



IS415 Geospatial Analytics and Application



spatial bros

User Guide

A Dynamic and Interactive R Shiny App for Point Patterns Analysis

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How to use Spatial Bros: Your Quick Start Guide

Welcome to Spatial Bros - A Dynamic and Interactive R Shiny App for Point Patterns Analysis (PPA).

Our application will assist users with two kinds of Point Pattern Analysis: Spatial Point Patterns Analysis and Network-Constrained Point Patterns Analysis.

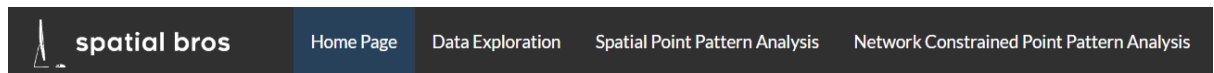
Application Link



spatial bros

<https://renjieteo.shinyapps.io/SpatialBros/>

Navigation Bar



The Navigation Bar is located at the top left of the screen, which will show the different functionalities the application can provide for you.

By default, you will be brought to the Home Page upon arriving on the website. Only when you click on a specific tab then it will highlight itself as the current active tab through a blue colour darkening.


1. Home Page

spatial bros Home Page Data Exploration Spatial Point Pattern Analysis Network Constrained Point Pattern Analysis

Project Motivation

In today's technological advancing world, there are many useful and interesting spatial data sources that exist in the forms of Geospatial and Aspatial format. Geographical Geospatial data sets the foundation based on the geographical boundary locations and the Aspatial data are the records of observation that can be further prepared to be used to derive meaningful insights.

Despite all the data sources out on the interweb, there are not many people who are knowledgeable and trained to perform such analysis. Without the fundamental knowledge and training involved, any results based on the analysis performed could result in inaccuracies. Our group attempt is to mainly focus on performing analysis and develop a website based geographical spatial tool. R Shiny tool will be used with regards to developing the 1st/2nd Order & Network Constrained Point Pattern Analysis of Melbourne City, Australia.




Spatial Bros

A Group Project done by

- Kwek Ming Rong
- Teo Ren Jie
- Harith Oh Yee Choon

Access our user guide [here](#)

This project is done for IS415 Geospatial Analytics & Application under the guidance of Professor Kam Tin Seong



What is Point Pattern Analysis and Network Constrained Point Pattern Analysis?

Point Pattern Analysis methods helps provide insights about where things occur, how the distribution of incidents or the arrangement of data aligns with other features in the landscape, and what the patterns may reveal about potential connections and correlations.

Network constrained Spatial Point Patterns Analysis (NetSPAA) is a collection of spatial point patterns analysis methods special developed for analysing spatial point event occurs on or alongside network. The spatial point event can be locations of childcare centre for example. The network, on the other hand can be a road network or river network.

About Spatial Bros

Spatial Bros is created to assist non technologically savvy users in performing geographical point pattern analysis. This application aims to assist users in 2 types of analysis, particularly in performing 1st/2nd Order & Network Constrained Spatial Point Pattern Analysis. For each of the analyses, the application will provide users with statistical functions, kernel density heat map estimation, various mappings and G&K function results. The application will cover an array of spatial points located in Melbourne City such as childcare centres, business establishments, famous landmarks including places of interest such as schools, theaters, health service, sports facilities, drinking fountains and public toilets. The spatial points will work in conjunction to cover areas of the city's road, pedestrian and tram network. From this application, users would be able to perform types of hypothesis testing that allow them to generate insights towards their conclusion on the distribution along the spatial points along the network.

The home page will be the first thing you will see when you access our application.

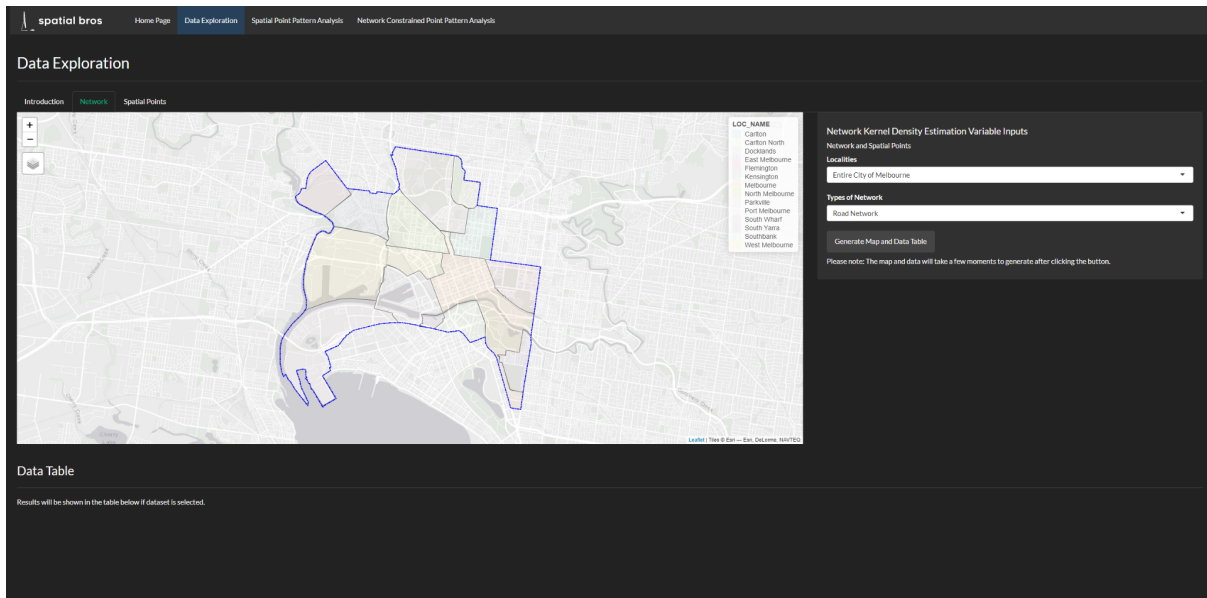
From the home page, you will see a quick overview of the project motivation. You will be able to see what our application does and gain a brief understanding and overview of what is point pattern and network constrained point pattern analysis.

On the right side of the home page, you are able to access our LinkedIn profiles of the creators of Spatial Bros to find out more about them.

Note

If you are unable to see our descriptions and images, please allow your browser to load for 2 - 3 minutes.

2. Data Exploration



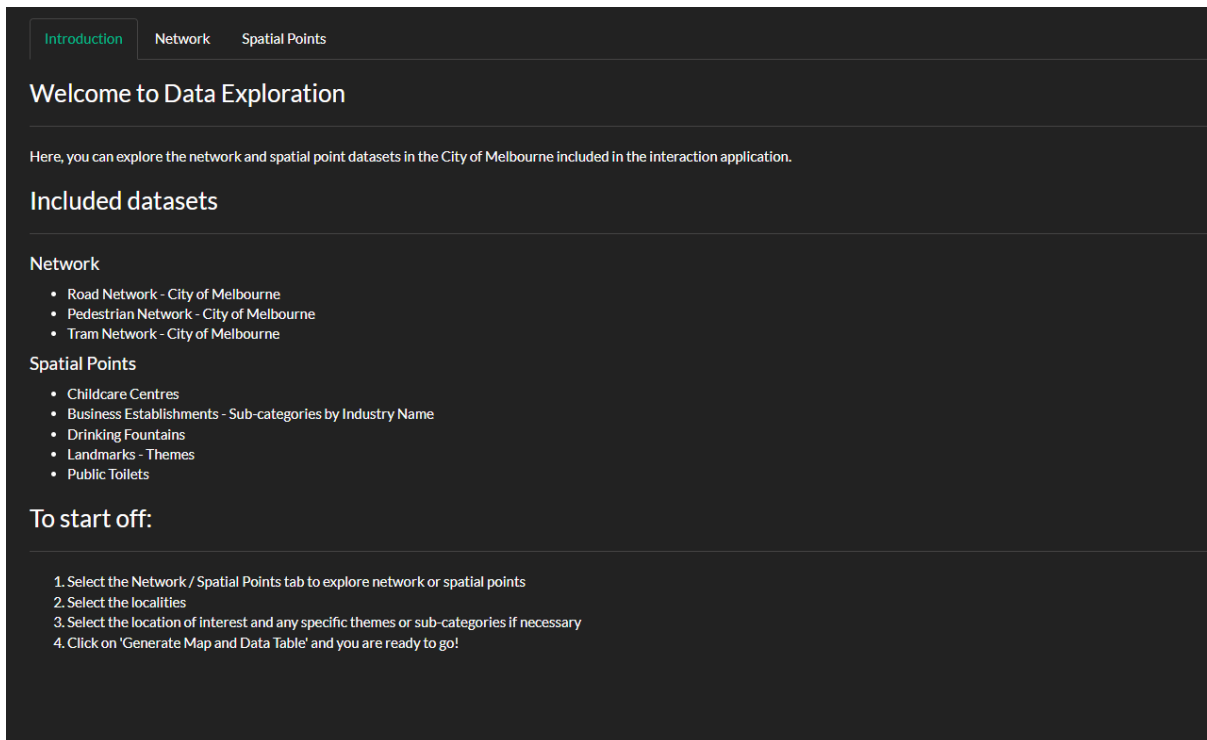
The Data Exploration is the second page that you will be able to access in our application.

From the Data Exploration, there are 3 sub tabs that is made available to you for usage:

- 1) Introduction
- 2) Network
- 3) Spatial Point

The layout of the Network and Spatial Point tab is similar in nature, with the main visualisation map being on the left and a side panel on the right for the selection of inputs.

2.1 Introduction



Introduction Network Spatial Points

Welcome to Data Exploration

Here, you can explore the network and spatial point datasets in the City of Melbourne included in the interaction application.

Included datasets

Network

- Road Network - City of Melbourne
- Pedestrian Network - City of Melbourne
- Tram Network - City of Melbourne

Spatial Points

- Childcare Centres
- Business Establishments - Sub-categories by Industry Name
- Drinking Fountains
- Landmarks - Themes
- Public Toilets

To start off:

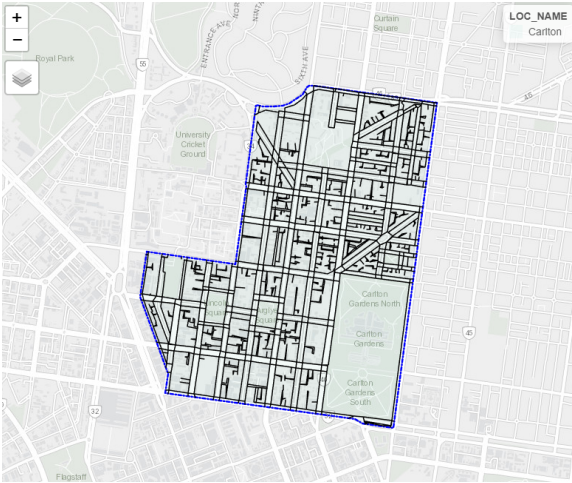

1. Select the Network / Spatial Points tab to explore network or spatial points
2. Select the localities
3. Select the location of interest and any specific themes or sub-categories if necessary
4. Click on 'Generate Map and Data Table' and you are ready to go!

Data Exploration Introduction

This is the data exploration introduction tab where you will learn about what are the available datasets included in this application. In addition, we also provide you a brief overview of how you can navigate around the data exploration section.

2.2 Network

Data Exploration Network Main Panel

Feature	Functionality
 <p data-bbox="376 1525 609 1559">Map Visualization</p>	<p data-bbox="807 1037 1383 1104">This map is a visualisation of the Data Exploration Network being computed.</p> <p data-bbox="807 1137 1383 1272">The LOC_NAME in the legend represents the locality district 'Carlton' being analysed. From the visualisation, you are able to see the district outline and the network outlines.</p>
 <p data-bbox="411 1760 574 1794">Zoom Control</p>	<p data-bbox="807 1588 1383 1722">The map visualisation provides the option of zooming in and out. You can click on the '+' icon to zoom further into the map and '-' to zoom further out.</p>



Base Map Control

- Esri.WorldGrayCanvas
- OpenStreetMap
- Esri.WorldTopoMap
- localities
- boundary
- network_type

Base Map Control

When you hover your cursor over to this icon, this menu will appear where you are able to select your desired base map from Esri.WorldGrayCanvas to OpenStreetMap to Esri.WorldTopoMap.

You will also have the option of selecting and deselecting options such as 'localities', 'boundary' and 'network_type' which are the Melbourne's city boundary outline and the network type outline.

Network Kernel Density Estimation Variable Inputs

Network and Spatial Points

Localities

Carlton

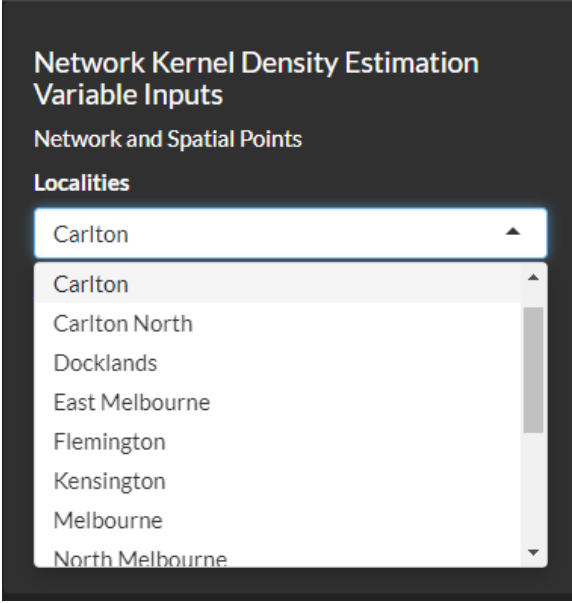
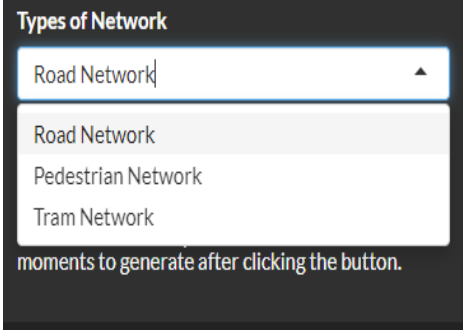
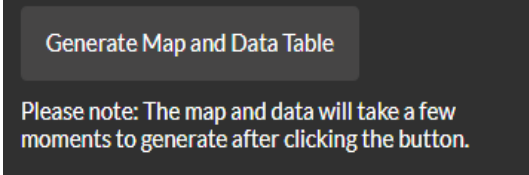
Types of Network

Road Network

Generate Map and Data Table

Please note: The map and data will take a few moments to generate after clicking the button.

Network Data Exploration Side Panel

Feature	Functionality
 <p>Network Kernel Density Estimation Variable Inputs</p> <p>Network and Spatial Points</p> <p>Localities</p> <p>Carlton</p> <p>Carlton North</p> <p>Docklands</p> <p>East Melbourne</p> <p>Flemington</p> <p>Kensington</p> <p>Melbourne</p> <p>North Melbourne</p> <p>Localities inputs for Data Exploration Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the localities variable to generate the data.</p> <p>'Entire City of Melbourne' will be the default option.</p> <p>Other options are 'Carlton', 'Carlton North', 'Docklands', 'East Melbourne', 'Flemington', 'Kensington', 'Melbourne', 'North Melbourne', 'Parkville', 'Port Melbourne', 'South Wharf', 'South Yarra', 'SouthBank' and 'West Melbourne'.</p>
 <p>Types of Network</p> <p>Road Network</p> <p>Road Network</p> <p>Pedestrian Network</p> <p>Tram Network</p> <p>moments to generate after clicking the button.</p> <p>Type of Network inputs for Data Exploration Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the type of network variable to generate the data.</p> <p>'Road Network' will be the default option.</p> <p>Other options are 'Pedestrian Network' and 'Tram Network'.</p>
 <p>Generate Map and Data Table</p> <p>Please note: The map and data will take a few moments to generate after clicking the button.</p> <p>Generate Map and Data Table Button</p>	<p>After selecting the above variable inputs, do remember to click on this 'Generate Map and Data Table' button to generate the data.</p>

Data Table

Results will be shown in the table below if dataset is selected.

