The topic this week is crime. Law enforcement increasingly relies on the sophisticated use of data, and that includes GIS, which police agencies use as a tool for deciding where to allocate agency resources. Each reported crime is a point on a map, and the attributes for each point will include information such as the type of crime and the actions of the police. Some police departments cooperate with private sector websites to make maps of crime incidents available to the public. For example, MNPD passes its data to crimemapping.com (http://www.crimemapping.com/map/tn/nashville).

With some work, one can also convert publicly available data into a shapefile. For example, the Clery Act compels university police departments to report crime incidents to the campus community; *S:\TEFF\450\420\arcview4\MTSU_Clery2016.shp* provides the MTSU Clery data from 2016. A map of those data is below. The format of this map is a "heatmap", in which changes in color represent changes in crime intensity.

All Violations
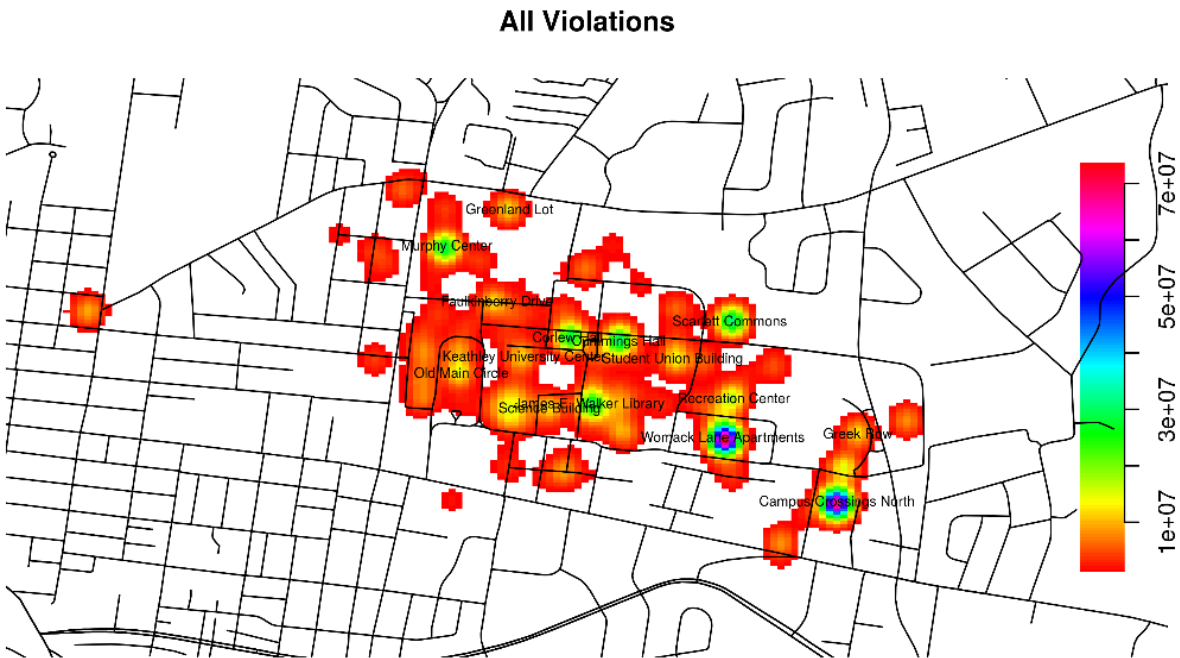
One nice crime incident dataset is provided by the National Geospatial-Intelligence Agency: *Anti-shipping Activity Messages*, located in the ASAM_gdb folder in *S:\TEFF\450\2020\arcview4*. Each record represents an incident of piracy. The data are in geodatabase format, which can be opened in the same way that one opens a shapefile (by clicking on the Add Data icon). These data will load into ArcMap as the *ASAM_events* layer. Export this layer as a shapefile, by right-clicking the layer in the *Table of Contents* (*ToC*) and then clicking *Data>Export Data*. In the *Export Data* pop-up box, select "All features", using the same coordinate system as "this layer's source data", and save the "Output feature class" to your Documents folder, giving it the name *ASAM.shp*. You will be asked if you wish to add the data to the map as a layer: click "Yes". Then remove the *ASAM_events* layer.

In addition, load *S:\TEFF\450\2020\arcview4\TM_WORLD_BORDERS-0.3.shp*.
