

GIS in Water Resources
Fall 2017
Homework #1

Goal

The goal of this homework is to reinforce the lecture material on Geodesy, Map Projections and Coordinate Systems by having you identify attributes and perform hand calculations related to coordinate systems and distances between points on a spherical earth.

1. Coordinate System Parameters

The map below shows the continental United States in geographic coordinates overlaid by a grid which has $10^\circ \times 10^\circ$ cells.



The parameters of the USA Contiguous Albers Equal Area Conic coordinate system as displayed in ArcGIS are given below. Draw on the map above the Central Meridian, Reference Latitude, and Standard Parallels used in this coordinate system.

Coordinate System Details	
Projected Coordinate System	USA Contiguous Albers Equal Area Conic
Projection	Albers
WKID	102003
Authority	Esri
Linear Unit	Meter (1.0)
False Easting	0.0
False Northing	0.0
Central Meridian	-96.0
Standard Parallel 1	29.5
Standard Parallel 2	45.5
Latitude Of Origin	37.5
Geographic coordinate system	GCS North American 1983
WKID	4269
Authority	EPSG
Angular Unit	Degree (0.0174532925199433)
Prime Meridian	Greenwich (0.0)
Datum	D North American 1983
Spheroid	GRS 1980
Semimajor Axis	6378137.0
Semiminor Axis	6356752.314140356
Inverse Flattening	298.257222101

- Put a large dot at the intersection of the Central Meridian and Reference Latitude on the map and label this with the (X,Y) coordinates that this location has in the given coordinate system.
- What earth surface property does the Albers projection preserve regardless of the projection parameters?
- What earth datum is used with this coordinate system?
- The geographic coordinates of UT Austin are: $30^{\circ} 17' 10''$ N and $97^{\circ} 44' 22''$ W. The geographic coordinates of Logan Utah are: $41^{\circ} 44' 45''$ N and $111^{\circ} 48' 30''$ W. Calculate the coordinates for each of these in decimal degrees. Express your answers using 5 digits following the decimal point.
- Assuming a spherical earth with radius 6371.0 km, calculate the distances in meters that UT Austin is south of the latitude of origin and west of the central meridian for this coordinate system.
- Based on the distances calculated in (e) determine the approximate coordinates of Austin in the USA Contiguous Albers Equal Area Conic coordinate system above.

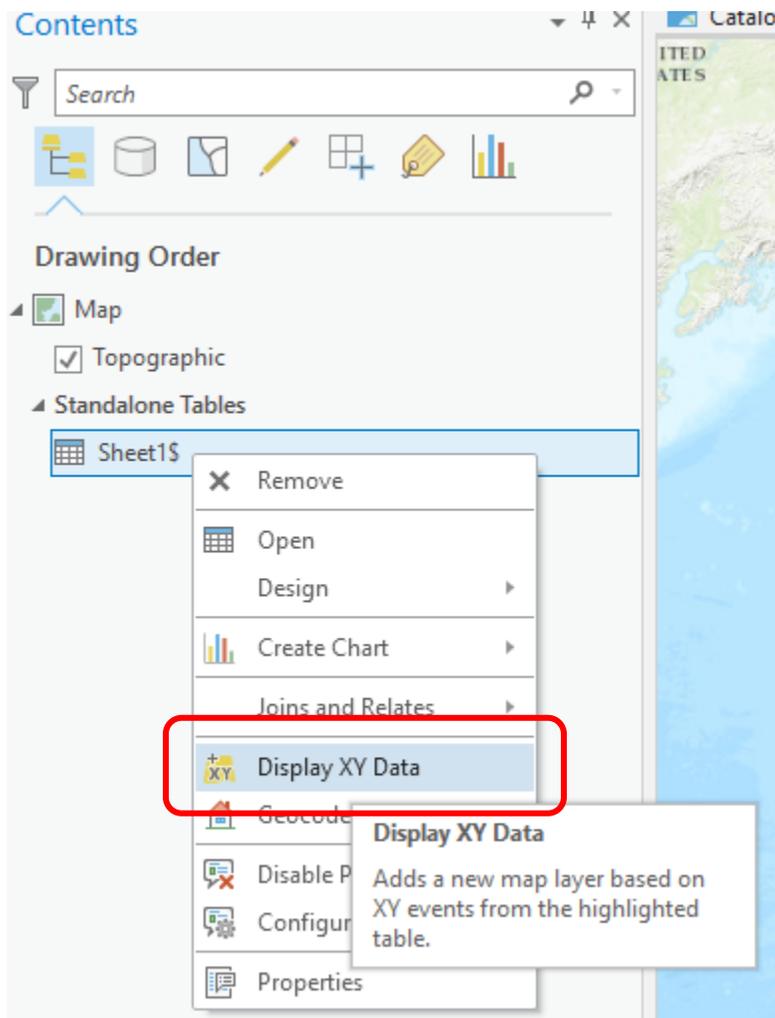
- g) Calculate the great circle distance between Austin and Logan in km if the radius of an equivalent spherical earth is 6371.0 km.
- h) Use ArcGIS Pro to determine the precise coordinates of Austin and Logan in the USA Contiguous Albers Equal Area Conic coordinate system to compare your answers to (f).

