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Socioeconomic Analysis Cost-Benefit Analysis Need Doc	Flows	Draw Radial Flows	Need Doc
	Socioeconomic Analysis	Cost-Benefit Analysis	Need Doc

Socioeconomic Analysis	Crop Production (InVEST 3.14.2)	There will be 2 Crop Production In Arcgis Pro 3.0. :Crop Production Percentile ; Crop Production : Regression [ Need Doc]
Socioeconomic Analysis	Fisheries Harvest (InVEST 3.11.0)	Can't be done due to Model itself has been deprecated. https://community.naturalcapit alproject.org/t/fisheries-model -not-availabe-in-users-guide/ 2540
Socioeconomic Analysis	Food Security	Need Google earthengine authenticate!!!!!
Socioeconomic Analysis	Nutrition Metrics	Need Doc
Socioeconomic Analysis	Population Count and Density	Need Doc
Socioeconomic Analysis	Visitation: Recreation and Tourism (InVEST 3.14.2)	Need Doc
Systems	Add Systems Interactively	Need Doc
Systems	Draw Systems from Table	Need Doc
Systems	Network Analysis Grouping	R Need Doc

# **Telecoupling Toolbox Update Instruction**

## 1. Introduction

## The Evolution of Telecoupling Research

In the ever-changing landscape of global interactions, the Telecoupling Toolbox has been a pioneering instrument, enabling a nuanced understanding of the complex relationships between human and natural systems across distances. Originally developed for ArcGIS Desktop and leveraging Python 2.7, the toolbox has served a diverse audience in visualizing and analyzing telecouplings. However, with the rapid evolution of technology and the retirement of Python 2, it is essential to update our tools to meet current standards and to integrate new capabilities.

## A New Era with ArcGIS Pro and Python 3

The transition to ArcGIS Pro represents a significant advancement in the GIS domain, offering a more powerful, flexible, and user-friendly platform. Python 3, the current industry standard for Python programming, provides improved performance, security, and an expanded feature set. The Telecoupling Toolbox update is designed to harness the strengths of these new platforms, ensuring that our users have access to the most effective and efficient tools for their research and decision-making.

## Why Update Now?

The timing of this update is critical for several reasons:

- End of Life for Python 2: Python 2 has reached the end of its life, meaning it no longer receives updates or support, including security updates.
- ArcGIS Pro Advancements: ArcGIS Pro has introduced groundbreaking features that are not available in ArcGIS Desktop, such as multi-factor authentication and enhanced 3D mapping capabilities.
- Community and Support: By updating to the latest platforms, the Telecoupling Toolbox community can benefit from broader support, a wealth of resources, and a collaborative user base.

## Getting Started with the Update

This guide will walk you through updating your Telecoupling Toolbox, from assessing your current setup to installing the new version and exploring its enhanced features. We will provide detailed instructions, troubleshooting tips, and resources for further learning and support.

# 2. GETTING STARTED

## 2.0 Prerequisite:

- ArcGIS Pro:
  - Version 3.3.0 [download link need to be added]
- Python:
  - When ArcGIS Pro is installed, it automatically installs a Python program in the path [arcgisPro\_installed path]/bin/Python, for example, "C:\Program Files\ArcGIS\Pro\bin\Python". Within this directory, an environment named "arcgispro-py3" is stored in the "envs" folder. The ArcPy script can be imported and executed in this environment. Additionally, when running toolboxes in ArcGIS Pro, the scripts are executed under this environment.
  - However, it is necessary to install a separate Python instance alongside the one installed with ArcGIS Pro. The reason for this is that some Python packages cannot be installed in the "arcgispro-py3" environment, as ArcGIS Pro uses a non-public version of GDAL (3.8.1e) for ArcGIS Pro 3.3. Updating, downgrading, or reinstalling GDAL in this environment is impossible, as it would render ArcGIS Pro inoperable. Therefore, a separate "free" Python is required to perform tasks outside of this environment. It is recommended to install Anaconda to create this public Python environment. In this update process, Anaconda 24.1.2 with Python 3.11.7 was utilized.
- R:
- Version 4.4.1 is currently in use, and the following libraries need to be installed: Rtools (4.4.1), RColorBrewer (1.1-3), missMDA (1.19), FactoMineR (2.11), arcgisbinding (1.0.1.306), dplyr (1.1.4), sp (2.1-4), and igraph (2.0.3).
- InVEST 3.14.2 Workbench:
  - The InVEST 3.14.2 Workbench must be downloaded via the URL: https://storage.googleapis.com/releases.naturalcapitalproject.org/invest/3.14.2/workb ench/invest\_3.14.2 workbench\_win32\_x64.exe. After installation, the InVEST CLI model will be used to run the InVEST model for data processing. The reason for not using the InVEST Python package directly is that it cannot be installed due to its dependencies on a version of GDAL that is newer than 3.4.2, which is incompatible with the GDAL version in the ArcGIS Pro environment.

Please follow the steps below to prepare the environment for utilizing the Telecoupling Toolbox ArcGISProV3.3.

## 2.1 Installation of ArcGIS Pro V3.3.

#### 2.1.1 Download ArcGIS Pro from ArcGIS Online:

Follow these steps to download ArcGIS Pro from ArcGIS Online. Optionally, you can download a localized version.

1. Sign in to your ArcGIS Online organization.

- 2. At the top of the page, click your username and click My settings.
- 3. On the My Settings page, click the Licenses side tab.
- 4. Your user type, role, and assigned licenses are listed. If you don't see ArcGIS Pro listed under your licensed products, or if the Download ArcGIS Pro link does not appear, contact your ArcGIS organization administrator.
- 5. Next to ArcGIS Pro, click Download ArcGIS Pro.
- 6. In the Download ArcGIS Pro window, review the language setting. To download a localized version of ArcGIS Pro, change the setting to the language you want.
- 7. Click Download. An executable file (.exe) is downloaded to your computer.

#### 2.1.2 Install ArcGIS Pro V3.3.

When you get the executable file of ArcGIS Pro V3.3.0, you can follow up the steps to install it below:

1. Double-click to start the unpackaging process and set the destination folder for unpackaging the file. Here, the path is set as "C:\ArcGIS Pro 3.3":

ArcGIS Pro		×
Destination Folder for Files Please select the destination folder where the files:	he package should extract the	
Please select the destination folder:		
C:\ArcGIS Pro 3.3		Bro <u>w</u> se
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 You may have an error as "Miss Prerequisite" and it means that "ArcGIS Pro requires Microsoft .NET Desktop Runtime 8.0.x (x64)". It needs to be downloaded from the "Download .NET Desktop Runtime x64" (<u>https://dotnet.microsoft.com/en-us/download/dotnet/8.0</u>) by selecting the "x64" version for Windows.

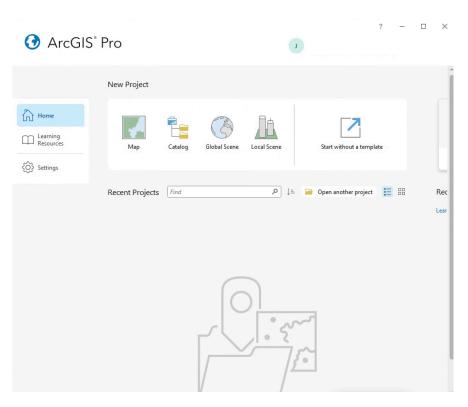
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Release note		4	Run app	os - Runtime
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Linux	Package manager instructions	Arm32   Arm32 Alpine   Arm64   Arm64 Alpine   x64   x64 Alpine	support	
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Windows	Arm64 x64 x86   winget instructions	<u>Arm64   x64   x86</u>	OS	Installers
All	dotnet-install scripts		Linux	Package manager instructions

3. After completion of unpackaging and installing .NET Desktop Runtime, double-clicking the setup file to start the process of installation of ArcGIS Pro.



Click "Next" multiple times to finish the installation process and the program is installed in the path "C:\Program Files\ArcGIS\Pro".

4. To start the ArcGIS Pro V3.3.0, user needs to input the account and passwords:



## 2.2 Install InVEST 3.14.2 Workbench:

Due to some tools in the Telecoupling Toolbox ArcGISProV3.3 depending on InVEST model calculator, InVEST workbench need to be download from here (https://storage.googleapis.com/releases.naturalcapitalproject.org/invest/3.14.2/workbench\_ch/invest\_3.14.2\_workbench\_win32\_x64.exe) and installed in the path "C:\Program Files\InVEST 3.14.2 Workbench"

## 2.3 Install Python environment

Although ArcGIS Pro provides its Python interpreter and environment as"arcgispro-py3", the GDAL package in this environment can not be utilized by InVEST, due to this version of GDAL is a special version for ArcGIS Pro only. Therefore, a public python needs to be installed and it is highly recommended to download Anaconda in Windows version from here (https://www.anaconda.com/download/success) which includes Python interpreter and some basic Python packages. After installing Anaconda (Here, it is installed in "C:\anaconda3"), the following paths "C:\anaconda3;

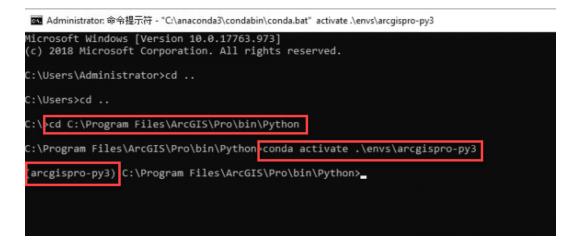
C:\anaconda3\Scripts; C:\anaconda3\Library\bin" need to be added to the system PATH environment. Then, open the CMD prompt on Windows and type: "conda", the following output will be displayed below:

	rsion 10.0.17763.973] rporation. All rights reserved.
C:\Users\Administrato usage: conda-script.p	r≻conda y [-h] [-v] [no-plugins] [-V] COMMAND
conda is a tool for m	anaging and deploying applications, environments and packages.
options:	
<pre>-h,help -v,verbose logging, thrice for</pre>	Show this help message and exit. Can be used multiple times. Once for detailed output, twice for INFO DEBUG
no-plugins -V,version	logging, four times for TRACE logging. Disable all plugins that are not built into conda. Show the conda version number and exit.
commands:	
The following built	-in and plugins subcommands are available.
COMMAND	
activate	Activate a conda environment.
build	Build conda packages from a conda recipe.
clean	Remove unused packages and caches.
compare	Compare packages between conda environments.
config	Modify configuration values in .condarc.
content-trust	Signing and verification tools for Conda
convert create	Convert pure Python packages to other platforms (a.k.a., subdirs).
deactivate	Create a new conda environment from a list of specified packages. Deactivate the current active conda environment.
debug	Debug the build or test phases of conda recipes.

Install Python libraries for 3rd party external software:

It is essential to install 3rd party package in the python environment "arcgispro-py3":

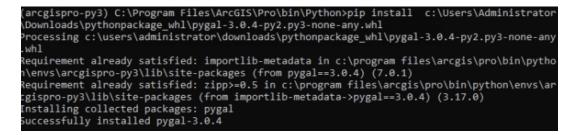
• Open CMD, change dictionary to the ArcGIS python path and use conda to activate the python environment.



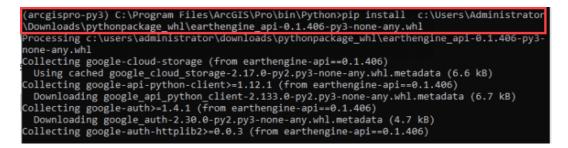
• Install pygal: you can install this package by using the whl file we prepared.

(arcgispro-py3) C:\Program Files\ArcGIS\Pro\bin\Python>pip install c:\Users\Administrator \Downloads\pythonpackage\_whl\pygal-3.0.4-py2.py3-none-any.whl

Then get result:



Install earthengine-api: you can install this package by using the whl file we prepared.



Then get result:

Installing collected packages: uritemplate, pyasn1, proto-plus, httplib2, googleapis-commo n-protos, google-crc32c, rsa, pyasn1-modules, google-resumable-media, google-auth, googleauth-httplib2, google-api-core, google-cloud-core, google-api-python-client, google-cloudstorage, earthengine-api Successfully installed earthengine-api-0.1.406 google-api-core-2.19.0 google-api-python-cl ient-2.133.0 google-auth-2.30.0 google-auth-httplib2-0.2.0 google-cloud-core-2.4.1 googlecloud-storage-2.17.0 google-crc32c-1.5.0 google-resumable-media-2.7.1 googleapis-common-pr otos-1.63.1 httplib2-0.22.0 proto-plus-1.23.0 pyasn1-0.6.0 pyasn1-modules-0.4.0 rsa-4.9 ur itemplate-4.1.1 (arcgispro-py3) C:\Program Files\ArcGIS\Pro\bin\Python>\_

## 2.4 Install R environment

Download R-4.4.1-win.exe (64bits) from here

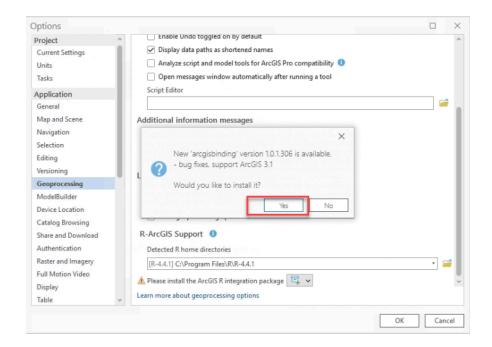
(<u>https://cran.r-project.org/bin/windows/base/</u>) and install it in the path of "C:\Program Files\R\R-4.4.1".

lect Components	
Which components should be installed?	
Select the components you want to install; clear the co install. Click Next when you are ready to continue.	omponents you do not want to
User installation	~
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64-bit Files	73.4 ME
Message translations	10.2 ME
Current selection requires at least 179.2 MB of disk sp	379
current seleculor requires at least 179.2 Mb or disk sp	dce.

Open ArcGIS Pro V3.3.0, and click "Options", then select "Geoprocessing" and you will find the R-ArcGIS Support options. Then you need to install the ArcGIS R integration pacakge as below:

oen	Recent Projects Find
	MyProject1 Culters/Administrator/Documents/ArcGS/Projects/MyProject1.apm
	MyProject C(Uters/Administrator/Document/MrGS/Project/MyProj
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nsing ions cage Manager	Project <ul> <li>Table those togging on hy denuit</li> <li>Current Steings</li> <li>Dighly data path path is solutened names</li> <li>Dinks:</li> <li>Days stopp and path path</li> <li>Dept messages window automatically after running a tool</li> <li>Application</li> <li>Scient Editor</li> <li>Carter Steings</li> <li>Control Editor</li> <li>Control Edit</li></ul>
-In Manager	General
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	Install from file

You might get a dialog like this and click "Yes"



When completed, it will show like below:

Options		
Project Current Settings Units Tasks	Enable Undo toggled on by default     Display data paths as shortened names     Analyze script and model tools for ArcGIS Pro compatibility     Open messages window automatically after running a tool	^
Application General	Script Editor R-ArcGIS Support ×	
Map and Scene Navigation Selection Editing Versioning Geoprocessing ModelBuilder Device Location Catalog Browsing	<pre>Output Messages &gt; install.packages('arcgisbinding', repos= 'https://r.esri.com/', type='win.binany', destdir='C:/ Users/Administrator/Downloads') trying URL 'https://r.esri.com/bin/windows/contrib/4.4/ arcgisbinding_1.0.1.306.zip' Content type 'application/zip' length 1623035 bytes (1.5 MB) downloaded 1.5 MB package 'arcgisbinding' successfully unpacked and MD5 sums checked Completed.</pre>	
Share and Download Authentication Raster and Imagery	[R-4.4.1] C:\Program Files\R\R-4.4.1	• 🚅
Full Motion Video Display Table	▲ Please install the ArcGIS R integration package 🖳 🗸	~
	ОК	Cancel

N-AICOD Support	1
Detected R home directories	
[R-4.4.1] C:\Program Files\R\R-4.4.1	• 🞬
Installed 'arcgisbinding' package version: [1.0.1.306] 🔄 🗸	
Learn more about geoprocessing options	

Due to some scripts needs some extra R packages, it is necessary to install them via R interface. For this step, it is highly recommended to download Rstuido and install it at first. You may find the Rstudio installer at here ("https://posit.co/download/rstudio-desktop").