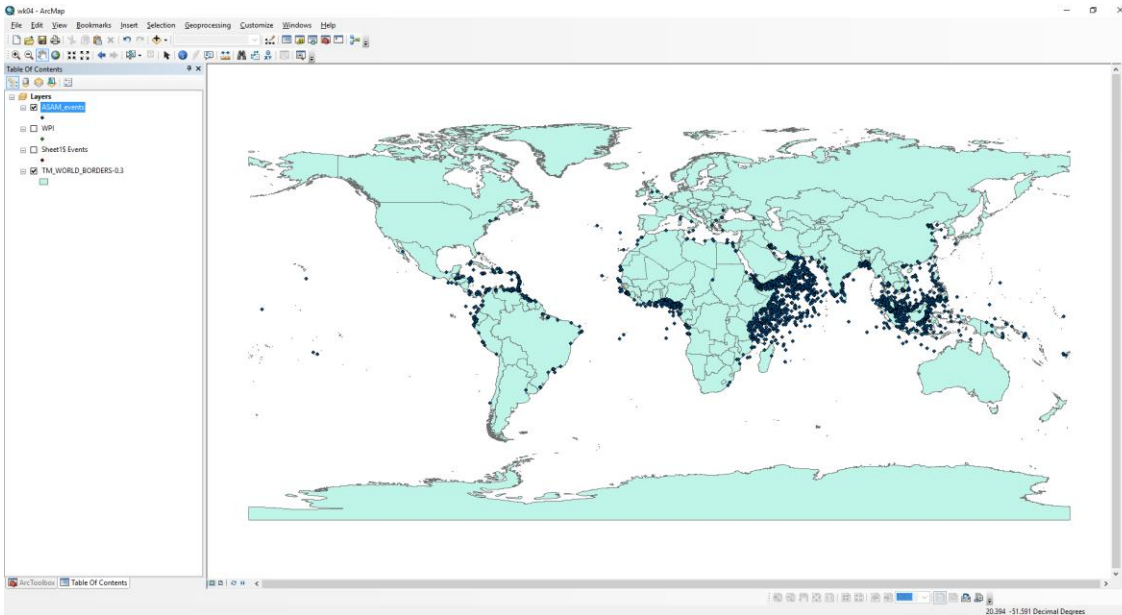
The piracy data contains a large number of points (over 8,700) and, in such a case, one often finds it useful to restrict the points to those of a specific subtype. We can easily do that by opening the *Layer Properties* box for *ASAM* (double-click on the name in the *ToC*), and then clicking on the tab for *Definition Query*. Here, click on the button for *Query Builder*, and double-click on the field name "hostilityt" so that it appears in the formula box at the bottom of the *Query Builder*. Put an equal sign after the name in the formula box. Next, click the button for *Get Unique Values*, so that the middle box is populated with all of the different values the variable might take. Click the value 1 in the middle box (category 1 represents all Pirate Assaults), so that the formula box contains "hostilityt = 1". Click OK, then OK again, and the resulting set of points show only the events where there was an actual pirate assault.


The plotted points provide an indication of where activity is heaviest, but the points overlap each other and it is not possible to see where the point density is highest. To pick out the areas of highest pirate activity, we need to create a *heatmap*.

Click on *Customize* in the top menu, and then click *Extensions*. In the pop-up window that opens, click the box next to *Spatial Analyst*, then click on the *Close* button.
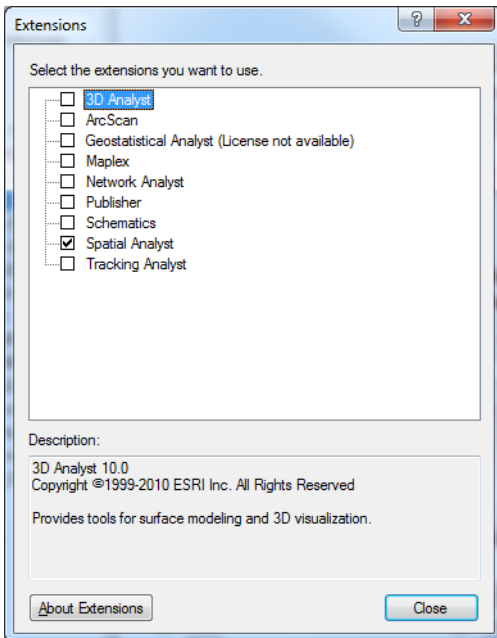
Next, click on the *ArcToolbox* icon (a red toolbox). In the *ArcToolbox* menu, click the plus sign next to *Spatial Analyst Tools*, and then click the plus sign next to *Density*. Finally, click the line that reads *Kernel Density*. A window pops up; in the top drop-down menu (labeled *Input point or polyline features*) select your piracy layer. The other fields will fill automatically, and you should next click *OK*. After some calculation, a heatmap raster is produced showing the world hotspots for piracy. Try experimenting with colors and classification methods to get a nice heatmap.