Show entries

Search:

seg_id	str_type	dtupdate	status_id	seg_descr	poly_area	gisid	street_id	seg_part	LGA_CODE22	LGA_NAME22	STE_CODE21	STE_NAME21	AUS_CODE21	AUS_NAME21	AREASQKM	LOC_URI21	SHAPE_Leng	SHAPE_Area	LC_PLY_PID
20542	Council Major	20210923	2	Drummond Street between Victoria Street and Queensberry Street	6181	1566	583	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
20664	Council Minor	20210923	3	Nicholls Lane from Canling Street	67	1709	117833	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
21599	Arterial	20210923	1	Victoria Street between La Trobe Street and Rathdowne Street	4299	1844	1152	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
20725	Council Minor	20210923	3	C11147 from Ormond Place	109	1547	212	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
20543	Council Major	20210923	2	Intersection of Drummond Street and Queensberry Street	920	1565	0	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
22832	Council Minor	20210923	3	C11017 from University Street	37	1969	1509	2	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
20842	Council Minor	20210923	3	C11035 from PHE004	83	1904	283	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132
20753	Council Minor	20210923	3	Chambers Place from	204	1987	117725	1	24600	Melbourne	2	Victoria	AUS	Australia	37.5452	https://linked.data.gov.au/dataset/aggregated/LGA2022/24600	0.414391862894	0.00384126308132	kg9b447132

Data Table Generated

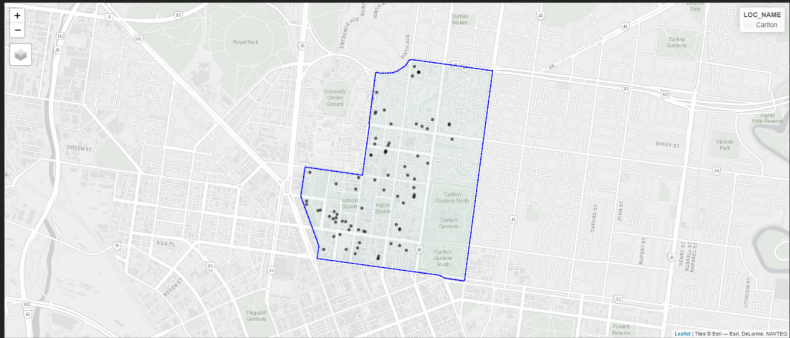
This will be the data table that will be generated upon clicking the 'Generate Map and Data Table' button. Pages will be split with 25 entries as default. The table comprises of columns such as 'seg_id', 'str_type', 'dtupdate', 'status_id', 'seg_descr', 'poly_area', 'gisid', 'street_id', 'seg_part', 'LGA_CODE22', 'LGA_NAME22', 'STE_CODE21', 'STE_NAME21', 'AUS_CODE21', 'AUS_NAME21', 'AREASQKM', 'LOC_URI21', 'SHAPE_Leng', 'SHAPE_Area', 'LC_PLY_PID', 'LOC_PID', 'DT_CREATE', 'LOC_NAME', 'LOC_CLASS', 'STATE' and lastly 'geometry'.

2.3 Spatial Points

spatial bros Home Page Data Exploration Spatial Point Pattern Analysis Network Constrained Point Pattern Analysis

Data Exploration

Introduction Network **Spatial Points**



LOC_NAME Carlton

Network Kernel Density Estimation Variable Inputs

Network and Spatial Points

Localities

Location of Interest

Specific Themes/Sub-Categories

Generate Map and Data Table

Please note: The map and data will take a few moments to generate after clicking the button.

Data Table

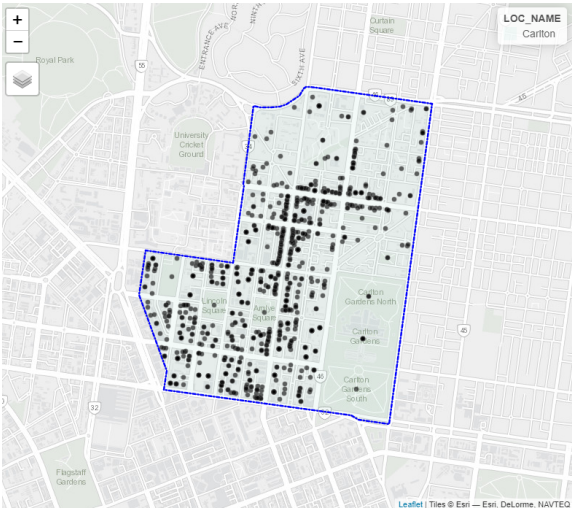

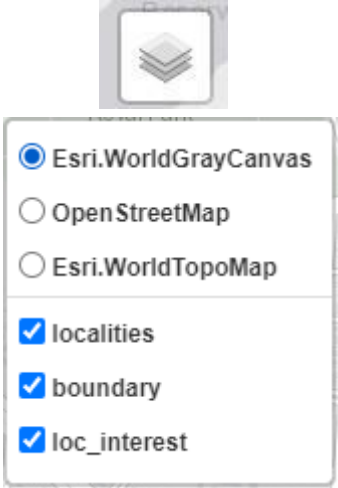
Results will be shown in the table below if dataset is selected.

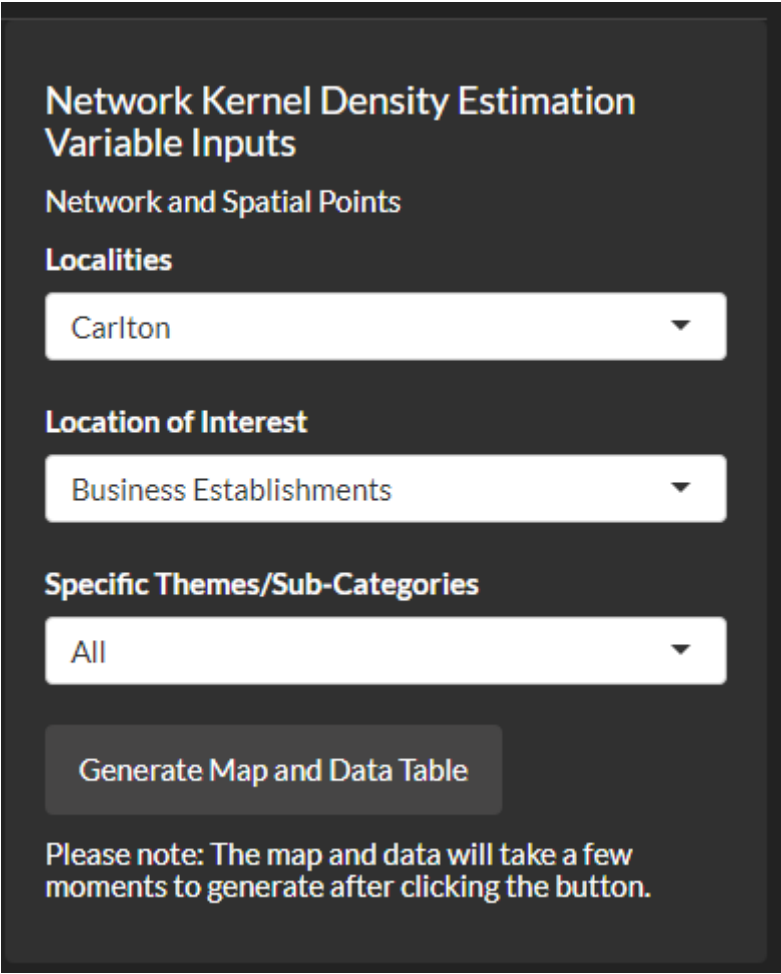
Show entries

Search:

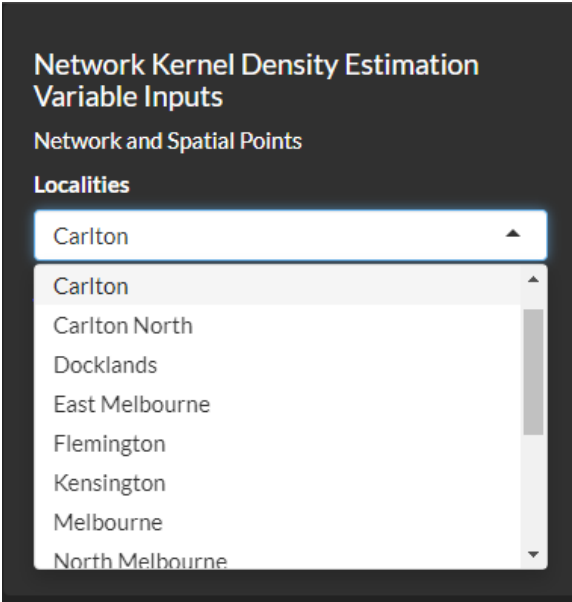
census_year	block_id	property_id	base_property_id	clue_small_area	business_address	trading_name	industry_ansi4_code	industry_ansi4_description	longitude	latitude	location	LGA_CODE22	LGA_NAME22	STE_CODE21	STE_NAME21	AUS_CODE21	AUS_NAME21	AREASQKM
2021	203	109349	109349	Carlton	864-866 Swarston Street CARLTON 3053	Student Residential	4400	Accommodation	144.96514	-37.79607		24600	Melbourne	2	Victoria	AUS	Australia	37.5452
2021	204	608876	608876	Carlton	266-270 Faraday Street CARLTON 3053	Student Residential	4400	Accommodation	144.96509	-37.79825		24600	Melbourne	2	Victoria	AUS	Australia	37.5452

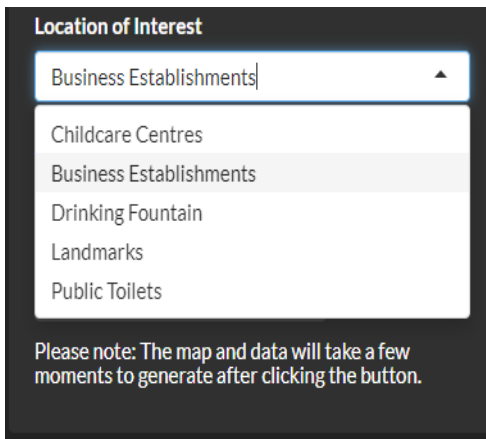
Data Exploration Spatial Point Main Panel

Feature	Functionality
 <p data-bbox="376 846 611 880">Map Visualization</p>	<p data-bbox="807 331 1385 398">This map is a visualisation of the Data Exploration Spatial Points being computed.</p> <p data-bbox="807 432 1385 600">The LOC_NAME in the legend represents the locality district 'Carlton' being analysed. From the visualisation, you are able to see the district outline, the network outlines and the spatial points.</p>
 <p data-bbox="411 1081 576 1115">Zoom Control</p>	<p data-bbox="807 909 1385 1037">The map visualisation provides the option of zooming in and out. You can click on the '+' icon to zoom further into the map and '-' to zoom further out.</p>
 <p data-bbox="384 1839 603 1872">Base Map Control</p>	<p data-bbox="807 1312 1385 1480">When you hover your cursor over to this icon, this menu will appear where you are able to select your desired base map from Esri.WorldGrayCanvas to OpenStreetMap to Esri.WorldTopoMap.</p> <p data-bbox="807 1514 1385 1709">You will also have the option of selecting and deselecting options such as 'localities', 'boundary' and 'loc_interest' which are the Melbourne's city boundary outline, the network type outline and lastly the point of interest.</p>



Spatial Points Data Exploration Side Panel

Feature	Functionality
 <p>Localities inputs for Data Exploration Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the localities variable to generate the data.</p> <p>‘Entire City of Melbourne’ will be the default option.</p> <p>Other options are ‘Carlton’, ‘Carlton North’, ‘Docklands’, ‘East Melbourne’, ‘Flemington’, ‘Kensington’, ‘Melbourne’, ‘North Melbourne’, ‘Parkville’, ‘Port Melbourne’, ‘South Wharf’, ‘South Yarra’, ‘SouthBank’ and ‘West Melbourne’.</p>

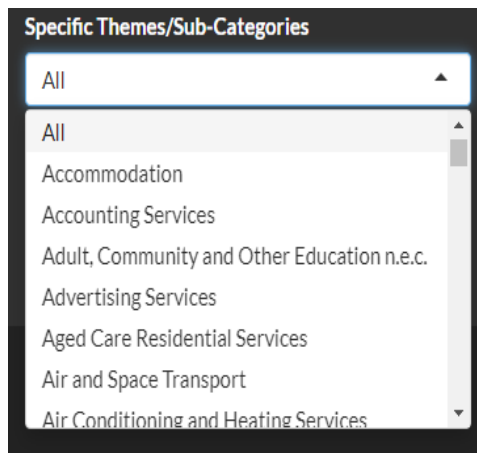


Location of Interest inputs for Spatial Points Data Exploration Network Kernel Density Estimation

From this drop down list, you can select the location of interest variable to generate the data.

'Childcare Centres' will be the default option.

Other options are 'Business Establishments', 'Drinking Fountain', 'Landmarks', and 'Public Toilets'.



Specific Themes/Sub-Categories inputs for Spatial Points Data Exploration Network Kernel Density Estimation

From this drop down list, you can select the Specific Themes/Sub-Categories variable to generate the data for Business Establishments.

'All' will be the default option

Other options are [1] "Clothing Retailing" [2] "Surveying and Mapping Services" [3] "Amusement Parks and Centres Operation" [4] "Footwear Retailing" [5] "Museum Operation" [6] "Optometry and Optical Dispensing" [7] "Sports and Physical Recreation Clubs and Sports Professionals" [8] "Sport and Camping Equipment Retailing" [9] "Takeaway Food Services" [10] "Cafes and Restaurants" [11] "Entertainment Media Retailing" [12] "Houseware Retailing" [13] "Sport and Physical Recreation Administrative Service" [14] "Vacant Space" [15] "Parking Services" [16] "Railway Rolling Stock Manufacturing and Repair Services" [17] "Computer System Design and Related Services" [18] "Primary Education" [19] "Port and Water Transport Terminal Operations" [20] "Convenience Store" [21] "Religious Services" [22] "Funeral, Crematorium and Cemetery"

