**Gis2**

**The Sand Table GIS Project**

**Introduction**

The purpose of our GIS2 course is to provide you with multiple hands-on learning experiences that involve building, using, and applying geographic information systems to solve problems.

Real world landscapes are interesting, but their complexities can pose difficult problems for the novice mapper – especially when you’ve never actually walked on that ground. Instead, we’re going to think about a landscape model that fits on a table. We can walk around it. We can get close to it. Or we can step away and look at it from many different vantage points.

We’re going to start by looking at and sketching the terrain in a sand table. We’re going to use that sketch to help us think about what we want to take from the table. And then we’re going to organize the observations we take from the table using GIS techniques. In other words, this hands-on learning experience will help you to conceptualize a landscape and to learn the process of collecting spatially-referenced data and preparing those data for use in a GIS.

The sand table project requires a variety of skills and some labor, so we’re going to pool human resources and work in teams. Lab work will be performed and lab reports will be submitted by teams (not by individuals). All team member names should appear atop the first page of your team’s report. All team members will receive the same score for your team’s work and report. As your professor, I will guide you through the process while also being watchful for signs of slack (a person not pulling his or her weight) and signs of overload (one person doing all the work). If need be, I’ll adjust the offending team member(s) “Professionalism” score(s) accordingly.

**Purpose (Why are we doing this?)**

The purpose of the Sand Table GIS Project is twofold:

- Lab 1 offers you a hands-on learning experience that will help you learn how to **conceptualize a landscape and collect spatial data**; and

- Lab 2 will help you gain experience **preparing your data for use in a GIS**.

Please know that each lab is designed to help you learn different things, so the purpose section for each report should be written differently.

**Objectives (What in general are we supposed to do?)**

You’ve been given a wooden table containing sand and rocks that were shaped into a physical terrain model. Also, a few wooden buildings have been placed on the terrain.

- For Lab 1, your objectives include thinking about the terrain, planning a data collection mission, reviewing your plan with me, and then collecting your spatial data.

- For Lab 2, your objectives include building digital datasets that accurately represent ‘entity’ locations and ‘field’ variations, and building a scaled map (using ArcGIS Desktop) that accurately represents your sand table.

**Advice for Lab 1**

Find the outside corner of the sandbox associated with 0 cm E, 0 cm N on the Sand Table Coordinate System. Use this point like a survey mark (a horizontal datum point against which all your horizontal distances can be spatially referenced). Let the Northing axis run parallel with the long side of the table. Let the Easting axis run parallel with the short side of the table.

Prepare, collect, store, and map all data using the ‘decimal centimeter’ as your unit of measure. Yes, ArcGIS is capable of handling mixed units (e.g., inches and cm), but it’ll be much easier if you use just one unit of measure of measure for all your x, y and z data.

*Read everything before doing anything.*
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**METHODS FOR LAB 1 (How, specifically, are we supposed to accomplish the objectives?)**

1. Observe your sand table, then identify and name any salient landforms;
2. Draw a detailed sketch of your sand table and its salient landforms. Be sure to:
   a. Annotate your sketch with landform names and other descriptive information.
   b. Label your coordinate system axes (Easting, Northing) and draw a north arrow;
   c. Find the horizontal origin (where x,y = 0,0) of the Sand Table Coordinate System and plot/label this very important point;
   d. Choose, plot, and label your vertical origin (where z = 0);
3. Think about how to represent each discrete building;
4. Think about how to represent elevation as it changes continuously across the landscape;
5. With respect to your landforms, choose an appropriate minimum mapping unit (mmu);
6. Based on your mmu, calculate the spatial sampling interval for collecting elevation data;
7. Identify methods and tools you’ll use to take observations and record data.

**Question 1:** Observe the sand table. Describe the average aspect of the terrain surface (i.e., find the highest region on the landscape, then report the general downhill direction (N, NE, E, SE, S …) that rainwater would tend to flow if a miniature rainstorm occurred over the table).

**Question 2:** What are the names your team has given to the salient landforms on your landscape?

**Question 3:** Which of your salient landforms has the shortest horizontal dimension (i.e., shortest length or shortest width; not the shortest height). What is the length (in cm) of that shortest dimension?

**Question 4:** The shortest horizontal dimension of a landform is sometimes called its semi-minor axis (the longest is called its semi-major axis). The semi-minor axis of your landform serves as your Minimum Mapping Unit (MMU). Given your MMU, what should be your horizontal sampling interval (in cm)?

I want to help you avoid mistakes, so meet and discuss your plan with me before starting step 8.

8. Collect your data.

**Question 5:** Build a captioned table in your report that provides the header and first 10 rows of your elevation field data (Table 1). Build another table (Table 2) that provides the header and all the records of your building entity data.

