Spatial Analysis

Assignment 1 (5%):   Due Jan. 16th

The questions in this lab form up assignment 1. You are required to answer the questions in this lab. Keep one decimal place for numeric value.

Submission

- Make a title page with course name, number, assignment number, your name and studentID and save the answers in a WORD / PDF file as ***lastname_firstname_geog413_A1***.
- Send the file to your lab instructor by email (baip@unbc.ca) as attachment with subject "Geog413 A1"

In this lab, you will be performing vector analysis for the Aleza Lake area. Skills and techniques required to answer the questions in this lab can be found in geog300 course.

Data location: L:\labs\geog413\data\analysis

Spatial Data	Description
bndy	Study Boundary
rivers	Rivers
streams	Streams
roads	Roads
zones	Primary zone
viewpoints	View point locations
plots	Sampling plots
campsites	Camping Sites
dem	Raster digital elevation
slp_as	Slope and aspect information
fc	Forest Coverage data

Tables	Description
fc_dat.dbf	Forest attribute
plots_dat.dbf	Sampling plots attributes

Examine dataset *fc*

- Copy the folder **analysis** from L drive to your local folder. Use your local copy for this lab
- Examine each datasets

fc is the forest coverage data containing vegetation information. **fc_dat.dbf** is the table containing attributes for each *fc* feature. The join field is FC_TAG.

Q *Extract all the **fc** polygons with the stand age (stand_age) greater than 100 and less than 200 years (exclusive). These polygons could be used as a new study boundary for a project which only the information about these stands areas is of interest.*

   Q1a.   *What is the query expression applied for extracting these **fc** polygons and how many features meet the criteria?*

   Q1b.   *What is the average stand age and the total area of the selected features?*

Q *Because the boundaries for stands are in reality indefinite (i.e. trees do not suddenly change from one height to another at a definite line), we will want to study regions 200 meters beyond the boundaries generated in the previous step. Create a new boundary that covers the selected features (from previous step) and 200 meters beyond that. The resulting dataset should be the original selected area plus 200 meters buffer zone (make sure to dissolve the barrier)*

    Q2. What is the total area in hectares of the new study region?

Q *The result from previous step should turn to the new boundary. But when you examine the new boundary, you should notice a problem. The new boundary have gone beyond the region for which we have valid data. Therefore, the region around the edge should be removed.*

- Clip the result from previous step with ***bndy*** to make up the new boundary

    Q3. What is the area in hectares of the new boundary?

Examine *fc*, *dem*, and *zones*

Q *We want to know which **fc** polygon (fc_id) has the highest average elevation, how many **fc** polygons have the average elevation falling into 600 – 620 (exclusive) and the total area in hectares of the selected **fc** polygon is*

- Clear the selection on ***fc*** if any, Perform a zonal statistics analysis (**Zonal Statistics as Table**). Make sure to set Zone Field to **FID**.
- Join the resulting table to ***fc*** layer using the **FID**
- Examine the statistic information for each ***fc*** polygon

    *Q4a.   Which **fc** polygon (FID) has the highest average elevation?*

    *Q4b.   How many **fc** polygons have average elevation falling into 600 – 620m(exclusive)?*

    *Q4c.   What is the total area in hectares of the selected **fc** (from Q4b)?*

Q *We also like to know the average elevation for the largest **fc** polygon and the average elevation for the largest Balsam Fir (BL) polygon (SP1: leading species)*

- Clear the selection on ***fc*** if necessary
- To find the average elevation for the largest ***fc*** polygon, first sort the AREA in descending order. The largest polygon will be listed on the top. Check the average elevation for the top record
- To find the average elevation for the largest BL polygon, first perform an attribute query to filter out all Balsam Fir polygons and then sort the AREA on the selected features in descending order.

    Q5a. What is the average elevation for the largest forest polygon?

    Q5b. What is the average elevation for the largest Balsam Fir (BL) polygon?