	<p>Services"</p> <p>[23] "Engineering Design and Engineering Consulting Services"</p> <p>[24] "Building and Other Industrial Cleaning Services"</p> <p>[25] "Management Advice and Other Consulting Services"</p> <p>[26] "Specialist Medical Services"</p> <p>[27] "Fuel Retailing"</p> <p>[28] "Libraries and Archives"</p> <p>[29] "Pathology and Diagnostic Imaging Services"</p> <p>[30] "Accommodation"</p> <p>[31] "Health and Fitness Centres and Gymnasias Operation"</p> <p>[32] "Other Administrative Services n.e.c."</p> <p>[33] "Communications Equipment Manufacturing"</p> <p>[34] "Legal Services"</p> <p>[35] "Employment Placement and Recruitment Services"</p> <p>[36] "Arts Education"</p> <p>[37] "Sewerage and Drainage Services"</p> <p>[38] "State Government Administration"</p> <p>[39] "Paper Product Wholesaling"</p> <p>[40] "Automotive Body, Paint and Interior Repair"</p> <p>[41] "Other Building Installation Services"</p> <p>[42] "Other Electrical and Electronic Goods Wholesaling"</p> <p>[43] "General Practice Medical Services"</p> <p>[44] "Other Interest Group Services n.e.c."</p> <p>[45] "Other Health Care Services n.e.c."</p> <p>[46] "Local Government Administration"</p> <p>[47] "Telecommunication Goods Wholesaling"</p> <p>[48] "Human Pharmaceutical and Medicinal Product Manufacturing"</p> <p>[49] "Advertising Services"</p> <p>[50] "Other Specialised Design Services"</p> <p>[51] "Plumbing Goods Wholesaling"</p> <p>[52] "Supermarket and Grocery Stores"</p> <p>[53] "Sports and Physical Recreation Venues, Grounds and Facilities Operation"</p> <p>[54] "Aged Care Residential Services"</p> <p>[55] "Nature Reserves and Conservation Parks Operation"</p> <p>[56] "Other Personal Services n.e.c."</p> <p>[57] "Other Residential Care Services"</p> <p>[58] "Furniture Retailing"</p> <p>[59] "Hairdressing and Beauty Services"</p> <p>[60] "Other Store-Based Retailing n.e.c."</p> <p>[61] "Accounting Services"</p> <p>[62] "Other Telecommunications Services"</p>
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	<p>[63] "Pubs, Taverns and Bars"</p> <p>[64] "Other Warehousing and Storage Services"</p> <p>[65] "Scientific Testing and Analysis Services"</p> <p>[66] "Higher Education"</p> <p>[67] "Cake and Pastry Manufacturing (Factory based)"</p> <p>[68] "Non-Residential Property Operators"</p> <p>[69] "Industrial and Agricultural Chemical Product Wholesaling"</p> <p>[70] "Child Care Services"</p> <p>[71] "Other Goods and Equipment Rental and Hiring n.e.c."</p> <p>[72] "Printing Support Services"</p> <p>[73] "Other Grocery Wholesaling"</p> <p>[74] "House Construction"</p> <p>[75] "Clothing Manufacturing"</p> <p>[76] "Veterinary Services"</p> <p>[77] "Other Heavy and Civil Engineering Construction"</p> <p>[78] "Architectural Services"</p> <p>[79] "Air and Space Transport"</p> <p>[80] "Scenic and Sightseeing Transport"</p> <p>[81] "Other Gambling Activities"</p> <p>[82] "Toy and Game Retailing"</p> <p>[83] "Other Social Assistance Services"</p> <p>[84] "Performing Arts Operation"</p> <p>[85] "Performing Arts Venue Operation"</p> <p>[86] "Real Estate Services"</p> <p>[87] "Bakery Product Manufacturing (Non-factory based)"</p> <p>[88] "Business and Professional Association Services"</p> <p>[89] "Laundry and Dry-Cleaning Services"</p> <p>[90] "Brothel Keeping and Prostitution Services"</p> <p>[91] "Other Auxiliary Finance and Investment Services"</p> <p>[92] "Antique and Used Goods Retailing"</p> <p>[93] "Technical and Vocational Education and Training"</p> <p>[94] "Credit Reporting and Debt Collection Services"</p> <p>[95] "Courier Pick-up and Delivery Services"</p> <p>[96] "Wired Telecommunications Network Operation"</p> <p>[97] "Newspaper and Book Retailing"</p> <p>[98] "Call Centre Operation"</p> <p>[99] "Central Government Administration"</p> <p>[100] "Financial Asset Investing"</p> <p>[101] "Other Manufacturing n.e.c."</p> <p>[102] "Data Processing and Web Hosting"</p>
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	<p>Services"</p> <p>[103] "Banking"</p> <p>[104] "Scientific Research Services"</p> <p>[105] "Book Publishing"</p> <p>[106] "Medical and Surgical Equipment Manufacturing"</p> <p>[107] "Labour Association Services"</p> <p>[108] "Dental Services"</p> <p>[109] "Liquor Retailing"</p> <p>[110] "Foreign Government Representation"</p> <p>[111] "Financial Asset Broking Services"</p> <p>[112] "Adult, Community and Other Education n.e.c."</p> <p>[113] "Internet Publishing and Broadcasting"</p> <p>[114] "Superannuation Funds"</p> <p>[115] "Other Mining Support Services"</p> <p>[116] "Non-Residential Building Construction"</p> <p>[117] "Non-Store Retailing"</p> <p>[118] "Travel Agency and Tour Arrangement Services"</p> <p>[119] "Other Personal Accessory Retailing"</p> <p>[120] "Other Allied Health Services"</p> <p>[121] "Electrical, Electronic and Gas Appliance Retailing"</p> <p>[122] "Watch and Jewellery Retailing"</p> <p>[123] "Jewellery and Silverware Manufacturing"</p> <p>[124] "Creative Artists, Musicians, Writers and Performers"</p> <p>[125] "Music and Other Sound Recording Activities"</p> <p>[126] "Womens Clothing Retailing"</p> <p>[127] "Other Electrical and Electronic Goods Retailing"</p> <p>[128] "Flower Retailing"</p> <p>[129] "Health Insurance"</p> <p>[130] "Clubs (Hospitality)"</p> <p>[131] "Pharmaceutical, Cosmetic and Toiletry Goods Retailing"</p> <p>[132] "Market Research and Statistical Services"</p> <p>[133] "Other Transport Support Services n.e.c."</p> <p>[134] "Airport Operations and Other Air Transport Support Services"</p> <p>[135] "Other Repair and Maintenance n.e.c."</p> <p>[136] "Sports and Physical Recreation Instruction"</p> <p>[137] "Other Residential Building Construction"</p> <p>[138] "Rail Freight Transport"</p> <p>[139] "Other Electricity Generation"</p>
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	<p>[140] "Office Administrative Services" [141] "Electricity Distribution" [142] "Land Development and Subdivision" [143] "Other Depository Financial Intermediation" [144] "On Selling Electricity and Electricity Market Operation" [145] "General Insurance" [146] "Auxiliary Insurance Services" [147] "Non-Depository Financing" [148] "Other Water Transport Support Services" [149] "Water Freight Transport" [150] "Computer and Computer Peripheral Retailing" [151] "Internet Service Providers and Web Search Portals" [152] "Amusement and Other Recreational Activities n.e.c." [153] "Mineral Exploration" [154] "Educational Support Services" [155] "Other Specialised Food Retailing" [156] "Other Telecommunications Network Operation" [157] "Gold Ore Mining" [158] "Hardware and Building Supplies Retailing" [159] "Dairy Produce Wholesaling" [160] "Gas Supply" [161] "Investigation and Security Services" [162] "Jewellery and Watch Wholesaling" [163] "Metal and Mineral Wholesaling" [164] "Wine and Other Alcoholic Beverage Manufacturing" [165] "Womens Footwear Retailing" [166] "Other Professional, Scientific and Technical Services n.e.c." [167] "Other Food Product Manufacturing n.e.c." [168] "Motion Picture Exhibition" [169] "Mens Clothing Retailing" [170] "Clothing and Footwear Repair" [171] "Chiropractic and Osteopathic Services" [172] "Printing" [173] "Petroleum Exploration" [174] "Physiotherapy Services" [175] "Computer and Electronic Office Equipment Manufacturing" [176] "Electricity Transmission" [177] "Other Construction Services n.e.c." [178] "Postal Services" [179] "Life Insurance" [180] "Silver-Lead-Zinc Ore Mining"</p>
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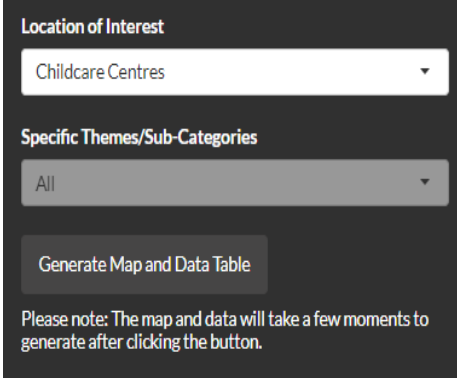
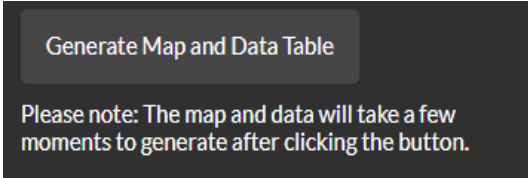
	<p>[181] "Professional Photographic Services"</p> <p>[182] "Other Agriculture and Fishing Support Services"</p> <p>[183] "Alternative Health Services"</p> <p>[184] "Electronic (except Domestic Appliance) and Precision Equipment Repair and Maint"</p> <p>[185] "Other Professional and Scientific Equipment Manufacturing"</p> <p>[186] "Other Specialised Industrial Machinery and Equipment Wholesaling"</p> <p>[187] "Regulatory Services"</p> <p>[188] "Other Goods Wholesaling n.e.c."</p> <p>[189] "Commission-Based Wholesaling"</p> <p>[190] "Waste Remediation and Materials Recovery Services"</p> <p>[191] "Stationery Goods Retailing"</p> <p>[192] "Pharmaceutical and Toiletry Goods Wholesaling"</p> <p>[193] "Department Stores"</p> <p>[194] "Radio Broadcasting"</p> <p>[195] "Other Agricultural Product Wholesaling"</p> <p>[196] "Catering Services"</p> <p>[197] "Electronic Information Storage Services"</p> <p>[198] "Petroleum Product Wholesaling"</p> <p>[199] "Justice"</p> <p>[200] "Childrens Clothing Retailing"</p> <p>[201] "Mens Footwear Retailing"</p> <p>[202] "Police Services"</p> <p>[203] "Secondary Education"</p> <p>[204] "Motor Cycle Retailing"</p> <p>[205] "Urban Bus Transport (Including Tramway)"</p> <p>[206] "Post-production Services and Other Motion Picture and Video Activities"</p> <p>[207] "Other Public Order and Safety Services"</p> <p>[208] "Labour Supply Services"</p> <p>[209] "Clothing and Footwear Wholesaling"</p> <p>[210] "Passenger Car Rental and Hiring"</p> <p>[211] "Fire Protection and Other Emergency Services"</p> <p>[212] "Fruit and Vegetable Retailing"</p> <p>[213] "Fresh Meat, Fish and Poultry Retailing"</p> <p>[214] "Car Retailing"</p> <p>[215] "Pre-school Education"</p> <p>[216] "Professional and Scientific Goods Wholesaling"</p> <p>[217] "Automotive Electrical Services"</p> <p>[218] "Credit Union Operation"</p> <p>[219] "Toy and Sporting Goods"</p>
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	<p>Wholesaling"</p> <p>[220] "Other Automotive Repair and Maintenance"</p> <p>[221] "Footwear Manufacturing"</p> <p>[222] "Freight Forwarding Services"</p> <p>[223] "Road and Bridge Construction"</p> <p>[224] "Software Publishing"</p> <p>[225] "Other Electronic Equipment Manufacturing"</p> <p>[226] "Plumbing Services"</p> <p>[227] "Tyre Retailing"</p> <p>[228] "Other Converted Paper Product Manufacturing"</p> <p>[229] "Packaging Services"</p> <p>[230] "Residential Property Operators"</p> <p>[231] "Other Motor Vehicle Parts Manufacturing"</p> <p>[232] "Wooden Furniture and Upholstered Seat Manufacturing"</p> <p>[233] "Potato, Corn and Other Crisp Manufacturing"</p> <p>[234] "Lottery Operation"</p> <p>[235] "Fruit and Vegetable Wholesaling"</p> <p>[236] "Garden Supplies Retailing"</p> <p>[237] "Magazine and Other Periodical Publishing"</p> <p>[238] "Textile Finishing and Other Textile Product Manufacturing"</p> <p>[239] "Other Hardware Good Wholesaling"</p> <p>[240] "Motion Picture and Video Production"</p> <p>[241] "Furniture and Floor Covering Wholesaling"</p> <p>[242] "Road Freight Transport"</p> <p>[243] "Customs Agency Services"</p> <p>[244] "Site Preparation Services"</p> <p>[245] "Kitchen and Diningware Wholesaling"</p> <p>[246] "Fish and Seafood Wholesaling"</p> <p>[247] "Meat Processing"</p> <p>[248] "Other Specialised Machinery and Equipment Manufacturing"</p> <p>[249] "Tiling and Carpeting Services"</p> <p>[250] "Reproduction of Recorded Media"</p> <p>[251] "Other Horse and Dog Racing Activities"</p> <p>[252] "Hospitals (except Psychiatric Hospitals)"</p> <p>[253] "Basic Organic Chemical Manufacturing"</p> <p>[254] "Coal Mining"</p> <p>[255] "Rail Passenger Transport"</p> <p>[256] "Combined Primary and Secondary Education"</p> <p>[257] "Electric Lighting Equipment Manufacturing"</p>
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	<p>[258] "Taxi and Other Road Transport"</p> <p>[259] "Milk and Cream Processing"</p> <p>[260] "Liquor and Tobacco Product Wholesaling"</p> <p>[261] "Pipeline Transport"</p> <p>[262] "Polymer Film and Sheet Packaging Material Manufacturing"</p> <p>[263] "Solid Waste Collection Services"</p> <p>[264] "Architectural Aluminium Product Manufacturing"</p> <p>[265] "Ready-Mixed Concrete Manufacturing"</p> <p>[266] "Electrical Services"</p> <p>[267] "Concreting Services"</p> <p>[268] "Cheese and Other Dairy Product Manufacturing"</p> <p>[269] "Lifting and Material Handling Equipment Manufacturing"</p> <p>[270] "Other Fabricated Metal Product Manufacturing n.e.c."</p> <p>[271] "Other Machinery and Equipment Wholesaling n.e.c."</p> <p>[272] "Cement and Lime Manufacturing"</p> <p>[273] "Heavy Machinery and Scaffolding Rental and Hiring"</p> <p>[274] "Marine Equipment Retailing"</p> <p>[275] "Defence"</p> <p>[276] "Other Machinery and Equipment Repair and Maintenance"</p> <p>[277] "Other Electrical Equipment Manufacturing"</p> <p>[278] "Computer and Computer Peripheral Wholesaling"</p> <p>[279] "Boatbuilding and Repair Services"</p> <p>[280] "Textile Product Wholesaling"</p> <p>[281] "Ambulance Services"</p> <p>[282] "Meat, Poultry and Smallgoods Wholesaling"</p> <p>[283] "Cut and Sewn Textile Product Manufacturing"</p> <p>[284] "Stevedoring Services"</p> <p>[285] "Free-to-Air Television Broadcasting"</p> <p>[286] "Pulp, Paper and Paperboard Manufacturing"</p> <p>[287] "Fertiliser Manufacturing"</p> <p>[288] "Gardening Services"</p> <p>[289] "Landscape Construction Services"</p> <p>[290] "Psychiatric Hospitals"</p> <p>[291] "Other Transport n.e.c."</p> <p>[292] "Air Conditioning and Heating Services"</p> <p>[293] "Motor Vehicle Dismantling and Used Part Wholesaling"</p> <p>[294] "Interurban and Rural Bus Transport"</p>
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	<p>[295] "Manchester and Other Textile Goods Retailing"</p> <p>[296] "Grape Growing"</p> <p>[297] "Zoological and Botanical Gardens Operation"</p> <p>[298] "Cable and Other Subscription Broadcasting"</p> <p>[299] "Other Publishing (except Software, Music and Internet)"</p> <p>[300] "Forestry Support Services"</p> <p>[301] "Motor Vehicle New Part Wholesaling"</p> <p>[302] "Roofing Services"</p> <p>[303] "Painting and Decorating Services"</p> <p>[304] "Car Wholesaling"</p> <p>[305] "Beer Manufacturing"</p> <p>[306] "Glass and Glass Product Manufacturing"</p> <p>[307] "Copper Ore Mining"</p> <p>[308] "Wooden Structural Fitting and Component Manufacturing"</p> <p>[309] "Other Metal Ore Mining"</p> <p>[310] "Corporate Head Office Management Services"</p> <p>[311] "Metal Coating and Finishing"</p> <p>[312] "Iron Smelting and Steel Manufacturing"</p> <p>[313] "Newspaper Publishing"</p> <p>[314] "Document Preparation Services"</p> <p>[315] "Prepared Animal and Bird Feed Manufacturing"</p> <p>[316] "Logging"</p> <p>[317] "Fire and Security Alarm Installation Services"</p> <p>[318] "Plastering and Ceiling Services"</p> <p>[319] "Other Information Services"</p> <p>[320] "Correctional and Detention Services"</p> <p>[321] "Other Motor Vehicle and Transport Equipment Rental and Hiring"</p> <p>[322] "Motor Vehicle Parts Retailing"</p> <p>[323] "Cereal, Pasta and Baking Mix Manufacturing"</p> <p>[324] "Retail Commission-Based Buying and/or Selling"</p> <p>[325] "Other Sheet Metal Product Manufacturing"</p> <p>[326] "Other Ceramic Product Manufacturing"</p> <p>[327] "Photographic Film Processing"</p> <p>[328] "Horse and Dog Racing Administration and Track Operation"</p> <p>[329] "Photographic, Optical and Ophthalmic Equipment Manufacturing"</p> <p>[330] "Carpentry Services"</p> <p>[331] "Metal Furniture Manufacturing"</p>
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	<p>[332] "Horse Farming"</p> <p>[333] "Casino Operation"</p> <p>[334] "Forestry"</p> <p>[335] "Floor Coverings Retailing"</p> <p>[336] "Cosmetic and Toiletry Preparation Manufacturing"</p> <p>[337] "Concrete Product Manufacturing"</p> <p>[338] "Fruit and Vegetable Processing"</p> <p>[339] "Basic Inorganic Chemical Manufacturing"</p> <p>[340] "Commercial Vehicle Wholesaling"</p> <p>[341] "Hire of Construction Machinery with Operator"</p> <p>[342] "Grain Storage Services"</p> <p>[343] "Grain Mill Product Manufacturing"</p> <p>[344] "Other Waste Collection Services"</p> <p>[345] "Oil and Gas Extraction"</p> <p>[346] "Toy, Sporting and Recreational Product Manufacturing"</p> <p>[347] "Structural Steel Erection Services"</p> <p>[348] "Music Publishing"</p> <p>[349] "Timber Wholesaling"</p> <p>[350] "Confectionery Manufacturing"</p> <p>[351] "Central Banking"</p> <p>[352] "Book and Magazine Wholesaling"</p> <p>[353] "Iron Ore Mining"</p> <p>[354] "Bauxite Mining"</p> <p>[355] "Domestic Government Representation"</p> <p>[356] "Other Structural Metal Product Manufacturing"</p> <p>[357] "Other Fishing"</p> <p>[358] "Motion Picture and Video Distribution"</p> <p>[359] "Bread Manufacturing (Factory based)"</p> <p>[360] "Seafood Processing"</p> <p>[361] "Cereal Grain Wholesaling"</p> <p>[362] "Plaster Product Manufacturing"</p> <p>[363] "Water Supply"</p> <p>[364] "Cured Meat and Smallgoods Manufacturing"</p> <p>[365] "Motor Vehicle Body and Trailer Manufacturing"</p> <p>[366] "Other Furniture Manufacturing"</p> <p>[367] "Aircraft Manufacturing and Repair Services"</p> <p>[368] "Rope, Cordage and Twine Manufacturing"</p> <p>[369] "Other Grain Growing"</p> <p>[370] "Cigarette and Tobacco Product Manufacturing"</p> <p>[371] "Other Non-Metallic Mineral Product Manufacturing"</p>
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	[372] "Farm Animals and Bloodstock Leasing"
 <p style="text-align: center;">Specific Theme/Sub-categories</p>	<p>Please take note by selecting 'Business Establishments' or 'Landmarks', you have the option of selecting specific themes/sub-categories. Other locations of interest such as</p> <ol style="list-style-type: none"> 1. Childcare Centres 2. Public Toilets 3. Drinking Fountains <p>do not have specific themes/sub-categories for you to select and will therefore be disabled. This does not mean you are unable to generate the map and data table results.</p>
 <p style="text-align: center;">Generate Map and Data Table Button</p>	<p>After selecting the above variable inputs, do remember to click on this 'Generate Map and Data Table' button to generate the data.</p>

Data Exploration Variable Inputs

Spatial Points

Localities

Docklands

Location of Interest

Landmarks

Specific Themes/Sub-Categories

Health Services

Generate Map and Data Table

Please note: The map and data will take a few moments to generate after clicking the button.

