ASEAN RISK AND VULNERABILITY ASSESSMENT

Exercise Manual Supporting the Implementation of the ASEAN RVA Guidelines

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INTRODUCTION

PURPOSE AND STRUCTURE

The exercises presented in this manual are designed to support the implementation of a regionally consistent approach to subnational Risk and Vulnerability Assessment (RVA) for ASEAN Member States (AMS). Each exercise provides practical, hands-on training with the tools, techniques, and datasets required to put the ASEAN RVA Guidelines into practice.

Exercise 1 provides an overview of secondary data preparation, a process that cleans, combines, and standardizes raw datasets for use in indicator development. Exercises 2 and 3 build on these skills, taking raw data through the processes of indicator preparation and index construction. Exercises 4 through 7 provide hands-on tutorials for using GIS in support of Risk and Vulnerability Assessment, introducing GIS software and basic methods for spatial analysis and risk mapping. Finally, Exercise 8 provides a tutorial for map development, a critical step for communicating risk and integrating RVA products into decision-making. Objectives, materials and instructions are provided within each exercise.

WORKING WITH SECONDARY DATA

EXERCISE 1: DATA PREPARATION

OBJECTIVE

The objective of this exercise is to provide participants with an opportunity to gain practical experience in techniques for preparing data for further analysis. Participants will perform a variety of data processing steps using sample datasets, including sorting and combining data from multiple spreadsheets, performing calculations, dealing with missing values, etc.

MATERIALS

This exercise requires the use of Microsoft Excel. To complete the tasks in this exercise you will need sample data (to be provided by instructors):

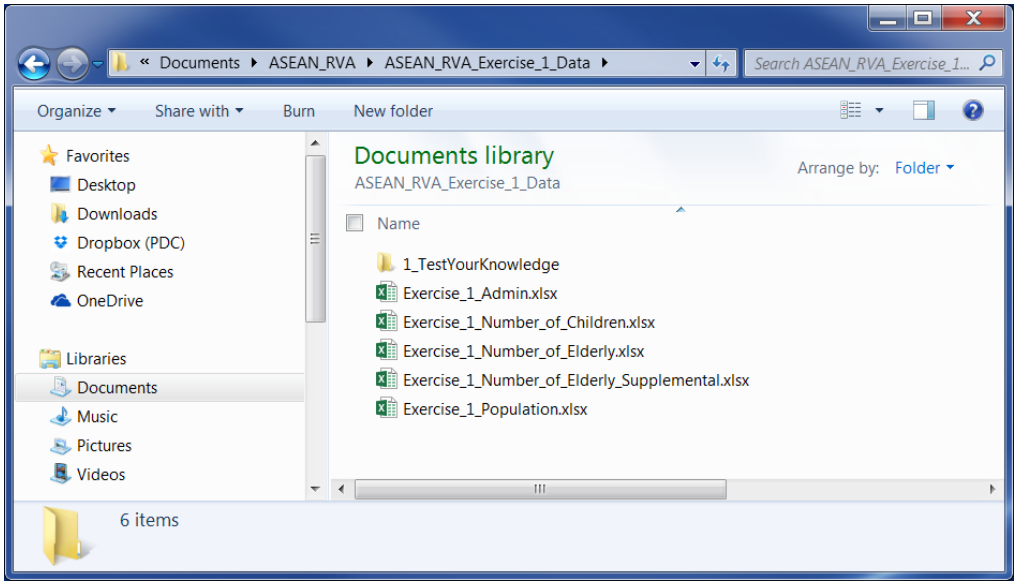
- Excel worksheets containing data for this exercise can be found in the '**ASEAN_RVA_Exercise_1_Data**' folder.

INSTRUCTIONS

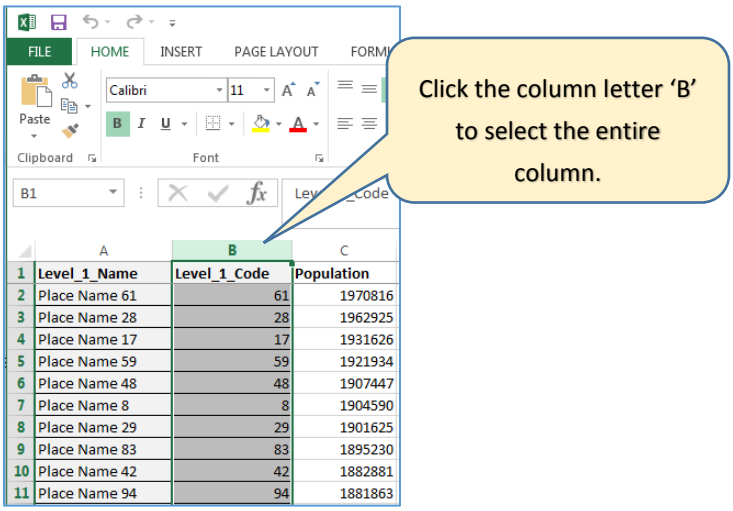
Sometimes, the indicator that you want to use in analysis must be created using other datasets that are available to you. In this exercise, you will combine data from several different Excel worksheets, and perform calculations to derive the indicator *Percent (%) of Children and Elderly*, representing the percentage of the population per administrative unit that is under the age of 15 or over the age of 64.

TASK 1: PREPARING YOUR INPUT DATA

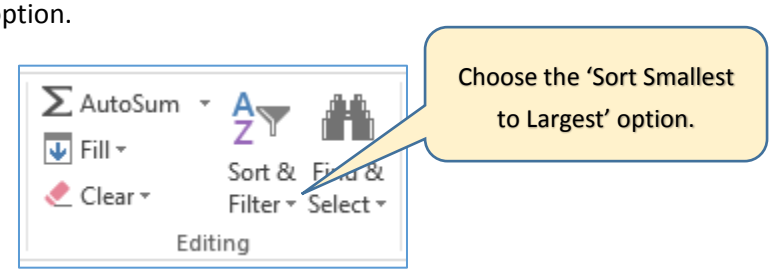
1. Open the folder entitled '**ASEAN_RVA_Exercise_1_Data**' and review the contents.



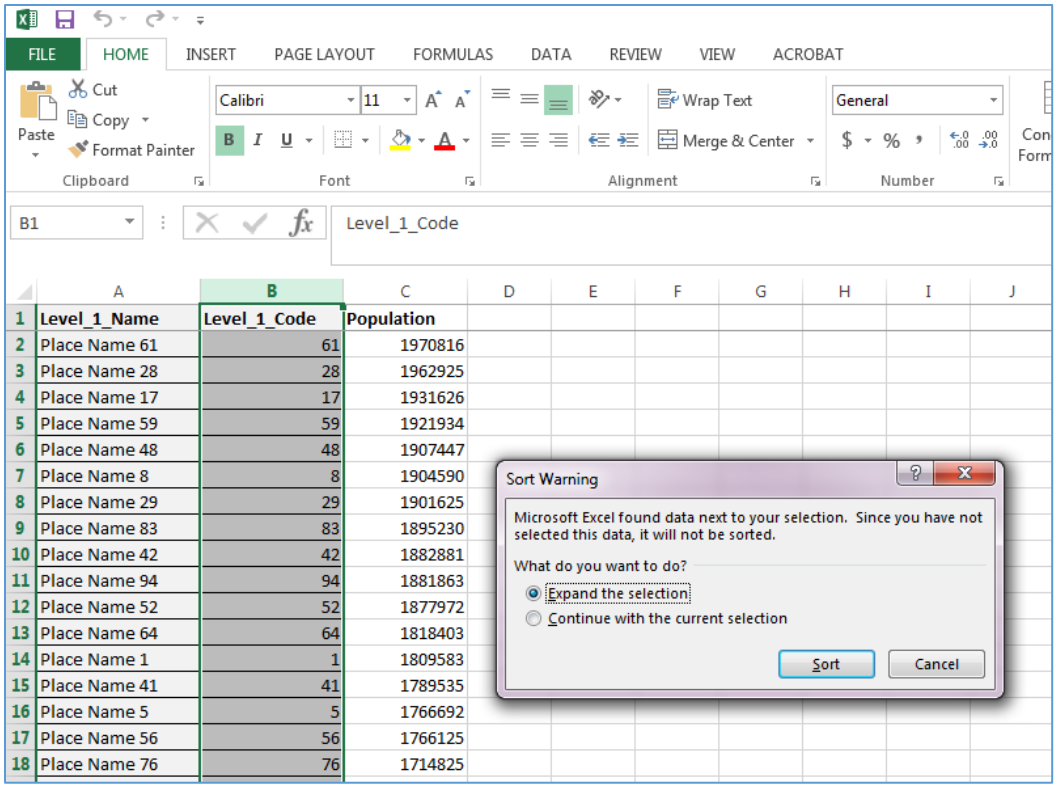
2. Recall from the preceding presentation that in order to combine datasets, a common field is required. All of the datasets provided include the fields: 'Level_1_Name' and 'Level_1_Code.' As a first step, it will be important to sort data in each worksheet by the same common field. This will ensure that when data from multiple spreadsheets are combined, values are associated with the correct place name/admin unit.
    a. Begin by sorting each dataset by a common field. In these sample datasets, the common field to sort by is, 'Level_1_Code.'
    b. **How to Sort Using Excel:**
        i. Select the 'Level_1_Code' column by clicking the column letter 'B' directly above the field name.



Under the 'Home' tab in Excel, click on the small arrow in the lower right-hand corner of the 'Sort & Filter' option in the 'Editing' menu. Choose the 'Sort Smallest to Largest' option.

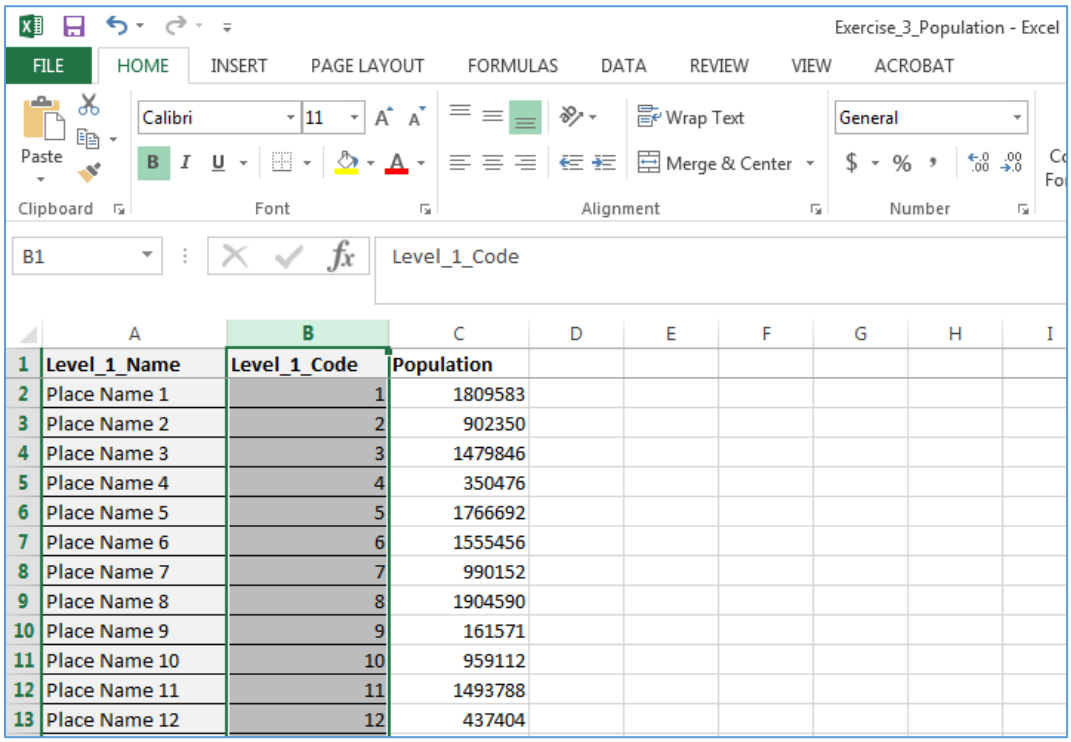


        ii. Notice that a 'Sort Warning' window will appear on your screen asking if you would like to 'Expand the selection,' or 'Continue with the current selection.' It is important that you choose the 'Expand the selection' option. This will ensure that all data in other columns that are associated with the selected data will be sorted along with it.



	A	B	C
1	Level_1_Name	Level_1_Code	Population
2	Place Name 61	61	1970816
3	Place Name 28	28	1962925
4	Place Name 17	17	1931626
5	Place Name 59	59	1921934
6	Place Name 48	48	1907447
7	Place Name 8	8	1904590
8	Place Name 29	29	1901625
9	Place Name 83	83	1895230
10	Place Name 42	42	1882881
11	Place Name 94	94	1881863
12	Place Name 52	52	1877972
13	Place Name 64	64	1818403
14	Place Name 1	1	1809583
15	Place Name 41	41	1789535
16	Place Name 5	5	1766692
17	Place Name 56	56	1766125
18	Place Name 76	76	1714825

iii. Click the 'Sort' button in the 'Sort Warning' window. The 'Level_1_Code' field should now appear in numeric order (see snapshot below). Remember to sort all datasets that will be used in this exercise.



	A	B	C
1	Level_1_Name	Level_1_Code	Population
2	Place Name 1	1	1809583
3	Place Name 2	2	902350
4	Place Name 3	3	1479846
5	Place Name 4	4	350476
6	Place Name 5	5	1766692
7	Place Name 6	6	1555456
8	Place Name 7	7	990152
9	Place Name 8	8	1904590
10	Place Name 9	9	161571
11	Place Name 10	10	959112
12	Place Name 11	11	1493788
13	Place Name 12	12	437404

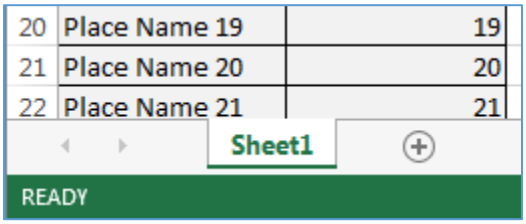
3. It is not uncommon for datasets to be incomplete due to variations in collection methods or frequency of collection. It may therefore be necessary to combine data from multiple sources to be able to obtain a complete (or nearly complete) dataset. When combining data from different sources, it is possible that values will differ from one source to another. A decision regarding which will be the primary data source and which will be the supplementary source will be necessary. In this step, you will be combining data from two different sources to develop a complete dataset.
    a. Open the dataset entitled, 'Number of Elderly Supplemental' and sort by the field, 'Level_1_Code.' Compare the values in this spreadsheet with those in the 'Number of Elderly' worksheet.
    b. Double-check that both worksheets have been sorted by 'Level_1_Code,' then copy the field 'Elderly_Persons_2' from the supplementary dataset into the 'Number of Elderly' worksheet. You can then copy and paste or drag supplemental values into the 'Elderly_Persons' column.
    c. **QAQC:** Spot check the values you just copied over with the original supplementary data values. When copying over supplemental data, it is good practice to copy both the column with the administrative code and the column with data so that you can more easily check for errors. Once checked, any duplicate fields can be deleted.
    d. Sort all remaining datasets (following the procedure outlined in Step 2) to create a single worksheet that includes data for:
        i. Level 1 Name
        ii. Level 1 Code
        iii. Population
        iv. Children
        v. Elderly Persons

	A	B	C	D	E
1	**Level_1_Name**	**Level_1_Code**	**Population**	**Elderly_Persons**	**Children_Count**
2	Place Name 1	1	1809583	82517	351783
3	Place Name 2	2	902350	129127	114508
4	Place Name 3	3	1479846	346284	230856
5	Place Name 4	4	350476	20047	71077
6	Place Name 5	5	1766692	220837	220837
7	Place Name 6	6	1555456	125214	419196
8	Place Name 7	7	990152	258133	68618

TASK 2: PERFORMING CALCULATIONS TO DERIVE AN INDICATOR

This task outlines a series of calculations to derive the indicator *Percent (%) of Children and Elderly.* It is a good practice, and recommended, that you copy the contents of this worksheet into a new worksheet before performing calculations to ensure that the integrity of the original datasets is preserved (especially useful should you need to start over).

1. **How to Copy Contents into a New Worksheet in Excel:**
   a. At the bottom of the worksheet you will see a tab entitled 'Sheet1.' Next to it is a "plus" symbol.

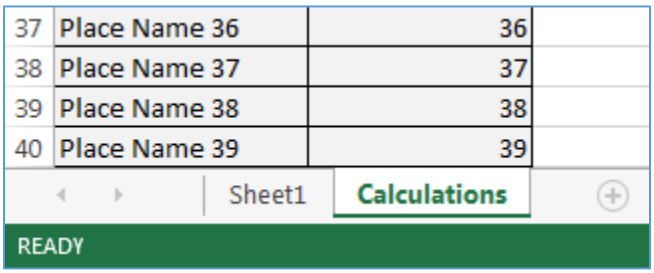


20	Place Name 19	19
21	Place Name 20	20
22	Place Name 21	21

Sheet1

READY

   b. Click the "plus" symbol to add a new worksheet. You have the option to rename the worksheet by right-clicking on the tab entitled 'Sheet2' and choosing the 'Rename' option. In the example below, the new sheet has been renamed as 'Calculations.'

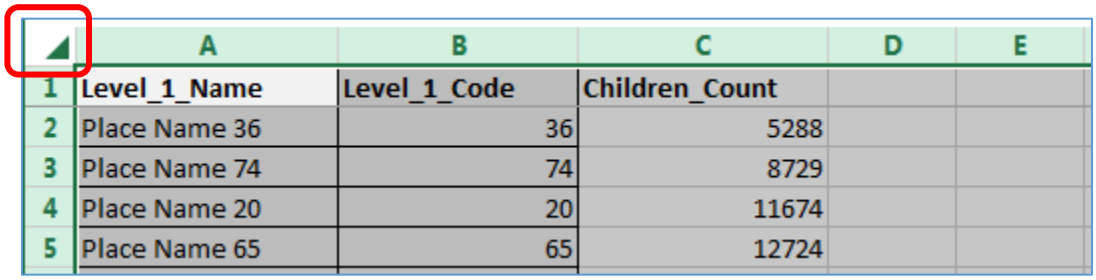


37	Place Name 36	36
38	Place Name 37	37
39	Place Name 38	38
40	Place Name 39	39

Sheet1 Calculations

READY

   c. Click on 'Sheet1' to make it the active sheet, then click once on the triangle adjacent (in the upper left corner) to cell 'A1'. This will select the entire worksheet. Right click in the same location, then click 'Copy' from the menu.



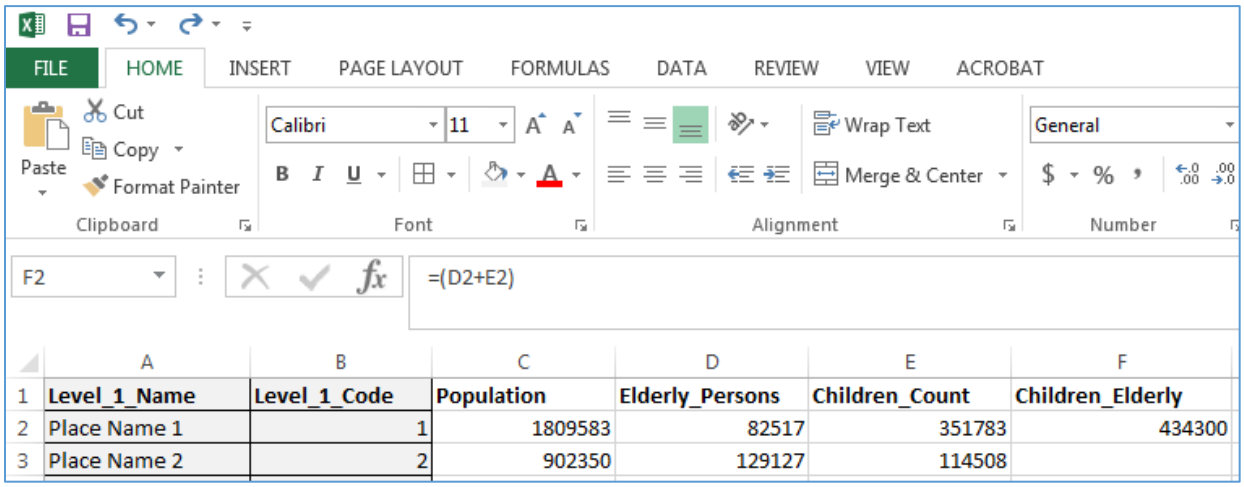
	A	B	C	D	E
1	Level_1_Name	Level_1_Code	Children_Count		
2	Place Name 36	36	5288		
3	Place Name 74	74	8729		
4	Place Name 20	20	11674		
5	Place Name 65	65	12724		

   d. Click on the 'Calculations' worksheet to make it the active sheet, click once on the triangle adjacent to cell 'A1' just as you did to copy in 'Sheet1' (you can alternatively click in cell 'A1') then right click and choose paste as 'Values (V).'

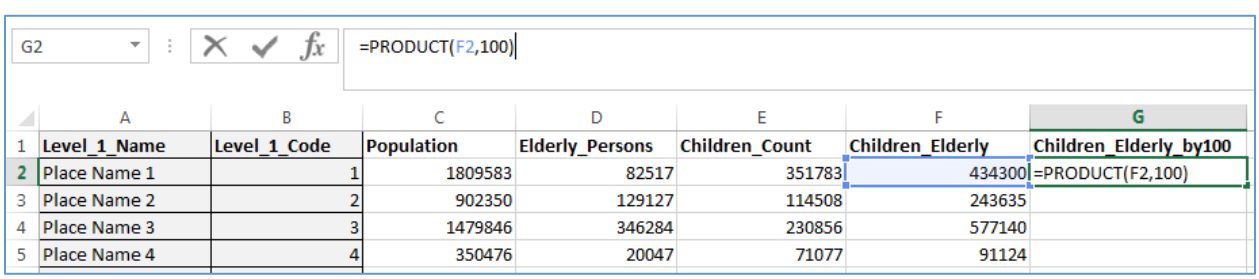
2. **Performing Calculations in Excel:** To obtain the percentage of the population per administrative unit that are children and elderly, you will need to first add the number of elderly persons with the number of children per admin unit. You will then multiply the sum by 100, and divide the resulting product by the population for each admin unit. If you are confident in using the formula functions in Excel, go ahead and perform the calculations described above.

For those new to using formulas in Excel, a step-by-step procedure is outline below. These steps illustrate two approaches to performing calculations in Excel.

a. The first calculation will add values in columns D and E for each admin unit. Create a field name in cell F1 that is descriptive, brief and clear. In the example below, the new field is 'Children_Elderly.'
b. Click in cell F2, and then in the 'Formula Bar' (denoted by *fx*). It is here that you will enter the calculation to be performed on the data in cells D2 and E2.
c. Enter the 'equals' (=) sign followed by a left parenthesis, click cell D2, insert a 'plus' (+) sign in the 'Formula Bar' window, click on cell E2, add the right parenthesis, and click 'Enter' on your keyboard. The sum of D2 plus E2 now appears in cell F2.