Grow your data science skills	s at posit::conf(2024) August 12th-14th in Seattle		LEARN MORE ×	
<b>posit</b> products ~ sol	UTIONS ~ LEARN & SUPPORT ~ EXPLORE MORE ~ PRICING		Q	
All Installers and Tarba	lls			
RStudio requires a 64-bit oper	rating system.			
	ort Posit's public code-signing key prior to operating system's security policy.			
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Windows 10/11		262 70 112		
	RSTUDIO-2024.04.2-764.EXE ±	262.79 MB	09E1E38A	
macOS 12+	RSTUDIO-2024.04.2-764.EXE ±	262.79 MB 664.40 MB	09E1E38A	

When you complete the downloading process, double-click the Rstudio installer:

🌐 RStudio Setup		_		$\times$
	Welcome to RStudio	nstallation of all other appli ke it possible	cations to update	
		Next >	Cance	el
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Setup will install RStudio in the and select another folder. Click	following folder. To install in a differe Next to continue.	ent folder, di	ck Browse	
Destination Folder		Brov	vse	
Space required: 1.1 GB Space available: 375.9 GB Nullsoft Install System v3.09 —				
	< Back	Next >	Cance	ł

Open the Rstuido and start to install the necessary R libraries:

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Console Terminal × Background Jobs ×	Ð	Environment H	listory Connections Tutorial		_	-
🕞 R 4.4.1 · ~/ 🕫		🞯 📊 🛛 🐨 Imp	ort Dataset 👻 💿 421 MiB 👻 🎻	= L8	t •	
>		R 🔹 🛑 Global B	invironment -	Q,		
			Environment is empty			
			ackages Help Viewer Presentation			
		🖸 Install 🕜 U				
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						э
		abind	Combine Multidimensional Arrays	1.4-5		
		abind arcgisbindin		1.4-5 1.0.1.306	•	Э
		arcgisbindin	g Bindings for ArcGIS Reimplementations of Functions	1.0.1.306	•	
		arcgisbindin backports	g Bindings for ArcGIS Reimplementations of Functions Introduced Since R-3.0.0	1.0.1.306 1.5.0	•	Э
		<ul> <li>arcgisbindin</li> <li>backports</li> <li>Ø base</li> </ul>	g Bindings for ArcGIS Reimplementations of Functions Introduced Since R-3.0.0 The R Base Package	1.0.1.306 1.5.0 4.4.1 0.1-3	•	2
		<ul> <li>arcgisbindin</li> <li>backports</li> <li>base</li> <li>base64enc</li> </ul>	g Bindings for ArcGIS Reimplementations of Functions Introduced Since R-3.0.0 The R Base Package Tools for base64 encoding Classes and Methods for Fast Memory	1.0.1.306 1.5.0 4.4.1 0.1-3 - 4.0.5	• •	3
		<ul> <li>arcgisbindin</li> <li>backports</li> <li>base</li> <li>base64enc</li> <li>bit</li> </ul>	g Bindings for ArcGIS Reimplementations of Functions Introduced Since R-3.0.0 The R Base Package Tools for base64 encoding Classes and Methods for Fast Memory Efficient Boolean Selections	1.0.1.306 1.5.0 4.4.1 0.1-3 - 4.0.5	00000	2
		<ul> <li>arcgisbindin</li> <li>backports</li> <li>base</li> <li>base64enc</li> <li>bit</li> <li>bit64</li> </ul>	g Bindings for ArcGIS Reimplementations of Functions Introduced Since R-3.0.0 The R Base Package Tools for base64 encoding Classes and Methods for Fast Memory Efficient Boolean Selections A S3 Class for Vectors of 64bit Integers Bootstrap Functions (Originally by	1.0.1.306 1.5.0 4.4.1 0.1-3 - 4.0.5 5 4.0.5		3

FactoMineR:

```
RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
🔾 • 🐼 💣 • 🗧 🛃 🧼 🥢 Go to file/function 📰 🗄 • Addins •
   Console Terminal × Background Jobs ×
                                                                                                                                                                                                                          ð
  R 4.4.1 . ~/
                                                                                                                                                                                                                    > install.packages("FactoMineR")
  WARNING: Rtools is required to build R packages but is not currently installe
d. Please download and install the appropriate version of Rtools before proce
  eding:
 https://cran.rstudio.com/bin/windows/Rtools/
also installing the dependencies 'crayon', 'fs', 'pkgbuild', 'rprojroot', 'di
ffobj', 'rematch2', 'rappdirs', 'stringi', 'cpp1', 'brio', 'callr', 'desc',
'pkgload', 'praise', 'processx', 'ps', 'waldo', 'cachem', 'memoise', 'mime',
'sass', 'backports', 'generics', 'purrr', 'stringr', 'tidyr', 'tidyselect',
'testthat', 'colorspace', 'evaluate', 'highr', 'xfun', 'bslib', 'fontawesom
e', 'tinytex', 'utf8', 'broom', 'dplyr', 'sparseM', 'MatrixModels', 'minga',
'nloptr', 'RcppEigen', 'farver', 'labeling', 'munsell', 'R6', 'RColorBrewer',
'viridisLite', 'base64enc', 'digest', 'fastmap', 'knitr', 'rmarkdown', 'yam
l', 'later', 'lazyeval', 'fansi', 'pillar', 'pkgconfg', 'carData', 'abind',
'pbkrtest', 'quantreg', 'lme4', 'scales', 'htmltools', 'htmlwidgets', 'httpu
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'rlang', 'tibble', 'vctrs', 'withr', 'Rcpp', 'car', 'DT', 'ellipse', 'gmeman
s', 'flashclust', 'leaps', 'multcompview', 'scatterplot3d', 'ggplot2', 'ggrep
el'
  s',
el'
        There is a binary version available but the source version is
        later:
                binary source needs_compilation
  xfun 0.44 0.45
                                                                                               TRUE
        Binaries will be installed
  trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/crayon_1.5.2.zi
  p
```

Waiting for the installation process to complete, you can check by:

```
package 'leaps' successfully unpacked and MD5 sums checked
package 'multcompview' successfully unpacked and MD5 sums checked
package 'scatterplot3d' successfully unpacked and MD5 sums checked
package 'ggplot2' successfully unpacked and MD5 sums checked
package 'ggrepel' successfully unpacked and MD5 sums checked
package 'FactoMineR' successfully unpacked and MD5 sums checked
The downloaded binary packages are in
C:\Users\Administrator\AppData\Local\Temp\RtmpkTBLrZ\downloaded_packages
> library(FactoMineR)
```

dplyr

```
> install.packages("dplyr")
WARNING: Rtools is required to build R packages but is not currently installe
d. Please download and install the appropriate version of Rtools before proce
eding:
https://cran.rstudio.com/bin/windows/Rtools/
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/dplyr_1.1.4.zip'
Content type 'application/zip' length 1581291 bytes (1.5 MB)
```

Waiting for the installation process to complete, you can check by:

> library(dplyr)
Attaching package: 'dplyr'
The following objects are masked from 'package:stats':
 filter, lag
The following objects are masked from 'package:base':
 intersect, setdiff, setequal, union
> |

missMDA

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      Background Jobs ×

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      Earning ×
      Background Jobs ×

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      <td
```

Waiting for the installation process to complete, you can check by:

```
package gimmet: successfully unpacked and MDS sums checked
package 'mitml' successfully unpacked and MDS sums checked
package 'miter' successfully unpacked and MDS sums checked
package 'doParallel' successfully unpacked and MDS sums checked
package 'doParallel' successfully unpacked and MDS sums checked
package 'foreach' successfully unpacked and MDS sums checked
package 'foreach' successfully unpacked and MDS sums checked
package 'missMDA' successfully unpacked and MDS sums checked
the downloaded binary packages are in
        C:\Users\Administrator\AppData\Local\Temp\RtmpkTBLrZ\downloaded_package
> library(missMDA)
```

#### o sp

```
      Console
      Terminal ×
      Background Jobs ×

      R
      Eackground Jobs ×
      Image: Console is a second sec
```

Waiting for the installation process to complete, you can check by:

#### RColorBrewer

```
> install.packages("RColorBrewer")
WARNING: Rtools is required to build R packages but is not currently installe
d. Please download and install the appropriate version of Rtools before proce
eding:
https://cran.rstudio.com/bin/windows/Rtools/
trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/RColorBrewer_1.1
-3.zip'
Content type 'application/zip' length 54471 bytes (53 KB)
downloaded 53 KB
```

Waiting for the installation process to complete, you can check by:

igraph

```
      Console
      Terminal ×
      Background Jobs ×

      R
      R4.1. ~/ ?

      > install.packages("igraph")

      WARNING: Rtools is required to build R packages but is not currently installe

      d. Please download and install the appropriate version of Rtools before proce

      eding:

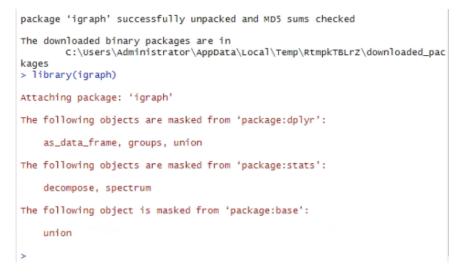
      https://cran.rstudio.com/bin/windows/Rtools/

      trying URL 'https://cran.rstudio.com/bin/windows/contrib/4.4/igraph_2.0.3.zi

      p'