Health Services in Entire City of ^x
Melbourne has no spatial
points to be analysed. The
analysis has been terminated.

Data Exploration Data Inputs (Error)

Please do take note that some localities together with the location of interest and specific themes/sub-categories to be analysed do not have relevant data to be generated. Therefore an error message will be prompted to terminate the analysis

Data Table

Results will be shown in the table below if dataset is selected.

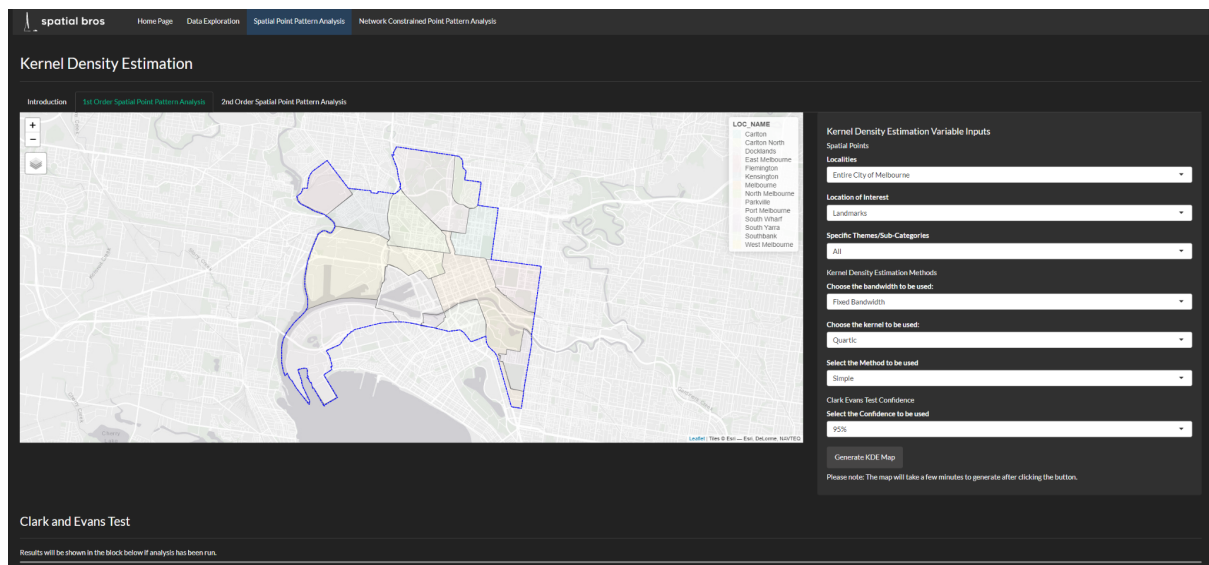
Show entries Search:

census_year	block_id	property_id	base_property_id	clue_small_area	business_address	trading_name	industry_anzsic4_code	industry_anzsic4_description	longitude	latitude	location	geometry
2021	1110	620308	593737	Docklands	Shop G03 4 Star Crescent DOCKLANDS VIC 3008	Sporting House	4251	Clothing Retailing	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620309	593737	Docklands	Shop F88 Level 117 Star Crescent DOCKLANDS VIC 3008	Cepmaps Pty Ltd	6922	Surveying and Mapping Services	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620309	593737	Docklands	Level 119-21 Star Crescent DOCKLANDS VIC 3008	Chipmunks Playland And Cafe	9131	Amusement Parks and Centres Operation	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620309	593737	Docklands	Ground 5 Star Crescent DOCKLANDS VIC 3008	Star Ugg & Sheepskin	4252	Footwear Retailing	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620310	593737	Docklands	Shop G05 26 Wharf Street DOCKLANDS VIC 3008	Australian Carbon Museum	8910	Museum Operation	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620311	593737	Docklands	Shop G01 122 Studio Lane DOCKLANDS VIC 3008	Sunglass Hut	8532	Optometry and Optical Dispensing	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620311	593737	Docklands	Shop G21 116 Studio Lane DOCKLANDS VIC 3008	The Melbourne Ice Limited	9112	Sports and Physical Recreation Clubs and Sports Professionals	144.938	-37.81329	318494.3944551335812899.36544297	
2021	1110	620311	593737	Docklands	Shop G07 30 Star Crescent DOCKLANDS VIC 3008	File Outlet	4241	Sport and Camping Equipment Retailing	144.938	-37.81329	318494.3944551335812899.36544297	

Data Table Generated

This will be the data table that will be generated upon clicking the 'Generate Map and Data Table' button. Pages will be split with 25 entries as default. You are allowed to perform a search on the right side as well. The table comprises of columns such as 'census_year', 'block_id', 'property_id', 'base_property_id', 'clue_small_area', 'business_address', 'trading_name', 'industry_anzsic4_code', 'industry_anzsic4_description', 'longitude', 'latitude', 'location' and 'geometry'.

3. Spatial Point Pattern Analysis



The Spatial Point Pattern Analysis is the third page that you will be able to access in our application.

From the Spatial Point Pattern Analysis, there are 3 sub tabs that is made available to you for usage:

1. Introduction
2. 1st Order Spatial Point Pattern Analysis
3. 2nd Order Spatial Point Pattern Analysis

The layout of the 1st Order Spatial Point Pattern Analysis and 2nd Order Spatial Point Pattern Analysis tab is similar in nature, with the main visualisation map being on the left and a side panel on the right for the selection of inputs.

3.1 Introduction

spatial bros Home Page Data Exploration **Spatial Point Pattern Analysis** Network Constrained Point Pattern Analysis

Kernel Density Estimation

[Introduction](#) [1st Order Spatial Point Pattern Analysis](#) [2nd Order Spatial Point Pattern Analysis](#)

Welcome to the Spatial Point Pattern Analysis!

You will be able to perform spatial point patterns analysis methods special developed for analysing spatial point event occurs on or alongside network for City of Melbourne, Australia!

There are 2 types of analysis that you can perform

1. Kernel Density Estimation
2. G & K Function Analysis

For each of the analysis, we offer you the options of selecting

1. Childcare Centres
2. Business Establishments
3. Drinking Fountains
4. Landmarks
5. Public Toilets

Benefits of performing Spatial Point Pattern Analysis

1. Statistical benefits: Spatial Point Pattern Analysis helps to identify and statistically conclude the underlying spatial patterns in data and detect clustering or dispersion of points over traditional point pattern analysis.
2. Better decision-making: Spatial Point Pattern Analysis can provide insights of the spatial distribution of points, which can be valuable for decision-making related to urban planning, and public policy

SPATIAL POINT PATTERN ANALYSIS

STEP BY STEP INSTRUCTION

1. SELECT TYPE OF ANALYSIS
2. SELECT POINT OF INTEREST
3. SELECT OTHER PARAMETERS
4. SELECT OTHER PARAMETERS
5. VIEW AND ANALYSE OUTPUT

1st/2nd Order Spatial Point Pattern Analysis Introduction

This is the spatial point pattern analysis introduction tab where you will learn about what is the available analysis included in this application. In addition, we also provide you a brief overview of the instructions and the benefits of performing spatial point pattern analysis.

3.2 1st Order Spatial Point Pattern Analysis

spatial bros Home Page Data Exploration Spatial Point Pattern Analysis Network Constrained Point Pattern Analysis

Kernel Density Estimation

Introduction 1st Order Spatial Point Pattern Analysis 2nd Order Spatial Point Pattern Analysis

LOC_NAME
Carlton
Carlton North
Docklands
East Melbourne
Flemington
Kensington
Maboum
North Melbourne
Parkville
Port Melbourne
South Yarra
Southbank
West Melbourne

Kernel Density Estimation Variable Inputs

Spatial Points
Localities
Carlton

Location of Interest
Landmarks

Specific Themes/Sub-Categories
All

Kernel Density Estimation Methods
Choose the bandwidth to be used:
Fixed Bandwidth

Choose the kernel to be used:
Quartic

Select the Method to be used
Simple

Clark Evans Test Confidence
Select the Confidence to be used
95%

Generate KDE Map

Please note: The map will take a few minutes to generate after clicking the button.

Clark and Evans Test

Results will be shown in the Mock below if analysis has been run.

1st Order Spatial Point Pattern Analysis Main Panel

Kernel Density Estimation Map and 1st Order Spatial Point Pattern Analysis

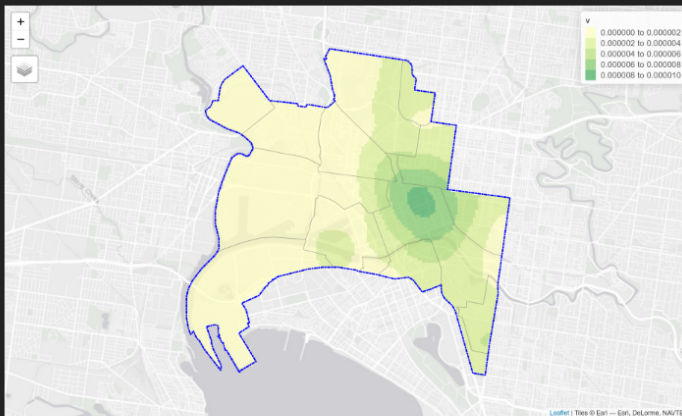
1st Spatial Point Pattern Analysis analyses point pattern events and its effects with the environment. We provide several point pattern (such as Business Establishment, Drinking Fountains) options to explore the effects of spatial point patterns and densities. These could be used to investigate the density of point patterns, such as the amount of drinking fountains to inform the planning and installing of more drinking fountains.

To begin your analysis, you can start by

1. Select your choice of locality
2. Select your location of interest and subcategories/theme if required
3. Select your kernel of choice
4. Select your method of choice
5. Click on 'Generate KDE Map' and you are ready to go!

Kernel Density Estimation explanation and 1st Order Spatial Point Pattern Analysis instructions

Interpreting the Results



Clark and Evans Test

Results will be shown in the block below if analysis has been run.

```
Clark-Evans test
No edge correction
Monte Carlo Test based on 1000 simulations of CSR with fixed n
data: loc_interest.ppp
R = 0.98842, p-value = 0.82
alternative hypothesis: two-sided
```

A legend will be shown at the top right side of the map. The colour shade intensity of the network will get darker if there is a higher relative density of spatial points specified (location of interest).

On contrary, if the colour shade intensity of the network is lighter, it represents a lower relative density alongside the network

The 'Clark and Evans Test' is a nearest neighbour test to analyse and statistically conclude point pattern events and its effects with the environment.

Hypothesis:

H0: The distribution of spatial points are randomly distributed

H1: The distribution of spatial points are not randomly distributed

If the p-value is less than the alpha of the confidence selected (ie. alpha will be 0.05 if confidence selected is 95%), we reject H0 (null hypothesis) that the spatial points are randomly distributed

If the p-value is more than the alpha of the confidence selected (ie. alpha will be 0.05 if confidence selected is 95%), we cannot reject H0 (null hypothesis) that the spatial points are randomly distributed

If H0 is rejected:

In the event if the $R < 1$, we can conclude that the spatial points resemble a clustered distribution

In the event if the $R > 1$, we can conclude that the spatial points resemble a dispersed distribution

Interpretation of the results of 1st order spatial point analysis

An example map will be shown on how to interpret the above results when you decide to try your own analysis. In addition, it further explains and concludes the hypothesis results based on H0, H1.

Key Function FAQ

Confidence Level

How many simulations to run the statistical analysis. The number of simulations are mapped as follows:

95% - 39 | 99% - 199 | 99.9% - 1999

Given by the following formula: $\alpha = 2 * \text{nrnk} / (1 + \text{nsim})$ where $\text{nrnk} = 1$

95% and 99% are typical confidence levels used

Kernel Density Estimation Methods

Bandwidth Type

Fixed: Appropriate bandwidth will be selected by algorithm to generate Kernel Density Estimate

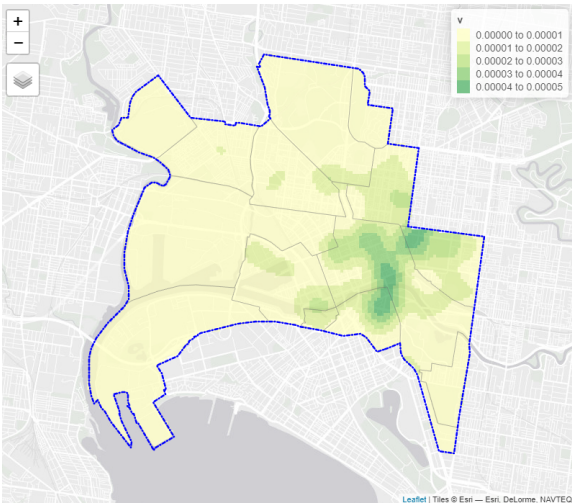

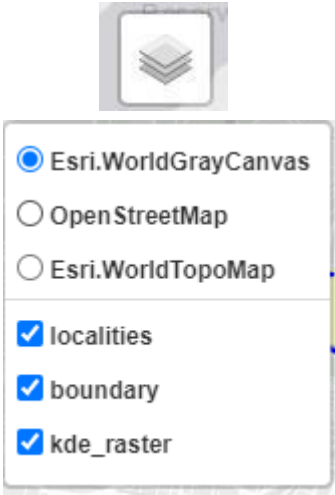
Adaptive: Appropriate bandwidth will be selected by algorithm to generate Kernel Density Estimate. Adaptive kernel is suitable to provide a smoother estimate when dealing with varying spatial point distributions. An example could be urban vs rural typologies where urban may have more spatial points over rural.

KERNEL	
TYPE	DESCRIPTION
QUARTIC	This kernel has a quartic shape and assigns more weight to points close to the centre than those further away. It has a slower decrease in weight towards the edges than triangular kernel.
EPANECHNIKOV	This kernel has a parabolic shape and assigns more weight to points close to the center than those further away. It has a faster decrease in weight towards the edges than tricube and triweight kernels.
GAUSSIAN	This kernel is a bell-shaped function that assigns weights to each data point in a neighborhood around a particular location, with the weights decreasing as the distance from the center location increases.

