

**Title:** Topoff Mining Company Assignment

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**Context:** This is the second-to-last computer lab exercise that the students on an introductory GIS course work on. It shows the students how to use the interpolation techniques discussed in the lecture.

# Geographic Information Systems (GEOL-ENVS 403/503)

Fall 2009

## Laboratory Exercise (Topoff Mining Company)

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### Introduction

The Topoff Mining Company has recently selected an area for mining. Their first job is to model the area to be mined. They have sent out a survey team with GPS equipment. The team has constructed a data set consisting of a set of points with X, Y, and Z coordinates. All readings are in meters. The Z values are meters above sea level.

The team has also done some test cores which indicate the depth to which the firm must excavate to reach coal. These values are in a X-Y-Z-format file, too.

Your job is to estimate the amount (in cubic meters) of overburden that must be removed before the coal surface is exposed. The files for creating the surfaces are SURFACE.TXT and COAL.TXT.

### Reading in GPS Points

Start ArcMap and add the 3D Analyst Extension. Download the SURFACE.TXT and COAL.TXT files from MyBGSU and add them to a new map document in ArcMap.

To make sure that all your files are saved to your Lab\_TMC directory click on 3D Analyst, then Options, and on the General Tab defined your working directory.

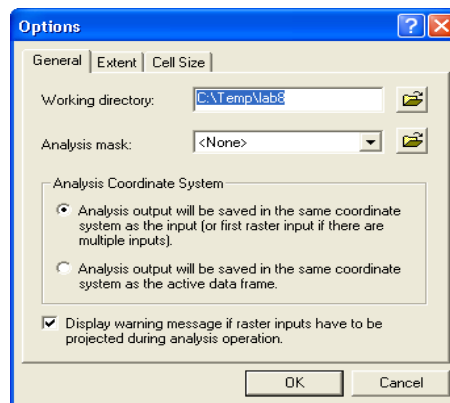


Figure 1. 3D Analyst options.

Click on Tools->Add X-Y Data to create a point layer map from the X-Y coordinates of the text files. Do it for the surface.txt and the coal.txt files.

The points collected and stored in the “.txt” files are not two-dimensional, but three-dimensional. So we need to create a 3D surface. Click on 3D Analyst, then Convert, then Features to 3D. This option creates a shapefile of the 2D map created above using the Z attribute as the source of heights. Notice that you have to use the point layer and set the source of heights as the Z attribute.

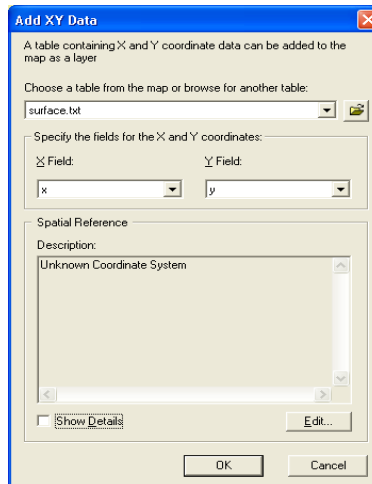


Figure 2. Add XY Data.

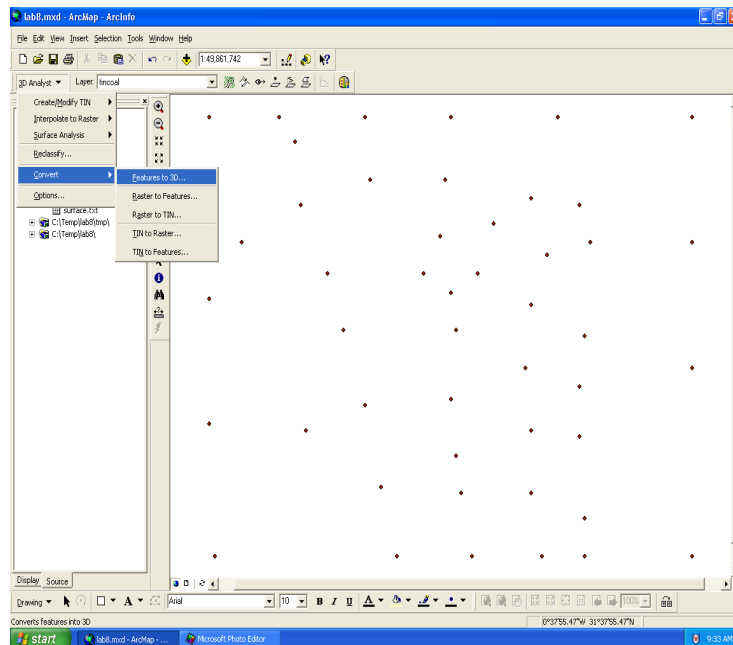


Figure 3. Convert feature to 3D menu.

