Project 6: Space

TOTAL: 15pts

GOAL

Analyze and predict where the next event in a crime series will occur.

HERE IS THE RECORDING FOR THIS PROJECT!
Passcode: a%cuX88j

Step 0: PREPARATION

- This is a continuation of tactical crime analysis. But what is tactical crime analysis?
- This project specifically focuses on spatial crime analysis. But what is spatial crime analysis?

Step 1: DATA

1. Begin with your active crime series data from Project 5.
    a. ***This is the dataset that has already removed the last known event of the series***.
    b. This should include columns already created and populated for:
        i. Sequence
        ii. T Coordinate
        iii. Day of Week
        iv. Interval
    c. Now add these columns:
        i. Hunting Ground (leave blank)
        ii. Centroid Distance (leave blank)
        iii. Sequence Distance (leave blank)
        iv. Prior Event
            1. Fill in this column with event number for the row above
                a. Row 2 (Event 1) should be 0, then row 3 (Event 2) should be labeled 1, row 4 should be labeled 2, etc.
    d. See below as an example:

	A	B	C	D	E	F	G	H	I
1	Sequence	Date	T Coordinate	Interval	DOW	Hunting Ground	Centroid Distance	Sequence Distance	Prior Event
2	1	7/28/79	0	0	Saturday				0
3	2	9/4/79	38	38	Tuesday				1
4	3	10/21/79	85	47	Sunday				2
5	4	3/4/80	220	135	Tuesday				3
6	5	3/11/80	227	7	Tuesday				4
7	6	5/18/80	295	68	Sunday				5
8	7	6/9/80	317	22	Monday				6
9	8	6/22/80	330	13	Sunday				7
10	9	6/23/80	331	1	Monday				8
11	10	7/6/80	344	13	Sunday				9
12	11	7/31/80	369	25	Thursday				10

2. Save this file as a.CSV and close it.

Step 2: DOTS ON A MAP

First, open ArcGIS:

- Start by going here. It's the AU version of ArcGIS online, a web-based, slightly less sophisticated but easier to use version of ArcGIS, everyone's favorite mapping software. You'll have to use your AU credentials to sign-in.
- Go to the MAP tab.
    - A new blank map. Sweet.
- In the top left corner, go to Add -> Add Layer from File
    - Click on Your device, and select your ***active crime series*** CSV you just created.
    - Choose Create a hosted feature layer and add it to the map, then Next
    - In the field selection screen, you can *keep all of your columns*. If your data has time, you can choose a time zone. Otherwise, click Next
    - For Location Settings,this should automatically populate your latitude and longitude fields. If not, choose them. Then click Next
    - Name your layer (every upload requires a new, unique name)
        - It's highly recommended to make a folder for and save all of your content there
        - Creating Tags and a Summary are completely optional
        - Click Create and add to map
- Success. Dots. On. A. Map.
- Want to know how many points you have?
    - Click on the ellipsis (three dots) next to your layer name and choose Show table
- Want to rename your layer?
    - Click on the ellipsis next to your layer name and choose Rename.
- Want to zoom in?
    - Use the tools along the bottom right side of the map, or scroll with your mouse. Click on the layer name to recenter your map to the extent of the points.
- Adjust the basemap by choosing the Basemap button along the left. Choose something that reduces the distractions - Light Gray and Dark Gray are solid options.
- Save your map - along the left side of buttons, you'll see a blue dot on the folder icon. Save As and save the map in the same folder as the map layer.

Step 3: CALCULATIONS

Run six different calculations on your map layer. Before each calculation, ***it is important to have all of your layer points visible on the screen***. Always recenter and zoom out so you can see them all!

1. **Analytic symbology**
    a. Along the right side of the screen, click the Styles button
        i. Click + Field and choose **Sequence**, then Add
        ii. Choose Counts and Amounts (size), then Style options
        iii. For Symbol style, choose a symbol that allows you to see thru/underneath it
            1. Circle 2 in Shapes is a good option. Then click Done.
            2. Choose your colors, and set the Fill transparency somewhere in the 10-50% range
            3. Experiment with colors, size, and transparency!
            4. Close the window, click Done multiple times.

2. **Ellipses**
    a. Along the right side of the screen, click Analysis -> Tools -> Summarize Data -> Summarize Center and Dispersion. Here's your inputs:
        i. Input layer: active crime series
        ii. Calculation settings: Mean center, Ellipse
        iii. Ellipse size: 1 standard deviation
        iv. Weight field: blank (for now)
        v. Group by field: blank
        vi. Output name: name it!
        vii. Choose a folder, click Run
    b. Now, rerun this analytic three different ways:
        i. Run 2:
            1. Ellipse size: 1 standard deviation
            2. Weight field: T Coordinate
        ii. Run 3:
            1. Ellipse size: 2 standard deviations
        iii. Run 4:
            1. Ellipse size: 2 standard deviations
            2. Weight field: T Coordinate

Brief pause. What have we done so far, and how do you make sense of it?

