10-3-2006

Using ArcGIS to Analyze the Attributes of the Service Areas of Local Public Libraries

Wilson Burgos
The College at Brockport

Using ArcGIS to Analyze the Attributes of the Service Areas of Local Public Libraries

Name: Wilson Burgos

Grade level(s)/Subject taught: Mathematics 10 – 12

Essential Questions

- What is the correlation between the amount of funding received by a public library and the attributes of its service area such as population density, circulation, and median income? As a result, are there any local libraries that are under funded or over funded?
- Comparing the population density of local service areas and circulation of local libraries, are there any areas in need of a new library or areas where an existing library can be eliminated?

Goals and Objectives

Students will:

- download ArcGIS data sets from the internet;
- use the ArcGIS software to visualize and analyze the data sets;
- organize the collected data in an Excel spreadsheet;
- use Excel or the TI graphing calculator to plot the data and determine if a correlation exists between the variables being analyzed;
- draw conclusions and make suggestions based on their analysis of the data.

Mathematical Concept or "key idea" that modeling will be used to teach:

Students will:

- collect, organize, display, and analyze data;
- make predictions that are based upon data analysis;
- recognize and apply mathematics in contexts outside of mathematics;
- use representations to model and interpret physical, social, and mathematical phenomena;
- build new mathematical knowledge through problem solving;
- make and investigate mathematical conjectures.

Materials: Internet access, ArcGIS software, Microsoft Excel, TI graphing calculator, graph paper

Overview

The lesson will begin with a discussion of how one may study the relationship between variables in the real world. The lesson will build on students' prior knowledge and ask students to predict the correlation between variables that they can relate to in every day life. The teacher will then pose questions that lead into the introduction of the activity. What determines how much funding will be received by a public institution, such as a public library? How do you determine when to reallocate services or if a public agency is no longer needed in a certain area? Undoubtedly, responses to such questions may be controversial, but students will be given the tools and knowledge to study this very idea. They will use mathematics to properly analyze the data, make informed decisions, and support their proposals. Clearly, this is a concept of importance to people in different sectors, including politicians, planners, economists, tax payers, and will surely engage students with differing interests.

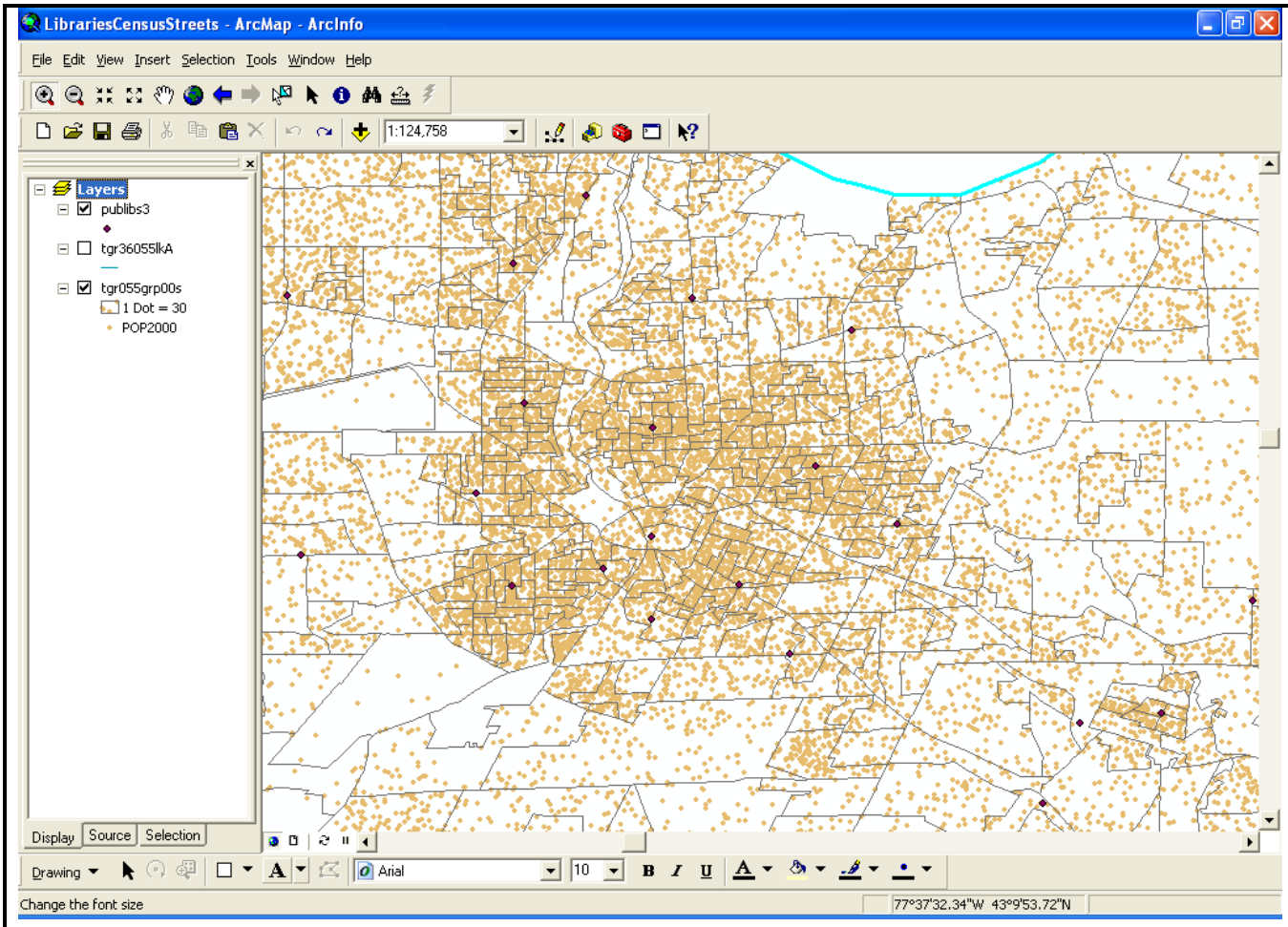
This activity will be completed as a small group project over several days. After being introduced to the software, students will work in a computer lab to complete the activity. The teacher will walk around to monitor students' progress and address misconceptions. At the conclusion, students will create a presentation of their findings and compare them to other students' findings. Students will answer the essential questions stated above as well as make suggestions for changes within the Monroe County Library System.

