POPSYN INPUT TOOLBOX USER GUIDE

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POPSYN INPUT TOOLBOX USER GUIDE

This documentation covers use of the PopSyn Data toolbox. This toolbox is designed to facilitate updating MAZ and TAZ geometries and attributes. The PopSyn Data Toolbox includes the following script tools:

1. Import Tool: Imports TAZ and MAZ shapefiles and CSV files into ArcGIS for ease of editing
2. Populate Attributes Tool: Populate the socio-economic data from a source feature to a target feature
3. Validation Tool: Performs several validations within and between TAZ and MAZ data
4. Export Tool: Export TAZ and MAZ shapefiles and CSV files
5. Create Time Series Tool: Generates CSVs with time series information

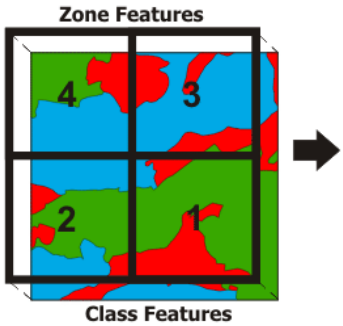
Note: The toolbox is developed for use in ArcMap 10.1+. Some features of this tool require at least an ArcGIS for Desktop Standard (ArcEditor) license. If an ArcGIS for Desktop Standard (ArcEditor) license is not available, this guide provides instructions for achieving similar results via some manual processes.

POPSYN DATA TOOLBOX WALKTHROUGH

This walkthrough will guide the user in importing, editing, validating and exporting TAZ and MAZ shapefiles and attributes.

IMPORTING TAZ AND MAZ GEOMETRIES AND ATTRIBUTES

The Import tool is used to import MAZ and TAZ shapefiles and CSVs into ArcGIS for ease of editing. The Import tool establishes a relationship or hierarchy between a TAZ and its associated MAZs as well as socio-economic data for various input years. The relationship between a TAZ and MAZ is created by computing the percentage of overlap between the two features and keeping only the maximum percentage of overlap.



Output

Zone	Color	AREA	PERCENTAGE
1	Blue	0.7	7.9
1	Green	6.3	67.5
1	Red	2.3	24.6
2	Blue	3.4	37.1
2	Green	4.1	44.3
2	Red	1.7	18.7
3	Blue	5.2	56.1
3	Green	1.3	13.9
3	Red	2.8	30.0
4	Blue	5.5	59.3
4	Green	2.0	21.5
4	Red	1.8	19.1

Figure 1 Conceptual illustration of TAZ and MAZ intersection computation. Records marked in red are preserved.

This relationship can be described as one-to-many, where one TAZ may have many associated MAZs. This tool also establishes a one-to-one relationship between the TAZ and MAZ geometries and each model year of data socio-economic data.

See Appendix A: Import for more detailed documentation.

1. Open an empty map document in ArcMap 10.1+.
2. Using the Catalog locate the PopSynInputTool.pyt toolbox. Note : If the Catalog is not visible, navigate to Windows and click Catalog.
3. Double-click the Import script tool.

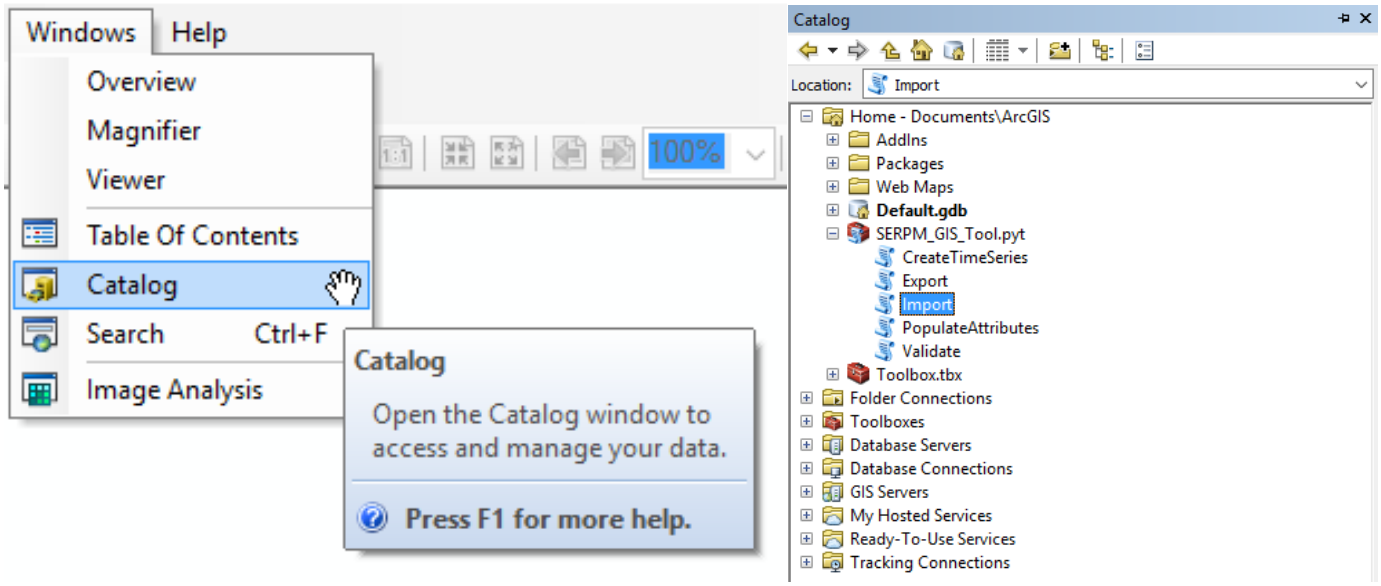


Figure 2 Open the Catalog in ArcMap. Navigate to and double-click the Import tool.

4 Accept or change the tool's default parameters, see Figure 3, and click OK. **Note: any feature classes or datasets that currently reside in the Edit Template map document will be removed by this operation.**

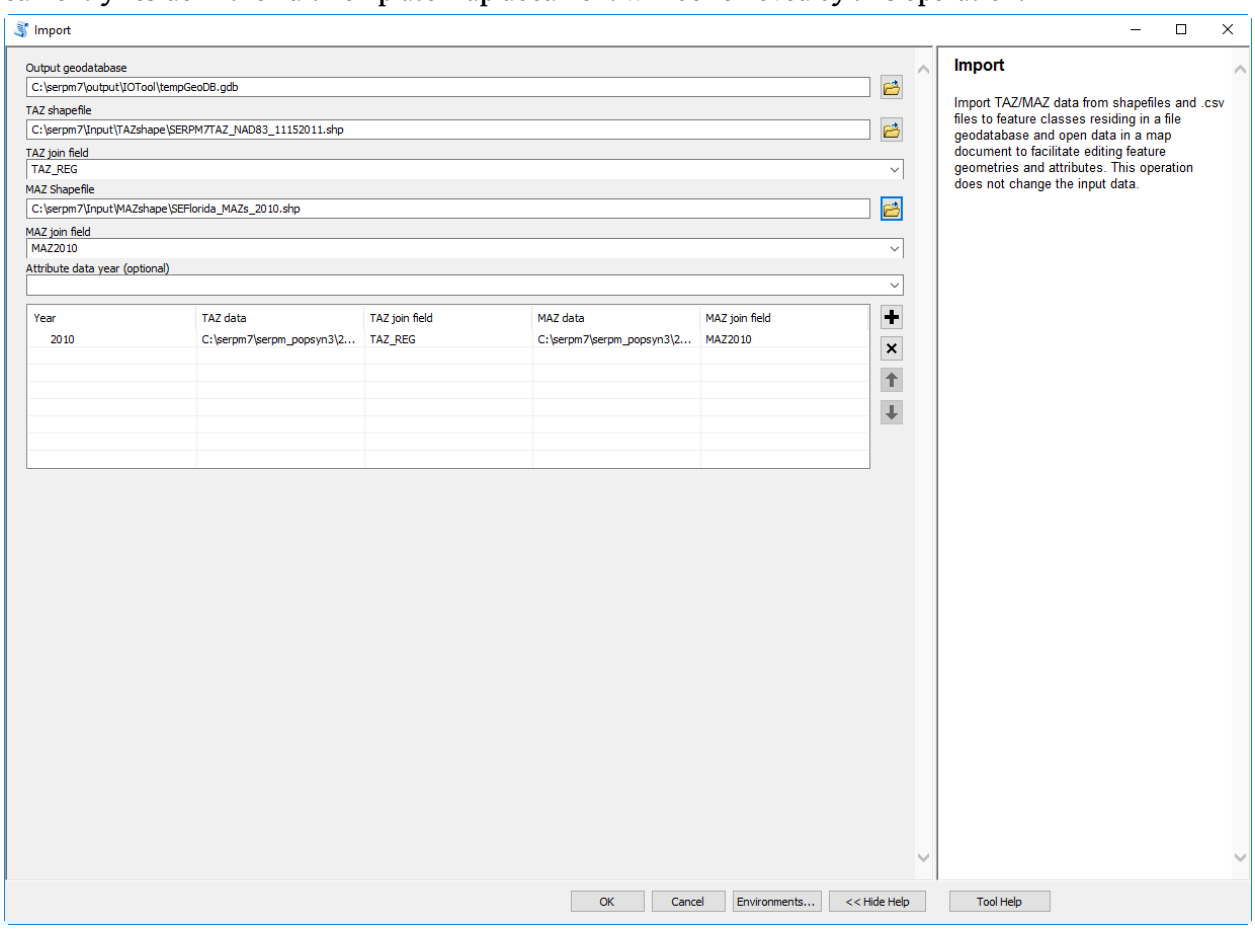


Figure 3 Import tool parameters

5 Once the Import tool is completed running, a new map document will automatically open.

ADDING RELATES (ARCVIEW ONLY)

This section includes instructions for manually adding relates to the TAZ and MAZ feature classes and feature datasets. Users with ArcGIS for Desktop Basic (ArcView) will need to manually complete the task of adding relates to the layers in the map.

