GEOG 653: Lab 3 (Line Analysis)

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Overview

For lab 3, we explore Line Analysis.

Question 1.

Question 1 was a bit of a struggle as it seemed a bit strange. Drawing the linear features themselves was not too difficult, but getting precise angular direction was a bit challenging. To pull this off, I discovered the "Constraints" feature near the bottom left of the ArcGIS Pro layout. This feature allows "snapping" of features to a specified distance and angle and which point we could properly load the linear features into the map.

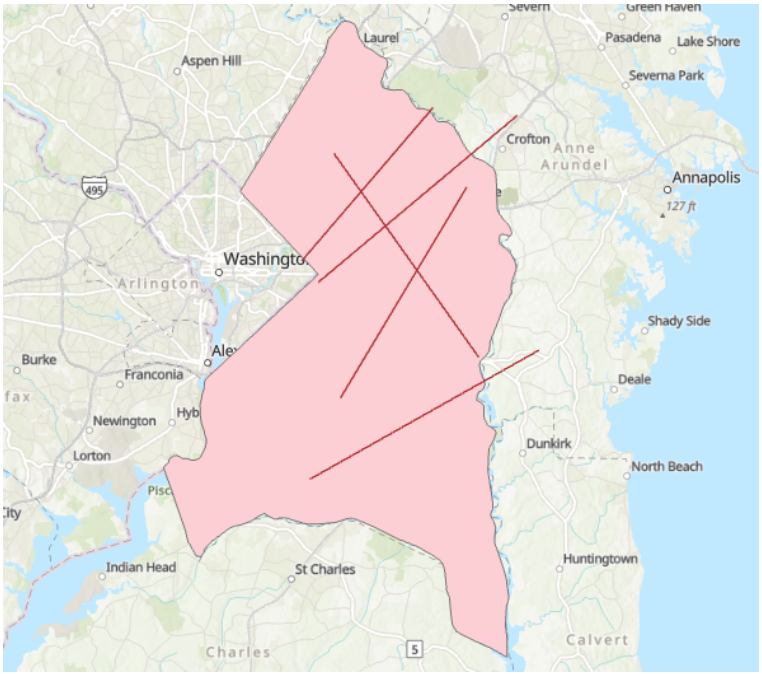


Figure 1: Line Features in Various Directions

Question 2.

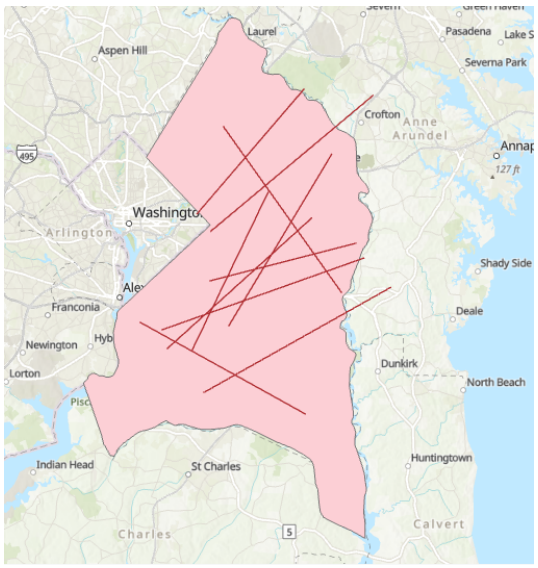


Figure 2: Additional Line Features

Question 3.

In the attribute table, the first OBJECTID is listed as 6, this is due to the fact that I made some mistakes in the first 5 entries which were subsequently removed. However, as we can see, our calculated lengths identically match the lengths originating to the features.

OBJECTID	Shape	Shape_Length	Length
6	Polyline	27444.809338	27444.809338
7	Polyline	27069.858274	27069.858274
8	Polyline	25594.877847	25594.877847
9	Polyline	26014.62571	26014.62571
10	Polyline	21021.14195	21021.14195
11	Polyline	19263.462197	19263.462197
12	Polyline	27398.302811	27398.302811
13	Polyline	24904.314632	24904.314632
14	Polyline	22363.894221	22363.894221
15	Polyline	24159.51802	24159.51802

0 of 10 selected

Figure 3: Attribute Table of Linear Features

Question 4.