Procedure

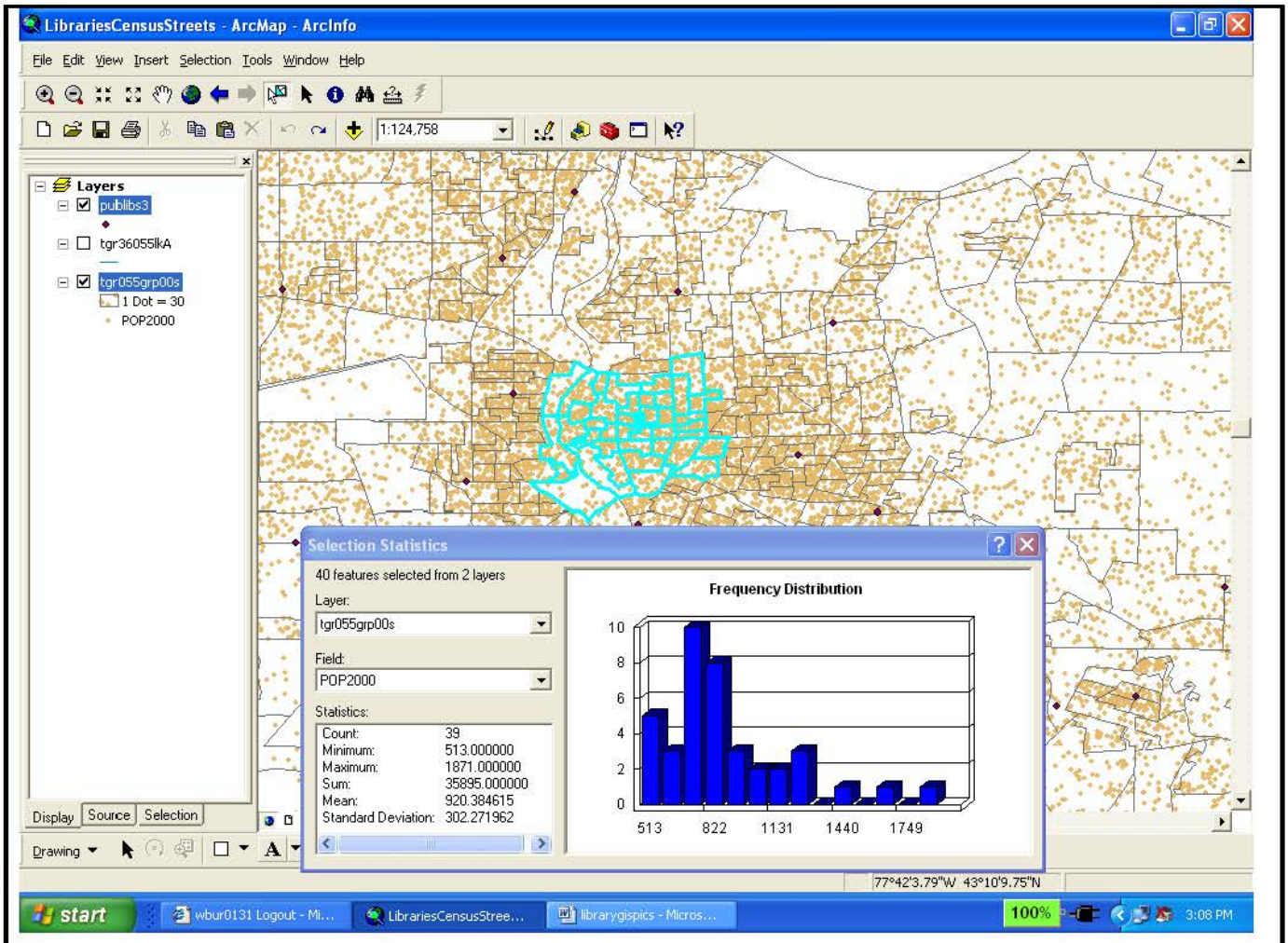
1. Download the "Monroe County Census Block Group 2000" data set from CUGIR:
   http://cugir.mannlib.cornell.edu/mapsheet.jsp?code=055

