## **School Redistricting Example**

Maptitude Workshop — March 31, 2018

**Background:** Washington, DC has nine public high schools: Anacostia, Ballou, Cardozo, Coolidge, Dunbar, Eastern, Roosevelt, Wilson, and Woodson (more on DC Public Schools <u>here</u>). These schools have vastly differing demographics in terms of overall number of students, racial and ethnic background, and socioeconomic status, so determining equitable catchment areas is difficult. Not discussed here will be DC's charter school system (more <u>here</u>) or specialized schools like the Duke Ellington School of the Arts, since these schools do not use catchment areas to determine attendance.

**Objective:** Learn to use Maptitude's Territory Tool to redistrict DC public high school catchment areas and visualize corresponding changes in school demographics in real time.

Input Data: DCSchools.shp, an ESRI shapefile containing information about DC's 179 census tracts, including:

- SCHOOL, the DC public high school that students from that census tract attend;
- STUDENTS, the current number of students residing in the census tract;
- PROJ2, the projected number of students living in the census tract in 2020; and
- PROJ5, the projected number of students living in the census tract in 2023.

#### **Contents:**

§1: Importing and Preparing an ESRI Shapefile for Analysis	.2
§2: Choropleth Mapping and Current Student Attendance	.5
§3: Introduction to Maptitude's Territory Tool	.8
§1. Starting the Territory Tool	.8
§2. Deleting Census Tracts from Territories	2
§3. Computing Statistics of All Territories1	4
§4. Transferring Students from One Territory to Another	5
§5. Removing Entire Territories	6
§6. Creating New Territories1	7
§4: Extensions	9

# **§1: Importing and Preparing an ESRI Shapefile for Analysis**

**Purpose:** One of Maptitude's strengths is its ability to import files of several formats. This section outlines the procedure for importing an ESRI Shapefile into Maptitude and addresses changing input data types, one of the most common issues of data import.

- 1. Open Maptitude on your PC.
- 2. Click the folder for File -> Open to open DCSchools.shp. Navigate to the directory where you saved the shapefile. When you have found your directory, select the file type ESRI Shapefile (\*.shp) to view shapefiles in your directory. Select DCSchools.shp and click "Open."

- → × <b>∧</b> 🖡	« Ma	aptitude Workshop > SampleData > !	SampleData2	ن v	Search SampleData	12	م
						-	
Organize • Ne	w folde	r			a== a==	-	
Quick access Desktop Downloads Documents Pictures OS_Install (C:	^ * * *	Name DCSchools.shp DCSchools2.shp DCSchoolsad83.shp DCSchoolsmad83.shp DCSchoolsmag84.shp	Date 3/20 3/24 3/24	e modified )/2018 6:07 PM 4/2018 10:52 A 4/2018 11:20 A 4/2018 11:20 A	Type SHP File SHP File SHP File SHP File	Size	582 k 582 k 582 k 582 k
<ul> <li>This PC</li> <li>AP Larson (E:)</li> <li>2016Fall</li> </ul>							_
2017Fall	v	<ul> <li>○ Open as read-only</li> <li>○ Open for exclusive access</li> </ul>	<mark>⊡ A</mark> dd to m	ар			
F	File <u>n</u> am	ne:		~	Esri Shapefile (*.shp	o)	~

3. You will see a new window allowing you to adjust properties of your file as you import. Check the box for "Import Layer," and give your layer name an appropriate title.

Esri Shapefile		?	×	
File	E:\2018Spring\Maptitude Workshop\Sa		OK	
Version	1000		Cancel	
Extent	(-77.119759,38.791645)-(-76.909393,38.9	9958	45)	
Туре	Polygon	<u>C</u> o	ordinates	5
Layer Name	Redistricting 1			
	🗹 Import layer			
Import Options				
	Eliminate duplicate boundary lines			
	If areas overlap			
	Merge the overlap with one of the	m		
	O Create a new area			
	O Maintain overlapping areas			

4. By selecting the "Import Layer" option, you can save your ESRI Shapefile in a Maptitude-compatible format. Save this file in your directory with the name of your choice. Click "Save."

