical products, the primary forms of static visuals will be **tables**, **charts**, and **maps**. These three visual forms are popular due to their effectiveness and simplicity in conveying information.

Each type of visual has strengths and weaknesses. Ultimately, the choice of visual is a trade-off that accepts certain weaknesses of the presentation format if they are outweighed by the strengths. These considerations are discussed in more detail later.

Box 1 demonstrates a process for creating a visual. While authors may be tempted to use a repetitive set of visuals throughout a product and across multiple variables, not every variable needs an accompanying visual. Authors should evaluate the advantages and pitfalls of data visualization to determine whether or not a visual is adding value to a product or distracting the audience from the key message.

Box 1.
Process for Creating a Visual

1) Which data are needed to visualize? When choosing an indicator to visualize, consider the main variable. This will usually become the x-axis in a two-dimensional graphical representation, e.g., census years, response categories.

2) Why is it important to visualize these data? The visual must have a purpose. Think about interesting patterns in the data that can only be shown with a visual.

3) What type of visual should be created? The choice of visual depends on the data. For example, if the purpose is to show a spatial pattern, a map is the preferable visual type. Or, if the purpose is to show a pattern over time, perhaps a line graph is the best visual. All visuals involve compromise.

4) How does this visual complement other visuals in the product? Unless a visual is released as a stand alone product, it must be chosen in consideration of the other visuals, publication medium, space available, and subject matter.

5) How will this visual be created? Software is required to create visuals. Maps are typically created in Geographic Information System (GIS) software, while charts and tables can be created in office productivity software.

Source: U.S. Census Bureau.

Skills and software required

Producing professional visuals requires skills in **graphic design**, **Web design**, **programming**, **cartography**, and/or **data management**. Other skills that are harder to train include artistic and analytical ability.

Many software applications can produce professional and attractive visuals. Some commonly used tools are shown in Figure 1, including both commercial and free/open source software options where possible. Note that some software tools require advanced training or extensive practice,

Figure 1.
Software Tools for Producing Visuals

Specialized applications may be required to produce certain visuals.

Category	Examples	Functionality	Difficulty
Productivity software	Microsoft Excel, OpenOffice	Creating simple visuals	Low
Dedicated visualization tools	Tableau, WEAVE	Creating more complex visuals	Intermediate
Data analysis	Stata, R	Data processing and analysis	Advanced
Graphics design	Adobe Illustrator, Inkscape	Producing and finalizing graphics	Advanced
Cartography	ArcGIS, QGIS	Map making and geospatial data	Advanced
Web development	D3, Leaflet	Building interactive Web visuals	Advanced

Note: Many of the examples provided in this table are advanced tools that require extensive training and experience to become a professional user.
Source: U.S. Census Bureau.

especially in graphic design, Web development, cartography, and data analysis.

For most applications, the data visualization tools provided in standard office productivity software can produce data visuals such as tables and charts with minimal additional training. Visuals produced in these applications are highly customizable and can be of professional quality.

However, not all functionality within these applications is desirable. Authors should keep their graphics clean and easy to interpret. Good practices, as well as practices to avoid, are discussed in more detail later in this technical note for specific types of visuals.

Each of these applications can be learned through training. However, training only provides a limited introduction to the topic. Extensive practice—possibly over several years—will be necessary to become a data visualization expert. Therefore, to avoid the loss of focus from subject matter expertise, some organizations should consider hiring professional graphics artists or contracting with vendors to assist with the production of more complex visuals.

GOOD PRACTICES

The primary goal of a visual is to improve understanding. To accomplish this goal, authors should follow the guidance below. This technical note uses examples from the U.S. Census Bureau to demonstrate good practices.

Use structured data

The key input into a visual is the underlying data. Generally, to produce a visual, data must be organized in a computer readable format such as Comma Separated Values (CSV), eXtensible Markup Language (XML), JavaScript Object Notation (JSON), or in a relational database. These formats are **structured data**, meaning that a computer can easily read the data for analysis. These formats contrast with unstructured data, such as the Portable Document Format (PDF), which are not easily readable by data analysis software. See Figure 2 for an example of the distinction between structured and unstructured data.

As a general practice, national statistical offices should release their data products as structured data to ease its use for visualization purposes internally and externally. These formats align with global efforts to improve the transparency and availability of government data and increase the usefulness of national statistical data (United Nations 2013).