      Content type 'application/zip' length 7117888 bytes (6.8 MB)
```

Waiting for the installation process to complete, you can check by:



#### 2.5 Install the Telecoupling Toolbox ArcGISProV3.3

To add the "Telecoupling+Toolbox" to ArcGIS Pro Version 3.3, follow these steps:

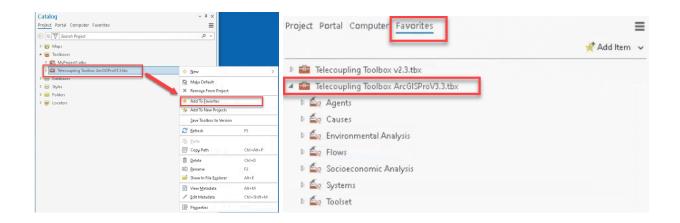
- 1. Open ArcGIS Pro Version 3.3.
- 2. Click on the "Insert" tab in the ribbon.
- 3. Select "Toolbox" from the available options.
- 4. Choose "Add Toolbox" from the dropdown menu.
- In the file dialog, locate and select the file named "Telecoupling+Toolbox ArcGISPROV3.3.tbx".
- 6. Click "OK" to add the toolbox to your ArcGIS Pro session.

😫 🛱 🛱 5 · C	✓		<ul> <li>Telecoupling+Toolbox ArcGISPro</li> </ul>		
			<ul> <li>Telecoupling+Toolbox_ArcGISPro</li> </ul>	<ul> <li>Image: Search Tele</li> </ul>	ecoupling+Toolbox_ArcGISPro 🔎 🗸
Project Map	Insert Analysis View	Edit Image	Name Figs Schemas	Type Geometry Folder	
	ew Presentation 🖄 Import I	· []	Scripts	Folder	2024/6/7 17:57:35 2024/6/9 23:32:43
New New New Map - Layout - Report - Drawing Order	Add Toolbox Mew Toolbox (.atbx) New Python Toolbox	Layout ~ Connection	Arc65PrvV3.3.tbs		Toolboxes (All Types)
✓ World Topographi	Netresh				OK Cancel

Once added, the "Telecoupling+Toolbox" will be visible in the catalog panel. To make it more accessible:

- You can select the toolbox in the catalog panel.
- Right-click on the selected toolbox.
- Choose "Add to Favorites" from the context menu.

This will add the toolbox to the favorites bar for quick access in future sessions. Utilizing the scripts within the toolbox will require you to follow the specific instructions provided for each script to ensure proper execution and results.



To utilize the scripts within the "Telecoupling+Toolbox" in ArcGIS Pro Version 3.3, follow these steps:

- 1. Locate the toolbox in the catalog panel or the favorites bar.
- 2. Expand the toolbox to reveal its contents.
- 3. Identify the relevant script category, such as "Agents".
- 4. Click on the "Agents" category to expand it and display the available scripts.
- 5. Right-click on the specific script you wish to execute.
- 6. From the context menu, select "Open" to launch the script.

By doing so, the script will open in a new window, where you can configure its parameters and initiate the execution process. Ensure that you have the necessary data and settings configured according to the script's requirements for successful execution.

# 3. TUTORIALS

The following tutorials will guide you through examples of potential applications of each script tool using the sample data provided with the toolbox

(SampleDataTelecoupling+Toobox\_ArcGISProV3.3.zip). All ESRI

basemaps are by default, typically found in most online web applications (e.g. Google Maps, Bing Maps). Suppose you decide to use your background administrative layer that is in a different coordinate system. In that case, ArcGIS will automatically re-project any additional layers (including output from geoprocessing tools) on-the-fly to the coordinate system of the first layer in your map.

Before using the toolbox, it is essential to initiate a New project via the ArcGIS Pro, here for the tutorials, we create a new project as "Myproject1" and store it in the path of "C:\Users\Administrator\Dcouments\ArcGIS\Projects\MyProject1".

NOTE: Although ArcGIS projects on-the-fly to avoid projection mismatch, we always encourage the user to have all layers in the same coordinate system appropriate for the scale of analysis and case study.

NOTE: some basic level of proficiency in ArcGIS Pro is necessary to better follow the tutorial examples.

## 3.1 SAMPLE DATASET

The sample dataset provided with the telecoupling toolbox has data on six different types of telecoupling: wildlife transfer, tourism (eco-tourism), agricultural trade, industrial trade, conservation subsidies, and information dissemination. Inside the SampleDataTelecoupling+Toobox\_ArcGISProV3.3 folder, you will also find several other subfolders divided by topic which will be used in some of the following tutorials. DISCLOSURE ON DATA USAGE: the sample datasets were either partially modified, or their format changed in some cases from the original datasets to protect privacy and sensitive data when deemed appropriate. Use the sample datasets for learning purposes only and under no circumstances data should be used to inform any policy. Please refer to the Telecoupling Toolbox license agreement for more details.

Date modified	Туре
4/4/2018 8:45 PM	File folder
10/2/2017 9:34 PM	File folder
6/2/2024 5:35 PM	File folder
12/4/2018 4:29 AM	File folder
6/4/2024 3:06 PM	File folder
4/4/2018 8:45 PM	File folder
	4/4/2018 8:45 PM 10/2/2017 9:34 PM 6/2/2024 5:35 PM 12/4/2018 4:29 AM 6/4/2024 3:06 PM

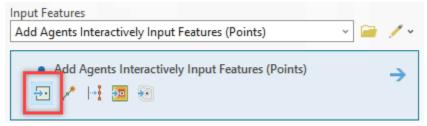
## 3.2 AGENTS TOOLSET

#### 3.2.1 Add Agents Interactively

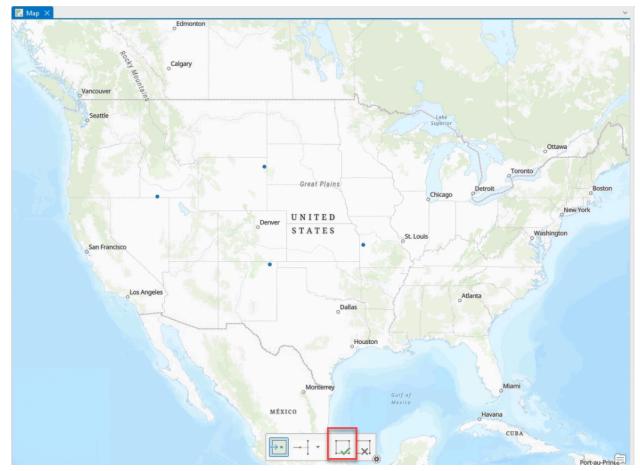
Geoproces	sing	~ 4 ×
	Add Agents Interactively	$\oplus$
Parameters	Environments	?
* Input Featur	res	
		🚞 🖉 🗸 🗸
* Input Attrib	utes	
		i 📄 🔤
Add XY	Coordinates	
Coordinate	System	
		· @

Right click the script and open it

- Click for the current map to use as input
- Select "Points" and Move the mouse cursor over the map and you should see points ready to be placed.

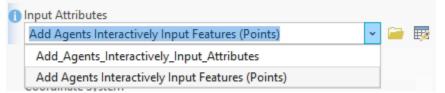


• Then, click on the map to mark the position your agents down.



And then, you need to click the button in red frame to finshi,

• Select the feature layer and Click to create an attribute table



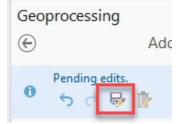
• You will get a table in the "Contents" tab and need to open it by right click and select "Open"

Contents	~ ‡ ×
Y Search	<i>ب</i> م
<u>t</u> 🖯 🖸 🖊 🛱 🤌 🦄	
Drawing Order	
🔺 🂽 Map	
▲ 🖌 Add Agents Interactively Input Feature	s (Points)
•	
✓ World Topographic Map	
🗌 World Hillshade	
▲ Standalone Tables	
Add_Agents_Interactively_Input_Attrib	outes

• In the opened table, you can input the description in "Name" or/And "Text" column

Field: 📰 Add 📰 Calculate   Selection: 🖺 Select By Attributes 🕀 Zoom To 🔮 Switch 📃 Clear									
1	OBJECTID *	Name		Text		IntegerValue	DoubleValue	DateTime	
1	1	P1		Point A		<null></null>	<null></null>	<null></null>	
2	2	P2		Point B		<null></null>	<null></null>	<null></null>	
3	3	P3		Point C		<null></null>	<null></null>	<null></null>	
0	4	P4		Pont D		<null></null>	<null></null>	<null></null>	

You need to click save button to save the editing table:



- Then, select the "Add XY Coordinates" as optional and run button.
- You will get the final results as below:

Search P v										Geoprocessing	~ 4
									Ottawa	Add Agents Interactively	
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1. S.					12	Great Plains		V B		0 5 c ₩ 1	
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Map							5		New York	Input Features	
Agents						UNITED			14.55	Add Agents Interactively Input Features (Points)	
Agent						STATES	St. Louis		Washington	Input Attributes	
		San Fi	Francisco				a ford			Add_Agents_Interactively_Input_Attributes	
4 🖌 Add Agents Interactively Input Features (Points)					•					Add XY Coordinates	
•					2 · · · ·					Coordinate System	
World Topographic Map			Los Angeles								
World Hillshade			° (			Dallas		Atlanta			
Standalone Tables			FX			ounds					
Add_Agents_Interactively_Input_Attributes											
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	Add_Ager	ents_Interactinput	it_Attributes ×							~	
	Field: ITT Ad	dd 🔃 Calculate	Selection: 🕞 Select By	Attributes 🖉 Zoom To	Et Switch		Rows Blocart v		=		
	OBJECTID		Text	IntegerValue D			nona 195 more				
			Text Point A			DateTime	none (§) nout			α	
	OBJECTID *	* Name		IntegerValue D	DoubleValue	DateTime <null></null>	tons to use .			• •	
	OBJECTID * 1 1 2 2 3 3	* Name P1	Point A	IntegerValue C	oubleValue <null></null>	OateTime <null> <null></null></null>	tools the little of			• •	
	OBJECTID *	* Name P1 P2	Point A Point B	IntegerValue C <null> <null></null></null>	OoubleValue <null> <null></null></null>	DateTime <null> <null></null></null>				• •	
	OBJECTID * 1 1 2 2 3 3 4 4	* Name P1 P2 P3	Point A Point B Point C	IntegerValue E <null> <null> <null></null></null></null>	Null> <null> <null> <null> <null></null></null></null></null>	DateTime <null> <null></null></null>					
	OBJECTID * 1 1 2 2 3 3 4 4	* Name P1 P2 P3 P4	Point A Point B Point C	IntegerValue E <null> <null> <null></null></null></null>	Null> <null> <null> <null> <null></null></null></null></null>	DateTime <null> <null></null></null>					
	OBJECTID * 1 1 2 2 3 3 4 4	* Name P1 P2 P3 P4	Point A Point B Point C	IntegerValue E <null> <null> <null></null></null></null>	Null> <null> <null> <null> <null></null></null></null></null>	DateTime <null> <null></null></null>	in the second seco				
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	OBJECTID * 1 1 2 2 3 3 4 4	* Name P1 P2 P3 P4	Point A Point B Point C	IntegerValue E <null> <null> <null></null></null></null>	Null> <null> <null> <null> <null></null></null></null></null>	DateTime <null> <null></null></null>					Run
	OBJECTID * 1 1 2 2 3 3 4 4	* Name P1 P2 P3 P4	Point A Point B Point C	IntegerValue E <null> <null> <null></null></null></null>	Null> <null> <null> <null> <null></null></null></null></null>	DateTime <null> <null></null></null>				Add Agents Interactively completed.     Vice Databa Open Hatory © opportions	• Run

• Coordinate System: can be an optional selection and just keep it empty.

#### 3.2.2 Draw Agents from Table

Geoprocessi	ng	~ ‡ ×
	Draw Agents from Table	$\oplus$
Parameters E	Environments	?
* Input Table		
* X Field		遼
* Y Field		蓉

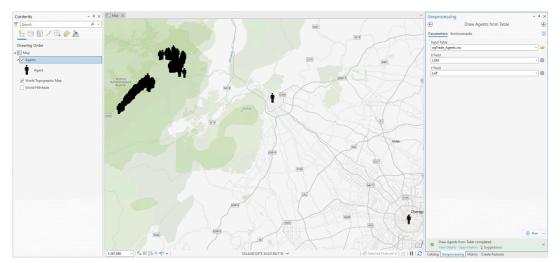
Right click the script and open it

• Click and select the input table. In this example, we selected the table as "agTrade\_Agents.csv" from the subfolder of "Agents" in the sample datasets.

⊖ ∋ ♠ 🔣 ∽ SampleData_ArcGISPro 🗸	Agents V Draw Agents from Table	<ul> <li>♥</li> <li>♥</li> <li>↓=</li> <li>Search Draw Agents f</li> </ul>	from Table 🔎 🗸
Organize 🗸 New Item 🗸			ETD
Portal	^ Name	Type Geometry	Date Modified
	agTrade_Agents.csv	Text File	9/2/2016 10:13:24 P
<ul> <li>My Content</li> <li>My Favorites</li> </ul>	conservation_Agents.csv	Text File	9/12/2016 10:02:22
<ul> <li>My Groups</li> </ul>	indTrade_Agents.csv	Text File	9/3/2016 1:38:04 AM
	info_Agents.csv	Text File	9/13/2016 2:58:48 A
My Organization     ArcGIS Online	tourism_Agents.csv	Text File	9/2/2016 9:56:02 PM
	wildlife_Agents.csv	Text File	9/23/2016 1:48:10 A
Diving Atlas Computer			
Computer Øuick access			
a30335			
Administrator			
<ul> <li>Administrator</li> <li>Libraries</li> </ul>			
Network			
Tools			>
Name agTrade_Agent	ts.csv	Tables and	Attribute Tables (All Typ 🔻

Geoprocessing	* * ^		
Draw Agents from Table	$\oplus$		
Parameters Environments	?	Geoprocessing	~ # ×
Input Table agTrade_Agents.csv		Oraw Agents from Table	$\oplus$
X Field LON	~ ¢	Parameters Environments Input Table	?
Y Field	<b>↓</b>	agTrade_Agents.csv	2
NAME Description		X Field LON	~ 亞
LON LAT		Y Field LAT	~ 祢

• Click Run button and get results as below:

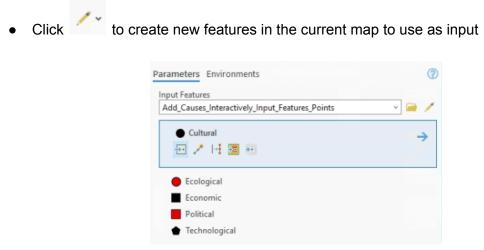


#### 3.3 Causes

## 3.3.1 Add Causes Interactively

Geoprocess	ing	~ å ×
	Add Causes Interactively	$\oplus$
Parameters	Environments	?
* Input Feature	5	
* Describe Cau	ises	i i i i i i i i i i i i i i i i i i i
Coordinate_S	Jystem	~ @

Right click the script and open it



Different categories are represented by different symbols.

• Select from different categories and mark it in the map.



• When completing the marking step, please click finish button in the map.



Select "Describe Causes" in the droplist and click I to create table.



• Right click the created table and click "open"

