SYMBOLOGY AND MULTI-PAGE PRINT LAYOUTS IN QGIS

Basics in QGIS

ABSTRACT

This lesson covers symbology and print layouts. You will learn how to manipulate choropleth displays, generate charts, create overview maps, and several other techniques. This lesson works with data from the Centers for Disease Control and Prevention and the US Census Bureau TIGER/Line database.

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CSSCR Workshops (2018)

TO USE THIS DOCUMENT

The document is arranged in sections, which can be overviewed in the Table of Contents. It is subsequently broken down as an outline.

Descriptions and purposes are listed in black

Instructions for execution are highlighted in purple

Questions are highlighted in burnt orange

System dialogue will often be highlighted in blue

YOU WILL NEED

- QGIS 3.2 (2.8 and 2.1.8 are acceptable, but some menu options and names differ)
    - Workflow in QGIS 3.0 has not been tested. As with 2.8 and 2.1.8, some menu options may differ
- Notepad ++, KomodoEdit, or your preferred IDE
- Notepad

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GETTINGS STARTED

1. Adding data
   a. Go to <tinyurl.com/uwayatut>
      i. Navigate to QGIS Tutorial page and download the "Symbology in QGIS" file archive
         1. Extract the file to your U Drive (flash drive, or preferred location)
   b. In QGIS, click Layer → Add Layer → Add Vector Layer
      i. Add cb_2017_us_state_20m.shp to the QGIS console
   c. Save this project as "Hepatitis.qgz"
   d. Open "HepABCState.csv" in Microsoft Excel or other spreadsheet viewer
      i. The first column indicates the state, which we will use as the cardinal for a "join" function
      ii. Subsequent columns indicate the number of individual people infected, and the rate of infection
         1. AN_2012 means "Hepatitis **A** Infection **N**umber in 2012"
         2. AR_2012 means "Hepatitis **A** Infection **R**ate in 2012"
      iii. These columns progress from Hepatitis A through C, and from 2012 through 2016
2. Importing CSV files
   a. CSV stands for "Comma Separated Values"
   b. QGIS does not automatically read CSV files, and often does not import Excel spreadsheets easily, so it is necessary to take some extra steps to make the CSV file readable
   c. QGIS does this with "CSVT" files. CSVT files provide instructions to QGIS about how to read the CSV file by assigning a data type to each column
   d. Look at the HepABCState.csv file
      i. The first column is a "String", or text
      ii. The second column is an "Integer", or whole number – we can't have half people
      iii. The third column is a "Float", or number that contains a decimal
      iv. The pattern of "Integer, Float" repeats for Hepatitis A from 2012-2016, and then repeats for Hepatitis B and C
      v. You may also notice several entries that say "U"
         1. This indicates "unknown", either there are no cases reported, or there was no data available at that scale, as is often the case with Washington DC
   e. In the file folder, open the file "HepABCState_W.csvt" in Notepad++, KomodoEdit, or your preferred IDE and observe the structure
   f. Close the file, and rename it "HepABCState.csvt"
      i. QGIS will only know to tie the CSVT file to a CSV if their names match exactly
   g. In the QGIS console, click **Layer → Add Delimited Text Layer**
      i. Make sure that the radio button for CSV (comma separated values) is selected

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ii. Click the **[…]** button after File Name
iii. Select "HepABCState.csv" and click **Open**
iv. The Sample Data window should display a table with the "State", "AN_2012", etc. entries listed as headers, and "Alabama" listed as the first
v. Do not change anything in the Records and fields options
vi. In the Geometry definition, click the radio button for No geometry
vii. The **[Add]** button should become live, click it!
viii. Close the Data Source Manager window

h. Right-click the HepABCState entry in the Layers list, and then click **Open Attribute Table**
   i. You should now see a table featuring all states and years of available data
   ii. Scroll to the right – you may see some "null" entries
      1. When we opened the CSV file in excel, you may have

i. Right-click the "cb_2017_us_state_20m.shp" entry and click **Rename Layer**
   i. Rename the entry "States"

j. Right-click the "States" entry and click **Properties**
   i. Click the **Joins** tab
   ii. Click the "+" sign
      1. In the Add Vector Join window, make the following selections
         a. Join layer: HepABCState
         b. Join field: State
         c. Target field: NAME
         d. Click **[OK]** and **[OK]** again

3. Prepping for Cartography
   a. Right-click the "States" entry and click **Open Attribute Table**
      i. Scroll to the right, you should now see all of the old column headers embedded within the new shapefile
         1. Right-click the "States" Layer listing, and click **Copy**
         2. Right-click anywhere in the Layer listing, and click **Paste Layer/Group**
         3. Drag the new copy to the top of the list
         4. Repeat steps 7 through 9 three more times, so that you have 4 total copies of "State" in the list
         5. Rename the top layer entry "Hep A 2012"
         6. Rename the second layer entry "Hep A 2014"
         7. Rename the third layer entry "Hep A 2016"
         8. Rename the fourth layer entry "Pie Chart"
         9. Save the project!