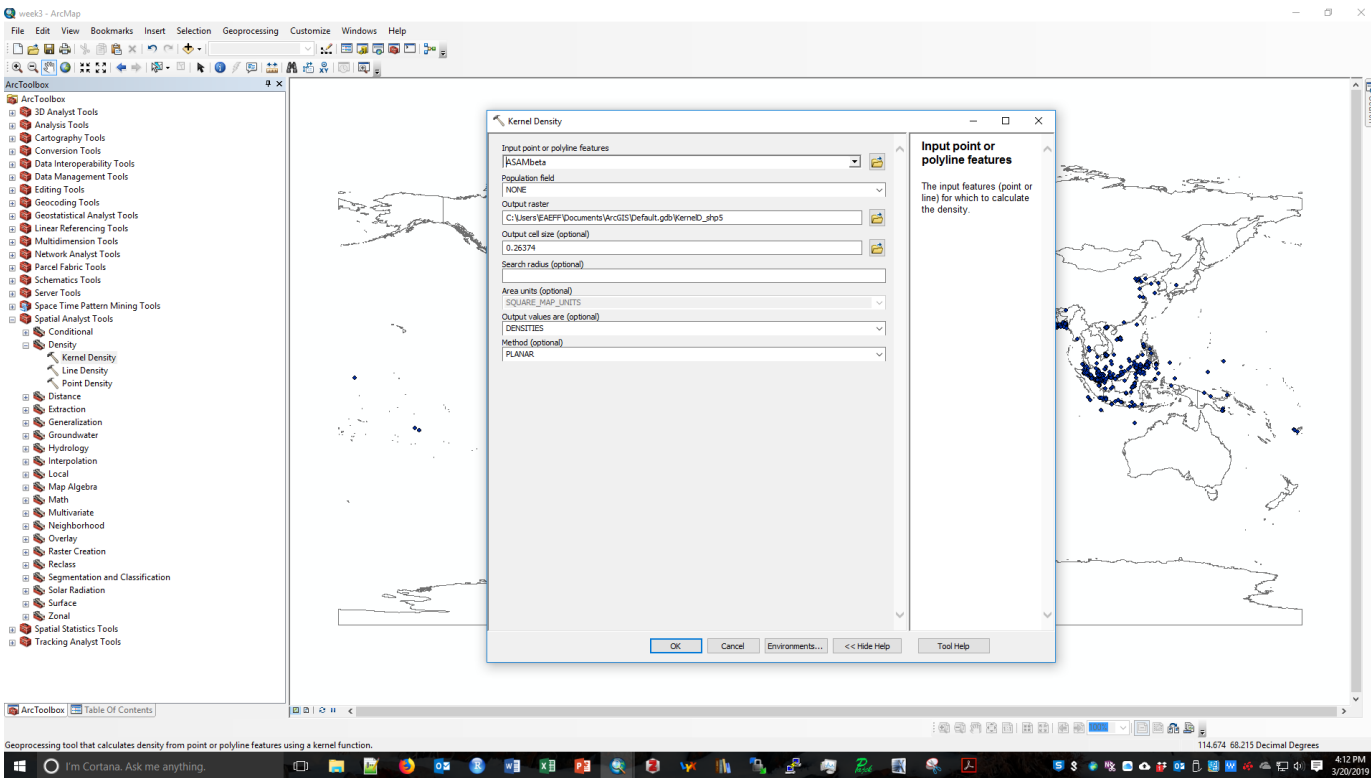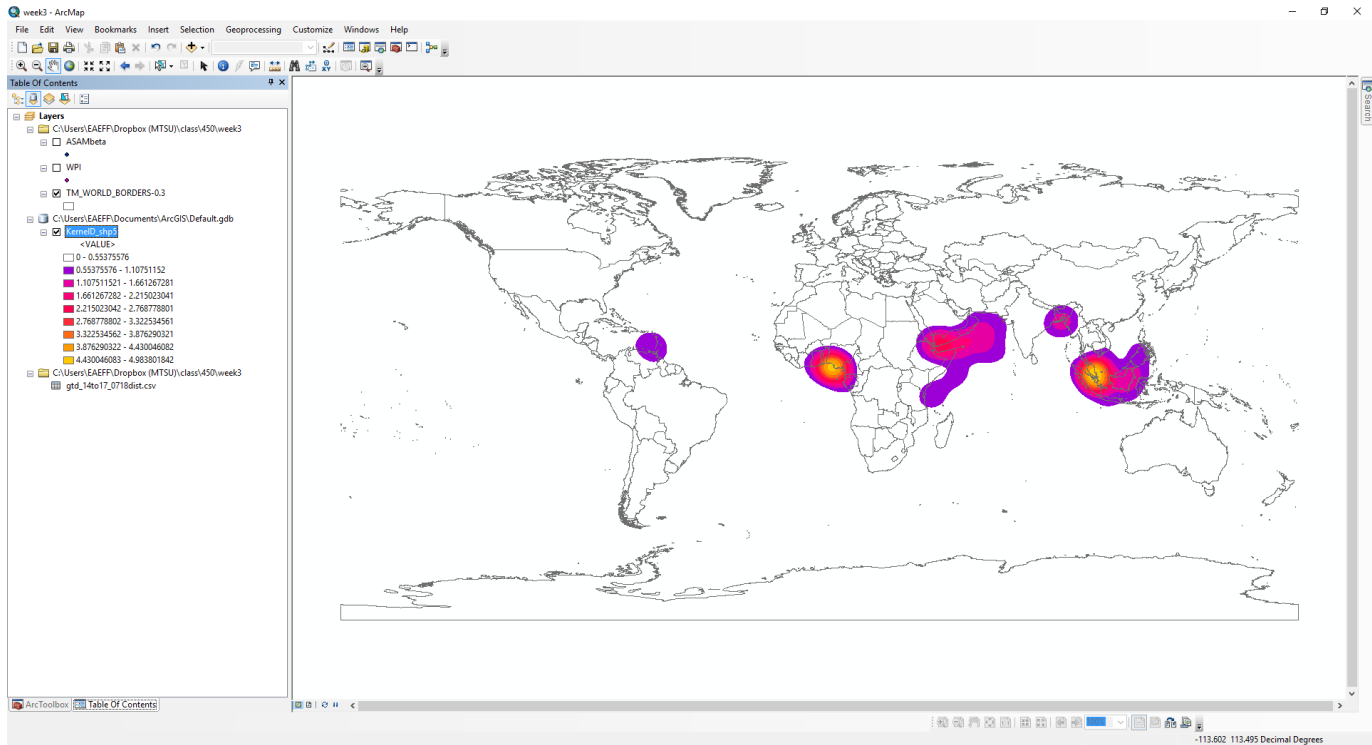
One can do some interesting analysis with point data. Bring in the shapefile *S:\TEFF\450\2020\arcview4\WPI.shp*. This layer contains the location and physical characteristics of major ports world-wide. We will find which port is closest to each reported incident of piracy. In *ArcToolbox*, click *Analysis Tools*, then *Proximity*, then *Near*. In the pop-up box, use *ASAM* for the *Input Feature*, and use *WPI* for the *Near Feature*. Set the *Search Radius* at 250 kilometers, and use "GEODESIC" for the *Method*. Click OK.
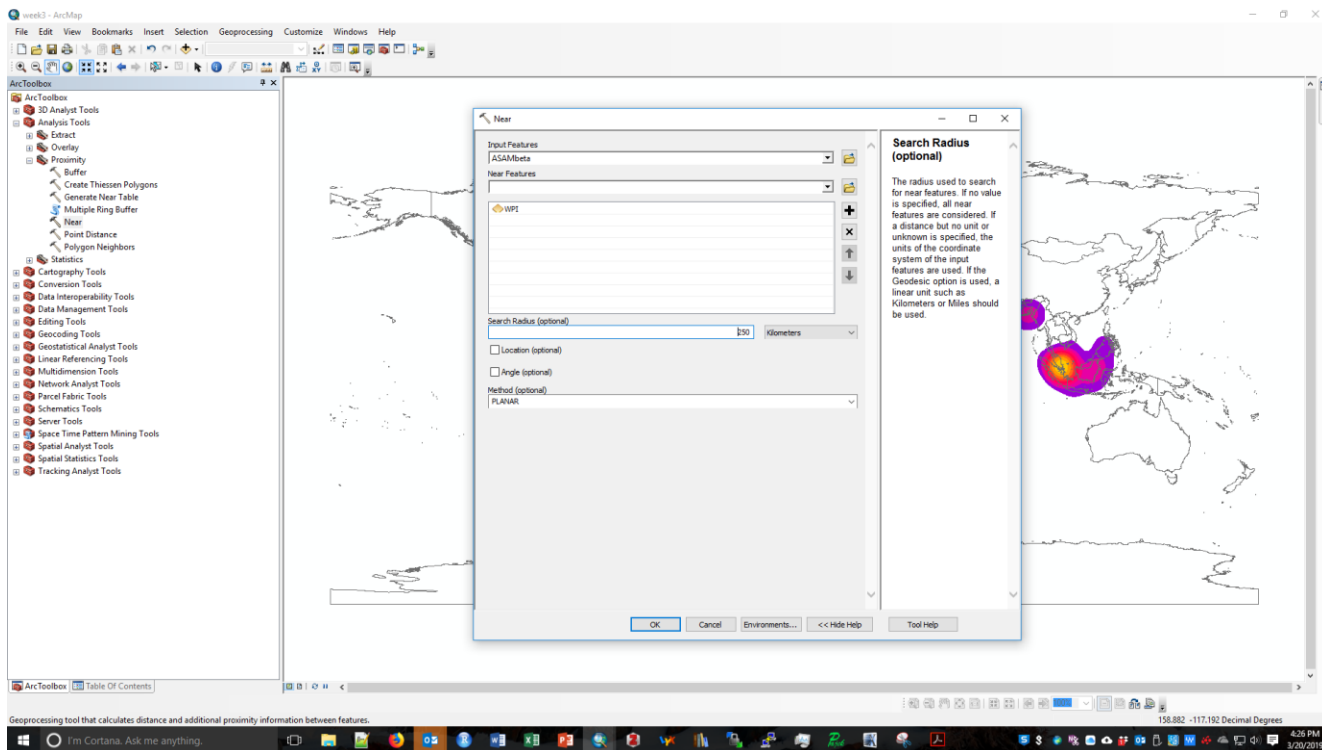
The identifying number of the nearest port will now be in the attribute table of the piracy layer.