At this point, a map of Washington, DC should appear in Maptitude.

2 Save As				×
← → × ↑ 📜 « 2018Spring > Maptitude Workshop > SampleDa	ta v Ö	Search SampleData	1	٩
Organize   New folder				?
2016Fall ^ Name ^	Date modified	Туре	Size	
2017Fall     SampleData2     2017Spring	3/24/2018 11:48 A	File folder		
2017Summer				
2018Spring				
bin				
Business Analyst				_
				>
File name: Redistricting 1				~
Save as type: Geographic File (*.dbd)				$\sim$
∧ Hide Folders		Save	Cancel	

- 5. When importing the ESRI Shapefile, all fields including the current and expected student populations — have been imported as text. These should be changed to an integer (numeric) format. Select Dataview -> New Dataview to view the data corresponding with each census tract. As you scroll rightward, you will see the fields SCHOOL, STUDENTS, PROJ2, and PROJ5.
- Click the Modify Table button. This dialog allows you to change the data types of fields as necessary. Change STUDENTS, PROJ2, and PROJ5 to a numeric field by clicking the drop-down menu under "Type" and selecting "Integer (4 bytes)." Click "OK" to save changes.

Now that the ESRI Shapefile has been successfully imported into Maptitude, it is time to visualize the current distribution of the student population.

able structure									
Field Name	Туре	Width	Deci	Index	Default	Format	Display Name	^	OK
MTFCC	Character	80				None			Cancel
UNCSTAT	Character	80				None			Add Field
ALAND	Real (8 bytes)	19	11			None			- Dron Field
AWATER	Real (8 bytes)	19	11			None			DTobulet
NTPTLAT	Character	80				None			Move Up
NTPTLON	Character	80				None			Move Dov
SCHOOL	Character	80				None			
PROJ2	Integer (4 byt 💌	8				None			Attach <u>C</u> oc
PROJ5	Integer (4 bytes)	8				None			D <u>r</u> op Cod
STUDENTS	Integer (4 bytes)	8				None			Export Coo
								~	
ield Descriptic	n								Aggregati

# **§2:** Choropleth Mapping and Current Student Attendance

**Purpose:** Choropleth mapping is a fundamental skill in GIS. This choropleth map will allow the viewer to see and understand the spatial distribution of DC public high school students at a glance.

- 1. Create a choropleth map of current enrollment. Select the map icon and input the following information:
  - a. Field: STUDENTS
  - b. Method: Optimal Breaks. Feel free to try others.
  - c. No. of Classes: 8.

Click "OK" to view.

2. Change the default color scheme of the map. Select the map icon , go to the "Styles" tab, and change the color options under "Color Sets." Click "Apply" to view the changes and "OK" to save.

	a class	(22)		
	149 and below	(23)		Style
	280 to 399 (28	)		Copy Patter
	400 to 599 (37	)		
	600 to 779 (29	)		Reset Text
	780 to 999 (16	)		
	1000 to 1399 (	12)		
	1400 and abov	re (4)		
149	and below (23)			
Color	Sets			
<< P	revious Next	:>> SI	wap Start	and End
From			✓ via	~
riom			via	

GIS Workshop: DC School Redistricting

3. Change the color of the default border between census tracts. Double-click the box to the left of DC Schools in the Display Manager. This will open a window allowing you to change the border color, style, and width.

- 4. Create a map of current school catchment areas in DC. Select the map icon <sup>▶</sup> and input the following information:
  - a. Field: SCHOOL
  - b. Method: List of Values
  - c. No. of Classes: 9.



## **§3: Introduction to Maptitude's Territory Tool**

**Purpose:** Use Maptitude's Territory Tool to create school catchment areas with balanced sizes and learn basic functions within the Territory Manager.