What you're now looking at is the standard deviation ellipse for your crime series. Depending on which you selected, you are either examining one or two standard deviations, which means:

- 1 standard deviation covers 68% of your events
- 2 standard deviations covers 95% of your events

Further, by weighting the ellipse by time (using our sequence), you are putting more significance on later events. It basically slightly changes the change and direction of the ellipse. That's a good thing.

While the ellipse alone is not entirely predictive, it is informative. You can make statements such as "95% of this crime series has occurred within this area". From a predictive perspective, you'll want to couple this ellipse with your analytic symbology to understand your point distribution. Are points:

- Expanding, meaning large (newer) points are on the ellipse edges
- Contracting, meaning newer events on closer to the middle
- Stable, the point distribution has stayed the same over time

If your series is contracting, the ellipse can likely be indicative of the next event occurring within it. If your series is expanding, you could expect your next event to potentially be outside of it.

So, based on this, ***choose the best ellipse for your crime series of the four you calculated***.

3. **Hunting Grounds**
    a. Analysis -> Tools -> Analyze Patterns -> Calculate Density (the hammer not the grid)
        i. Run 1:
            1. Input: active crime series
            2. Optional Layers -> Clip output to -> Draw input features _. Rectangle
                a. Draw a box around your points big enough to eliminate any edge errors
            3. Classify by: Natural breaks
            4. Number of classes: choose a number with relevance to your series event count
        ii. Run 2:
            1. Everything's the same, except add:
                a. Population field: T Coordinate
        iii. Filter Run 1 and Run 2, to remove noise, by:
            1. Click the ellipsis next to the layer name
                a. Show Properties -> Filter -> Add new
                b. Condition: Class is greater than xxx
                    i. Choose the highest number possible without removing/losing any active areas
                    ii. Click Save.
            2. The goal is to create the smallest areas possible without losing any details. These are the Hunting Grounds.
    b. Choose the layer (Run 1 or Run 2) that best represents the activity areas for this series.
    c. Now, manually recode your events based on their Hunting Ground.
        i. Alphabetize your Hunting Grounds
        ii. Open the active crime series .CSV in Excel and populate the Hunting Ground field.
            1. Use color coding to identify movement patterns over time.

4. **Centroid**
    a. Use the 'MeanCenterLayer' from the corresponding ellipse you choose in #2.
    b. Analysis -> Tools -> Use Proximity -> Find Closest
        i. Input: active crime series
        ii. Near layer: MeanCenterLayer

iii. Measurement type: Line distance
iv. Turn OFF 'Limit the number of closest locations'
v. Turn OFF 'Limit the search range'
vi. Name it, click Run

c. Use the lines generated to populate the 'Centroid Distance' field in your ***active crime series*** .CSV in Excel
   i. Manually type these distances into that field
      1. Analyze these distance measures, using graphs and stats
      2. At a minimum, calculate the mean and standard deviation
         a. Buffer 1: mean + standard deviation
         b. Buffer 2: mean - standard deviation
      3. Identify movement patterns over time
         a. The mean may not be the best predictor of the next event
         b. Create a graph in Excel
            i. Insert -> 2d line -> line with markers -> select data -> choose your Centroid Distance column
   ii. The goal is to identify a distance range from the center of the series that the next event is likely to occur within
d. Back in ArcGIS, create buffers for the best set of values
      1. Analysis -> Tools -> Use Proximity -> Create Buffers
         a. Input: MeanCenterLayer
         b. Enter values, name the output, click Run
   ii. Consider changing the colors (make the area hollow, change the outline colors)
e. ***In theory, the next event in the series will occur in between these buffers***.

HERE IS THE MAP WE MADE IN CLASS ON 16 APRIL 2025

HERE IS THE MAP WE MADE IN CLASS ON 23 APRIL 2025

5. Sequencing

a. Create a ***destinations*** file
   i. Open your ***active crime series*** in Excel
   ii. File -> Save As -> ***destinations.csv***
   iii. Delete the first row after the column headers (the first event)
   iv. Examine the location coordinates.
      1. If any sequential events occur at the exact same location, slightly nudge one of them (literally manually adjust the hundreds place to the right of the decimal point. Slightly).
   v. Save, close, add as a layer to your map just like in Step 2
b. Create a ***last active event*** file
   i. Open your ***active crime series*** in Excel
   ii. File -> Save As -> ***lastevent.csv***
   iii. Delete all the events *except* the very last event
   iv. Save, close, add as a layer to your map just like in Step 2
c. Analysis -> Tools -> Use Proximity -> Calculate Travel Cost
   i. From: active crime series
   ii. To: destinations
   iii. From route ID: Sequence