MAKING A CHOROPLETH DISPLAY

A choropleth map utilizes color contrast based on values to display variation in data. Data can be categorical or quantitative. For now, we will work with quantitative data. The final steps in the previous section, which made copies of the original HepatitisST shapefile, will facilitate the process of building multiple maps and saving choropleth displays. The rationale behind this will become more clear as we generate cartographic displays.

1. Hepatitis A Choropleth Display
   a. Click the Symbology tab
   b. In the drop menu that currently says Single Symbol, click the down arrow
      i. Select Graduated
      ii. Under Column, select "HepABCState_AR_2012"
      iii. Set Precision to "2"
      iv. Set Color ramp to white and red
         1. If the color ramp is not already set to those colors, click anywhere on the ramp, and it will open a window
            a. Set Color 1 to white, and Color 2 to red
            b. Make sure that Type is set to Continuous
            c. Click [OK]
      v. Set Mode to Natural Breaks (Jenks)
      vi. Leave Classes at "5"
      vii. Click the [Classify] button
      viii. Click [OK]
   c. Repeat these steps for the "Hep A 2014" and "Hep A 2016" layers
   d. Look at the Layers list and observe the numbers
      i. 2016 has an entry for 20…. What's going on, here?
         1. Open the attributes table for 2016
         2. Scroll to the Hepatitis A rate for 2016 column, and click the column header it until the 20 is at the top (sort descending)
         3. Which state has a rate of 20? _____
   e. Let's not forget a data source! Add "Source: Centers for Disease Control and Prevention Viral Hepatitis Statistics and Surveillance, accessed January 2018"

We've found something strange. Take a look at the article in this link to read more about what happened.

2. Working in the print layout window
   a. Click Project → New Print Layout
   b. Name the Layout "Hepatitis A Atlas"
      i. This will open a new window
      ii. Click Add Item → Add Map
         1. You will now have a "+" cursor

       2. Click and drag the cursor beginning at marker 20 along the top across to marker 120, and down to marker 150

       3. The zoom may be a little off

         a. Go back to the project window, and draw a box around the view that includes only the continental US and Puerto Rico

       4. Go back to the print layout window and look below the Items box

         a. Click Item Properties, and scroll to the Extents region

           i. Click the **[Set to map canvas extent]** button

       5. Scroll up to the Layers region in the Item Properties pane

         a. Click Lock Layers and Lock Styles for Layers

   c. Click back to the project window, and then center Alaska

     i. Click **Add Item → Add Map** in the print layout window, and draw a small box to the lower left side of the continental US display

       1. Be sure to lock the layers!

     ii. Repeat this step for Hawai'i, placing a small box to the right of Alaska

       1. Lock the layers!

     iii. In the Items box

       1. Double-click Map 1, and rename it "USA"

       2. Double-click Map 2, and rename it "Alaska"

       3. Double-click Map 3, and rename it "Hawai'i"

     iv. Now let's add some boxes to clarify context

       1. Click USA in the Items box

       2. In the Item Properties, fill the check box for Frame

       3. Repeat these steps with Alaska and Hawai'i

       4. Click the Select/Move Items button – it is the third button from the top on the left side of the layout window, and has a white arrow

         a. Drag the newly framed Alaska and Hawai'i boxes to the place in the lower left side of the display that looks neat

         b. Save the project!

  d. **Click Layout → Insert Pages**

     i. Insert 3 pages

     ii. Click **[OK]**

To keep things neat, we'd like for all three of our years to look the same, so we'll copy what we've already created.

  e. In the Items list, click the USA item, and copy it, and paste it onto the next two pages

     i. Select and drag these new maps into the same position as the original

     ii. Lock the original

  f. Repeat these steps for the next two pages, and be sure to lock the originals!

  g. In the items list, rename each layer to include the number that corresponds to its page

  h. Now sort the list items so that they are clustedred together by page

     i. Make sure that Alaska and Hawai'i are positioned above the USA in the list

        ii.   Lock the positioning of all these elements by filling the checkbox under the padlock in the Items list