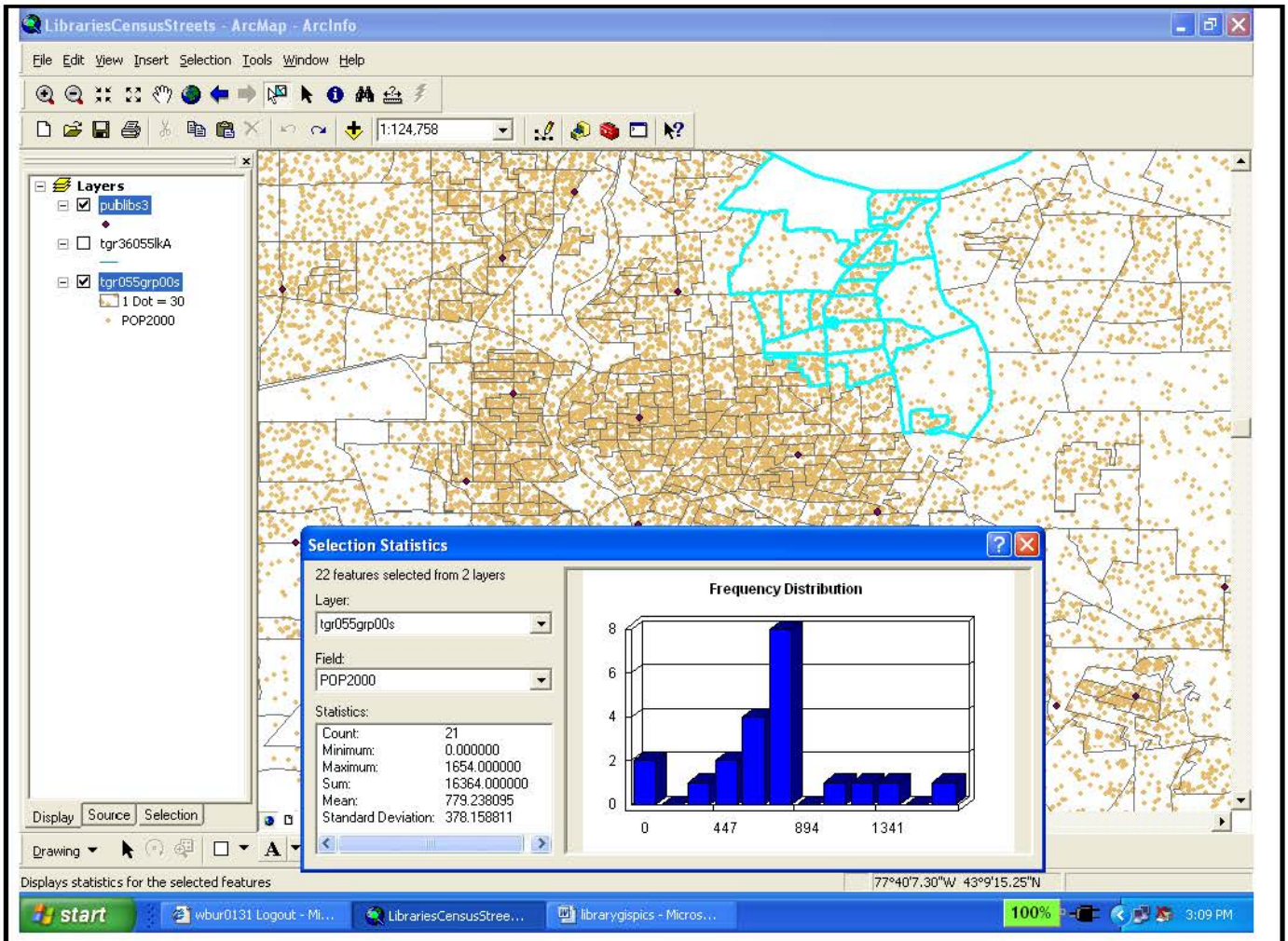
2. Download the "Public Libraries in NY" dataset from the NYS GIS Clearinghouse
   http://www.nysgis.state.ny.us/gisdata/inventories/results.cfm?SWIS=26

