

# EGM702 – Photogrammetry and Advanced Image Analysis

Week 5, Part 5: Accuracy Analysis

- To be useful, we need to understand how accurate our classification is
- A number of different ways to evaluate our classification
- One common way:
  - Randomly sample points, manually classify ('actual' or 'true' )
  - If possible, check these in the field ('ground truth')
  - Compare to the classified image

- Overall accuracy: % correctly classified
- Errors of omission:
  - % of false negative
- Errors of commission:
  - % of false positive
- Producer's Accuracy: probability that class is correctly classified
- User's Accuracy: probability that map classification is correct

		Classified					
Actual		A	B	C	Sum	Producer's Accuracy	Error of Omission
	A	<b>True A</b>	False B	False C	$\Sigma$ Actual A	$\text{True A} / \Sigma \text{ Actual A}$	$\text{False B+C} / \Sigma \text{ Actual A}$
	B	False A	<b>True B</b>	False C	$\Sigma$ Actual B	$\text{True B} / \Sigma \text{ Actual B}$	$\text{False A+C} / \Sigma \text{ Actual B}$
	C	False A	False B	<b>True C</b>	$\Sigma$ Actual C	$\text{True C} / \Sigma \text{ Actual C}$	$\text{False A+B} / \Sigma \text{ Actual C}$
	Sum	$\Sigma$ Classified A	$\Sigma$ Classified B	$\Sigma$ Classified C	Overall Total		
	User's Accuracy	$\text{True A} / \Sigma \text{ A}$	$\text{True B} / \Sigma \text{ B}$	$\text{True C} / \Sigma \text{ C}$			
Error of Commission		$\text{False A} / \Sigma \text{ A}$	$\text{False B} / \Sigma \text{ B}$	$\text{False C} / \Sigma \text{ C}$			

$$\text{Overall accuracy} = \frac{(\text{True A} + \text{True B} + \text{True C})}{\text{Overall Total}}$$

$$\begin{aligned} \text{Error of Commission} &= 1 - \text{User's accuracy} \\ \text{Error of Omission} &= 1 - \text{Producer's accuracy} \end{aligned}$$

# Kappa coefficient

- It is possible that our classification only looks correct due to random chance
- Kappa coefficient: indicator of whether accuracy is due to random chance:

$$\kappa = \frac{\text{observed agreement} - \text{chance agreement}}{1 - \text{chance agreement}}$$

- Chance agreement:

$$\sum \% \text{ actual} * \% \text{ classified}$$

- Values typically between 0, 1:
  - $\kappa < 0$ : agreement is worse than random
  - $\kappa = 0$ : agreement no better than random
  - $\kappa > \sim 0.5$ : moderate – good agreement

# A worked example

- Overall accuracy:  $(24 + 21) / (30 + 30) = 0.75$
- User's Accuracy:
  - Water:  $24 / 33 = 0.73$
  - Land:  $21 / 27 = 0.78$
- Producer's Accuracy:
  - Water:  $24 / 30 = 0.8$
  - Land:  $21 / 30 = 0.7$
- Kappa:
  - $(0.75 - 0.5) / (1 - 0.5) = 0.5$

	Classified			
		Water	Land	Total
Actual	Water	24	6	30
	Land	9	21	30
	Total	33	27	

$$\kappa = \frac{\text{observed agreement} - \text{chance agreement}}{1 - \text{chance agreement}}$$

Chance agreement: % actual water \* % classified water +  
% actual land \* % classified land

$$= (30/60) * (33/60) + (30/60) * (27/60) \\ = 0.5$$

- Accuracy assessment is key to understanding how reliable our classification is
- Compare classified image to:
  - “ground truth” data collected in the field
  - Manually-classified test points/regions
- Assess both overall and by-class accuracy
- Compare accuracy with random chance (kappa coefficient)

- Lillesand, Kiefer & Chipman – Chapter 7
- Jensen – Chapter 13
- Accuracy Assessment for Image Classification [[ESRI](#)]
- Accuracy Assessment [[ERDAS Imagine](#)]
- Evaluating the Classification [[Geo Data Design](#)]