1. After running the Import tool, the editing map document should open automatically.
2. Right-click on the TAZ feature class and navigate to Joins and Relates. Click Relate… Add a relate to the TAZ feature class and MAZ feature class. Complete the dialog box with appropriate parameters. Click OK. See Figure 4 for reference.

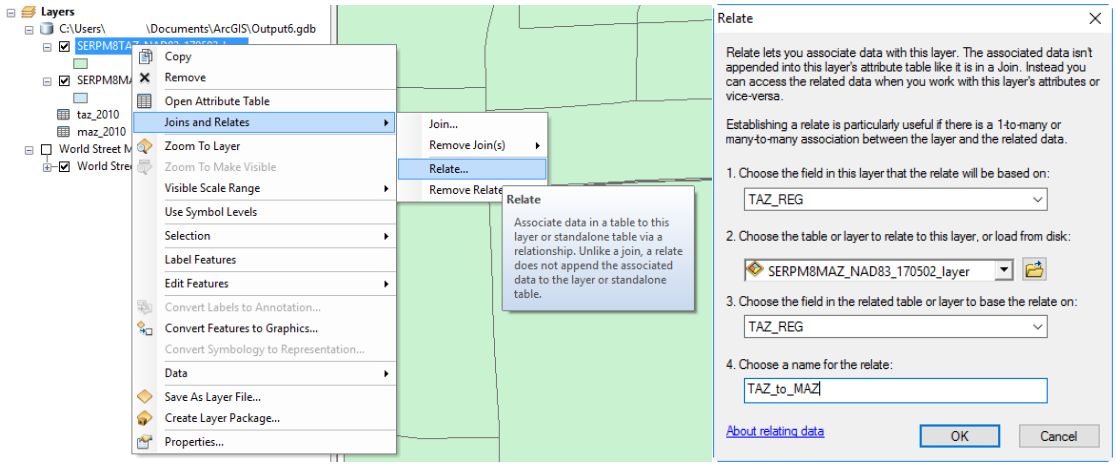


Figure 2 Right-click a feature class or dataset to add a relate and complete the dialog box with the appropriate parameters

3. Right-click on the TAZ feature class and navigate to Joins and Relates. Click Relate… Add a relate to the TAZ feature class and TAZ attributes (e.g. taz_2010). Complete the dialog box with appropriate parameters. Click OK.
4. Right-click on the MAZ feature class and navigate to Joins and Relates. Click Relate… Add a relate to the MAZ feature class and MAZ attributes (e.g. maz_2010). Complete the dialog box with appropriate parameters. Click OK.
5. Repeat steps 3 and 4 for each year of attribute data.

EDITING TAZS AND MAZS

This section describes how to accomplish some common operations in editing TAZ and MAZ geometries and attributes. Once the Import tool is finished running, a new map document will automatically open for editing. The TAZ and MAZ geometries and attributes are assembled into a hierarchy that was established upon import. A TAZ may have one or many associated MAZs and each TAZ and MAZ will have a single record for each model year of data socio-economic data.

This example will cover the addition of a new TAZ and MAZ. We will split TAZ 2767 into two distinct TAZs. In addition, we will also split MAZ 6380 into two MAZs – MAZ 6380 and MAZ 12025. These TAZs and MAZs that will be affected by these changes are highlighted in Figure 5.

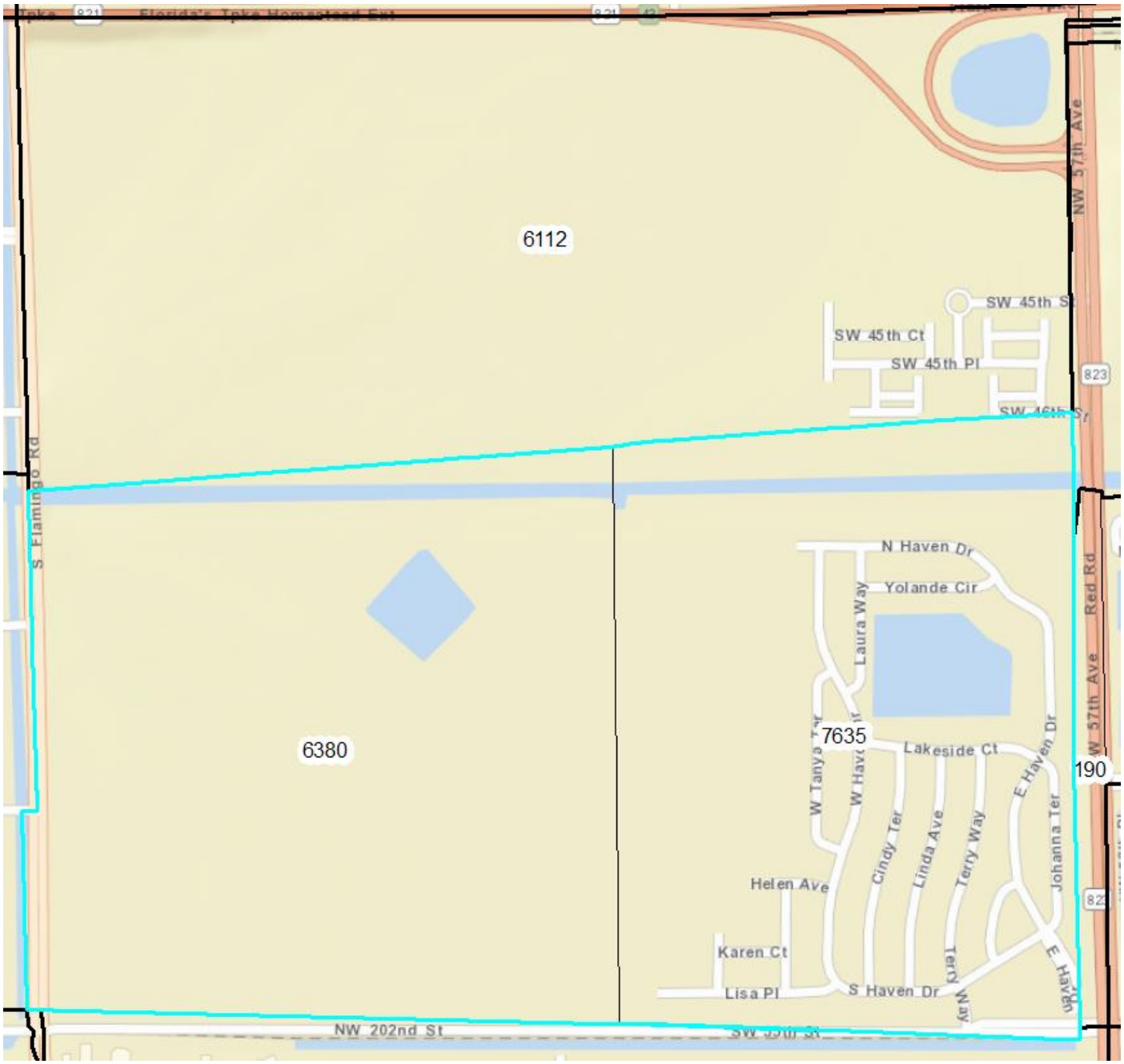


Figure 5 TAZ 2767, highlighted in blue, containing MAZs 6380 and 7635

SPLITTING A TAZ OR MAZ

This section will review splitting TAZ 2767 into two distinct TAZs – TAZ 2767 and TAZ 2854.

