

Conquering the LEAF/CLEA Exam

SKILL SET 12

About the Instructor/Course

- Instructor – Jenny Zawitz Jennifer.Zawitz@gmail.com
- CLEA Study Guide: https://iaca.net/wp-content/uploads/2021/06/CLEA-Skill-Sets_Study-Resources-051821.pdf
- LEAF Study Guide: https://iaca.net/wp-content/uploads/2021/06/en_LEAF-Core-Competencies_Study-Resources.pdf
- Exploring Crime Analysis: Readings on Essential Skills (3rd Edition) - IACA
- Each month will cover a different section of the study guide
- Intended as a supplement NOT a substitute for the texts and the Essential Skills classes
 - This course will help you focus your studying, but the courses and text will provide the actual understanding you need to pass the tests



Temporal Analysis – Type and Measure

- Temporal analysis is the study of time in all of its forms
- Time is the fourth factor in the crime triangle (need offender, victim, and place/location for a crime to take place). All three factors must come together at the same time for a crime to occur.
- Time measurements can also include seasonal crime patterns, offender movements, etc.
- Measuring time typically includes date and time (though presents problems)
- Calendar date typically recorded in Gregorian Calendar (note variety of calendars – Islamic, Hebrew, Chinese, etc.). Note calendar for both your reference and cultural significance
- US format is mmddyyyy vs. European ddmmyyyy – important esp if using numbers/software
- Time recording also different – US has 12 hr periods with am/pm. European/military 0-23
- Need to know how your database stores dates/times before exporting

Time of Day/Day of Week

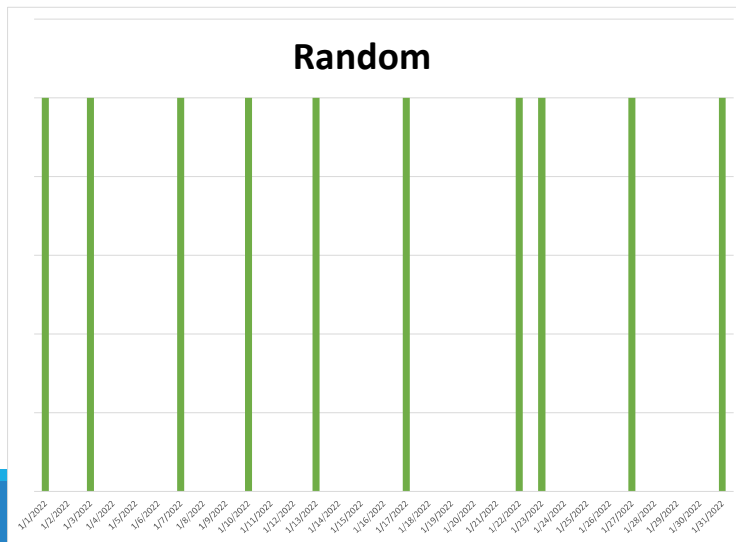
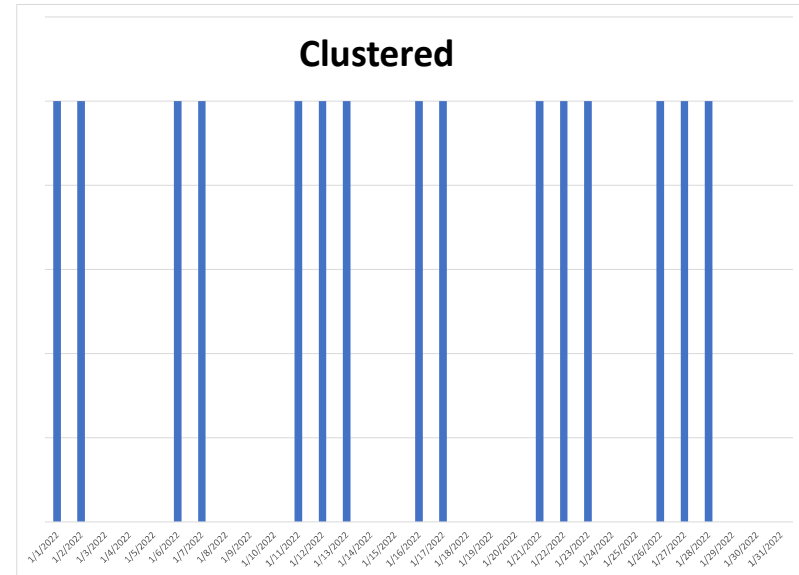
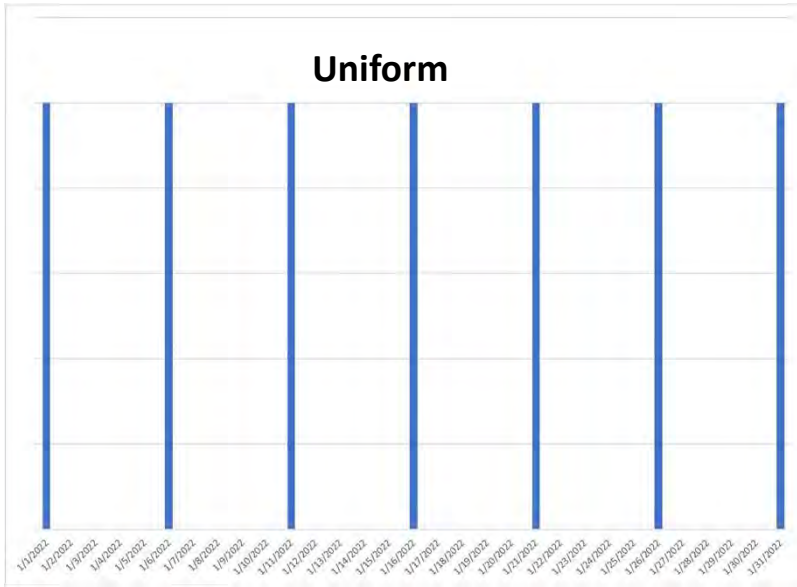
- Most analysts use 24 hours in each day to analyze crime on a daily basis (11 pm has more crimes than 11 am; 2300 hrs vs. 1100 hrs)
- Can also break time into shifts to determine patterns though need to provide notations for shifts for references outside agency or in the future if shifts change.
- Adding Day of Week to your hourly crime analysis adds information to determine trends and creates a Temporal Matrix.
- Can use conditional formatting to note “hot” and “cold” times for crimes to occur.
- Hot spots may also be explained by normal activities (more people out later on weekend nights = more potential for victims)
- Note any gaps in data. Example – weekends may show a higher amount of activity but depending on the month, you may have a higher number of weekends than normal.

