

ROAD ACCIDENT ANALYSIS – A VISUAL APPROACH

Using a GIS Approach to Analysing Accident Information

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Abstract: Vicroads currently utilizes an analysis approach that identifies and graphically maps worst sections of roads (blacklengths) by accidents/kilometre/year as well as worst areas (blackareas) by accidents/square kilometer/year. This concept was described by Walker/Sliogeris (1). This produces maps and listings used for identifying and targeting problem areas and sections of roads for further investigation. This system utilizes the SAS system software. A further extension of this idea is to view and analyse the accident data directly on the road system using a GIS tool (SAS/GIS) to target problem areas and produce reports and more detailed data. Once the accident data is setup the abilities to explore and manipulate the data become much more flexible and powerful than *non* visual techniques. This will be demonstrated using data from the Victorian Road Network and using SAS system software.

Notation: GIS refers to Geographical Information System
Blacklength refers to worst sections of lengths of road by Accidents/km/year
Blackarea refers to worst areas (either Local Traffic Areas or Floating Areas)
Floating Areas refers to *open* area analysis e.g. *not* restricted to any boundaries
SAS is trademark software e.g. SAS/GIS is GIS product
Also SAS/INSIGHT SAS/FSP etc.

Introduction: Maps are a powerful and effective way to see what patterns are occurring with accident data spatially. Figure 1. is an analysis of the worst Casualty accident sections of road and areas using pre-determined criteria and rules for comparison. These are ranked into clear groups e.g. Top 10% band, Second Top 10% band etc. using a colour coding approach. Listings give more detailed breakdowns of data for designated groupings for more clarity and information. E.g. no. accs per grouping, length of road section, size of blackarea etc.



Fig 1.

Black colouring defines the top 10% band for blacklength road sections (% determined by length of road in LGA). Pink defines second top 10% band and cyan makes up the third 10% band. Similarly for accident blackareas we have pale pink/green/pale blue defining the 3 top 10% bands. If we load this data into SAS/GIS with the Road network overlay then we can begin to explore further what other data trends or accident breakdowns may be of interest. The layers are displayed at the top for blacklength and blackarea. Sections of road are coloured for 10% bands as per map and similarly for blackarea. Note the areas here are fixed boundaries called LTA'S or Local Traffic Areas. The analysis is contained within the boundaries for this type of analysis. LTA analysis *excludes* accidents on the bounding roads (arterials). This is to distinguish main road/arterial accident patterns from local road issues. There is also another style of area analysis called *Floating Blackarea* which allows a moving worst area analysis to be performed (e.g. worst 4 sq. km areas over the whole analysis region) This idea will not be discussed for purposes of this demonstration however. Along the top of the GIS window are Segment and Intersection layer definitions. Segment layer refers to accidents between intersection points (midblocks) as distinct from intersection point accidents. Layers can be turned on/off by clicking on the layer tab. Note that these layers can also be broken down to further layers e.g. by year/accident category etc. if necessary.

Themes

Themes for layers can be defined by linking to other data sets, data sources or by using computed attributes. The blacklength layer has used the data from the *pre-computed* blacklength program run for Hobson's Bay (1993-1998). This allows us to identify which sections of road have been calculated as the worst for the selected accident category/year grouping etc. We have used all casualty accidents category in this example. Similarly for the blackareas we have *linked* to the blackarea data set from the same analysis to highlight the top 30% using 3 x 10% bands. Colour identification gives a clear and easy method of honing in on the top level of potential accident hotspots here. We can also use themes on the accident points themselves e.g. to separate high accident tally sites from lower ones or to identify a trend analysis (e.g. years 1993-1995 compared to years 1996-1998). Here we have used a dot scaling theme for accident points with high accident sites changing to a darker colour in order to distinguish. Themes can easily be changed at any time to suit the analysis.

Legends

Legends can be viewed/hidden as needed. These show what the active theme for the layer is (if any).

Labels

Labels can be applied to any displayed feature using either composite fields (imported data at load time) or related attribute data that can be “linked” to map display. Attribute data can be either pre-existing or created on the fly using an ACTION step which will be discussed later. Here we have applied labels to accident points with the total no. accidents at that point for the time period.

Zoom

We can easily zoom in and out of any part of map for greater clarity or to target a smaller area of accidents for further analysis. We may also want to run an ACTION step on a smaller target area that is manually selected from zooming in on the display area.

Panning

Panning allows movement around the map at any time particularly from a zoomed in position for exploratory purposes.