iv. To route ID: Prior
v. Measurement type: Line distance
vi. Name output, click Run

d. Use the lines generated to populate the 'Sequence Distance' field in your ***active crime series*** .CSV in Excel
   i. Manually type these distances into that field
      1. Analyze these distance measures, using graphs and stats
      2. At a minimum, calculate the mean and standard deviation
         a. Buffer 1: mean + standard deviation
         b. Buffer 2: mean - standard deviation
      3. Identify movement patterns over time
         a. The mean may not be the best predictor of the next event
         b. Create a graph in Excel
            i. Insert -> 2d line -> line with markers -> select data -> choose your Centroid Distance column
   ii. The goal is to identify a distance range from the last event of the series that the next event is likely to occur within
e. Back in ArcGIS, create buffers for the best set of values
      1. Analysis -> Tools -> Use Proximity -> Create Buffers
         a. Input: last event layer
         b. Enter values, name the output, click Run
   ii. Consider changing the colors (make the area hollow, change the outline colors)
f. ***In theory, the next event in the series will occur in between these buffers***.

6. **Micro site analysis**
   a. Change the basemap to aerial imagery
   b. Zoom to each Hunting Ground and potentially each event location
   c. Identify unique features for the events and surrounding areas
      i. Freeway egress
      ii. Commercial vs residential
         1. Types of commerce (shopping, recreation, etc.)
         2. Types of residences (single family, apartments, etc.)
      iii. Places of interest
         1. Parks, landmarks, government facilities, etc.
   d. Track similarities and differences between target locations, over time

HERE IS THE MAP FROM THE RECORDING ON 26 APRIL 2025

Step 3: ANALYSIS

For starters, think of your analysis as inputs to this template. For this project focus on slides 3, 5, and 7.

Next, consider this: when conducting next-event spatial prediction analysis, there are several key concepts to understand:

- Spatial crime prediction occurs at the macro and micro level
  - Macro focuses on movement patterns between crime locations, including:

        - Ellipses
        - Hunting Grounds
        - Centroids
        - Sequencing
    - Micro focuses on specific site analysis, studying the unique characteristics of crime locations
- Spatial crime prediction is an interdependent facet of next-event prediction. Trends and patterns for behavior and time influence where the next crime may occur.
- As you progress thru this project, with each calculation ask yourself how that analytic informs on the next event. Literally ask yourself "where is the next event most likely to occur?"

Then, identify the area(s) most likely for the next event in your series. Do this by finding the areas of overlap among your best fitting ellipse, your Hunting Grounds, your centroid buffer(s), and your sequence buffer(s). Once those area(s) are identified, conduct micro-site analysis of them to identify specific potential target location(s).

Be precise in your prediction and analysis. Try to avoid words such as "many" and "most;" instead use specifics ("...8 of 10 attacks occur," for example).

Keep this in mind: your analysis should inform law enforcement on a specific pattern of crimes. There is going to be unique, exploitable, identifying characteristics about that pattern that creates actionable opportunities for law enforcement to do something about it. When writing up your analysis, consider this perspective, and focus on the details that are most relevant.

Also, write your analysis in 'real-time,' assuming that the crime pattern is still active/on-going. Basically, treat the bulletin as if it were the day after the most recent attack.

SUBMISSION

Once your analysis is complete, please submit your project via Canvas. Your submission should be a document - either as PDF, Word, or Google Doc.

GRADES

- **Part I: Series Analysis (12pts)**
    - Provide four analytic findings (3pts each)
    - Each finding should be 5+ sentences describing a spatial pattern in the event points.
        - Specifically use each of these analytics (symbology, ellipse, Hunting Grounds, centroid(s), sequences) across your four findings.
        - Each finding should discuss how the measure/calculation further informs on the predictability of when the next event will occur
- **Part II: Prediction (2pt)**
    - Provide 2-3 sentences describing *where* the next event in this series is likely to occur. Be as precise as possible. This prediction should be the natural evolution of your analytic findings.

- **Part III: Data (1pt)**
    - Provide a URL for your map
        - Click 'Share' -> click 'American University', and then copy the URL
        - Your map should include the following layers:
            - Analytic symbology
            - Ellipses
            - Hunting Grounds
            - Centroid(s)/Spider Diagram
            - Centroid buffers
            - Sequence lines
            - Sequence buffers

Please email me with any questions.