

Spatial Statistics and Spatial Econometrics
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Lecture - 42
ArcGIS Session 1

Hello everyone, welcome back to this lecture series on Spatial Statistics and Spatial Econometrics. Today we are going to start with a new chapter on working with ArcGIS. So, here we make a transition from lectures to hands-on exercises for spatial statistics and spatial econometrics, and the first module in this process is working with ArcGIS. After this module on ArcGIS, we will have a module on working with R.

So, combining these two modules will ramp you up to apply all the tools that you have studied in the lecture series including the variograms the exploratory analysis, the regressions, and so on, on these two software. Now, remember you know for certain functions one software may be better than the other.

So, knowledge of both these software in combination is sort of important if you are working professionally with spatial data. So, in this series of working with ArcGIS, I will first talk about the software itself and how to download it and then we will start working with a real-world data set.

So, let us start with the software itself and let us look at the process or the steps to download the software.

So, I am simply working with a Google search portal.

And I am going to download ArcGIS. So, it gives me this first option pro dot ArcGIS dot com, download ArcGIS pro. The second option in the series is doc download ArcGIS for Office and it is coming from www.esri.com. So, ultimately Esri is the main host or provider of the ArcGIS software all the modules, and so on. So, let us work with the first link that we stumbled upon.

So, here we are. So, here are the steps that you get for downloading ArcGIS on your system.

And we will be looking at this module of downloading ArcGIS Pro from my Esri. So, I am just going to click on go to my Esri, you can also look at the steps to do that. So, here are the steps provided on the same page there you go.

So, you can follow the steps from here, but the main sort of host as I said is this web domain called My Esri.

So, here under products we have ArcGIS online ArcGIS pro-enterprise, and the platform we are interested in is ArcGIS pro.

So, we are going to just click on that and now it gives me it says ArcGIS pro do you want to go to pricing or sign up for a free trial?

And then there is a bunch of information on how it works, you know what are the different utilities and so on.

So, I am going to talk about both the priced version as well as the trial for students, for this course the trial version will be sufficient for you. However, I should make it very clear right away that the trial version is not to be used for any commercial purposes, any professional purposes not even for instruction, right? So, For the trial version, you guys can just go in you can say sign up for a free trial.

And it just you know says, professional students.

So, you know you want the student's version. So, here you say to sign up for a trial.

So, here we are. So, it has a lot of options here it has a student gallery this it has software access. So, we will go to software access, but let us wait a minute before we go to the software access and just scroll down a little bit.

Scrolling down gives us a very important resource called online lessons.

And these are really important lessons, some of them are interesting, and they will be very interesting, but a very very good thing is that even though we are studying formally introducing you to the functionality of ArcGIS.

What I want to point out is this incredible resource that Esri provides for new beginners, professional workers, researchers, and so on. So, for example, choose the right projection. So,

now, we have looked at our lectures and we know what geographic projection systems are, and why are they so important for example, remember the world geographic system WGS 1984.

And the whole idea of projecting the sphere of the earth on a two-dimensional plane that is a piece of paper holding a lamp and getting an orthogonal projection. How does that translate into the latitudes and longitudes-based coordinate system and so on, right?

So, now, you can study the same thing in detail here by clicking on our lecture just on choosing the right projection. So, I recommend that you go through this particular session, but apart from that you have these very interesting sessions classifying land cover, and exploring future, climate projections.

Then if you go down there is design symbology on a thematic map, something we will also study in this module there are things like investigating pollution patterns, if you are from Delhi or India in general you will be very interested in investigating pollution patterns for India, right?

And the data are out there, right? I mean there is the central pollution control board, you know the Delhi Pollution Control Committee so, all these agencies provide us with incredible amounts of data that can be mapped, right? I mean they are all mappable data and they can be analyzed using the tools that we have studied in this course.

So, all these nice modules can be used and can be exploited for your benefit, all it requires is investing some time and it will ramp you up in terms of using ArcGIS professionally.

So, coming back to access the software so, you know on this student page I can just click on access software, and then on the right-hand side, you can see it says sign up for education trial.

So, all you need to do is provide your information your email id the one that you want to register and what you are going to get is a 21-day trial, right? I am again saying the amount of material for ArcGIS in this course is going to be approximately one week and probably even a little less than that. So, a three-week trial is more than sufficient for you to get ramped up.

So, it is pretty simple you will sign up for it you will get an email, you will activate your license and then it provides you with all the steps to download and have the software for your

use. What I will be using on the other hand is the paid version for this particular class right? So, I am going to for that just click on go to pricing.