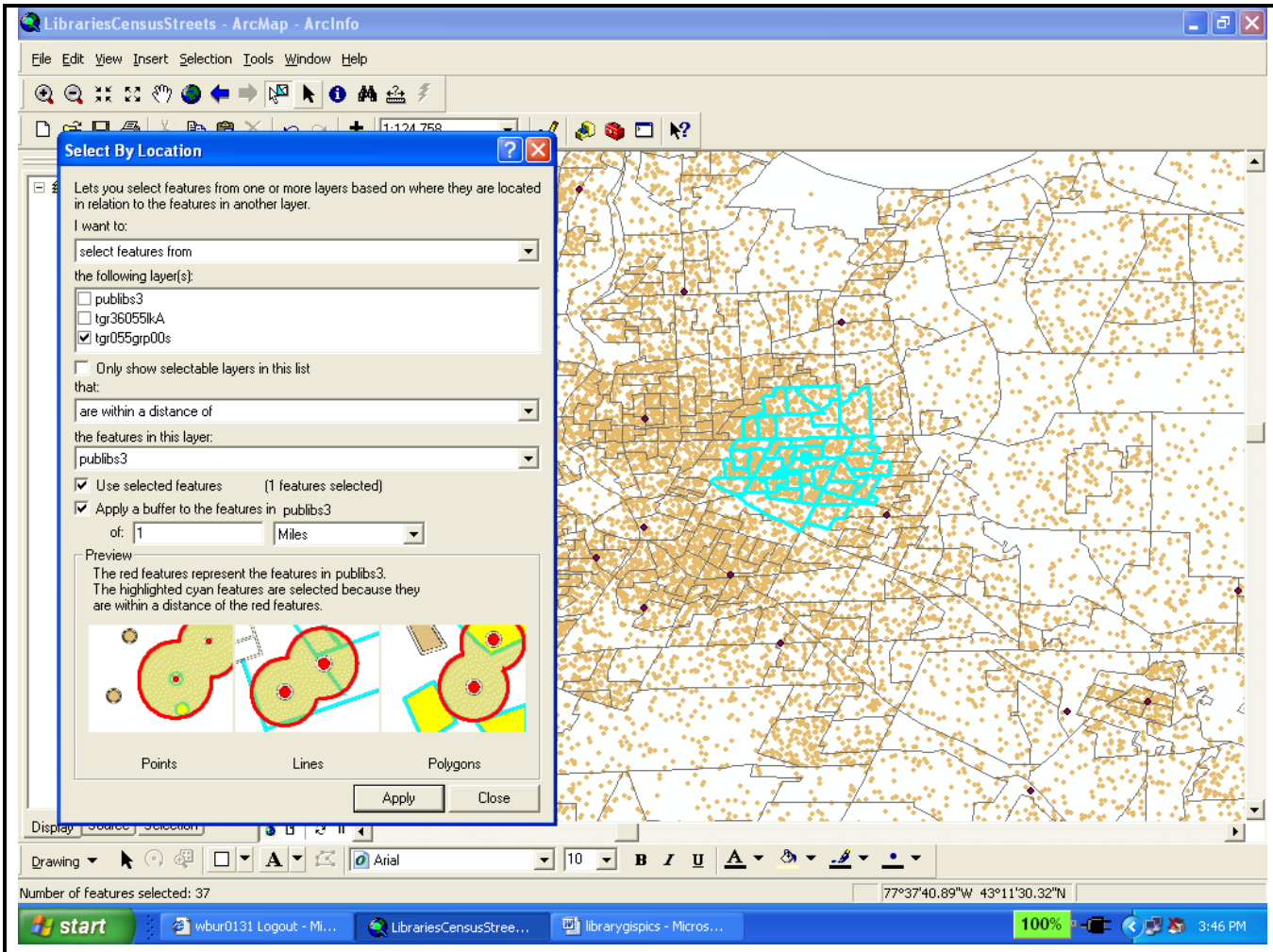
3. Using ArcGIS superimpose both of these layers and zoom in to our local area. Change the "symbology" of the Census Block layer to visualize population density.