OBJECTIC	0 * Name		Text		IntegerValue	DoubleValu	e DateTime	Cause		
1 1	P1		Point A		<null></null>	<null< td=""><td>&gt; <null></null></td><td>Cultural</td><td></td><td></td></null<>	> <null></null>	Cultural		
2 2	P2		Point B		<null></null>	<null< td=""><td>&gt; <null></null></td><td>Ecological</td><td></td><td></td></null<>	> <null></null>	Ecological		
3 3	P3		Point C		<null></null>	<null< td=""><td>&gt; <null></null></td><td>Economic</td><td></td><td></td></null<>	> <null></null>	Economic		
4 4	P4		Point D		<null></null>	<null< td=""><td>&gt; <null></null></td><td>Political</td><td></td><td></td></null<>	> <null></null>	Political		
5 5	P5		Point E		<null></null>	<null< td=""><td>&gt; <null></null></td><td>Technolog</td><td>jical</td><td></td></null<>	> <null></null>	Technolog	jical	
	d d an anna a sao a									
	Add Cause	s Interactively (	Describe *							
Click to a		s_Interactively_[ Field Name	Describe 🔹	Data Type	Allow NULL	Highlight	Number Format	Domain	Default	Length
Current Layer	Add_Cause			Data Type Object ID	Allow NULL	Highlight	Number Format	: Domain	Default	Length
Current Layer	Add_Cause	Field Name	Alias			Highlight		: Domain	Default	Length
Current Layer	Add_Cause	Field Name OBJECTID	Alias OBJECTID	Object ID				: Domain	Default	
Current Layer	Add_Cause	Field Name OBJECTID Name	Alias OBJECTID Name	Object ID Text				: Domain	Default	255

#### • Click "Add" to add new field as "DESCRIPTION", then close it and save.

Date

DateTime

Cause DESCRIPTION DESCRIPTION Text

Input description text into the table as below: ٠

Cause

DateTime

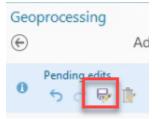
 $\checkmark$ 

 $\checkmark$ 

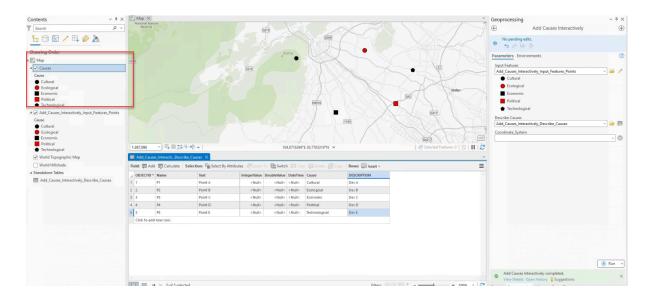
Field: 📰 Add 📰 Calculate Selection: 🖫 Select By Attributes 🚭 Zoom To 🖶 Switch 📄 Clear 💭 Delete 🖨 Copy								
	OBJECTID *	Name	Text	IntegerValue	DoubleValue	DateTime	Cause	DESCRIPTION
1	1	P1	Point A	<null></null>	<null></null>	<null></null>	Cultural	Des A
2	2	P2	Point B	<null></null>	<null></null>	<null></null>	Ecological	Des B
3	3	P3	Point C	<null></null>	<null></null>	<null></null>	Economic	Des C
4	4	P4	Point D	<null></null>	<null></null>	<null></null>	Political	Des D
0	5	P5	Point E	<null></null>	<null></null>	<null></null>	Technological	Des E

255

Then to click save to save the editing. •



Click "Run" and keep the "Coordinate\_System" empty as default. And the result shows • here: The new layer as "Causes" will be created:



#### 3.3.2 Factor Analysis for Mixed Data

Geoproces	sing		~ 1	Ψ×
	Factor Analysis for Mixed Data			$\oplus$
Parameters	Environments			?
* Input Table			_	-
⊗ Quantitative	e Variables	Select All	豪	5
😵 Qualitative \	Variables	Select All	豪	9
Number of I 5	Dimensions			
* Output PDF				-
> Supplement	ntary Variables			

Note: For "Quantitative Variables" and "Qualitative Variables", ONLY after the input the "Input Table", you can select value from the list

Right click the script and open it

• Click and select the input Table.. In this example, we selected the file as "gtgp\_hhsurvey\_2006.shp" from the subfolder of "Causes/Factor Analysis for Mixed Data" in the sample datasets. Then you will see the lists for "Quantitative Variables" and "Qualitative Variables".

Geoprocessing		~ 1	ч×
(€) Factor Analysis for Mixed Data			$\oplus$
Parameters Environments			?
Input Table			
gtgp_hhsurvey_2006.shp			
😵 Quantitative Variables	Select All	亦	\$
FID			^
Shape			
hh_id			
FID_			
Township			
Village			
Group			
location			
elevation			
GDEM_eleva			
· · · · · · · · ·			~
🛿 Qualitative Variables	Select All	弶	ଚ
FID			^
Shape			
hh_id			
FID_			
Township			
🗌 Village			
Group			
location			
elevation			
GDEM_eleva			
~~			~

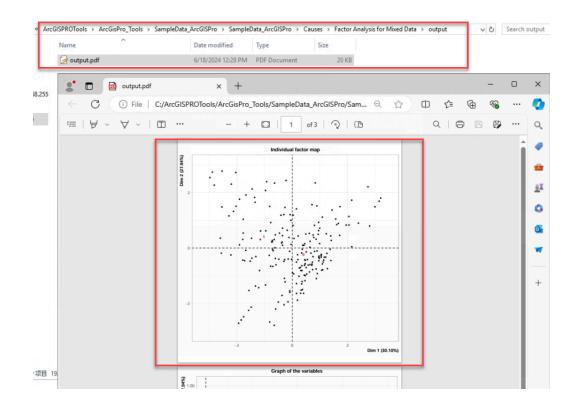
- For "Quantitative Variables", select "GTGP", "GTBP", "Crop\_produ", and "Number\_of".
- For "Qualitative Variables", select "Tourism\_pa"
- Check the "Compute Missing Values"
- Input "Output PDF" path as "/Causes\Factor Analysis for Mixed Data\output\output.pdf"
- Keep other parameters as default and it looks like:

Geoprocessing		~ # )
€ Fa	ctor Analysis for Mixed Data	(
Parameters Environments		G
Input lable		
gtgp_hhsurvey_2006.shp		
Quantitative Variables		Select All 南 🥠
li id		^
Household		
✓ GTGP		
GTBP		
Tourism_pa		
Labor_migr		
✓ Crop_produ		
✓ Number_of		
Adult_educ		
Househol_1		
		×
Qualitative Variables		Select All 🎄 🥠
GTBP		^
✓ Tourism_pa		
Labor_migr		
Crop_produ		
Number_of		
Adult_educ 22: Crop_produ		
Househol_1		
Average_ag		
Social_tie		
Social_t_1		
C Las data		×
Compute Missing Values		이 같은 것은 것은 것이 같아요. 이 것이 같아요. ????????????????????????????????????
Number of Dimensions		
Output PDF	Data and a standard off	
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleData_ArcGISPro\Causes\Factor Analysis for Mi	xed Data\output\output.pdf	
Supplementary Variables		
		() Run -

- Click Run to execute the script and get the result.
- Check the text output like the following:

	(€) Factor Analysis for Mixed Data
	Parameters Environments
	Input lable
	gtgp_hhsurvey_2006.shp
Factor Analysis for Mixed Data	Quantitative Variables Select All 🖗 🤄
Started: Today at 12:28:28 PM	lid
Completed: Today at 12:28:33 PM	Household
Elapsed Time: 5 Seconds	GTGP
Parameters Environments Messages (19)	GTBP
	Tourism_pa
	Labor_migr
Start Time: Tuesday, June 18, 2024 12:28:28 PN Loading required package: FactollineR	Crop_produ
Loading required package: missNDA	✓ Number_of
Reading Input Parameters	Adult_educ
Creating Dataframe from Input Table	Househol_1
Running Factor Analysis Call:	
FAVD(base = df, ncp = as.integer(num_fact), graph = FALSE)	Qualitative Variables Select All 🖓 🤄
Eigenvalues	GTBP
Dim.1 Dim.2 Dim.3 Dim.4 Dim.5 Variance 1.595 1.397 1.112 0.699 0.286	✓ Tourism_pa
% of var. 30.104 27.945 22.236 13.990 5.726	Labor_migr
Cumulative % of var. 30.104 58.048 80.284 94.274 100.000 Individuals (the 10 first)	Crop_produ
Dist Dim.1 ctr cos2 Dim.2 ctr cos2 Dim.3	Number_of
1 2.651 -2.284 1.716 0.742 1.157 0.474 0.190 -0.172 2 2.740 -1.767 1.027 0.416 0.538 0.103 0.039 -1.161	Adult_educ
3 2.711 1.726 0.980 0.405 1.493 0.790 0.303 -0.992	Househol_1
4 2.076 1.605 0.848 0.598 0.841 0.251 0.164 0.756 5 1.381 0.463 0.070 0.112 -1.180 0.493 0.731 0.216	Average_ag
6   1.082   0.729 0.175 0.454   -0.508 0.091 0.220   -0.603	Social_tie
7 0.959 0.898 0.266 0.878 -0.109 0.004 0.013 0.058 8 2.935 -0.964 0.305 0.108 2.074 1.524 0.499 -1.392	Social_t_1
9 1.160 -0.146 0.007 0.016 -0.398 0.056 0.118 -0.850 10 0.099 0.195 0.013 0.046 -0.242 0.021 0.074 -0.513	- 1 Zas
	Compute Missing Values
	Number of Dimensions
ANTARCTICA	
	A Outp PDF
	() Run
	Factor Analysis for Mixed Data completed. View Details upon History Vsuggestions

• Check the PDF file from the Output PDF path as "/Causes\Factor Analysis for Mixed Data\output\output.pdf "



## 3.3.3 Model Selection (OLS)

Geoproces	sing	~ ‡ ×
$\odot$	Model Selection (OLS)	$\oplus$
Parameters	Environments	?
* Input Featur	es	
Denerdenti	(citle	
* Dependent	Variable	资
* Candidate E	xplanatory Variables - 핥	
Weights Ma	trix File	
Search Crit	teria	

Right click the script and open it

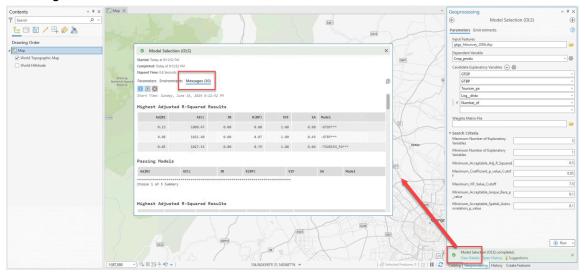
• Click *and* select the input features. In this example, we selected the features file as "gtgp\_hhsurvey\_2006.shp" from the subfolder of "Causes/Model Selection OLS" in the sample datasets.

🔣 Map	×			~	Geoprocessing	~ # ×
		941	516		Model Selection (OLS) Parameters Environments Input Features [gtgp_hhuwey_2006.shp]	() () () ()
	A State of the second se	T S		4	* Dependent Variable	
	Input Features		□ × [5401]	X		~ 资
	(€ ○ ① ① SampleData_ArcGISPro ∨ Causes ∨ Model Selection OLS	<ul> <li>♥</li> <li>↓= Search Model Selection OLS</li> </ul>	ب م ب م	4	* Candidate Explanatory Variables (◇ 撤	
	Organize V New Item V					~
Nation		Type Geometry	Date Modified	G	Weights Matrix File	
Ne	Databases gtgp_hhsurvey_2006.shp	Shapefile Point	10/12/2016 10:39:58			
	Folders				> Search Criteria	
	A 🖉 Portal		A			
8	<ul> <li>My Content</li> <li>My Favorites</li> </ul>					
G350	<ul> <li>Wy ravorites</li> <li>A My Groups</li> </ul>		51			
	<ul> <li>My Groups</li> <li>My Organization</li> </ul>			-		
	ArcGIS Online					
	Eiving Atlas		Xinfan			
	4 🗊 Computer			$\langle n$		
	Quick access					
	Þ 🔜 a30335		G317			
	Administrator					
	D Libraries		· · · · · · · · · · · · · · · · · · ·	E Y		
	Name gtgp_hhsurvey_2006.shp	Feature Classes (A				
		OK	Cancel			
		( )) PA	5105			

- For the Dependent Variable, select "Crop\_produ" from the drop list.
- For Candidate Explanatory Variables, multiple values can be selected from the drop list as "GTGP", "GTBP", "Tourism\_pa", "Log\_dista", and "Number\_of".
- You will get the parameter setting as below and leave all other tool options unaltered and click run.

Geop	rocessing	~ ‡ ×
€	Model Selection (OLS)	$\oplus$
Paran	neters Environments	?
Inpu	t Features	
gtg	p_hhsurvey_2006.shp	i i i i i i i i i i i i i i i i i i i
Depe	endent Variable	
Cro	p_produ	~ 资
Cano	didate Explanatory Variables 📀 嫝	
	GTGP	~
	GTBP	Ý
	Tourism_pa	~
	Log_dista	÷
×	Number_of	~
		Ŷ
Weig	hts Matrix File	
		i i i i i i i i i i i i i i i i i i i
> Sear	rch Criteria	

• When run it successfully, click the "View Details" on the bottom right side and click "Message" to check the results:



n v

#### 3.4 Environment Analysis 3.4.1 CO2 Emissions

# Geoprocessing CO2 Er

Geoprocessing		~ + X
$\odot$	CO2 Emissions	$\oplus$
Parameters Enviro	onments	?
* Input Feature		
		<b></b>
* Wildlife Units		
		寧
Transportation Cap	acīty	1
* Units of CO2 Emitte	ed	
> Future Scenario		

Right click the script and open it

 Click and select the input features. In this example, we selected the features file as "Lines.shp" from the subfolder of "Calculate CO2 Emissions on Flows/results\_layers" in the sample datasets.

🛍 📾 🛱 5 × ♂ × ⊽			MyProject1 🔎 🏹 🖲	3 Irch (Alt+Q)		jianan2 - N	Tichigan State University Online ArcGIS 🥑 🎝 ? – 🗗 🗙
Project Map Insert Analysis View	Edit	Imagery Share Help			à la m		
En - GO New Matchash or Strengt		1 1 1		a Aa 🔒 🤝		*	
New New New New Motebook * (;; import Map * Layout * Report * 🚔 Toolbox *		v Folder Investigation No	t Map Line Map Polygon Text Map Text stes Notes Map Notes Notes 1:1,000 Notes	Map Text Map 1:25,000 Notes 1:250,  Vew Link Di Chart	istance and Direction	Add em ~	
Project		Knowledge Graph	Layer Templates	Link Analysis Me	easurements Styles Far	vorites	^
Contents v # ×	🔣 Map	×				~	Geoprocessing v # ×
₹ Search P v				5421			€ CO2 Emissions ⊕
E= C					5216		Parameters Environments (?)
Drawing Order					3210		* Input Feature
A E Map							
World Topographic Map		Input Feature			× [5401]	- X-	* Wildlife Units
World Hillshade		€ ) () Kalculate CO2 Emissions or	n Flows 👻 results_layers 🔹 🖑	↓= Search results_layers	P ~	$-\!\!/\!\!\times$	Transportation Capacity
		Organize V New Item V					* Units of CO2 Emitted
	Nationa Res	🔺 💼 Project	Name Type	Geometry Date Modi		6	Future Scenario
	100	<ul> <li>Databases</li> <li>Folders</li> </ul>	Eines.shp Shapefil	e Line 6/8/2024 6:1	15:03 PM		Puture Scenario
	1. 2.	Portal	L				
		My Content			RHT~		
	6350	👂 🥋 My Favorites	1				
		My Groups			51		
		My Organization     ArcGIS Online					
		ArcGIS Online     Eiving Atlas			Xinf		
		Computer					
		D 🖈 Quick access			M A		
		Þ 💻 a30335			6317		
		Administrator					
		b Hibraries	~ [	Line Feature Classes (All Type		THE	
		Name Lines.shp		Line Feature Classes (All Type	s) • 64217		
				OK Ca	ncel	\$105	
			69910	V Con		THUS	
						Chengo	
			NG VAD	5424			
			69910		600		
		5532	The second		HAN		
				MAN.			🕟 Run 🗸
	1:387,090	二- 二==================================	103.9271938*E 31.0702588*N	v	Selected Features: 0		Catalog Geoprocessing History Create Features

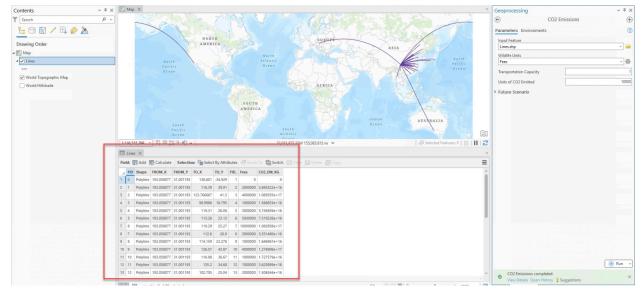
