Lecture - 44
ArcGIS Session 3

Ok. So welcome to the third session of ArcGIS in this lecture series on Spatial Statistics and Spatial Econometrics, we will pick up from where we left, in the second session.

So, one thing I forgot to do while I ended that session and that can be fatal at times in terms of analyzing spatial data. So, I did it a little bit on purpose to save the project. So, we should not leave our chairs after we have spent an hour, half an hour, 2 hours often more hours working on these data. So, the screen is exactly where it was when I left.

So, what you see on the screen is the same snapshot. So, I am going to just close the measure tool and I am going to save the project. I am going to save the project it's saving the project on ours on my screen now it is saved. The beauty of saving the project is that I can now close this and start right at this junction where I left, let me show you. I am going to now close it.

So, now, it is gone.

I go to the folder got of ArcGIS practice sessions and here is my project under project you see a 33-kilobyte file.

Which is SSSE ArcGIS Project if I double click it; it will just start ArcGIS Pro and now with at the same point where I left my screen a minute ago.

It has started its loading map it is doing everything it is just loading the same project, wait for it there we go fantastic. So, it has everything exactly at the same location at the same point where I left my project. So, I can also by the way take the project file and take it to a different computer let us say my home computer is different from my office computer and I can distribute time between working on these projects the only one thing to be very careful about is that the data location would should be same.

So, the data should be located in the same exact structure as it was on this system for it to read those data. If it is not able to read the data you can go out and change the locations and work with them.

So, now, I have my data again I am going to focus on Uttar Pradesh going forward. So, here is Uttar Pradesh, the black boundary demarcates the state from other states. West of Uttar Pradesh is Haryana national capital territory of Delhi Rajasthan, south is Madhya Pradesh Chhattisgarh east is Jharkhand and Bihar and north of Uttar Pradesh is Himachal Pradesh and Uttarakhand.

Say for a particular project that I am doing, is only focused on Uttar Pradesh, then how do I work with files when I do not need other files? For symbology purposes, I want to draw a map and show my international audience who may not be aware of different states in India, this is I am looking at the Northern State of Uttar Pradesh.

But then going forward then I am conducting my analysis I do not need the entire map of India I do not need all the states of India I only want to focus on Uttar Pradesh right? So, what do I do? So, for that, I am going to now clip the features by the state name and I am going to now create files that are only focusing on Uttar Pradesh ok. So, let us try to do that.

Let us start with the easiest file which is the state file. Right-click, I am going to say attribute table.

Under the attribute table I have this top tab area where I have a field it says Add Calculate Selection and it says Select by Attributes.

So, I am going to say select by Attributes and I am going to say select new selection where should I look? You should look at NAME-1, and NAME-1 it automatically picks the names of the states and I am going to say I want to please pick Uttar Pradesh for me. And I am going to say apply.

And it selects a state for me, I can also go to the row and click and select the state I know that, but I am now selecting by this state I am going to say ok.

So, once it is selected, it has selected Uttar Pradesh, I am going to now go and right-click on this one on India adm1 which is the state file, I can refer from my folder I can rename the file here as well right? Let me do that just for me, let me rename, I am going to just click on it.

I am going to say states just for my purpose, I am going to before I do any clipping I am just changing the name for my purpose. States, districts then we have taluks right and adm0 we then change it here. So, it is the national-level file from DIVA-GIS. So, whenever I make

changes I always save my project, I am going to just save my project. Now I am only focusing on the state file.

So, India states I am right clicking and I am going to Data and I am going to say Export Features I can export features and I can export just the table that is the CSV.

I am going to say, I am going to Export Features and it says ok, you want to Export Features, fine output features.

I want to now change the name of the output features.

I want to go to the same location.

Gaurav ArcGIS practice sessions India admin data, I am going to name this as Uttar Pradesh.

State from DIVA-GIS save, and it creates a new layer called Uttar Pradesh state.

If I uncheck, the India states.

They will all go away, I can now say Zoom To Layer, when I do Zoom To Layer after right-clicking what it does is, whatever pane size I have, it just fits the map there you go.

It does not just do that it wonderfully also adjusts all the other panes accordingly.

Now, I see Uttar Pradesh and I see all of it is districts. I see other districts as well, but I am not interested in the state boundaries anymore outside of Uttar Pradesh because that is as an analyst I am choosing to analyze the data for Uttar Pradesh.