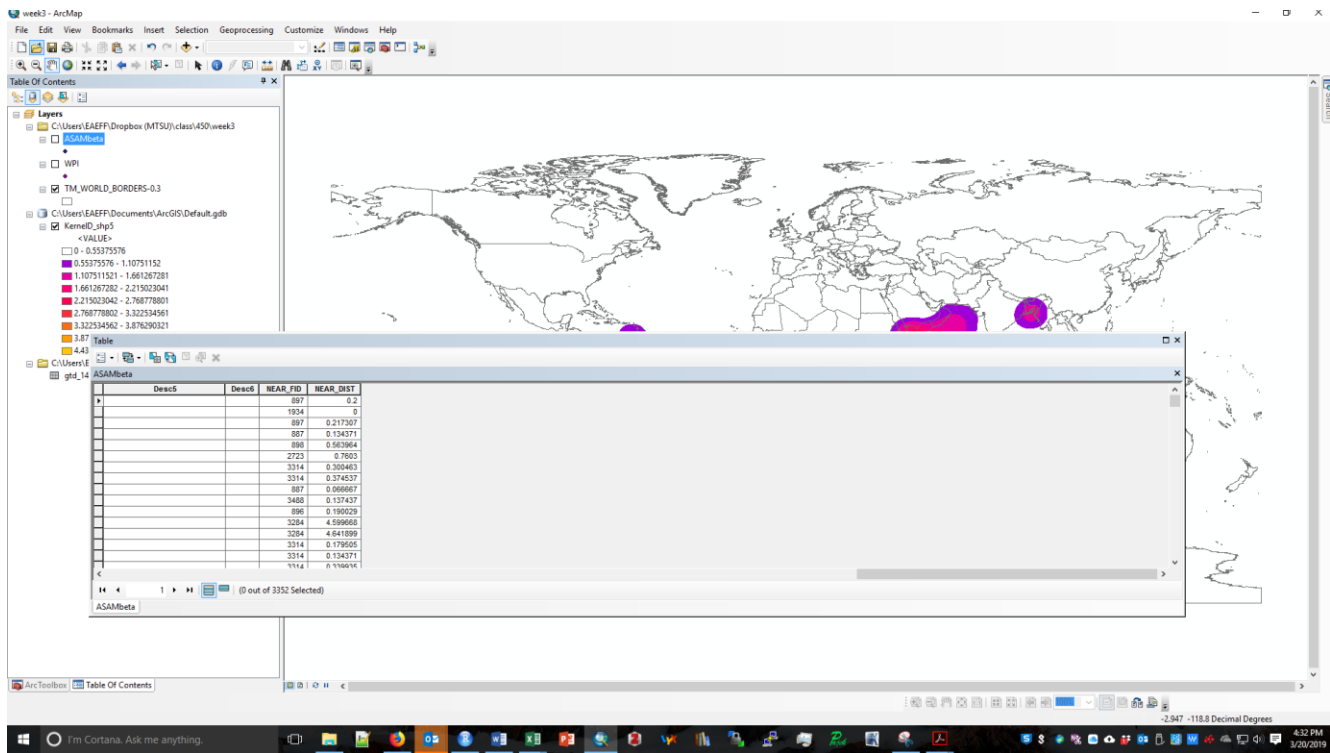
Highlight *ASAM* in the *ToC*, and join the *WPI* attributes to the attribute table for *ASAM*. Use NEAR_FID and FID as the join fields.