• Select "Fees" in the droplist of Wildlife Units. Set Transportation Capacity as 1 and Units of CO2 Emitted as 10000 for example.

Geoprocessing		~ ± ×
	CO2 Emissions	$\oplus$
Parameters Environ	ments	(?)
Input Feature		
Lines.shp		200
Wildlife Units		
Fees		~ 凉
Transportation Capaci	ty	1
Units of CO2 Emitted		10000
> Future Scenario		

• Then click run to execute the script and results will be shown as below:



• The "Lines" layer will be added into the map and right click it with selecting "Attribute Table", the details on the table will be shown.



#### 3.4.2 Coastal Blue Carbon (InVEST 3.14.2)

Geoprocessing	~ ‡ ×
Coastal Blue Carbon (InVEST 3.14.2)	$\oplus$
Parameters Environments	(?)
* LULC Lookup Table	
	2
* LULC Snapshots Table	
* Biophysical Table	
* LULC Transitions Table	
* Baseline Raster	
* Year Of Baseline	
* Transition Raster List	
	<sup>(</sup>
* Transition Year List	
	+) Add another
Do Economic Analysis	
Use Price Table	
Price	10
Interest Rate	3
Discount Rate	б
Analysis Year	
* invest_exe_path	_

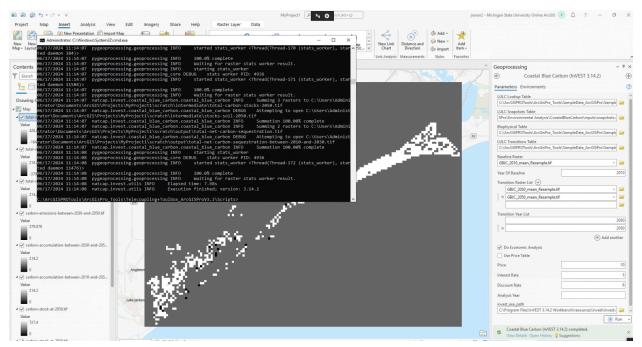
Right click the script and open it

- Click and select the LULC Lookup Table. In this example, we will use"lulc\_lookup.csv" from the folder "\Environmental Analysis\CoastalBlueCarbon\inputs"
- By the same operation, for LULC Snapshots Table, use "snapshots.csv" from the folder "\Environmental Analysis\CoastalBlueCarbon\inputs".

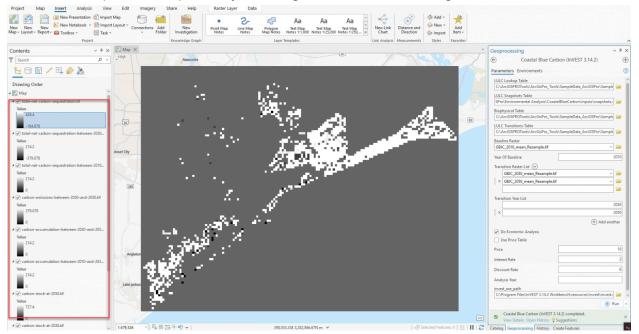
- For Biophysical Table, use "biophysical\_table\_sample.csv" from the folder "\Environmental Analysis\CoastalBlueCarbon\outputs\_preprocessor".
- For LULC Transitions Table, use "transitions\_sample.csv" from the folder "\Environmental Analysis\CoastalBlueCarbon\outputs\_preprocessor".
- For Baseline Raster, use "GBJC\_2010\_mean\_Resample.tif" from the folder "\Environmental Analysis\CoastalBlueCarbon\inputs".
- For the "Year of Baseline", input "2010"
- For "Transition Raster List", select "GBJC\_2030\_mean\_Resample" and "GBJC\_2050\_mean\_Resample" from the folder "\Environmental Analysis\CoastalBlueCarbon\inputs" and add them to the list.
- For "Transition Year List", input "2030" and "2050" to the list.
- Keep other parameters as default, except the invest\_exe\_path.
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- The Final parameters setting is below:

Geoprocessing	~ å ×		
Coastal Blue Carbon (InVEST 3.14.2)			
Parameters Environments	?		
LULC Lookup Table			
C:\ArcGISPROTools\ArcGisPr	o_Tools\SampleData_ArcGlSPro\SampleDa		
LULC Snapshots Table SPro\Environmental Analysis	\CoastalBlueCarbon\inputs\snapshots.csv 🧎		
Biophysical Table			
	o_Tools\SampleData_ArcGlSPro\SampleDa  🗃		
LULC Transitions Table			
C:\ArcGISPROTools\ArcGisPr	o_Tools\SampleData_ArcGISPro\SampleDa  🗃		
Baseline Raster			
GBJC_2010_mean_Resample.	tif 🤅 🗃		
Year Of Baseline	2010		
Transition Raster List			
GBJC_2030_mean_Resam	nple.tif 🧁		
× GBJC_2050_mean_Resan	nple.tif 🧰		
Transition Year List			
	2030		
×	2050		
	(+) Add another		
	0		
Do Economic Analysis			
Use Price Table			
Price	10		
Interest Rate	3		
Discount Rate 6			
Analysis Year			
invest_exe_path			
	.2 Workbench\resources\invest\invest.exe 🦳		
	🜔 Run 👻		

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When the script run completed, you can get results as following:



3.4.3 Coastal Blue Carbon Preprocessor (InVEST 3.14.2)

Geoprocessing ~	ά×
Coastal Blue Carbon Preprocessor (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* LULC Lookup Table	
* LULC Time Snapshots	
* invest_exe_path	

- Click and select the LULC Lookup Table. In this example, we will use"lulc\_lookup.csv" from the folder "\Environmental Analysis\Coastal Blue Carbon Preprocessor".
- By the same operation, for LULC Snapshots Table, use "snapshots.csv" from the folder "\Environmental Analysis\Coastal Blue Carbon Preprocessor".
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Then Click Run to execute the script and you will get result files in the Scratch folder of the project. Here it is

"C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\scratch\outputs \_preprocessor"



aligned\_lulc\_2010 .tif

aligned\_lulc\_2030 .tif



aligned\_lulc\_2050



carbon\_biophysi cal\_table\_templat e.csv



carbon\_pool\_tran sition\_template.c sv

3.4.4 Forest Carbon Edge Effect (InVEST 3.14.2)

Geoprocessing	~ # ×
Forest Carbon Edge Effect (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Land Use/Land Cover Map	
* Biophysical Table	
Carbon Pools to Calculate	
all	~
<ul> <li>Compute Forest Edge Effects</li> </ul>	
Global Forest Carbon Edge Regression Models	
Number of Nearest Model Points to Average	10
Forest Edge Biomass to Carbon Conversion Factor	0.47
Service Area of Interest	
* invest_exe_path	

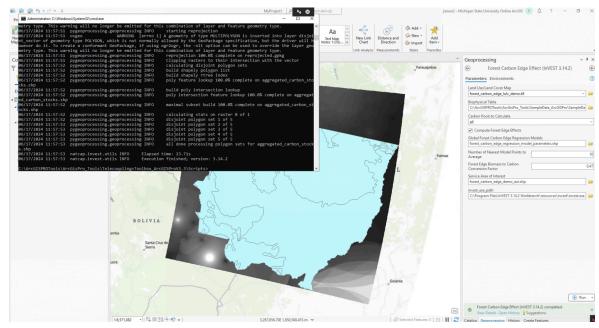
- Click and select the LULC image. In this example, we will use"forest\_carbon\_edge\_lulc\_demo.tif" from the folder "\Environmental Analysis\forest\_carbon\_edge\_effect".
- By the same operation, for Biophysical Table, use "forest\_edge\_carbon\_lu\_table.csv" from the folder "\Environmental Analysis\Coastal Blue Carbon Preprocessor".
- Set "Carbon Pools to Calculate" as "all" and check "Compute Forest Edge Effects"
- For "Global Forest Carbon Edge Regression Models", select the file of "forest\_carbon\_edge\_regression\_model\_parameters.shp" from the folder "\Environmental Analysis\forest\_carbon\_edge\_effect\core\_data".
- For "Service Area of Interest", select "forest\_carbon\_edge\_demo\_aoi.shp" from the folder "\Environmental Analysis\forest\_carbon\_edge\_effect" .
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the

path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.

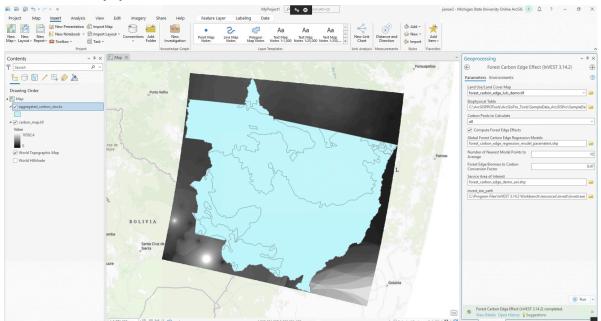
• Keep other parameters as default. And the final parameters are setting like below:

eoprocessing	~ † ×	
<ul> <li>Forest Carbon Edge Effect (InVEST 3.14.2)</li> </ul>	$\oplus$	
arameters Environments	?	
Land Use/Land Cover Map		
forest_carbon_edge_lulc_demo.tif	<b></b>	
Biophysical Table		
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\Sam	pleDa 🧀	
Carbon Pools to Calculate		
all		
<ul> <li>Compute Forest Edge Effects</li> <li>Global Forest Carbon Edge Regression Models</li> </ul>		
forest_carbon_edge_regression_model_parameters.shp		
Number of Nearest Model Points to Average	10	
Forest Edge Biomass to Carbon Conversion Factor	0.47	
Service Area of Interest		
forest_carbon_edge_demo_aoi.shp		
invest_exe_path		
	st.exe 🦳	

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• And finally, you will have the results like:



3.4.5 Habitat Quality (InVEST 3.14.2)

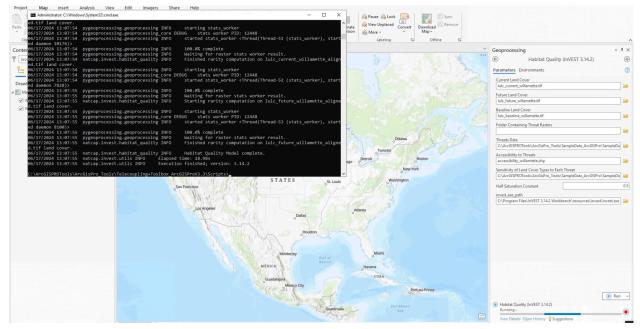
Geoprocessing	~ † ×
Habitat Quality (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Current Land Cover	_
Future Land Cover	
Baseline Land Cover	
baseline Land Cover	
Folder Containing Threat Rasters	
	2
* Threats Data	
A	
Accessibility to Threats	
* Sensitivity of Land Cover Types to Each Threat	
	<u> </u>
Half Saturation Constant	0.5
* invest_exe_path	

- Click and select the "Current Land Cover". In this example, we will use"lulc\_current\_willamette.tif" from the folder "\Environmental Analysis\HabitatQuality".
- By the same operation, for "Future Land Cover", use "lulc\_future\_willamette.tif" from the folder "\Environmental Analysis\HabitatQuality".
- for "Baseline Land Cover", use "lulc\_baseline\_willamette.tif" from the folder "\Environmental Analysis\HabitatQuality".
- For "Threats Data", use "threats\_willamette.csv" from the folder "\Environmental Analysis\HabitatQuality" .
- For "Accessibility to Threats", use "accessibility\_willamette.shp" from the folder "\Environmental Analysis\HabitatQuality" .
- For "Sensitivity of Land Cover Types to Each Threat", use "sensitivity\_willamette.csv" from the folder "\Environmental Analysis\HabitatQuality".

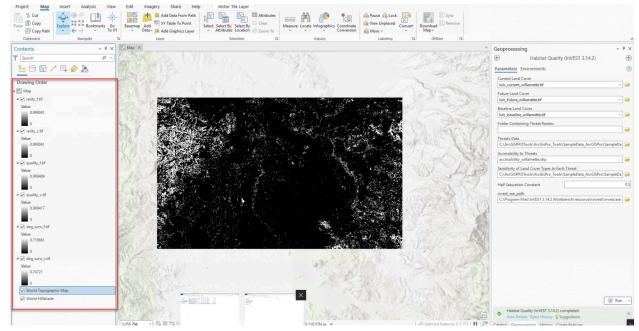
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- All parameters are set like below:

Habitat Quality (InVEST 3.14.2)
Current Land Cover Iulc_current_willamette.tif Future Land Cover Iulc_future_willamette.tif Baseline Land Cover Iulc_baseline_willamette.tif Folder Containing Threat Rasters Threats Data C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa Accessibility to Threats accessibility_willamette.shp
Iulc_current_willamette.tif   Future Land Cover   Iulc_future_willamette.tif   Baseline Land Cover   Iulc_baseline_willamette.tif   Folder Containing Threat Rasters   Threats Data   C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa   Accessibility to Threats   accessibility_willamette.shp
Future Land Cover          Iulc_future_willamette.tif         Baseline Land Cover         Iulc_baseline_willamette.tif         Folder Containing Threat Rasters         Threats Data         C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa         Accessibility to Threats         accessibility_willamette.shp
Iulc_future_willamette.tif       Image: Constant of the second seco
Baseline Land Cover          Iulc_baseline_willamette.tif         Folder Containing Threat Rasters         Image: Containing Threat Rasters
Iulc_baseline_willamette.tif         Folder Containing Threat Rasters         Image: Containing Threat Rasters         Image: C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleData         Accessibility to Threats         accessibility_willamette.shp
Folder Containing Threat Rasters Threats Data C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa Accessibility to Threats accessibility_willamette.shp
Threats Data C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa Accessibility to Threats accessibility_willamette.shp
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa Accessibility to Threats accessibility_willamette.shp
Accessibility to Threats accessibility_willamette.shp
accessibility_willamette.shp
Sensitivity of Land Cover Types to Each Threat
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
Half Saturation Constant 0.5
invest_exe_path
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe

- Keep other parameters as default and please remove all contents in the Scratch folder and click run
- Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:



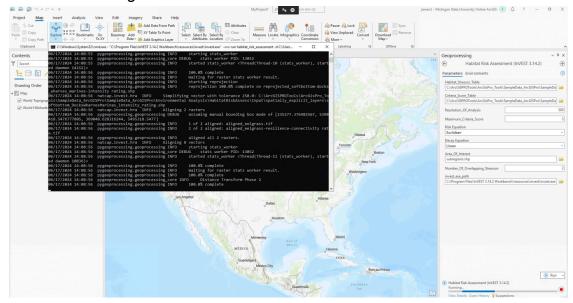
### 3.4.6 Habitat Risk Assessment (InVEST 3.14.2)

Geoprocessing	~ Ŧ ×
Habitat Risk Assessment (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Habitat_Stressor_Table	
* Criteria_Score_Table	
* Resolution_Of_Analysis	
* Maximum_Criteria_Score	
Risk Equation	
Euclidean	~
Decay Equation	
None	~
* Area_Of_Interest	
	<u></u>
* Number_Of_Overlapping_Stressors	
* invest_exe_path	

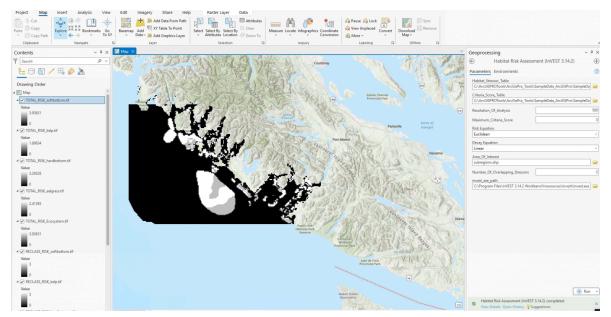
- Click And select the "Habitat\_Stressor\_Table". In this example, we will use "habitat\_stressor\_info.csv" from the folder "\Environmental Analysis\HabitatRiskAssess\input".
- By the same operation, for "Criteria\_Score\_Table", use "exposure\_consequence\_criteria.csv" from the folder "\Environmental Analysis\HabitatRiskAssess\input".
- Set "Resolution\_Of\_Analysis" as 500 and "Maximum\_Criteria\_Score" as 3.
- Set "Risk Equation" as "Euclidean" and "Decay Equation" as "Linear"
- For "Area\_Of\_Interest", select "subregions.shp" from the folder "\Environmental Analysis\HabitatRiskAssess\input".
- Set "Number\_Of\_Overlapping\_Stressors" as 2
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- All parameters are set like below:

Geoprocessing v # ×
Habitat Risk Assessment (InVEST 3.14.2)
Parameters Environments (?)
Habitat_Stressor_Table
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
Criteria_Score_Table
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
Resolution_Of_Analysis 500