I can also change the size of the attribute table and then again do this Zoom To Layer and see what happens, here we go it has uses the entire space.

So, it is very smart that way I can close the catalog pane again do Zoom To Layer, and see what happens. Nothing happens because it has already adjusted its extent according to the given size of the pain. So, now, I have this feature sitting here as Uttar Pradesh, I can go back to my catalog pane.

Go to my folders Gaurav ArcGIS practice sessions and now I should be able to also see the Uttar Pradesh shape file. The icon in front of this shape file is a polygon file.

If I go to roads or I go to railroads and I actually drag it and bring it here.

You will see these, I can go to its symbology, and I will change its color just so that we are able to see these are the railroads provided by DIVA-GIS.

Now, I can see where the railroads run across Uttar Pradesh and what is the density within each district, I can visualize it. It seems to me there is some important town here because there are many many intersections of rails here and if I click on the world topographic map India I will know what this location is, well it is like now it is the state capital.

So, of course, the density of railroads was characteristically high in that area, very interesting. Now, what I wanted to also point out here is that if you look at the icon in front of India Rails it is a line this is again a vector file, but it is a line form right?

The vector data are stored as lines whereas; data in the case of Uttar Pradesh state is a polygon shape. So, the icon itself is identifying what kind of vector data are we looking at.

That is that. So, I am going to now uncheck the India rails, it can sit there, I have no problem with that I will make the catalog pane smaller. I will again Zoom To Layer to my Uttar Pradesh layer.

So, I can look at Uttar Pradesh it is again still labeled. If I removed if I want to remove the label I could just click on the label and remove it, that is fine.

So, now what if I want to clip the districts as well.

I am going to say attribute table.

I am going to say select by attributes I want to select by again NAME-1 and NAME-1 is equal to Uttar Pradesh let me do that apply.

Now it selects everything in that polygon, which comes under the NAME-1 category of Uttar Pradesh.

I can again go, I can say right click, I can say Data Export Features.

I want to change the name I want to go to the Folders I want to go to my desktop.

So, I can say Uttar Pradesh districts I am just going to say from DIVA-GIS instead of DIVA-GIS just make the name a little shorter. I am going to save one because I am going to show you an alternate path of clipping the features, an alternate strategy of clipping the features. So, right now let us just clip the features with the select attributes methodology Save.

It is saving the features and it gives me a new layer called Uttar Pradesh Districts 1.

If I de-select other districts the entire country is districts fantastically it only gives me the districts of Uttar Pradesh, and if I open the attribute table.

So, the attribute table for India districts had 667 units; that means, the India layer has 667 districts as far as this data is concerned and 75 of those were selected; that means, 75 should be the number of districts in Uttar Pradesh.

So, if I look at the attribute table for the Uttar Pradesh districts 1 file attribute table it will in all have 75 units or polygons. So, there are 75 districts, I can select differently.

You know they are all there to be seen, there is a methi.

That is say a methi is, that is where Azamgarh is, this is Ballia on your screen I can also look at some others let us say Chitrakoot.

I can look at Bijnor which is your sugarcane belt right?

There is Gautam Budh Nagar and Ghaziabad the two urban settlements on the east of Delhi, the satellite towns of Delhi, they are themselves districts, I have Ghazipur, Fatehpur, Firozabad, Hapur, Hathras, and so on right.

So, I can now move across these units and try to locate where they are on my map. Within these districts, I may also want to do some labeling. So, I am let me just remove the selection, right?

So, I can go and I can say labeling properties on Uttar Pradesh districts file, I can say labeling properties let me label these.

I have my class, I want NAME-2 because I want district names. So, I want to remove this feature and I want to say NAME-2 and I want to say apply.

I can also go and I can change for like I said, I like Times New Roman. Now, I want the size to be smaller because I am aware that there are going to be 75 different names being written in those little polygons. So, I am going to just make it 8 and I am going to say apply and I am going to close this going to go back to Uttar Pradesh districts 1 right-click I am going to say click the label.

There we go fantastic.