METHOD	
SIMPLE	This method uses a linear activation function, which simply multiplies the input by a weight and adds a bias term. This is the simplest activation function and is sometimes used in the output layer of a neural network.
CONTINUOUS	This method uses a continuous activation function such as the sigmoid function or the hyperbolic tangent function. These functions smoothly transform the input values into an output value between 0 and 1 (for sigmoid) or -1 and 1 (for hyperbolic tangent).
DISCONTINUOUS	These functions have a constant value for a range of input values and then abruptly switch to another constant value. Discontinuous activation functions are rarely used in neural networks due to their non-smoothness, which can cause optimization problems.

FAQ and explanation for Kernel Type and Method Type

This section will explain to you some of the frequently asked questions and address your doubts regarding the statistical analysis. In addition, it explains the difference between each kernel type and method type.

Feature	Functionality
 <p data-bbox="376 837 609 869">Map Visualization</p>	<p data-bbox="807 331 1385 432">This map is a visualisation of the 1st Order Spatial Point Pattern Analysis being generated.</p> <p data-bbox="807 465 1385 600">The 'v' in the legend represents intensity of the location of interest being analysed. From the visualisation, you are able to see the district outline as well.</p>
 <p data-bbox="411 1077 574 1108">Zoom Control</p>	<p data-bbox="807 904 1385 1039">The map visualisation provides the option of zooming in and out. You can click on the '+' icon to zoom further into the map and '-' to zoom further out.</p>
 <p data-bbox="384 1666 601 1697">Base Map Control</p>	<p data-bbox="807 1137 1385 1305">When you hover your cursor over to this icon, this menu will appear where you are able to select your desired base map from Esri.WorldGrayCanvas to OpenStreetMap to Esri.WorldTopoMap.</p> <p data-bbox="807 1339 1385 1541">You will also have the option of selecting and deselecting options such as 'localities', 'boundary' and 'kde_raster' which are the Melbourne's city boundary outline, the localities location of interest and lastly the intensity of the location of interest.</p>

Kernel Density Estimation Variable Inputs

Spatial Points

Localities

Entire City of Melbourne

Location of Interest

Landmarks

Specific Themes/Sub-Categories

All

Kernel Density Estimation Methods

Choose the bandwidth to be used:

Fixed Bandwidth

Choose the kernel to be used:

Quartic

Select the Method to be used

Simple

Clark Evans Test Confidence

Select the Confidence to be used

95%

Generate KDE Map

Please note: The map will take a few minutes to generate after clicking the button.

1st Order Spatial Point Pattern Analysis Side Panel

Kernel Density Estimation Variable Inputs

Spatial Points

Localities

Docklands

Location of Interest

Landmarks

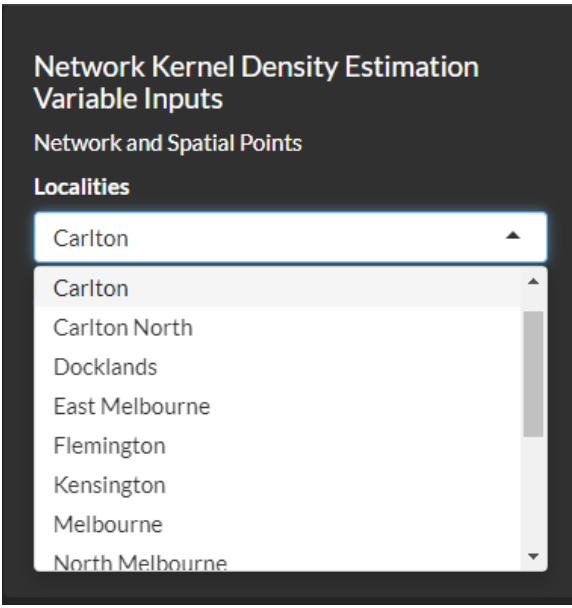
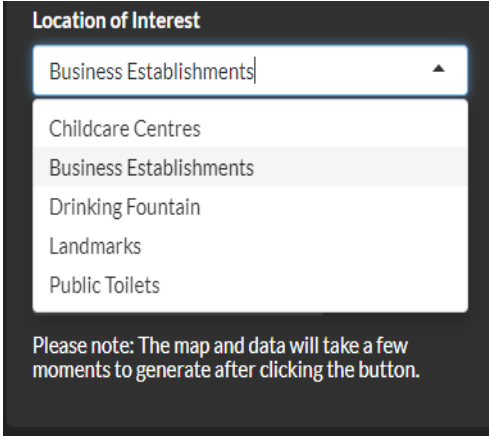
Specific Themes/Sub-Categories

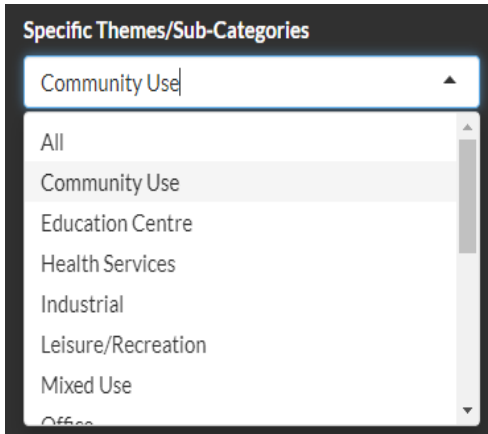
Health Services

Health Services in Entire City of ^x
Melbourne has no spatial
points to be analysed. The
analysis has been terminated.

1st Order Spatial Point Pattern Analysis Data Inputs (Error)

Please do take note that some localities together with the location of interest and specific themes/sub-categories to be analysed do not have relevant data to be generated. Therefore an error message will be prompted to terminate the analysis

Feature	Functionality
 <p>Network Kernel Density Estimation Variable Inputs</p> <p>Network and Spatial Points</p> <p>Localities</p> <p>Carlton</p> <p>Carlton Carlton North Docklands East Melbourne Flemington Kensington Melbourne North Melbourne</p> <p>Localities inputs for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the localities variable to generate the data.</p> <p>‘Entire City of Melbourne’ will be the default option.</p> <p>Other options are ‘Carlton’, ‘Carlton North’, ‘Docklands’, ‘East Melbourne’, ‘Flemington’, ‘Kensington’, ‘Melbourne’, ‘North Melbourne’, ‘Parkville’, ‘Port Melbourne’, ‘South Wharf’, ‘South Yarra’, ‘SouthBank’ and ‘West Melbourne’.</p>
 <p>Location of Interest</p> <p>Business Establishments</p> <p>Childcare Centres Business Establishments Drinking Fountain Landmarks Public Toilets</p> <p>Please note: The map and data will take a few moments to generate after clicking the button.</p> <p>Location of Interest inputs for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the location of interest variable to generate the data.</p> <p>‘Childcare Centres’ will be the default option.</p> <p>Other options are ‘Business Establishments’, ‘Drinking Fountain’, ‘Landmarks’, and ‘Public Toilets’.</p>

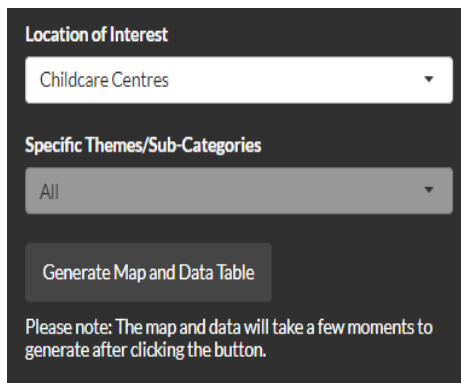


Specific Themes/Sub-Categories inputs for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation

From this drop down list, you can select the Specific Themes/Sub-Categories variable to generate the data.

'All' will be the default option.

Other options are 'Community Use', 'Education Centre', 'Health Services', 'Industrial', 'Leisure/Recreation', 'Mixed Use', 'Office', 'Place of Assembly', 'Place of Worship', 'Purpose Built', 'Residential Accommodation', 'Retail', 'Specialist Residential Accommodation', 'Transport', 'Vacant Land' and 'Warehouse/Store'

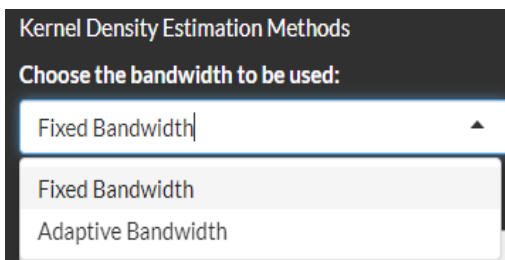


Specific Theme/Sub-categories

Please take note by selecting 'Business Establishments' or 'Landmarks', you have the option of selecting specific themes/sub-categories. Other locations of interest such as

4. Childcare Centres
5. Public Toilets
6. Drinking Fountains

do not have specific themes/sub-categories for you to select and will therefore be disabled. This does not mean you are unable to generate the map and data table results.

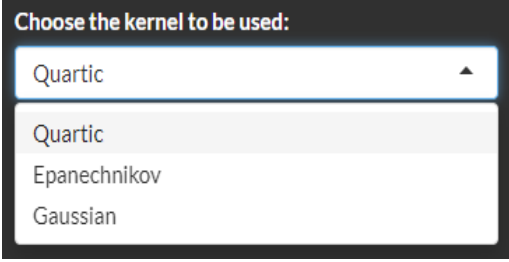
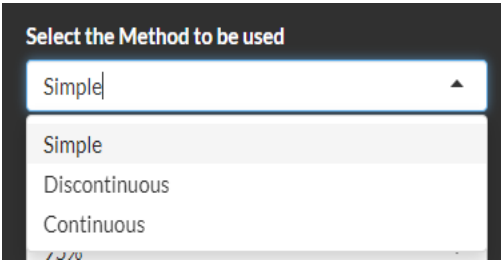
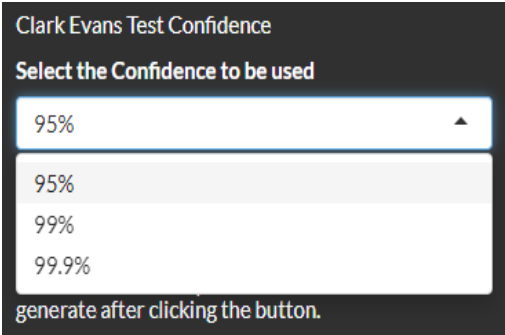
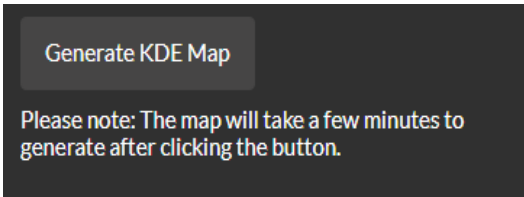


Bandwidth method for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation

From this drop down list, you can select the Bandwidth method variable to generate the data.

'Fixed Bandwidth' will be the default option.

The other option is 'Adaptive Bandwidth'.

 <p>Choose the kernel to be used:</p> <p>Quartic</p> <p>Quartic</p> <p>Epanechnikov</p> <p>Gaussian</p> <p>Kernel method for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the Kernel method variable to generate the data.</p> <p>'Quartic' will be the default option.</p> <p>The other options are 'Epanechnikov' and 'Gaussian'</p>
 <p>Select the Method to be used</p> <p>Simple</p> <p>Simple</p> <p>Discontinuous</p> <p>Continuous</p> <p>Method to be used for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the method variable to generate the data.</p> <p>'Simple' will be the default option.</p> <p>The other options are 'Continuous' and 'Discontinuous'.</p>
 <p>Clark Evans Test Confidence</p> <p>Select the Confidence to be used</p> <p>95%</p> <p>95%</p> <p>99%</p> <p>99.9%</p> <p>generate after clicking the button.</p> <p>Clark Evans Test Confidence for 1st Order Spatial Point Pattern Analysis Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the Clark Evans Test Confidence variable interval to generate the data.</p> <p>'95%' will be the default option.</p> <p>The other options are '99%' and '99.9%'.</p>
 <p>Generate KDE Map</p> <p>Please note: The map will take a few minutes to generate after clicking the button.</p> <p>Generate KDE Map Button</p>	<p>After selecting the above variable inputs, do remember to click on this 'Generate KDE Map' button to generate the data.</p>

Clark and Evans Test

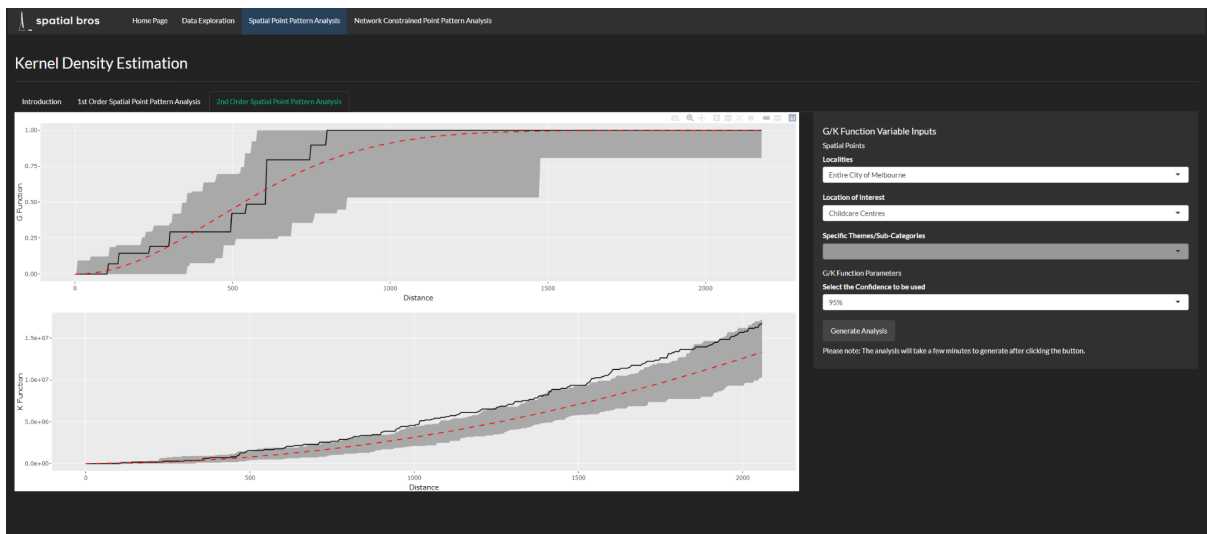
Results will be shown in the block below if analysis has been run.

```
Error: non-numeric argument to binary operator
```

Clark and Evans Test Results

Upon clicking on the 'Generate KDE Map' button, the Clark and Evans Test result will be generated here.

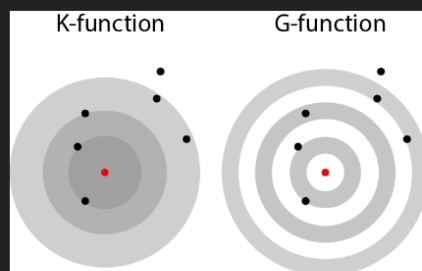
3.3 2nd Order Spatial Point Pattern Analysis



2nd Order Spatial Point Pattern Analysis Main Panel

2nd Order Spatial Point Pattern Analysis and Statistical Functions - G & K

2nd Spatial Point Pattern Analysis analyses effects of interaction between point pattern events.



The G/K-function is a method used in spatial Point Pattern Analysis (PPA) to inspect the spatial distribution of a set of points. It allows the user to assess if the set of points is more or less clustered than what we could expect from a given distribution.