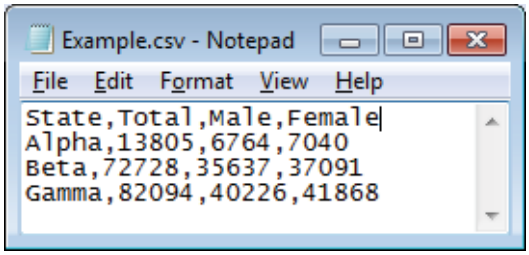
Structured data can be flat or a cross tabulation. Individual cells within a flat table represent a single variable, while cells within a cross tabulation represent the combination of multiple variables. A visual can be created using either format and will depend on the author's purpose.

Figure 2.
Structured vs. Unstructured Data

The following table of information may look structured. However, when presented in a format such as this document (PDF), the numbers are not easily computer-readable. Therefore, it is unstructured.

State	Total	Male	Female
Alpha	13,805	6,764	7,040
Beta	72,728	35,637	37,091
Gamma	82,094	40,226	41,868

Conversely, the picture below shows the same table stored as a comma-separated values (CSV) file and viewed in the Notepad software application. This data format is structured since each number column is clearly separated by a delimiter (in this case, a comma) and each record is placed on a separate row.



Source: U.S. Census Bureau.

Provide context

Context is important with data visualization. Since readers may only read the visuals and ignore the text in a larger product, every visual should have sufficient information for the audience to interpret quickly.

The **title** is the first item most readers will see and should be descriptive. Within the title, clearly state the variable(s) shown in the visual and the period covered. Titles can also be used to convey the main message of the chart.

Cite the **sources** used to produce the visual. For published reports, the citation should appear in the visual itself and be cross-referenced to the footnotes or to complete citations at the end of the document. For stand-alone visuals that appear on posters or as Internet products, the full citation should be included with the visual. Citation information includes the source author or organization (e.g., the NSO itself); the specific operation, report, and year (e.g., 2010 Census, Summary File 1, 2011); and a hyperlink if available online.

Also include **data use** instructions in the visual. For national censuses and surveys, these instructions commonly include links to educational documents providing variable definitions, sampling error, and nonsampling error (e.g., coverage error and response error).

For tables of data, a hyperlink is usually provided to access the **structured (computer-readable) dataset**. As described previously, organizations should aim to provide access to the structured datasets to increase data use by other government agencies, academia, and the private sector.

Make use of graphics

Graphic design is an art. Graphic artists are often needed to produce attractive, professional, and effective visuals. However, even data users with minimal artistic ability can produce visuals of sufficient quality by effectively using the graphical elements below.

Authors should exercise caution when using these graphical elements. For example, a percentage of the population is unable to distinguish between certain colors due to colorblindness (commonly red and green), and therefore colorblind-friendly color palettes should be used for most products. Color can also have either positive or negative cultural significance. These elements can also be overused, resulting in a distracting visual that is ultimately less functional.

Use **color** to draw attention to specific elements of the visual or subdue other elements of less importance. For example, a line graph may contain a series of lines and a single trend line. By coloring the trend line red and the other lines a light gray, the author can effectively draw attention to the most important element in the visual.

For instance, **symbols** can more accurately convey proportion than pie charts since pie charts are difficult to interpret accurately. Another common use of symbols is in graduated symbol maps, where the symbols are sized differently to reflect an absolute value (a larger size reflects a larger value, and vice versa).

The choice of **font** will also affect an audience's interaction with a visual. Maps, for instance, may use different fonts for labeling natural features (e.g., water bodies) and sociocultural features (e.g., place names). Font color and style (e.g., bold, italic) will also emphasize certain elements while subduing others.

Other examples of graphical elements to consider in visuals include: orientation, shape, line length, line width, size, curvature, added marks, enclosure, intensity, spatial position, and motion (Knaflic 2015, p. 105).

EXAMPLES BY TYPE

The remainder of this technical note will provide recommendations for producing effective, attractive, and meaningful visuals of census and survey data for three major types: charts, maps, and tables. These recommendations are in addition to the previously discussed good practices that apply to all visuals.