**Question 6:** Did you modify your horizontal sampling interval as you collected your elevation data? If so, then report the new sampling interval (in cm).

**Question 7:** Did you have to sample your population of buildings? Consult your notes and explain.

and skip to the **DELIVERABLES** section for information about writing your first lab report.

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METHODS FOR LAB 2

9. In your GIS2 folder, labs subfolder, create a subfolder called “SandTable”.
10. use ArcGIS/ArcCatalog to create a new file geodatabase in your SandTable folder;
11. use Microsoft Excel or Notepad to organize your spatial data into files;
12. right-click your file geodatabase, create a feature class > From Add XY table (once for buildings and once again for spot heights), and check your work;
13. go back to Tasks 11 and 12 as needed to correct any blunders or errors in your data;
14. interpolate a surface of elevations from your point feature class of spot heights;
15. create contour lines that represent your terrain surface.
16. Now use ArcMap to build a scaled representation of the landscape in your sand table;

Question 8: Which interpolation algorithm did you use to interpolate a surface from your point data? Explain it.

Question 9: Does your interpolated surface – your digital elevation model (DEM) - adequately represent the terrain in your sand table? Do your point features adequately represent your building entities? Which parts of your map turned out better than others? Explain.

Question 10: If you had to do this project all over again, then what would you change or do differently to improve your group’s efficiency and product quality? Explain.

ADVICE FOR LAB 2

I want you to design and build a properly scaled map of your sand table using a style that mimics a USGS Topographic map. Admittedly, your map will have fewer layers than a USGS topo, but you should still be able to use one as a reference (i.e., the map area is big, the title font is small, contour lines are brown, salient landforms are labeled, a scale bar is visible but unobtrusive, etc.). Specify your map layout and symbols accordingly. Your map collar should include the:

1. a (small) title;
2. names of authors, the date(s) your data were collected, and the date your map was published;
3. a (small) north arrow;
4. a symbol key (to provide map readers with definitions for symbols/colors used);
5. set the map scale property of you data frame using a user-friendly ratio (e.g., a map scale of 1:50 is user-friendly; a ratio like 1:50.38953 is not) (Kimerling et al., p24).
6. and label your landforms.

Figure 1: A map produced by students in 2015.
DELIVERABLES FOR BOTH LABS

Write a well-written and proofread report for Lab 1 and another for Lab 2. Each report should be typed and printed on letter size (8.5” by 11”) paper. Before drafting your report, set all page margins to be 0.7”, except for the left margin; set the left margin to 1.2”. Include page numbers on every page. Set the normal font face to be Bookman Antiqua, Bookman Old Style, or Georgia; never use Times New Roman. Set the normal font size to be 11 points. Use 1.5 line spacing throughout. All section headings should be in bold face and left-justified. Report the names of all group members, the date, and the lab name atop the first page. Don’t waste paper by including a cover sheet. Each report should include five sections and section headings:

1. Purpose
2. Objectives
3. Methods and Data
4. Results and Answers; and
5. Summary.

For each lab, write a concise statement of purpose in your own words that answers the question: *Why are we doing this lab - what are we supposed to learn?*

Next, identify the objectives using your own words by answering the question: *What tasks, in general, are we supposed to accomplish during this lab?*

Next, describe the methods and data you used (i.e., *How, specifically, did we accomplish each objective? Software? Equations? Steps?*). If describing a particular method using text becomes cumbersome, then try explaining it by using a worked example, drawing a sketch, building a diagram, or inserting an equation.

Your Results and Answers section should contain any data tables, images, or results as well as the answers to all the questions that were posed during the lab. All tables (Insert > Table) must be numbered sequentially and captioned; table captions are to be placed above the tables they describe (e.g., Table 2-2 on page 59 in Bolstad, 2015). All figures (Insert > Picture) must be numbered sequentially and captioned; figure captions are to be placed below the figures they describe (e.g., Figure 2-3 on page 31 in Bolstad, 2015). When equations are used (Insert > Symbols > Equations), be sure to define each term.

Use the Summary section to describe how well you think you achieved the purpose of the lab. Feel free to identify anything that you learned, found interesting, or found difficult. Feel free to describe any moment when your mental ‘light bulb’ glowed brighter (or flickered). You may also use the Summary section to ask me questions.

GLOSSARY

**e.g.** An abbreviation of the Latin phrase *exempli gratia*, which is translated to English as “for example.” It is used to introduce an illustrative example.

**etc.** An abbreviation of the Latin phrase *et cetera*, which is translated to English as “and other things” or “and so forth.” It is to end a list that could go on and on.

**i.e.** An abbreviation of the Latin phrase *id est*, which is often translated to English as “in other words” or “that means.” It is used to clarify or rephrase the meaning of a statement.