Most of the time, the set of point is compared with a random distribution. The empirical K-function for a specified radius r is calculated with the following formula listed: [G Function K Function](#)

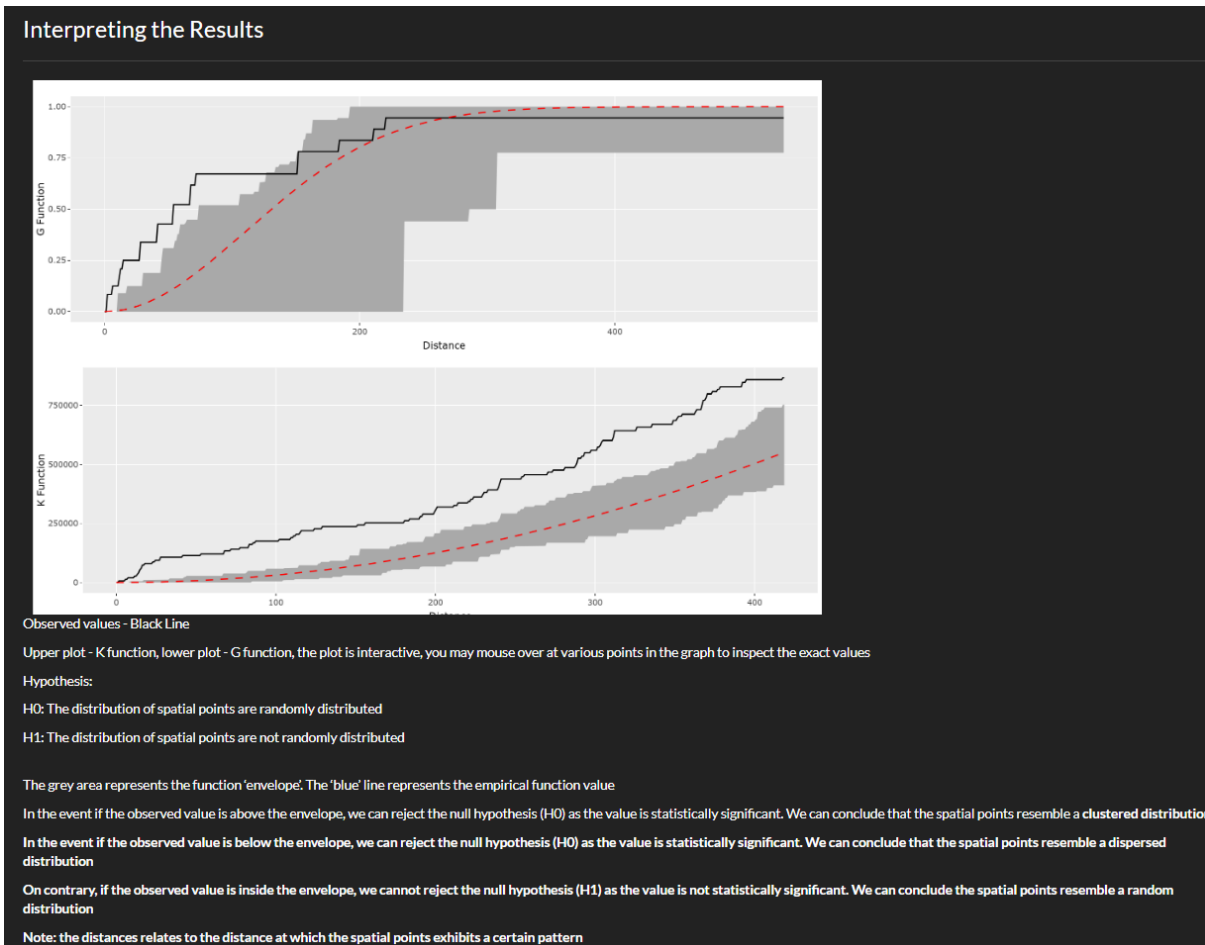
Basically, the K-function calculates for a radius r the proportion of cells with a value below r in the distance matrix between all the points D_{ij} . In other words, the K-function estimates the average number of neighbours of a typical random point

A modified version of the K-function is the G-function (Pair Correlation Function). The regular K-function is calculated for subsequent disks with increasing radii and thus is cumulative in nature. The G-function uses rings instead of disks and permits the analysis of the points concentrations at different geographical scales.

1. Select your location of interest
2. Select your start value in (metres). We will recommend you to start with 0 to begin.
3. Select your end value in (metres). We will recommend you to end with 500 metres to begin.
4. Select the confidence level to perform the statistical testing.
5. Click on 'Generate Analysis' and you are ready to go!

2nd Order Spatial Point Pattern Instructions and Explanations

An example on the concept of 2nd order spatial point pattern analysis will be shown. In addition, it provides you with instructions on how to perform your own analysis.



Interpretation of the results of 2nd order spatial point analysis

An example of the results of the G & K function will be shown on how to interpret the above results when you decide to try your own analysis. In addition, it further explains and concludes the hypothesis results based on H0, H1.

Key Function FAQ

Start/End

Distances for statistical analysis to be run and plotted

Confidence Level

How many simulations to run the statistical analysis. The number of simulations are mapped as follows:

95% - 39 | 99% - 199 | 99.9% - 1999

Given by the following formula: $\alpha = 2 * nrank / (1 + nsim)$ where $nrank = 1$

95% and 99% are typical confidence levels used

Key Function FAQ

This section will explain to you some of the frequently asked questions and address your doubts regarding the 2nd order G & K function analysis.

G/K Function Variable Inputs

Spatial Points

Localities

Entire City of Melbourne

Location of Interest

Business Establishments

Specific Themes/Sub-Categories

All

G/K Function Parameters

Select the Confidence to be used

95%

Generate Analysis

Please note: The analysis will take a few minutes to generate after clicking the button.

2nd Order Spatial Point Pattern Analysis Side Panel

G/K Function Variable Inputs

Spatial Points

Localities

Docklands

Location of Interest

Landmarks

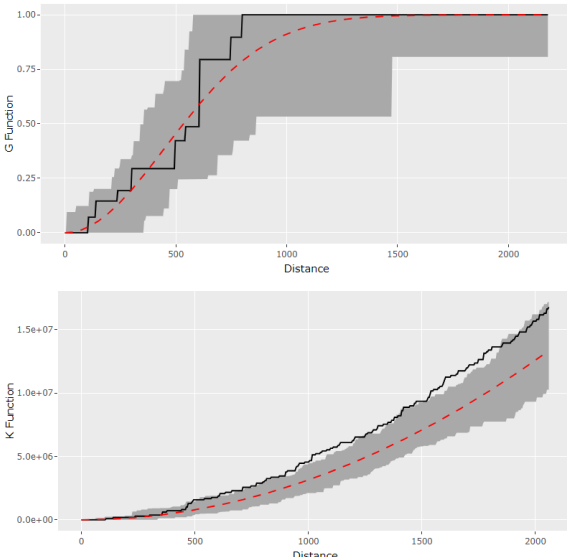
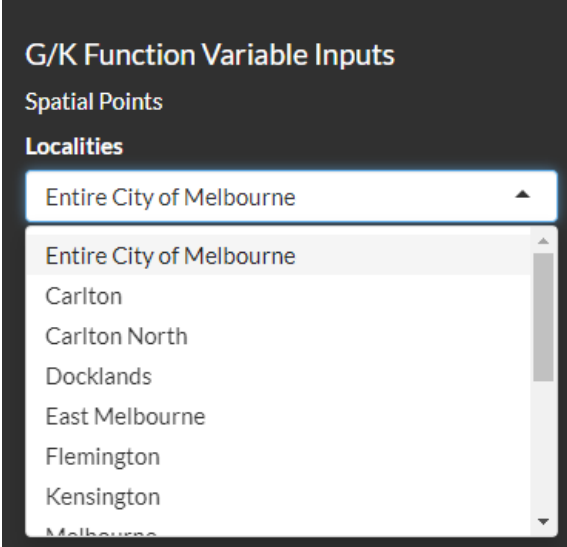
Specific Themes/Sub-Categories

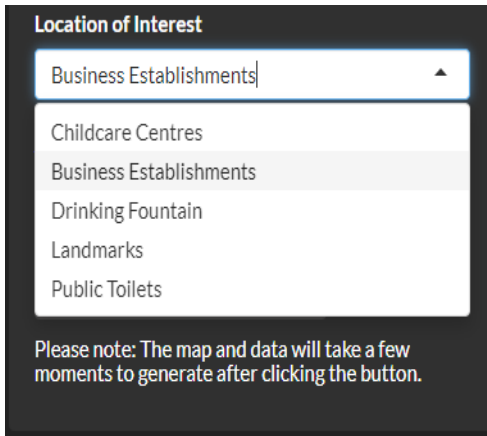
Health Services

Health Services in Entire City of ^x
Melbourne has no spatial
points to be analysed. The
analysis has been terminated.

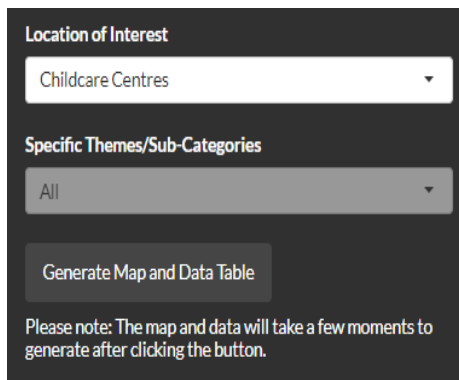
2nd Order Spatial Point Pattern Analysis Data Inputs (Error)

Please do take note that some localities together with the location of interest and specific themes/sub-categories to be analysed do not have relevant data to be generated. Therefore an error message will be prompted to terminate the analysis.

Feature	Functionality
 <p data-bbox="357 904 628 972">G&K Function graph visualisation</p>	<p data-bbox="807 331 1385 434">This is the G&K Function graph visualisation of the 2nd Order Spatial Point Pattern Analysis being generated.</p>
 <p data-bbox="209 1563 778 1659">Localities inputs for 2nd Order Spatial Point Pattern Analysis for G&K Function graph visualisation</p>	<p data-bbox="807 1003 1385 1070">From this drop down list, you can select the localities variable to generate the data.</p> <p data-bbox="807 1106 1385 1173">'Entire City of Melbourne' will be the default option.</p> <p data-bbox="807 1209 1385 1406">Other options are 'Carlton', 'Carlton North', 'Docklands', 'East Melbourne', 'Flemington', 'Kensington', 'Melbourne', 'North Melbourne', 'Parkville', 'Port Melbourne', 'South Wharf', 'South Yarra', 'SouthBank' and 'West Melbourne'.</p>
	<p data-bbox="807 1691 1385 1794">From this drop down list, you can select the location of interest variable to generate the data.</p> <p data-bbox="807 1830 1385 1897">'Childcare Centres' will be the default option.</p> <p data-bbox="807 1933 1385 2036">Other options are 'Business Establishments', 'Drinking Fountain', 'Landmarks', and 'Public Toilets'.</p>



Location of Interest inputs for 2nd Order Spatial Point Pattern Analysis for G&K Function graph visualisation

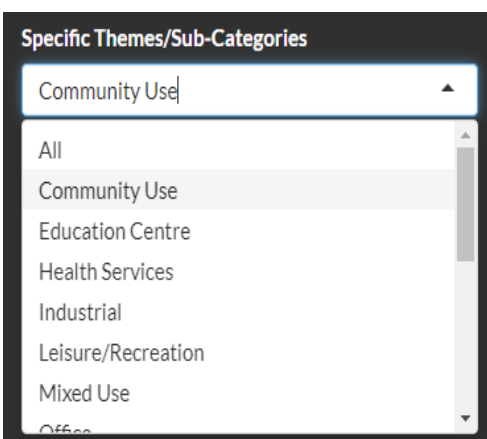


Specific Theme/Sub-categories

Please take note by selecting 'Business Establishments' or 'Landmarks', you have the option of selecting specific themes/sub-categories. Other locations of interest such as

7. Childcare Centres
8. Public Toilets
9. Drinking Fountains

do not have specific themes/sub-categories for you to select and will therefore be disabled. This does not mean you are unable to generate the map and data table results.

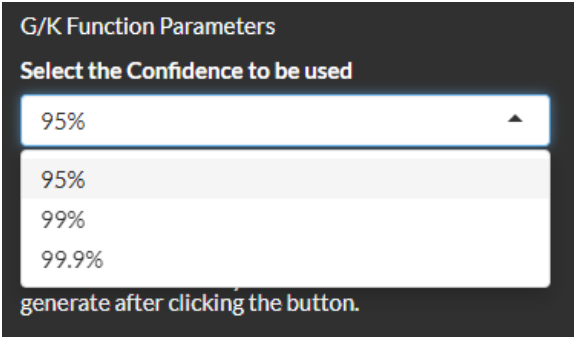
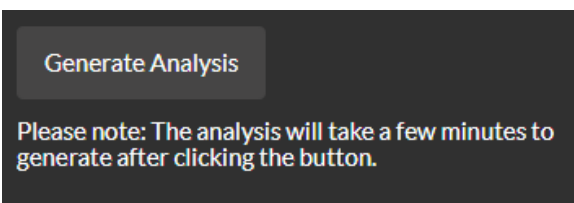


Specific Themes/Sub-Categories inputs for 2nd Order Spatial Point Pattern Analysis for G&K Function graph visualisation

From this drop down list, you can select the Specific Themes/Sub-Categories variable to generate the data.

'All' will be the default option.

Other options are 'Community Use', 'Education Centre', 'Health Services', 'Industrial', 'Leisure/Recreation', 'Mixed Use', 'Office', 'Place of Assembly', 'Place of Worship', 'Purpose Built', 'Residential Accommodation', 'Retail', 'Specialist Residential Accommodation', 'Transport', 'Vacant Land' and 'Warehouse/Store'

 <p>G/K Function Parameters Select the Confidence to be used</p> <p>95% 95% 99% 99.9%</p> <p>generate after clicking the button.</p> <p>G&K Function parameters for 2nd Order Spatial Point Pattern Analysis graph visualisation</p>	<p>From this drop down list, you can select the confidence variable interval to generate the data.</p> <p>'95%' will be the default option.</p> <p>The other options are '99%' and '99.9%'.</p>
 <p>Generate Analysis</p> <p>Please note: The analysis will take a few minutes to generate after clicking the button.</p> <p>Generate Analysis Button for 2nd Order Spatial Point Pattern Analysis graph visualisation</p>	<p>After selecting the above variable inputs, do remember to click on this 'Generate Analysis' button to generate the data.</p>

4. Network Constrained Point Pattern Analysis

The Network Constrained Point Pattern Analysis is the fourth page that you will be able to access in our application.

From the Network Constrained Point Pattern Analysis, there are 3 sub tabs that is made available to you for usage:

1. Introduction
2. Network Kernel Density Estimation
3. Statistical Function

The layout of the Network Kernel Density Estimation and Statistical Function tab is similar in nature, with the main visualisation map being on the left and a side panel on the right for the selection of inputs.

4.1 Introduction

spatial bros Home Page Data Exploration Spatial Point Pattern Analysis **Network Constrained Point Pattern Analysis**

Network Constrained Point Pattern Analysis

[Introduction](#) [Network Kernel Density Estimation](#) [Statistical Functions](#)

Welcome to the Network Constrained Point Pattern Analysis!

You will be able to perform network constrained spatial point patterns analysis methods special developed for analysing spatial point event occurs on or alongside network for City of Melbourne, Australia!

There are 2 types of analysis that you can perform

1. Network Kernel Density Estimation
2. G & K Function Analysis

For each of the analysis, we offer you the options of selecting

1. Road Network
2. Pedestrian Network
3. Tram Network

In addition you are allowed to pick your location of interest such as

1. Childcare Centres
2. Business Establishments
3. Drinking Fountains
4. Landmarks
5. Public Toilets

Benefits of performing Network Constrained Point Pattern Analysis

1. **Accurate analysis:** Network Constrained Point Pattern Analysis provides more accurate results compared to traditional point pattern analysis because it accounts for the underlying transportation network. This is particularly important in areas where the transportation network is dense and complex.
2. **Better decision-making:** Network Constrained Point Pattern Analysis can provide insights into how the network infrastructure affects the spatial distribution of points, which can be valuable for decision-making related to urban planning, transportation planning, and public policy
3. **Improved resource allocation:** Network Constrained Point Pattern Analysis can help optimize the allocation of resources, such as improving the accessibility to more drinking fountains/public toilets, by identifying areas with high concentrations of points and areas that are more accessible by the transportation network.

NETWORK SPATIAL POINT PATTERN ANALYSIS

STEP BY STEP INSTRUCTION

- 1. SELECT TYPE OF ANALYSIS**
- 2. SELECT TYPE OF NETWORK**
- 3. SELECT POINT OF INTEREST**
- 4. SELECT OTHER PARAMETERS**
- 5. VIEW AND ANALYSE OUTPUT**

This is the introduction page where you will learn about the types of analysis you are able to perform and also the benefits.

4.2 Network Kernel Density Estimation

Network Constrained Point Pattern Analysis

Introduction Network Kernel Density Estimation Statistical Functions

LOC_NAME
Carlton
Carlton North
Docklands
East Melbourne
Flemington
Kensington
Melbourne
North Melbourne
Port Melbourne
Port Melbourne
South Wharf
South Yards
Southbank
West Melbourne

Network Kernel Density Estimation Variable Inputs

Network and Spatial Points

Localities
Entire City of Melbourne

Types of Network
Road Network

Location of Interest
Childcare Centres

Specific Themes/Sub-Categories

Lixel
Length of Lixel
500

Min. Lixel Length
250

Kernel Density Estimation Methods
Choose the kernel to be used:
Quartic

Select the Method to be used
Simple

Generate KDE Map

Please note: The map will take a few minutes to generate after clicking the button.