CHARTS

Chart types of varying complexity are useful for visualizing national statistics. For simplicity, this technical note will focus on four chart types: **bar charts**, **line charts**, **population pyramids**, and **pictograms**.

BAR CHARTS

Bar charts can show relative magnitude for discrete/categorical census and survey variables for the same time period or over time. Bar charts can be presented as single bars per category, stacked bar charts (with bars placed on top of others), and double bar charts (with side-by-side comparisons). Bars can also be presented vertically or horizontally.

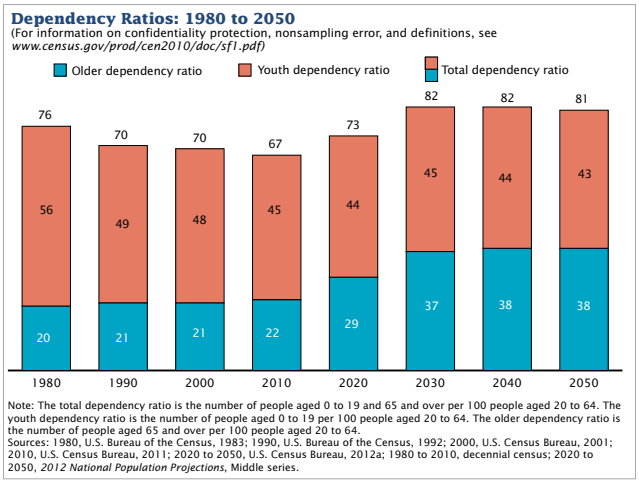
In Figure 3, for example, the total dependency ratio is separated into youth and older dependency ratios with a stacked bar chart. This technique shows that older dependency is increasing relative to youth dependency over time.

Advantages: Condenses large datasets into a simple format; compares several categories simultaneously; it is accessible to the public due to popularity.

Disadvantages: Subjective, depending on ordering of categories and scale formatting; can only display a limited number of bars before overcrowding.

Figure 3.
Visual Example: Bar Chart

Bar charts are useful for showing proportions. This example is a stacked bar chart with one set of bars (youth dependency) placed on top of another (older dependency). This bar chart successfully shows that older dependency has increased relative to youth dependency, supporting the author's narrative that the U.S. population is aging.



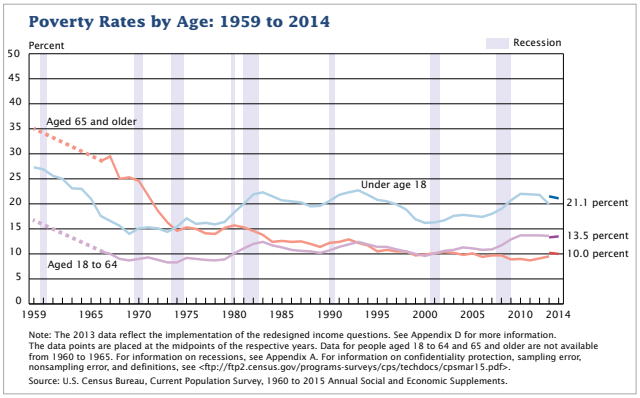
Source: U.S. Census Bureau, 2014.

LINE CHARTS

Line charts are useful for capturing trends in continuous census and survey data over time. For example, the line chart in Figure 4 shows the poverty rate as captured by censuses and surveys increasing and decreasing over time. The slope of the line presented should have meaning, whether used for temporal or nontemporal data.

Figure 4.
Visual Example: Line Chart

Line charts are useful for showing trends. In this case, poverty rates are broken down by age, showing how rates for certain groups have increased or decreased over time. Extra information is added by highlighting years in which the national economy was in recession. However, this information is subdued to avoid distracting from the primary data points. Additional notes are also provided explaining the appearance of the data series from 2013–2014, when the survey questions were redesigned.



Source: U.S. Census Bureau, 2015.

Advantages: View trends over time; useful for presenting several variables of the same category; can combine with other visual elements to highlight important areas along the trend.

Disadvantages: Can only use a few lines before overcrowding (even though it can use more lines than bars in a bar chart); requires many data points to show meaningful trends over time.

POPULATION PYRAMIDS

Population pyramids (e.g., Figure 5) are one of the most effective means of visualizing the structure of population in a census or survey. For example, a pyramid with a wider bottom than top (i.e., a younger population) will reflect a country with different needs than an evenly sized pyramid. The shape of a population pyramid can quickly tell the audience about the demographic trajectory of a country in the coming years.