Here we are. So, undergo to pricing it gives me, you know here is the core GIS software and it says do you want ArcGIS for the desktop, do you want it for different user types for credits, for personal use, and so on? I am just going to go for the ArcGIS software desktop. So, I am going to say pricing, here you know I need it for individuals.

So, here is ArcGIS for personal use and this is the one that we want right? So, either for personal use or for student use, the 1-year software is 8,500 including taxes, it will come to around 10,000 rupees per year which is a bit pricey but not that all that pricey either right?

I mean given the fact that there is all this resource that is available to us in terms of the learning sessions the functionality of the software we will see is very advanced, the software can do a lot of things it is integrated with Python. So, for those of you who have an extensive background in programming, this software will provide you with incredible resources.

So, the idea is that we will simply, whichever route you want to take, I would say that you should make use of the trial version for yourself, there is also an open-source version of the ArcGIS out there which is called QGIS now. I am not teaching QGIS here, but the functionalities may be similar, if not the same, the documentation etcetera may not be as systematic as for ArcGIS.

But I know that as a researcher, I am aware that many of my colleagues indeed use QGIS. So, you are free to also explore that. I believe that learning the functionality of ArcGIS will also help get the functionality of this one. One other point is that there are also older versions of ArcGIS. So, if you happen to have one, and maybe earlier it was also cheaper, and so on.

If you happen to have an older version of ArcGIS you are perfectly fine, you know the functionality is the same, but the buttons etcetera might be different. What is very good is that you can simply conduct a Google search for different functions and say I have ArcGIS version 10.4 and you want to say visualize symbology, ArcGIS 10.4 will provide you all the steps for 10.4 with all the visuals not just the steps.

So, there is an incredible amount of resources, 100s of YouTube videos explaining various functions of ArcGIS for different versions right? So, if you are a new beginner all I want to

motivate here is that there is nothing to you know, you will be able to pick up ArcGIS pretty easily all it requires is a little bit of time and patience, and investment in terms of focused learning of ArcGIS from different sources.

So, you can take this class as the starting point, but then the more you explore the more you are going to learn. So, there is really a lot that one can achieve from this software. So, with that, I am going to you know.

So, one can just download the software, download the license, and purchase a license, but ultimately what you are going to have is a downloaded version of ArcGIS that looks like the one on your screen.

So, under the start button, I have ArcGIS and I have ArcGIS Pro. I also have ArcGIS Pro online help which is very helpful, very good you know, they are very responsive it has a lot of resources, again there is a reason it's paid right it has something called I Python, Jupyter, Notebook which means that the software is fully integrable with Python scripts, there is Python command prompt and Python interactive terminal.

So, if you are a programmer who is well aware of Python ArcGIS can fully integrate that language. So, I am going to start with ArcGIS Pro.

So, let the software begin. So, if you are this is the first time, let us say this is not the first time on my system, but if it is the first time that you are starting ArcGIS it takes a while to set it up. So, if it is a couple of minutes 2, 3, 4, 5 minutes and you know, this thing is always it is not starting. So, be patient it's starting, and it takes a bit while to set itself up right?

So, the first bit is a bit slow to completely ramp up once you have it on your system you close it you start it again it will be faster. So, here we go, we have home, we have learning resources, again a lot of resources right throughout this journey of just looking at the software, we have seen that there are learning resources after resource after resource which is fantastic.

Now in a new project, I have to start a new project and I have four components of a new project the first is called a map, the second is called a catalog, the third is called a global scene, the fourth is called a local scene and the fifth is start without a template. So, here for

our purposes, you are free to explore all of those, but for our purposes, map and catalog are the most useful extensions.

So, I am going to click on map as soon as I click on it gives me a screen that says create a new project, it asks me for a name and it asks me for a location. So, whatever I do on this software is called a project, and just like any other software when you are working on that software and you come back to it later you want to start with where you left off.

So, this is the right at the outset it sort of encourages you to create a new project and save it. So, I am going to do that.

So, I am going to say open, I am going to go to desktop and I am going to go to this software called gaurav arcgis which is just my name with ArcGIS and here I have these two folders already there with me called data sets and practice sessions. I am simply going to just start a name a folder here at this location. I am going to call it the spatial statistics and spatial econometrics ArcGIS project.

And I am going to say ok alright. So, it says cannot access alright? So, I am going to say ok alright. So, let us see if I can do something different and say ok open ok alright.