Maximum_Criteria_Score 3
Risk Equation
Euclidean ~
Decay Equation
Linear v
Area_Of_Interest
subregions.shp 🥁
Number_Of_Overlapping_Stressors 2
invest_exe_path
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:



3.4.7 Habitat Risk Assessment Preprocessor (InVEST 3.14.2)

Geoprocessing ~	<b>4</b> ×
€ Habitat Risk Assessment Preprocessor (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Species/Habitat Layers Folder	
* Stressors Folder	
* Exposure Criteria	
* Consequence: Sensitivity	
* Consequence: Resilience	
Use Spatially-Explicit Risk Scores in Shapefile	

- Click and select the "Species/Habitat Layers Folder". In this example, we will use the folder "\Environmental Analysis\Habitat Risk Assessment Preprocessor\HabitatLayers".
- For the "Stressors Folder", we will use the folder "\Environmental Analysis\Habitat Risk Assessment Preprocessor\StressorLayers".

- For the "Exposure Criteria", input "Temporal Overlap Rating", "Management Effectiveness" and "Intensity Rating"
- For the "Consequence: Sensitivity", input "Frequency of Disturbance", "Change in Area Rating" and "Change in Structure Rating"
- For the "Consequence: Resilience", input "Recruitment Rate", "Natural Mortality Rate", "Connectivity Rate" and "Recovery Time"
- Check the "Use Spatially-Explicit Risk Scores in Shapefile"
- For the "Spatially-Explicit Criteria Folder", we will use the folder "\Environmental Analysis\Habitat Risk Assessment Preprocessor\Spatially\_Explicit\_Criteria".
- All parameters are set like below:

Geop	rocessing ~	<b>#</b> ×
Ð	Habitat Risk Assessment Preprocessor (InVEST 3.14.2)	$\oplus$
aran	neters Environments	?
Spec	ies/Habitat Layers Folder	
	bitatLayers	
Stres	sors Folder	
Stre	ssorLayers	
Ехро	sure Criteria	
	Temporal Overalp Rating	
	Management Effectiveness	
	Intensity Rating	
×		
Cons	sequence: Sensitivity	
con	Frequency of Disturbance	
	Change in Area Rating	
	Change in Structure Rating	
×		
Cons	sequence: Resilience	
con	Recruitment Rate	
	Natural Mortality Rate	_
	Connectivity Rate	
	Recovery Time	
×		_
_	Jse Spatially-Explicit Risk Scores in Shapefile	
_	ially-Explicit Criteria Folder	
spa	tially_Explicit_Criteria	

• Then, click Run and when running is completed, the result files are stored in the Scratch folder. In this example, these files are in the path "C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\scratch\habitat\_ stressor\_ratings", showing like:

Name	Date modified
dir_names.txt	6/17/2024 2:30 PN
eelgrass_ratings.csv	6/17/2024 2:30 PN
) hardbottom_ratings.csv	6/17/2024 2:30 PN
kelp_ratings.csv	6/17/2024 2:30 PN
softbottom_ratings.csv	6/17/2024 2:30 PM
stressor_buffers.csv	6/17/2024 2:30 PM

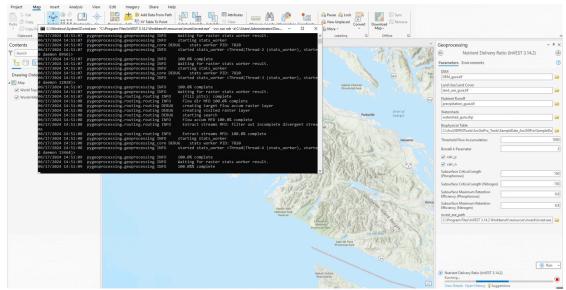
# 3.4.8 Nutrient Delivery Ratio (InVEST 3.14.2)

Geoprocessing	~ # ×	
€ Nutrient Delivery Ratio (InVEST 3.14.2) ⊕		
Parameters Environments	(?	
* DEM		
* Land Use/Land Cover		
* Nutrient Runoff		
· Weberlande		
* Watersheds		
<ul> <li>Biophysical Table</li> </ul>		
Threshold Flow Accumulation	1000	
Borselli k Parameter	2	
* calc_p * calc_n		
Subsurface Critical Length	150	
(Phosphorous)	150	
Subsurface Critical Length (Nitrogen)	150	
Subsurface Maximum Retention Efficiency (Phosphorous)	0.8	
Subsurface Maximum Retention Efficiency (Nitrogen)	0.8	
* invest_exe_path		

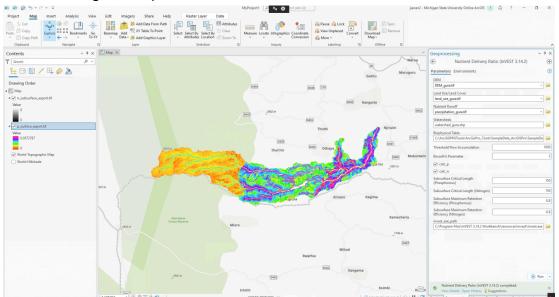
- Click and select the "DEM". In this example, In this example, we will use"DEM\_gura.tif" from the folder "\Environmental Analysis\NDR".
- For the "Land Use/Land Cover", we will use "land\_use\_gura.tif" from the folder "\Environmental Analysis\NDR".
- For the "Nutrient Runoff", we will use "precipitation\_gura.tif" from the folder "\Environmental Analysis\NDR".
- For the "Watersheds", we will use "watershed\_gura.shp" from the folder "\Environmental Analysis\NDR".
- For the "Biophysical Table", we will use "biophysical\_table\_gura.csv" from the folder "\Environmental Analysis\NDR".
- Check the "calc\_p" and "calc\_n"
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Keep other parameter as default and it looks like:

Geoprocessing	~ † X
Nutrient Delivery Ra	atio (InVEST 3.14.2)
Parameters Environments	(?)
DEM	
DEM_gura.tif	- 🛁
Land Use/Land Cover	
land_use_gura.tif	🗎
Nutrient Runoff	
precipitation_gura.tif	i i i i i i i i i i i i i i i i i i i
Watersheds	
watershed_gura.shp	i i i i i i i i i i i i i i i i i i i
Biophysical Table	
C:\ArcGISPROTools\ArcGisPro_Tools\	SampleData_ArcGISPro\SampleDa 🧎
Threshold Flow Accumulation	1000
Borselli k Parameter	2
* 🗌 calc_p	
* 🗌 calc_n	
Subsurface Critical Length	150
(Phosphorous)	130
Subsurface Critical Length (Nitrogen)	150
Subsurface Maximum Retention Efficiency (Phosphorous)	0.8
Subsurface Maximum Retention	
Efficiency (Nitrogen)	0.8
	0.8

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:



3.4.9 Seasonal Water Yield (InVEST 3.14.2)

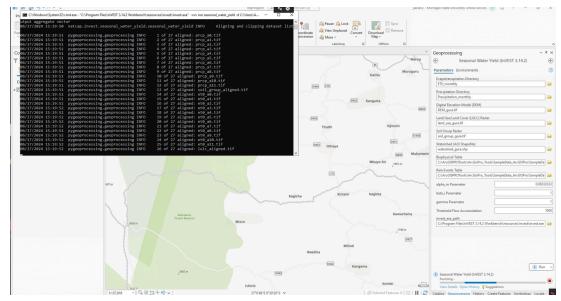
Geoprocessing	~ ‡ ×
Seasonal Water Yield (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Evapotranspiration Directory	
* Precipitation Directory	
	. 📄
* Digital Elevation Model (DEM)	
* Land Use/Land Cover (LULC) Raster	
* Soil Group Raster	
* Watershed (AOI Shapefile)	
* Biophysical Table	
* Rain Events Table	
alpha_m Parameter	0.08333333
beta_i Parameter	1
gamma Parameter	1
Threshold Flow Accumulation	1000
* invest_exe_path	

- Click and select the "Evapotranspiration Directory". In this example, we will use the path as "\Environmental Analysis\Seasonal\_Water\_Yield\ET0\_monthly"
- For the parameter "Precipitation Directory", it is set as "\Environmental Analysis\Seasonal\_Water\_Yield\Precipitation\_monthly"
- For the "Digital Elevation Model (DEM)", it is set as "DEM\_gura.tif" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield"
- For the "Land Use/Land Cover (LULC) Raster", it is set as "land\_use\_gura.tif" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield"
- For the "Soil Group Raster", it is set as "soil\_group\_gura.tif" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield"
- For the "Watershed (AOI Shapefile)", it is set as "watershed\_gura.shp" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield"
- For the "Biophysical Table", it is set as "biophysical\_table\_gura\_SWY.csv" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield"

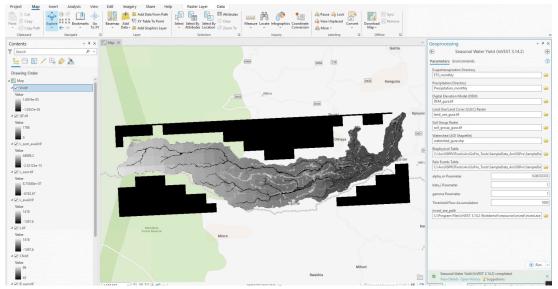
- For the "Rain Events Table", it is set as "rain\_events\_gura.csv" from the folder "\Environmental Analysis\Seasonal\_Water\_Yield".
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Keep other parameters as default. And the all parameters are shown like:

Geoprocessing v # ×
€ Seasonal Water Yield (InVEST 3.14.2) ⊕
Parameters Environments (?)
Evapotranspiration Directory
ET0_monthly
Precipitation Directory
Precipitation_monthly
Digital Elevation Model (DEM)
DEM_gura.tif
Land Use/Land Cover (LULC) Raster
land_use_gura.tif
Soil Group Raster
soil_group_gura.tif
Watershed (AOI Shapefile)
watershed_gura.shp 🥯
Biophysical Table
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
Rain Events Table
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa
alpha_m Parameter 0.08333333
beta_i Parameter 1
gamma Parameter 1
Threshold Flow Accumulation 1000
invest_exe_path
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:



# 3.4.10 Sediment Delivery Ratio (InVEST 3.14.2)

Geoprocessing	~ å ×
Sediment Delivery Ratio (InVEST 3	3.14.2)
Parameters Environments	(?)
* Biophysical Table	
* DEM	
* Soil Erodibility	~
* Rainfall Erosivity Index	
	<u></u>
IC Parameter	0.5
K Parameter	2
* I_max	
* Land Use/Land Cover	
Max SDR	0.8
Threshold Flow Accumulation	1000
* Watersheds	
Designed	
Drainage	
* invest_exe_path	

- Click e and select the "Biophysical Table". In this example, we will use the file of "biophysical\_table\_Gura.csv" in the path of "\Environmental Analysis\SDR".
- For the "DEM", select "DEM\_gura.tif" from the path of "\Environmental Analysis\SDR".
- For the "Soil Erodibility", select "erodibility\_gura.tif" from the path of "\Environmental Analysis\SDR".
- For the "Rainfall Erosivity Index", select "erosivity\_gura.tif" from the path of "\Environmental Analysis\SDR".
- For the "Land Use/Land Cover", select "land\_use\_gura.tif" from the path of "\Environmental Analysis\SDR".
- For the "Watersheds", select "watershed\_gura.shp" from the path of "\Environmental Analysis\SDR".
- Set "I\_max" as 122.
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the

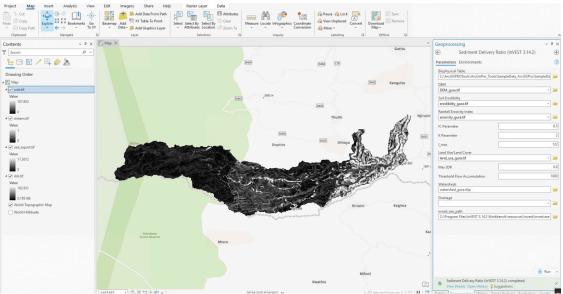
pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
Keep other parameters as default. And the all parameters are shown like:

Geoprocess	ing	~ Ţ ;
€	Sediment Delivery Ratio (In	VEST 3.14.2)
Parameters	Environments	C
Biophysical T	able	
C:\ArcGISPR	OTools\ArcGisPro_Tools\SampleDa	ata_ArcGISPro\SampleDa 🧯
DEM		
DEM_gura.ti	f	<u></u>
Soil Erodibilit	ý	
erodibility_g	ura.tif	Contract (1998)
Rainfall Erosi	vity Index	
erosivity_gu	ra.tif	
IC Parameter		0.:
K Parameter		
I_max		12
Land Use/Lar	d Cover	
land_use_gu	ra.tif	
Max SDR		0.8
Threshold Flo	w Accumulation	1000
Watersheds		
watershed_g	ura.shp	200
Drainage		
		<u></u>
invest_exe_pa	th	
C:\Program	Files\InVEST 3.14.2 Workbench\res	ources\invest\invest.exe

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.

pr. 🖬 Administraton C\Windows\System32.cmd.exe — 📃 . @6/17/2024 15:34:51 pygeoprocessing.geoprocessing INFO 100.0% complete		
Wirking 13:41:31 propertiessing perprocessing involution of the second processing involution of the second perpendicular and the	An Pause & Lock      Content of the second sec	
06/17/2024 15:34:51 osgeo WARNING [errno 3] Cannot find tms_NZTM2000.json (GDAL_DATA is not defined)	Labeling IS Offline IS	
86/17/2024 15:34:51 pygeoprocessing.geoprocessing INFO starting reprojection Co86/17/2024 15:34:51 pygeoprocessing.geoprocessing INFO reprojection 100.0% complete on reprojected.gpkg	* Geoprocessing	~ # >
θ6/17/2024 15:34:51 pygeoprocessing.geoprocessing INFO θ6/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO calculating stats on raster θ of 5	Gatitu 🕞 Sediment Delivery Ratio (InVE	ST 3.14.2)
<pre>66/i7/2024 15:34:52 pygeoprocessing.geoprocessing INFO 06/i7/2024 15:34:52 pygeoprocessing.geoprocessing INFO 06/i7/2024 15:34:52 pygeoprocessing.geoprocessing INFO all done processing polygon sets for watershed_results_sdr.</pre>	D484 C79 Parameters Environments	(7
hp D06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO calculating stats on raster 1 of 5	Biophysical Table	
06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO disjoint polygon set 1 of 1	C:\ArcGISPROTools\ArcGisPro_Tools\SampleData	ArcGISPro\SampleDa
@06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO all done processing polygon sets for watershed_results_sdr. hp	D632 Kanguita DEM	
06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO calculating stats on raster 2 of 5 06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO disjoint polygon set 1 of 1	DEM_gura.tif	
e6/17/2024 15:34:32 pygeoprocessing.geoprocessing info all dome processing polygon sets for watershed_results_sdr.	Soil Erodibility erodibility, gurs.tif	
hp 06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO calculating stats on raster 3 of 5	[0433] Betall Encycle Letter Rainfall Encycle Letter	
06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO disjoint polygon set 1 of 1	Thuthi Njiruini erosivity.gura.bf	
06/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO all done processing polygon sets for watershed_results_sdr. hp	IC Parameter	0.5
86/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO calculating stats on raster 4 of 5 86/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO disjoint polygon set 1 of 1		