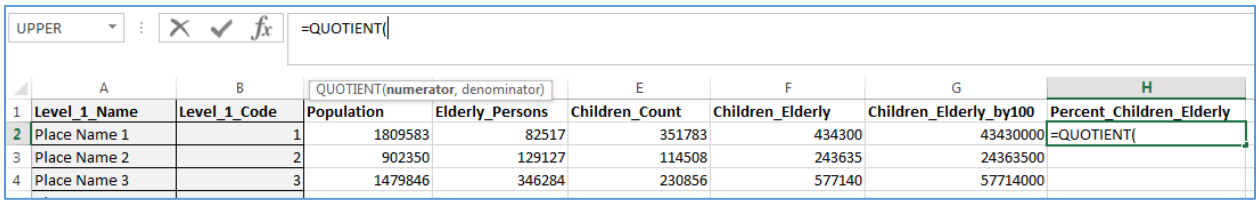
d. To quickly and easily copy this function to other cells in the same column, click on cell F2. Hover your mouse cursor over the lower right-hand corner of cell F2 until a plus '+' sign appears. Click the plus sign, and drag down the length of column F. The cells in column F should now contain sums of the corresponding values from columns D and E.
e. The second calculation will multiply the values in column F by 100. Create a descriptive field name in cell G1, such as 'Children_Elderly_by100.'
f. Click in cell G2, then in the 'Formula Bar.'
g. Enter the 'equals' sign (=) and start typing 'PRO.' The 'PRODUCT' function will appear in a list. Double-clicking on the word 'PRODUCT' will automatically insert this function and a left parenthesis. Click cell F2, insert a comma, and type 100. Add the right parenthesis, and click 'Enter.' The cell G2 now contains the product of cell F2 multiplied by 100.



h. Just as you did in step 2d above, copy the function in cell G2 down the length of the column.

i. The final calculation for this dataset will divide the values in column G by the Population values in column C. To begin, create a field name in cell H1 called 'Percent_Children_Elderly.'

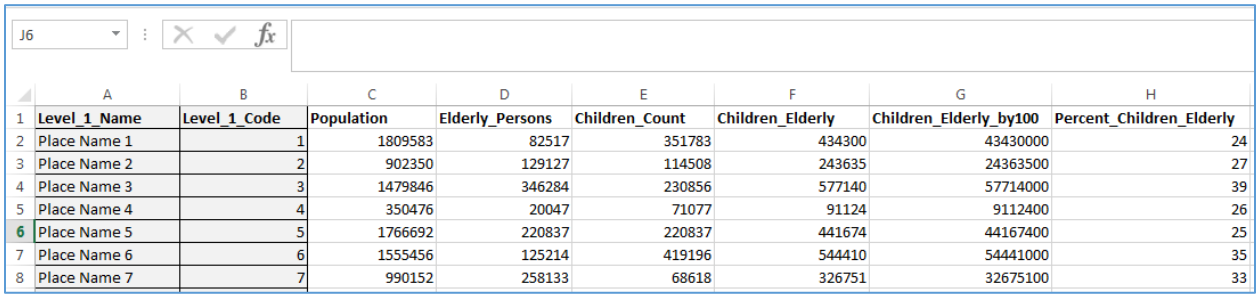
j. Click in cell H2, then in the 'Formula Bar.' Enter the 'equals' sign (=) and type the letters 'QU.' The 'QUOTIENT' function will appear in a list. Double-clicking on the word 'QUOTIENT' will automatically insert this function and a left parenthesis.



	A	B	C	D	E	F	G	H
1	Level_1_Name	Level_1_Code	Population	Elderly_Persons	Children_Count	Children_Elderly	Children_Elderly_by100	Percent_Children_Elderly
2	Place Name 1	1	1809583	82517	351783	434300	43430000	=QUOTIENT(
3	Place Name 2	2	902350	129127	114508	243635	24363500	
4	Place Name 3	3	1479846	346284	230856	577140	57714000	

k. Notice that you must enter first the 'numerator' followed by the 'denominator.' Click cell G2, insert a comma, then click cell C2. Add the right parenthesis, and click 'Enter.'

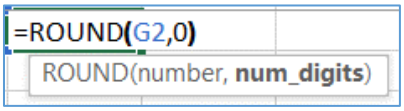
l. As before, copy the function in cell H2 down the length of the column.



	A	B	C	D	E	F	G	H
1	Level_1_Name	Level_1_Code	Population	Elderly_Persons	Children_Count	Children_Elderly	Children_Elderly_by100	Percent_Children_Elderly
2	Place Name 1	1	1809583	82517	351783	434300	43430000	24
3	Place Name 2	2	902350	129127	114508	243635	24363500	27
4	Place Name 3	3	1479846	346284	230856	577140	57714000	39
5	Place Name 4	4	350476	20047	71077	91124	9112400	26
6	Place Name 5	5	1766692	220837	220837	441674	44167400	25
7	Place Name 6	6	1555456	125214	419196	544410	54441000	35
8	Place Name 7	7	990152	258133	68618	326751	32675100	33

Congratulations! You have just learned how to combine multiple datasets using Excel and perform calculations to derive a new dataset. Two methods for performing calculations were demonstrated here. In the first example, you manually spelled out the calculation to be performed. In the second and third, you used the 'PRODUCT' and 'QUOTIENT' functions. As you become more practiced with the functions in Excel, you will find ways to refine and/or combine calculations and accomplish the same results in fewer steps.

A Note on Rounding: Based on the number of significant digits, your answers may vary slightly from the example provided above. Excel allows you to permanently round any value to a specified number of decimal places using the ***ROUND*** function. To use the ***ROUND*** function, simply type ***=ROUND([cell to be rounded], [desired number of decimal places])***. In the example below, we are rounding **cell G2** to **zero decimal places**.



TASK 3: PREPARING DATA FOR USE IN A GIS

Three additional steps are required before this dataset is ready for integration into a geographic information system (GIS) such as ArcMap. You must convert cell contents from formulas to values, address missing values, and perform a quick formatting check to ensure that the data can be easily integrated into GIS.

1. **Convert Cell Contents from Formulas to Values:** Converting cell contents from formulas to values is quick and easy. Two ways of accomplishing this are described here. If you'd like to maintain the worksheet with all calculations that have been performed (a good QAQC practice), select the data in the 'Calculations' worksheet, and click 'Copy.' Add a new worksheet to your workbook. Click in cell A1 in the new worksheet, then right click and paste the data as 'Values (V).' All formulas will be removed.

   There are times when it may not be necessary to preserve formulas. In these cases, you can convert cells with formulas to cells with values by selecting a column, right-click and choose 'Copy,' right-click again and choose 'Paste' as 'Values.' The column will now contain values only.

2. **Address Missing Values:** You will have noticed that values for the number of children and the number of elderly persons are missing for five administrative units. As a result, calculations for these admin units were not possible, and cells in column H show a 'Divide by Zero Error.'

   It is helpful to identify missing data by assigning these a value that is unquestionably distinct, such as '-9999' or '-8888.' This can be done prior to integrating the data into GIS, or afterwards. **Important:** If further calculations or statistics will be performed using these data, it is best to leave cells with missing data blank at this point.

3. **Prepare Data for GIS Integration:** Once the initial processing of indicators is complete, a number of steps are necessary to ensure that the data that you have been processing are ready for GIS integration.
   a. Make sure that when initial processing was completed, data was copied as 'Values' into a new "GIS ready" worksheet.
   b. Some GIS tools have limits as to the number of characters in field (column) headings, and rules regarding syntax. For example, field headings must begin with letters only, and include underbars instead of spaces. Shapefiles have a 10-character limit for field headings, so you may need to truncate headings while at the same time maintaining as much clarity as possible.
   c. Another thing to consider is the order of appearance of fields. How will it display in an attribute table? Is the derived dataset (e.g., *Percentage of Children and Elderly*) prominently featured? You will most likely need to remove some of the fields created during data processing steps. The image below shows the "GIS ready" form of the data processed for

this indicator. Notice that field headings have been abbreviated to 10 or fewer characters, several columns have been removed, and the order of field headings has been modified so that 'ChildElder' (representing the *Percentage of Children and Elderly*) appears immediately following the 'PlaceCode.' Data for 'Population,' 'Elderly' and 'Children' have been retained for reference purposes. Note also that cells with missing data have been assigned '-9999' values. Recall that cells with missing data are best left blank if additional calculations will be performed on the dataset so as not to introduce any errors.

	A	B	C	D	E	F
1	**PlaceName**	**PlaceCode**	**ChildElder**	**Population**	**Elderly**	**Children**
2	Place Name 1	1	24	1809583	82517	351783
3	Place Name 2	2	27	902350	129127	114508
4	Place Name 3	3	39	1479846	346284	230856
5	Place Name 4	4	26	350476	20047	71077
6	Place Name 5	5	25	1766692	220837	220837
7	Place Name 6	6	35	1555456	125214	419196
8	Place Name 7	7	33	990152	258133	68618
9	Place Name 8	8	31	1904590	495955	94468
10	Place Name 9	9	25	161571	27725	14283
11	Place Name 10	10	46	959112	145593	295599
12	Place Name 11	11	30	1493788	273214	189860
13	Place Name 12	12	38	437404	54851	111363
14	Place Name 13	13	41	1083285	75505	368642
15	Place Name 14	14	-9999	339390	-9999	-9999

d. Take a few minutes to review the data and check for any errors that may have been introduced.
e. Finally, to overcome issues regarding compatibility, convert the Excel (.xlsx) file that you've been working with into an Excel 97-2003 Workbook (.xls) using the 'File' -> 'Save As' option in Excel.

It is important that all data processing steps are recorded for the purposes of creating metadata. A good practice is to summarize information about the data in a new worksheet so that these notes are readily accessible. Useful information to record includes: the data source (including web link or other reference), the date the data was downloaded or obtained, format of the data, calculations performed, year in which the data was collected, a brief description of each field, etc.

TASK 4: TEST YOUR KNOWLEDGE

The following task provides an opportunity for you to test the skills you've just learned in working with secondary data. Abbreviated instructions (below) will walk you through the steps of processing two additional indicators: *Physicians per 10,000 Persons* and *Nurses per 10,000 Persons*. If at any point you need more detailed instructions, refer back to Exercise 1, Tasks 1 through 3.

1. Locate the 'Exercise 1' → '1_TestYourKnowledge' folder and open the following three datasets: Population, Number of Physicians, and Number of Nurses. Sort each dataset by 'Level_1_Code' and copy data into a new Excel file. Sheet 1 in the new Workbook should contain data for:

   Level_1_Name
   Level_1_Code
   Population
   Physicians
   Nurses

2. Copy the contents of Sheet 1 into a new worksheet. Recall that you can rename worksheets to more easily distinguish between them. In the example below, Sheet 1 has been renamed 'Data' and Sheet 2 has been renamed 'Calculations.'

	A	B	C	D	E
1	Level_1_Name	Level_1_Code	Population	Physicians	Nurses
2	Place Name 1	1	1809583	724	9410
3	Place Name 2	2	902350	1173	4512
4	Place Name 3	3	1479846	2960	8583
5	Place Name 4	4	350476	280	210
6	Place Name 5	5	1766692	1060	2650
7	Place Name 6	6	1555456	1089	11355
8	Place Name 7	7	990152	396	2970
9	Place Name 8	8	1904590	2286	11428
10	Place Name 9	9	161571	194	113
11	Place Name 10	10	959112	0	5467
12	Place Name 11	11	1493788	2390	8365

3. Derive the number of *Physicians per 10,000 Persons.* You will need to perform a few calculations.
   a. First, multiply the number of doctors by 10,000. In cell F2, enter the formula to multiply the number of physicians (D2) by 10,000. In this example, a simpler equation was entered into the formula window (=D2*10000). Copy the formulas down the length of each column and check for errors.

F2 =D2*10000

	A	B	C	D	E	F
1	Level_1_Name	Level_1_Code	Population	Physicians	Nurses	Physicians_by_10000
2	Place Name 1	1	1809583	724	9410	7240000
3	Place Name 2	2	902350	1173	4512	
4	Place Name 3	3	1479846	2960	8583	
5	Place Name 4	4	350476	280	210	
6	Place Name 5	5	1766692	1060	2650	

   b. Divide the resulting product by the population. In cell G2, divide contents of F2 by the Population (C2). In this example, a simpler equation was entered into the formula window (=F2/C2). Copy the formulas down the length of each column and check for errors.

G2 =F2/C2

	A	B	C	D	E	F	G
1	Level_1_Name	Level_1_Code	Population	Physicians	Nurses	Physicians_by_10000	Physicians_Per_10k
2	Place Name 1	1	1809583	724	9410	7240000	4
3	Place Name 2	2	902350	1173	4512		
4	Place Name 3	3	1479846	2960	8583		
5	Place Name 4	4	350476	280	210		
6	Place Name 5	5	1766692	1060	2650		

4. Repeat Step 3 to derive the indicator for *Nurses per 10,000 Persons.*
5. When all calculations have been performed, copy the 'Calculations' worksheet into a new worksheet, remembering to Paste as 'Values (V).' Use this worksheet to finalize the data for GIS integration. As necessary:
    a. Remove extraneous data fields
    b. Adjust field names
    c. Adjust field order
    d. Check for missing values

The image below shows a snapshot of a "GIS ready" worksheet. Field names have been truncated, and the field order prominently displays the derived indicators.

	A	B	C	D
1	Level_1_Name	Level_1_Code	Phys_10k	Nurs_10k
2	Place Name 1	1	4	52
3	Place Name 2	2	13	50
4	Place Name 3	3	20	58
5	Place Name 4	4	8	6
6	Place Name 5	5	6	15
7	Place Name 6	6	7	73
8	Place Name 7	7	4	30
9	Place Name 8	8	12	60
10	Place Name 9	9	12	7
11	Place Name 10	10	0	57
12	Place Name 11	11	16	56

Data | Calculations | GISReady

Ready

6. Take a few minutes to summarize the data processing steps just completed in a new 'Metadata' worksheet.
7. Finally, convert the Excel (.xlsx) file that you've been working with into an Excel 97-2003 Workbook (.xls) using the 'File' -> 'Save As' option in Excel. The data in your 'GISReady' worksheet can now be easily integrated into GIS.

CONSTRUCTING INDICES

EXERCISE 2: INDICATOR PREPARATION AND SCALING

OBJECTIVE

This exercise will demonstrate the steps required to prepare derived indicators for composite index construction. Participants will take a collection of derived indicators through the process of normalization (or scaling), compression, and ensuring consistent conceptual direction, to create a final indicator score. These steps can be applied to create a complete set of indicators that are polished and ready to be used to construct the Vulnerability Index, one of the component indices of the Societal Risk Index. Similar steps can also be applied to prepare indicators for construction of the Multi-hazard Exposure and Disaster Risk Management Capacity Indices.

MATERIALS

This exercise requires the use of Microsoft Excel. Instructors will provide two Excel Workbooks:

- **Exercise_2_Sample_Data.xlsx**: This file contains sample data and descriptions for 26 vulnerability indicators
- **ASEAN_RVA_Template.xlsx**: This Excel Workbook is designed as a guide through the process of Index Construction for the ASEAN Risk and Vulnerability Assessment (RVA). It provides field names, descriptions, examples, and templates that will be used throughout the training and exercises.

Please do not hesitate to ask the instructors for help as you navigate this exercise.

INSTRUCTIONS

TASK 1: GETTING FAMILIAR WITH THE INDICATORS

1. Make a copy of the Excel file "Exercise_2_Sample_Data.xlsx" file to work from. This is good practice and ensures that you can access the original data should any error occur.

2. Open your copy of "Exercise_2_Sample_Data.xlsx" – The table contains the sample data that has already been derived for you. The file contains two worksheets:

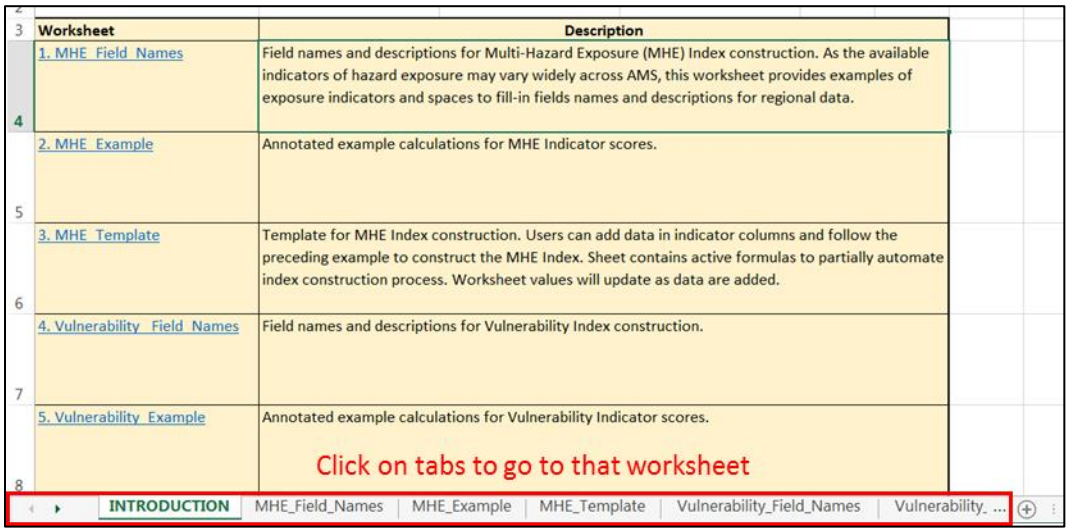
    a. **Indicator_Descriptions**: Contains field names and descriptions for the 26 indicators representing various dimensions of vulnerability

    b. **Vulnerability_Indicators**: Contains the derived sample indicators which will be used to construct the Vulnerability Index. These indicators will be copied and pasted into your copy of the ASEAN_RVA_Template.xlsx to be scaled and prepared for index construction.

TASK 2: GETTING FAMILIAR WITH THE TEMPLATE

1. Make a copy of the Excel Workbook "ASEAN_RVA_Template.xlsx" to work from. You may want to add your initials to the end of the file name to easily distinguish between the two.

    a. Open your copy of "ASEAN_RVA_Template.xlsx" – This Workbook provides comprehensive guidance for construction of the ASEAN Risk and Vulnerability Assessment (RVA). This file contains 10 worksheets or "tabs". The first worksheet, entitled **INTRODUCTION**, provides a basic overview of the workbook and a "Table of Contents." Users can navigate between worksheets by using the links in the table of contents, or click on the corresponding tab at the bottom of the screen (see image below)



Worksheet	Description
1. MHE_Field_Names	Field names and descriptions for Multi-Hazard Exposure (MHE) Index construction. As the available indicators of hazard exposure may vary widely across AMS, this worksheet provides examples of exposure indicators and spaces to fill-in fields names and descriptions for regional data.
2. MHE_Example	Annotated example calculations for MHE Indicator scores.
3. MHE_Template	Template for MHE Index construction. Users can add data in indicator columns and follow the preceding example to construct the MHE Index. Sheet contains active formulas to partially automate index construction process. Worksheet values will update as data are added.
4. Vulnerability_Field_Names	Field names and descriptions for Vulnerability Index construction.
5. Vulnerability_Example	Annotated example calculations for Vulnerability Indicator scores.

2. Briefly explore the worksheets. An annotated example of indicator preparation and scaling for the vulnerability indicators is provided in the **Vulnerability_Example** worksheet.

3. For this exercise, we will be using the **Vulnerability_Template** worksheet. Columns are provided for you to copy and paste derived indicators. Each indicator will be normalized, checked for compression, and reviewed for conceptual direction (processes detailed below). Each step in the processing of each indicator will take place in a separate column. Field names and descriptions for each column are provided in the **Vulnerability_Field_Names** worksheet. Columns are also color-coded for the purposes of organization:

Indicators
Scaled and Compressed Indicators
Indicator Scores and Ranks
Sub-index Scores and Ranks
Sub-component Index Scores and Ranks
Component Index Scores and Ranks

a. **Note:** The template and example worksheets contain active formulas to partially automate indicator preparation and index construction, therefore some fields will update automatically. These formulas are designed to help you and will be described in the following sections. **IMPORTANT! Care should be taken not to change or delete existing formulas.**

TASK 3: ENTER DERIVED INDICATORS INTO THE TEMPLATE

1. In the **Vulnerability_Template** worksheet, the first gold column, "**ChildElder**" refers to the derived indicator representing the % of population that are children or elderly. The derived data that will populate this column are provided in the **Vulnerability_Indicators** worksheet in the **"**Exercise_2_Sample_Data.xlsx" file:

Vulnerability_Template

Level1Name	Level1Code	ChildElder	ChEldScale	ChEldCompr	ChEldScore
Place Name 1	Place Code 1		-1.500		
Place Name 2	Place Code 2		-1.500		
Place Name 3	Place Code 3		-1.500		
Place Name 4	Place Code 4		-1.500		
Place Name 5	Place Code 5		-1.500		
Place Name 6	Place Code 6		-1.500		
Place Name 7	Place Code 7		-1.500		
Place Name 8	Place Code 8		-1.500		
Place Name 9	Place Code 9		-1.500		
Place Name 10	Place Code 10		-1.500		
Place Name 11	Place Code 11		-1.500		
Place Name 12	Place Code 12		-1.500		
Place Name 13	Place Code 13		-1.500		
Place Name 14	Place Code 14		-1.500		
Place Name 15	Place Code 15		-1.500		
Place Name 16	Place Code 16		-1.500		
Place Name 17	Place Code 17		-1.500		
Place Name 18	Place Code 18		-1.500		
Place Name 19	Place Code 19		-1.500		
Place Name 20	Place Code 20		-1.500		
Place Name 21	Place Code 21		-1.500		
Place Name 22	Place Code 22		-1.500		
Place Name 23	Place Code 23		-1.500		
Place Name 24	Place Code 24		-1.500		
Place Name 25	Place Code 25		-1.500		
Place Name 26	Place Code 26		-1.500		
Place Name 27	Place Code 27		-1.500		
Place Name 28	Place Code 28		-1.500		

... | MHE_Example | MHE_Template | Vulnerability_Field_Names | Vulnerability_Example | V

Vulnerability_Indicators

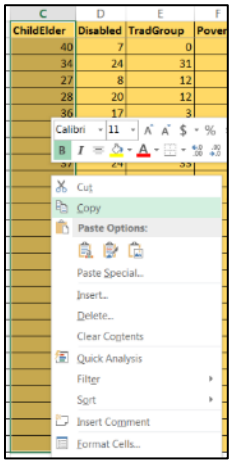
Level_1_Name	Level_1_Code	ChildElder	Disabled	TradGroup
Place Name 1	1	24	17	26
Place Name 2	2	27	9	39
Place Name 3	3	39	12	27
Place Name 4	4	26	27	19
Place Name 5	5	25	16	29
Place Name 6	6	35	10	15
Place Name 7	7	33	13	15
Place Name 8	8	31	21	13
Place Name 9	9	26	7	8
Place Name 10	10	46	9	11
Place Name 11	11	31	5	20
Place Name 12	12	38	13	11
Place Name 13	13	41	15	17
Place Name 14	14	NoData	15	13
Place Name 15	15	27	4	21
Place Name 16	16	25	9	28
Place Name 17	17	38	19	16
Place Name 18	18	24	21	27
Place Name 19	19	36	13	32
Place Name 20	20	40	7	4
Place Name 21	21	NoData	5	8
Place Name 22	22	38	19	29
Place Name 23	23	43	17	4
Place Name 24	24	27	9	21
Place Name 25	25	38	17	30
Place Name 26	26	39	20	35
Place Name 27	27	32	25	20
Place Name 28	28	33	6	30

Indicator_Descriptions | Vulnerability_Indicators

2. Inside the **Vulnerability_Indicators** worksheet, carefully ***click and drag*** to select all of the data in the "ChildElder" Column. Once selected, right-click and select ***Copy.***

3. Now open the **Vulnerability_Template** worksheet, right-click the first cell in the "**ChildElder**" Column, and select ***Paste***.