So, I have to use an existing folder, I cannot create a folder there. So, I am simply using the folder practice session which is fantastic. I mean it is one folder for us, right? So, I am going to name the project spatial statistics and spatial econometrics ArcGIS project.

So, create a new folder for this project I am going to say ok, you can create a new folder and say ok. So, now, it is setting itself up ok alright. So, it is going to take 1 or 2 minutes, it has now opened. So, we have a panel we have on the left we have the contents pane right a contents pane means it is a pain you know window which has all the contents that are listed on the middle screen which is called the map. The map sort of stores or you know sort of arranges the data in layers.

So, if you have worked with some other layer-based software you would be aware that when you have if you are working with image data you are often using this idea of one layer over the other one layer over the other. So, you can visualize things work compare contrast copy manipulate, and so on.

So, I have this third pane which I am going to just cancel I am just going to say I do not need it for now. So, I have two panes, to begin with, I have the map and I have the contents.

Now under so, I have a project, which is the project which I am working with on the top tab then we have the map. Now the map has many things it says to go to xy bookmarks, explore. So, right now it is at explore.

So, I can explore, I can just hold my cursor and I can visit different parts of the World. But what are these different parts of the World, why am I able to visit these parts of the world simply on my screen on the map window? Well, you have this under contents you have these buttons, and on the first button is a list by drawing order.

So, we will always have this button clicked, right we will always have this activated for our purposes. Under that, we have the map, the project that we have started the map right the one that we have started and it has two layers. The first layer is called the world topographic map India, the second is called the world hill shade. And if you see you notice there are these check marks in front of both these layers. So; that means, I mean the first intrigue that one would have is let me uncheck and see what happens.

So, let me do that, let me just uncheck the world topographic map of India alright? So, those names and those you know so, what is gone. So, the boundaries are gone ok, the country boundaries are gone, some of the locations of cities are gone, the regional sort of names are gone, and so on right?

So, this layer called the world topographic map is an inbuilt layer that comes with ArcGIS Pro right?

And it gives me a starting point in terms of where am I on the map.

What is the second layer, the second layer is called the world hill shade.

If I remove it, I have a completely blank screen. So, it is possible on your system you begin where with a completely blank screen and that is fantastic, no problem. So, these inbuilt base maps are only there to help you they do not have a substantive value so far as conducting

analysis and so on. So, because we have these Mays snaps we are going to use them just for our purposes. So, let us look at the world hill shade.

So, just by looking at it, I can tell that the world hill shade is somehow an elevation digital elevation map, it is drawn in grayscale the darker the scale the higher the elevation it seems to me.

And how do I know that? I have this region in India this is the Indo-Gangetic plains and here are the Himalayas right? So, the planes are all white, and as we move from the plains upward into the mountain the mountain range is the Himalayan range.

We have these darker colors providing us an understanding of a wonderful visualization of elevation right?

So, we can keep zooming in and you can see how wonderful these things are drawn, right? Remember when we studied things like you know the ridges and the planes, spatial heterogeneities, and spatial dependence in the first introductory class I had some very modest images to sort of borrowed from elsewhere to explain those concepts.

We could again go back and look at spatial heterogeneity, and spatial dependence using these images, right? I mean if I look at this, I really do not see much of a heterogeneous structure, but a highly dependent structure in the sense that all the ridges are of similar colors and the valleys are of similar colors, right?

So, the space there is high spatial dependence, but maybe not so much spatial heterogeneity. But if I just change this a little bit, change my location a little bit.

Here now, I also have spatial heterogeneity if I move from the southwest to the northeast, I have a clear change in means and also I have spatial dependence, right? So, with different scales and different locations, we have different characteristics to our data. So, to this if I add the second layer I can see the reverse now you know I can see the rivers, I can see the boundaries, I can look at the names of the locations, and so on right?

So, a really nice spatial visualization tool to begin with. So, let me just do one thing let me go to world hill shade.

And let me just say right-click there when I right-click I get these different options and on these options, I am going to save properties.

I am going to click on properties you should click on all of them and explore. I am going to click on properties under properties let us click on source, under source the data type is ArcGIS map service.

So, here is the data type is that it is a data set that belongs to ArcGIS because we downloaded the software, a paid software version, they are just providing this base map to me for a good starting point let us say for my analysis, the units are meters it is called elevation, it is an elevation service of ArcGIS.

And if I click on spatial reference you have this projected coordinate system. Now, this is something we have formally introduced in our lectures on geographic coordinate systems. So, here the geographic coordinate system of this map is WGS the World Geodetic System 1984 something that we again looked at as a standard system of visualizing data. Now if we are putting one layer over the other and we have different projection systems then that should worry you.