So, now, if I zoom in a little bit, I can actually see all the names of different districts assigned to their respective locations. So, now I can see Mathura, I can see Gautam Budh Nagar, I can see Ghaziabad, I can see Bulandshahr, I can see Amroha, I can see Firozabad, I can see Kasganj, I can see Jalaun, Jhansi, Mahoba, Lakhnau, Barabanki, Sitapur, Lakhimpur, Kheri you know Gonda, Baliya, Azamgarh Gorakhpur, and so on.

So, I can now visualize at once the spatial structure organization or spatial organization of districts in the state of Uttar Pradesh. So, I have done that. So, I told you when I began this exercise that I am going to show you an alternative path or methodology of clipping features.

So, what did I want? I have an India-level districts file, this is an India-level districts file here for now we have the selection by attributes inside Uttar Pradesh.

And I have this sitting feature which is my polygon within which I want to clip the data. So, I can go to view and there is something called Geoprocessing, right?

So, I am going to click on Geoprocessing and it is going give me three tabs favorites tool boxes, and portals. Favorites provide me with favorite features that were probably on this system and were used many times earlier by someone else. It is like the favorites that I have on this system it is a memory that the software pertains.

But what is most important for us is this portal, these toolboxes, right? These toolboxes you can see have many many sorts of little little little tools boxes and within those toolboxes, there are these sub-tools.

Now focus on the analysis tools under that we have overlay right we have extract, we have a pairwise overlay, and so on. Each of these tools does some kind of manipulation of the given spatial data. The tool of interest for me right now is the analysis extract clip.

So, let me double-click. So, it gives me input features what are the input features you can click and figure out what is this all about, you can click on the question mark and it will give you a very very nice description that is why the software is paid. So, you have a clip which is an analysis tool what does it do? It extracts input features that overlay the clip features.

So, I have an input feature let us say the district file, it is a bigger file, and then let us say I have a clip feature. The clip feature here is the Uttar Pradesh state boundary such a clip feature can come from some other source as well right? I mean you can as an analyst source such features from different from a different location.

For example, it may be a river basin, I will show you in 5 10 minutes, I will show you India's water resource inventory system, which is again a fantastic spatial data set well, you have to construct its spatial data sets from there, but it is a fantastic data set for water resources in India, right?

So, you can bring in a basin and instead of the state if you want to study something within a basin let us say the Ganga basin, the Yamuna basin, and so on. Then you may have a shape file a polygon of the shape of the basin right? If you want instead to study a region which is a climatic region right which is an agricultural region, which may be an ecosystem.

It could be for example, the Jim Corbett National Park, you want to only focus on the Jim Corbett National Park then you need a shape file a polygon that is externally sourced from the Jim, you know India's wildlife areas inventory and they may provide you, a shape file for the Jim Corbett National Park.

So, if you have such pre-defined areas of interest or features that you want to study data for and not everything else inside a state or a country, or a given larger region, then you can clip the features inside that area of interest. Here my larger region is India's district file and my area of interest is the Uttar Pradesh extent. So, I am going to now clip the features so that they are only contained in that file.

So, the Input Features drop-down will catch all the files in the map drawing order under contents. So, I want India districts from DIVA-GIS my clip features are Uttar Pradesh state from DIVA-GIS. Output Feature I am going to open, I am going to search for. I have districts I am going to say this is districts 2 because this is method 2 and I am going to also say clip because I am identifying that I am using the tool clip from the analysis.

Analysis extract clip save and I am going to say run when I say run it is going to actually run the module.

Says running and it is done. Now I have the Uttar Pradesh districts 2 clip. So, I am going to close Geoprocessing and I am going to now analyze the 2. I am going to uncheck the India-level file.

I have one, now file open which is India districts 2 which is exactly looks exactly the same as India districts 1. To visualize that I am going to go to symbology and I am going to change the color of this to green I am going to make it thinner.

Apply and close uncommitted simple formatting do you want to know what happened.

So, something alright, this is Uttar Pradesh district 2 just like district 1.

It has 75 features. I think I did something wrong with its symbology.

Let me go back to symbology, let me see if I can, let me do one thing let me undo something here see if I can get my symbology back.

Here I get it back by undoing it. Let me save things till here, save the project. I am going to go back to its symbology, I want to change its outline color I want to change its color and I want to say apply.

It applies it and if I open the other one which is sitting behind it and I make it slightly thicker then I can visualize both.