Q *How many **fc** polygons have the elevation range value greater than 50 and border to Aspen (AT) or Balsam Fir (BL) polygons and what is the total area?*

Several steps are required to answer this question

- Clear the selection on ***fc***
- First extract all the ***fc*** polygons with Aspen (AT) or Balsam Fir (BL) as the leading species (SP1)
- Second, with Select by Location, find all the polygons that are adjacent to these selected polygons (within 0 distance of).
- Third, remove the polygons that have Aspen or Balsam as their leading species from the selected features since these are not the polygons we are looking for.
- Finally, select the polygons that have the elevation range value greater than 50 from the selected features

Q6. What is the total number of *fc* polygons that have the elevation range value greater than 50 and border to Aspen (AT) or Balsam Fir (BL) polygon?

Q7. What is the total area in hectares of these polygons?

Q How many Balsam Fir (BL) polygons with the average elevation greater than 700 are intersect with Upper Camp Creek Zone?

- Clear selection on *fc*
- Extract all BL polygons with average elevation greater than 700 meters from *fc*
- Extract 'Upper Camp Creek 'zone
- Select by location from the selected *fc* that are INTERSECT with the selected *zones*

Q8. How many Balsam Fir (BL) polygons with average elevation greater than 700 and are intersect with Upper Camp Creek Zone?

Examine *plots, plots.dat, streams, fc*

The attribute table **plots_dat.dbf** contains none spatial information on sampling plots. Use this table together with *plots* attribute table to answer the following questions.

- Join the **plots_dat** to *plot*s using **plot_id** field

Q We want to know how many Spruce (SP1: S) *plots* fall into 50 meters distance of 'Gravel Road 2 Lane' roads and are within 50 meters of *streams* and what the average stand age of these *plots* is?

- Select all Spruce plots (`'S'`)
- Select all *roads* with 'Gravel Road 2 Line' type
- With the selected features on both layers, Apply Select by location on selected *plots* (select from current selection) that are within 50 meters distance of selected *roads*.
- Next do Selection by Location from the selected *plots* that are within 50 meters distance of *streams*

Q9a. How many Spruce (SP1) plots that fall into 50 meters distance of 'Gravel Road 2 Lane' roads and are within 50 meters distance of streams?

Q9b. What is the average stand age of these plots?

Q How many *fc* polygons contain the sampling *plots* that have Spruce as the leading species (SP1) and the stand age greater than 200 years old? What is the area in hectares of the largest selected forest polygon?

We are looking for the *fc* polygons that meet certain conditions.

- First, filter out all the Spruce *plots* with stand age greater than 200 years old
- With Select by Location, select the *fc* polygons that contain the selected *plots*

Q10a. What is the total number of *fc* polygons that contain the sampling plots with Spruce as the leading species and the stand age greater than 200 years old?

Q10b. What is the area in hectares of the largest selected forest polygon?

Examine *fc, slp_as, roads*

slp_as is a polygon feature class containing slope (Degree_Slo) and aspect (Aspect) information for Aleza Lake area.

Q *We want to know which parts of the **roads** have slope greater than 5 and less than 10 degree. That will help planner to decide what kind of equipment they need for logging.*

To solve this problem, you need to perform an overlay operation on *roads* and *slp_as* to get slope information for each road segment.

- Clear the selection on each layer
- Perform an overlay on *roads* and *slp_as* with INTERSECT tool. Note: this may take time as the number of features in *slp_as* is big

Q11a. How many road segments that have slope greater than 5 and less than 10 degree?

Q11b. What is the total length in kilometres of these road segments?

Q *We are also interested in finding the areas that are more suitable for new camping sites. These areas should meet following criteria:*

1. Mainly covered by Spruce
2. Face to south (135 < aspect< 225) and slope is less than 5 degree.
3. Water sources must be available within 150 meters distance (*streams*)

To locate the potential camping area, you will need to find the area that meet all conditions listed above

- First, filter out all Spruce polygon from *fc*
- Second, make an attribute selection on *slp_as* to get the area that face to south (135 < Aspect< 225) and relatively flat area (Degree_Slo < 5)
- Third, create a 150 meter buffer zone on *streams* to locate the area that have water sources available (within 150 meters of streams).
- Finally, perform an overlay operation with INTERSECT tool on both selected *slp_as* and *fc* and *the* buffer of *streams.* Save the output as *camp_area*. Recalculate the AREA.

Q12. What is the total area in hectares of the potential camping area?