Advantages: Visualize population structure; see disparities by age/sex; break down by specific subgroups, e.g., ethnicities or languages, or by geography.

Disadvantages: Lost granularity if large age cohorts are used; difficult to incorporate additional variables.

Pictograms

Pictograms are visual representations of data using small icons familiar to the audience. Each icon is sized proportionally (e.g., one icon represents 10,000 people) and multiple icons are used to show overall trends. For example, in Figure 6, the proportion of male to female military veterans is shown using icons to demonstrate the sex ratio disparity.

Advantages: Accessible by a broad audience; quick representation of general patterns or trends; good for mass media products.

Disadvantages: More abstract representation; typically not suitable for advanced data users or analytical reports.

GOOD PRACTICES

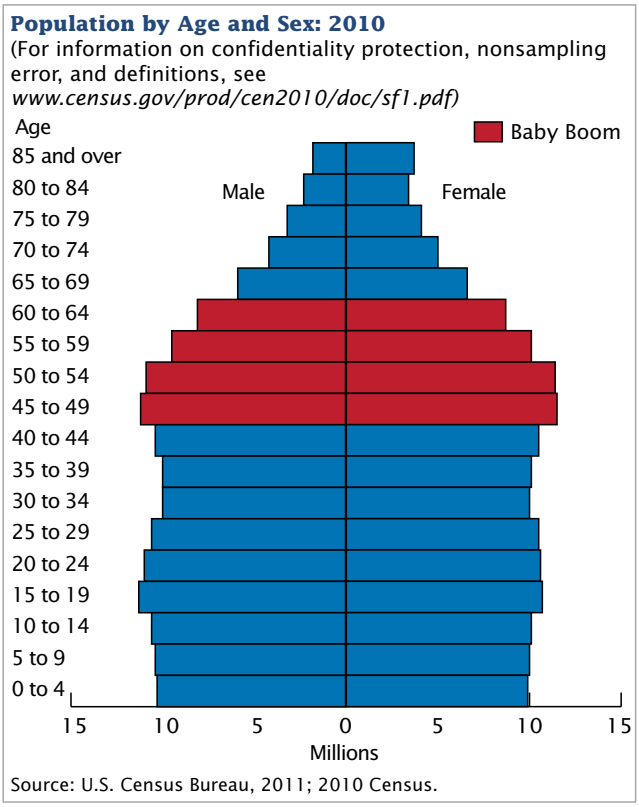
Note: These good practices are reflected in Figure 3 through Figure 6.

Show a trend or pattern: Each of these charts highlights something important to the author's story. If a chart is confusing or not particularly useful, do not include the chart in the product.

Unambiguous data: Each data element is distinct from the others by using different colors and line borders. For example, the trend lines in Figure 4 are three unique colors, and the stacked bars in Figure 3 are also unique colors and include borders around each bar. All of these figures use legends to clarify what each color represents. Figure 3 and Figure 4 also use labels.

Figure 5.
Visual Example: Population Pyramid

Population pyramids effectively visualize population distribution by age and sex. This visual also highlights a specific cohort, the "Baby Boomers," born between 1946 and1964.



Source: U.S. Census Bureau, 2014.

Accurate axes: The values along the x (horizontal) and y (vertical) axes should accurately reflect the chart graphics. For time series, position the data points relative to the length of time between each data point (e.g., Figure 4). Further, quantitative axes should usually start at zero.

Highlight key points: Use graphical elements to highlight points important to the author. For example, the red color in Figure 5 highlights a specific age cohort, while the gray color in Figure 4 notes years in recession.

Know your audience: Choose a chart type appropriate to your audience and message. Figure 6 is understandable by most audiences. Conversely, Figure 5 may be more suitable for subject matter experts than the public. Figure 3 and Figure 4 are common chart types but may still be difficult to interpret for audiences unfamiliar with the underlying data.

Practices to avoid

3D graphics: Three-dimensional (3D) graphics are typically not effective, distract the reader, and can obscure data. Do not use unless there is a third dimension to the data.