Time	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
0000	1	0	0	0	1	4	0	6
0100	2	0	0	0	1	1	2	6
0200	0	1	0	0	1	1	1	4
0300	2	2	0	3	0	1	0	8
0400	3	1	0	2	1	4	1	12
0500	0	0	1	2	0	6	2	11
0600	0	0	0	2	1	0	1	4
0700	2	0	4	0	2	2	1	11
0800	1	0	0	1	0	6	0	8
0900	0	1	0	0	2	3	0	6
1000	2	0	0	0	0	1	0	3
1100	2	1	0	1	2	2	0	8
1200	1	1	1	0	1	2	0	6
1300	4	1	0	0	2	3	1	11
1400	1	0	0	0	3	2	1	7
1500	3	1	0	1	1	3	0	9
1600	1	0	0	2	1	3	0	7
1700	3	1	0	1	0	2	2	9
1800	1	0	1	1	0	2	3	8
1900	4	0	1	1	1	6	0	13
2000	1	0	3	0	1	1	0	6
2100	2	0	0	2	1	4	3	12
2200	2	1	0	0	1	3	0	7
2300	2	0	1	3	0	2	0	8
Total	40	11	12	22	23	64	18	190

Example of a temporal matrix.

Temporal Distribution and Intervals

- Distribution describes how events are situated in relation to one another throughout a study area.
- Uniform distribution – events tend to occur with equal spacing from one to another
 - Occurs when events take place far apart from one another.
 - May have regular, even spacing but may not always have that appearance (armed robberies by a gang)
- Clustered distribution – events tend to occur in close proximity to one another
 - Events tend to occur close together
 - To calculate temporal distance, use the midpoint of each cluster.
 - Ex: burglaries where different apartments in the same complex are targeted in close succession with the offender moving to a different complex after some time.
- Random distribution - events are neither clustered nor uniform
 - May be a combination of clusters and uniformity or it may be a truly chaotic distribution
- Temporal distance (distance between events) is useful for forecasting what will happen in the future.
- Distribution can also be used to understand behavioral aspects of a crime series/pattern.



Examples of the three classes of distribution

Tempo

- Temporal distribution of events previously discussed talk about how events are related to each other. Time can only move in one direction, so we can analyze the change in the interval between events to assess the **TEMPO**. Tempo can be
 - Accelerating – interval between events decreases as the number of events increases
 - Basically, the offender is committing crimes closer together
 - Decelerating – interval between events increases as the number of events increases
 - Basically, the offender is chilling out. Maybe they are making more money on his hits? 😊
 - Stable – interval between events is neither increasing or decreasing
- Use a tempogram with time along the X axis and interval along the Y axis. Use the time of the next event to chart the interval, so you can't do the last event. Can use this to make a trend line.
- Simplified, chart out your events using date initially and see if your offender is committing crimes sooner or is taking a longer cooling off period. You can't determine how long the offender will take to commit their next offense (without predictive measures) because they haven't done it yet.