4. Notice that the values in the adjacent column "**ChEldScale**" have automatically updated. Next, we will explore the calculation that occurs in this column.



TASK 4: INDICATOR SCALING

1. Indicators used to construct themes of the Vulnerability Index represent different concepts and have inconsistent units, ranges, and scales. In order to make meaningful comparisons between datasets, and combine them to create a single composite index score, indicator values must be standardized. To do this, we use Min-Max Normalization to re-scale indicator values between 0 and 1, using the following equation:

$$\frac{(observed\ indicator\ value\ - AMS\ indicator\ minimum\ value)}{(AMS\ indicator\ maximum\ value\ - AMS\ indicator\ minimum\ value)}$$

   a. This equation is being calculated for you in the adjacent column, "**ChEldScale**". If you click on a cell in this column, you can view the equation used to calculate the scaled value in Excel's "Formula Bar."

2. Minimum and maximum values are provided and can be viewed by scrolling to the bottom of the worksheet. **NOTE**: Min and Max values are intended to represent reasonable best case and worst case scenarios across the region and were developed based on national level data. They are <u>not</u> intended to capture the full range of conditions within the region, nor are they intended to be specific to one ASEAN Member State. Therefore, data for some provinces at the very high end or very low end will fall outside the given range.

   a. Values that fall outside the given range are highlighted in red in the **ChEldScale** Column.

   b. For Example, in **Row 93**, you see that the value of **45% Children and Elderly** falls outside the range of **24 to 40%**. Consequently, the scaled value is greater than 1.

   c. Since scaled values must fall between 0 and 1, any values outside this range must be compressed. We will explore compression in the next task.

	A	B	C	D
1	**Level1Name**	**Level1Code**	**ChildElder**	**ChEldScale**
93	Place Name 92	Place Code 92	45	1.313
94	Place Name 93	Place Code 93	24	0.000
95	Place Name 94	Place Code 94	30	0.375
96	Place Name 95	Place Code 95	37	0.813
97	Place Name 96	Place Code 96	38	0.875
98	Place Name 97	Place Code 97	37	0.813
99	Place Name 98	Place Code 98	33	0.563
100	Place Name 99	Place Code 99	35	0.688
101	Place Name 100	Place Code 100	27	0.188
102				
103	**Mean**		32.800	
104	**Std. Dev.**		6.070	
105	**ASEAN Min.**		24	
106	**ASEAN Max**		40	

Note: Some Provinces may have missing values. These cases are shown in the dataset as "NoData." NoData values cannot be scaled. In the Case of NoData, simply ***type*** **"NoData"** in the ***Scale*** (***ChEldScale***) column and continue with the exercise.

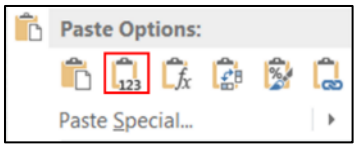
TASK 5: INDICATOR COMPRESSION

1. Scroll up and down to review all of the normalized values in the **ChEldScale** column. A total of 12 provinces have values that fall outside the 0 to 1 range. These cells are highlighted in red.

2. These values must be manually *compressed*:

    a. ***Copy*** the ***scaled values*** from the **ChEldScale** column to the "**ChEldCompr**" column.

    b. **IMPORTANT:** When you ***paste*** the data, be sure to select the "***Paste Values***" option (shown in the graphic). If you do not select paste values, formulas from the **ChEldScale** column will be pasted – This is not what we want.



    c. Again, values outside the 0 to 1 range will be highlighted.

        i. **To compress these values**:

            1. Assign a value of 1 where the scaled values are greater than 1.

            2. Assign a value of 0 where scaled values are less than 0.

            3. As you replace these values, the cells will no longer be highlighted, as shown below:

Scaled Value

Derived Value

Compressed Value

	A	B	C	D	E
1	**Level1Name**	**Level1Code**	**ChildElder**	**ChEldScale**	**ChEldCompr**
5	Place Name 4	Place Code 4	26	0.125	0.125
6	Place Name 5	Place Code 5	25	0.063	0.063
7	Place Name 6	Place Code 6	35	0.688	0.688
8	Place Name 7	Place Code 7	33	0.563	0.563
9	Place Name 8	Place Code 8	31	0.438	0.438
10	Place Name 9	Place Code 9	26	0.125	0.125
11	Place Name 10	Place Code 10	46	1.375	1.000
12	Place Name 11	Place Code 11	31	0.438	0.438
13	Place Name 12	Place Code 12	38	0.875	0.875
14	Place Name 13	Place Code 13	41	1.063	1.000

TASK 6: ENSURE CONSISTENT CONCEPTUAL DIRECTION

1. In this analysis, the aim is to emphasize areas with high vulnerability. In order to do this, a value of "0" needs to consistently represent relatively better conditions (**Low vulnerability**) and a value of "1" needs to consistently represent relatively worse conditions (**High Vulnerability**).

2. However, for some indicators, higher values may represent better conditions and lower vulnerability. For example, consider the following indicators where <u>higher</u> values indicate <u>lower</u> vulnerability:

    a. % Literacy

    b. Hospital beds per 10,000 persons

    c. Access to improved water source

3. In these cases, it is necessary to reverse or "reflect" the directionality of the indicator by **subtracting the normalized (and compressed) value from 1.**

4. NOT all indicators require this reflection. ***Ask yourself: As the Indicator value increases, does vulnerability increase or decrease?***

5. In the case of **ChildElder**, as the percentage of the population that are children and elderly <u>increases</u>, vulnerability also <u>increases</u>. This represents a conceptual match. The indicator does NOT need to be reflected.

6. Since the indicator does <u>not</u> need to be reflected, the compressed value represents the final indicator score. Values from the **ChEldCompr** column can simply be copied and pasted (***Paste Values***) into the "**ChEldScore**" column.

	A	B	C	D	E	F
1	**Level1Name**	**Level1Code**	**ChildElder**	**ChEldScale**	**ChEldCompr**	**ChEldScore**
2	Place Name 1	1	24	0.000	0.000	0.000
3	Place Name 2	2	27	0.188	0.188	0.188
4	Place Name 3	3	39	0.938	0.938	0.938
5	Place Name 4	4	26	0.125	0.125	0.125
6	Place Name 5	5	25	0.063	0.063	0.063

7. In cases where the final indicator score needs to be reflected, simply calculate the score by subtracting the compressed value from 1, as shown below for ***Access to Improved Water*** (you will process this indicator later).

	BU	BV	BW	BX
1	**ImpWater**	**WaterScale**	**WaterCompr**	**WaterScore**
2	72	0.097	0.097	=1-BW2

8. When computing the reflected score, copy and paste the **formula** into all rows in the **Score** column (this time ***<u>do not</u>*** choose *Paste Values*). Examples of reflected indicator scores for ***Access to Improved Water*** are provided below:

	BU	BV	BW	BX
1	**ImpWater**	**WaterScale**	**WaterCompr**	**WaterScore**
2	72	0.097	0.097	0.903
3	73	0.129	0.129	0.871
4	86	0.548	0.548	0.452
5	92	0.742	0.742	0.258
6	75	0.194	0.194	0.806
7	92	0.742	0.742	0.258
8	70	0.032	0.032	0.968
9	75	0.194	0.194	0.806
10	70	0.032	0.032	0.968
11	70	0.032	0.032	0.968
12	73	0.129	0.129	0.871
13	79	0.323	0.323	0.677
14	62	-0.226	0.000	1.000

Where reflection is necessary to ensure conceptual match:
Reflected Indicator =
(1 - Compressed Value)

9. A final consideration for the indicator score is dealing with missing values. As noted above, **NoData** values cannot be scaled, and therefore will not be scored or ranked. Simply copy all '**NoData**' values through the Scale, Compression and Score columns. The rank equation will ignore these cells.

10. After finalizing the indicator scores, rankings will automatically appear in the adjacent column. Remember – since we scaled and compressed the indicators using Min and Max values based on data for the region, multiple areas may display the same rank at the top and bottom of the distribution. **This is ok** – It is a result of indicator compression.

Level1Code	ChildElder	ChEldScale	ChEldCompr	ChEldScore	ChEldRank
10	46	1.375	1.000	1.000	1
11	31	0.438	0.438	0.438	56
12	38	0.875	0.875	0.875	20
13	41	1.063	1.000	1.000	1

TASK 7: PREPARE AND SCALE THE REMAINING INDICATORS

1. Follow Tasks 3 through 6, entering the remaining derived indicators from "**Exercise_2_Sample_Data.xlsx"** workbook into the template. Remember to carefully consider the conceptual match for each indicator. For clarification, refer to the field descriptions, provided in both Excel Workbooks.

EXERCISE 3: INDEX CREATION

OBJECTIVE

This exercise builds on Exercise 2: Indicator Preparation and Scaling, using indicator scores to construct thematic sub-indices and sub-component indices that comprise the Vulnerability Index. The hierarchical approach to RVA allows users to build concepts upwards, developing indices that have distinct implications for disaster risk reduction.

This exercise will result in a better understanding of the composite index aggregation process, which combines multiple datasets to represent the larger, multidimensional concept of disaster vulnerability. Though much of the aggregation process has been automated, users will review and explore index development from normalized indicators through construction of a component index.

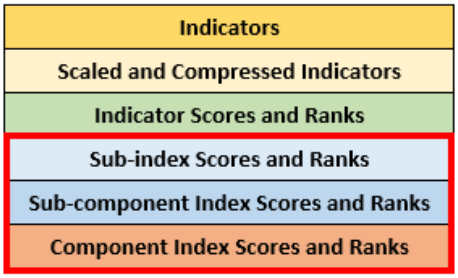
MATERIALS

This exercise requires the use of Microsoft Excel. Participants will continue using their copy of the template provided in the previous exercise:

- **ASEAN_RVA_Template.xlsx:** This Excel Workbook is designed as a guide through the process of Index Construction for the ASEAN Risk and Vulnerability Assessment (RVA). It provides field names, descriptions, examples, and templates that will be used throughout the training and exercises.

INSTRUCTIONS

TASK 1: EXPLORING COMPOSITE INDEX AGGREGATION



1. Index creation includes three levels of indices: component, sub-component, and sub-index. Each sub-index and sub-component index is made up of a varying number of indicators.

2. Indices are computed by calculating the arithmetic mean of the scaled scores of the contributing indicators:

    a. **Sub-index scores** = average of indicator scores

        i. **Note**: The Vulnerability Index Includes only 2 sub-indices

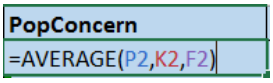
    b. **Sub-component index scores** = average of sub-index (or indicator) scores

    c. **Component index scores** = average of sub-component index scores

3. ***Open*** your copy of **Vulnerability_Template** Worksheet and ***scroll right*** until you reach the first light blue column, "**PopConcern**"

4. This column represents the **Sub-component Index Score** for **Populations of Concern**

    a. ***Click*** on the first cell of data in this column to reveal the calculation:



    b. ***Question: Which Indicator scores are being averaged in this subcomponent?***

5. ***Scroll Right*** until you reach the next light blue column.

    a. ***Question: What is the next subcomponent index? Which Indicators are Included?***

6. The next light blue column, **HOutcome** is the first of two **Sub-Indices** of the **Health Sub-component Index**

    a. ***Question: How is the Health Sub-component Index, "HlthIndex" calculated?***

7. Continue exploring the subcomponents to examine the thematic hierarchy of the Vulnerability Index. Finally, scroll all the way to the right of the table and examine the Vulnerability Index, "**VIndex.**" Here, all the thematic sub-component scores are combined to represent the characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard.

TASK 2: DEALING WITH MISSING VALUES IN INDEX CONSTRUCTION

1. While index construction in mostly automated in the template, users must take care to check for missing data values and omit these observations from the index calculations.

2. For example, the **ChildElder Indicator** has missing values in five Provinces. Consequently, the calculations for the **Populations of Concern Subcomponent Index**, "**PopConcern**" should EXCLUDE this indicator when taking the arithmetic mean in these Provinces.

    a. To exclude the Indicator, click on the corresponding cell in the "**PopConcern**" column to view the calculation, and ***Delete*** the reference cells that contain **NoData**.

    b. For example, the **Indicator Score** for **ChildElder** is in **Column F**. If **Row 15** Contains the missing data, **cell F15** should be deleted from the **PopConcern** Subcomponent Index:

c. Users must do this manually. Every cell in the index column should be carefully checked to ensure that cells containing Missing Data are excluded from the index calculations.

3. **This raises an <u>important question</u>:**

If I've removed the indicator, can I still calculate the Sub-index, Sub-component and Component Index Scores for those Provinces?

4. While there are no concrete rules to help answer this question, we offer the following general guidance:

    a. If an index calculation is missing data for only **one indicator**, proceed in calculating the index.

        i. In the example above, the Populations of Concern Sub-component Index only had missing values for one indicator – Children and Elderly – so we were able to calculate the index.

    b. However, it is important to ***Document*** all missing data:

        i. Note all provinces with missing data

        ii. Note which indicators are missing

        iii. Note which sub-indices, sub-components, and component indices are affected.

    c. If an index calculation is missing data for <u>more than one</u> indicator, **<u>do not calculate the index</u>**.

USING THE TEMPLATE TO CALCULATE INDICES FOR YOUR MEMBER STATE

Aside from these exercises, the provided template can be used to calculate Component Indices (Multi-Hazard Exposure, Vulnerability, and DRMC), as well as Risk and Lack of Resilience Indices, using real data with minimal adjustments. Rows can be removed **from the <u>bottom</u> of the worksheets** without affecting index calculation. These exercises can serve as guidance for processing your Member State's data during implementation of the ASEAN RVA Guidelines.

USING GIS IN SUPPORT OF RISK AND VULNERABILITY ASSESSMENTS

EXERCISE 4: GETTING FAMILIAR WITH GIS

Many of you may be familiar with GIS, or even have used a GIS at some time. Though GIS is often used to make maps, it provides a powerful toolset beyond mapmaking. A GIS is a computer based system that helps us create, maintain, store, analyze, display, and distribute spatial data. A GIS seamlessly links coordinate data that locates an object on a map to attribute information that tells us something about it.

GIS data are generally stored in one of two formats, known as vector and raster. Vector data are representations of points, lines, or polygons. Raster maps take a different approach by dividing the map area into a grid of rectangular cells (usually square). Each grid cell has a value attached to it, which may be a categorical value (e.g. land use code), a continuous numeric value (e.g. elevation), a color value (e.g. a single pixel in an aerial photo), or a null value to indicate no data.

OBJECTIVE

This exercise will explore basic GIS functionality and tools using ESRI ArcGIS Desktop. The result will be a better understanding of GIS functions, the ArcGIS Interface, and basic tools to analyze spatial information. ArcGIS Desktop was selected to provide a consistent reference during training. QGIS and other open source options have similar capabilities, but somewhat different interfaces.

MATERIALS

This exercise requires the use of ESRI ArcGIS Desktop. Bundled in the software are three primary applications:

- **ArcMap**: ArcMap allows the user to display and query maps, create quality hardcopy maps and perform many spatial analysis tasks. ArcMap provides an easy transition from viewing a map to editing its spatial features.
- **ArcCatalog**: Allows users to easily access and manage geographic data that is stored in folders on local disks or relational databases that are available on the user's network. Data can be copied, moved, deleted, renamed and quickly viewed before it is added to a map. Metadata can also be viewed and authored in ArcCatalog.
- **ArcToolbox**: Provides a comprehensive collection of tools for performing complex geoprocessing operations, including data alteration and information extraction. ArcToolbox can be accessed from both ArcMap and ArcCatalog.

Instructors will provide the following spatial datasets in the **Exercise_4_Data** Folder:

- **lspop2014_ASEAN.tif:** Raster contains 2011 population estimates with a grid cell size of approximately 1 km.

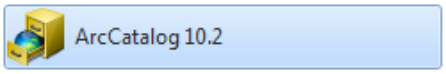
- **Roads.shp:** Shapefile contains major roadways in AMS.
- **seaports.shp:** Shapefile contains major roadways in AMS.
- **stormzones.shp:** Shapefile contains major storm zones across AMS.
- **volcano.shp:** Shapefile contains volcanoes in AMS.
- **Admin0_gaul_asean.shp:** Shapefile contains level 0 administrative boundaries for AMS.
- **Admin1_gaul_asean.shp:** Shapefile contains level 1 administrative boundaries for AMS.
- **Admin2_gaul_asean.shp:** Shapefile contains level 2 administrative boundaries for AMS.

INSTRUCTIONS

TASK 1: DATA MANAGEMENT IN ARCCATALOG

1. ArcCatalog is used for managing your spatial data, creating new datasets, database design, and for creating and managing your metadata. This tool can be accessed in multiple ways, including through the ArcMap application or the "Start" menu on your Desktop.

    a. Start by Clicking your **Start Menu or Desktop Icon** > Go to ArcGIS or Search for **ArcCatalog**> ***Double click*** **ArcCatalog**



Menu & Toolbars

1. The menu options and toolbars share a similar look and feel to the ArcMap desktop application. From here, users are able to launch tools and applications, connect to workspaces, and customize the interface.

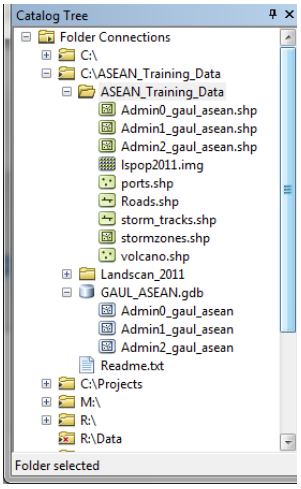
2. From the toolbar, click the "**Connect to Folder Button**" navigate to **ASEAN_RVA_Exercise_4_Data**
3. Using the **Connect to Folder** button allows you to create short-cuts to your workspace.

Catalog Tree

1. The Catalog Tree allows you to organize folders and data, and build project databases on your computer. You can also create empty shapefiles and geodatabases to be edited within ArcMap.

2. Navigate to **ASEAN_RVA_Exercise_4_Data**

3. You will see a list of shapefiles. The .shp extension of the file means that these files are in shapefile format and thus can be read by ArcGIS. Although this is not the only file format ArcGIS can read, it is a popular format and the one we will use for training.



Preview, and Metadata Description

Preview

1. If you select a data source in the catalog tree or **Contents** tab (e.g., ***Admin0_gaul_asean.shp***), you can view it in several ways, depending on the tab that you choose. Each tab has a toolbar associated with it that allows you to modify how you can view your data. You can switch between **Geography** and **Table** at the bottom of the window.

Common Data Formats

GEODATABASE

Geodatabases define, manage, process and store all the types of data that can be used in ArcGIS (i.e., feature, rasters, relationships, attributes, etc)

SHAPEFILES

A shapefile format is a widely adopted format and comprises three or more associated files. Be careful copying this data to a disk. It is recommended you use ArcCatalog or Zip files together when moving across networks.

LAYER

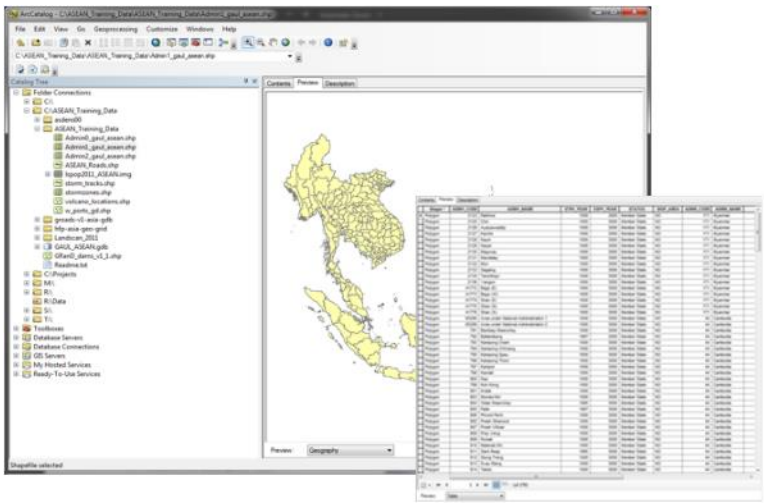
The layer file (.lyr) stores symbology, labeling properties, scale, and other properties that can be moved across ArcMap projects.

RASTER / IMAGE FORMATS

ArcGIS accepts and uses a variety of image and GRID formats

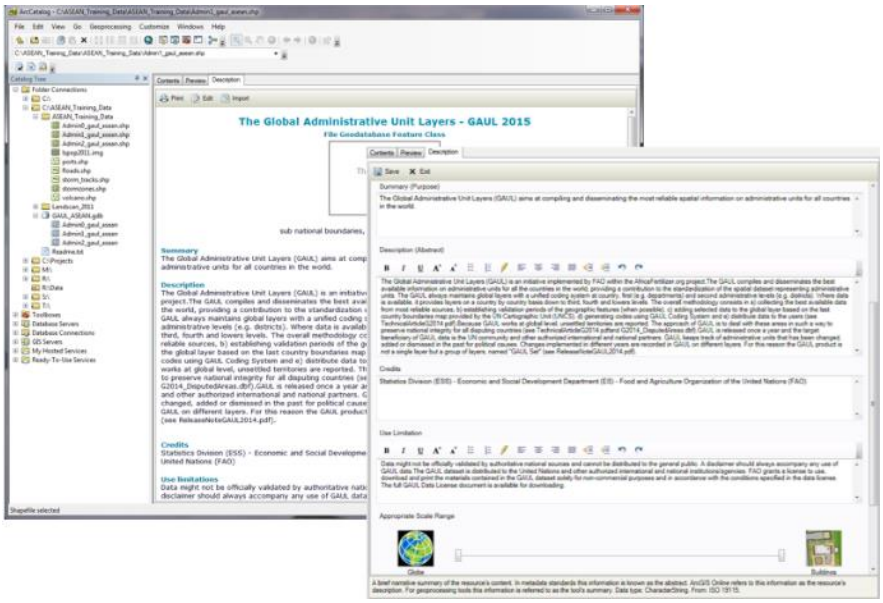
TEXT FILES

ArcMap can view tables in Excel 2007 or earlier, .csv, or.txt formats.