1 In the Edit Template map document, right-click the TAZ feature class and click Edit Features.

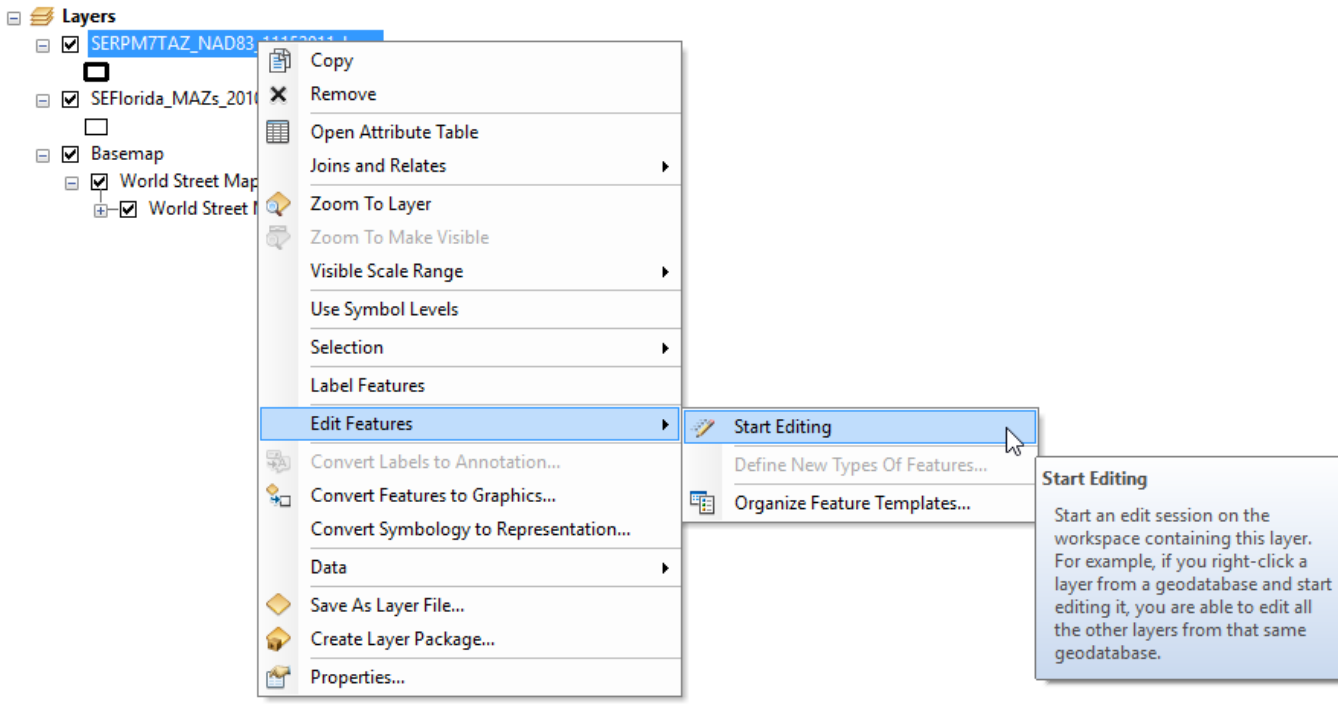


Figure 6 Begin editing the TAZ feature class

2 From the Edit toolbar, select the Cut Polygons tool, see Figure 7. If the Edit toolbar is not visible, click Customize scroll to Toolbars and select Editor from the dropdown.

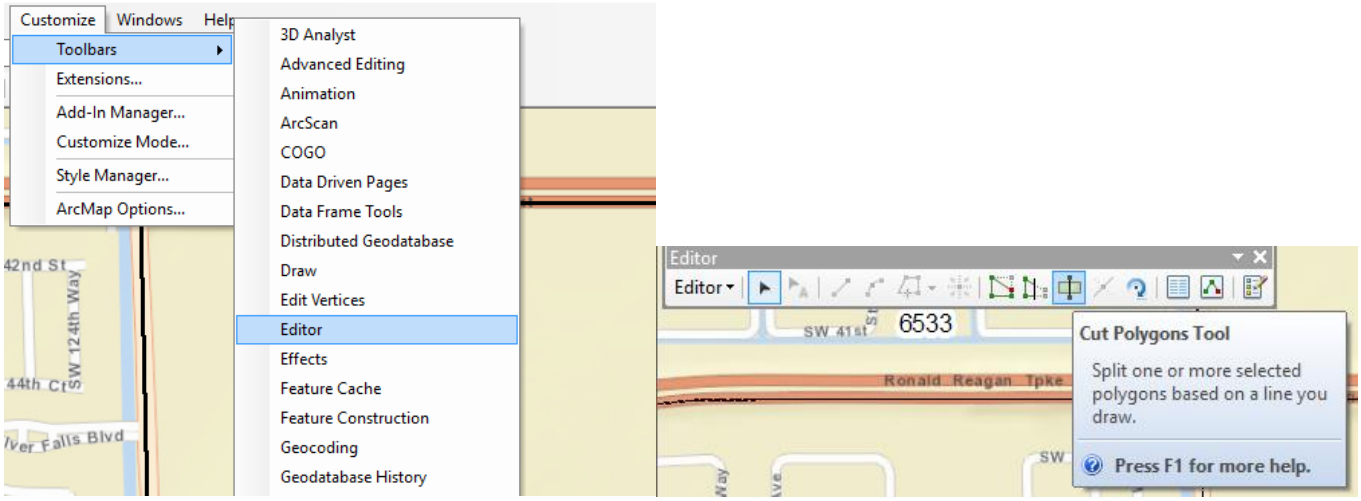


Figure 7 Using the editor toolbar, select the Cut Polygons tool

3 Split TAZ 2767 with the Cut Polygons tool along the border of MAZ 6380 AND 7635. Single-click to start drawing, double-click to complete the split. The tool will automatically snap to edges and vertices.

4 After splitting the polygon, there will be two TAZs with ID 2767. We will change the ID of the left-most feature to 2854. In the attributes pane, change the TAZ ID field, in this case, TAZ_REG to a new unique TAZ ID, 2854, as seen in Figure 8. If the attributes pane is not visible, click the Attributes icon in the Edit toolbar.

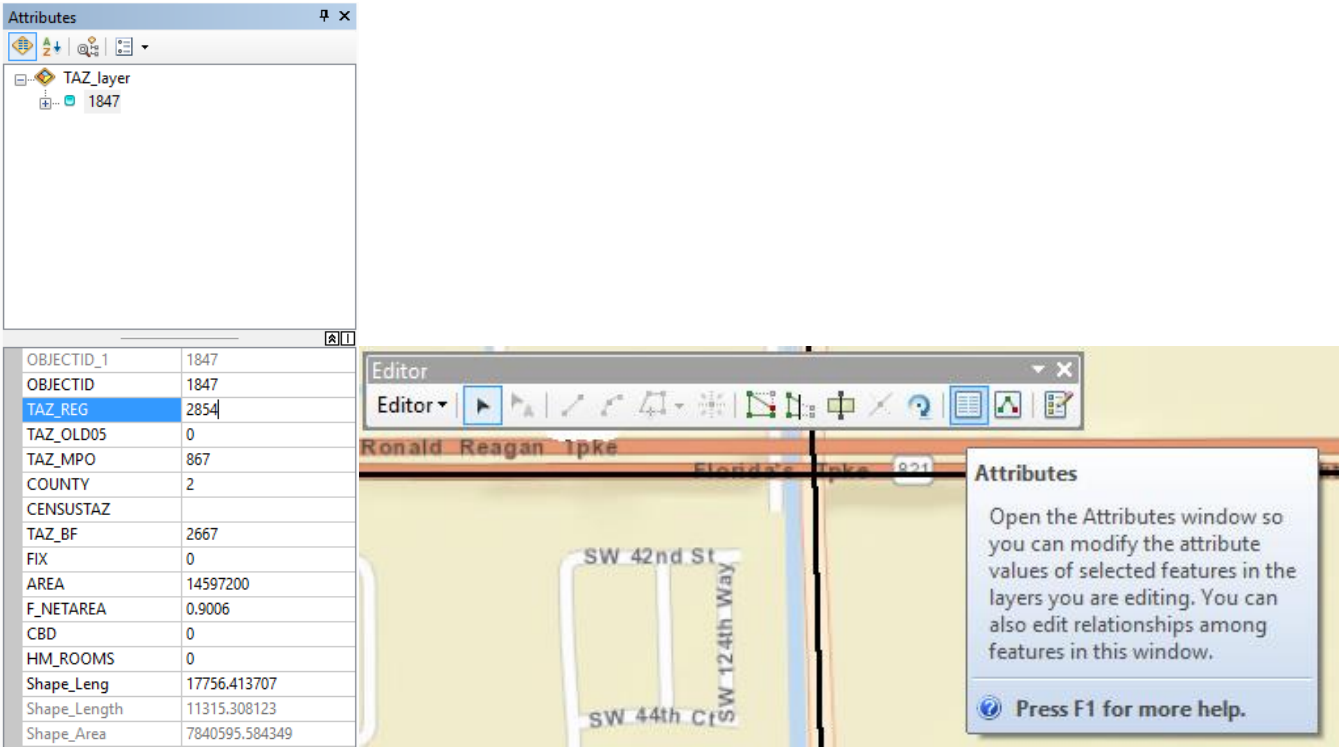


Figure 8 In the Attributes Pane, change the TAZ ID field to create a distinct TAZ

5 When a new TAZ ID is created, it is not associated with any MAZs or socio-economic data. Change the TAZ ID in MAZ 6380 to 2854 to 'link' it to TAZ 2854.

6 Add socio-ecnomic data to to the new TAZ. Select TAZ 2854, right-click on the taz_2010 table, and click Add New. This row will have the same TAZ ID, and null entries for all other attributes.

