Exercise 10: Accuracy Assessment

72 Points scaled to 20 Points

Introduction

In this exercise, you will calculate metrics from confusion matrices to assess the overall and class-level accuracies of a classification product. In the first section, you will analyze provided error matrices. In the second section, you will generate a validation set in ArcGIS Pro then calculate assessment metrics from it.

Objectives

- *Interpret confusion matrices to assess overall and class-level classification performance*
- *Calculate the following metrics from confusion matrices: overall accuracy, the Kappa statistic, class user's accuracy, and class producer's accuracy*
- *Understand the meaning of and appropriate use of different assessment metrics*
- *Synthesize information provided in a confusion matrix to determine what classes are most confused and the dominant sources of error*

Prerequisite Materials

- ❖ Modules: Classification and Accuracy Assessment
- ❖ Videos
  - o Confusion Matrix: https://youtu.be/6XHyYh45PxA
  - o Lab 9 Intro: https://youtu.be/tytnxVwpxgc
  - o Accuracy Assessment in R (Optional): https://youtu.be/ww8KWgT98Hw

Data

- ❖ **WV_Spectral_classes_NAIP_2016.tif**: land cover dataset for West Virginia derived from National Agriculture Imagery Program (NAIP) orthophotography using geographic object-based image analysis (GEOBIA) and machine learning
- ❖ **WV_Spectral_classes_NAIP_2016.lyr**: layer file for symbolizing the land cover raster grid
- ❖ **validation_points.shp**: validation locations across the state of West Virginia to assess accuracy of land cover dataset

This paper describes how this dataset was created:

Maxwell, A.E., M.P. Strager, T.A. Warner, C.A. Ramezan, A.N. Morgan, and C.E. Pauley, 2019. Large-area, high spatial resolution land cover mapping using random forests, GEOBIA, and NAIP orthophotography: findings and recommendations, *Remote Sensing*, 11(12) 1409: 1-27. https://doi.org/10.3390/rs11121409.

Background Questions

Question 1: Explain the difference between overall accuracy and the Kappa statistic. (4 Points)

Question 2: Explain the difference between producer's accuracy and user's accuracy. (4 Points)

Question 3: Explain the difference between precision and recall. (4 Points)

Question 4: Explain the relationship between precision and recall and user's and producer's accuracy. (4 Points)

Question 5: Why is it important that validation samples be collected using unbiased, randomized methods? (4 Points)

Question 6: Explain the concept of a population confusion matrix? Why is a population confusion matrix more informative than a non-population confusion matrix? (4 Points)

Part 1: Calculations from the Confusion Matrix

Confusion Matrix 1

Answer the provided questions using the example confusion matrix, which represents a general land cover classification.

		Reference			
		Developed	Low Vegetation	Forest	Water
Classification	Developed	152	35	11	13
	Low Vegetation	31	189	17	5
	Forest	2	27	231	11
	Water	7	6	8	93

Question 7: How many total validation samples were collected? (2 Points)

Question 8: How many samples were correct? (2 Points)

Question 9: What was the overall accuracy of the classification? (2 Points)

Question 10: What was the Kappa statistic for the classification? (2 Points)

Question 11: What was the producer's accuracy for the Low Vegetation class? (2 Points)

Question 12: What was the producer's accuracy for the Developed class? (2 Points)

Question 13: What was the user's accuracy for the Low Vegetation class? (2 Points)

Question 14: What was the user's accuracy for the Developed class? (2 Points)

Question 15: Describe the dominant sources of error in the classification and what classes were most confused. (2 Points)

Confusion Matrix 2

Answer the questions using the provided binary confusion matrix.

		Reference	
		True	False
Classification	True	193	27
	False	13	167

Question 16: How many samples were False Negatives? (2 Points)

Question 17: How many samples were False Positives? (2 Points)

Question 18: What is the recall value relative to the True class? (2 Points)

Question 19: What is the precision value relative to the True class? (2 Points)

Question 20: What is the F1 Score for the True class? (2 Points)

Confusion Matrix 3

Answer the provided questions using the example confusion matrix, which represents a classification of forest types.

		Reference				
		Mixed Mesophytic	Northern Hardwood	Spruce	Oak/Pine	Oak/Hickory
Classification	Mixed Mesophytic	152	38	4	26	34
	Northern Hardwood	41	142	11	31	19
	Spruce	2	7	120	8	6
	Oak/Pine	17	21	31	135	61
	Oak/Hickory	31	51	27	57	159

Question 21: What is the overall accuracy of the classification? (2 Points)

Question 22: Which class has the lowest producer's accuracy? (2 Points)

Question 23: Which class has the lowest user's accuracy? (2 Points)

One means to potentially reduce classification error is to merge classes that are similar or commonly confused. Re-populate the confusion matrix using the following groupings:

❖ Deciduous = Mixed Mesophytic + Northern Hardwood
❖ Spruce = Spruce
❖ Oak Dominant = Oak/Pine + Oak/Hickory

		Reference		
		Deciduous	Spruce	Oak Dominant
Classification	Deciduous			
	Spruce			
	Oak Dominant			

Question 24: What is the overall accuracy once categories are combined? (2 Points)

Part 2: Generate Confusion Matrix in ArcGIS Pro using Reference Samples

You have been provided with a vector point layer of validation locations. Each location has the correct classification associated with it in the "GrndTruth" column. You have

also been provided with a classification result as a raster grid. Using the validation points, correct classification, and predicted class, generate a confusion matrix. The class codes are defined below.

- ❖ 1 = Forest
- ❖ 2 = Low Vegetation
- ❖ 3 = Barren
- ❖ 4 = Water
- ❖ 5 = Impervious
- ❖ 6 = Mixed Developed

In order to complete this task, you will need to:

- ❖ Open the provided project file.
- ❖ Extract the land cover codes from the raster grid at each point location. This can be accomplished with the Update Accuracy Assessment Points Tool. Use the provided "Classified" column.
- ❖ Compute a confusion matrix with the Compute Confusion Matrix Tool.

Fill out the provided confusion matrix using your results.

		Reference					
		Forest	Low Vegetation	Barren	Water	Impervious	Mixed Developed
Classification	Forest						
	Low Vegetation						
	Barren						
	Water						
	Impervious						
	Mixed Developed						

Question 25: What is the overall accuracy of the classification? (2 Points)

Question 26: What is the Kappa statistic for the classification? (2 Points)

Question 27: Which class had the highest producer's accuracy? (2 Points)

Question 28: Which class had the lowest producer's accuracy? (2 Points)

Question 29: Which class had the highest user's accuracy? (2 Points)

Question 30: Which class had the lowest user's accuracy? (2 Points)