Metadata

1. By clicking on the **Description** tab, you can view Metadata about the dataset if available. You can also easily create, edit and import pre-existing metadata to document information about your datasets.



Launching ArcMap

1. ArcMap is the tool for creating, viewing, querying, editing, composing, and publishing maps. We will open ArcMap through ArcCatalog. You can also launch ArcMap through Desktop icons or the Start Menu.

2. From the Toolbar at the top of ArcCatalog, locate and click on the ArcMap button

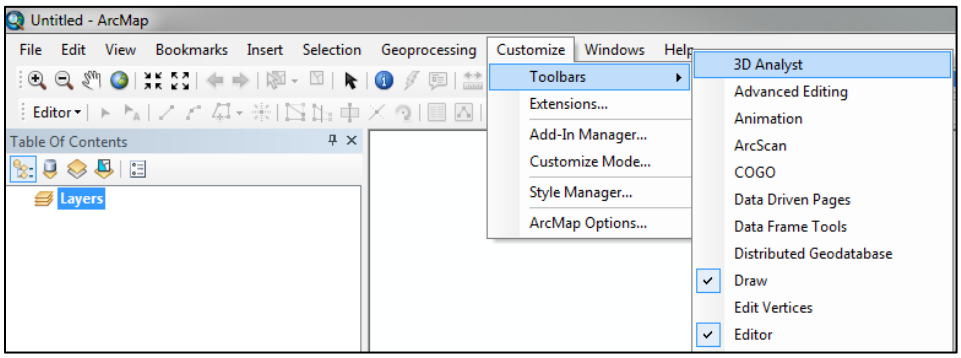
TASK 2: EXPLORING ARCMAP

1. When ArcMap opens, a dialog box may appear highlighting recent project history, or allowing a user to search for a previously saved document.

2. We will be setting up a new project so click "**Cancel**" if prompted with this box.

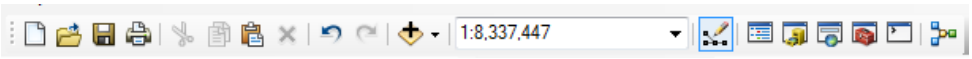
ArcMap Look and Feel

1. The toolbars and windows are customizable to your preference. You can add, remove, and change the location of each by clicking and dragging a toolbar to the desired location. You can add tools by clicking on the **Customize** drop down menu. We will be using the; **Tools**, **Standard**, and **Draw** toolbars

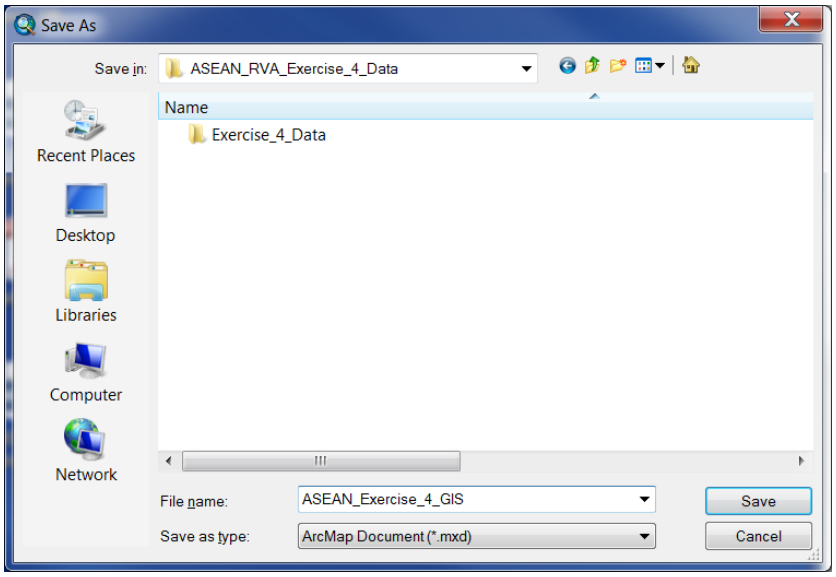


Tool Bars

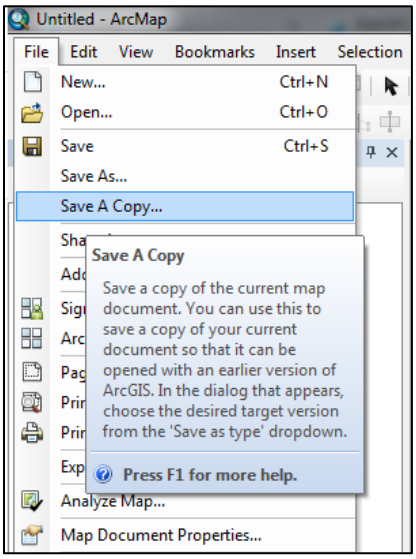
1. The **Standard** toolbar is used to save a copy of your map, add data, and access ArcCatalog and ArcToolbox functions. We will start by saving the map to your local Exercise 4 directory.



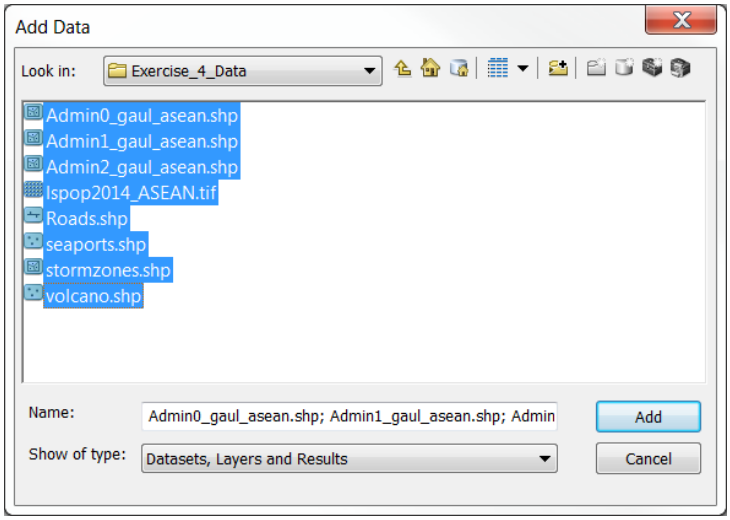
2. Click on the **Save** button , navigate to your **ASEAN_RVA_Exercise_4_Data** folder and enter the file name "**ASEAN_Exercise_4_GIS**".



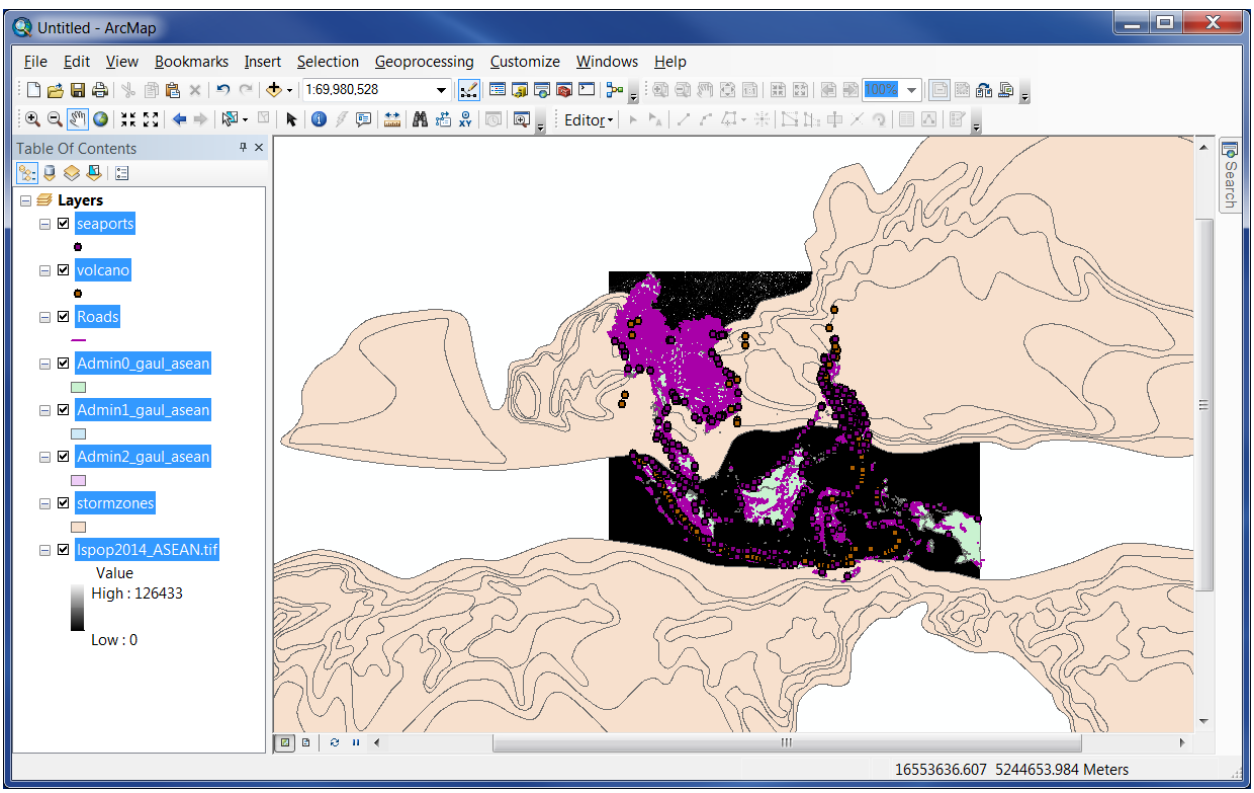
a. *Tip: ArcMap documents are sometimes not compatible with older versions of the software. You can save your project as an older version by selecting the **File** menu and clicking on **Save A Copy**



3. You will now add the GIS datasets (or layers) to the map. From the Standard Toolbar, click on the **Add Data** icon and add all the layers located in the **ASEAN_RVA_Exercise_4_Data** folder. (*Tip: Use the Shift / Ctrl key on your keyboard to select multiple layers.)

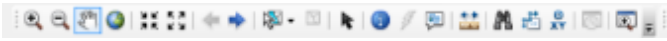


4. Your map should look like the image below. Each of the newly added layers will be located within the **Table of Contents** window on the left side. The **Data Frame** on the right side will display the geospatial data. Don't worry if the colors are different. ArcMap will choose random colors to symbolize points, lines, polygons, and raster will always be given a grey scale by default.

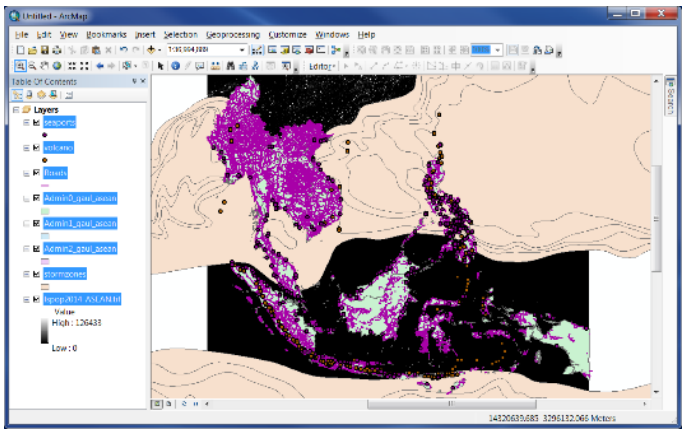


Navigation

1. Using the **Tools** toolbar, you can pan, zoom in, zoom out, select, and identify data. **NOTE:** *If you hover your cursor over a tool, ArcMap provides a tooltip with additional information on how to use the tool.*



2. Using the **Zoom In** tool , click and drag a box around the ASEAN Countries to zoom in closer



3. Using the **Pan** tool, click and drag to pan through the map view

4. **Zoom in** to an area that interests you. Use the **Identify** tool by either clicking on a feature, or click and dragging a box to select multiple features.

5. The resulting information shown in the **Identify** window (see example below) represents the selected features' attributes. This information is stored in tabular format and is associated with the geographic feature. The following task will explore attributes tables and basic functionality.

Common Data Types

POINT

Represents a discrete geographic feature or even. For example, a city, hospital, or earthquake epicenter.

LINE

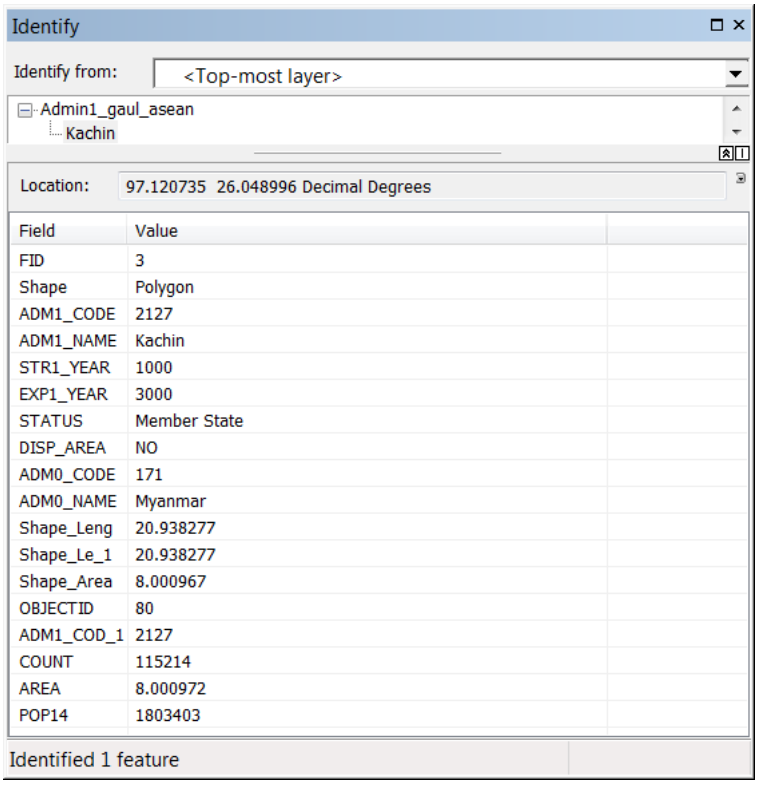
Represents a linear geographic feature such as a road, river, or elevation contour.

POLYGON

Represents an enclosed geographic surface or area such as an administrative boundary, or evacuation zone.

RASTER

A spatial data model that defines space as an array of equally sized cells arranged in rows and columns such as a digital elevation model (DEM).



TASK 3: EXPLORING ATTRIBUTE TABLES

1. The attribute table contains available data for all features and allows a user to manipulate and work with it. The information in the attribute table is linked to the spatial information used to display the features in the viewing window.

2. Open the attribute table of the *"seaports"* layer by right-clicking on the layer name in the Table of Contents and clicking on **Open Attribute Table**.

3. The *"seaports"* Attribute Table will open in a new window. In ArcMap terminology, the column of each table is called a **Field**. Within the Attribute Table, you can view the attributes associated with each seaport, sort fields, add new fields, query attributes, edit attributes, and join tables as well as other tasks.

Table

seaports

FID	Shape *	portname	code	latitude	longitude	updatedate	Country	ISO3	POINT_X	POINT_Y
0	Point	Pomala	IDPUM	-4.25137	121.5349	12/5/2013	Indonesia	IDN	121.5349	-4.251366
1	Point	Telok Ayer	IDTKA	-0.74694	109.55263	1/19/2015	Indonesia	IDN	109.552633	-0.746945
2	Point	Cebu		10.62704	124.40993	1/19/2015	Philippines	PHL	124.409928	10.627043
3	Point	Coco Grove Nature Resort		10.61699	124.28416	1/19/2015	Philippines	PHL	124.284159	10.616992
4	Point	My Tho	VNMUT	10.33193	105.4819	12/5/2013	Viet Nam	VNM	105.4819	10.331934
5	Point	Bassein	MMBS	16.78112	94.73082	1/19/2015	Myanmar	MMR	94.730816	16.781122
6	Point	Woodlands	SGWD	1.42793	103.6885	12/5/2013	Singapore	SGP	103.6885	1.427934
7	Point	Kidjang	IDKID	0.84953	104.6133	12/5/2013	Indonesia	IDN	104.6133	0.849534
8	Point	Moulmein	MMMN	16.48411	97.62477	12/5/2013	Myanmar	MMR	97.624769	16.484115
9	Point	Sampit	IDSMQ	-3.03507	113.0103	1/19/2015	Indonesia	IDN	113.0103	-3.035066
10	Point	Sittwe	MMAK	20.14133	92.90185	8/6/2015	Myanmar	MMR	92.90185	20.141331
11	Point	Thi Nai		13.77764	109.24708	1/20/2015	Vietnam	VNM	109.247084	13.777638
12	Point	Kuantan	MYKU	3.96303	103.4335	12/5/2013	Malaysia	MYS	103.4335	3.963034
13	Point	Port Kelang	MYPK	3.00093	101.3823	12/5/2013	Malaysia	MYS	101.3823	3.000934
14	Point	Banten	IDCIG	-6.01375	105.95816	12/5/2013	Indonesia	IDN	105.958159	-6.013746
15	Point	Hongai	VNHO	20.94833	107.0795	12/5/2013	Viet Nam	VNM	107.0795	20.948334
16	Point	Biak	IDBIK	-1.25596	136.37557	1/19/2015	Indonesia	IDN	136.375566	-1.255958
17	Point	Labuan	MYLBU	5.27473	115.2529	12/5/2013	Malaysia	MYS	115.2529	5.274734
18	Point	Balogo	PHBLG	13.75535	121.04302	12/5/2013	Philippines	PHL	121.043021	13.75535
19	Point	Map Ta Phut	THMAT	12.67353	101.1515	12/5/2013	Thailand	THA	101.1515	12.673534
20	Point	Semangka Bay		-5.49767	104.61774	12/5/2013	Indonesia	IDN	104.617739	-5.497669

1 (0 out of 314 Selected)

seaports

4. Most of your available functions are accessible by clicking on the **Table Options** button located on the top left of table toolbar. You can also right-click on each Field in the attribute table to bring up additional menu options.

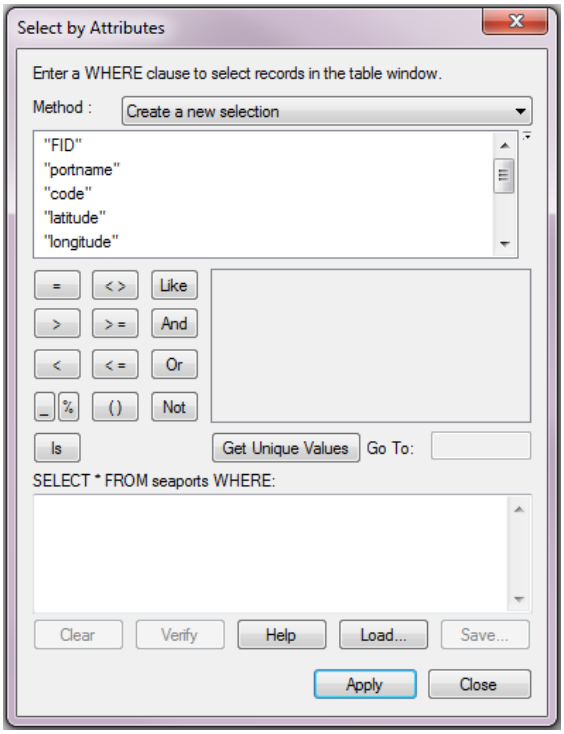
Searching Attributes

1. You can query data by clicking on the **Table Options** button and selecting **Select By Attributes…** from the dropdown menu. A new window will open where you can select the Field on which to query. For this exercise we will select all seaports that are in Indonesia.

2. Within the **Select By Attributes** window, double click on **"Country"** and verify the Field has been added to the "SELECT * FROM seaports WHERE:" window.

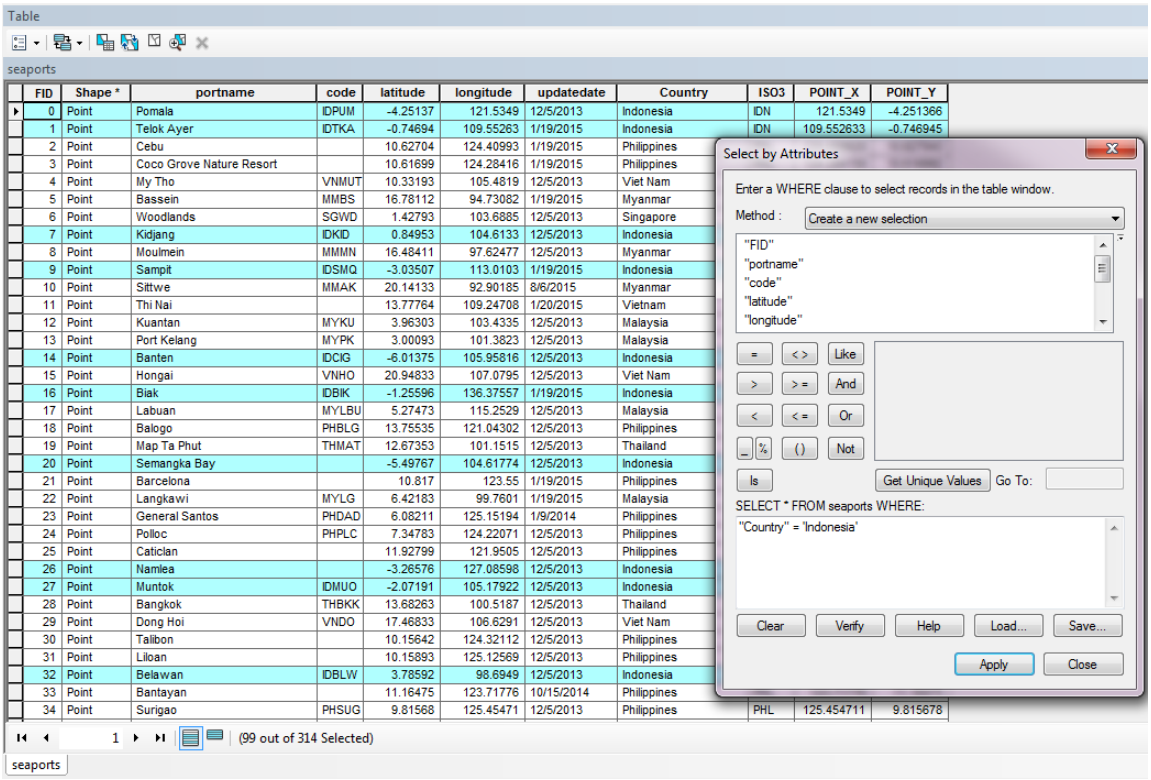
3. Next click on the **Equals** button.