Network Kernel Density Estimation main panel

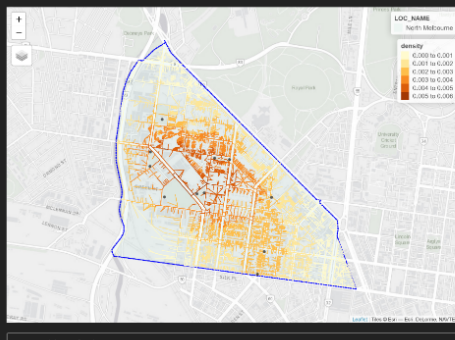
Network Kernel Density Estimation Map

Network Constrained Spatial Point Pattern Analysis analyses point pattern events that happens alongside a network. We provide several point pattern (such as Business Establishment, Drinking Fountains) and Network (such as Pedestrian or Road) options to explore the effects of spatial point patterns and densities surrounding networks. These could be used to investigate the density of point patterns along networks, such as the amount of drinking fountains along pedestrian routes to inform the planning and installing of more drinking fountains.

To begin your analysis, you can start by

1. Select your choice of locality
2. Select your choice of network
3. Select your location of interest and subcategories/theme if required
4. Select your lixel length - we recommend you to start with 500 metres
5. Select your minimum lixel length - we recommend you to start with 250 metres
6. Select your kernel of choice
7. Select your method of choice
8. Click on 'Generate KDE Map' and you are ready to go!

Interpreting the Results



A legend will be shown at the top right side of the map. The colour shade intensity of the network will get darker if there is a higher relative density of spatial points specified (location of interest).

On contrary, if the colour shade intensity of the network is lighter, it represents a lower relative density alongside the network

The 'NetKDE Bandwidth Selection' tells us what bandwidth has been selected by the algorithm for bandwidth range between 100 and 900, in steps of 20. The goal is to find the highest possible Cross Validation (CV) score. The larger the bandwidth, the increased amount of smoothing, hence, the CV score has been capped at 900 to reduce the amount of detail lost.

Network Kernel Density Estimation main panel (instructions and interpreting result)

This section explains to you what network kernel density estimation is all about with instructions provided on how to perform your analysis. In addition, it also shows u an example on how to interpret the results

Key Function FAQ

Lixels

bike accident density by kilometres in 2016,
within a radius of 300 metres (adaptive bandwidth)

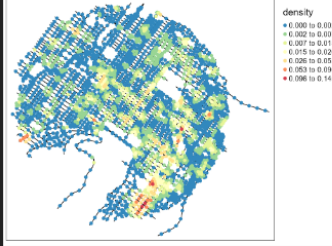


Image credit to [spNetwork](#)

Lixels are point samples along existing network lines to calculate the density of points near the region. 'Length of Lixel' defines the typical length between such point and 'Min. Lixel Length' defines the minimum if the typical length cannot be fulfilled.

Key Function FAQ

This section describes and addresses the frequently asked question with regards to lixels.

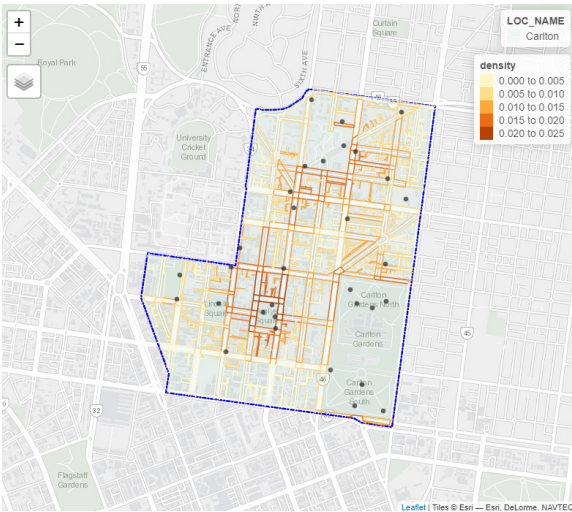

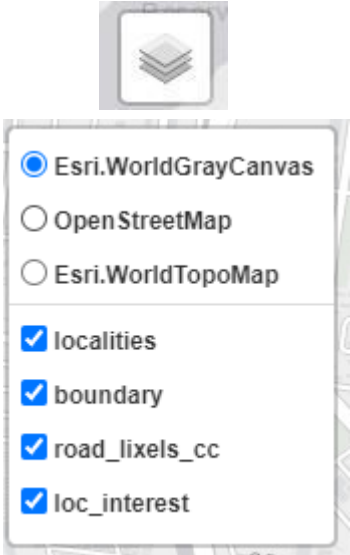
Kernel Density Estimation Methods

An infographic has been prepared below:

KERNEL	
TYPE	DESCRIPTION
QUARTIC	This kernel has a quartic shape and assigns more weight to points close to the centre than those further away. It has a slower decrease in weight towards the edges than triangular kernel.
TRIANGLE	This kernel has a triangular shape with its maximum at zero and decreases linearly towards the edges. It assigns equal weight to all points within a bandwidth.
TRICUBE	This kernel has a cubic shape and assigns more weight to points close to the center than those further away. It has a slower decrease in weight towards the edges than the triangular kernel.
COSINE	This kernel has a semicircular shape and assigns equal weight to all points within a bandwidth. It is most used in spectral analysis.
TRIWEIGHT	This kernel has a quartic shape and assigns more weight to points close to the center than those further away. It has a slower decrease in weight towards the edges than the tricube kernel.
EPANECHNIKOV	This kernel has a parabolic shape and assigns more weight to points close to the center than those further away. It has a faster decrease in weight towards the edges than tricube and triweight kernels.
UNIFORM	This kernel assigns equal weight to all points within a bandwidth, regardless of their distance from the center. It has a constant weight within the bandwidth and zero weight outside of it.
METHOD	
SIMPLE	This method uses a linear activation function, which simply multiplies the input by a weight and adds a bias term. This is the simplest activation function and is sometimes used in the output layer of a neural network.
CONTINUOUS	This method uses a continuous activation function such as the sigmoid function or the hyperbolic tangent function. These functions smoothly transform the input values into an output value between 0 and 1 (for sigmoid) or -1 and 1 (for hyperbolic tangent).
DISCONTINUOUS	These functions have a constant value for a range of input values and then abruptly switch to another constant value. Discontinuous activation functions are rarely used in neural networks due to their non-smoothness, which can cause optimization problems.

Explanation for Kernel Type and Method Type

This section will explain to you the difference between each kernel type and method type.

Feature	Functionality
 <p data-bbox="233 846 754 913">Network Kernel Density Estimation Map Visualisation</p>	<p data-bbox="807 331 1385 432">This map is a visualisation of the Network Kernel Density Estimation Map Visualisation being computed.</p> <p data-bbox="807 465 1385 633">The LOC_NAME in the legend represents the locality district 'Carlton' being analysed. From the visualisation, you are able to see the district outline, the network outlines and the spatial points.</p> <p data-bbox="807 667 1385 734">The density legend represents the intensity of network outlines of the spatial points</p>
 <p data-bbox="411 1117 576 1146">Zoom Control</p>	<p data-bbox="807 943 1385 1077">The map visualisation provides the option of zooming in and out. You can click on the '+' icon to zoom further into the map and '-' to zoom further out.</p>
 <p data-bbox="403 1807 622 1836">Base Map Control</p>	<p data-bbox="807 1243 1385 1411">When you hover your cursor over to this icon, this menu will appear where you are able to select your desired base map from Esri.WorldGrayCanvas to OpenStreetMap to Esri.WorldTopoMap.</p> <p data-bbox="807 1444 1385 1646">You will also have the option of selecting and deselecting options such as 'localities', 'boundary', 'road_lixels_cc' and 'loc_interest' which are the Melbourne's city boundary outline, network type and location of interests.</p>

Network Kernel Density Estimation Variable Inputs

Network and Spatial Points

Localities

Carlton

Types of Network

Road Network

Location of Interest

Drinking Fountain

Specific Themes/Sub-Categories

Lixels

Length of Lixel

100 700 1,500

100 250 400 550 700 850 1,000 1,150 1,300 1,450 1,500

Min. Lixel Length

100 350 1,500

100 250 400 550 700 850 1,000 1,150 1,300 1,450 1,500

Kernel Density Estimation Methods

Choose the kernel to be used:

Quartic

Select the Method to be used

Simple

Generate KDE Map

Please note: The map will take a few minutes to generate after clicking the button.

Network Kernel Density Estimation Side Panel

Network Kernel Density Estimation Variable Inputs
Network and Spatial Points

Localities
Docklands

Types of Network
Road Network

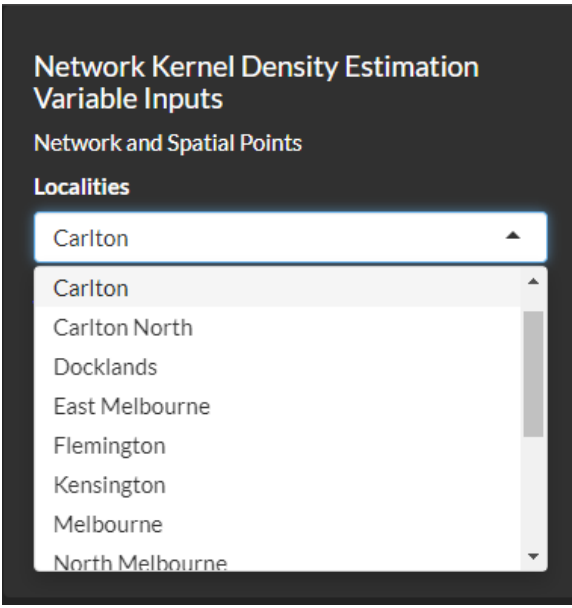
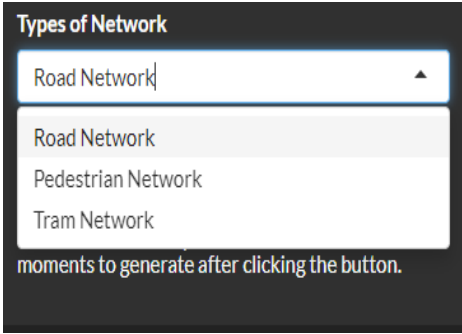
Location of Interest
Landmarks

Specific Themes/Sub-Categories
Health Services

Health Services in Entire City of ^x
Melbourne has no spatial
points to be analysed. The
analysis has been terminated.

Network Kernel Density Estimation Analysis Data Inputs (Error)

Please do take note that some localities together with the location of interest and specific themes/sub-categories to be analysed do not have relevant data to be generated. Therefore an error message will be prompted to terminate the analysis

Feature	Functionality
 <p>Network Kernel Density Estimation Variable Inputs</p> <p>Network and Spatial Points</p> <p>Localities</p> <p>Carlton</p> <p>Carlton North</p> <p>Docklands</p> <p>East Melbourne</p> <p>Flemington</p> <p>Kensington</p> <p>Melbourne</p> <p>North Melbourne</p> <p>Localities inputs for Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the localities variable to generate the data.</p> <p>'Entire City of Melbourne' will be the default option.</p> <p>Other options are 'Carlton', 'Carlton North', 'Docklands', 'East Melbourne', 'Flemington', 'Kensington', 'Melbourne', 'North Melbourne', 'Parkville', 'Port Melbourne', 'South Wharf', 'South Yarra', 'SouthBank' and 'West Melbourne'.</p>
 <p>Types of Network</p> <p>Road Network</p> <p>Road Network</p> <p>Pedestrian Network</p> <p>Tram Network</p> <p>moments to generate after clicking the button.</p> <p>Type of Network inputs for Network Kernel Density Estimation</p>	<p>From this drop down list, you can select the type of network variable to generate the data.</p> <p>'Road Network' will be the default option.</p> <p>Other options are 'Pedestrian Network' and 'Tram Network'.</p>

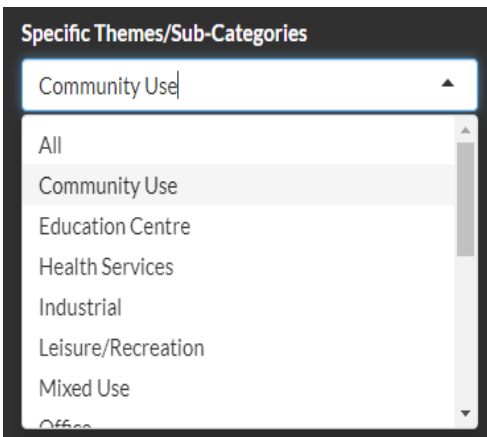


Location of Interest inputs for Network Kernel Density Estimation

From this drop down list, you can select the location of interest variable to generate the data.

'Childcare Centres' will be the default option.

Other options are 'Business Establishments', 'Drinking Fountain', 'Landmarks', and 'Public Toilets'.

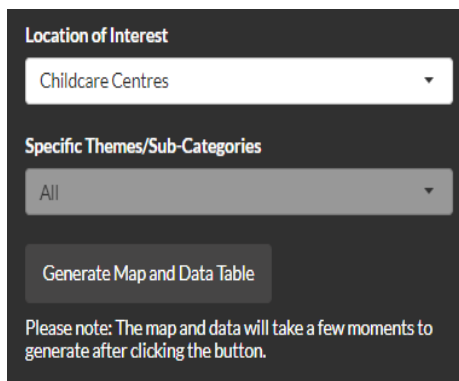


Specific Themes/Sub-Categories inputs for Network Kernel Density Estimation

From this drop down list, you can select the Specific Themes/Sub-Categories variable to generate the data.

'All' will be the default option.

Other options are 'Community Use', 'Education Centre', 'Health Services', 'Industrial', 'Leisure/Recreation', 'Mixed Use', 'Office', 'Place of Assembly', 'Place of Worship', 'Purpose Built', 'Residential Accommodation', 'Retail', 'Specialist Residential Accommodation', 'Transport', 'Vacant Land' and 'Warehouse/Store'

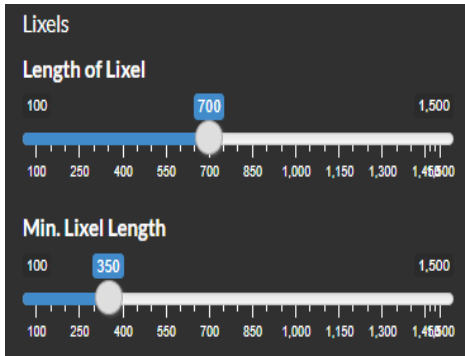


Specific Theme/Sub-categories

Please take note by selecting 'Business Establishments' or 'Landmarks', you have the option of selecting specific themes/sub-categories. Other locations of interest such as

- 10. Childcare Centres
- 11. Public Toilets
- 12. Drinking Fountains

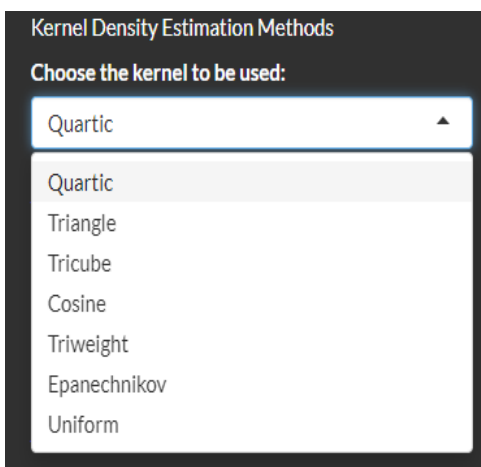
do not have specific themes/sub-categories for you to select and will therefore be disabled. This does not mean you are unable to generate the map and data table results.



Length of Lixel, Minimum Lixel Length for Network Kernel Density Estimation

From these 2 sliders, you can select the distance of the length of lixel and minimum lixel length in metres from 0 to 1500.

The default length will be 700m for length of lixel and 350m for min lixel length

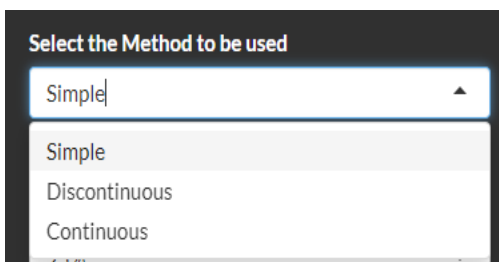


Kernel Method used for Network Kernel Density Estimation

From this drop down list, you can select the Kernel method variable to generate the data.