### **§3.1 Starting the Territory Tool**

1. Select the New Map button 🗋 to open the Create-A-Map Wizard. Select "Territories" and click "Next."

2. Select "From my existing area layer." Your file should be highlighted automatically. Click "Next."

Create-a-Map Wizard		?	×
	Create a New Map Map of my own data General purpose map File Area to Display in the Map Region USA (HERE) - 2016 Quarter 4	Browse	
Territory Wizard	Cancel <back next=""></back>	Finish	(211) ×
	Create Territories		
	O Interactively from areas in a map		
	O From my territory table	Browse	
	• From my existing area layer		
From my existing area layer lets you use an area layer in an open map as your territories. The layer cannot be one of the default map layers. This is a good choice if you have an existing territory layer you want to work with and modify.	Redistricting 1        O From my existing point layer		
	Cancel <back next=""></back>	Finish	

- 3. Since DC data is available at the census tract level, update the Territory Wizard with this information.
  - a. Map: The United States
  - b. Geography Layer: Census Tract
  - c. Geography Field: Tract
  - d. Territory Field: SCHOOL

Click "Next."

Territory Wizard			?	Х
	Map Settings Map The Geography Layer Cens Geography Field Tract Examples 6911	United States		
Choose the Geography Layer that the Territories will be based on. It is recommended to start with the mailest geographical area that will be represented within your territories are built from courties, then thome notatic/IP Codes and some arb built from courties, then thome notatic/IP Codes are the	In Region USA Area Layer Settings Territory Field SCH Examples Ball	(HERE) - 2016 Quarter 4	] ~ 	
Geography Layer.		copy Attributes Attributes	Finis	h

4. Then, select a Tracking Field. This can be filled with any of Maptitude's built-in datasets. To approximate the current high school attendance in DC, add the number of DC residents ages 15-19.

Click the green plus (+) sign -> Tracking Fields -> Add Geography Layer Fields -> [Age 15 to 19]. Once [Age 15 to 19] is highlighted, click "OK."



5. A map showing DC and its corresponding high school catchment areas should appear.



### **§3.2 Deleting Census Tracts from Territories**

1. The area surrounding the U.S. Capitol is designated as a census tract in Ballou High School's catchment area, which is located at the southern end of DC. Technically, no students are recorded as living in the census tract that contains the U.S. Capitol and White House. Remove this census tract from Ballou's catchment area.

View the Territory Manager window and select the following:

- a. Territory: Ballou
- b. Select: Areas to remove
- c. Geography: Census Tract

Ferritory Manage	r - Redistricting 1 Territories			×
$\frac{1}{2} \cdot f_x$	🚫 📀 🔩 🔩 🔍 🕄 🖬 -		4	<b>k</b> -
Territory	Ballou	~		
Select	Areas to remove	~		
Geography	Census Tract	~		
Territories	Changes			
	[Age 15 to 19]		$\sim$	
Anac	ostia	5,	828	^
Ballo	bu	3	288	
Card	ozo	8,	562	
Cool	idge	4,	363	
Dunk	bar	3,	486	
Easte	ern	2,	071	~

2. Click the "Select by Pointing" tool 🐩 in the top left hand corner of the Territory Manager and select the census tract that contains the U.S. Capitol. Your screen should look like this:



3. After selecting the tract to delete, click the green check mark 
to remove the tract. Click the red X
to undo any changes.

#### **§3.3 Computing Statistics of All Territories**

- 1. Because the ultimate objective is to balance student attendance across all nine DC public high school catchment areas, it would be useful to compute the grand mean of students across all 9 catchment areas. Maptitude makes this statistic simple.
- 2. Visit Dataview -> New Dataview to see the current balance of students.
- Calculate the mean number of students across all catchment areas by clicking the "Compute Statistics" *x* button. This will display the grand mean.

-	wiew1 - Tei	mones						
	ID	Area	rerritory				[Age 15 to 19]	
	1	9.76 /	Anacostia				5828	
	2	3.24 E	3allou				3288	
	3	8.28 0	Cardozo				8562	
	4	8.32 0	Coolidge				4363	
	5	9.06 [	Junbar				3486	
	6	5.54 E	fastern				2071	
	7	3.19 F	Roosevelt				1331	
	8	10.38 \	Vilson				7762	
	11	2.30 \	Noodson				1748	
		- Territo	ories Statistics					
🖬 Da Field	ataview2		Count	Sum	Minimum	Maximum	Mean	[Std. De
∎ Da Field D	ataview2		Count 9	Sum 47.00	Minimum 1.00	Maximum 11.00	Mean 5.2222	[Std. De 2.97
ield D D	ataview2		Count 9 9	Sum 47.00 60.07	Minimum 1.00 2.30	Maximum 11.00 10.38	Mean 5.2222 6.6744	[Std. De 2.97 2.95