4. Ensure the "Country" field is still highlighted in the top window and click on **Get Unique Values** to see a full list of the available countries.



5. Your "**Select by Attributes**" window should look like the image below:

a. Click the **Apply** button to view the results in the table.



FID	Shape *	portname	code	latitude	longitude	updatedate	Country	ISO3	POINT_X	POINT_Y
0	Point	Pomala	IDPUM	-4.25137	121.5349	12/5/2013	Indonesia	IDN	121.5349	-4.251366
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4	Point	My Tho	VNMUT	10.33193	105.4819	12/5/2013	Viet Nam			
5	Point	Bassein	MMBS	16.78112	94.73082	1/19/2015	Myanmar			
6	Point	Woodlands	SGWD	1.42793	103.6885	12/5/2013	Singapore			
7	Point	Kidjang	IDKID	0.84953	104.6133	12/5/2013	Indonesia			
8	Point	Moulmein	MMMN	16.48411	97.62477	12/5/2013	Myanmar			
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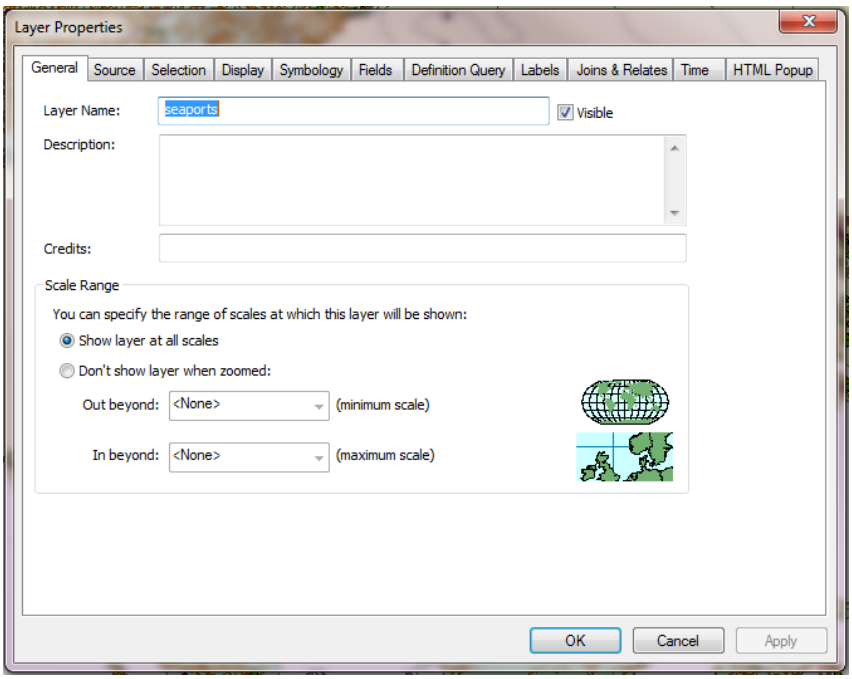
10	Point	Sittwe	MMAK	20.14133	92.90185	8/6/2015	Myanmar			
11	Point	Thi Nai		13.77764	109.24708	1/20/2015	Vietnam			
12	Point	Kuantan	MYKU	3.96303	103.4335	12/5/2013	Malaysia			
13	Point	Port Kelang	MYPK	3.00093	101.3823	12/5/2013	Malaysia			
14	Point	Banten	IDCIG	-6.01375	105.95816	12/5/2013	Indonesia			
15	Point	Hongai	VNHO	20.94833	107.0795	12/5/2013	Viet Nam			
16	Point	Biak	IDBIK	-1.25596	136.37557	1/19/2015	Indonesia			
17	Point	Labuan	MYLBU	5.27473	115.2529	12/5/2013	Malaysia			
18	Point	Balogo	PHBLG	13.75535	121.04302	12/5/2013	Philippines			
19	Point	Map Ta Phut	THMAT	12.67353	101.1515	12/5/2013	Thailand			
20	Point	Semangka Bay		-5.49767	104.61774	12/5/2013	Indonesia			
21	Point	Barcelona		10.817	123.55	1/19/2015	Philippines			
22	Point	Langkawi	MYLG	6.42183	99.7601	1/19/2015	Malaysia			
23	Point	General Santos	PHDAD	6.08211	125.15194	1/9/2014	Philippines			
24	Point	Polloc	PHPLC	7.34783	124.22071	12/5/2013	Philippines			
25	Point	Caticlan		11.92799	121.9505	12/5/2013	Philippines			
26	Point	Namlea		-3.26576	127.08598	12/5/2013	Indonesia			
27	Point	Muntok	IDMUO	-2.07191	105.17922	12/5/2013	Indonesia			
28	Point	Bangkok	THBKK	13.68263	100.5187	12/5/2013	Thailand			
29	Point	Dong Hoi	VNDO	17.46833	106.6291	12/5/2013	Viet Nam			
30	Point	Talibon		10.15642	124.32112	12/5/2013	Philippines			
31	Point	Liloan		10.15893	125.12569	12/5/2013	Philippines			
32	Point	Belawan	IDBLW	3.78592	98.6949	12/5/2013	Indonesia			
33	Point	Bantayan		11.16475	123.71776	10/15/2014	Philippines			
34	Point	Surigao	PHSUG	9.81568	125.45471	12/5/2013	Philippines	PHL	125.454711	9.815678

6. You can use the additional buttons found within the **Select by Attributes** window to create more complex queries including multiple attributes, or value ranges for numeric fields.

TASK 4: EXPLORING LAYER PROPERTIES AND SYMBOLOGY

1. The **Layer Properties** window is the best method to interact with an individual data layer and allows you to effectively manage most aspects of the layer including: applying symbology, adding a description, setting data source location, setting a scale range, managing the attribute table and field names, labeling features in your map, and joining different tables together using a common field.

2. To access the **Layer Properties** window, double click on the ***"Seaports"*** layer or right-click to activate an action tab and select **Properties** and browse through the tabs.

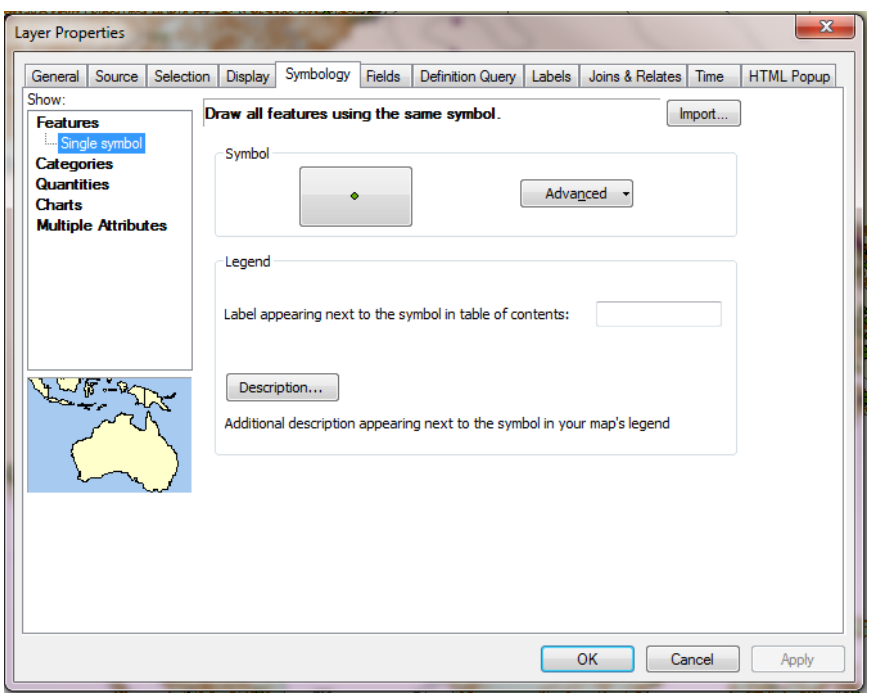


Symbology

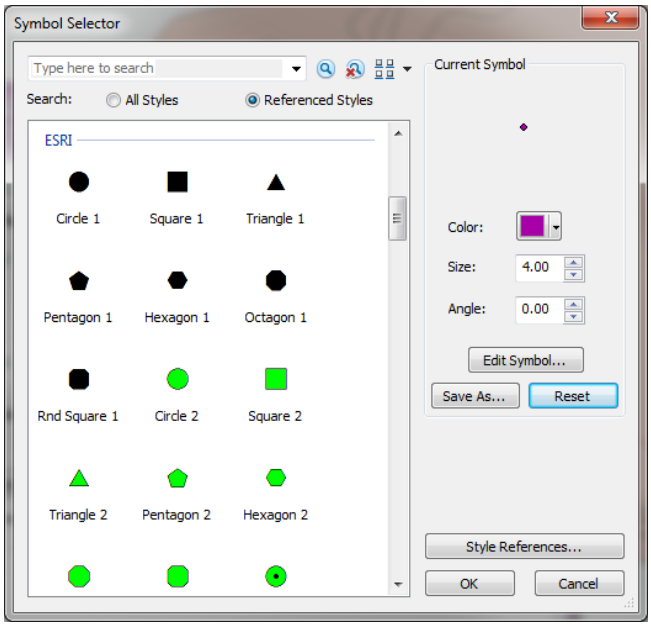
1. Symbology determines how features are represented on a map. Using appropriate symbology can help make communication more effective. There are many ways to alter the appearance of features, we will look at the more common methods using the **Layer Properties** window.

Simple Symbology

2. Select the **Symbology** tab under the **Layer Properties** window for *"**Seaports**"*.



3. For data layers with a Single Symbol such as seaports, you can change the symbol by clicking on which will activate another **Symbol Selector** window:



4. From the Symbol Selector window, you can scroll through a list of default ESRI symbols and choose one that fits your needs. You can also search by keyword such as "Seaports" to narrow your search. ArcMap also has a number of other Style References that do not display in the Symbol Selector by default. You can see a list by clicking on the **Style Reference** button

in the **Symbol Selector** window.

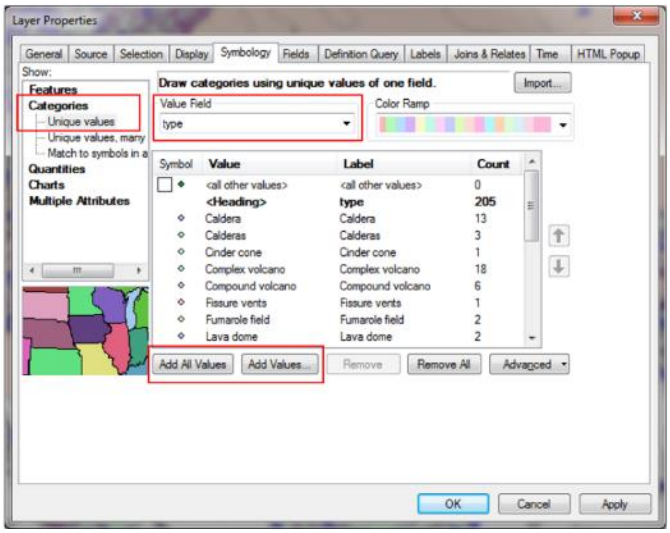
5. Find an appropriate symbol for Seaports using one of the functions described. You can adjust the size and color now. The size depends on various factors such as the size of your map, scale, and the density of other symbology that is used. It will take time to learn the best combination. In this exercise we are mainly focusing on how to modify symbology.

    a. When finished click the **OK** button

Category Symbology

1. You can also symbolize data based on Categories found within the Attribute Table for each data layer.

2. Open the **Layer Properties** window for "volcano" and go to the **Symbology** tab.



3. Under **Categories** (left side of window) click on **Unique values.** Select the field you would like to symbolize on under **Value Field,** choose **"type"**, and click the **Add All Values** button. A list should appear showing all the volcano types listed in the attribute table. You can now select individual symbology for each type.

    a. When finished click the **OK** button

Quantities Symbology

1. You can symbolize data layers based on quantities, or numeric value ranges where applicable. Quantitative symbologies differ based on the method of **classification**. Classification dictates how data are grouped into numeric classes.

2. For the purposes of this exercise, we have added Population data to the Administrative Level 0 boundary from the 2014 World Bank statistics.

3. Open the **Layer Properties** window for *"Admin0_gaul_asean"* and go to the **Symbology** tab.

4. Select **Quantities, Graduated colors** from the left side and select **Population** as the **Value Field**

Common Quantitative Classification Methods

EQUAL INTERVAL

Divides data into classes of equal range (e.g. max – min for each class is equal). For example: Data values range from 0-150. Three equal interval classes: class1= 0-50; class2= 51-100; class3=101-150. Each interval = 50.

QUANTILE

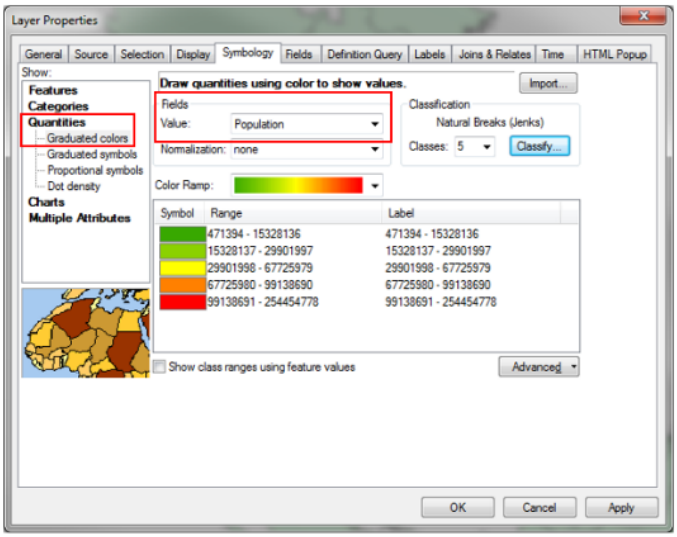
Places an equal number of data observations in each class (e.g. quartile, or 4 quantile classes each represent 25% of the data).

NATURAL BREAKS

Using a clustering approach, classes are optimized to minimize differences within each class of data and maximize differences between classes. Searches for natural separations in data values.

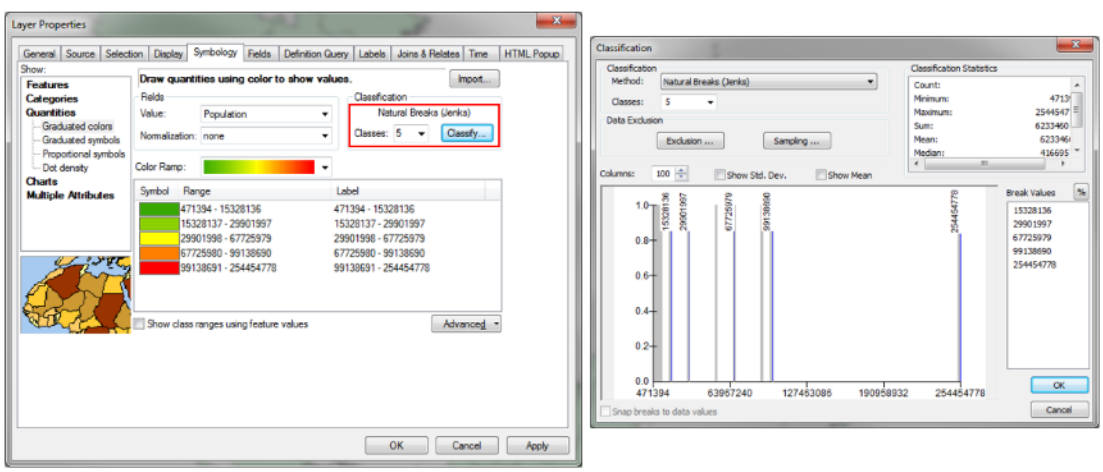
STANDARD DEVIATION

Places break points above and below the mean value at intervals of 1, 0.5, or 0.25 standard deviations until all values are included in a class.



5. You can adjust the number of **Classes** or **Method of Classification** by clicking on the **Classify** button. Briefly explore the different classification methods and press 'Apply' to see how they change your map.

    a. You can also create your own classification by choosing the **Manual** methods from the dropdown and typing your own **Break Values.**



6. Adjust the ranges to rounded numbers by typing the break values listed below:

    a. 5,000,000

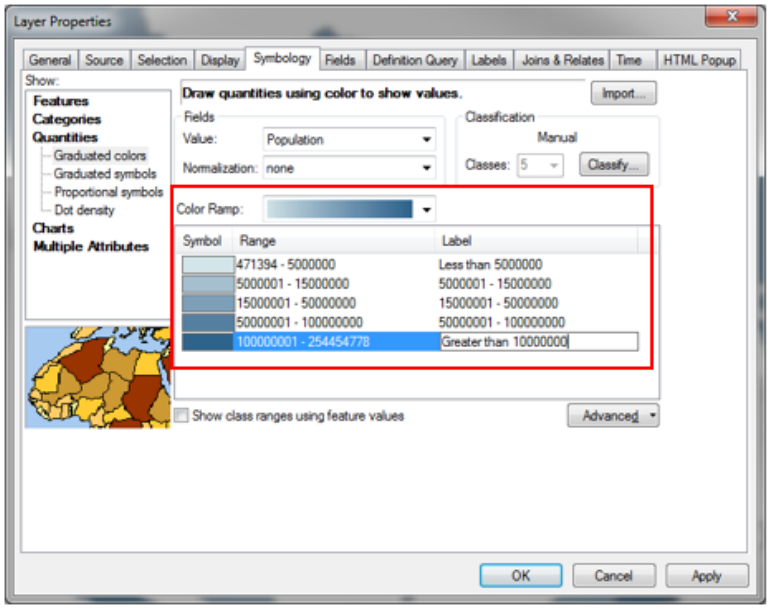
    b. 15,000,000

    c. 50,000,000

    d. 100,000,000

    e. 300,000,000

7. When you have identified your value range and number of classes, you can select a Color Ramp and edit the Labels for your map.



   a. When finished click the **OK** button

8. Finally – ***SAVE A COPY OF YOUR MAP!*** We will use this Map Document (.mxd file) again to create a map product in **Exercise 8**.

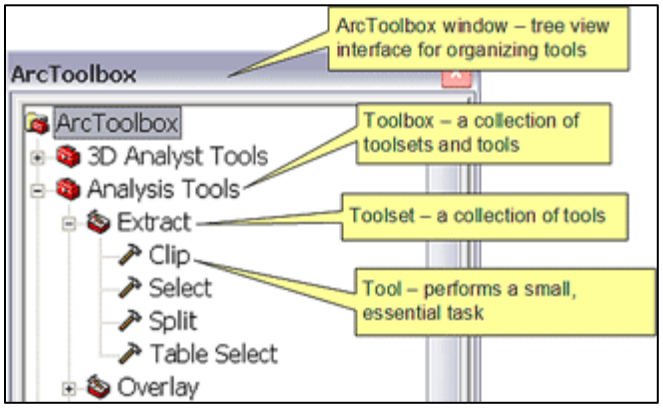
TASK 5: EXPLORE ARCTOOLBOX

1. ArcToolbox is a central application where you can find, manage and execute geoprocessing tools. ArcToolbox can be used within both ArcMap and ArcCatalog. To open ArcToolbox, click the ArcToolbox button from the standard toolbar.

2. From the ArcToolbox window, you can explore the collection of Geoprocessing Tools available.

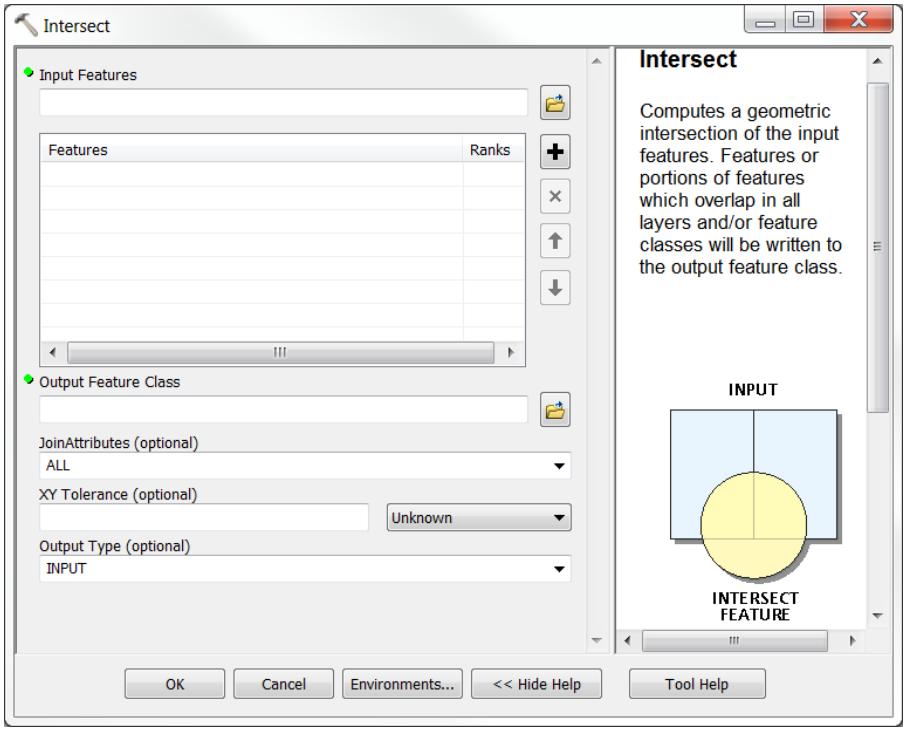
   a. To open a tool, simply double-click it.

   b. Explore the **Intersect** tool, found within Analysis Tools > Overlay > **Intersect.**



3. From the Intersect window, click **Show Help>>** for an explanation of the tool's function.

    a. We will use the intersect tool in a later exercise.



4. Choose one other tool from the Extract or Overlay Toolbox. What does it do? Why might you use it?

EXERCISE 5: CREATING GEOSPATIAL FILES FROM TABULAR DATA

OBJECTIVE

This exercise will demonstrate the creation of geospatial data from tabular files, including the conversion of x,y coordinates to spatial points and tabular joins. The result will be a comprehensive spatial dataset generated from tabular files.