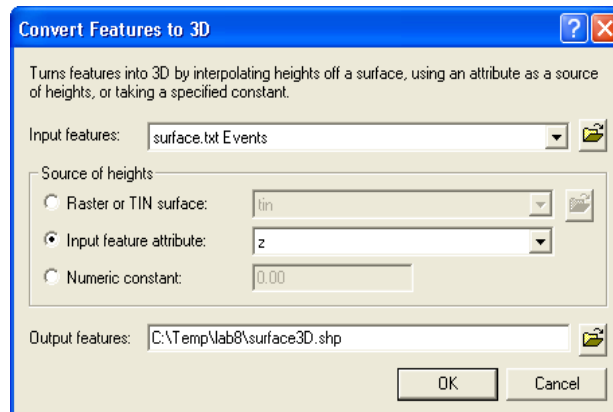


Figure 4. Convert feature to 3D options.

To create a 3D surface we are going to use TINs. So click on 3D Analyst, Create/Modify TIN, Create TIN from features. The layer you are using is the 3D surface created above and the height source is Feature Z Values, accept the other defaults.

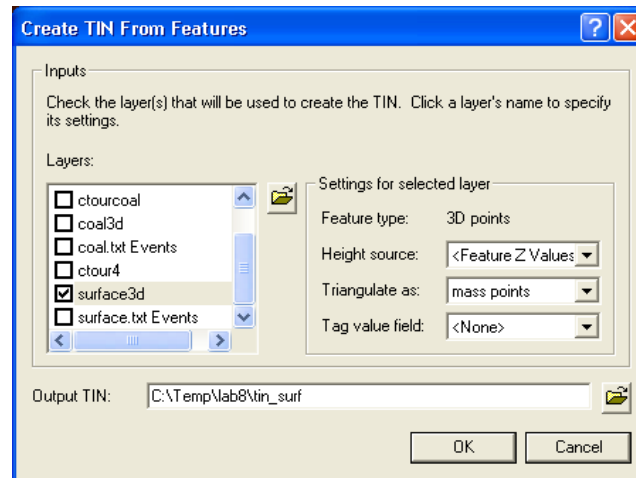


Figure 5. Create TIN from features options.

Click on 3D Analyst, Surface Analysis, Contour to create contours of the surface data using the TIN just produced. Accept the defaults in the Contour dialog (see figure below).

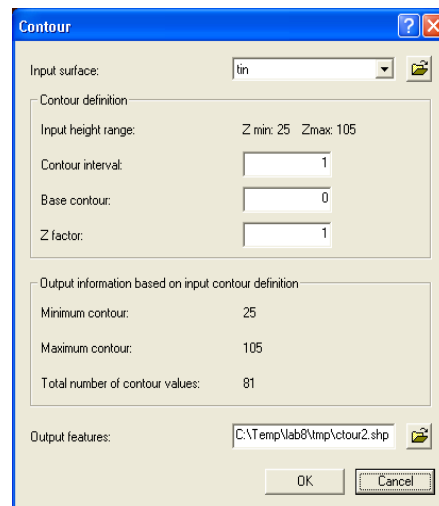


Figure 6. Contour options.

### ArcScene

Open ArcScene (second to last rightmost button on the 3D Analyst toolbar) and add the surface points shapefile, the TIN, and the contour layers. Let's consider to how best present the relationship between them.

In ArcScene, select the TIN surface, right click then select Properties. Go to symbology and add "face elevation with graduated color ramp" then select a "good" color ramp. Within properties click on the Base Heights tab and click on "Obtain heights for layer from surface" and give it the name of your TIN surface. Leave the other settings in Base Heights alone.