Now that we've arranged subsequent pages, let's move on to filling them with the appropriate content.

    i.   Scroll to the second page
        i.   Click Hawai'i2, Alaska2, and USA2, and uncheck Lock Layers and Lock Styles for Layers
        ii.   Click back to the project window, and deactivate the Hep A 2012 layer
        iii.   Click back to the print layout window, and click the USA2 box
            1.   If it does not automatically update, make sure that the layers are unlocked, and click the **[Update preview]** button
            2.   You should see some slight changes. Repeat these steps for Alaska2 and Hawai'i2
            3.   LOCK THE LAYERS AGAIN WHEN YOU ARE DONE
        iv.   Repeat these steps for the third page – Lock the layers when you are done!!!
        v.   Maybe this is a good time to save your progress, too!!!

We've made a lot of progress. Next we'll add some essential map elements, starting with a legend.

3. Adding map elements
    a.   Click Add Items → Add Legend
    b.   Click and drag to draw the element, just like you did the maps
    c.   Looks like it added more than we need, so we'll have to remove some elements
    d.   In the Legend pane, uncheck to box for Auto update
        i.   Click the HepABCState entry at the top of the Legend Items list
            1.   Click the red "-" button to remove it
            2.   Repeat this step for Hep A 2014, Hep A 2016, Pie Chart, and States legend list entries
        ii.   In the Main properties region, enter the title "Rate per 100,000"
        iii.   In the Legend items region, right-click Hep A 2012 under the main header, and click hidden
            1.   This will remove the title for the shapefile
    e.   Copy and paste the legend onto Page 2 and Page 3
        i.   Click the green "+" button, and add Hep A 2014
        ii.   Remove Hep A 2012
        iii.   Hide the title for the Hep A 2014 entry
    f.   Repeat these steps for 2016
    g.   Save the project! – If at this point you need to close the project and reopen the print layout, you can find it under **Project → Layouts → Hepatitis A Atlas**

Having a title is essential for building context.

    h.   **Add Item → Label**

       i. Draw a box for the label

      ii. In the Main Properties text box, type "Hepatitis A Rate of Infection in the United States, 2012"

     iii. Under Appearance, set the Horizontal Alignment to Center

     iv. Click Font

         1. Increase the font size to 20

            a. Stretch and adjust the text box until it looks and fits where you would like for it to be

            b. Copy the text box, and then repeat the title for the next two pages, but be sure to adjust the year to reflect the data

A scale bar isn't totally necessary given the content of this data, but we'll practice adding one anyway.

       i. Make sure that the USA item in the Items list is selected

      j. **Add Item → Scale Bar**

      k. Draw the box from about Louisiana to Maine, beginning in the Gulf of Mexico

        i. Set the units to miles

        ii. Alaska and Hawai'i aren't quite to that scale, so we'll need bars for those two as well

      l. Make sure that the Alaska item is selected in the Items list

        i. Add the scale bar, and set the unit to miles

           1. It's a little crammed, change the font to a smaller size until it fits and is legible

     m. Repeat these steps for Hawai'i

        i. For Hawai'i, the text will be very small, and you may need to adjust the Height of Segments, as well

No need to repeat these steps for subsequent maps, since this is only for practice. We'll move on to the next section – adding charts to maps.

    4. Pie charts on maps

      a. Unlock USA4, Hawai'i4, and Alaska4

      b. Make sure that all other layers are locked

      c. Deactivate the 3 Hepatitis layers

      d. Make sure that the continental US is centered -

      e. Double-click the "Pie Chart" layer entry

        i. Set the Pie Chart Layer to a color that you like

           1. I generally pick a tan or olive, as it is unobtrusive

        ii. Click the Diagrams tab, select Pie Chart

        iii. Let's look at the raw number of Hepatitis A, B, and C cases from 2016

           1. Select "AN_2016", "BN_2016", and "CN_2016"

           2. Double-click the color box to the right of AN_2016, and enter the HTML notation to the corresponding legend entries

              a. AN_2016: #FFC200 (amber)

              b. BN_2016: #0000ff (blue)