MATERIALS

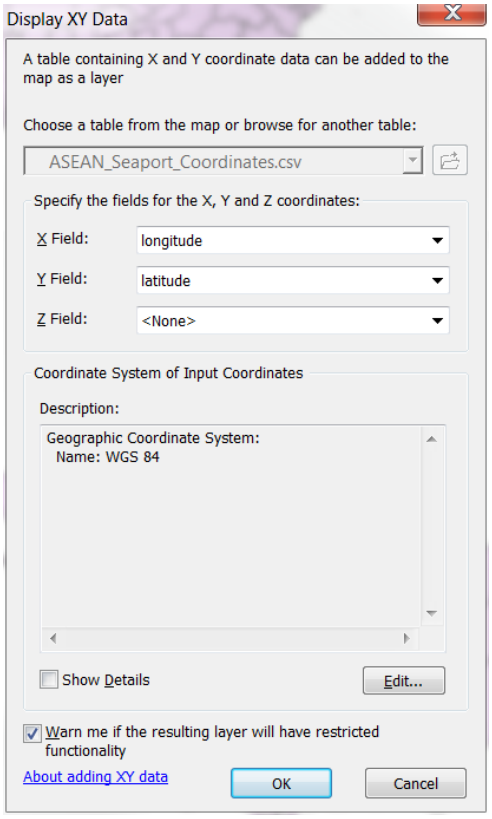
This exercise requires the use of ESRI ArcMap. Instructors will provide the following datasets in the ASEAN_RVA_Exercise_5_Data folder:

- **ASEAN_Seaport_Coordinates.csv:** A comma-separated file including latitude and longitude coordinates for seaports in AMS.
- **seaport_attributes.xls:** An Excel file containing detailed seaport attributes.

INSTRUCTIONS

TASK 1: CREATE A POINT LAYER FROM X,Y COORDINATES

1. Open a new ***ArcMap document.*** Click on the **Add Data** icon and navigate to the **ASEAN_RVA_Exercise_5_Data** folder to add the table "**ASEAN_Seaport_Coordinates.csv**"
    a. Right-click the table and choose **Open**.
        i. Notice that this is a tabular file – its features do not draw in ArcMap. However, the table contains coordinates (latitude and longitude) that allow us to create spatial features from the tabular information.
2. Close the table and right-click the layer again from the Table of Contents. This time, choose **Display XY Data**
    a. For X Field, choose **longitude**
    b. For Y Field, choose **latitude**
    c. Click **OK**



Note: A window will pop up telling you that the layer will not have an Object-ID Field. Without this field, the layer may have limited functionality in ArcMap. To address this issue, we will export the layer as a new shapefile. ***Click OK***.

3. You should now see a new layer – "**ASEAN_Seaport_Coordinates.csv Events**" in ArcMap's Table of Contents. Right-click this layer and Choose **Data > Export Data**. Navigate to your Exercise 5 folder and save the layer as "**ASEAN_Seaports"**

    a. For Save as Type, choose **Shapefile**.

    b. When asked "Do you want to add the exported Data to the map as a layer?" Choose **Yes.**

        i. You can now remove the "**ASEAN_Seaport_Coordinates.csv Events**" from the Table of Contents (**Right-click > Remove**)

4. Next, we will add attributes to our new layer using a **Join**.

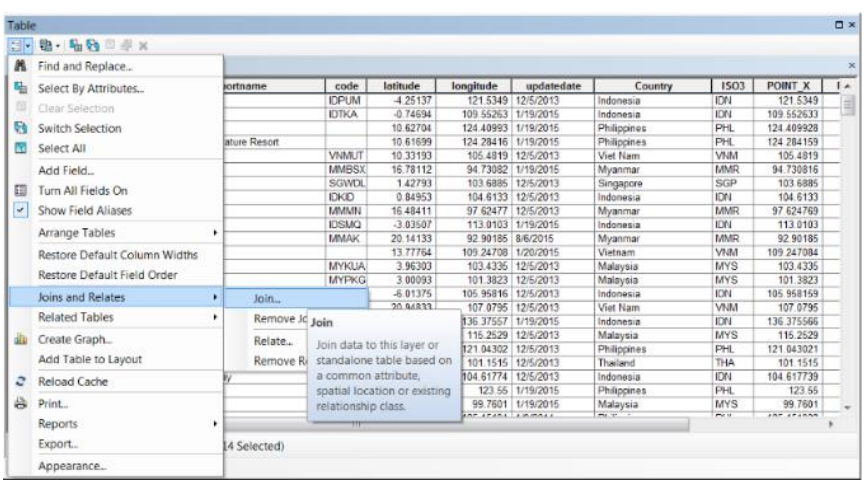
TASK 2: JOIN ATTRIBUTES FROM A TABLE

1. Tabular joins involve taking fields and attributes from one table and joining them to another based on a common identifier. For example, you can join tables such as census statistics that are in spreadsheet format to an administrative boundary file in your ArcMap project. To do so, each table must have a common field that can be uniquely linked together such as an administrative code. Tables can also be joined based on an overlapping spatial location.

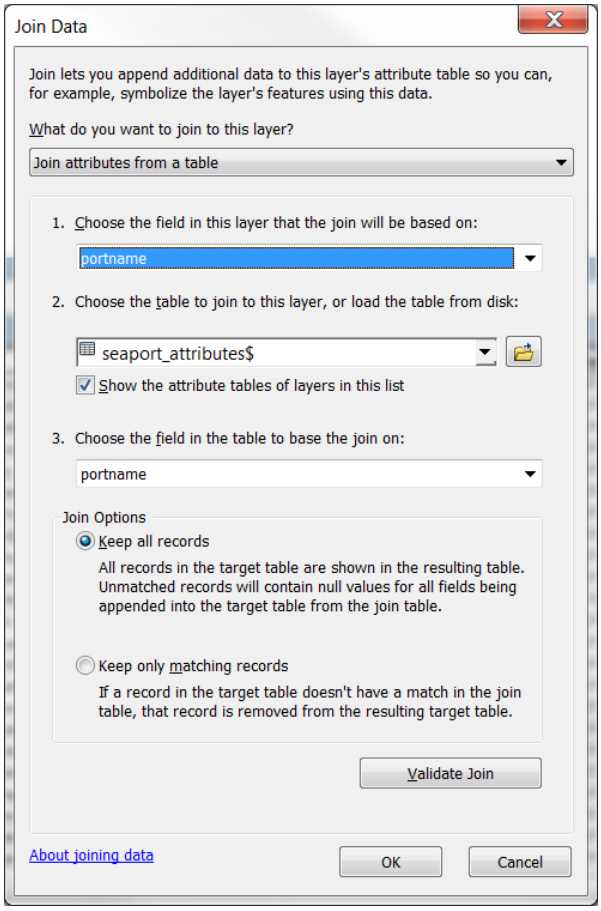
2. First, click on the **Add Data** icon and navigate to the **ASEAN_RVA_Exercise_5_Data** to add the table "**seaport_attributes.xls**" (seaport_attributes$)

3. Next, open the attribute table for your new layer *"***ASEAN_Seaports***"* by right-clicking the layer in the **Table of Contents** and selecting **Open Attribute Table**.

4. From the Table Options button, click on **Joins and Relates** and click on **Join** as shown below.



5. A new **Join Data** window will open.



a. Under Option 1: Select *"**portname**"* as the field in this layer that the join will be based on.

b. Under Option 2: Click on the dropdown and select "**seaport_attribute$"**

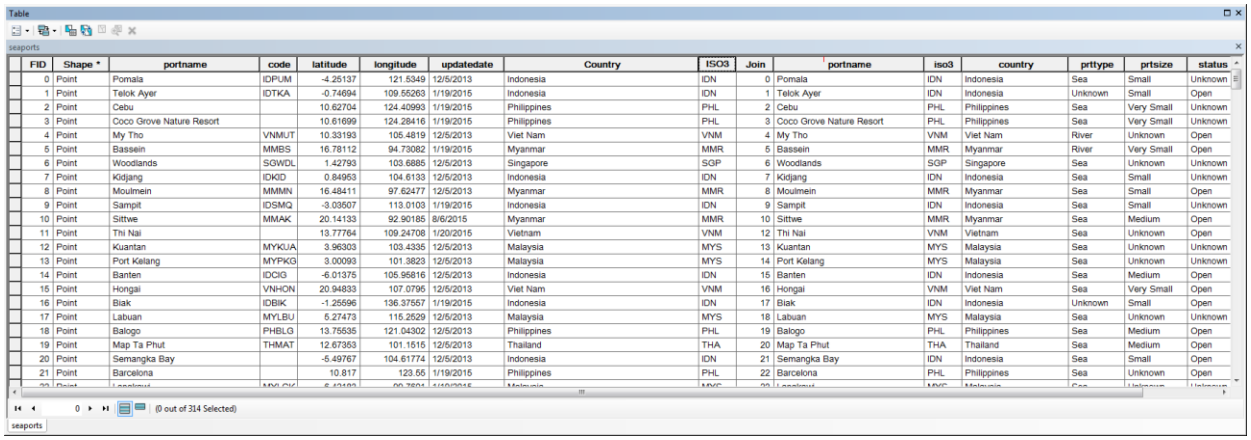
   i. **Tip:** ArcMap may have difficulty opening Excel spreadsheets from versions later than 97-2003. If your spreadsheet is in a later version, open the table in Excel and Save as "Excel 97-2003 Workbook" or as a "Text (Tab delimited)" file type.

c. Under Option 3: Select *"**portname**"* as the field in this layer that the join will be based on. In this instance, the field names from the two tables are the same.

d. Join Options: Select **Keep all Records**

e. Click **OK**

6. You can now view the table and verify that the join was completed successfully.



Table

seaports

FID	Shape *	portname	code	latitude	longitude	updatedate	Country	ISO3	Join	portname	iso3	country	prttype	prtsize	status
0	Point	Pomala	IDPUM	-4.25137	121.5349	12/5/2013	Indonesia	IDN	0	Pomala	IDN	Indonesia	Sea	Small	Unknown
1	Point	Telok Ayer	IDTKA	-0.74694	109.56263	1/19/2015	Indonesia	IDN	1	Telok Ayer	IDN	Indonesia	Unknown	Small	Open
2	Point	Cebu		10.62704	124.40993	1/19/2015	Philippines	PHL	2	Cebu	PHL	Philippines	Sea	Very Small	Unknown
3	Point	Coco Grove Nature Resort		10.61699	124.28416	1/19/2015	Philippines	PHL	3	Coco Grove Nature Resort	PHL	Philippines	Sea	Very Small	Unknown
4	Point	My Tho	VNMUT	10.33193	105.4819	12/5/2013	Viet Nam	VNM	4	My Tho	VNM	Viet Nam	River	Unknown	Open
5	Point	Bassein	MMBS	16.78112	94.73082	1/19/2015	Myanmar	MMR	5	Bassein	MMR	Myanmar	River	Very Small	Open
6	Point	Woodlands	SGWDL	1.42793	103.6885	12/5/2013	Singapore	SGP	6	Woodlands	SGP	Singapore	Sea	Unknown	Unknown
7	Point	Kidjang	IDKID	0.84953	104.6133	12/5/2013	Indonesia	IDN	7	Kidjang	IDN	Indonesia	Sea	Small	Unknown
8	Point	Moulmein	MMMN	16.48411	97.62477	12/5/2013	Myanmar	MMR	8	Moulmein	MMR	Myanmar	Sea	Small	Open
9	Point	Sampit	IDSMQ	-3.03507	113.0103	1/19/2015	Indonesia	IDN	9	Sampit	IDN	Indonesia	Sea	Small	Unknown
10	Point	Sittwe	MMAK	20.14133	92.90185	8/6/2015	Myanmar	MMR	10	Sittwe	MMR	Myanmar	Sea	Medium	Open
11	Point	Thi Nai		13.77764	109.24708	1/20/2015	Vietnam	VNM	12	Thi Nai	VNM	Vietnam	Sea	Unknown	Open
12	Point	Kuantan	MYKUA	3.96303	103.4335	12/5/2013	Malaysia	MYS	13	Kuantan	MYS	Malaysia	Sea	Unknown	Unknown
13	Point	Port Kelang	MYPKG	3.00093	101.3823	12/5/2013	Malaysia	MYS	14	Port Kelang	MYS	Malaysia	Sea	Unknown	Unknown
14	Point	Banten	IDCIG	-6.01375	105.95816	12/5/2013	Indonesia	IDN	15	Banten	IDN	Indonesia	Sea	Medium	Open
15	Point	Hongai	VNHON	20.94833	107.0795	12/5/2013	Viet Nam	VNM	16	Hongai	VNM	Viet Nam	Sea	Very Small	Open
16	Point	Biak	IDBIK	-1.25596	136.37557	1/19/2015	Indonesia	IDN	17	Biak	IDN	Indonesia	Unknown	Small	Open
17	Point	Labuan	MYLBU	5.27473	115.2529	12/5/2013	Malaysia	MYS	18	Labuan	MYS	Malaysia	Sea	Unknown	Unknown
18	Point	Balogo	PHBLG	13.75535	121.04302	12/5/2013	Philippines	PHL	19	Balogo	PHL	Philippines	Sea	Medium	Open
19	Point	Map Ta Phut	THMAT	12.67353	101.1515	12/5/2013	Thailand	THA	20	Map Ta Phut	THA	Thailand	Sea	Medium	Open
20	Point	Semangka Bay		-5.49767	104.61774	12/5/2013	Indonesia	IDN	21	Semangka Bay	IDN	Indonesia	Sea	Small	Open
21	Point	Barcelona		10.817	123.55	1/19/2015	Philippines	PHL	22	Barcelona	PHL	Philippines	Sea	Unknown	Open

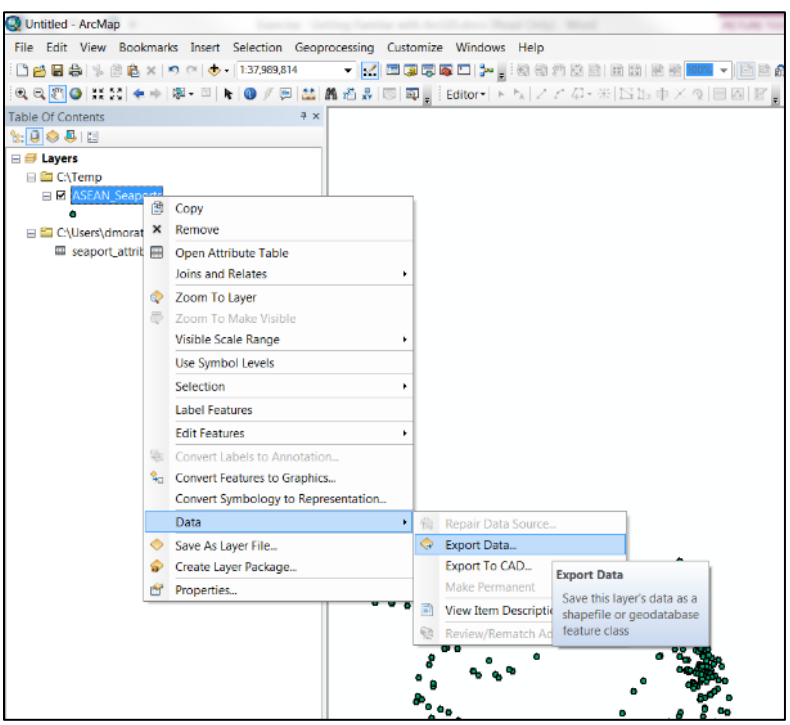
(0 out of 314 Selected)

seaports

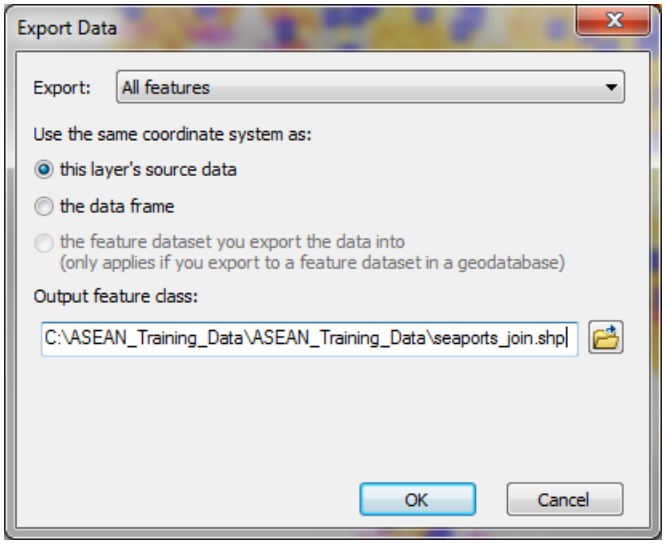
7. Joins are not permanent. The join is only viewable within the current ArcMap project and does not modify the original layer in any way. To make the join permanent, you must copy the data over to a Field in the original table, or export the joined data to a new layer.

8. The fastest way to ensure all the joined Fields are capture permanently is by exporting the data to a new layer.

9. Close the Attribute Table. Next, in the **Table of Contents**, right-click on the *"***ASEAN_seaports***"* layer and click on **Data > Export Data**



10. A new **Export Data** window will open. Save the new layer to the **ASEAN_RVA_Exercise_5_Data** folder and call it "seaports_join.shp"



11. A dialog box will open that says "Do you want to add the exported data to the map as a layer?" Click **Yes** to continue. View the new data layer and attribute table, created by joining attributes from two different tabular files.

USING JOINS IN RISK ASSESSMENT AND MAPPING

Tabular joins allow users to join tabular attributes to spatial boundaries. For example, indicators and indices developed for your Member State in tabular format (such as those introduced in Exercises 1 - 3) can be joined to province boundaries, enabling users to visualize and map the derived outputs of the risk assessment process. Exercise 8 will explore map creation in ArcMap.

EXERCISE 6: ESTIMATING EXPOSURE

OBJECTIVE

This exercise will demonstrate some basic GIS tools for estimating exposure to hazards. Students will combine hazard zones with administrative boundaries and population information to estimate the population exposed to earthquakes and tropical cyclone winds. The result will be a spatial dataset representing exposed populations in each level-1 administrative unit across AMS.

MATERIALS

This exercise requires the use of ESRI ArcMap. Instructors will provide four spatial datasets:

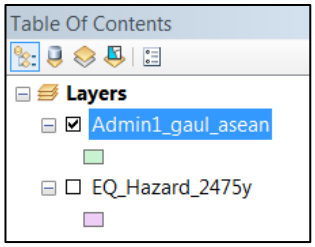
- **Admin1_gaul_asean.shp:** Shapefile contains level 1 administrative boundaries for AMS.
- **EQ_Hazard_2475y.shp:** Shapefile contains the seismic hazard zone, indicating areas exposed to earthquake intensity MMI VII and above, based on a 2475-year return period.
- **TC_Hazard_500y.shp:** Shapefile contains the tropical cyclone wind hazard zone, indicating areas exposed to Category 1 (119 km/h) winds or greater, based on a 500-year return period.
- **lspop2014_ASEAN.tif:** Raster contains 2014 population estimates with a grid cell size of approximately 1 km.
- **seaports.shp:** Shapefile contains major seaports in AMS.

INSTRUCTIONS

TASK 1: ADD DATA TO ARCMAP

1. Open a new ***ArcMap document.*** From the Main Toolbar, ***Click*** the ***Add Data*** button: to add layers to the map.
2. Navigate to the data folder for Exercise 6 and add the following layers:
    a. EQ_Hazard_2475y.shp
    b. Admin1_gaul_asean.shp
        i. **Note**: you can add multiple layers at once by holding the ***Ctrl*** key

3. The layers will be displayed in ArcMap. **Note:** you can change the drawing order of the layers by clicking and dragging them in the ***Table of Contents*** window. Layer properties and map symbology can also be accessed here.



TASK 2: GET FAMILIAR WITH THE DATA LAYERS

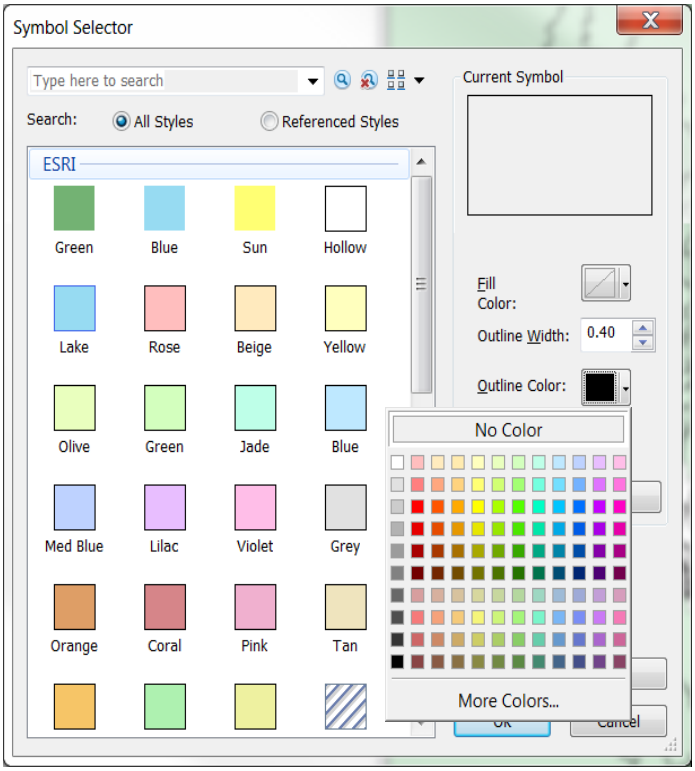
1. Right-click on the **Admin1_gaul_asean.shp** layer and choose **Open Attribute Table.**
   a. The attribute table contains all of the tabular infromation associated with each spatial feature.

2. Scroll through the table to view the attributes. Note that the table contains Place Name, Code, and Population Estimate (**"POP14"**).

   a. **Important Note: "ADM1_CODE"** represents each feature's ***Unique Identifier***.

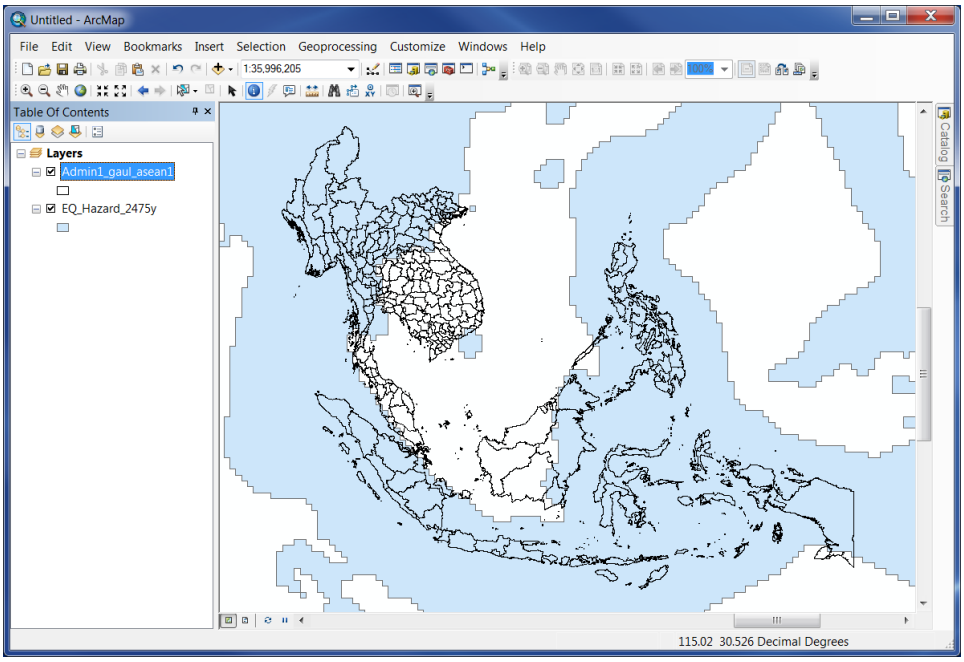
      i. Each Level 1 administrative unit has its own distinct code. Each code consists of only numbers and icontains no special characters that might not be recognized in other software. This ensures that additional data can be joined easily and that the identifier is retained if the data are exported and opened in another program (for example, Excel).