4. Select the estimated service area of each library by considering the distance of surrounding libraries. You may want to experiment using the “selection icon”, “select by attributes” menu, or “select by location” menu, and use the method you feel is most accurate. Using the “selection statistics” function calculate the population density, circulation data, and median income of each library’s service area.


LibrariesCensusStreets - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:124,758
Layers
publibs3
tgr36055lkA
tgr055grp00s
1 Dot = 30
POP2000
Display Source Selection
Drawing
Selection Statistics
40 features selected from 2 layers
Layer:
tgr055grp00s
Field:
POP2000
Statistics:
Count: 39
Minimum: 513.000000
Maximum: 1871.000000
Sum: 35895.000000
Mean: 920.384615
Standard Deviation: 302.271962
Frequency Distribution
10
8
6
4
2
0
513
822
1131
1440
1749
77°42'3.79"W 43°10'9.75"N
start
wbur0131 Logout - Mi...
LibrariesCensusStree...
librarygispics - Micros...
100%
3:08 PM

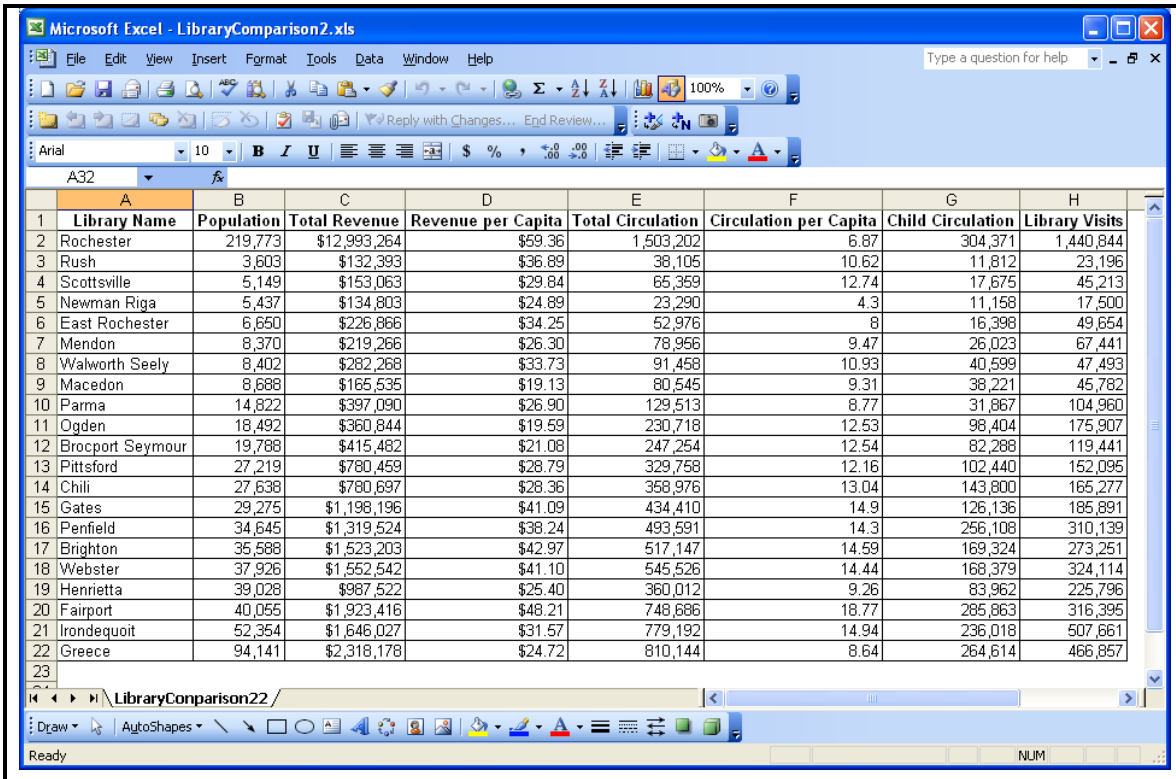

LibrariesCensusStreets - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:124,758
Layers
publibs3
tgr36055lkA
tgr055grp00s
1 Dot = 30
POP2000
Display Source Selection
Drawing
Selection Statistics
22 features selected from 2 layers
Layer:
tgr055grp00s
Field:
POP2000
Statistics:
Count: 21
Minimum: 0.000000
Maximum: 1654.000000
Sum: 16364.000000
Mean: 779.238095
Standard Deviation: 378.158811
Frequency Distribution
8
6
4
2
0
0
447
894
1341
Displays statistics for the selected features
77°40'7.30"W 43°9'15.25"N
start
wbur0131 Logout - Mi...
LibrariesCensusStree...
librarygispics - Micros...
100%
3:09 PM



5. Record the data for each library in an Excel spreadsheet. Additional data not found in the SHP files above can be found on the following websites:

http://nces.ed.gov/index.asp

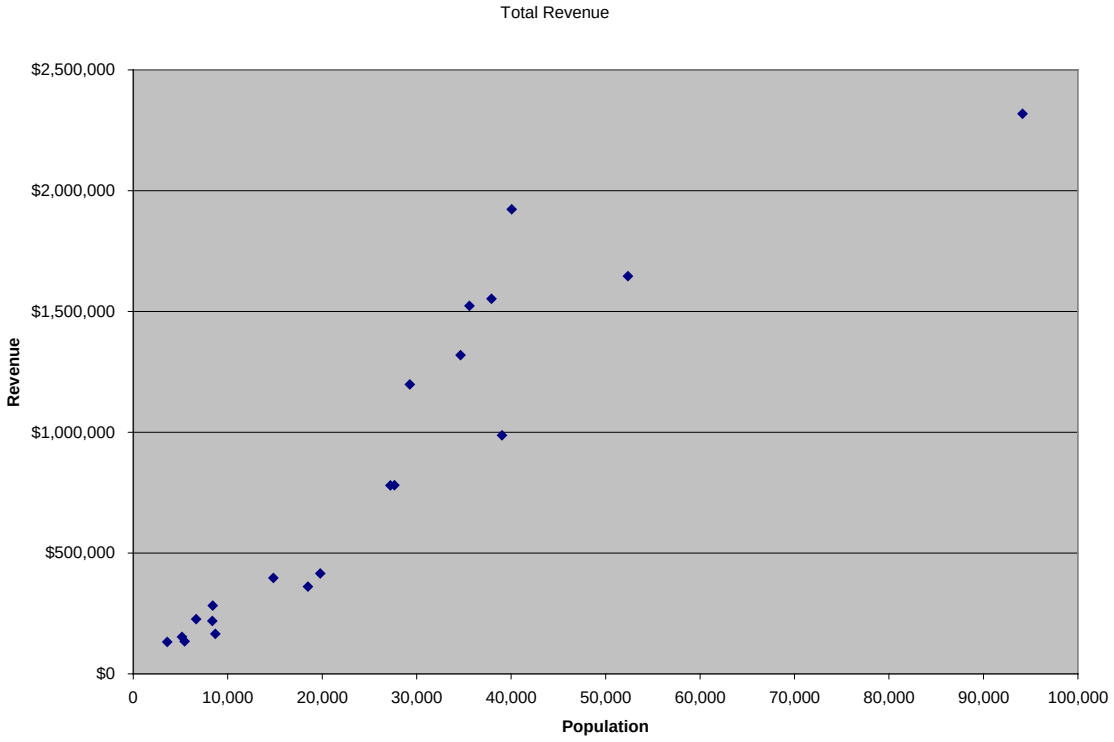
http://plgdb.freac.fsu.edu/imf.jsp?site=geolib