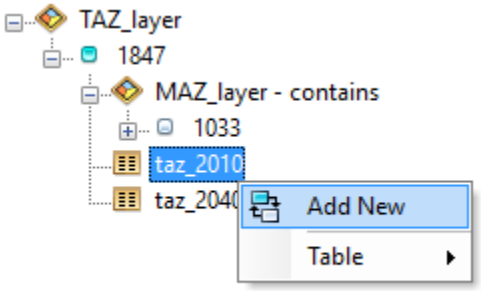


Figure 9 Add socio-economic attributes to TAZ

7 Populating socio-economic data can occur in a number of ways : 1) Manually edit each attribute, 2) Copy and Paste attributes from a different TAZ or, 3) use the PopulateAttributes tool. The next steps (8-10) will use the PopulateAttributes tool to complete the process of adding socio-economic data.

8 Using the Catalog locate the PopSynInputTool.pyt toolbox. Note : If the Catalog is not visible, navigate to Windows and click Catalog.

9 Double-click the PopulateAttributes script tool.

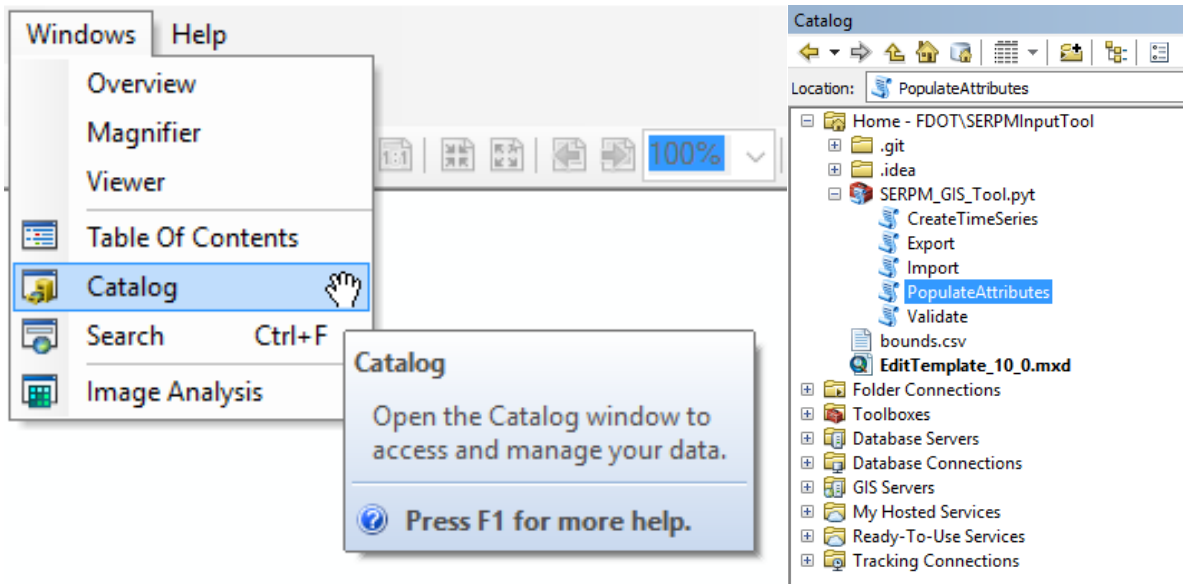


Figure 10 Open the Catalog in ArcMap. Navigate to and double-click the PopulateAttributes tool.

10 Run the PopulateAttributes tool from the PopSynInputTool. The Target ID is the feature for which values will change, the Source ID feature is unaffected by this operation. Target fields are the fields that will be re-calculated using this tool. By default, all Integer or Float fields are selected (excluding the ID field), but additional fields can be added or removed.

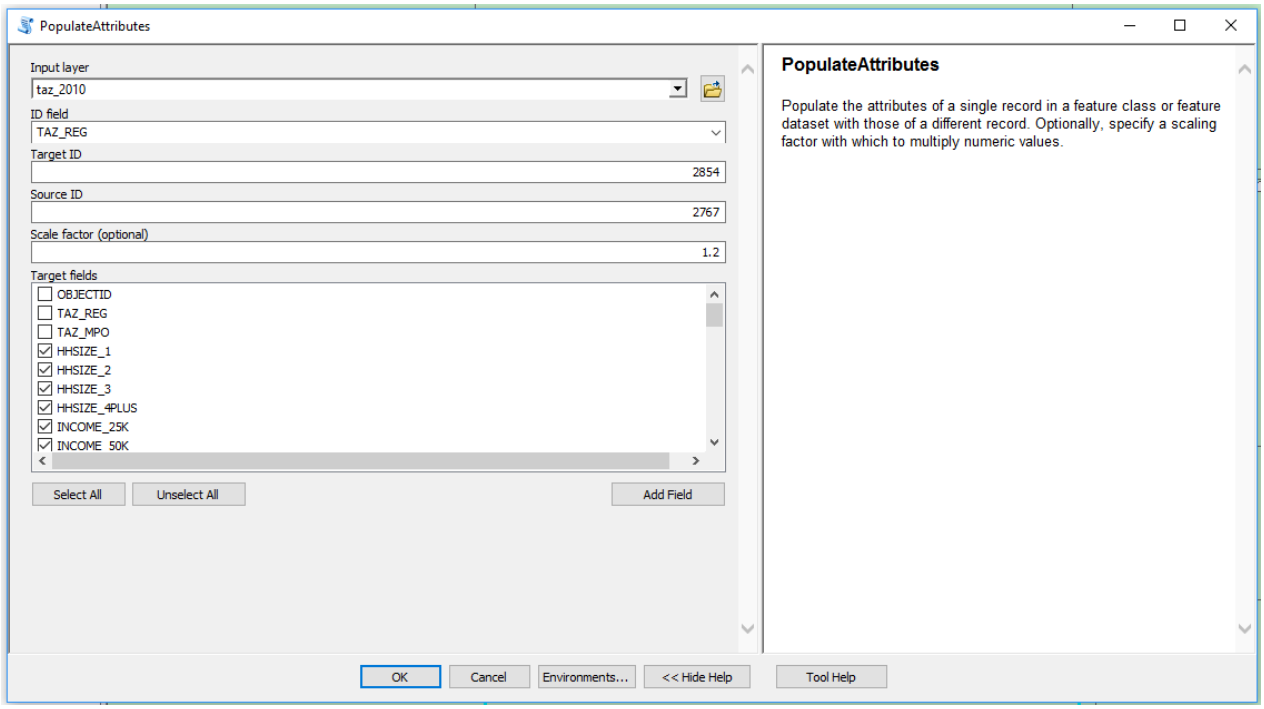


Figure 11 PopulateAttributes tool

11 Changes produced by the PopulateAttributes tool may not propagate immediately. You may need to reload the cache to see changes. To reload the cache, right-click on the TAZ feature class and click Open Attributes Table. In the Table Options dropdown, click Reload Cache.

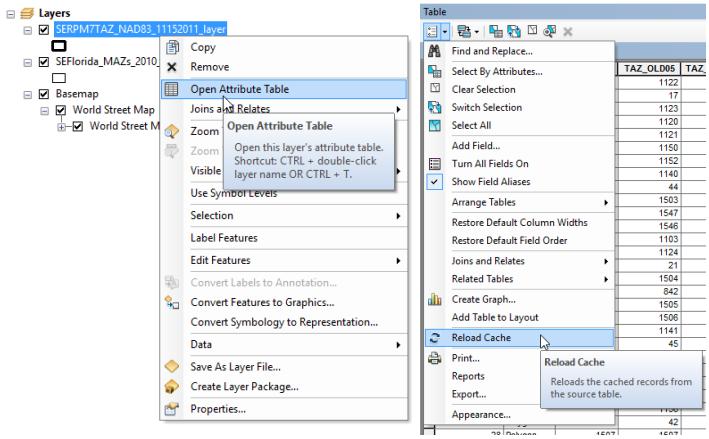


Figure 12 Open the attribute table and reload the cache

12 (Optional) Instead of populating attribute with the PopulateAttributes tool, you can paste attributes from a different TAZ into the new TAZ or edit the attributes manually. To copy attributes right-click the source TAZ attributes and click Copy Attributes. Navigate to the target TAZ, right-click and click Paste Attributes. **Remember <u>all</u> the attributes will be pasted, including the TAZ ID. Be sure to make the TAZ ID unique <u>before</u> navigating away from the target TAZ.**

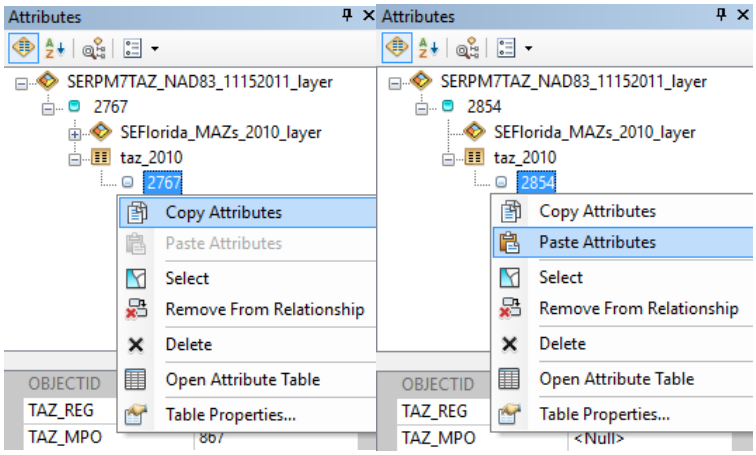


Figure 13 Copy and paste attributes from a source feature to a target feature

13 Save your changes.

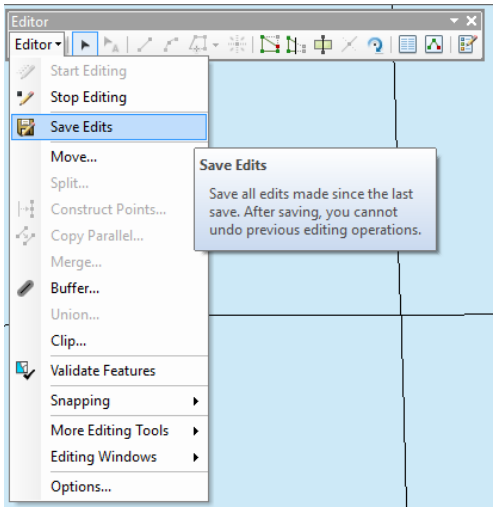


Figure 14 Save edits

14 Once the TAZ is split and attributes added, a MAZ can be split in much the same way. Refere to the previous steps for instructions on splitting polygons and adding attribute information. Be sure to save your edits!