This can be done as follows

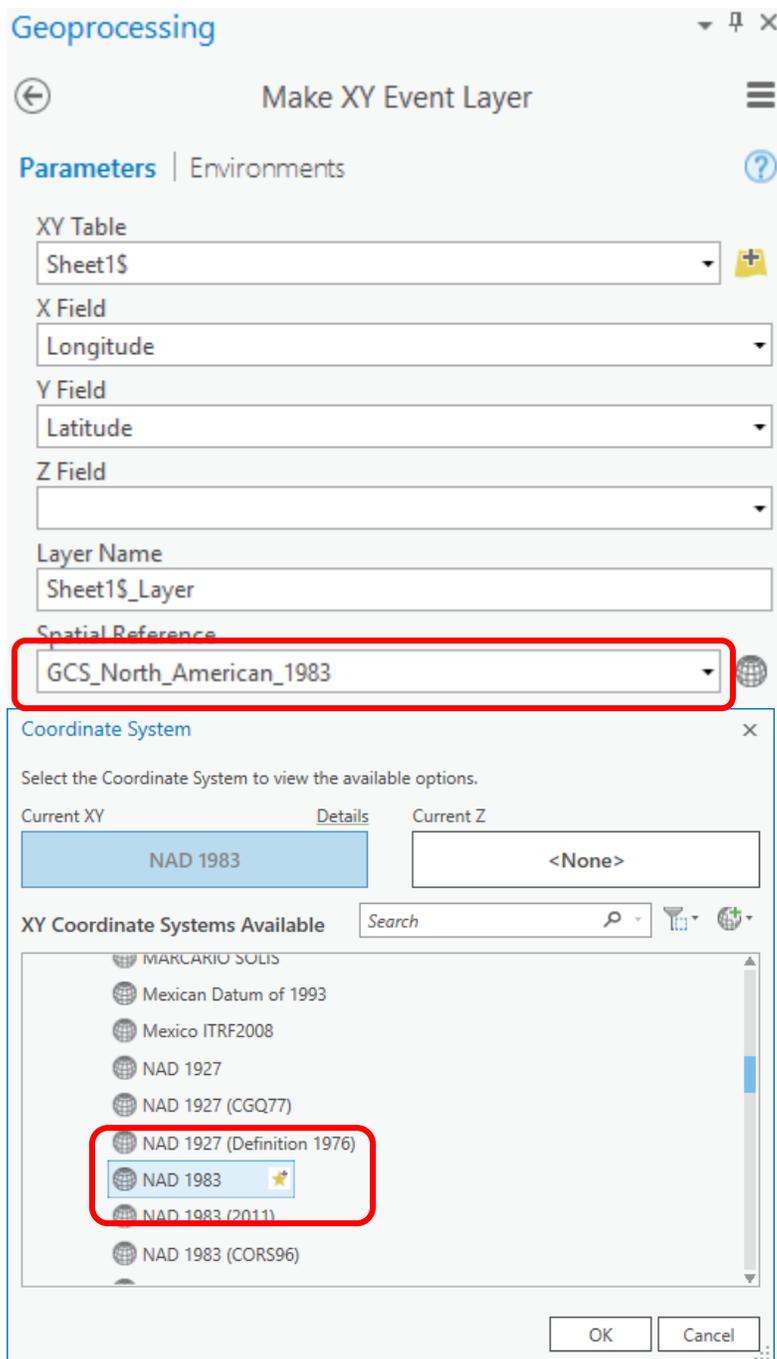
Use Excel to create a table with decimal degree Latitude and Longitude (This should be your answer to (d) above).