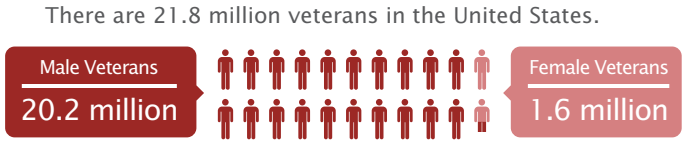
Pie charts: The human mind poorly interprets circular area and angles. Pie charts can therefore mislead, especially with more than two or three slices.

Excessive complexity: Avoid communicating too many ideas at once. The chart should stay focused on a core message and be easy for the audience to understand.

Misleading scales: Scale values should be chosen carefully and will depend on the type of data. Truncating scales (e.g., for data with a narrow range) can lead to misinterpretation or overemphasized variability.

Figure 6.
Visual Example: Pictogram

Pictograms are typically used for a wide audience. Simple icons, such as the ones shown in this example, are easily understood by readers at most education levels, including schoolchildren. In this example, one icon represents one million veterans.



Source: U.S. Census Bureau, 2012.

Maps

Maps present the spatial distribution of data. With maps, patterns are shown that are otherwise left hidden in data tables or charts. If designed well, a map can reinforce the narrative and support the author's argument. On the other hand, if designed poorly, a map may confuse the audience or cause the reader to lose interest in the product.

Broadly, maps can be divided into two categories: thematic and reference. Thematic maps, as shown in Figure 7, are used to illustrate a particular theme, including social and physical geography. Reference maps primarily show landmarks, physical features, places, and other information for navigation or context. This technical note focuses on thematic maps since they are most commonly used for presenting census and survey data.

ADVANTAGES

Spatial patterns: Show geographic patterns and regional disparities that are otherwise obscured in charts or tables.

Enhance the narrative: The patterns shown in maps can improve the author's narrative by providing additional areas for analysis.

Conveys information quickly: If well designed, a map can compress a tremendous amount of data into a meaningful graphic that can be easily interpreted.

Excites the audience: Due to the large amount of information conveyed, maps can draw readers in and generate extensive discussion on the meaning of the patterns shown.

DISADVANTAGES

Technically demanding: Producing maps typically requires Geographic Information Systems (GIS) and graphic design software to execute professionally.

Steeper learning curve: The tools required to map effectively require extensive experience to master. Producing interactive Web maps also requires Web site design expertise.

Limited number of indicators: Typically, a single thematic map should illustrate one indicator. Expanding to multiple indicators enhances the complexity and reduces the effectiveness of the map itself unless designed by a master artist.

GOOD PRACTICES

Note: These good practices are reflected in Figure 8.

The **categorization** in the legend supports the author's narrative. Specific break points are identified that capture the most important themes in the map.

The **color scheme** is appropriate. Numbers above zero are categorized using a logical color ramp, while numbers below zero are categorized using a distinct color.

The **labels** are unobtrusive but descriptive (state postal abbreviations). Label colors also vary between black or white depending on the darkness of the background. Labels are also placed to fall approximately in the center of the polygon but not touch its borders. In cases where that is unavoidable, labels are moved outside of the state with lines pointing to their correct reference.

Inset maps are provided for certain areas. These maps allow for additional detail that would otherwise be lost.

The **national average** is provided for reference to the audience.

The geospatial data (lines and polygons) used to produce this map are **simplified** to reduce geometric complexity.

PRACTICES TO AVOID

Too many maps: Only include maps that enhance the narrative. Not every variable needs

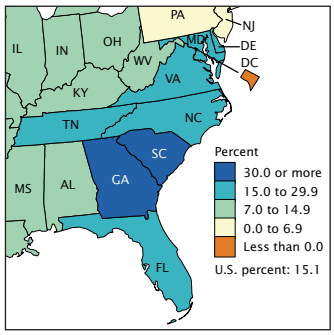
Figure 7.
Types of thematic maps often used in national statistics

Choropleth Map

These maps contain areas that are shaded or patterned in proportion to the statistical variable being displayed on the map. Data are aggregated over predefined areal units (administrative or statistical, e.g., census geography).

Optimal uses: Best used when data are standardized (e.g., rates), discrete, and are evenly distributed within well-defined areal units.

Design considerations: Number of categories should be limited (three to seven).