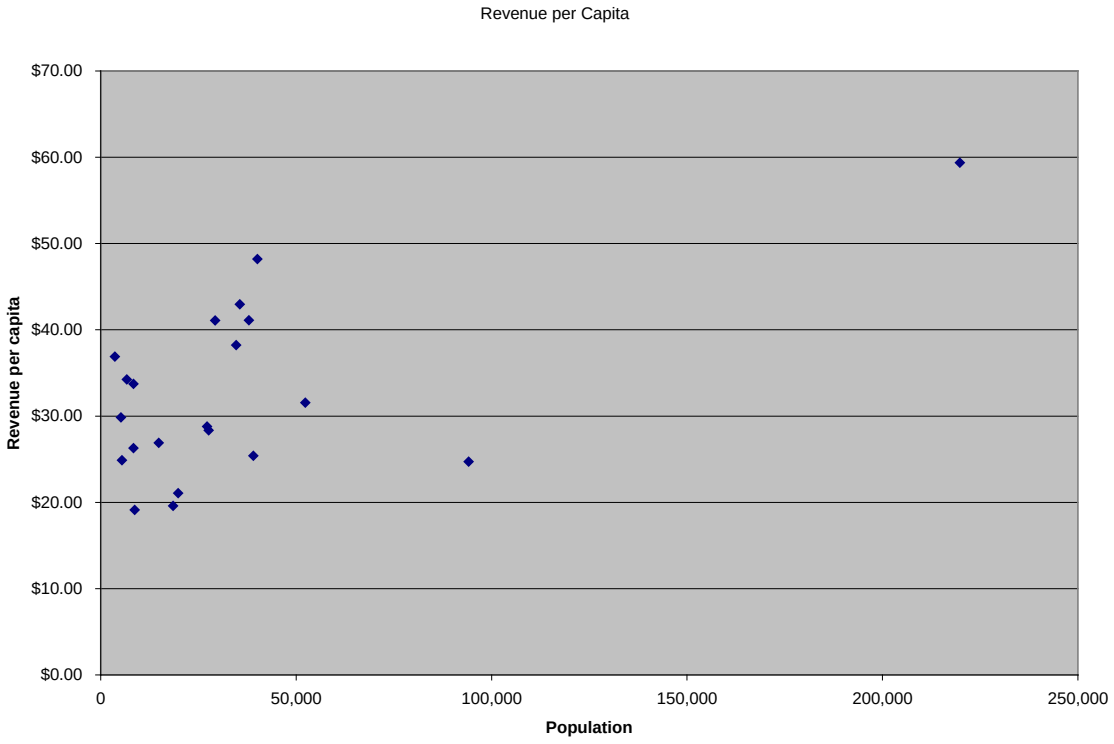


Microsoft Excel - LibraryComparison2.xls

	Library Name	Population	Total Revenue	Revenue per Capita	Total Circulation	Circulation per Capita	Child Circulation	Library Visits
2	Rochester	219,773	$12,993,264	$59.36	1,503,202	6.87	304,371	1,440,844
3	Rush	3,603	$132,393	$36.89	38,105	10.62	11,812	23,196
4	Scottsville	5,149	$153,063	$29.84	65,359	12.74	17,675	45,213
5	Newman Riga	5,437	$134,803	$24.89	23,290	4.3	11,158	17,500
6	East Rochester	6,650	$226,866	$34.25	52,976	8	16,398	49,654
7	Mendon	8,370	$219,266	$26.30	78,956	9.47	26,023	67,441
8	Walworth Seely	8,402	$282,268	$33.73	91,458	10.93	40,599	47,493
9	Macedon	8,688	$165,535	$19.13	80,545	9.31	38,221	45,782
10	Parma	14,822	$397,090	$26.90	129,513	8.77	31,867	104,960
11	Ogden	18,492	$360,844	$19.59	230,718	12.53	98,404	175,907
12	Brocport Seymour	19,788	$415,482	$21.08	247,254	12.54	82,288	119,441
13	Pittsford	27,219	$780,459	$28.79	329,758	12.16	102,440	152,095
14	Chili	27,638	$780,697	$28.36	358,976	13.04	143,800	165,277
15	Gates	29,275	$1,198,196	$41.09	434,410	14.9	126,136	185,891
16	Penfield	34,645	$1,319,524	$38.24	493,591	14.3	256,108	310,139
17	Brighton	35,588	$1,523,203	$42.97	517,147	14.59	169,324	273,251
18	Webster	37,926	$1,552,542	$41.10	545,526	14.44	168,379	324,114
19	Henrietta	39,028	$987,522	$25.40	360,012	9.26	83,962	225,796
20	Fairport	40,055	$1,923,416	$48.21	748,686	18.77	285,863	316,395
21	Irondequoit	52,354	$1,646,027	$31.57	779,192	14.94	236,018	507,661
22	Greece	94,141	$2,318,178	$24.72	810,144	8.64	264,614	466,857