3. Close the attribute table and open the ***Symbol Selector*** by ***left-clicking the symbol*** (a colored box) below the **Admin1_gaul_asean** layer in the Table of Contents. Click to set the Fill Color to "No Color" and set the Outline Color to black. ***Click OK***.

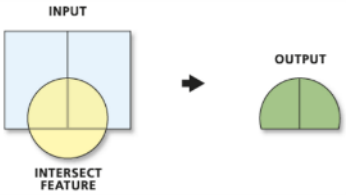


4. If you haven't already, ***Drag*** the **Admin1_gaul_asean** layer to the top of the Table of Contents so that it draws over the Earthquake Hazard Layer, **"EQ_Hazard_2475y**".

5. Finally, Right-click the **Admin1_gaul_asean** layer and choose **Zoom to Layer.** The map should be re-centered over the ASEAN member states. You should be able to see the earthquake hazard layer beneath the AMS level-1 boundaries:

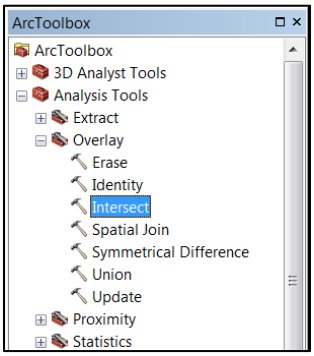


TASK 3: IDENTIFY THE AREAS EXPOSED TO EARTHQUAKES



1. To estimate the population exposed to earthquake hazards, we must first determine exactly which areas are exposed. To do this, we need to combine, or ***intersect*** the two data layers.

2. ArcMap's ***Intersect Tool*** allows us to combine information from the provinces with the hazard zone.



   a. We can access the Tool inside ***ArcToolbox*** by clicking the icon in the main toolbar.

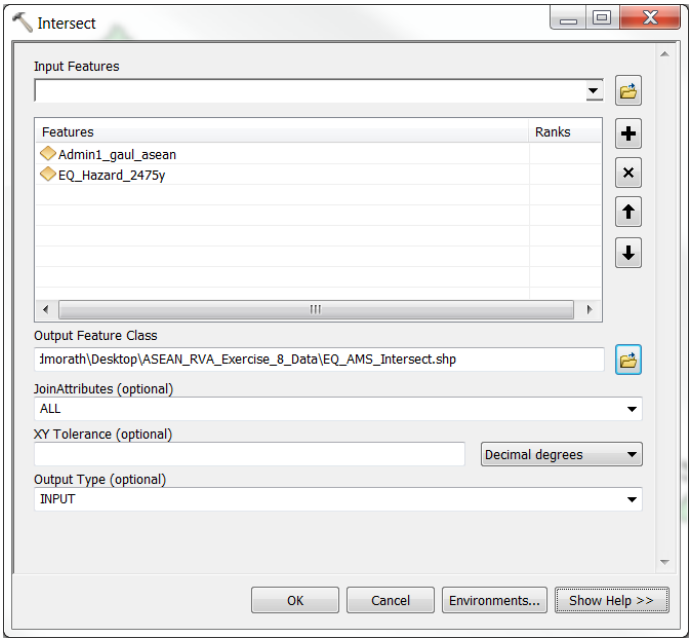
      i. Navigate to the tool by clicking through the toolboxes:

         1. Analysis Tools > Overlay > **Intersect. *Double-click*** to open the tool.

   b. Under ***Input Features***, click the arrow to open the dropdown box and select the layers to intersect. Be sure to add both layers, individually. You should see both **EQ_Hazard_2475y** and **Admin1_gaul_asean** listed in the "**features"** window.

   c. Under **Output Feature Class**, click the folder button to navigate to your working folder. Save the feature class as "**EQ_AMS_Intersect**"

   d. Leave all other parameters on their default settings, and ***Click OK*** to run the tool.



Note: It may take a few moments to run the tool, and it will simply run in the background. When the process is complete, your new layer, **EQ_AMS_Intersect** will be added to the top of the Table of Contents.

3. Carefully examine your results. Note how the results of the ***Intersect*** represent ONLY those areas of AMS that are within the earthquake hazard zone. These results are important for estimating how much of the population within each province is exposed to a particular hazard.

TASK 4: ESTIMATE THE POPULATIONS WITHIN EACH PROVINCE THAT ARE EXPOSED TO EARTHQUAKES

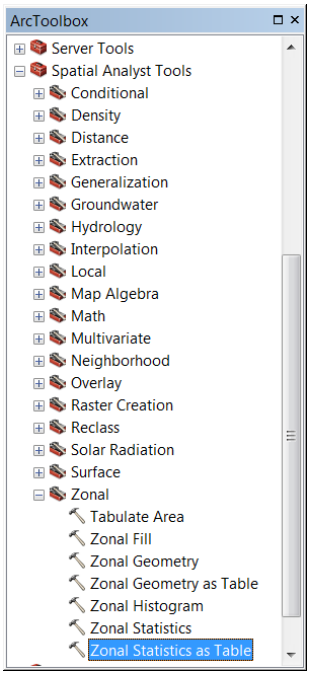
1. ***Click*** the ***Add Data*** button: to an additional layer to the map: "**lspop2014_ASEAN.tif"**

    a. The LandScan Population dataset provides a 2014 population estimate in ~1km raster grid cells. We will use this dataset along with the results of the Intersect to estimate the population within the exposed portions of the AMS provinces.

2. ArcToolbox's ***Zonal Statistics*** tools allow us to calculate statistics on values of a raster within zones defined by another dataset (vector or raster). For our assessment, the ***zones*** are the portions of the AMS that are exposed to earthquakes (**EQ_AMS_Intersect**) and the desired statistic is the ***SUM*** of the population within those zones.

    a. To complete this assessment, we will need to use a set of tools contained in ArcMap's ***Spatial Analyst*** Extension. From the main toolbar, click on Customize > Extensions and make sure that **Spatial Analyst** is checked. **Click OK**.

3. The ***Zonal Statistics as Table*** tool produces a table of summary values for each zone, which can be ***joined*** with spatial features.



   a. Navigate to the ***Zonal Statistics as Table*** tool in ArcToolbox:

      i. Spatial Analyst Tools > Zonal > **Zonal Statistics as Table**

   b. Under ***Input Raster or Feature Zone Data***, choose **EQ_AMS_Intersect** (areas in AMS exposed to earthquake)

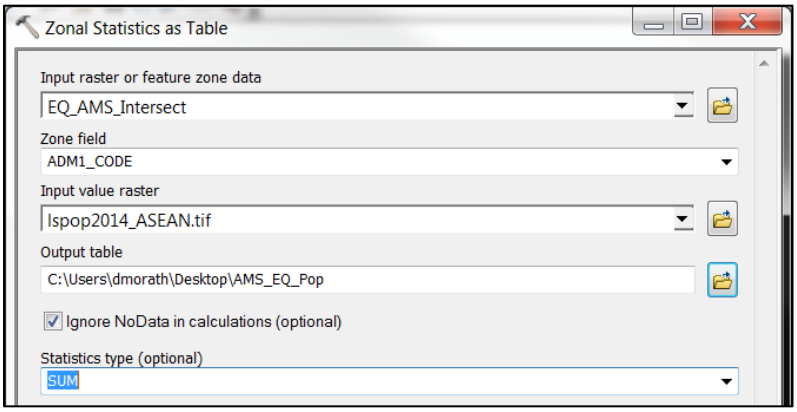
   c. Under ***Zone Field***, choose **ADM1_CODE** (Remember: This is our unique identifier!)

   d. Under ***Input Value Raster***, choose **lspop2014_ASEAN**

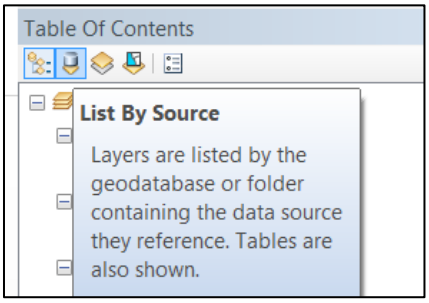
   e. Under ***Output Table***, navigate to your working folder and save the output as "**AMS_EQ_Pop"**

   f. Leave the box next to "Ignore NoData…" **checked**

   g. Under ***Statistics Type*****,** choose **SUM** (this will give the sum of the population within the exposed portions of each province). ***Click OK***.



4. To view the resulting table, you will need to change the view of the ***Table of Contents*** to **List by Source** (second button from the left). "**AMS_EQ_Pop"** will be at the bottom of the Table of Contents.



5. Right-click **AMS_EQ_Pop** and choose ***Open*** to view the results.

   a. The ***SUM*** column provides an estimate of the population in each exposed province.

b. Next, we'll use our unique identifier, ADM1_CODE to join the exposed population attributes to the AMS adm1 Boundaries so that we can view a map of our results.

TASK 5: JOIN THE RESULTS TO THE AMS BOUNDARIES

1. In the ***Table of Contents***, Right-click on **Admin1_gaul_asean** and choose **Joins and Relates > Join…**

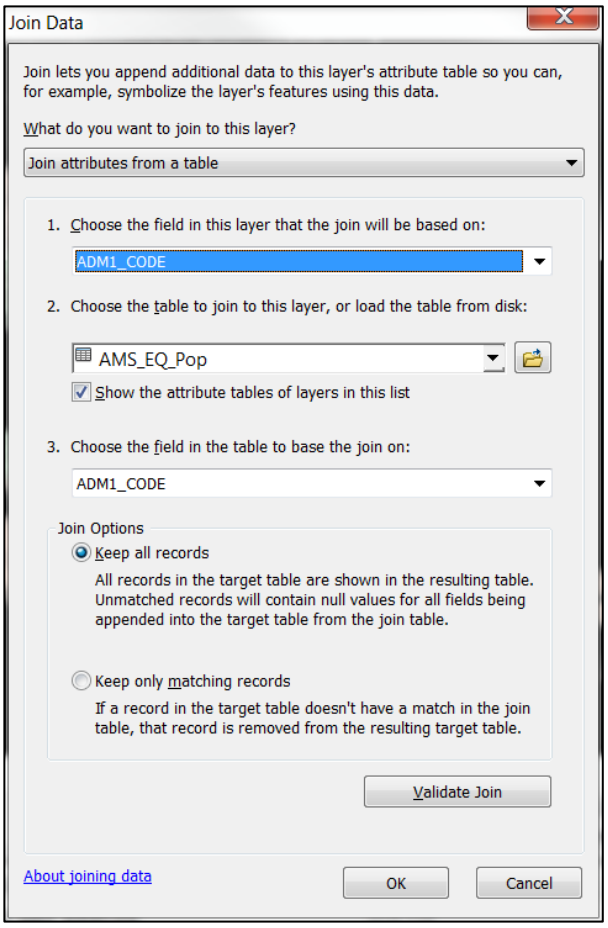
   a. Under *What do you want to join to this layer?* Choose **Join attributes from a table.**

   b. Under *Choose the field in this layer that the join will be based on*, choose **ADM1_CODE.**

   c. Under *Choose the table to join to this layer*, choose the results of the Zonal Statistic, **AMS_EQ_Pop**

   d. Under *Choose the field in the table to base the join on*, again choose **ADM1_CODE.**

   e. Under *Join Options* choose **Keep all records. *Click OK***



2. Right-click on **Admin1_gaul_asean** and choose **Open Attribute Table**

   a. Scroll the whole way to the right to see that the results of the Zonal Statistic, including the SUM column, are now ***Joined*** to the AMS boundaries. You may notice that some provinces have ***NULL*** values in the SUM column. In these cases, the province was outside the Earthquake Zone, so these areas were excluded from the intersect and zonal statistic. In these places, the exposed population is zero (0).

3. ***Joins are NOT permanent***. To permanently attach the exposed population estimate to the AMS boundaries, we must **Export the data layer**:

   a. Right-click on **Admin1_gaul_asean** and choose **Data > Export Data.**

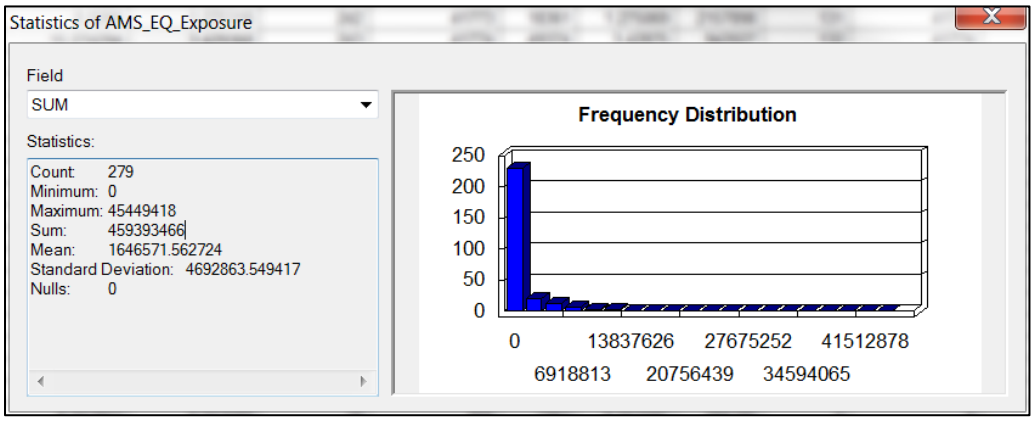
   b. ***Click*** the folder icon to navigate to your working folder. Save the layer as "**AMS_EQ_Exposure**". Under ***Save as type,*** choose **Shapefile.**

i. **Note**: For our purposes, the Shapefile is useful for a few reasons. First, this file type can be opened and edited easily in **QGIS**. Second, the Shapefile file type automatically converts NULL values to zero. In our case, this is desirable, because NULL values correspond to zero exposed population.

ii. ***Click Save***, then ***Click OK***. When it asks **"Do you want to add the exported data to the map as a layer?"** - ***Click Yes.***

c. ***Open*** the **Attribute Table** for your new layer, **AMS_EQ_Exposure**. Notice how all the values that were previously **NULL** are now **zero**.

4. As a final exploratory summary, Right-click the **SUM** column and Choose **Statistics…** to compute summary statistics on the population exposed to earthquake hazards in AMS.



a. Next, Calculate Statistics on the **POP14** column.

b. ***Question: What percentage of the total population is exposed to earthquake hazards in AMS?***

TASK 6: ESTIMATE THE POPULATION EXPOSED TO TROPICAL CYCLONE WINDS

1. Add the **TC_Hazard_500y.shp** data layer to the map.

2. ***Repeat Tasks 3 through 5*** above to intersect the administrative boundaries with the tropical cyclone hazard zone and estimate exposed population exposed to tropical cyclone wind.

   a. As you work through each task, remember to ***save your data layers in your working folder***. Choose intuitive file names that make sense to you.

OPTIONAL TASK: ESTIMATING SEAPORT EXPOSURE

1. In addition to population, estimating the exposure of critical infrastructure, such as major seaports, is important for anticipating potential losses or obstructions to disaster relief operations.

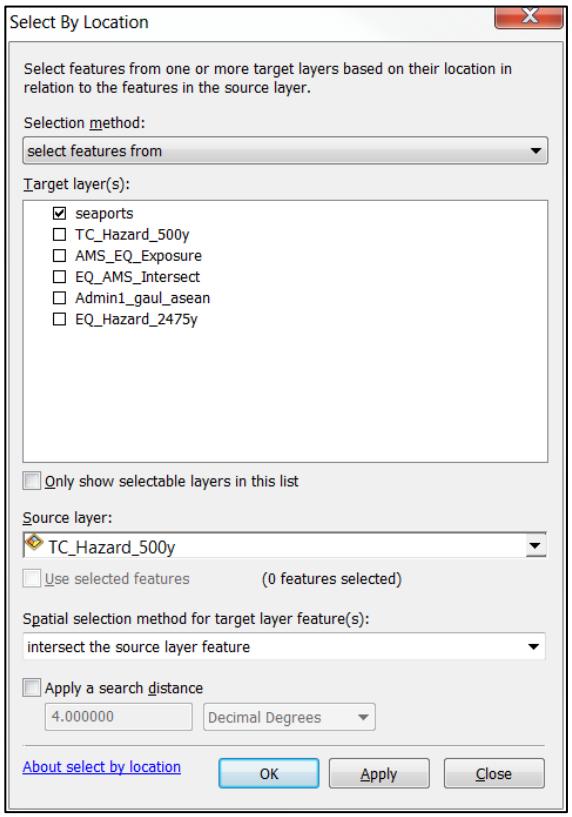
2. Add "**seaports.shp**" to your map.

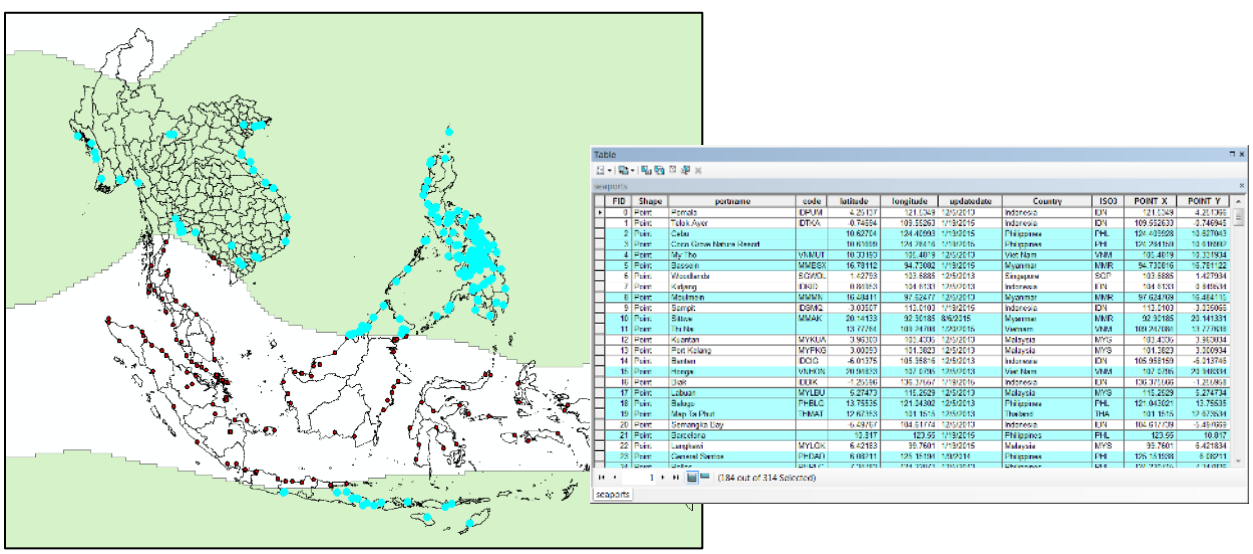
3. To determine which seaports are exposed to Earthquakes, **Intersect** seaports.shp with the **EQ_Hazard_2475y** layer (ArcToolbox > Analysis Tools > Overlay > Intersect). Save the new layer as **EQ_Seaports_Intersect**.

4. Repeat this step with TC_Hazard_500y to determine which seaports are exposed to tropical cyclone winds.

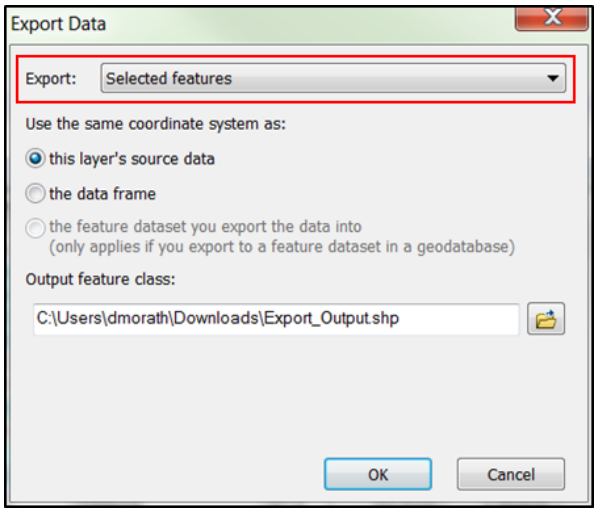
Alternate Method: Select by Location

1. To determine the exposure of the seaports without running a tool or creating a new layer, choose **Selection > Select by Location** from the top menu.
    a. Under Target Layer, choose **seaports**
    b. Under Source layer, choose **TC_Hazard_500y**
    c. Under Spatial selection method…, choose **"Intersect the source layer feature"**
        i. ***Click OK***
2. The features selected in **seaports** layer (shown below) represent those that fall inside the TC_Hazard_500y zone.
    a. Attributes of these features can be viewed by opening the attribute table.





3. If desired, selected features can also be exported as a separate layer. As practiced above, right-click the **seaports** layer from the Table of Contents and choose **Data > Export Data**. This time, however, ensure that **Selected Features** are chosen at the top of the window:



EXERCISE 7: CREATING AN EXPOSURE INDEX

OBJECTIVE

This exercise will demonstrate the steps required to calculate indicators of multi-hazard exposure, and will follow the process of indicator normalization (or scaling), compression and aggregation to construct an exposure index. The result will be a complete Multi-Hazard Exposure Index, one of the component indices of the Societal Risk Index. This exercise will draw upon skills developed in exercises 1, 2 and 3 from data preparation through index construction.

MATERIALS

This exercise requires the use of Microsoft Excel. Instructors will provide two Excel Workbooks:

- **Exercise_7_Sample_Data.xlsx**: This file contains sample raw data including population exposed to earthquakes, tropical cyclones, and floods. Students will use this data to calculate indicators of multi-hazard exposure.
- **ASEAN_RVA_Template.xlsx:** This Excel Workbook is designed as a guide through the process of Index Construction for the ASEAN Risk and Vulnerability Assessment (RVA). It provides field names descriptions, examples, and templates that are used throughout the training and exercises. In this Exercise, we will use this template to construct a sample Multi-Hazard Exposure Index.

INSTRUCTIONS

TASK 1: GETTING FAMILIAR WITH THE RAW DATA

1. Make a copy of the Excel workbook "**Exercise_7_Sample_Data.xlsx**" file to work from. The table contains the sample raw data that you will use to derive the multi-hazard exposure indicators. The workbook contains two worksheets:
    a. **Raw_Data_Descriptions**: Contains field names and descriptions for the raw exposure data.
    b. **Exposure_Raw_Dataset**: Contains the raw data that will be used to derive the multi-hazard exposure indicators.