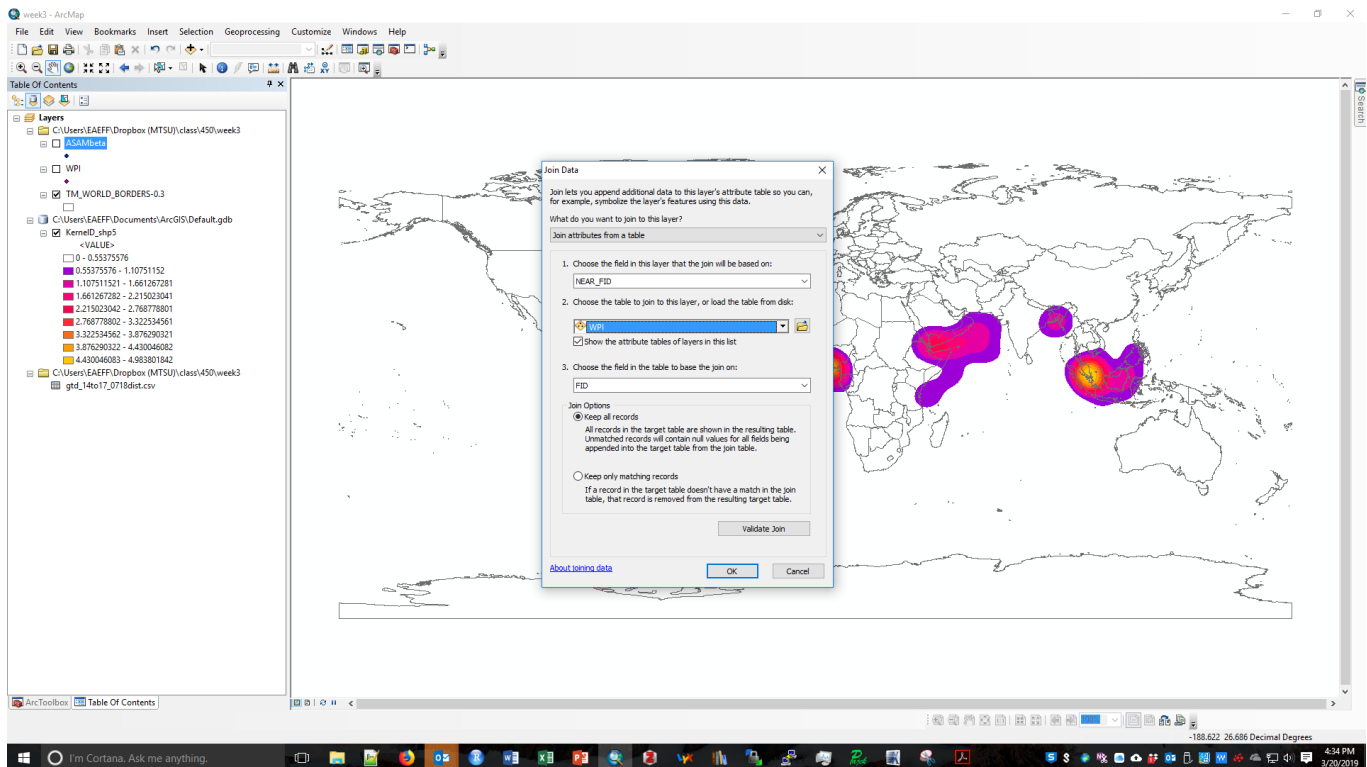
You can now do some basic statistical analysis of the joined data. Again go to ArcToolbox, then to *Analysis Tools*, then *Statistics*, and click on *Frequency*. For Input Table use *ASAM*, and for *Frequency Field(s)* check *WPI.PORT.NAME* and *WPI.COUNTRY*. Click OK.