c. CN_2016: #7f1734 (cherry)
   i. Click the [Apply] button
d. These are quite large. We can adjust the size to make a more sensible map
   i. Click the Size tab
   ii. Set the size roughly to 7 – whatever keeps the Midwest pie charts visible
      1. Click [Apply]
   iii. Which state appears to not have any data? _____
f. Head back to the atlas, and the final page should have updated with all of the pie charts
   i. It should look good for the most part, except for the small and clustered states of the east coast
      1. Lock layers and Lock Styles for Layers for Hawai'i4, Alaska4, and USA4
      2. Click back to the data view, and at the top right corner of the window, select Restore Down
         a. Resize the window so that it is roughly the shape of a vertical rectangle
         b. Zoom so that the extent as far west as the western Pennsylvania border, as far south as the Virginia border with North Carolina, and as far north as Maine
         c. Click back to the print layout window, and draw a map that is roughly the same shape as the project window
         d. Feel free to adjust pie chart sizes based on this level of zoom
         e. When you are done, lock the layer and the style
      3. Add an overall title to the map page: "Proportion of Hepatitis A, B, and C infections by State in the USA in 2016"
      4. Draw a legend
         a. Remove any extraneous layers
         b. Change the title text of the "Pie Chart" layer to "State"
         c. Adjust the title text for the infection numbers to something more intuitive, such as "Hepatitis A Infections", "Hepatitis B Infections", etc.
         d. Add a title: "Proportion of Infections"
            i. Here you may see a text box that says "Wrap text on"
            ii. Sometimes titles for legends can be long, especially given the limited space on a layout page
            iii. "wrapping" text simply means starting a new line for text
            iv. Practice the with the following:
               1. Copy the title text from step 3 above: "Proportion of Hepatitis A, B, and C infections by State in the USA in 2016"
               2. Paste it into the title box for the legend

3. See how it overshoots the page
4. Put "$" in the Wrap text on box
5. Now place a "$" after the word "Hepatitis" in the Title text box
6. Choose another good break point
7. Be cognizant of spaces. Sometimes it is necessary to delete them in order to align your text properly
8. Reset the Title to "Proportion of Infections"
9.

g. Since we have a zoomed subset of a region that is also visible on the main map, it may be helpful to include an overview that indicates the zoomed area
  i. Click USA4 in the Items list
    1. In Item Properties, scroll until you find Overviews, and then click the green "+' sign
    2. For Map frame, select the entry that corresponds to the zoomed portion of the Mid Atlantic and New England
    3. Click the red box to the right of Frame style, and set the style to Red Outline
    4. Feel free to adjust the opacity if the red frame feels too punchy
    5. Change the frame color of the zoomed portion of the map to match that of the overview frame
  ii. Add a north arrow
    1. Click **Add Item → Add Picture**
    2. Click the down arrow on the Search directories region
      a. Once the previews are loaded, double-click a simple north arrow
      b. Set the fill color and stroke color to something that is easily visible
h. Now add a label to an empty space in your layout
  i. In the Main properties text box, copy and paste the following text

<h2> Proportionally, the number of Hepatitis A, B, and C infections vary across the US </h2>

Hepatitis B tends to be the most common type of infection in the South and Midwest

[Fill in your own talking point

[Fill in your own talking point]

  i. You may have noticed that the font has changed to Times New Roman. This is the HTML default font in QGIS

j. You can set the fonts using HTML tags to match the font stylings already used in the project
k. You can also change the font stylings within the project to Times New Roman – style it the way you like it!

MAPPING CONVENTIONS

A cartographic production should include the following

1. Title
2. Scale indicator
3. Legend
4. Orientation (or north arrow)
5. Display Borders/Frames (and sometimes a neatline)
    a. A frame around the map indicates the cutoff extent of a display
        i. Leaving Alaska and Hawai'i unframed on the previous maps could potentially lead to some geographic misunderstandings of where they are positioned in relation to the continental US
    b. A neatline is often, but not always, featured on map layouts. A neatline encloses the extent of the map layout, including insets, legends, and other elements
        i. It can be used to help guide the designer to abide page margins, space and position elements evenly, and generally provides a more cohesive feel for a map production
6. Source info
    a. Data source – who published the data?
    b. Date the data was created and/or accessed
    c. Name of the map author(s)
    d. Date the map was created
    e. Map projection
7. Locator maps (insets or overviews)

Do however exercise discretion. These are conventions – not hard rules. Sometimes a north arrow may not be necessary, or perhaps a scale bar will cause unnecessary clutter on a map that does not prioritize scalar data anyway. Sometimes it's helpful to add a subtitle or brief talking points directly to the display.

Knowing what you do of these conventions, practice adding these elements to your map. Consider that since this is an atlas and all of the data sources are the same, you may only need to list the source, author and other information one time. Just make sure that your information listings accurately reflect the reality of how your data has been used and where it was produced.