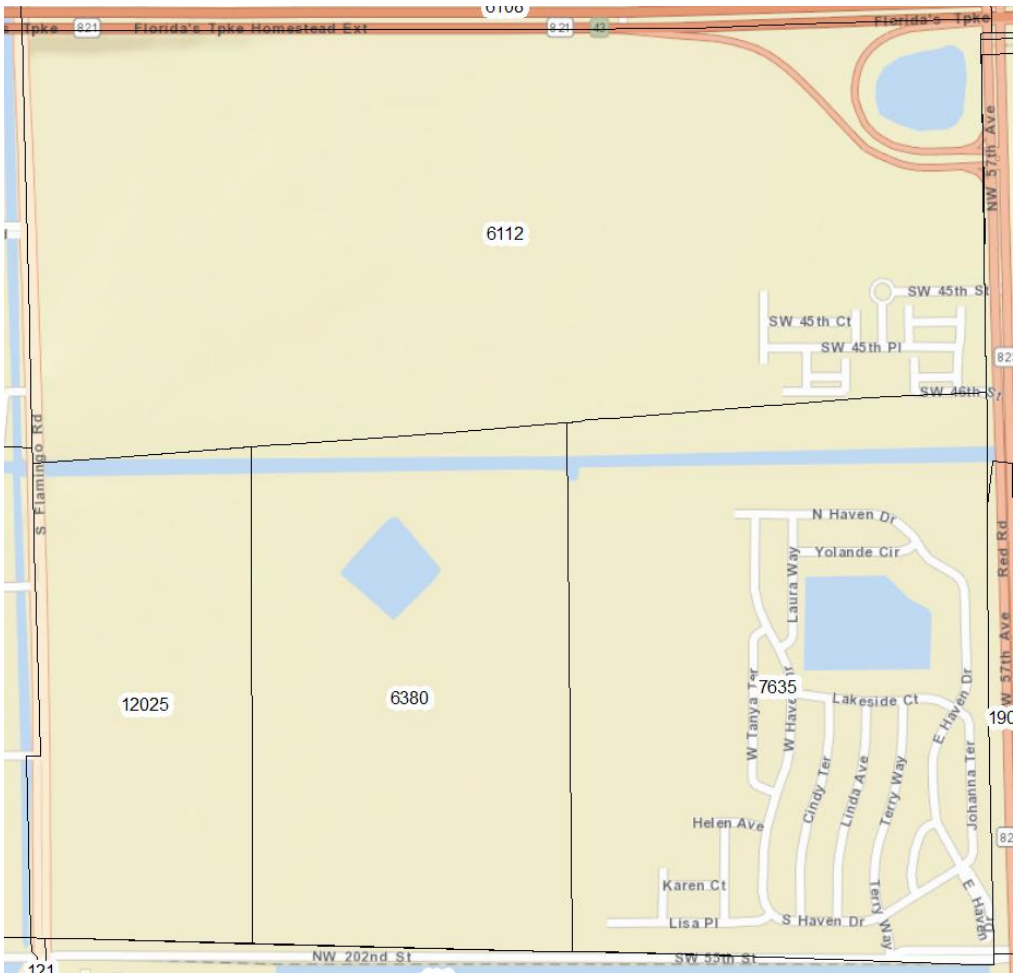


Figure 15 Result of splitting TAZ 2767 and MAZ 6380

VALIDATING TAZ AND MAZ ATTRIBUTES

The Validate tool performs several checks and validations within and between TAZ and MAZ data. The validate tool does not attempt to make any changes to the TAZ or MAZ attribute data. The validate tool will generate the following outputs:

- TAZ_<YEAR>_internal_validation
- TAZ_<YEAR>_MAZ_<YEAR>_validation

TAZ INTERNAL VALIDATION

For each year of TAZ data, the validate tool will verify the internal validity of a TAZ using the following equivalencies:

```
HHSIZE_1 + HHSIZE_2 + HHSIZE_3 + HHSIZE_4PLUS                                  = TOTAL_HOUSEHOLDS
INCOME_25K + INCOME50K + INCOME75K + INCOME100K + INCOME100KPLUS               = TOTAL_HOUSEHOLDS
WORKERS_0 + WORKERS_1 + WORKERS_2 + WORKERS_3PLUS                              = TOTAL_HOUSEHOLDS
SINGLE_FAMILY + MULTI_UNIT + MOBILE_HOME                                       = TOTAL_HOUSEHOLDS
AGE0TO17 + AGE18TO24 + AGE25TO34 + AGE35TO49 + AGE50TO64 + AGE65TO79 + AGE80PLUS = MALE + FEMALE
CHILDREN_0 + CHILDREN_1PLUS                                                    = TOTAL_HOUSEHOLDS
```

```
HISPANIC + WHITE + RACEOTHER                                    = MALE + FEMALE
GQ_INST + GQ_COLL + GQ_MIL + GQ_OTHER                           = TOTAL_GQ
```

If any of the equalities are not met, the validate tool will add a record in the output dataset (TAZ_<YEAR>_internal_validation) identifying the invalid TAZ and specify the difference between the expected value (TOTAL_HOUSEHOLDS) and the aggregated values.

Additionally, the internal validation tool also checks the number of 1, 2, 3 and 4+ person households and determines if they are outside 3 standard deviations of the expected value. The bounds of these deviations are stored in the "bounds.csv" file.

MAZ TO TAZ VALIDATION

For each year of MAZ and TAZ data, the validate tool will verify the validity between a TAZ and the MAZs it contains. The sum of total households and total group quarters within a set of MAZs should equal the total households and total group quarters of the containing TAZ.

RUNNING THE VALIDATE TOOL

1 In the same map document used for editing, navigate to the PopSynInputTool.pyt toolbox in the Catalog and double-click the Validate tool.

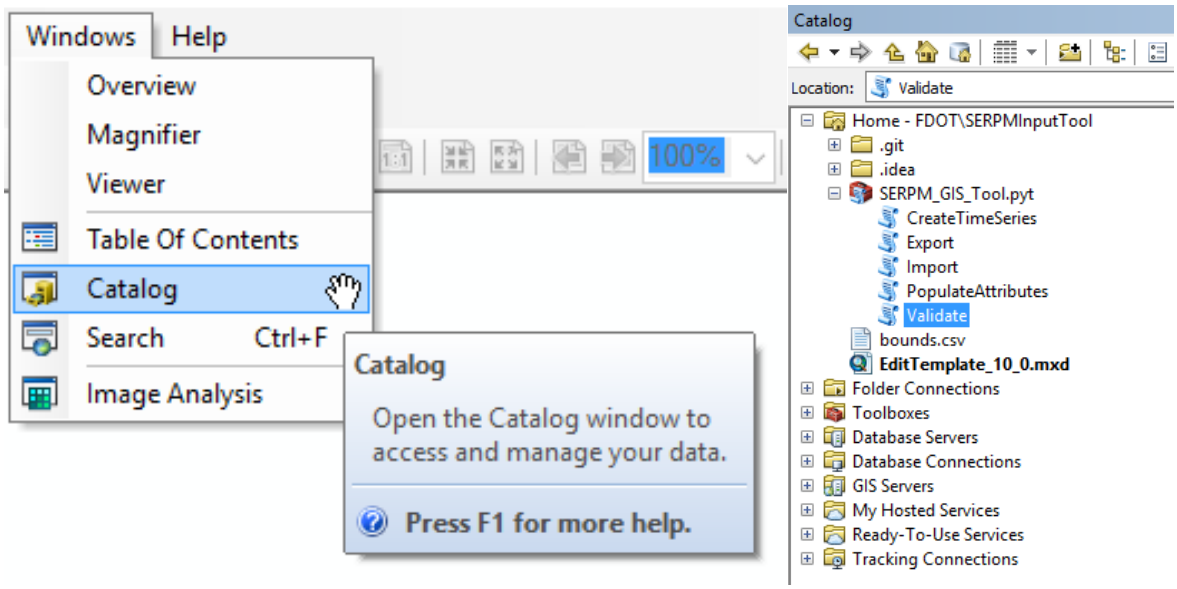


Figure 16 Open the Catalog in ArcMap. Navigate to and double-click the Validate tool.