So, now, I have the India or UP Uttar Pradesh districts 1 and districts 2 files which look exactly the same, but they were recovered with different methodologies. So, I am clipping the data, I am bringing it in, and now I can actually just work with Uttar Pradesh data.

So, this is a particular modification that I have done with these data, and going forward the next step that what we are going to do is we are going to look at a points level data. Well, we could do one thing as homework for you guys.

So, remember we looked at the railroads. So, we could bring the railroads here and you could try to clip the railroads. What could you do then? Well, you will go to your analysis, we will say view the Geoprocessing clip.

Now the feature that I am interested in is India Rails. So, I am going to say 1 and 2 because I have opened it twice. So, I am just going to say rails 1 it does not matter then you know the one that I really care about is UP state from, and I am going to clip it and I am going to call it Uttar Pradesh railroads and I am going to say clip because I am using that function and I am going to say shape save and I am going to say a run.

And if I now uncheck, the clip is completed, done. I am going to close this and I am going to now remove and now I can visualize.

I am just going to keep one of them let us see.

So, I am now able to visualize the districts and the distribution of railroads on UP, right? So, you can do this for roads, for inland waterways, we can also look at the attribute table of this and see what the railroad's data actually have the CSV file has.

So, it has it says it is a railroad, it is operational, it is a multiple or a single railroad, single line multiple lines, right? India ISO country it has a rail id. So, if you click to select a particular rail id it is going to select a particular line there we go. So, it is a join of different lines there we go right?

So, you can see how these line features are joined together to store information. We can do one very interesting thing, we can calculate the length and the area of these units.

So, let us say we say add a field, under field we say add and we can type the name of this field I can say length and I am going to say, I want it to be long. I actually like double and this is it. I am done alright. So, I can then just close it done a current layer, yes done. I do not

want that alright. So done, save all changes yes. So, if I apply changes it is going to add a new field.

Fantastic it adds a new field, I am going to de-select the one that I had selected I am going to Zoom To Layer.

I right-click on lengths and I say calculate geometry.

When I want to calculate geometry, I want to tell what coordinate system I am working with. So, I am working with the coordinate system of this particular one which is GCS, WGS 84 and I want to calculate the property, what property do I want to calculate? I want to calculate the length, right? What unit of length? Well, I want it in meters and then what I want to do is I want to say ok.

Soon as I say ok what it does for me it actually calculates the length of each feature in meters, right? So, each little feature is now calculated in meters. I am a little worried that the numbers are very small for meters, you know that would mean that there are 292 of these lines they are certainly not meters even though I ask for them.

So, I can do one thing, I can go to measure and I can try to see what ok I need to ok ok ok, and ok. So, I am looking at overall 187 kilometers. So, it is giving me 1.85 which means I have now 1.85 into 10 to power 2 kilometers. So, that is how we cross-validate the unit that we are using sometimes because of the coordinate system or some kind of internal calculations we may see some of these weird kinds of variables; what we then do is we simply just cross-check using the measure tool.

So, now I know that the numbers that I am looking at are just your hundreds of kilometers. So, 1.85 multiplied by 10 to power 2 kilometers. So, what I am going to do for the benefit of myself you know I am going to try and you know rename the field.

So, I am going to just say, can I just change the name it seems like it is going to be a little bit more complicated, but I can rename the field and I can just call it hundreds of kilometers. So, that is something I am going to leave to you so that you can figure out a way to change the name of the field which reflects its units also.

So, once I have done that as one step, now I want to know as a next step, what is the length of a railway line within each district. So, I want to do that I have a separate file which is for Uttar Pradesh, both files are for Uttar Pradesh.

So, I know very well that for Uttar Pradesh, I have district data I can identify these districts.

But I cannot tell within Muzaffarnagar what is the length of the rail line and how it compares with the rail line length in Bareilly, ok?

So, for that, I will go back to my analysis, my view, and my Geoprocessing under analysis. I have this tool under overlay called intercept, let us look at this tool.

Now let us see what this tool does. Interestingly, this tool will intersect two files over one another. So, what it does is, let us say I begin with this feature input and I begin with this intersect feature as an output it gives me the feature being clipped as you know as one right?

So, what it will do is it will now create polygons by the names of the rail line or the id of the rail line and the district. So, let us try and see what we get.