Selecting Items

Selecting objects allows details of items to be displayed or creation of a data subset for use in ACTIONS. By clicking on an accident point for example we can find out details about that accident site (or multiple sites). Spatial information can be displayed as well as non-spatial data (e.g. dates of accidents/no. persons involved/vehicle info /weather conditions etc.). Selected items are always highlighted with a different colour to designate their selection. Holding down the *shift key* allows additional items to be selected/de-selected. Colours and highlight features can also be altered as needed. Selection from layers can be controlled from the layer tab. Note that selection of items can be performed also by defining circles/polygons on display area. For example select all accidents within 1 km radius of a given point (say a school or shopping strip) or select all accidents within a 4 sq. km region.

Adding Layers

New layers can be imported to map at any time. If a school age accident analysis was needed for example then a school layer could be added for analysis of accidents within these areas. Layers can be added also from other GIS products or systems or can be generated from SAS code directly using data in any form.

Actions

Actions are the powerful link to running analysis on the data utilising both spatial and non-spatial data. In the simplest sense we may want to Browse or View more detailed information relating to displayed data as described earlier. This can also be applied to say a highlighted blackarea to find out more about that worst region. The map itself only shows accident totals at a given point or a highlighted section of road (blacklength) or area (blackarea) but this in itself doesn't necessarily give a lot of specific information about what is occurring at these points. We often need to drill down to view the data at another level. For example what is the breakdown of accident categories (fatalities/casualty accidents etc.), time of day of accidents, age of persons involved, weekday/weekend patterns etc. This is the third dimension of analysis which is possible. In this example we have created a Browse action to look at accident information details for a *black* section of road (Acc-details). We can scan the time of day, no. persons involved, light conditions, road conditions, no. vehicles involved and so on. Note that data can also be edited in this way using a View action. This is useful for updating incorrect spatial attributes attached to that point e.g. incorrect LGA coding or road type can be amended directly on screen. A spatial action can be defined that returns all related info about that item spatially (as well as any other non spatial attributes imported into map).

Advanced Actions

Using the power of the SAS system it is possible to create actions that can perform complex analysis or graphs/charts. It can also be used to generate a new layer to display in GIS window for more map detail if needed. For example if we wanted to look at school age accidents (4-16 yrs of age) at certain times of day and designated school days we could create an ACTION that gives a breakdown of accidents (tabulate) for this category using SAS procedures and code. If we wanted to look at specific sites only we could use this ACTION

in conjunction with selected sites by clicking on the points of interest and then running the ACTION against the selected data rather than attempting a general data analysis of the whole LGA. Once the ACTION has been defined we have the power to use this on *any* selected data without doing any more work. A good use of this is to run for example an analysis for selected points around a school area and then running a comparison to another school zone and comparing the results. In the example we have generated an action that produces charts and tables for selected points. The bar charts are a breakdown of time of day vs accident severity generated automatically from the action. Charts can be tailor designed as needed for specific requirements with full range of graphing abilities available.

Accidents By Time of Day and Severity



Fig 2

If we want to change the time grouping we can modify the time zones readily by *editing* the proc format in the code and re-running the action. This becomes a permanent change to the output if required. Here we have added the 8am-9am and 3pm-4pm breakdown (Fig 2.) which may be useful for school time movement accident analysis. This action has also produced tables with breakdowns of accidents by years as well as person severity (injury level) by age group. Again these breakdowns can be readily appended to or modified depending on needs. The flexibility is in customising the output generated. We can also apply the analysis in a broader sense to say cross-compare age group breakdowns for each LTA (Local Traffic Area) to see which has the highest ratio of 4-16 yrs age accidents. To do this we create an action called school-lta. This action pops up a window to select accidents where 4-16 yr olds are involved on weekdays by selecting category (3) from MENU. Additionally we have restricted the time analysis to 8.am-9am and 3pm-4.30pm. to explore school transit times. We can also select the years/months of interest from the MENU. This action then ranks the LTA'S by *descending* accident frequency (with a minimum accident total of 4). This data set can be utilised by the blackarea layer to identify the worst LTA areas visually. Again we can use a ranking colour coding approach. We have also produced some tables and graphs in the background automatically based upon this ranking. In this example we have used all accident sites for analysis but we can filter sites by manual selection if necessary for specific area analysis. Even though we are dealing with a specific category here we can extend the analysis to any desired accident category/age groups as needed.