2 The Validate tool will intelligently guess the tool's parameters based upon the feature classes and datasets in the current map document. The validate tool is capable of batch processing and therefore accepts multiple sets of values. Accept or changed the tool's default parameters and click OK.

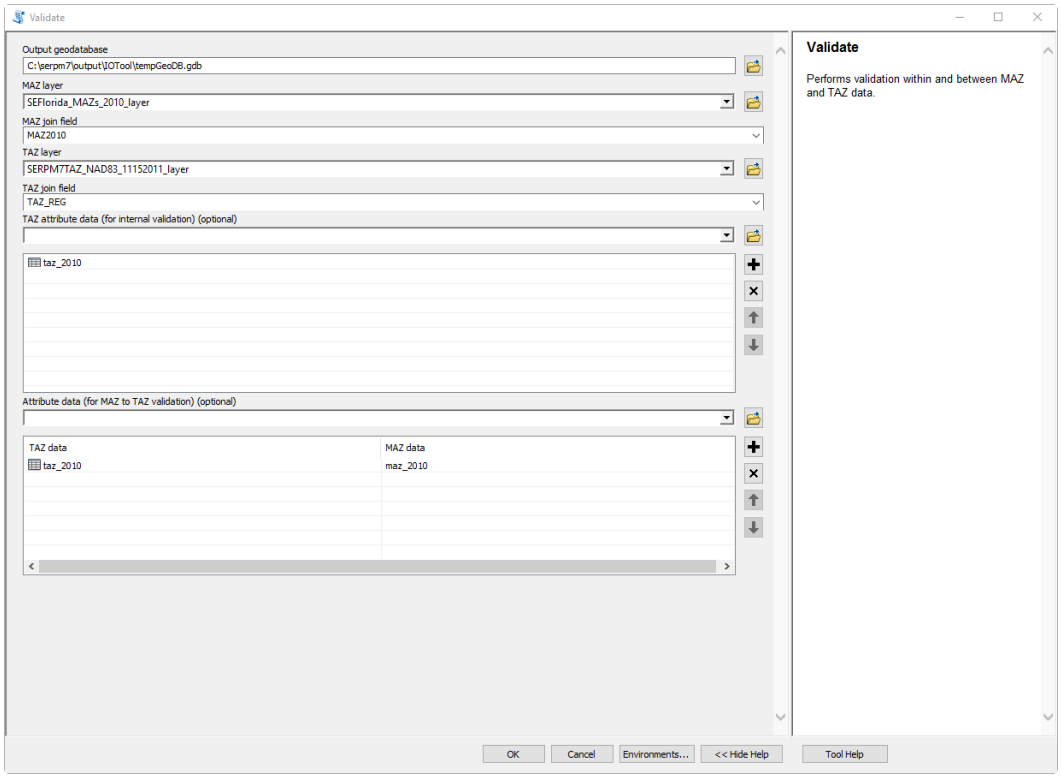


Figure 17 Validate tool

3 Some of the output datasets may not immediately appear in the Table of Contents after running this tool. To refresh the Table of Contents, switch between List by Source and List by Drawing Order view in the Table of Contents pane.

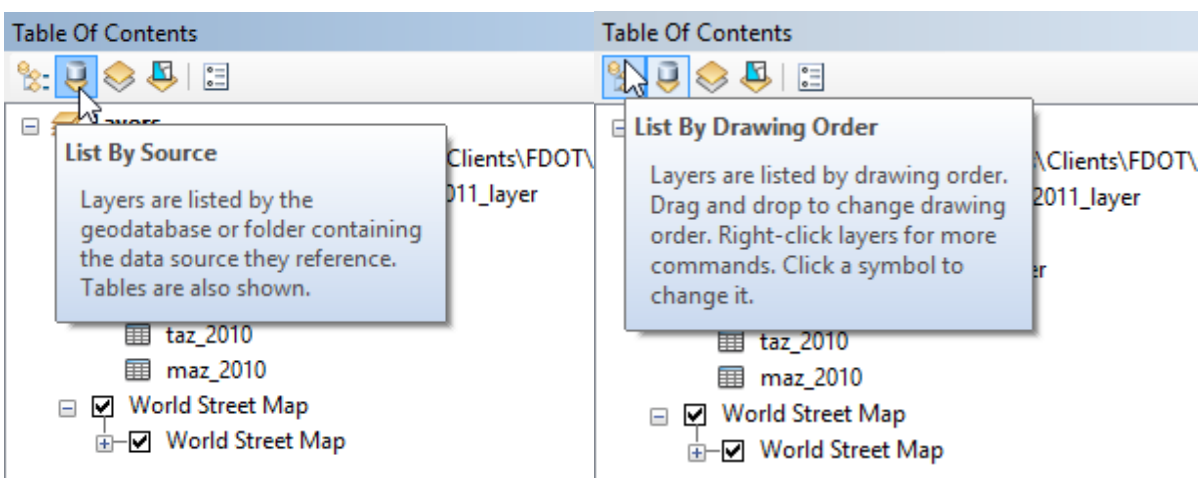


Figure 18 Refresh items in the Table of Contents by switching between the List by Source and List by Drawing Order views

4 (Optional) To facilitate the correction of data inconsistancies, it may be useful to join the validation table to the TAZ feature layer. To accomplish this, right-click the TAZ feature layer, scroll to Joins and Relates and click Join... See relevant parameters in Figure 19. To remove this join, right-click the TAZ feature layer, scroll to Joins and Relates, hover over Remove Join(s) and click on the appropriate join to remove or click Remove All Joins.

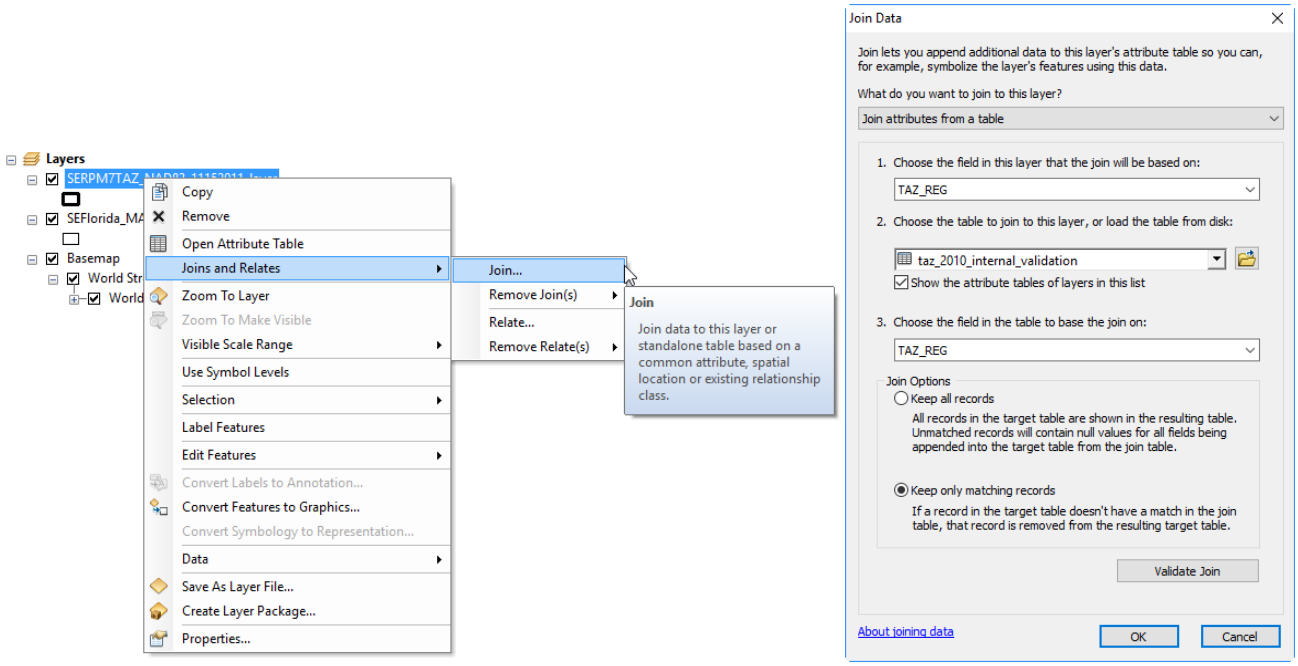


Figure 19 Adding a join to the TAZ layer

GENERATING TIME SERIES DATA

The CreateTimeSeries generates "long" format .csv files containing time series information. This tools combines each year of socio-economic data into a single file with a `YEAR` field denoting the model year. This format is especially useful for quickly creating pivot tables.