Limitations of a Tempogram

- Additional factors may influence the distribution of a crime pattern
- Ex: financial crimes can be influenced by how much the offender takes. If they get a lot of money from their crimes, they may take longer between crimes.
- Why the offender is committing crimes may also influence the distribution. If they need \$1,000 to support a drug habit, they may steal until they get that amount. The amount they get from each crime will determine the frequency and interval by which they commit their crimes.
- Offenders get sick like we do. Their kids miss school. They have jobs. A lot of things can influence their frequency of committing crimes that tempograms may not be able to take into account.
- For crimes like this, it is important to look at the totality of the circumstances surrounding the crime.

Schedules and Activity Matrices

- Again, offenders are just like us! They need to eat, sleep, socialize, etc.
- If you focus on an offender for any length of time, you may be able to map their patterns to make general predictions about an offender's temporal behavior.
- Best to analyze a person's schedule across a week as their weekdays may differ from their weekends. (Note not everyone's weekends are Saturday/Sunday).
- Assign a modal (name) value for the predominant activity for each hour during the week (Ex: if your offender gets up at 0645 for work, his modal value for 0600 would be "sleep")
- Can gather this information from crime data, CCTV, covert operations/surveillance, cell phone data
- Can also do this with financial expenditures (bank account details/receipts) to track what your offender is withdrawing/depositing and see if it relates to your timeline.

Activity Matrix Example

Activity Matrix		Mon	Tue	Wed	Thu	Fri	Sat	Sun	
Subject	Hour	Activity	Activity	Activity	Activity	Activity	Activity	Activity	Modal
Bad Guy	0600	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep	Sleep
Bad Guy	0700	Commute	Commute	Sleep	Commute	Commute	Sleep	Sleep	Commute
Bad Guy	0800	Work	Work	Sleep	Work	Work	Sleep	Sleep	Work
Bad Guy	0900	Work	Work	Unknown	Work	Work	Eat	Eat	Work
Bad Guy	1000	Work	Work	Unknown	Work	Work	Watch TV	Church	Work
Bad Guy	1100	Work	Work	Unknown	Work	Work	Park	Church	Work
Bad Guy	1200	Eat	Eat	Commute	Eat	Eat	Park	Family	Eat
Bad Guy	1300	Work	Work	Work	Work	Work	Eat	Eat	Work
Bad Guy	1400	Work	Work	Work	Work	Work	Sleep	Family	Work
Bad Guy	1500	Commute	Commute	Work	Commute	Commute	Watch TV	Family	Commute

Financial Expenditures

- Can track these like a temporal distribution to include tempo
- Payments like car payments, bills, credit card payments will probably have a uniform distribution (due about the same time every month) and be relatively stable
- Things like food expenditures may be random though stable unless their living situation changes (a good hint for you if they are accelerating/decelerating – do they have a new partner/break up with a partner?)
- ATM withdrawals are a great thing to monitor for acceleration/deceleration. What are they doing that's unusual for them?
- Don't forget to consider other factors like the weather/employment for payments.
- Compare each set of financial expenditures to other expenditures/crime trends to see if anything aligns. Also compare to activity matrix. Are they doing anything unusual?


Temporal Cycles and Seasonality

- Particularly useful for strategic analysis of long term problems
- May also exist in overall crime patterns (ex: shoplifting/larcenies from vehicles around holidays, higher crime rates in the summer)
- Temporal cycles can exist in crime patterns where the problem refers to a specific set of reported crimes and is of short duration and do not need to be defined by a weekly cycle.
- Temporal cycles can be longer term as well – examining crime levels across several years can show seasonal patterns
- Crime can show upward trends but also show a seasonal trend as well
- Want to break any seasonal data into normal time of day/day of week analysis if you are seeing an increase to determine if this is expected or if you have an emerging trend. Seasonal data can hide trending activity.

Temporal Crime Data Considerations

- Time of day/day of week logged as when the crime was reported vs. when the crime took place. Note for many crimes, you may not know when the crime actually took place.
- Crimes like burglary, auto theft, pick-pocketing, and criminal damage are crimes that often don't have exact times. In these cases, explore aoristic analysis.
- Note most RMS have a Date/Time From and a Date/Time To
- Aoristic Analysis: probability analysis that indicates that a crime can occur with the same probability during a set time period. If a robbery occurs at 1430, the probability of the crime occurring between 1400-1500 is 100%. If a burglary occurs between 0800 and 1800 while a victim is at work, the crime could have occurred any time in the 10 hours the victim was gone. This gives each hour a 10% chance of the crime having occurred. Combine this data with past and future crimes to help narrow the timeframe. If another burglary in the series occurs between 1200 and 1600, there is a 25% chance in each of these hours that the crime may have occurred. This raises the percent chance of 1200 to 1600 for future burglaries.