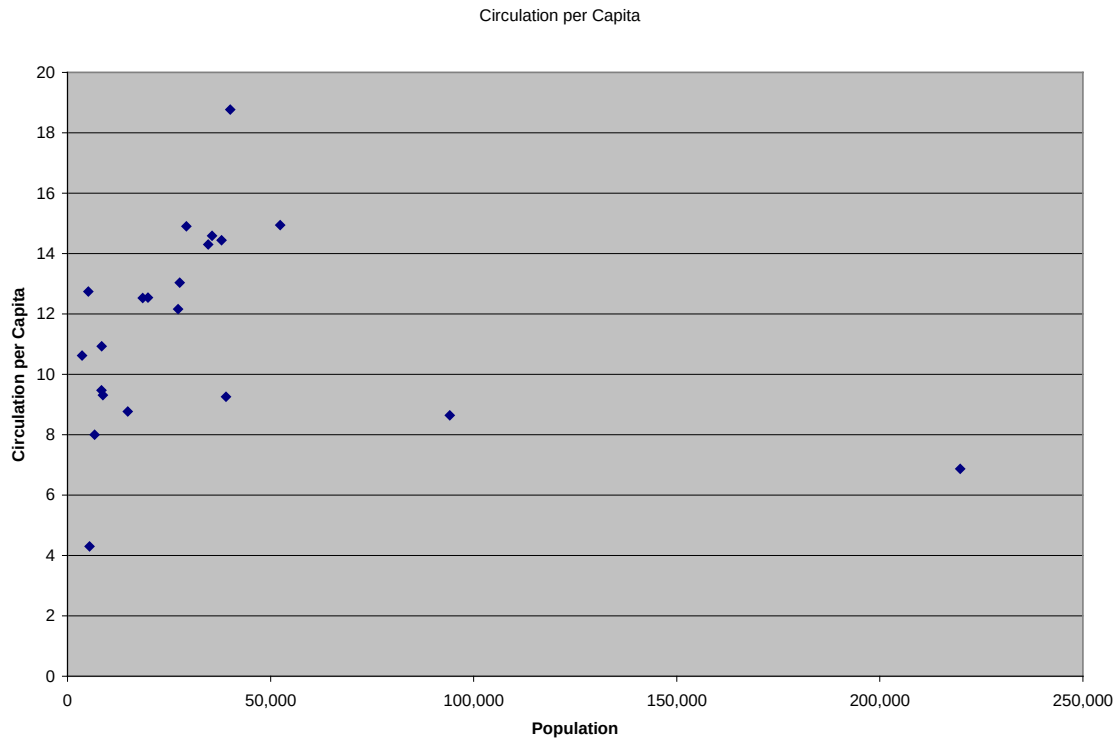
6. Using Excel or the TI graphing calculator, make scatter plots of revenue versus each of the variables in question. For each variable, determine if there is a correlation to a library's funding. Are there any libraries that fall outside the norm (outliers in your scatter plot)? What is the correlation between the amount of funding received by a public library and the attributes of its service area such as population density, circulation, and median income? As a result, are there any local libraries that are under funded or over funded?





7. Do a similar analysis of population density versus circulation. Comparing the population density of local service areas and circulation of local libraries, are there any areas in need of a new library or areas where an

existing library can be eliminated?



Assessment (Rubric)

Category	1	2	3
Use of ArcGIS Software	Did not use the software to model the problem.	Software was used but the data generated was not used effectively.	Software was used effectively, including appropriate calculations.
Use of model to make conjectures and test their validity	Conclusions are not consistent with the model and the evidence provided is irrelevant.	Conclusions may be inconsistent with the data generated by the model due to minor errors.	Able to describe the relationships between variables and use the model to support findings.
Accuracy of data and calculations	Many flaws in calculations or shows no understanding of the task.	Calculations are inaccurate or show partial understanding of the task.	Calculations are accurate, well organized, and demonstrates full understanding of the task.

Understanding of the connection between the mathematics used and real life application.	Does not show any understanding of the relationship between the model and the concepts being studied.	Partial understanding of the concepts and the implications of the activity.	Fully understands the concepts, is able to make generalizations, and can apply the results of the activity.