1. Using the Catalog, locate the PopSynInputTool.pyt toolbox.
2. Double-click the CreateTimeSeries script tool.

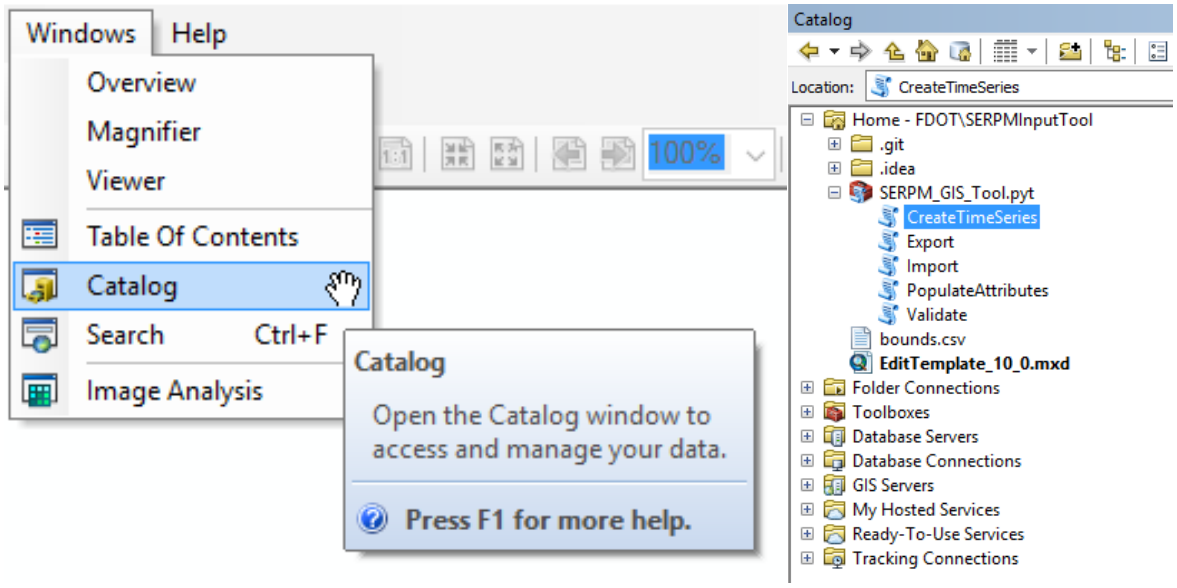


Figure 20 Open the Catalog in ArcMap. Navigate to and double-click the CreateTimeSeries tool.

3 Enter the desired tool parameters. The tool is capable of processing TAZ and MAZ attributes simultanesouly.

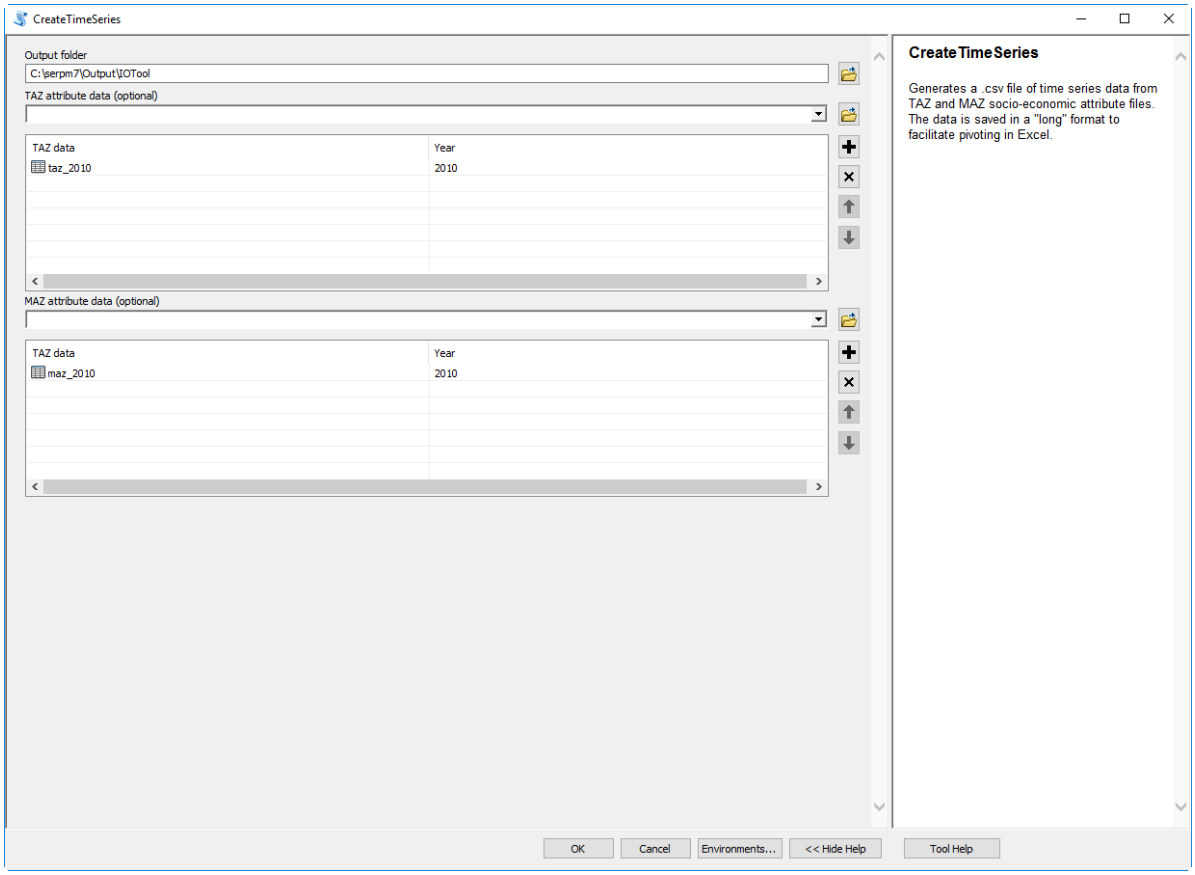


Figure 21 CreateTimeSeries tool

4 The tool outputs can be found in the user specified *Output folder*.

EXPORT TOOL

The export tool will save the modified feature classes as a series of shapefiles and CSVs. The following files are produced by the Export tool:

- TAZ shapefile
- MAZ shapefile
- TAZ socioeconomic attributes (one file for each year)
- MAZ socioeconomic attributes (one file for each year)
- TAZ/MAZ/PUMA/Region crosswalk

1 In the same map document used for editing, navigate to the PopSynInputTool.pyt toolbox in the Catalog and double-click the Export tool.

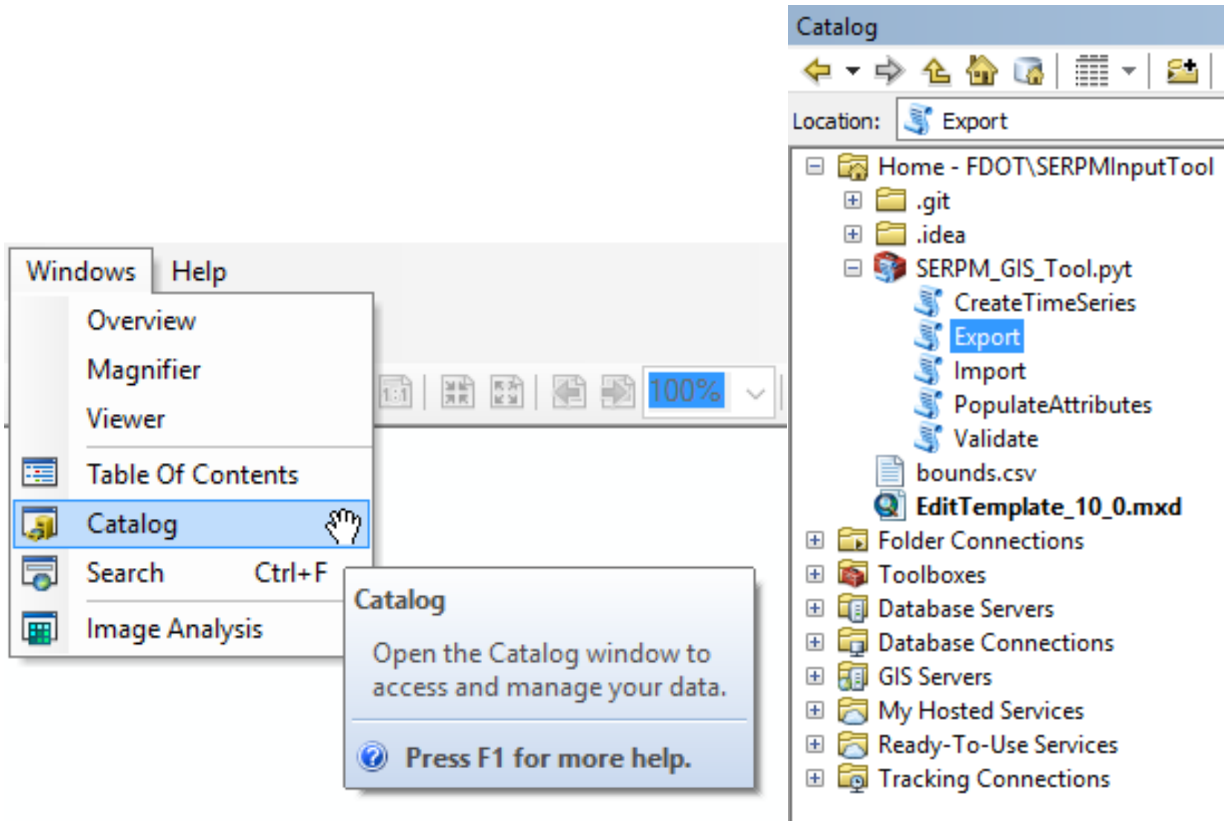


Figure 22 Open the Catalog in ArcMap. Navigate to and double-click the Export tool.