	A	B	C
1	Name	Latitude	Longitude
2	Austin	30.	-97.
3	Logan	41.	-111.

Open ArcGIS Pro and create a new project with a Map. Use Add Data to add your Excel Sheet. Right click on the Sheet Table and Display XY Data

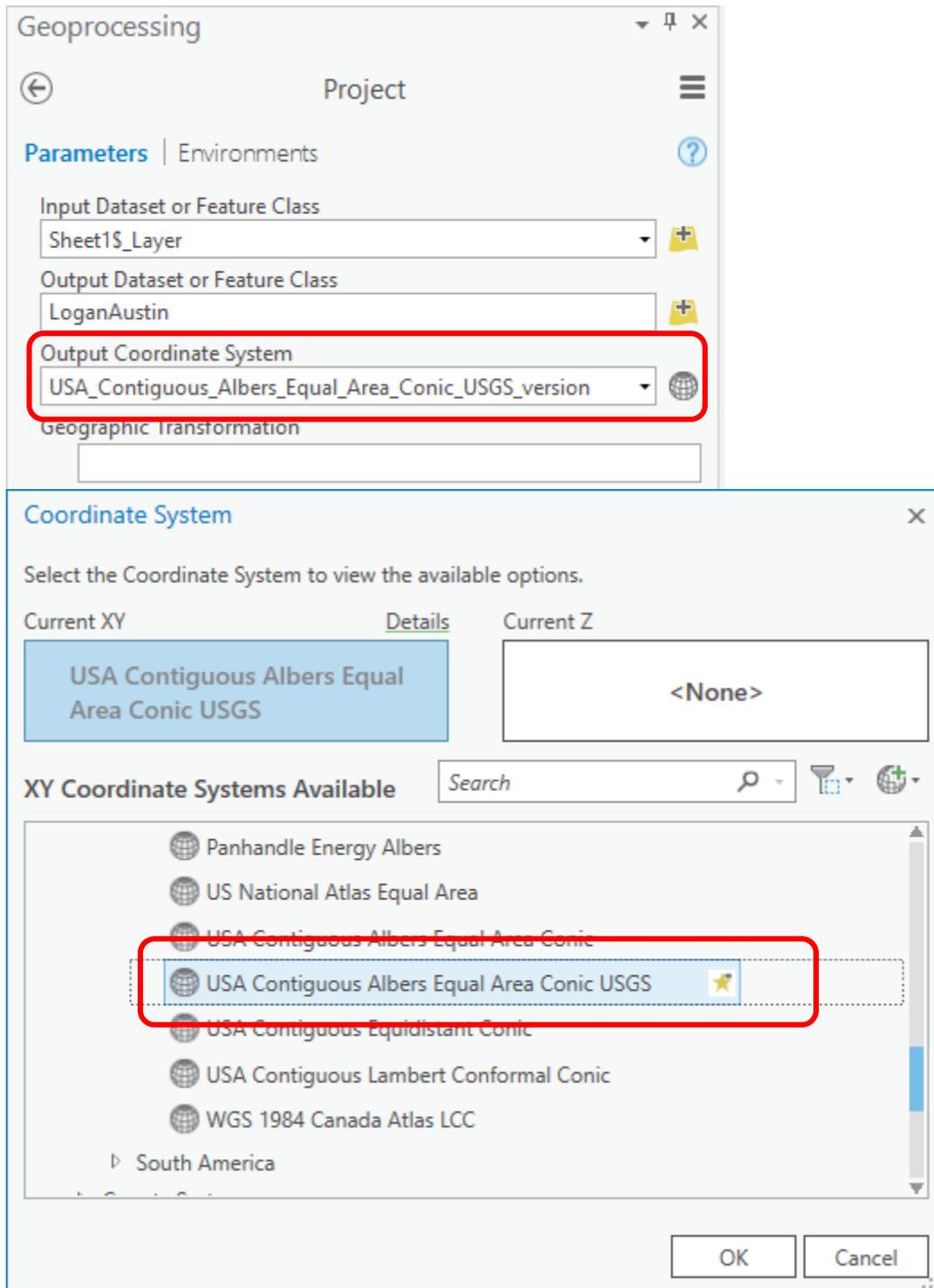


In the Make XY Event Layer geoprocessing tool that opens set the Spatial Reference to NAD 1983 in the North America Group. Here we are assuming the latitude and longitude information provided are with respect to the NAD 1983 datum.

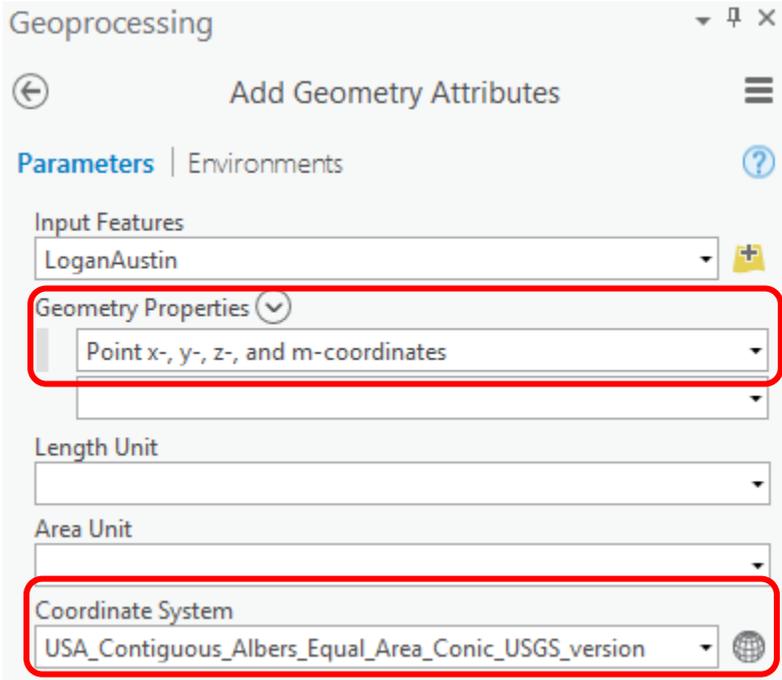


You should see two dots on your map, one for Logan and one for Austin.

In Geoprocessing locate the Project tool and Project your Sheet Layer to a Feature Class with USA Contiguous Albers Equal Area Conic coordinate system (in the Projected, Continental, North America group)



Locate the Add Geometry Attributes Tool at Run it for this Projected Feature Class

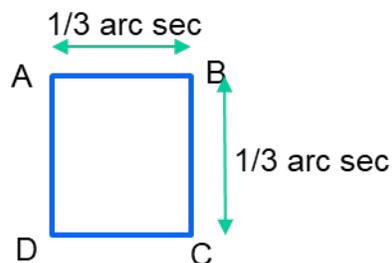


Open the attribute table of the LoganAustin Feature class and report the values of Point_X and Point_Y fields.

Explain why the answers that ArcGIS gives are different from what you computed in (e)

2. Sizes of DEM Cells

The National Elevation Dataset uses $1/3$ arc sec grid cells. The locations of UT Austin and USU Logan, are given above. Assuming the earth is spherical with a radius of 6371 km, determine the lengths of the lines AB and BC in meters at these locations.



Determine the area of a $1/3$ arc sec grid cell in Logan and in Austin in m^2 .