66/17/2024 15:34:52 pygeoprocessing.geoprocessing INFO all done processing polygon sets for watershed_results_sdr.	PU3 Others	4
hp -	L'max	122
	E Land Use/Land Cover	
	Mbuyu-Ini	
	_ 1801 / Max SDR	0.8
	C70 Threshold Flow Accumulation	1000
	Watersheds	
	watershed_gura.shp	
	Drainage	
	gicha Kirialni Kagima	
	invest_exe_path C\Program Files\InVEST 3.14.2 Workbench\resou	rces\invest\invest.exe 🥃
Aberdares	Kar	
Forest Reserve Mioro		
Mioro		
		🕞 Run 🗸
	Mihuti () Sediment Delivery Ratio (InVEST 3.14.2) Bunning	~
	Rwathia	

• When running is completed, the result shows like:



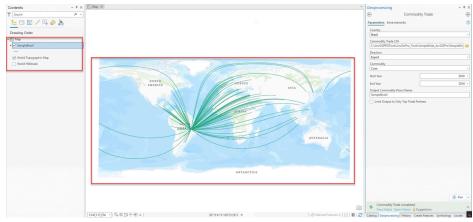
# 3.5 Flows 3.5.1 Commodity Trade

Geoprocessing		~ † ×
$\odot$	Commodity Trade	$\oplus$
Parameters Environme	nts	(?)
* Country		
		¥
* Commodity Trade CSV		
* Direction		
* Commodity		
		~
* Start Year		Ŷ
* End Year		Ŷ
* Output Commodity Flow	is Name	
Limit Output to Only	Top Trade Partners	

- Set "Country" as "Brazil" from the droplist
- For the "Commodity Trade CSV", select the file of "comm\_trade.csv" from the folder of "\Flows\Commodity Trade".
- Set "Direction" as "Export" from the droplist
- Set "Commodity" as "Corn" from the droplist
- Set "Start Year" as 2010 from the droplist
- Set "End Year" as 2014 from the droplist
- Set "Output Commodity Flows Name" as "SampleBrazil"
- Keep other parameters as default:

Geoprocess	ing	~ ‡ X
$\odot$	Commodity Trade	$\oplus$
Parameters	Environments	(?)
Country		
Brazil		~
Commodity	Irade CSV	
C:\ArcGISPR	OTools\ArcGisPro_Tools\SampleData_ArcGISP	Pro\SampleDa 🦳
Direction		
Export		~
Commodity		
Corn		Ŷ
Start Year		2010 ~
End Year		2014 ~
Output Com	modity Flows Name	
SampleBrazi		
Limit Out	put to Only Top Trade Partners	

• Click RUN button to execute the script and get the result:



### 3.5.2 Draw Radial Flows

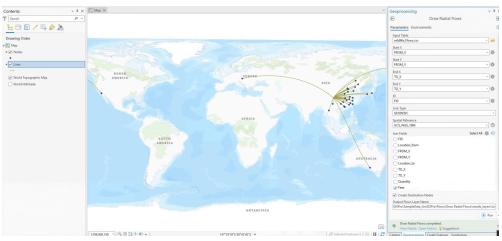
Geoprocessing	~ ‡ ×
Draw Radial Flows	$\oplus$
Parameters Environments	?
* Input Table	
* Start X	
	臺
* Start Y	凉
* End X	- 
* End Y	
	凉
ID	资
Line Type	14-
GEODESIC	~
Spatial Reference	
WGS_1984_Web_Mercator_Auxiliary_Sphere	~
Create Destination Nodes	
* Output Flows Layer Name	

- Click and select the "Input Table". In this example, we will use the file of "wildlife\_Flows.csv" from the folder of "\Flows\Draw Radial Flows".
- Set "Start X", "Start Y", "End X" and "End Y" as "FROM\_X", "FROM\_Y", "TO\_X" and "TO\_Y" from the droplists respectively.
- Set "ID" as "FID" from the droplist.
- Select "Fees" as the "Join Fields"
- Click "Create Destination Nodes" option.
- Set the path "\Flows\Draw Radial Flows\results\_layers\Lines" in "Output Flows Layer Name"
- Set the path "\Flows\Draw Radial Flows\results\_layers\Nodes" in "Output Nodes Layer Name"

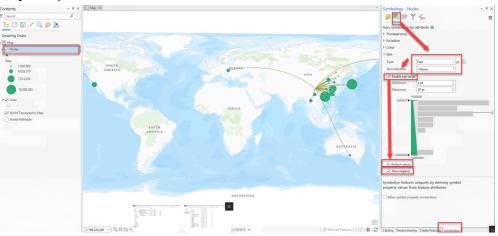
• Set "Spatial Reference" as "Current Map" and finally, it looks like:

Geoprocessing			~ ‡ ×
€	Draw Radial Flows		$\oplus$
Parameters Environme	nts		?
Input Table			
wildlife_Flows.csv			× 🦳
Start X			
FROM_X			~ 资
Start Y			_
FROM_Y			~ 资
End X			_
TO_X			~ 资
End Y			_
TO_Y		_	~ 资
ID			_
FID			~ 资
Line Type			_
GEODESIC			×
Spatial Reference			
GCS_WGS_1984			•
Join Fields		Select All	資う
FID			
Location_from			
FROM_X			
FROM_Y			
Location_to			
TO_X			
TO_Y			
Quantity			
✓ Fees			
Create Destination No	odes		
Output Flows Layer Nam	e		
GISPro\SampleData_Arc0	GISPro\Flows\Draw Radial Flow	vs\results_laye	ers\Lines
Output Nodes Layer Nam	ne SPro\Flows\Draw Radial Flows	\results laver	s\Nodes
,			
			Run v

• Click Run to execute the script and get the result:



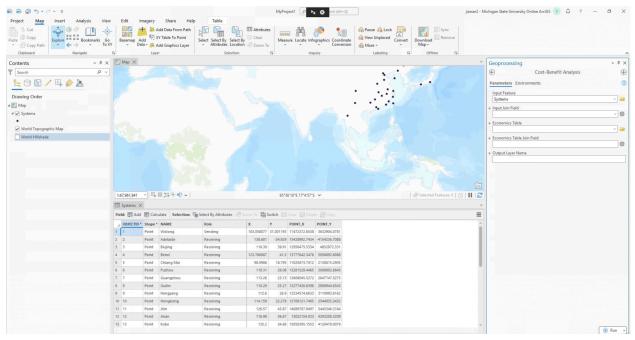
• You can select the "Nodes" layer and set the "Symbology" property as follows to vary the point size related to the fees number:



# 3.6 Socioeconomic Analysis

3.6.1 Cost-Benefit Analysis

Note: You need to run "3.7.2 Draw Systems from Table" to generate the feature layer in the map to get the result like below at first!!

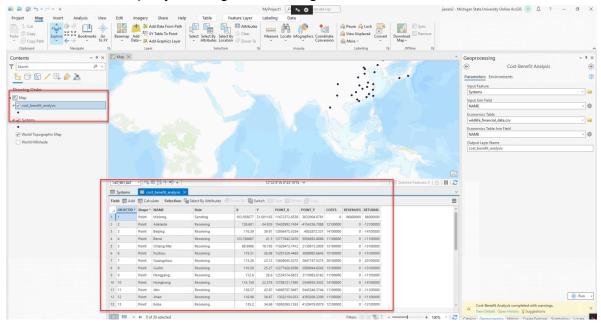


Then it is ready to use "Cost-Benefit Analysis"

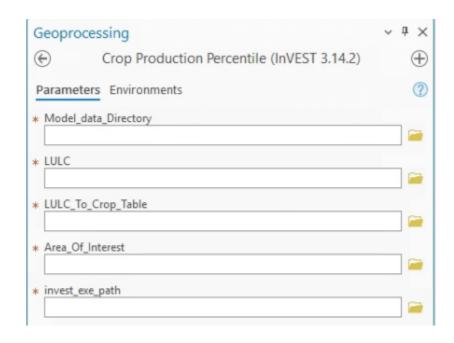
Geoprocessir	ng	~ Ŧ ×
$\odot$	Cost-Benefit Analysis	$\oplus$
Parameters E	nvironments	(?)
* Input Feature		2
* Input Join Field	1	凉
* Economics Tab	le	-
* Economics Tab	le Join Field	资
* Output Layer N	lame	

- Click end select the "Input Feature". Select "Systems"
- Set "Input Join Field" as "NAME" from droplist.
- For the "Economics Table", select "wildlife\_financial\_data.csv" from "\Socioeconomic Analysis\Cost-Benefit Analysis".

- Set "Economics Table Join Field" as "NAME" as well.
- Set "Output Layer Name" as "cost\_benefit\_analysis"
- Run the script by clicking "Run" and get the result as:



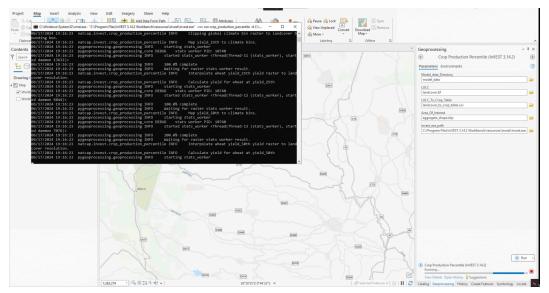
### 3.6.2 Crop Production Percentile (InVEST 3.14.2)



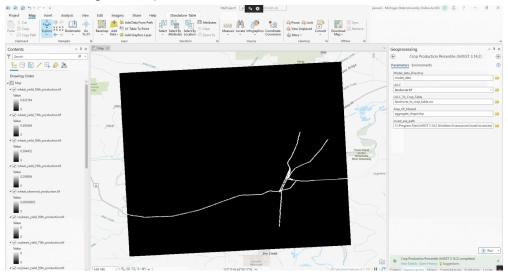
- Click and select the "Model\_data\_Directory". In this example, we will use the model data folder as "\Socioeconomic Analysis\CropProductionPercentile\model\_data".
- For the "LULC", it is set as "landcover.tif" from "\Socioeconomic Analysis\CropProductionPercentile\sample\_user\_data".
- For the "LULC\_To\_Crop\_Table", it is set as "landcover\_to\_crop\_table.csv" from "\Socioeconomic Analysis\CropProductionPercentile\sample\_user\_data".
- For the "Area\_Of\_Interest", it is set as "aggregate\_shape.shp" from "\Socioeconomic Analysis\CropProductionPercentile\sample\_user\_data".
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Keep other parameters as default. And the all parameters are shown like:

Geoprocessing	, † ×
Crop Production Percentile (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
Model_data_Directory	_
model_data	
LULC	_
landcover.tif	
LULC_To_Crop_Table	_
landcover_to_crop_table.csv	
Area_Of_Interest	
aggregate_shape.shp	
invest_exe_path	
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.ex	ke 🦳

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:



3.6.3 Crop Production Regression (InVEST 3.14.2)

Geoprocessing	~ † X
Crop Production Regression (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Model_data_Directory	
* LULC	
* LULC_To_Crop_Table	
* Area_Of_Interest	
* fertilization_rate_table_path	
* invest_exe_path	

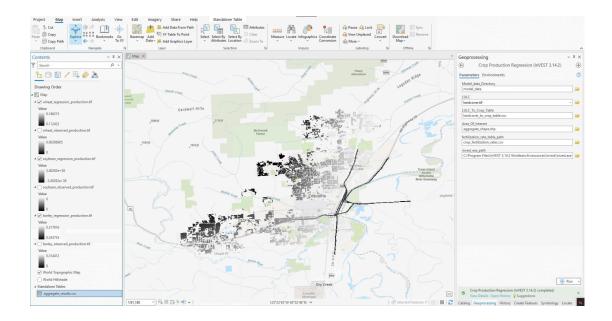
- Click and select the "Model\_data\_Directory". In this example, we will use the model data folder as "\Socioeconomic Analysis\CropProductionRegression\model\_data".
- For the "LULC", it is set as "landcover.tif" from "\Socioeconomic Analysis\CropProductionRegression\sample\_user\_data".
- For the "LULC\_To\_Crop\_Table", it is set as "landcover\_to\_crop\_table.csv" from "\Socioeconomic Analysis\CropProductionRegression\sample\_user\_data".
- For the "Area\_Of\_Interest", it is set as "aggregate\_shape.shp" from "\Socioeconomic Analysis\CropProductionRegression\sample\_user\_data".
- For the "fertilization\_rate\_table\_path", it is set as "crop\_fertilization\_rates.csv" from "\Socioeconomic Analysis\CropProductionRegression\sample\_user\_data".
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Keep other parameters as default. And the all parameters are shown like:

Geoprocessing	~ å ×
Crop Production Regression (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
Model_data_Directory	
model_data	
LULC	
landcover.tif	i
LULC_To_Crop_Table	
landcover_to_crop_table.csv	i
Area_Of_Interest	
aggregate_shape.shp	i
fertilization_rate_table_path	
crop_fertilization_rates.csv	i 📄
invest_exe_path	
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest	t.exe 🦳

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.

		•							
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roject Map Insert	Analysis View Edit	Imagery Share Help							
🕺 🏷 Cut 🛛 🛵 🛞	😤 🛄 -🔶 🔡	🕂 😹 Add Data From Path	🖌 🔛 🔛 Attributes	i 🚃 🖄 🥀 🔚	🏫 Pause 🎪 Lock  💭	Sync 💮			
ste Copy	Bookmarks Go Basema	n Add XY Table To Point Sele	ect Select By Select By Clear	Measure Locate Infographics Coordinate	Q View Unplaced Convert	Download Remove			
Copy Path	→ * To XY *	Data - 👼 Add Graphics Layer	Attributes Location 🖓 Zoom To	Conversion	Ame 🖌 🗸 🖌	Map ~			
Clipboard	Navigate 15	Layer	Selection	ti Inquiry	Labeling IS	Offline IS			
ontents	~ # X 🔣 Map	×					~	Geoprocessing	~
P Search	<u>ب م</u>					Gatitu		Crop Production Regression (InVEST 3.14.2)	!)
10 N/ H 0	Sec.							Parameters Environments	
	C:\Windows\System32	\cmd.exe - "C:\Program Files\InVEST 3.14.	2 Workbench\resources\invest\invest.e	exe" -vvv run crop_production_regression -d C:	– 🗆 🗙				
Drawing Order	d daemon 8620)>	and the second			^			Model_data_Directory model_data	
Map		<pre>pygeoprocessing.geoproces: pygeoprocessing.geoproces;</pre>		lete raster stats worker result.		D432 Kanguita			
World Topographic Map	06/17/2024 19:24:24	natcap.invest.crop_product	tion_regression INFO C	Calc the min of N, K, and P		Kanguna		LULC	
World Hillshade	06/17/2024 19:24:24	<pre>pygeoprocessing.geoproces: pygeoprocessing.geoproces;</pre>	sing INFO starting sta sing core DEBUG stats w	its_worker worker PID: 13316					
	06/17/2024 19:24:24	pygeoprocessing.geoproces:		ts_worker <thread(thread-10 (sta<="" td=""><td>ts_worker), start</td><td></td><td></td><td>LULC_To_Crop_Table landcover to crop table.csv</td><td></td></thread(thread-10>	ts_worker), start			LULC_To_Crop_Table landcover to crop table.csv	
	ed daemon 15272)> 06/17/2024 19:24:24	pygeoprocessing.geoproces	sing INFO 100.0% compl					Area Of Interest	
	06/17/2024 19:24:24	pygeoprocessing.geoproces	sing INFO Waiting for	raster stats worker result.			Njiruini	aggregate_shape.shp	
		pygeoprocessing.geoproces		Calculate observed yield for bar ats worker	ley			fertilization_rate_table_path	
	06/17/2024 19:24:25	pygeoprocessing.geoprocess	sing_core DEBUG stats w	orker PID: 13316	and the second second			crop_fertilization_rates.csv	
	ed daemon 1780>>	pygeoprocessing.geoproces	ing INFO started stat	ts_worker <thread(thread-11 (sta<="" td=""><td>ts_worker), start</td><td></td><td>D431</td><td>invest_exe_path</td><td></td></thread(thread-11>	ts_worker), start		D431	invest_exe_path	
		pygeoprocessing.geoproces:						C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\inv	rvest.exe
	06/17/2024 19:24:25	<pre>pygeoprocessing.geoproces: natcap.invest.crop product</pre>	tion regression INFO	raster stats worker result. Interpolating observed barley ra	ster to landcover		6		
			sing INFO starting sta						
	06/17/2024 19:24:25	<pre>pygeoprocessing.geoproces: pygeoprocessing.geoproces</pre>	sing_core DEBUG stats w	orker PID: 13316		Mbuyu-In	1801 /		
	06/17/2024 19:24:25 ed daemon 13968)>	pygeoprocessing.geoproces	sing INFO started stat	ts_worker <thread(thread-12 (sta<="" td=""><td>ts_worker), start</td><td>~</td><td></td><td></td><td></td></thread(thread-12>	ts_worker), start	~			
		pygeoprocessing.geoproces	sing INFO 100.0% compl						
		pygeoprocessing.geoprocess natcap.invest.crop_product		raster stats worker result. Processing crop wheat	and the second	1			
	06/17/2024 19:24:25	natcap.invest.crop_product	tion_regression INFO C	Clipping global climate bin rast	er to landcover b				
	ounding box.	natcap.invest.crop product		Hap vield ceiling to climate bin					
	00/17/2024 19:24:23	naccap.invest.crop_product	101_regression into h	ap yield_ceiling to climate bin	s. viain	Kagima			
				-	~				
		Aberdares					Kar		
		Forest Reserve							
			Mioro						
							1		
									🕞 Rur
					м	huti		Crop Production Regression (InVEST 3.14.2)	
					Rwathia		~	Running	
							æ	View Details Open History 💡 Suggestions	
	1:107,837			36°52'2'E 0°39'17'S 💙		Selected Features: 0	1112	Catalog Geoprocessing History Create Features Symbology	Locate

• When running is completed, the result shows like:



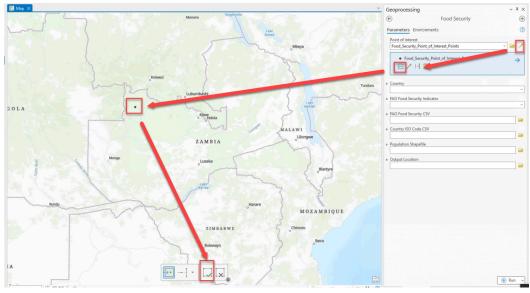
# 3.6.4 Food Security

Geoprocessing		~	ά×
$\odot$	Food Security		$\oplus$