From the equation:

$$D = \arccos\left(\sin\left(lat_1\right) \cdot \sin\left(lat_2\right) + \cos\left(lat_1\right) \cdot \cos\left(lat_2\right) \cdot \cos\left(\Delta\right)\right) \cdot R$$

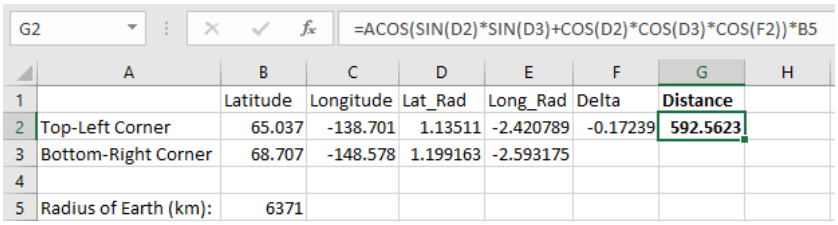
Where:

$$R : Radius\ of\ the\ Earth\ (6,371\ km)$$

And:

$$\Delta = long_2 - long_1$$

We arrive at the calculation:



	A	B	C	D	E	F	G	H
1		Latitude	Longitude	Lat_Rad	Long_Rad	Delta	Distance	
2	Top-Left Corner	65.037	-138.701	1.13511	-2.420789	-0.17239	592.5623	
3	Bottom-Right Corner	68.707	-148.578	1.199163	-2.593175			
4								
5	Radius of Earth (km):	6371						

Figure 4: Excel calculation of Question 4, yielding a distance of **592.562 km**

Question 5.

Our results in ArcGlobe slightly differ from our calculations. From what I can gather, ArcGlobe calculates a distance by "ground" path. In the case there is terrain (which there seems to be), our path distance can be greater than our calculation which assumes a perfectly spherical surface. I think this is the cause of our discrepancy.

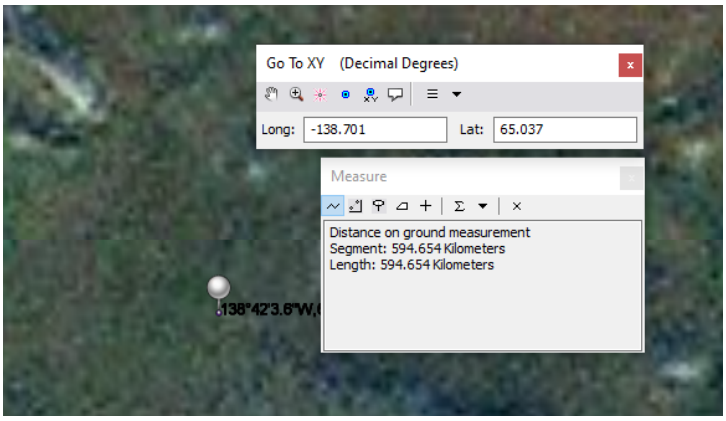


Figure 5: ArcGlobe results showing a distance of **594.654 km**

Question 6.

Direction	Direction (Rad)	Sin (theta)	Cos (theta)
30	0.523598776	0.5	0.8660254
40	0.698131701	0.6427876	0.76604444
60	1.047197551	0.8660254	0.5
125	2.181661565	0.819152	-0.5735764
230	4.01425728	-0.766044	-0.6427876
15	0.261799388	0.258819	0.96592583
20	0.34906585	0.3420201	0.93969262
43	0.750491578	0.6819984	0.7313537
65	1.134464014	0.9063078	0.42261826
330	5.759586532	-0.5	0.8660254
	Sum:	3.751066	4.84132162
	LMD:	0.6591864	
	LMD (Degrees):	**37.768598**	

Figure 6: Linear Directional Mean calculated in excel at around 38°.

Question 7.

Our results from ArcGIS Pro and Excel nearly agree with each other, with a discrepancy of only about 0.48°

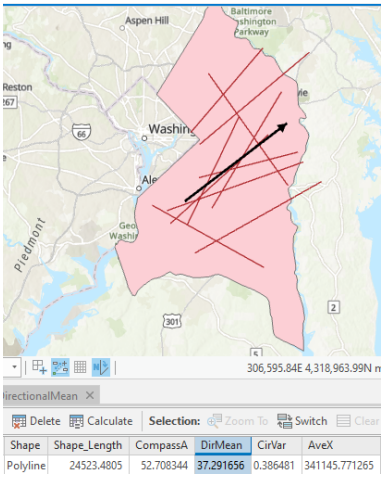


Figure 7: Linear Directional Mean calculated in ArcGIS Pro at around 37°.

Question 8.