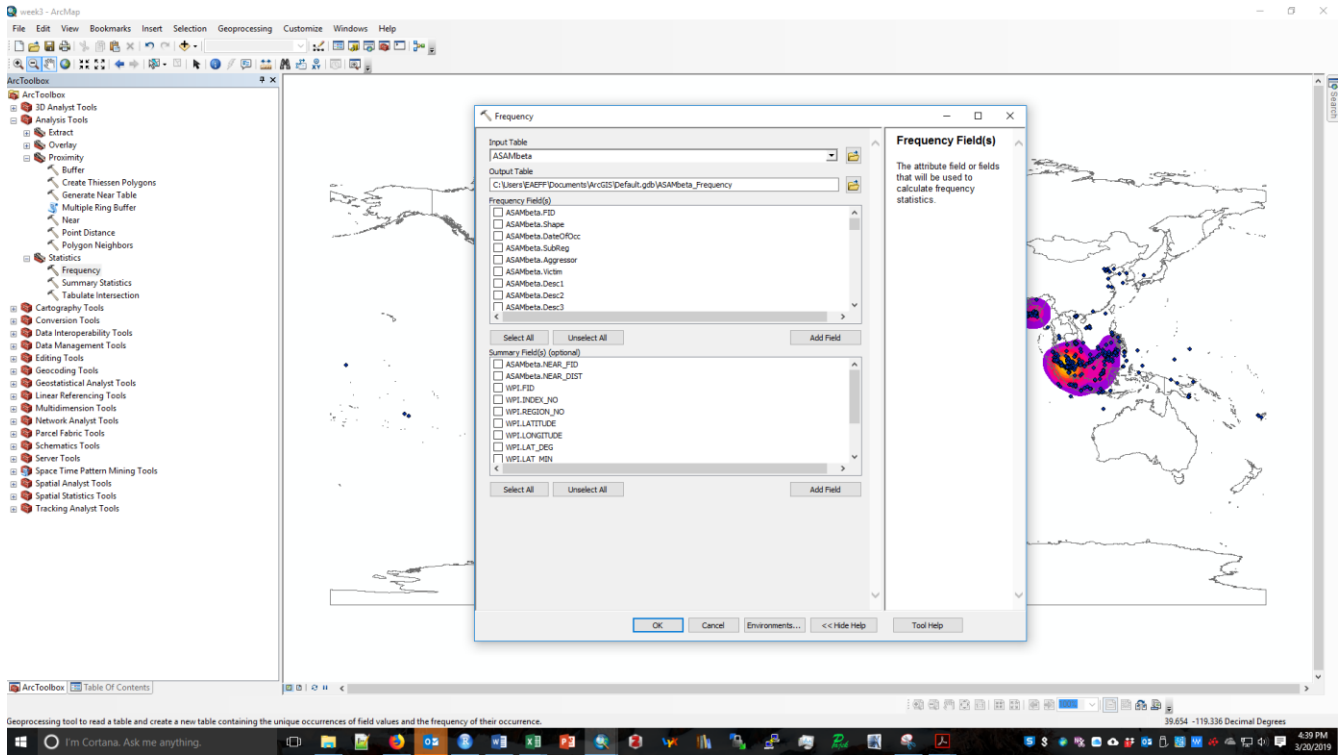
The resulting frequency table will be in the *ToC*. Right-click on the name of the frequency table and click *Open* in the drop-down menu. Export this to a dbf file (dBASE Table), and open in Excel to sort on FREQUENCY and identify the ports with the most serious piracy problem.
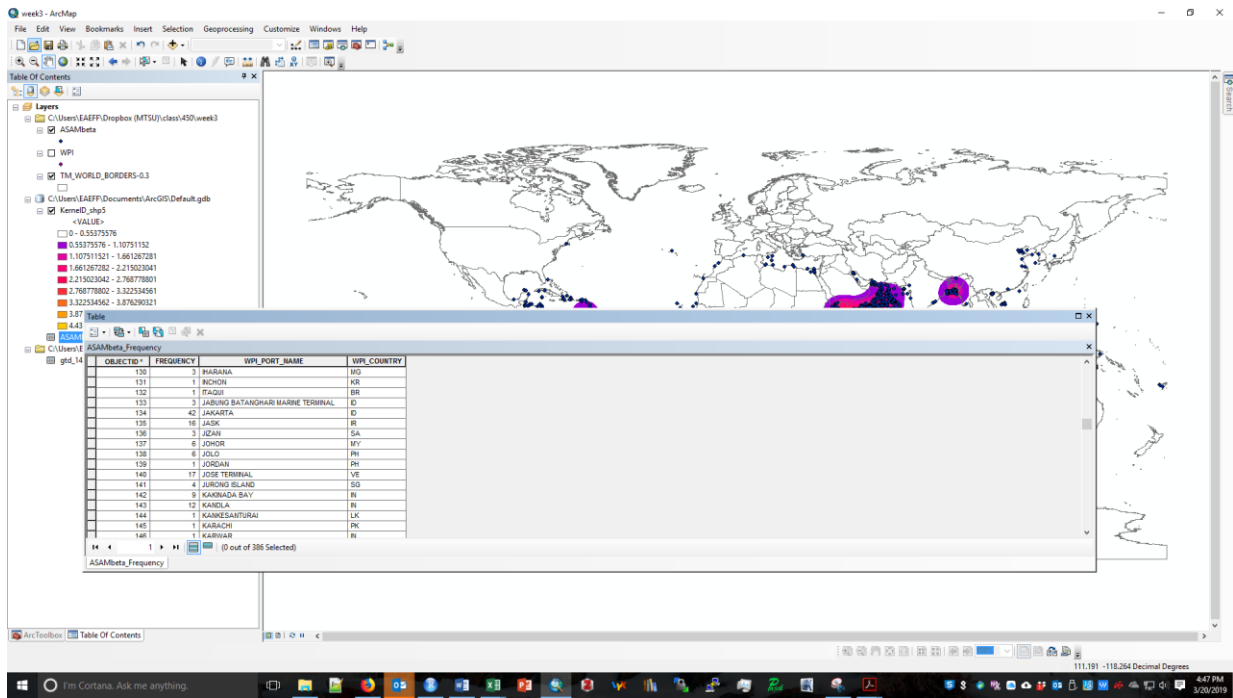
A second (and easier) way to learn the impact of terrorism on ports is to find, for each point, the heatmap value at its location. Go to *ArcToolbox*, click on *Spatial Analyst*, then *Extraction*, then *Extract Multi Values to Points*. Use your port points as *Input point features*, and use your heatmap as *Input rasters*. Change the *Output field name* to something meaningful, such as "piracy." Click OK. When finished, go back to the *ToC*, and look at the attribute table; there should be a column at the far right giving the heatmap value for each point. Export the attribute table to a dbf file, and open in Excel.