#### §3.4 Transferring Students from One Territory to Another

- 1. A glance at the Territory Manager's Territories window reveals that Roosevelt High School has the fewest students. Use the Territory Manager to transfer additional students to its catchment area.
  - a. Territories: Roosevelt
  - b. Select: Any area & prevent overlapping territories

Select the "Changes" tab to see how the student population changes with edits to the school catchment areas.

Territory Manager - DC Schools 1	Ferritories		×
$  \cdot f_x  \otimes \bigcirc$		8	*
Territory Roos	evelt	×	~
Select Any area 8	k prevent overlappin	g territories	~
Geography Census Tra	ct	````	~
Territories Changes			
	Change	Deviation	Percent
Roosevelt [Age 15 to 19]	1,331		^
			×

- 2. After adjusting the settings in the Territory Manager, use the "Select by Pointing" tool to attach additional census tracts to Roosevelt's catchment area. Click additional census tracts around the Roosevelt catchment area to add them to Roosevelt HS. The expected attendance of Roosevelt will increase as surrounding high schools decrease.

### **§3.5 Removing Entire Territories**

1. Say that you want to delete the Woodson catchment area in its entirety. Highlight Woodson in the Territory Manager by left-clicking its name, then right-click the record and select "Remove."

2. You will be given the option to remove the territory along with the following dialog. Select "Yes" to remove.

Territories	Changes			
		[Age 15 to 19]	$\sim$	
Cool	idge		4,363	^
Dunb	bar	:	3,486	
Easte	ern	:	2,071	
Roos	evelt		1,331	
Wilso	on		7,762	
Woo	dson		1,748	$\sim$
VIII CAUNT				
Confirm	Are you sure you want to rem	ove the territory "Wood	dson"?	×
Confirm	Are you sure you want to rem	ove the territory "Wood	dson"?	×

#### **§3.6 Creating New Territories**

- Say that you want to divide the Wilson school catchment area in half by adding another school. One way to do this would be to remove territory in the Wilson district that roughly equates half its student population. Visit the Territory Manager.
  - a. Territory: Wilson
  - b. Select: Areas to remove
  - c. Geography: Census Tract

Select the "Changes" tab to see how the student population changes with edits to Wilson's catchment area.



- 2. Then, allocate the removed areas to a new school. Visit the Territory Manager.
  - a. Territory: New Territory
  - b. Select: Empty areas
  - c. Geography: Census Tract

3. Once you select all the census tracts within your new school catchment area, select the green check mark 
✓ to save. Click the red X 
✓ to undo any changes. You will be given the option to select a name and color for your new catchment area.

Territory Manager - Redistricting 1 Territories	×
🏷 - f <sub>X</sub> 😣 📀 🖳 🦳 🔍 🔍 🗈 -	<b>*</b>
Territory New Territory ~	
Select Empty areas	
Geography Census Tract	
T is in Changes	
Territories Changes	
Change Deviation Percent	
New [Age 15 to 19] 0	^
[196191012]	
	$\sim$
New Territory Settings ?	×
Territory Settings	
Territon, Name Friendship Heights	1
Color 🔽 🗸	
Balancing Values	
Field Balancing Value	
OK Cano	el

## **§4: Extensions**

- 1. Make choropleth maps for PROJ2 and PROJ5, the projected number of high school students in each census tract in 2020 and 2023, respectively. Can you identify any areas of high student growth in Washington, DC?
- 2. The DC Office of the State Superintendent of Education has stated its intent to build a new high school in Washington, DC. Where would you place the school, and how would you propose to draw school catchment areas?
- 3. In planning for school catchment areas, it is important to anticipate future student growth. Would your catchment areas change when incorporating younger DC residents? (Hint: include younger residents in your calculation instead of residents ages 15-19).