Temporal Crime Data Considerations

- Simpler way to deal with uncertain data is to use a midpoint of the recorded period.
 - For the previously mentioned burglary, the midpoint is 1300 so this analysis would put the probability of the crime occurring at 1300 hrs at 100%.
 - Problematic to use such definitive language for something that is far from definite.
 - Aoristic analysis while more complicated ensures any information you produce can be used with confidence.
 - Midpoint analysis assigns an artificially high quality rating to poor data.
 - In sum, midpoint analysis is not recommended.
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Times Series Analysis/Forecasting

- Forecasting is what most crime analysts want out of temporal analysis – use the understanding of what happened in the past to predict what will happen in the future.
- Forecasting can be reliable for things like strategic analysis of repeatable seasonal issues but harder to fully understand and describe a temporal pattern.
- Almost impossible to accurately predict the exact day a future crime will occur because of the number of variables previously discussed, so instead we try to identify a temporal trend to make sure the quality of the forecast is as high as possible.
- Similar to weather forecasting – the 10 day is far less reliable than the forecast for tomorrow.
- Build on temporal trends with linear forecasts, cyclical forecasts, leading indicator forecasts, and charting.

Linear and Cyclical Forecasts

- Extrapolate what will happen based on a historic trend.
- Tempogram used to visualize linear trends and make a forecast by generating a trendline from an analysis of intervals between events.
- Most software applications used to chart temporal data can add a trendline for you.
- Trendlines draw a line that goes through the known points of data and extrapolates beyond the last known data point to estimate when the next event will take place.
- Can use for accelerating, decelerating, or stable crime series.
- The best fitting trendline may not be linear, so most software applications allow different forms of a trendline to be generated.
- Seasonal patterns are a very straightforward example of a cyclical trend
- Timeline charts of events can be used to verify if a cycle exists
- Can use cyclical forecasts to confirm the pattern and then create a temporal matrix to forecast future events.

Leading Indicator Forecasts

- Bi or multi-variate in nature – uses other factors in conjunction with temporal elements of the crime pattern to make the forecast.
- Includes things like the value of the property stolen which can be added to the chart with the intervals between crimes.
- Often very complex requiring many different analytical approaches
- Other leading indicators can include payment schedules, meetings, holidays, and market value for stolen property like scrap metal
- No best method – approaches taken will depend on data quality, software, training, and time available to the analyst (haha!)

Charting

- Visualize the analysis conducted to communicate the message
- Often charts of temporal analysis are used as analytical tools themselves and not for an external audience.
- May not be necessary or advisable to include these in the final report
- Frequency Chart: show how many events occur during different temporal periods
- Timeline Chart: display events in sequential matters over time.
- Tempogram: similar to a timeline, but includes interval as a second set of data.
- Seasonal Chart: bar or line chart to convey annual cyclical crime patterns
- Generally recommended to avoid 3D charts – great visual, hard to communicate information
- If using a bar chart, start at 0 on the Y axis – can be misleading if not.

Temporal Analysis Applications

➤ Strategic Analysis

- Identify the main crime types that will be of concern for a year ahead
- Assess special training needs for officers for expected number of offenses in the coming years
- Identify the reasons for decreases in detection rate for auto theft over the past four years
- Assess required budget to allocate extra overtime patrols to prevent burglaries over the winter
- Redesign shift schedules to ensure sufficient officers available to deal with issues

➤ Tactical Analysis

- Establish a patrol schedule to target recent increase in burglaries in a neighborhood
- Produce crime prevention advice for new college students after a rash of stolen tablets
- Identify temporal profile for two months worth of incidents involving pizza delivery drivers being robbed at knifepoint following false orders
- Assess a set of monitored sexual offenders as suspects for a series of sexual assaults from the temporal pattern of the crimes and the offenders' known schedules.

Conclusions

- Read the books and take the classes to strengthen understanding.
- Try to apply the things learned to your every day work to “make them stick”.
- Use the study guides.
 - <https://iaca.net/about-clea/> (links for program outline and study guides here)
 - <https://iaca.net/about-leaf/> (links for program outline and study guides here)
- Next month: GIS and Crime Mapping (Skill Set 14) and Spatial Analysis and Forecasting (Skill Set 15).

Any questions?