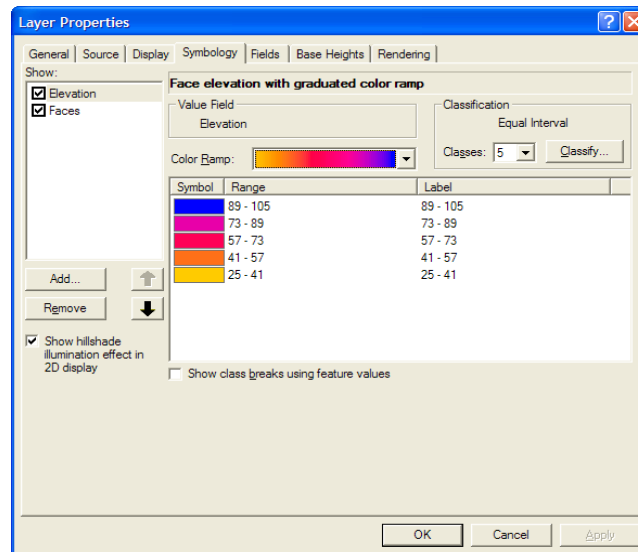


Figure 7. Symbology for TIN surface.

Select the surface points shapefile layer and right-click on it. In Properties select the Extrusion tab and extrude the points by  $-[z]$  (notice the negative sign). You should get a screen just like the one below.

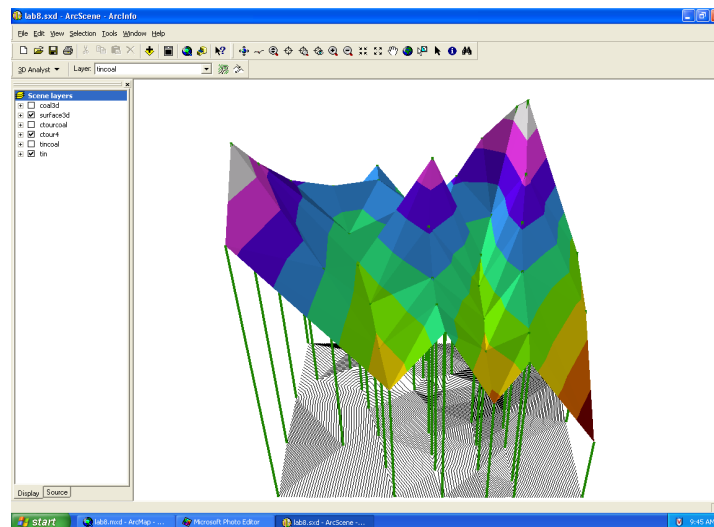


Figure 8. ArcScene surface display.

Repeat the same procedure in **Reading in GPS Points and ArcScene** sections for the Coal.txt file. Can you see the differences between the coal and surface shapes? ArcScene allows you to rotate the figure so you can see it from different perspectives.

### Area and Volume

Go back to ArcMap, no need to close ArcScene, just minimize it. We are going to estimate volumes under a surface. Highlight your TIN-surface and click on 3D Analyst, then Surface Analysis, then Area and Volume... You will get a dialog like in the figure below. Make the height of plane equal to 0.0 (Why?) and click on calculate statistics (you can save your answers in a text file). Also estimate the volume under the coal surface.

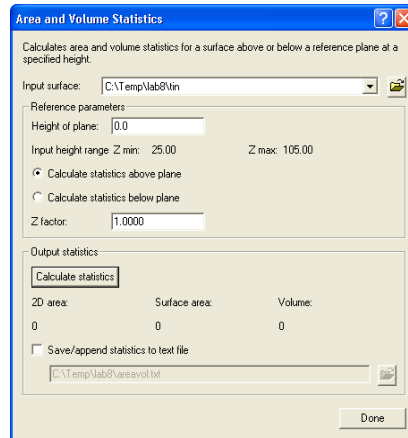


Figure 9. Area and Volume dialog.

Now we will re-do the volume calculations using a different surface estimation method. But first, let's set the extent of the analysis to be the same as the surface points shapefile (it should not cover the whole display) and the Cell Size to Maximum of Inputs (largest of cell sizes). Click on 3D Analyst, then Options to do it.

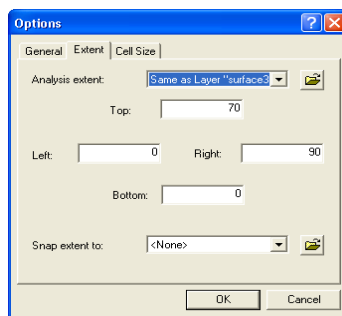


Figure 10. Extent of analysis.

Click on 3D Analyst, Interpolate to Raster, Inverse Distance Weighted (IDW). That is the different surface estimation method we will use. The Input Points come from the surface point shapefile. Leave the other settings as they are (see dialog below) and save your output raster.