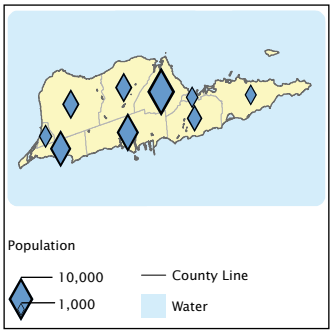


Graduated Symbol Map

These maps contain symbols varying in size to show their relative quantitative values; used with point/location data.

Optimal uses: Best used when there is substantial variation and range in the data. The goal is to show relative magnitudes of phenomena at specific locations. This map is also good choice for count data.

Design considerations: Should not be used for standardized data such as rates or percentages.

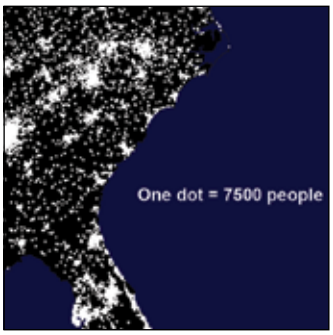


Dot Density Map

Uses dots to show the presence of a feature or occurrence; displays a spatial pattern and relative density. Individual dots can represent single or multiple occurrences.

Optimal uses: Best used for count data; can also show multiple data sets (by using different symbols or colors).

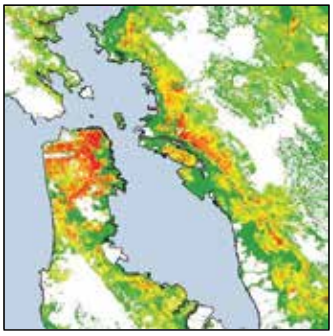
Design considerations: Requires additional tools (e.g., geocoding) to locate dots on the map; perceptual issues as well as design techniques (e.g., dot size, value, and arrangements) should be considered.



Dasymetric Map

A thematic map that uses symbols to spatially classify volumetric data; serves as an alternative to choropleth maps.

Optimal uses: Most appropriate to use dasymetric maps when the assumption of uniformly distributed phenomena is not met (e.g., population distribution). Interpretation can be facilitated when mapping technique is provided to map users. As with choropleth mapping, this technique is for depicting standardized data (e.g., rates).



Design considerations: This method is quite complex and time-consuming; the extent of the mapped areas rarely correspond to the boundaries of enumeration units.

Sources: U.S. Census Bureau, CDC, and USGS.

to be mapped, especially indicators that simply follow an existing known pattern (e.g., population distribution). Maps should enhance the narrative and show patterns otherwise obscured.

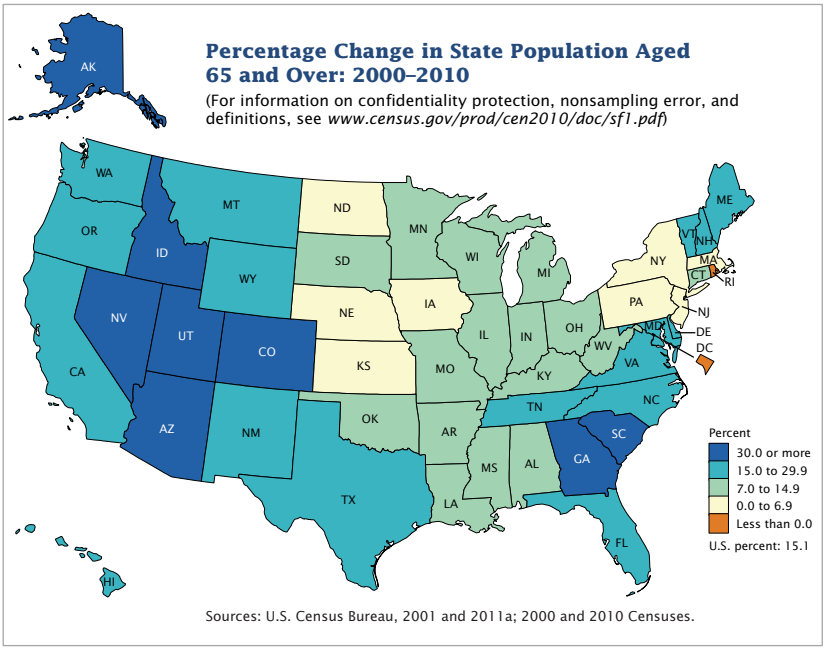
Color: Generally, a multihue color scheme is reserved for categorical (nominal) data. Use a single hue (e.g., blue) scheme for interval and ratio data. In the example, a multihue scheme is used since there is a natural zero point (greater than or less than 0).