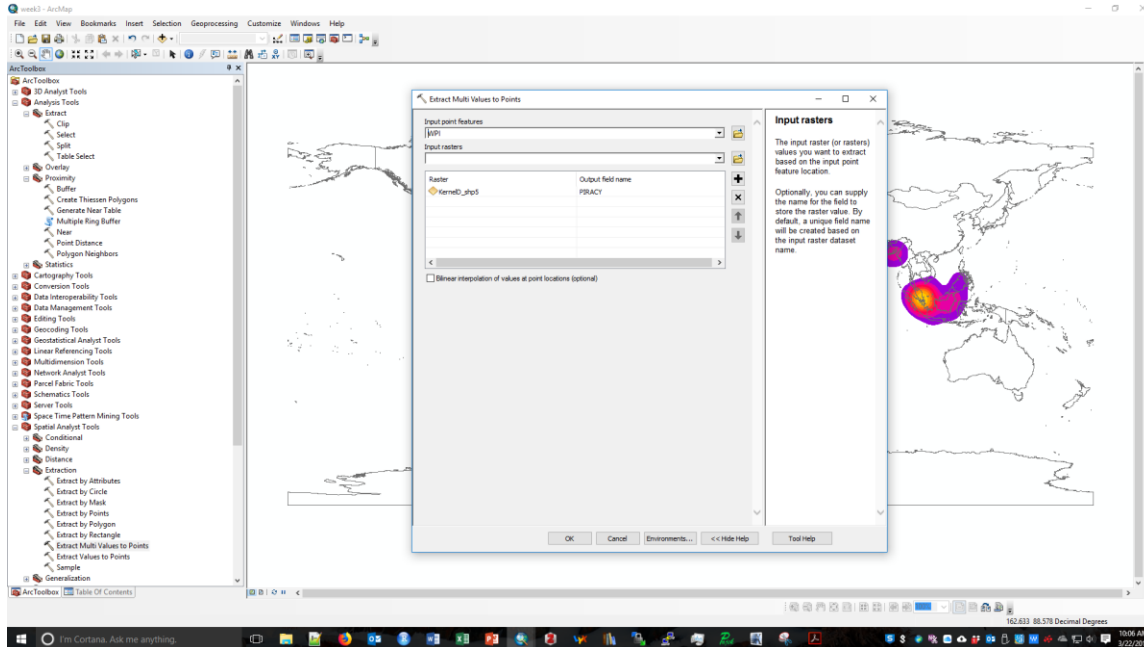
Homework assignment

The [Global Terrorism Database](#) provides approximate point locations for terrorist incidents. This version has data for all terrorist incidents in 1970-2018 at: *S:\TEFF\450\2020\arcview4\GTD_usethis.shp*.

After the shapefile loads, double-click the layer name, and in the *Layer Properties* pop-up window, click the *Definition Query* tab. Click the *Query Builder* button to restrict the layer to a set of meaningful incidents. For example, one can restrict the set of incidents to just suicide attacks, or just assassinations, or to a single country, or to a single year. A heatmap made on a restricted set of incidents will apply just to that restricted set.

The codebook for the attribute data is at *S:\TEFF\450\2020\arcview4\Codebook.pdf*. I have modified the dataset a bit, in order to make it smaller, by removing observations that were not clearly terrorist events, and by removing some of the less interesting fields.

Also bring in a world point shapefile of [major populated places](#):

> *S:\TEFF\450\2020\arcview4\ne_10m_populated_places.shp*.

For the terrorism data, create three heatmaps, based on different selection criteria. Then create fields in the populated places shapefile attribute table that record the value of each heatmap. Make a good-looking map of each heatmap, using the country outlines shapefile to provide visual reference. Include in your presentation, for each map, the top five places affected by terrorism.