Proximity Analysis

Proximity is another the most basic GIS questions, such as:
- How close is this well to a landfill?
- Do any roads pass within 1000 meters of a stream?
- What is the distance between two locations?
- What is the nearest or farthest feature from something?

POINTDISTANCE, NEAR, THIESSEN POLYGON functions can be used for proximity analysis. These tools are located under ArcToolbox ->Analysis Tools -> Proximity

NEAR command determines the distance from each feature in the Input Features to the nearest features in the Near Features within the Search Radius.

— The Input Features can be one of the following feature types: POINT, POLYLINE, POLYGON, MULTIPOINT
— The Near Features can include one or more feature classes of different types.
— The results are recorded in the Input Features attribute table. Fields for distance and feature ID of the closest feature are added or updated.

When you run this tool, the distance and the Internal-ID (feature#) of the closest feature are added as new items to the input dataset attribute table. Sample input and output attribute table from the NEAR command are shown below**.**

Input Attribute Table

FID	Build-id
1	1
2	2
3	3
4	4
5	5
6	6

Output Attribute Table

FID	Build-id	Near_FID	Near_DIST
1	1	4	10.4
2	2	2	20.4
3	3	6	12.7
4	4	1	37.5
5	5	5	23.1
6	6	3	8.5

Examine *viewpoints, campsites*

Q *We want to determine the distance from each **viewpoints** location to the nearest **roads**. NEAR tool can be used to generate a distance table from each viewpoint to the nearest **roads**. The distance field will be added automatically into the input features (**viewpoints**).*

- Add *viewpoints* from your local folder. Clear the selection on each layer

ArcToolbox->Analysis Tools->Proximity-> NEAR

Input Features	***viewpoints***
Near Features	***roads***
Search Radius	**12000 meters**

Examine the attribute table of ***viewpoints***. You should see new data fields were added into the attribute table (roads#, distance).

Input_FID	Near_FID	Distance
2	101	50.45
2	102	71.13
2	104	56.76
1	105	64.34
2	105	69.37
1	107	32.49

*Q13a. What is the total number of **viewpoints** that are within 300 meters distance of **roads**?*

Q13b. Which viewpoints (FID) is the furthest from a road?

*Q13c. How many **viewpoints** are beyond 500 meters distance of a road?*

Another tool used for proximity analysis is **POINTTDISTANCE.**

POINTDISTANCE computes the point-to-point distance between each point in the input dataset to all points in second dataset within a specified Search radius. The results are recorded in an Output table containing items for the internal numbers and DISTANCE. The precision for DISTANCE is the higher of the two input dataset.

POINTDISTANCE generate a database table not a spatial dataset. The output table will include ID of each feature from input dataset, the ID which is near the input feature and the distance.

Q *With POSINTTDISTANCE tools, calculate the distance from each camping site location (**campsites**) to each location in **viewpoints**.*

Analysis Tools->Proximity-> POINT DISTANCE

Input Features	***campsites***
Near Features	***viewpoints***
Output Table	**camp_view.dbf** (in your local folder)

Q14a. Which camping site (FID) is closest to a viewpoint?

Q14b. What is the distance?

Note: Use the POINTDISTANCE command with care as calculating distances between two point files with 1000 points in each coverage will produce a database file with 1,000,000 records!

THIESSEN POLYGONS

Create Thiessen Polygons tool converts input points to an output feature class of thiessen proximal polygons. Thiessen polygons have the unique property that each polygon contains only one input point, and any location within a polygon is closer to its associated point than to the point of any other polygon.

Thiessen Polygons tool can be used for determining such as service area or school catchment area etc.

Q *Assume **viewpoint** locations will be used for the locations of corner store to serve the surrounding neighbourhood area and we want to determine the tread area/service area of each corner store.*

- In order to get correct service area within study boundary, you need first set processing extent to make sure the output cover entire study area. From the top menu bar, click Geoprocessing->Environments-> Processing Extent and choose **bndy** from the dropdown for Extent. Click OK

  Analysis Tools->Proximity-> Create Thiessen Polygon

Input Features	***viewpoints***
Output Feature Class	***thiessen***

- Examine **thiessen**

Q15a. What is the service area in hectares for the eastern most corner store?

Q15b. Which corner store (FID) has the largest service area?

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