2 The Export tool will intelligently guess the tool's parameters based upon the feature classes and datasets in the current map document. Accept or change the tool's default parameters, see Figure 23, and click OK.

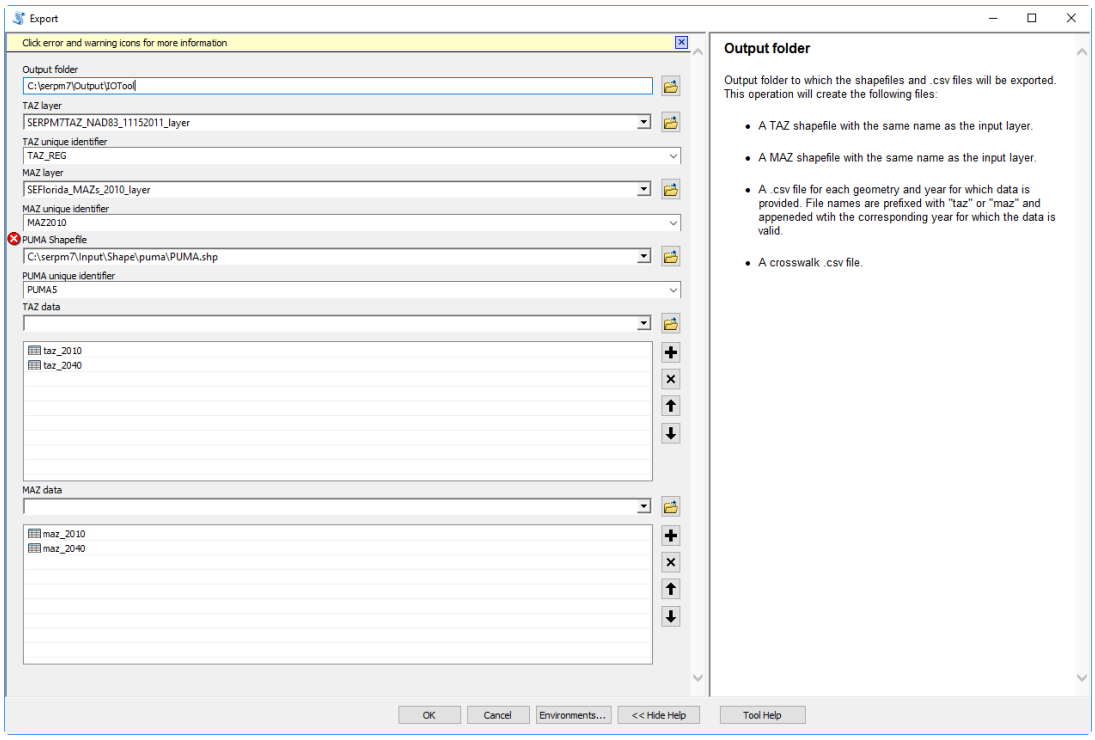


Figure 23 Export tool parameters

3 The tool outputs can be found in the user-specified *Output folder*.

APPENDIX A

POPSYN INPUT TOOL REFERENCE

The PopSyn input tool reference outlines documentation on the script tools provided in the ArcGIS PopSynInputTool toolbox.

IMPORT

Import TAZ and MAZ data from shapefiles and .csv files to feature classes residing in a file geodatabase and open data in a map document to facilitate editing feature geometries and attributes. This operation does not change the input data.

Parameter	Description	Data Type
`output_gdb`	File geodatabase for output to reside. If the geodatabase exists, feature classes in the geodatabase will be overwritten, otherwise a new geodatabase will be created. The following outputs will be created: • A feature class derived from TAZ geometry. This feature class will have the same name as the input shapefile/feature class. • A feature class derived from MAZ geometry. This feature class will have the same name as the input shapefile/feature class. • A feature dataset for each year of TAZ and MAZ attribute data. These feature datasets will be labeled per its associated geometry and year.	Geodatabase
`taz_shapefile`	TAZ feature class or shapefile.	Shapefile or feature class
`taz_field`	A field uniquely identifying a TAZ. This field will be used as a primary key to establish a relationship class.	Field
`maz_shapefile`	MAZ feature class or shapefile.	Shapefile or feature class
`maz_field`	A field uniquely identifying a MAZ. This field will be used as a primary key to establish a relationship class.	Field
`attr_data (optional)`	Attribute data for TAZ and MAZ including: • **Year (long)** - Model year • **TAZ data (table or feature dataset)** - Full directory path and name of the TAZ data source • **TAZ join field (field)** - A field uniquely identifying a TAZ. This field will be used	Value table containing the following data types: • Long • Table or feature dataset • Field • Table or feature dataset • Field

	as a primary key to establish a relationship class. • **MAZ data (table or feature dataset)** - Full directory path and name of the MAZ data source • **MAZ join field (field)** - A field uniquely identifying a MAZ. This field will be used as a primary key to establish a relationship class.	

POPULATE ATTRIBUTES

Populate the attributes of a single record in a feature class or feature dataset with those of a different record. Optionally, specify a scaling factor with which to multiply numeric values.

Parameter	Description	Data type
input_layer	The feature class or feature dataset to update.	Shapefile, feature class or feature dataset
id_field	The ID field. This field **must** be unique for each feature or record.	Field
target_id	The ID of the target feature. This feature will be updated by running this tool.	Long
source_id	The ID of the source feature. This feature will **not** be affected by running this tool.	Long
scale_factor (optional)	An optional scaling factor. All values from target fields will be multiplied by this scaling factor. Defaults to 1 if no scaling factor is provided.	Double
input_fields	Target fields. Values in these fields will be multiplied by the scaling factor. **Note: only fields of type Integer or Float will be affected by this tool.**	Fields

VALIDATE

Performs validation within and between MAZ and TAZ data. This tools performs numerous validations, but does not change the underlying data. See Section Validating TAZ and MAZ Attributes for more information regarding how validations are performed.

Parameter	Description	Data type
output_gdb	Output geodatabase to which feature datasets will be saved.	Geodatabase
maz_shapefile	MAZ feature class or shapefile.	Shapefile or feature class

maz_field	A field uniquely identifying a MAZ.	Field
taz_attr (optional)	TAZ attribute tables upon which internal validation will be performed.	Table or feature dataset
taz_to_maz (optional)	Pairs of TAZ and MAZ attributes tables. Each pair will be compared and verified for validity. • **TAZ data (table or feature dataset)** – TAZ attribute data • **MAZ data (table or feature dataset)** – MAZ attribute data	Value table containing the following data types: • Table or feature dataset • Table or feature dataset

EXPORT

This tool will export modified TAZ and MAZ geometry and attributes. Geometries will be exported as a shapefile and socio-economic attributes will be saved as .csv files. Additionally, this tool will generate a crosswalk table relating TAZ, MAZ and PUMA geographies. **This operation will overwrite existing data**.

Parameter	Description	Data type
output_folder	Output folder to which the shapefiles and .csv files will be exported. This operation will create the following files: • A TAZ shapefile with the same name as the input layer. • A MAZ shapefile with the same name as the input layer. • A .csv file for each geometry and year for which data is provided. File names are prefixed with "taz" or "maz" and appended with the corresponding year for which the data is valid. • A crosswalk .csv file with timestamp.	Folder
taz_input	TAZ feature class or shapefile.	Shapefile or feature class
taz_field	A field uniquely identifying a TAZ. This field will be used to construct the crosswalk table.	Field
maz_input	MAZ feature class or shapefile.	Shapefile or feature class
maz_field	A field uniquely identifying a MAZ. This field will be used to construct the crosswalk table.	Field
puma_shapefile	PUMA feature class or shapefile.	Shapefile or feature class
puma_field	A field uniquely identifying a PUMA. This field will be used to construct the crosswalk table.	Field

taz_data	TAZ attribute table or feature dataset.	Table or feature dataset
maz_data	MAZ attribute table or feature dataset.	Table or feature dataset

CREATE TIME SERIES

Generates a .csv file of time series data from TAZ and MAZ socio-economic attribute files. The data is saved in a "long" format to facilitate pivoting in Excel.

Parameter	Description	Data type
output_folder	Output folder to which the time series .csv files will be exported.	Folder
taz_attr (optional)	Pairs of TAZ data and corresponding model year: • TAZ data (table or feature dataset) • Model year (long)	Value table containing the following data types: • Table or feature dataset • Long
maz_attr (optional)	Pairs of MAZ data and corresponding model year: • MAZ data (table or feature dataset) • Model year (long)	Value table containing the following data types: • Table or feature dataset • Long