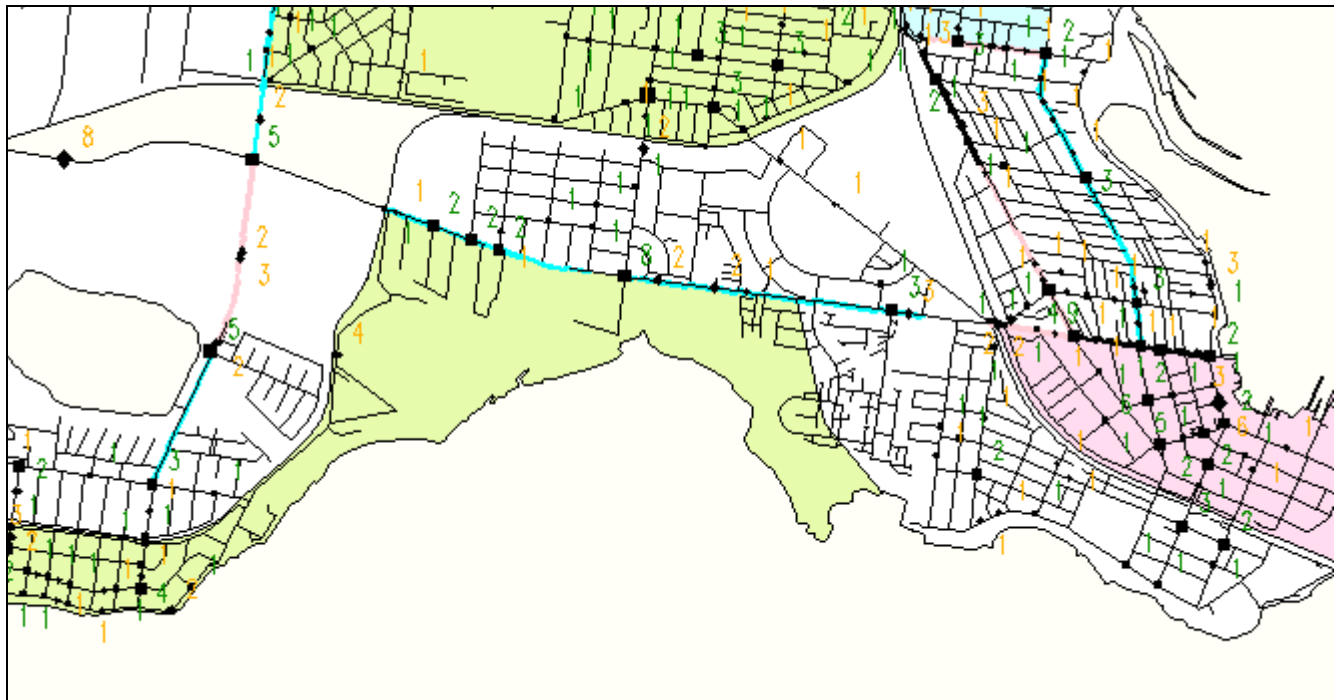
Analysis Flexibility

As you can see there is much flexibility in the approach described so far in terms of combining spatial and non-spatial analysis. New functionality can be readily included as can detailed analysis of selected areas/points. Applications or features can be progressively built according to needs. Note that the data can also be utilised in other SAS based modules such as SAS/INSIGHT for other types of data exploration. Data can also be exported to *non* SAS based applications or be added to existing data bases. Data from most GIS systems can be imported readily into the SAS environment or constructed from the raw input text data. Data for this application was

imported directly from ascii files. Layers can be updated as needed or replaced if geographical information changes over time.

Advantages of GIS approach

1. Greater ability to target specific geographical areas
2. Broad area analysis through to single point analysis possible
3. Point and click ease for building analysis
4. Visual interaction available to understand patterns
5. Full power of data analysis available through ACTIONS
6. Export of specific data possible through visual selection
7. Additional analysis available directly using other modules
8. Complex analysis can be designed in background if needed



Hobsons Bay –Victoria GIS window

Conclusions

Using a GIS style interface with data analysis capabilities, the scope for interactive exploration and reporting is unlimited. Any data that is geographically based can be more effectively viewed without sacrificing the non-spatial analysis capabilities. Applications can expand and adapt readily allowing for simple reporting/browsing through to highly complex analysis where required. SAS/GIS allows this flexibility and offers the full power of the SAS base programming language and other SAS products. Importantly the resulting applications allow a high level of analytical ability *without* the front end user ever needing to write programming code but may if they desire. What has been demonstrated here is a concept which may be integrated into most environments.

Acknowledgments

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SAS system is registered U.S software and is available worldwide on most platforms
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References

1. Christopher Walker Data Dimensions /John Sliogeris VICROADS
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