Direction	Direction Corrected	Direction Radians	Sin(theta)	Cos(Theta)
30	30	0.523598776	0.5	0.8660254
40	40	0.698131701	0.64278761	0.7660444
60	60	1.047197551	0.866025404	0.5
125	-55	-0.959931089	-0.819152044	0.5735764
230	50	0.872664626	0.766044443	0.6427876
15	15	0.261799388	0.258819045	0.9659258
20	20	0.34906585	0.342020143	0.9396926
43	43	0.750491578	0.68199836	0.7313537
65	65	1.134464014	0.906307787	0.4226183
330	-30	-0.523598776	-0.5	0.8660254
		Sum:	3.644850748	7.2740497
		LOM:	0.46450793	
		LOM (Degrees):	**26.61434396**	

Figure 8: Linear Orientational Mean calculated with excel at around 27°.

Question 9.

Our results from ArcGIS Pro and Excel nearly agree with each other, with a discrepancy of only about 0.46°

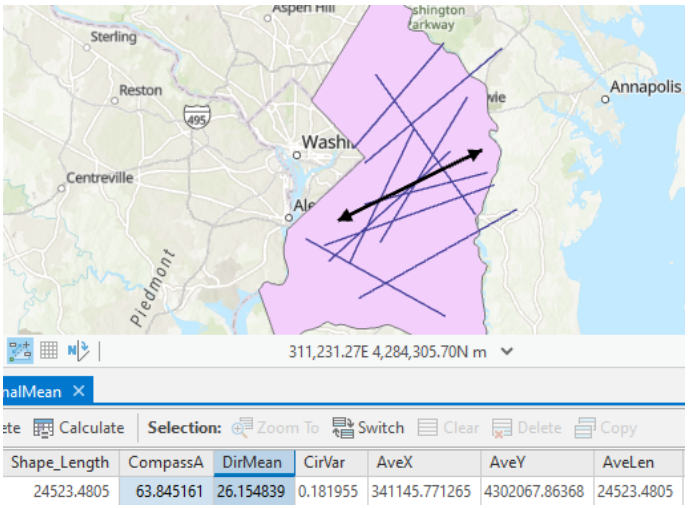


Figure 9: Linear Directional Mean calculated in ArcGIS Pro at around 26°.

Question 10.

The following are the Circular Variance calculated in ArcGIS Pro.

By Direction: 0.38648051
By Orientation: 0.18195452

Question 11.

The following are the Circular Variance calculated in Excel.

By Direction: 0.387554976
By Orientation: 0.186386233

These results are very close to those calculated in ArcGIS Pro only deviating at the level of thousandths.

Direction Radians	sin(theta)	cos(theta)		Direction Corrected	sin(theta)	cos(theta)
0.523598776	0.5	0.8660254		0.523598776	0.5	0.8660254
0.698131701	0.6427876	0.7660444		0.698131701	0.6427876	0.7660444
1.047197551	0.8660254	0.5		1.047197551	0.8660254	0.5
2.181661565	0.819152	-0.573576		-0.959931089	-0.819152	0.5735764
4.01425728	-0.766044	-0.642788		0.872664626	0.7660444	0.6427876
0.261799388	0.258819	0.9659258		0.261799388	0.258819	0.9659258
0.34906585	0.3420201	0.9396926		0.34906585	0.3420201	0.9396926
0.750491578	0.6819984	0.7313537		0.750491578	0.6819984	0.7313537
1.134464014	0.9063078	0.4226183		1.134464014	0.9063078	0.4226183
5.759586532	-0.5	0.8660254		-0.523598776	-0.5	0.8660254
Sum:	3.751066	4.8413216			3.6448507	7.2740497
Sum Squared:	14.070496	23.438395			13.284937	52.911799
Circular Variance:	**0.387555**					**0.1863862**

Figure 10: Circular Variance calculated in Microsoft Excel

Question 12.

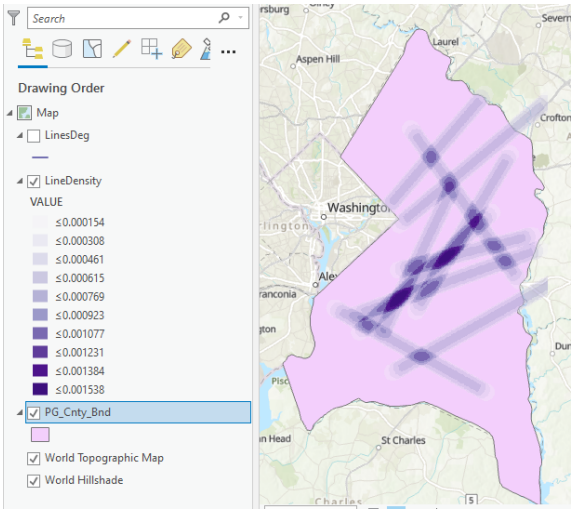


Figure 11: Line Density computed in ArcGIS Pro.