Map elements: The north arrow and scale bar are usually unnecessary. In this context, the audience will almost certainly know the map is oriented with north to the top of the map, and the scale is not necessary to interpret the patterns. A north arrow and scale bar should be included in a reference map, however.

Crowding: Avoid cluttering the map with unnecessary information. Thematic maps should generally show only one variable. Labels should be kept simple and discretion should be used when labeling maps with many features.

Figure 8.
Visual Example: Maps

This map format is used by the U.S. Census Bureau across its products, reflecting the agency's corporate identity standards.



Source: U.S. Census Bureau, 2014.

Use of charts: In general, charts (e.g. pie, bar) should not be placed on top of map data. Charts reduce the benefits of using a map since the patterns become difficult to interpret. Instead of using charts on top of map data, consider splitting the map into a series with each map representing a single variable.

Poor categorization: The chosen break points should highlight patterns of importance to the author. Conversely, break points should not be chosen to conceal undesirable information or to provide a false indication of geographic variability where none exists.

TABLES

The exclusive focus of data presentation is often visualization (e.g., charts and maps). However, since the data table (e.g., Figure 9) is arguably the most common form of data presentation for census and survey data, care should be taken in its design.

ADVANTAGES

Greater accessibility: Maps and charts can only present a finite number of variables at once before overwhelming the reader. Conversely, tables can present many variables, levels of geography, and points in time. Tables also provide contextual information more effectively, such as margin of error.

More flexibility for users: Users can perform their own analysis on a data table, and no data point receives higher priority than another. Further, data users will expect access to data tables, not just the visuals or summary statistics derived from them.

More efficient than prose: Tables can display data in less space than if described in prose, and enables advanced users to easily find the numbers most relevant for their needs.

Popularity: Tables are perhaps the most common form of data presentation for national statistics. Most audiences can interpret the information presented in a table.

DISADVANTAGES

Lengthy analysis: Interpreting a data table may require the audience to invest a substantial amount of time. While strategic formatting can help highlight key points (such as bolding text or using another color), the information in the table should be complemented with summary statistics, maps, and charts to highlight important findings.

Weak advocate for the author's story: Tables do not elicit immediate reactions from an audience. Maps and charts are much more effective at quickly conveying the author's message.

GOOD PRACTICES

Note: These good practices are reflected in Figure 9.

The table is **formatted** consistently. For example, all numbers are evenly spaced, commas appear in the exact same location in the column, lines are the same thickness, and all items are aligned.

Figure 9.
Visual Example: Tables

Tables can present a large volume of data, so they must be designed carefully. These examples show how graphical elements are used to draw the audience to the statistical data. Graphics are kept minimal: e.g., there are no lines separating rows and the lines separating columns and the headings are kept thin.

Population Aged 65 and Over by Age: 1900 to 2050

(Numbers in thousands. For information on confidentiality protection, nonsampling error, and definitions, see *www.census.gov/prod/cen2010/doc/sf1.pdf)*

Source, year, and reference date	Total population	65 and over		85 and over	
		Number	Percent	Number	Percent
Census					
1900 (June 1)	75,995	3,080	4.1	122	0.2
1910 (April 15)	91,972	3,950	4.3	167	0.2
1920 (January 1)	105,711	4,933	4.7	210	0.2
1930 (April 1)	122,775	6,634	5.4	272	0.2
<Table Truncated for Example>					
2000 (April 1)	281,422	34,992	12.4	4,240	1.5
2010 (April 1)	308,746	40,268	13.0	5,493	1.8
Projection					
2020 (July 1)	333,896	55,969	16.8	6,693	2.0
<Table Truncated for Example>					

Note: Data for 1900 to 1950 exclude Alaska and Hawaii.
Sources: 1900 to 1940, and 1960 to 1980, U.S. Bureau of the Census, 1983; 1950, U.S. Bureau of the Census, 1953; 1990, U.S. Bureau of the Census, 1992; 2000, U.S. Census Bureau, 2001; 2010, U.S. Census Bureau, 2011; 2020 to 2050, U.S. Census Bureau, 2012b; 1900 to 2010, decennial census; 2020 to 2050, 2012 National Population Projections, Middle series.