Parameters Environments			?
* Point of Interest			
			1
* Country		_	~
* FAO Food Security Indicator			~
* FAO Food Security CSV			
* Country ISO Code CSV			
* Population Shapefile			
* Output Location			

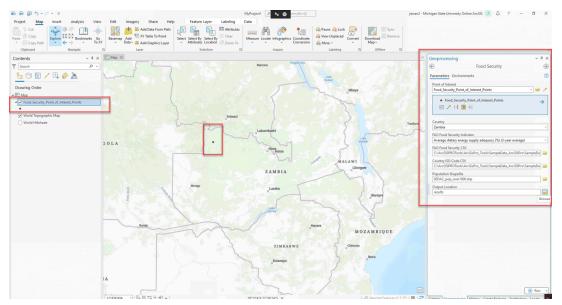
Right click the script and open it

• To run the Food Security tool, you will need to populate the interface with some

information. First, you will want to place the Point of Interest within the map viewer. Below, the Point of Interest has been placed in the northern part of Zambia's NorthWestern province.



- Set "Country" as "Zambia"
- Set "FAO Food Security Indicator" as "Average dietary energy supply adequacy (%) (3-year average)" from the droplist.
- For "FAO Food Security CSV", select "fao.csv" from the folder of "\Socioeconomic Analysis\FoodSecurity"
- For "Country ISO Code CSV", select "iso\_codes.csv" from the folder of "\Socioeconomic Analysis\FoodSecurity"
- For "Population Shapefile", select "SEDAV\_pop\_over1000.shp" from the folder of "\Socioeconomic Analysis\FoodSecurity"
- For "Output Location", select "\Socioeconomic Analysis\FoodSecurity\results"
- All parameters are set like below:



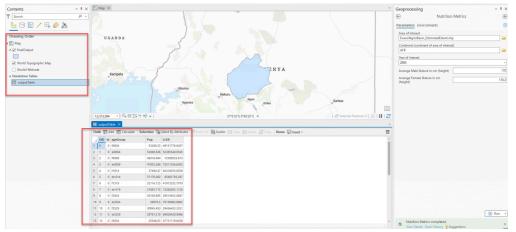
• Then, click Run and get results in the output folder, here it is "\Socioeconomic Analysis\FoodSecurity\results"

Contents	- # x 🔣 Map ×							Geoprocessing		~ # ×
Y Search	р. v	{		Manono	Tangdepike			Food Security		$\oplus$
10 1 / H / A	📕 i 🕑 📙 🖬 i results							neters Environments		0
	File Home Share	View						Y 🕐 t of Interest		
Drawing Order	← → * ↑ _ « An	cGISPROTools > ArcGisPro_Tools > Sam	pleData_ArcGISPro > SampleD	lata_ArcGISPro > Si	cioeconomic Analysis > FoodSe	curity⇒ results v	Ö Search results	o d_Security_Point_of_Interest_Points		- 🗎 🖊
Map     Map     Food_Security_Point_of_Interest_Points     World Topographic Map     World Hillshade	✔ Quick access 2 a30335 2 公共区 (192.168.255 2 公共区	Name DistanceTeUrban.bt DistanceTeUrban.bt FAO_plot.svg	Date modified 6/17/2024 9:59 PM 6/17/2024 9:59 PM		Size 1 KB 21 KB			Food_Security_Point_of_Interest_Points     ✓ I+i III III     retry     rbia		→ ,
	Local Disk (C:)									L
	Network				Average Dietary	Energy Supply A 🗙 🕂		- 0	×	
DistanceToUrban			1080 - I		C 🕕 File   C://	ArcGISPROTools/ArcGisPro	_Tools/SampleData_ArcGIS	Pro/Sampl 🏠 🗊 🖆 🚱 ·	· 📀	ampleDa 🗃
Note: An urban equal to 1,000 This is the defir to Measure Me The distance to	people per sq km. hition used by the OEC tropolitan Areas, OEC the nearest urban cer and latitude of this urb	Docation where population d	lefining "Urban": A Ne 3.462648 km).		Zambla Loss-In-tone Unes-In-tone Unes-In-tone High-Income	L	zambia	dequary -	0,	impleDa 🚘
	17,828,924	Windows (CRLF)	Ln 1, Cel 1 100%	21°5424°E		90 3861 2862 2863	2004 2005 2006 2007 2008 200 End Year of 3	0 384 381 381 384 385 384 387	g ø	Run v

## 3.6.5 Nutrition Metrics

Geoprocessing		~ # ×
$\odot$	Nutrition Metrics	$\oplus$
Parameters Environm	ents	(?)
* Area of Interest		
* Continent (continent of	f area of interest)	
* Year of Interest		~
* Average Male Stature in	n cm (height)	
<ul> <li>Average Female Stature (height)</li> </ul>	in cm	

- Click And select the "Area of Interest". In this example, we will use the file of "EwasoNgiroBasin\_EstimatedExtent.shp" from the folder "\Socioeconomic Analysis\Nutrition Metrics"
- For the Continent (continent of area of interest), select the folder "\Socioeconomic Analysis\Nutrition Metrics\AFR"
- Set "Year of Interest" as 2005 from the droplist.
- Set "Average Male Stature in cm (height)" as 170
- Set "Average Female Stature in cm (height)" as 158.2
- Then click Run to get the result:



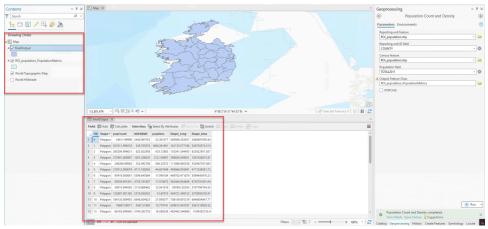
### 3.6.6 Population Count and Density

Geoprocessing	~ # ×
Population Count and Density	$\oplus$
Parameters Environments	?
* Reporting unit feature	
* Reporting unit ID field	-ţör
* Census feature	
* Population field	凉
* Output Feature Class	
POPCHG	

- Click and select the "Reporting unit feature". In this example, we will use the file of "ROI\_population.shp" from the folder "\Socioeconomic Analysis\Population Count and Density"
- Set "Reporting unit ID field" as "COUNTRY" from the droplist.
- Click And select the "Census feature". In this example, we will use the file of "ROI\_population.shp" from the folder "\Socioeconomic Analysis\Population Count and Density"
- Set "Reporting unit ID field" as "TOTAL2011" from the droplist.
- Keep other parameters as default

Geoprocessing	~ † ×
Population Count and Density	$\oplus$
Parameters Environments	?
Reporting unit feature	
ROI_population.shp	
Reporting unit ID field	
COUNTY	~ 资
Census feature	
ROI_population.shp	
Population field	
TOTAL2011	~ 资
Output Feature Class	
ROI_population_PopulationMetrics	i
POPCHG	
0	

• Run the script to get the result:



# 3.6.7 Visitation: Recreation and Tourism (InVEST 3.14.2)

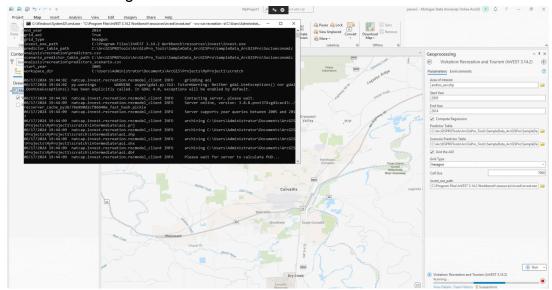
Note: This script needs an internet connection.

Geoprocessing ×	ф ×
( Visitation: Recreation and Tourism (InVEST 3.14.2)	$\oplus$
Parameters Environments	?
* Area of Interest	
Start Year	
2005	
End Year	
2014	
<ul> <li>Compute Regression</li> </ul>	
Predictor Table	
	_
Scenario Predictor Table	_
Grid the AOI	· · · ·
Grid Type	
hexagon	~
Cell Size	7000
* invest_exe_path	
	_

- Click and select the "Area of Interest". In this example, we will use the file "andros\_aoi.shp" from the folder "\Socioeconomic Analysis\recreation".
- For "Predictor Table", it is set as "predictors.csv" from the folder "\Socioeconomic Analysis\recreation".
- For "Scenario Predictor Table", it is set as "predictors\_scenario.csv" from the folder "\Socioeconomic Analysis\recreation".
- Due to we need to use InVEST CLI model, we need to set the InVEST PATH into the parameter of "invest\_exe\_path". Because, currently, the InVEST was installed in the pathe of "C:\Program Files\InVEST 3.14.2 Workbench", we can input the path of "C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe" here.
- Keep other parameters as default. And the all parameters are shown like:

Geoprocessing v #	×
	$\oplus$
Parameters Environments	?
Area of Interest	
andros_aoi.shp	
Start Year	
2005	
End Year	
2014	
Compute Regression Predictor Table C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa	-
Scenario Predictor Table	
C:\ArcGISPROTools\ArcGisPro_Tools\SampleData_ArcGISPro\SampleDa	
Grid the AOI	
Grid Type	
hexagon	~
Cell Size 70	00
invest_exe_path	
C:\Program Files\InVEST 3.14.2 Workbench\resources\invest\invest.exe	

• Then, click Run and an additional CMD window will show and that means the InVEST is running now.



• When running is completed, the result shows like:

Project <u>Map</u> Insert Analysis View → Cut Pathe Copy Path Copy Pathe Copy Path	Edit Imagery Share Help	Standalone Table	Conversion     Conversion     Conversion     Conversion     Conversion     Conversion     Conversion	t Download Map -	
Clipboard Navigate IS	Layer	Selection IS Inquiry		rs Offline rs	
Contents · · · · · · · · · · · · · · · · · · ·					Concerning     Parameters     Concerning     C
					) hun

# 3.7 Systems

## 3.7.1 Add Systems Interactively

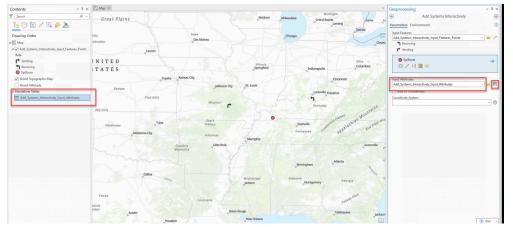
Geoprocessir	ng	~ 1	φ×
	Add Systems Interactively		$\oplus$
Parameters E	nvironments		?
* Input Features			
		-	1
* Input Attribute	S		
		i	
Add XY Co	ordinates		
Coordinate_Sys	stem		
		~	۲

- Click it to create new features in the current map to use as input
- Select "Points" and Move the mouse cursor over the map and you should see points ready to be placed.
- Then, click on the map to mark the position your down and click the "Finish".

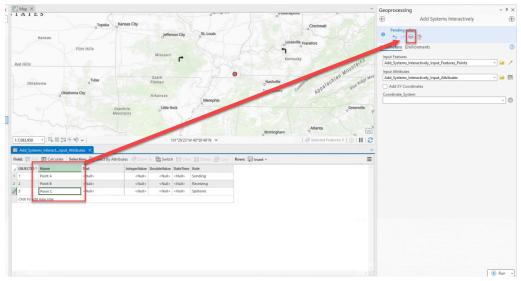
Contents	-> ₽ × 🖬 Map ×			Geoprocessing	~ 8
Search	P - Great Plains	Madison	Milwaukee Grand Rapids	Add Systems Interactively	
६ 🗇 🕅 / 🗛 🤌 🦄			oLansing	Parameters Environments	(
Drawing Order	6070	Iowa	Chicago	erroit Input Features	
Map	lebraska	Des Moines	Sector	Clevel Add Systems Interactively Input, Features Points	2
Add_Systems_Interactively_Input_Feature	uncoln glincoln			° r Sending	
Role f Sending	INITED			thio Sollover	<i>→</i>
Receiving	TATES	111inols Springfield		iolumbus 👘 🖂 🖂	
<ul> <li>Spillover</li> <li>World Topographic Map</li> </ul>	Topeka	N	Cindinut		
World Hillshade		Jefferson City St. Louis	Choimas	Input Attributes	- 🔒 🛙
	Kansas	and a state	Louisville Frankfort	Add XY Coordinates	
	Fliet Hills	Missouri	Entry Contraction	Coordinate_System	
	Red Hills	r Missouri	Kentucky	ains	
	2 9 7		autras .	Wanteins	
	Oklahoma	Ozark Plateau	Nutrylle sterists alachiat	- 8 8125 × MOV	
	Oklahoma Oty	To have	Tennessee Com Appa.	Bite	
	A TOP IT	Memphis			
	Ouechite Mountains	Utile Rock		Greenville p	
		A STATE AND	Birmingham		
	Dallas				
	and the second second	Mississippi	Alabama Montgomery Georgia	- A Contraction of the second s	
		marker & all			
	Texas	Louisiana	Ceased Plat		
	wards Integr				
	Austin		Tallahassee	Jackson	
	Houston				🕞 Run
	1:7,083,958 (日本田 215 中市) ~	89*29/38"W 36*56'54"N 🛩	Selected Features	🕫 🛛 🖬 😴 Catalog Geoprocessing Create Features Symbology	

Select the feature layer and Click

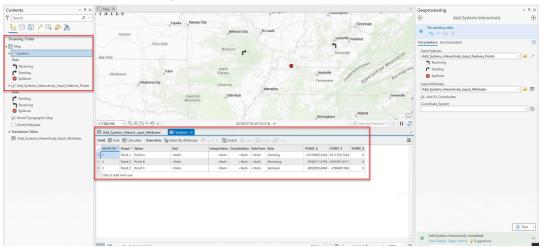
to create an attribute table



- You will get a table in the "Contents" tab and need to open it by right click and select "Open"
- Then, input the description in the "Name" colum and then click "save"



- You can check "Add XY Coordinates" and keep other parameters as default, then click RUN to execute the script.
- For the result, you can check the "Systems" layer in the Contents, and right click it to open the attribution table, you will see the data there.



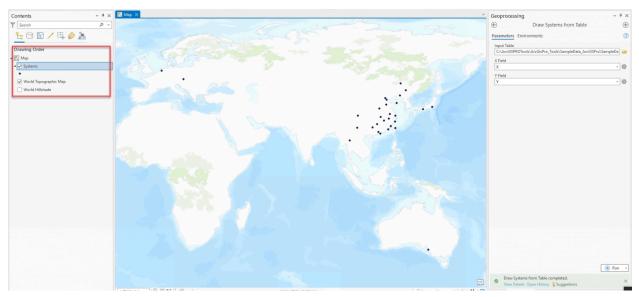
### 3.7.2 Draw Systems from Table

Geoprocess	ing	~ Ŧ ×
	Draw Systems from Table	$\oplus$
Parameters	Environments	?
* Input Table		
* X Field		
* Y Field		<u>ښ</u>
		凉

- Click e and select the "Input Table". In this example, we will use the file "wildlife\_Systems.csv" from the folder "\Systems\Draw Systems from Table".
- Set "X Field" as "X" and "Y Field" as "Y" from the droplist.
- All parameters are set like:

Geoproces	sing	~	Ψ×
	Draw Systems from Table		$\oplus$
Parameters	Environments		?
	ROTools\ArcGisPro_Tools\SampleData_ArcGlSPro\Sam	pleDa	•
X Field X		~	· 读
Y Field Y		~	寧

• Then, click "Run" and the results shows like:



3.7.3 Network Analysis Grouping

Geoprocessing	~	<b>¤</b> ×
Network Analysis Grouping		$\oplus$
Parameters Environments		?
* Nodes Table		
	_	
* Nodes Join Attribute	_	
* Links Table		
* Telecoupling Systems Layer		
* Layer Join Attribute		
Clustering Algorithm		
walktrap		~
* Network Graph Plot	_	1 👝
* Group Number		
* Network Metrics Table		
> Plotting Options		

- Click and select the "Nodes Table". In this example, we will use the file "nodes.csv" from the folder "\Systems\Network Analysis Grouping".
- Set "Nodes Join Attribute" as "CODE"
- Click e and select the "Links Table". In this example, we will use the file "links.csv" from the folder "\Systems\Network Analysis Grouping".
- For the "Telecoupling Systems Layer", select "World\_countries\_2002.shp" from the folder "\Systems\Network Analysis Grouping".
- Set "Layer Join Attribute" as "ISO\_3\_CODE"
- Set "Network Graph Plot" as "C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\result.pdf"
- Set "Group Number" as "C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\result.sh p"

• Set "Network Metrics Table" as

"C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\result.csv

• The parameters are set as below:

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• You can check the pdf from

"C:\Users\Administrator\Documents\ArcGIS\Projects\MyProject1\result.pdf" as below:

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