TASK 2: DERIVING RAW MULTI-HAZARD EXPOSURE

1. Just as you practiced in Exercise 3, you will prepare these raw datasets for index construction by calculating derived indicators. The worksheet contains 4 datasets for each sample province: ***Total Population, Population Exposed to Earthquakes, Population Exposed to Tropical Cyclone Winds, and Population Exposed to Flood***. Keep in mind that these are sample data and do not represent the full range of hazards identified in the Guidelines.

2. The first indicator that you will derive is ***Raw Multi-Hazard Population Exposure***, or the raw count of "person units" exposed to one or more hazards. In this example case, those hazards include earthquakes, tropical cyclone wind, and flood inundation.

    a. Looking at exposure as raw counts provides an indication of *how many* or *how much*, which can assist in planning and give an idea of the raw scale of potential activities, such as evacuation or sheltering.

3. Create a new column heading in the worksheet called "**RawPopExp**" (Raw Population Exposure).

Level_1_Name	Level_1_Code	Total_POP	EQ_Pop	Wind_Pop	Flood_Pop	RawPopExp
Place Name 1	1	1809583	1302900	687642	597162	
Place Name 2	2	902350	333870	424105	415081	

4. To calculate raw multi-hazard exposure, combine the population counts from each of the hazard types by simply adding the population exposed from each of the three hazards:

1	Level_1_Name	Level_1_Code	Total_POP	EQ_Pop	Wind_Pop	Flood_Pop	RawPopExp
2	Place Name 1	1	1809583	1302900	687642	597162	=D2+E2+F2

    a. To apply the calculation to all provinces, ***Copy*** and ***Paste*** the formula to each row.

TASK 3: DERIVING RELATIVE MULTI-HAZARD EXPOSURE

1. The second indicator that you will derive is ***Relative Multi-Hazard Population Exposure***, or the total count of person units exposed to multiple hazards <u>as a proportion of the province population</u>.

    a. Representing exposure as a proportion of the total population provides an indication of *how important* and can assist with prioritization. Including relative exposure also helps highlight the relevance of hazards to provinces with small populations or economies during comparative analyses.

2. Create a new column heading in the worksheet called "**RelPopExp**" (Relative Population Exposure).

5. To represent relative multi-hazard exposure, we will calculate the total population count exposed to one or more hazards (i.e. raw exposure) per 1,000 persons in the province. The syntax for the calculation is **[RelPopExp] = ([RawPopExp] / [TotalPop]) * 1,000**. You could also calculate the proportional exposure for each type of hazard for inclusion in a GIS layer using the same basic syntax.

1	Level_1_Name	Level_1_Code	Total_POP	EQ_Pop	Wind_Pop	Flood_Pop	RawPopExp	RelPopExp
2	Place Name 1	1	1809583	1302900	687642	597162	2587704	=(G2/C2)*1000

    a. Again, to apply the calculation to all provinces, ***Copy*** and ***Paste*** the formula to each row.

TASK 4: MHE INDICATOR PREP AND SCALING

1. Now that we've derived our indicators, raw multi-hazard population exposure ("RawPopExp") and relative multi-hazard population exposure ("RelPopExp"), we can draw upon our skills practiced in Exercise 2 to prepare and scale the indicators.

2. Open your working copy of the Excel Workbook "**ASEAN_RVA_Template.xlsx**." Using the tabs at the bottom of the workbook, open the **MHE_Template** worksheet.

   a. Just like you practiced in Exercise 2, you will ***copy*** and ***paste*** the derived indicators into the yellow columns in the template. Be sure to ***<u>Paste as Values</u>.***

3. After you've pasted your data for "**RawPopExp**", ***scroll*** to the bottom of the worksheet:

   a. Minimum and maximum exposure values based on regional patterns (such as those provided for the Vulnerability indicators used in Exercise 2) are forthcoming. Instead, this exercise demonstrates how to scale the exposure data using minimum and maximum values based on the distribution of the sample data. **Note**: This is the methodology you would use to generate country-specific indicator scores for a more customized assessment.

Level1Name	Level1Code	RawPopExp
Place Name 94	94	4121280
Place Name 95	95	1027081
Place Name 96	96	2079771
Place Name 97	97	234250
Place Name 98	98	269610
Place Name 99	99	1975076
Place Name 100	100	996383
Mean		1825727.330
Std. Dev.		1168143.459
RVA Min.		-510559.588
RVA Max		4162014.248

103	Mean		1825727.330
104	Std. Dev.		1168143.459
105	RVA Min.		=C103-(2*C104)
106	RVA Max		4162014.248

103	Mean		1825727.330
104	Std. Dev.		1168143.459
105	RVA Min.		-510559.588
106	RVA Max		=C103+(2*C104)

   b. **For Scaling the Exposure Indicators:**

      i. **RVA Min** = Mean **minus** two standard deviations

      ii. **RVA Max** = Mean **plus** two standard deviations

4. **<u>Important Note</u>:** For each indicator, you must check to ensure that the minimum values make sense. In "**RawPopExp**" we are measuring the number of people exposed to one or more hazards. The minimum value calculated using the equation above is negative. ***Since it is not possible to have negative population exposure, we need to set the minimum value to zero. The worksheet contains conditional formatting to indicate where minimum values will need to be reset.***

Mean		1825727.330
Std. Dev.		1168143.459
RVA Min.		0.000
RVA Max		4162014.248

a. When the value is set to zero, the cell is no longer highlighted in red (as shown in the image).

5. Next, check to see if the indicators need to be compressed. Any scaled values in "**RawPEScale**" that are greater than 1 or less than 0 must be compressed.

   a. Just like Exercise 2, the template will indicate values that require compression by highlighting them in red.

   b. ***Copy*** and ***Paste*** the scaled values from "**RawPEScale**" to "**RawPECompr**" (Use ***Paste Values***).

   c. **To compress these values**:

      i. Assign a value of 1 where the scaled values are greater than 1.

      ii. Assign a value of 0 where scaled values are less than 0.

Level1Code	RawPopExp	RawPEScale	RawPECompr	RawPEScore	RawPERank
61	3547469	0.852	0.852	0.852	10
62	350996	0.084	0.084	0.084	94
63	734622	0.177	0.177	0.177	81
64	4327800	1.040	1.000	1.000	1

6. In contrast to the Vulnerability Index, it is **NOT likely** that the exposure indicators will require reflection. Reflection is not necessary where there is a directional match, or, where higher values equal worse conditions. For example, a higher raw population exposure indicates higher overall multi-hazard exposure (a directional match).

   a. As a result, the "**Score**" and "**Rank**" columns in the **MHE_Template** will automatically update as values are checked for compression.

7. Repeat the steps in this task to prepare and scale the Relative Multi-hazard Population Exposure, "**RelPopExp**".

TASK 5: MHE INDEX CALCULATION

1. As noted in Exercise 3, much of the index aggregation process is automated in the template. In this exercise, we combine just two indicators – Raw Multi-hazard Population Exposure, and Relative Multi-hazard Population Exposure – in the calculation of the **Multi-hazard Exposure Component Index**, "**MHEIndex**." ***Examine*** the formula used to calculate **MHEIndex**.

Level1Name	RawPEScore	RawPERank	RelPopExp	RelPEScale	RelPECompr	RelPEScore	RelPERank	MHEIndex	MHERank
Place Name 1	0.622	28	1430.00	0.337	0.337	0.337	76	=AVERAGE(K2,F2)	49
Place Name 2	0.282	62	1300.00	0.274	0.274	0.274	83	0.278	81
Place Name 3	0.804	13	2260.00	0.736	0.736	0.736	18	0.770	11

   a. Notice that we did not construct subcomponent indices. This is because we included only two indicators, both of which represent exposure of one element – Population.

b. If we could include additional elements, such as the value of exposed building stock, we could construct separate thematic subcomponents for population exposure and economic exposure.

APPLYING RVA OUTPUTS TO DECISION MAKING

EXERCISE 8: INTRODUCTION TO MAP DEVELOPMENT AND EXPORT

OBJECTIVE

This exercise introduces the steps required to develop a map in ArcMap for the purposes of exporting and printing. Using files and symbology developed and saved in Exercise 4, each participant will create their own map product, including basic cartographic design elements and principles. The result will be a digital map, both in the form of an ArcMap Document and PDF or JPEG.

MATERIALS

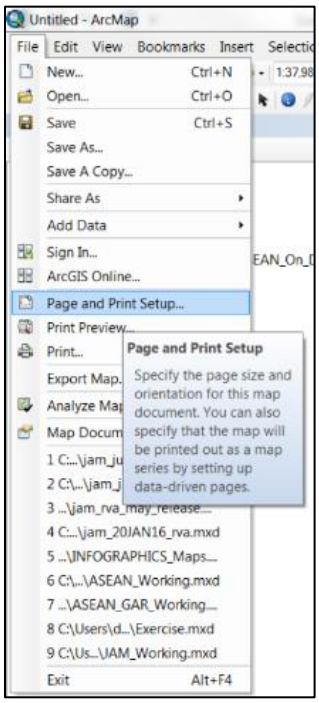
This exercise requires the use of ESRI ArcMap. To make your map, you will use the ArcMap document (.mxd) and spatial data from Exercise 4.

INSTRUCTIONS

TASK 1: PAGE SETUP

1. Open the .mxd file that you generated in Exercise 4.

2. Before creating your map, it is recommended that you define your map width and height within the **Page and Print Setup** menu. When creating a map to publish and print, it's generally best practice to design your map to using the desired layout size to ensure appropriate scale and organization of cartographic elements.



3. Click on the **File** dropdown menu and select **Page and Print Setup**

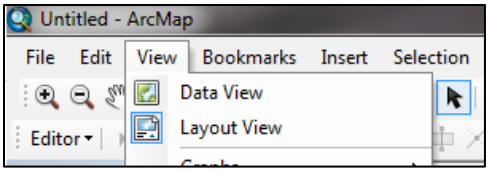
4. You can select a predefined Printer Paper Setting if you have printers configured on your computer, or define a custom extent and orientation between portrait or landscape mode.

5. Find and Select **11x17 inches** (**~28x43 centimeters**) and change the orientation to landscape and click **OK**.

    a. If you do not have a predefined page size, you can uncheck "**Use Printer Paper Settings**" and enter the parameters manually.

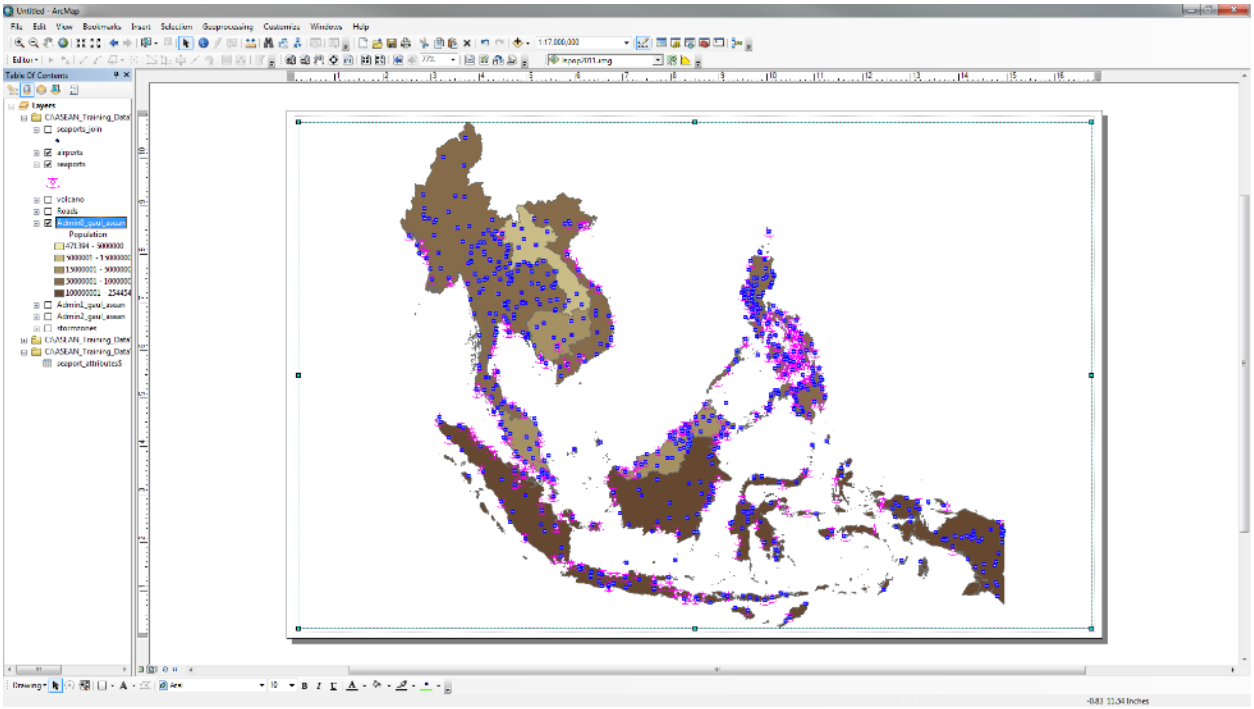
TASK 2: CREATING A MAP IN ARCMAP

1. Using our symbolized data from Exercise 4, we will look at the basic steps to create a map in ArcMap using the **Layout View**. You can toggle between the Data View and Layout View by clicking on the **View** dropdown menu and selecting **Layout View.**



2. You are able to change the size and shape of the Data Frame by clicking and dragging the vertices of the map.

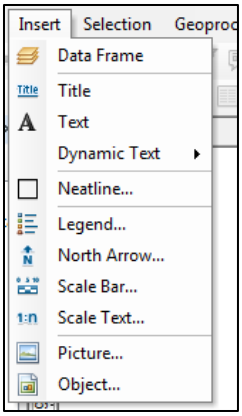
3. Reshape the Data Frame to fit the Layout extent if needed similar to the image below.



4. In map design, there are basic cartographic elements that are essential to every map: Title, legend, scale, and north arrow. Other elements might include data sources, publication data, and use limitations. Below, we will practice adding essential cartographic elements to the map.

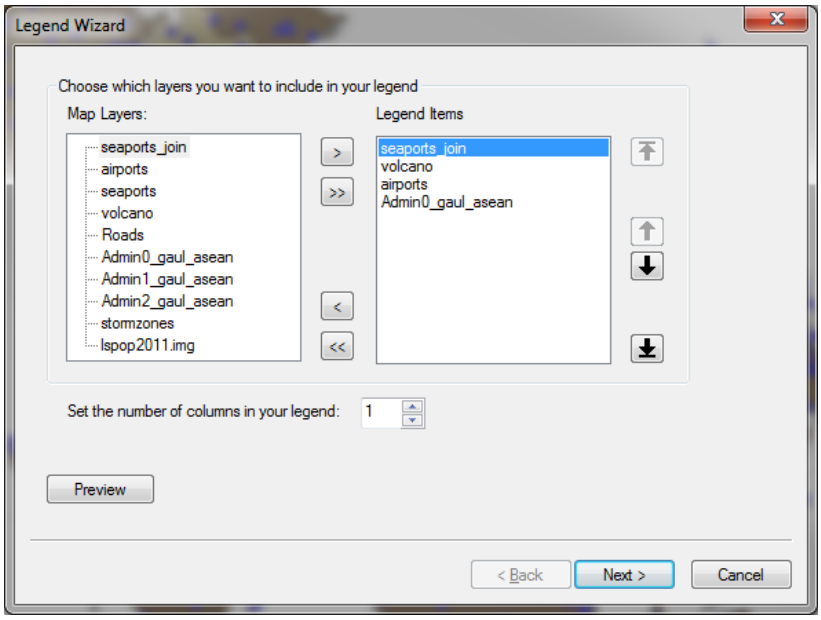
Adding a Legend

1. Under the **Insert** dropdown menu, you will find options to add other elements to your map. Next we will add a **Legend.**

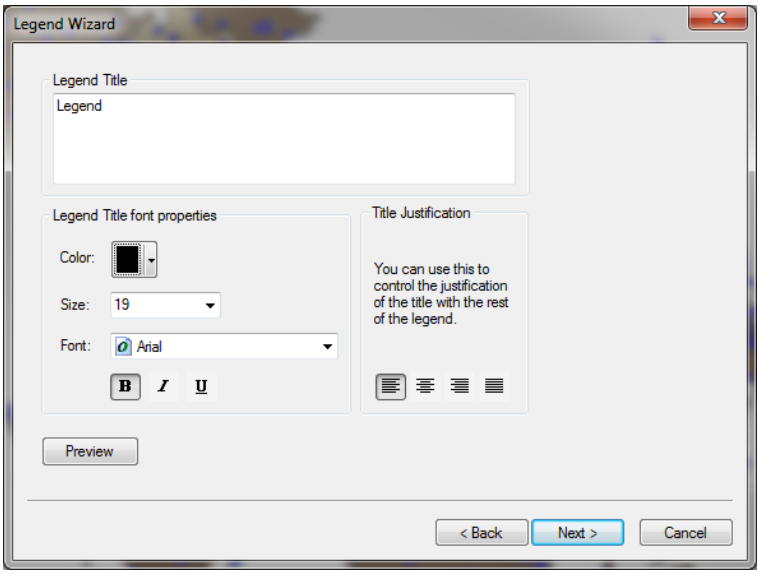


2. Click on the **Legend** button under the **Insert** dropdown menu.

3. A Legend Wizard window will open. There are many options to customize how a legend will look. In the first dialog window, you two lists of layers; the **Map Layers** list will show all available map layers in your Table of Contents; the Legend Items by default only show the layers that are active in your Table of Contents. You are able to add and remove layers by selecting the arrow keys.



4. The next window will provide options for your Legend Title, similar to the text properties we looked at earlier.



5. Click through the remaining windows until finished. You can change the legend parameters again if you need to.

6. The Legend is dynamically linked to your Table of Contents. For instance, if you change the name of a layer in the Table of Contents, the name will change in the Legend.

7. Change the name of *"Admin0_gaul_asean"* in the Table of Contents to *"ASEAN Population".*

    a. Hint: Right-click on the *"Admin0_gaul_asean"* in the Table of Contents and select **Properties**. Under the **General tab**, you can change the Layer Name**.**

8. Notice the Legend updated with the new name of the layer.

Adding a Title

1. To add a title to you map, click on **Title** under the **Insert** dropdown menu.

2. Type an appropriate title for your map to summarize the key information or purpose of the map. For example, you could call this map "**ASEAN Population 2014**"

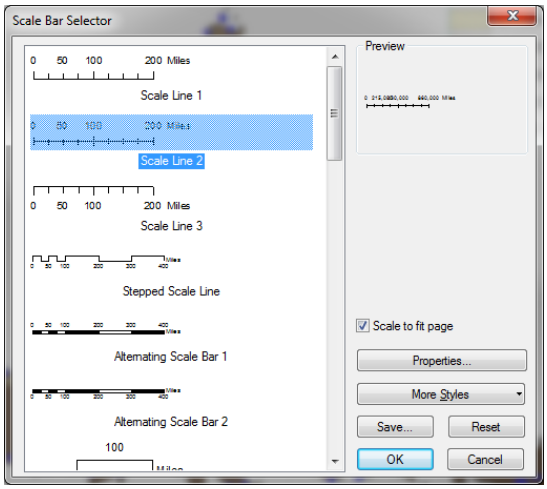
3. Click and drag the title to an appropriate area on the map

4. Note: You can edit the title, including the text and font, by double clicking, or right-clicking and selecting **Properties**.

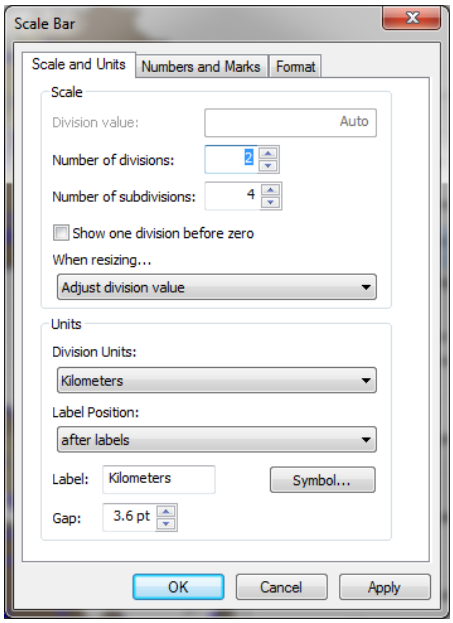
Adding a Scale Bar

1. A scale bar is a graphic element that represents the scale of a map. Click on the **Scale Bar** button under the **Insert** dropdown menu.

2. A **Scale Bar Selector** window will open providing a number of options. Select any type of Scale Bar then click on the **Properties** button.



3. A Scale Bar properties window will open allowing you to change the Division Units, Label, Position, and other customization options. Once completed, click OK. You will be able to modify the properties at any time by double clicking on the Scale Bar in your Layout View.



4. Go back to your Layout View and examine the Scale Bar. Similar to adjusting the size and shape of the Data Frame, you are able to adjust the size and position of the Scale Bar by clicking it and moving the vertices.

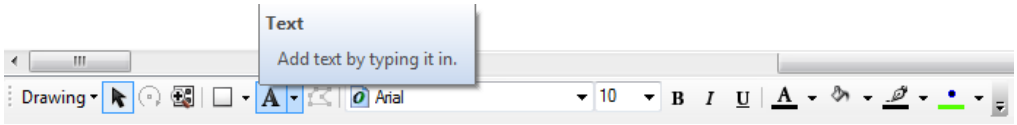
Adding a North Arrow

1. Under the **Insert** dropdown box select **North Arrow.**
2. Select a basic north arrow to add to your map, such as **ESRI North 2:**

3. From the map, you are able to adjust the size and position of the north arrow by clicking it and moving the vertices.

OPTIONAL: Adding Text to a Map

1. When making a map, it may be useful to add text annotation to the layout such as a description or data source.
2. Text can be added two ways: 1) Insert > **Text**, or 2) Using **Draw** toolbar (shown below). If you do not see the Draw toolbar, try clicking on the **Customize > Toolbars** menu at the top of the application and make sure Draw toolbar is checked



   a. **Note**: From the Draw toolbar, you can click on the **Text** button to add text. A small text box will appear where you clicked.

3. You can double click on the box you placed to edit text and font.

OPTIONAL: Customize Your Map

If there is time, you might want to further customize your map using the tools, techniques, and data resources that you've explored throughout the training exercises. In Exercise 9, you will develop and present a customized map and/or data product to help answer a relevant question raised in discussion with policy and decision makers.

TASK 3: EXPORTING YOUR MAP

1. When your map is complete, you can export your map to variety of formats including PDF and JPEG.
2. Click on the **File** dropdown menu and select **Export Map…**
3. From here you can add a File Name, change the file type, and modify the resolution of the map.
4. Navigate to your working folder for this exercise, and click the **Save** button.