Population Aged 65 and Over and Percentage Change by Region and State: 2000 and 2010

(For information on confidentiality protection, nonsampling error, and definitions, see *www.census.gov/prod/cen2010/doc/sf1.pdf)*

Region and state	65 and over		Change, 2000 to 2010	
	2000	2010	Number	Percent
United States	**34,991,753**	**40,267,984**	**5,276,231**	**15.1**
Northeast	7,372,282	7,804,833	432,551	5.9
Connecticut	470,183	506,559	36,376	7.7
Maine	183,402	211,080	27,678	15.1
Massachusetts	860,162	902,724	42,562	4.9
New Hampshire	147,970	178,268	30,298	20.5
New Jersey	1,113,136	1,185,993	72,857	6.5
New York	2,448,352	2,617,943	169,591	6.9
Pennsylvania	1,919,165	1,959,307	40,142	2.1
Rhode Island	152,402	151,881	–521	–0.3
Vermont	77,510	91,078	13,568	17.5
<Table Truncated for Example>				

Sources: U.S. Census Bureau, 2001, *Census 2000 Summary File 1*, Table P12, Washington, DC, available at <http://factfinder2.census.gov/>, accessed on February 20, 2012; U.S. Census Bureau, 2011, *2010 Census Summary File 1*, Table PCT12, Washington, DC, available at <http://factfinder2.census.gov/>, accessed on February 20, 2012.

Source: U.S. Census Bureau, 2014.

All numbers **sum** to the total, where expected, both vertically and horizontally.

Trends over time are clearly visible, thanks to the use of percentages in both tables to normalize the total population changes.

The data chosen for these tables **support the author's narrative** that the U.S. population is aging. Only a few variables are included in the example table to improve readability.

The **time series** is clearly noted. While the title of the upper table states "1900 to 2050," the census and projection dates vary depending on the decade. Those deviations are noted next to each year in the first column.

PRACTICES TO AVOID

Distracting formatting: Limit the use of lines in the table, and keep all necessary lines thin. Also, separate column headers from the data and only emphasize a few items.

Information overload: Choose the data to include in the table wisely. Like every visual, the table is supposed to support the author's narrative. There is no need to include every variable since the full tables should be available for download from the NSO Web site or attached to the main document as appendixes.

Inconsistent presentation: Each table should present a consistent set of information, by year, by geography, and/or by theme. If presenting data by geography, do not exclude equal units (e.g., provinces or districts) without explanation.

REFERENCES

Cairo, A., *The Functional Art: an Introduction to Information Graphics and Visualization,* New Riders, 2013.

Centers for Disease Control and Prevention (CDC), *Types of Thematic Maps*, available at <www.cdc.gov/dhdsp/maps/gisx/resources/maps4.html>, accessed on February 22, 2017.

Few, S., *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, 2nd ed., Analytics Press, 2012.

Knaflic, C.N., *Storytelling with Data: a Data Visualization Guide for Business Professionals*, Wiley, 2015.

Tufte, E.R., *The Visual Display of Quantitative Information*, 1st ed., Graphics Press, 1983.

United Nations, *Fundamental Principles of Official Statistics*, October 28, 2013, available at <https://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx>, accessed on February 22, 2017.

U.S. Census Bureau, "How Do We Know? A Snapshot of Our Nation's Veterans," 2012, available at <www.census.gov/library/visualizations/2012/comm/veterans.html>, accessed on February 22, 2017.

____, P23-212, *65+ in the United States: 2010*, U.S. Government Printing Office, Washington, DC, 2014, available at <www.census.gov/library/publications/2014/demo/p23-212.html>, accessed on February 22, 2017.

____, Current Population Reports, P60-252, *Income and Poverty in the United States: 2014*, U.S. Government Printing Office, Washington, DC, 2015, available at <www.census.gov/library/publications/2015/demo/p60-252.html>, accessed on February 22, 2017.

U.S. Geological Survey (USGS), "Dasymetric Mapping: An Alternative Approach to Visually and Statistically Enhancing Population Density", 2016, available at <http://geography.wr.usgs.gov/science/dasymetric/index.htm>, accessed on February 22, 2017.