So, the first thing to check when we are combining the two data sets learning from two different layers, which we will do throughout this course, and if they are not coming from the same coordinate system then the first step is to convert them to the same coordinate system right and to do that we will talk about it in a minute.

So, you know it has many different. So, the datum here is again the projection system, the angular unit is degree right and we saw degrees. So, from the origin of the earth, you know how many degrees east how many degrees west. So, the measurement that you get from these data are going to be in degrees and there are some other information about this layer.

So, that is that and similarly, for the world topographic map we can go to properties and here we go. So, now, here the data type is vector tile service. So, this second data set is a vector data set and it is the server, it tells me where can you get it from you know again the vertical units are meters, and the projected coordinate system is exactly the same as the previous one right, which is the world hill shade.

So, that is why putting them on each other provides us a good reference point that we are putting apples on apples.

So, you know we can actually believe that the boundaries are indeed these boundaries these pink color boundaries are indeed correctly placed. So, far as the elevation map is placed. So, they are both talking about the same locations on Earth, right?

So, this is about the setups, one more, last thing that I want to just point out is that in the view under map insert analysis and view we have two more interesting tabs that we will be working with, first is called as the catalog pane right?

When we began I said ok so, there are two panes, that are going to be useful for me the first one is called the map which is right here and the second is the catalog. So, arc map and arc catalog if you are using the older versions then these two come as two different windows right here in ArcGIS pro which is the latest version they are just integrated within the same window right?

In the older versions arc catalog opens a separate window and the arc map opens as a separate window, but they talk to each other. They fully integrate. So, far as if you make a change in the arc catalog it will show up in arc for arc map as well. So, what happens here? So, under catalog, the interest that we have mostly is in folders. So, under folders I see one folder which is already included is called the SSSE ArcGIS project.

And if I keep my marker on it shows me that this folder was modified on the 18th of July which is today which is when I am recording this lecture and its path tells me that it is on the desktop under the folder gaurav arcgis under practice sessions and then SSSE ArcGIS project.

So, phenomenal it is already providing me a location for where the project is going to be saved. So, let me just click on the arrow here to see what happens. So, this has SSSE ArcGIS project dot gdb. Now this geodatabase GDB is geodatabase if you say want to take the full project from one machine to the other you take the GDB file and run it there.

The GDB file will take all the information that you have. So, let us say you have multiple like 5 layers that you have worked out it will contain all 5 layers ok. So, it is a it is a compressed

geodata base ok now the project has other files right the project has many other files which contain different information.

Now the next part is the last in this module of this introduction or ramping up onto ArcGIS is adding a folder. So, I am going to say insert map project, map insert, I am going to say add a folder.

So, I am going to say add folder let us go to the desktop, and go to ArcGIS. Now gaurav of arcgis is the parent folder that I am very interested in for this particular project. So, I am going to say gaurav arcgis.

And I am going to say go to desktop gaurav arcgis and I am going to say add this folder. So, I am not double-clicking on the folder just selecting the folder and I am saying ok alright.

As soon as I do that you see under folders it has now added gaurav arcGIS. So, if you have data sets scattered around, you can just add folders and access them directly from these data. So, now, I can see everything here. So, under practice sessions I already have another folder called India admin data under data sets I have many different data sets.

So, I have all these pre-cooked stuff that I brought from somewhere and now I can visualize that directly on the catalog name. Not just this, I can move files, move files between folders right from here, let me show you something.

So, if I go to India ADM, I can say India RDS, I can say right-click copy.

I can come to the SSSER project and I can say paste and it adds this folder here. Now let me go to windows explorer and show you what happened there. So, I go to my windows explorer.

So, here is my desktop here is gaurav arcgis.

Now, I go to data sets, I go to practice sessions.

And I go to SSSE and look what happened it added this entire folder, copied this folder on my windows explorer from its original location that is here.

Not only that all the contents of this folder will also be brought out.

So, it is a very useful tool, it is like an ArcGIS Windows Explorer integrated into ArcGIS and it becomes very useful when we are working with the image data that we will start to do in the next session of ArcGIS.

So, thank you very much for your attention, I hope you are here before we end we are going to do one very important thing always we are going to keep saving our projects, I am going to say save and it will start you know if I close it and I start it will start exactly at this point.

So, that is about it for this particular session and we will now start working with vector data and with polygons data as a first step into working with ArcGIS.

Thank you for your attention.