So the first input feature that is the parent feature that I am interested in is UP districts 1 and the second feature that I am interested in is UP railroads clip, which has rank 1 and this has rank 2. Rank 1 is the file that will determine the extent of the resulting feature. I want to retain the district's feature, I do not want to just retain the rail line feature it can do that, right?

I want to retain that and I want to then intersect the two. So, let me do that. So, output feature class, I will go and say I want to take Uttar Pradesh districts, UP districts, and railroads intersect dot shp I say save ok. I want to join all the attributes and the output type is the same as the input which I want to be basically a polygon that is why I have given rank 1 to the polygon shape if I give the rank 1 to the line shape then the resulting output will be the line shape.

So, I am going to say run, let us run this, it is running and it is done very quickly now what does it give me?

I need to close down both of these things and now I see what I see is wonderfully a UP district railroad ok What is it that I see here ok?

So, let me now just show you what we see attribute table ok.

So, let us look at the attribute table now the attribute table has 437 units why? Because each unit has been now broken down by the rail line that lies between that within that if there are more than one rail line or rail line objects inside a district it is going to now count as two objects.

So, I am going to now look at this thing for Muzaffarnagar which was something of interest. So, let us go to Muzaffarnagar and see what we get.

So, now, I have my UP district's railroad, I want the railroad, not the district. So, I am going to check it, yes UP districts railroad now I have FID Uttar Pradesh this is the FID related to the districts file name India NAME 1 Uttar Pradesh, NAME-2 Muzaffarnagar keep going and then it has FID Uttar Pradesh rail id.

There is one rail going through it which is a single line and it has a length of 94 kilometers. So, one rail is going through 94 kilometers. Here on the CSV or the Excel sort of type of format on the attribute table let us close all other attribute tables to focus on this one.

What do we have? We have the first unit is a polyline. So, it is a polygonal line. So, it is an intersection of the two it is a polyline, it is Saharanpur in it and it has a railroad of size 22 kilometers or 23 kilometers.

 Now, interestingly Saharanpur is occurring 1, 2 one second occurs once twice thrice 4, 5 wow 8 times. So, Saharanpur was made up of eight line objects that were representing railroads and to see the total size of rail lines within Saharanpur I will have to sum all of these and multiply it by 100 and I will have the kilometer length within Saharanpur.

So, if I go back to my map and look at the selected area, it will make much more things interesting for me.

So, here is Saharanpur, and Saharanpur if I go back to my district file Saharanpur has all these rail lines well it has more. So, it will show up later as well. So, this is not going to be all for Saharanpur then.

So, I am going to have to see if I can select my attributes and I am going to say Name 1 on let us say NAME-2 and I am going to say Give me Saharanpur apply ok there you go.

So, now, all the rail lines within Saharanpur are selected and now you can go in and you can actually just sum the length for all the selected areas and you will get the length of rail within Saharanpur. You can also export these data by the way, you can export these data to Excel.

So, you can say you can go to Uttar Pradesh district you can say data and you can say export table.

I want to export the table.

And I want to say output table where should the output table be, let us just wait and see if we can export it. So, we can say Uttar Pradesh UP districts railroad. I do not want HSP I want a table Save.

Now it will add a table file separately for this one and you can also sort of go to the attribute table click on the three buttons and here will say Export ok.

You can Export this file you can just say output table here you will be able to again save the same thing as a table it saves it as a dot dbf file. I am just going to call it two because this is the second method that I have for saving the table ok.

So, it adds it here. So, if I close this I will be able to double-click.

And open this table by right-clicking open here we go right?

So, here I have the table which is separate from the file itself. I do not need the file anymore I can just look at the table. So, that is about it, I am going to save my work. In the next session, we will go over exporting these Data to Excel and then we will go on to working with the points data set, which will be a groundwater data set, something that you have seen in so many lectures in your theory classes, you will actually be able to work with those data, I will show you where to get those data.

So, the first step in the next class will be to take this export these data to Excel, to just take it to an Excel file, and then from there on you are free to use it in any statistical software like Strata, R, Python whatever you are comfortable with or you could just work on excel, so, which is very convenient, that will be very nice to do.

So, let us end it here, I have saved my project and I will start right here in the next session. We will go through the first step, which will be to export it to the Excel file, and the second is to start working with groundwater data for Uttar Pradesh alright.

Thank you for your attention.