'Quartic' will be the default option.

The other options are 'Triangle', 'Tricube', 'Cosine', 'Triweight', 'Epanechnikov' and 'Uniform'

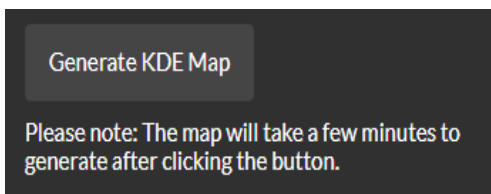


Method to be used for Network Kernel Density Estimation

From this drop down list, you can select the method variable to generate the data.

'Simple' will be the default option.

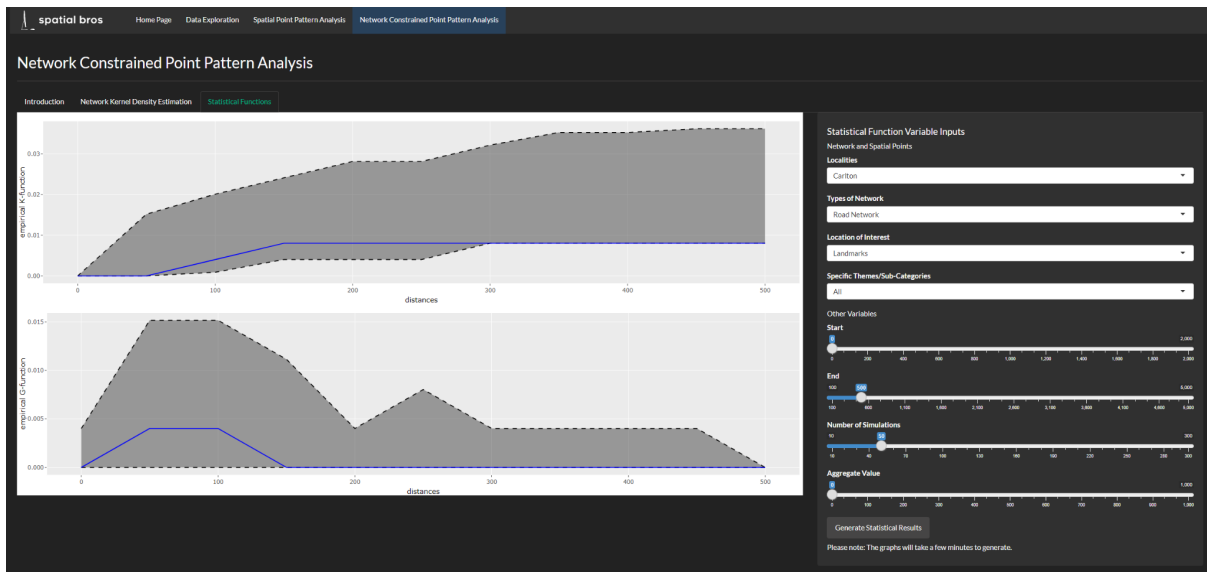
The other options are 'Continuous' and 'Discontinuous'.



Generate KDE Map button for Network Kernel Density Estimation

After selecting the above variable inputs, do remember to click on this 'Generate KDE Map' button to generate the data.

4.3 Statistical Function



Statistical Function Main Panel

Statistical Functions - G & K

K-function

G-function

The K-function is a method used in spatial Point Pattern Analysis (PPA) to inspect the spatial distribution of a set of points. It allows the user to assess if the set of points is more or less clustered than what we could expect from a given distribution.

Most of the time, the set of point is compared with a random distribution. The empirical K-function for a specified radius r is calculated with the following formula listed [here](#)

Basically, the K-function calculates for a radius r the proportion of cells with a value below r in the distance matrix between all the points D_{ij} . In other words, the K-function estimates the average number of neighbours of a typical random point

A modified version of the K-function is the G-function (Pair Correlation Function). The regular K-function is calculated for subsequent disks with increasing radii and thus is cumulative in nature. The G-function uses rings instead of disks and permits the analysis of the points concentrations at different geographical scales.

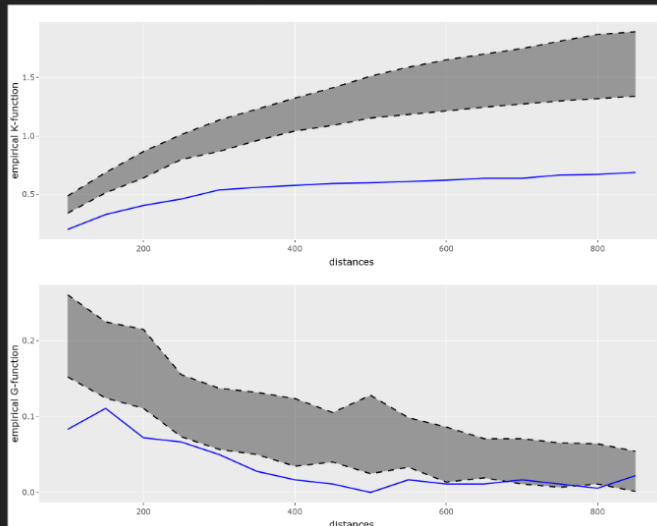
Statistical Function G & K Concept

This section explains to you the concept with regards to G & K function for network constraint point pattern analysis.

To begin your analysis, you can start by:

1. Select your choice of network
2. Select your location of interest
3. Select your start value in (metres). We will recommend you to start with 0 to begin.
4. Select your end value in (metres). We will recommend you to end with 500 metres to begin.
5. Select your number of simulations. We will recommend you to start with 50 simulations to begin.
6. Select your aggregate value. We will recommend you to start with 0 to begin.
7. Click on 'Generate Statistical Results' and you are ready to go!

Interpreting the Results



Observed values - Black Line

Upper plot - K function, lower plot - G function, the plot is interactive, you may mouse over at various points in the graph to inspect the exact values

Hypothesis:

H0: The distribution of spatial points are randomly distributed

H1: The distribution of spatial points are not randomly distributed

The grey area represents the function 'envelope'. The 'blue' line represents the empirical function value

In the event if the observed value is above the envelope, we can reject the null hypothesis (H0) as the value is statistically significant. We can conclude that the spatial points resemble a clustered distribution

In the event if the observed value is below the envelope, we can reject the null hypothesis (H0) as the value is statistically significant. We can conclude that the spatial points resemble a dispersed distribution

On contrary, if the observed value is inside the envelope, we cannot reject the null hypothesis (H1) as the value is not statistically significant. We can conclude the spatial points resemble a random distribution

Note: the distances relates to the distance at which the spatial points exhibits a certain pattern

Statistical Function G & K (Instructions & Interpreting Results)

This section explains the steps involved in aiding you to perform your own analysis. On top of that, it guides you on how you can interpret your own results with examples provided.

Key Function FAQ

Start/End

Distances for statistical analysis to be run and plotted

Number of Simulations

How many simulations to run the statistical analysis. The more simulations, the more accurate the results will be.

Aggregate Value

Points within that radius will be aggregated (in metres)

o - Null (no aggregation) | >0 - Aggregation of points

Key Function FAQ

This section will explain to you some of the frequently asked questions and address your doubts regarding the network constrained point pattern G & K function analysis.

Statistical Function Variable Inputs

Network and Spatial Points

Localities

Docklands

Types of Network

Road Network

Location of Interest

Landmarks

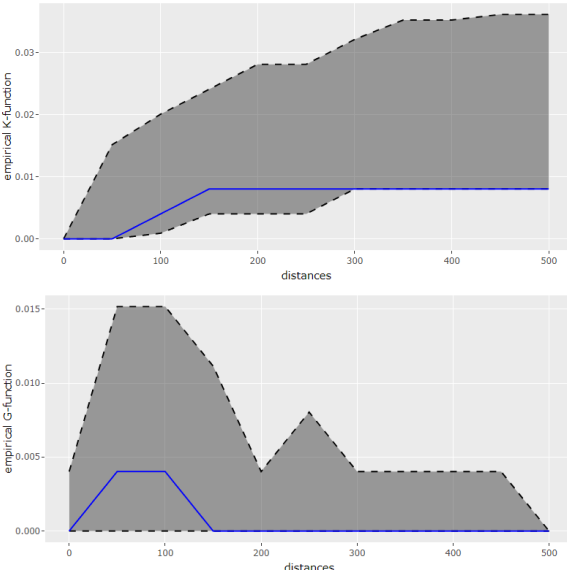
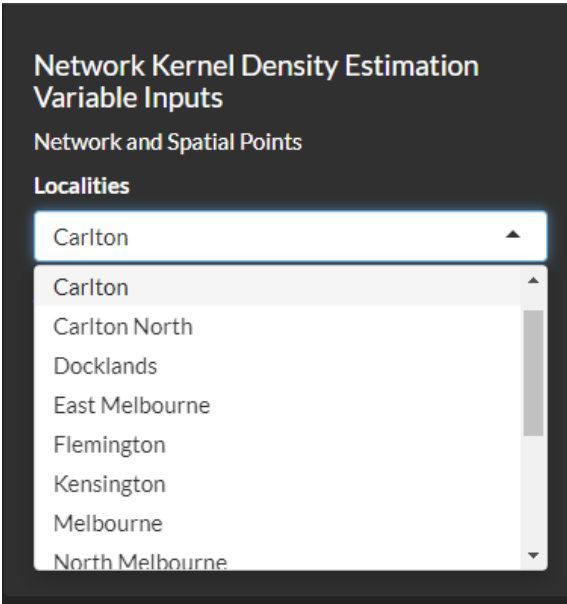
Specific Themes/Sub-Categories

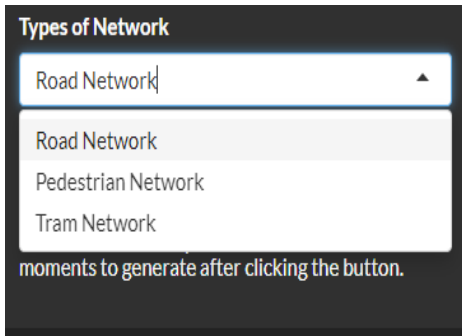
Health Services

Health Services in Entire City of ^x
Melbourne has no spatial
points to be analysed. The
analysis has been terminated.

Statistical G & K Function Analysis Data Inputs (Error)

Please do take note that some localities together with the location of interest and specific themes/sub-categories to be analysed do not have relevant data to be generated. Therefore an error message will be prompted to terminate the analysis

Feature	Functionality
 <p>The figure consists of two vertically stacked line graphs. The top graph plots the 'empirical K-function' on the y-axis (ranging from 0.00 to 0.03) against 'distances' on the x-axis (ranging from 0 to 500). It shows a solid blue line that rises to about 0.015 at distance 150 and then levels off, and a dashed black line that rises more steeply to about 0.03 at distance 500. The bottom graph plots the 'empirical G-function' on the y-axis (ranging from 0.000 to 0.015) against 'distances' on the x-axis (ranging from 0 to 500). It shows a solid blue line that peaks at approximately 0.004 around distance 100 and then drops to zero, and a dashed black line that peaks at approximately 0.015 around distance 100 and then has a secondary peak around distance 250.</p> <p style="text-align: center;">G&K Function graph visualisation</p>	<p>This is the G&K Function graph visualisation of the Network Constrained Point Pattern Analysis</p>
 <p>The screenshot shows a web interface with a dark background. At the top, it says 'Network Kernel Density Estimation Variable Inputs' and 'Network and Spatial Points'. Below that is a section titled 'Localities' with a dropdown menu. The dropdown menu is open, showing a list of localities: Carlton, Carlton North, Docklands, East Melbourne, Flemington, Kensington, Melbourne, and North Melbourne. The 'Carlton' option is currently selected and highlighted.</p> <p style="text-align: center;">Localities inputs for G&K Function graph visualisation</p>	<p>From this drop down list, you can select the localities variable to generate the data.</p> <p>'Entire City of Melbourne' will be the default option.</p> <p>Other options are 'Carlton', 'Carlton North', 'Docklands', 'East Melbourne', 'Flemington', 'Kensington', 'Melbourne', 'North Melbourne', 'Parkville', 'Port Melbourne', 'South Wharf', 'South Yarra', 'SouthBank' and 'West Melbourne'.</p>

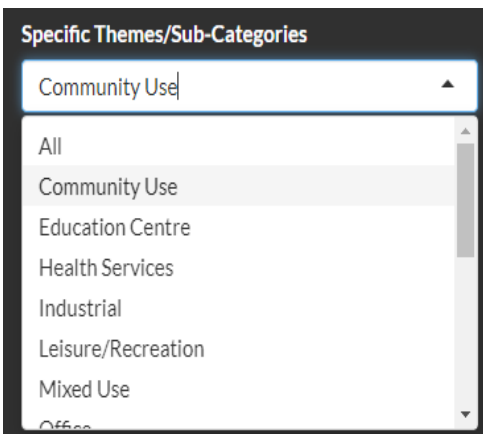


Type of Network inputs for G&K Function graph visualisation

From this drop down list, you can select the type of network variable to generate the data.

'Road Network' will be the default option.

Other options are 'Pedestrian Network' and 'Tram Network'.

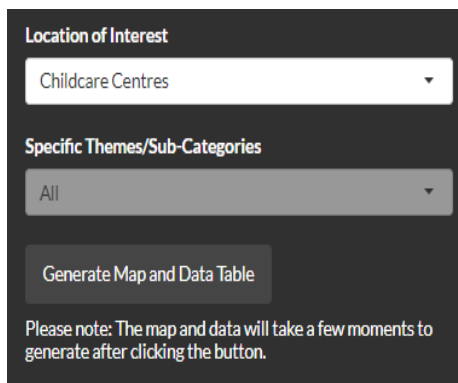


Specific Themes/Sub-Categories inputs for G&K Function graph visualisation

From this drop down list, you can select the Specific Themes/Sub-Categories variable to generate the data.

'All' will be the default option.

Other options are 'Community Use', 'Education Centre', 'Health Services', 'Industrial', 'Leisure/Recreation', 'Mixed Use', 'Office', 'Place of Assembly', 'Place of Worship', 'Purpose Built', 'Residential Accommodation', 'Retail', 'Specialist Residential Accommodation', 'Transport', 'Vacant Land' and 'Warehouse/Store'

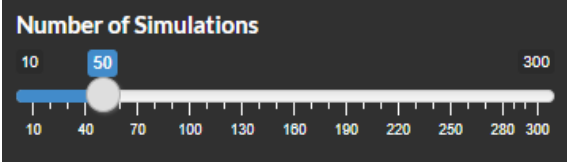
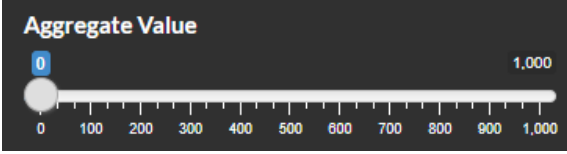
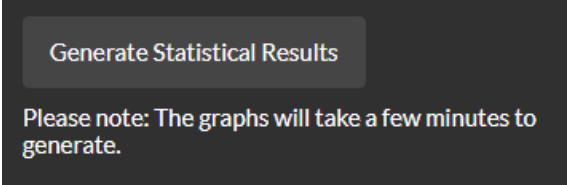


Specific Theme/Sub-categories

Please take note by selecting 'Business Establishments' or 'Landmarks', you have the option of selecting specific themes/sub-categories. Other locations of interest such as

- 13. Childcare Centres
- 14. Public Toilets
- 15. Drinking Fountains

do not have specific themes/sub-categories for you to select and will therefore be disabled. This does not mean you are unable to generate the map and data table results.

 <p>Other Variables inputs for G&K Function graph visualisation</p>	<p>From these 2 sliders, you can select the start and end distance of the network from 0 to 2000 and 0 to 5000 metres respectively.</p> <p>The default length will be 100m for start and 500m for end.</p>
 <p>Number of Simulation inputs for G&K Function graph visualisation</p>	<p>From this slider, you can select the number of simulations for the function from 0 to 300.</p> <p>The default number of simulations will be 50.</p>
 <p>Aggregate Value inputs for G&K Function graph visualisation</p>	<p>From this slider, you can select the aggregate value for the function from 0 to 1000.</p> <p>The default aggregate value will be 0.</p>
 <p>Generate Statistical Result for G & K Function graph visualisation</p>	<p>After selecting the above variable inputs, do remember to click on this 'Generate Statistical Results' button to generate the function results.</p>

We hope you have a good time enjoying our application!

The End