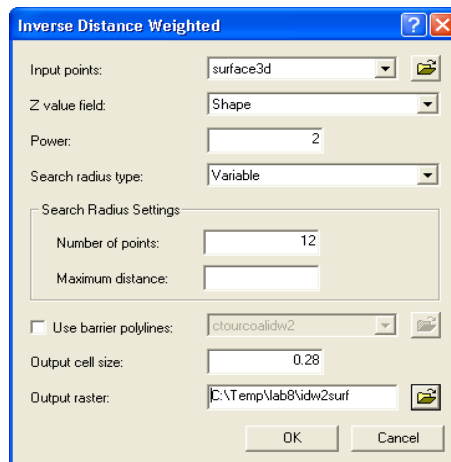


Figure 11. IDW options dialog.

Once you have created the surface layer add it to ArcScene together with a contour layer created from the IDW layer. Make sure to set the Base Heights tab of the IDW layer, so you can see the vertical component of the data. Select an appropriate color ramp for it.

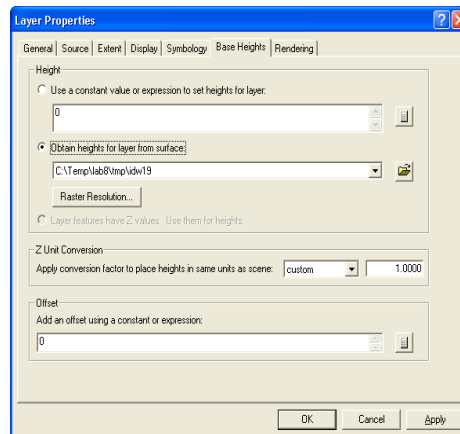


Figure 12. Base Heights tab for IDW.

Do the same for the coal data using again IDW to estimate the surface. Add the layer to ArcScene, you should have something like the figure below.

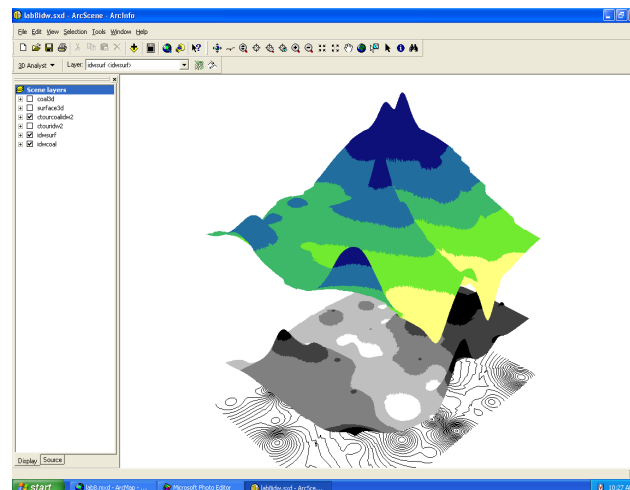


Figure 13. ArcScene for IDW.

Estimate the volume of overburden obtained by this surface estimation method and repeat it for an IDW power of 1 and 6 (see question 9). Notice that you can also use the Cut/Fill method in the Surface Analysis option of 3D Analyst.

All students have to use one more different surface estimation method: the spline. Graduate students also have to use Kriging.

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## Laboratory Exercise – Question Sheet

Due Date:

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**Instructions:** create a folder named “Lab\_TMC” within your hard-disk/usb drive space and work and store all files for this exercise there. I may check that you did the exercise by looking at the files in this directory only. If they are not there, then you did not do the work. No excuses.

1. What does TIN stands for? What is the use of TIN data models?
2. What is the 3D Analyst Extension? What capabilities does it add to ArcMap?
3. What is ArcScene? What capabilities does it add to ArcGIS?
4. Include a copy of the surface and the coal 3D perspectives created in ArcScene with IDW (power = 2).
5. What is the volume under the Surface (include units!)?
6. What is the volume under the coal surface (include units!)?
7. What is the estimate of the volume of overburden using TIN (include units!)?
8. What is the estimate of the volume of overburden using IDW (include units!)?
9. What are the estimates of the volume of overburden using IDW with a power of 1 and a power of 6 (include units!)?
10. What are the estimates of the volume of overburden using regularized spline (include units!)? What is a spline?
11. (*Grad only*) Estimate the volume of overburden using Kriging (ordinary and universal) as the surface estimation method.
12. (*Grad only*) An alternative title for this lab could be: “The Subjectivity of Objective Methods - or How to Lie with Computers and be a Successful Consultant? Explain why this title would be appropriate or not?