Question 13.

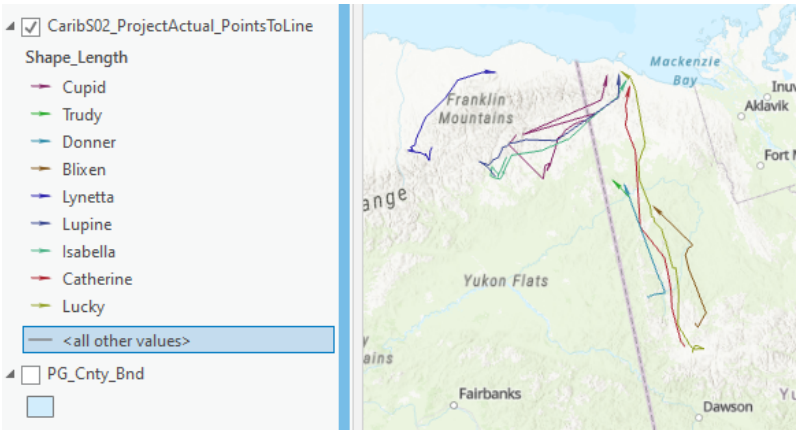


Figure 12: Paths of Caribou Migrations.

Question 14.

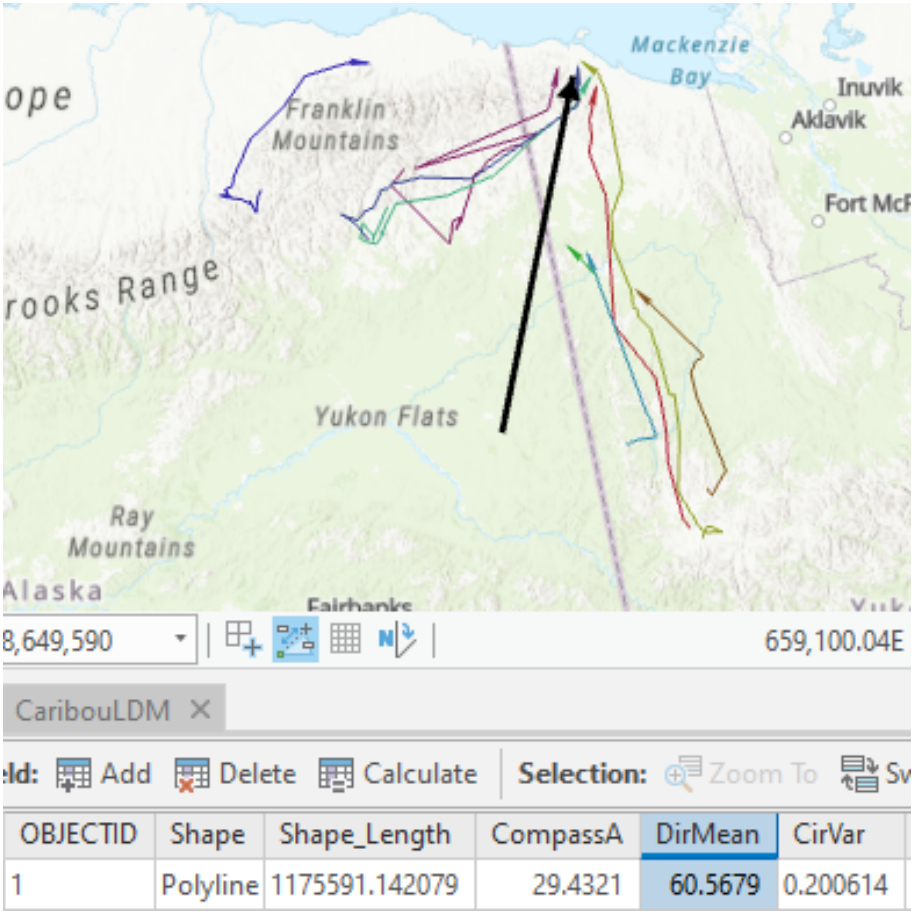


Figure 13: Linear Directional Mean of Caribou Migrations.

Question 15.

From the above image we can see the "Shape_Length" field calculates the length for us, in this case coming around to **1180 km**.