Take-home Exercise 1: Application of Spatial Point Patterns Analysis to discover the geographical distribution of Grab hailing services in Singapore

2023-01-08

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| Note |
| This handout provides the context, the task, the expectation and the grading criteria of Take-home Exercise 1. Students must review and understand them before getting started with the take-home exercise. |

## Setting the Scene

Human mobility, the movement of human beings in space and time, reflects the spatial-temporal characteristics of human behavior. With the advancement Information and Communication Technologies (ICT) especially smart phone, a large volume of data related to human mobility have been collected. By using appropriate GIS analysis methods, these data are potentially useful in supporting smart city planning and management.

In Singapore, one of the important source of data related to human mobility is from Land Transport Authority (LTA) DataMall. Two data sets related to human mobility are provided by the portal, they are: Passenger Volume by Origin Destination Train Stations and Passenger Volume by Origin Destination Bus Stops. One of the limitation of these data sets is that their location are biased to either bus stops or MRT/LRT stations. In 2020, another very interesting human mobility data set called Grab Posisi was released by GRAB, one of the largest shared taxi operator in South-east Asia. There are two data sets been released and one of them is for Singapore.

## Objectives

Geospatial analytics hold tremendous potential to address complex problems facing society. In this study, you are tasked to apply appropriate spatial point patterns analysis methods to discover the geographical distribution of functional and non-function water points and their co-locations if any in Osun State, Nigeria.

## The Task

The specific tasks of this take-home exercise are as follows:

### Exploratory Spatial Data Analysis (ESDA)

* Derive kernel density maps of functional and non-functional water points. Using appropriate tmap functions,
* Display the kernel density maps on openstreetmap of Osub State, Nigeria.
* Describe the spatial patterns revealed by the kernel density maps. Highlight the advantage of kernel density map over point map.

### Second-order Spatial Point Patterns Analysis

With reference to the spatial point patterns observed in ESDA:

* Formulate the null hypothesis and alternative hypothesis and select the confidence level.
* Perform the test by using appropriate Second order spatial point patterns analysis technique.
* With reference to the analysis results, draw statistical conclusions.

### Spatial Correlation Analysis

In this section, you are required to confirm statistically if the spatial distribution of functional and non-functional water points are independent from each other.

* Formulate the null hypothesis and alternative hypothesis and select the confidence level.
* Perform the test by using appropriate Second order spatial point patterns analysis technique.
* With reference to the analysis results, draw statistical conclusions.

## The Data

#### Apstial data

For the purpose of this assignment, data from [WPdx Global Data Repositories](https://www.waterpointdata.org/access-data/) will be used. There are two versions of the data. They are: WPdx-Basic and WPdx+. You are required to use **WPdx+** data set.

#### Geospatial data

This study will focus of Osun State, Nigeria. The state boundary GIS data of Nigeria can be downloaded either from The [Humanitarian Data Exchange](https://data.humdata.org/) portal or [geoBoundaries](https://www.geoboundaries.org/index.html).

## Grading Criteria

This exercise will be graded by using the following criteria:

* **Geospatial Data Wrangling (20 marks):** This is an important aspect of geospatial analytics. You will be assessed on your ability to employ appropriate R functions from various R packages specifically designed for modern data science such as readxl, tidyverse (tidyr, dplyr, ggplot2), sf just to mention a few of them, to perform the entire geospatial data wrangling processes, including. This is not limited to data import, data extraction, data cleaning and data transformation. Besides assessing your ability to use the R functions, this criterion also includes your ability to clean and derive appropriate variables to meet the analysis need. (Warning: All data are like vast grassland full of land mines. Your job is to clear those mines and not to step on them).
* **Geospatial Analysis (30 marks):** In this exercise, you are expected to use the appropriate thematic and analytics mapping techniques and R functions introduced in class to analysis the geospatial data prepared. You will be assessed on your ability to derive analytical maps by using appropriate rate mapping techniques.
* **Geovisualisation (20 marks):** In this section, you will be assessed on your ability to communicate the complex spatial statistics results in business friendly visual representations. This course is geospatial centric, hence, it is important for you to demonstrate your competency in using appropriate geovisualisation techniques to reveal and communicate the findings of your analysis.
* **Reproducibility (20 marks):** This is an important learning outcome of this exercise. You will be assessed on your ability to provide a comprehensive documentation of the analysis procedures in the form of code chunks of RMarkdown. It is important to note that it is not enough by merely providing the code chunk without any explanation on the purpose and R function(s) used.
* **Bonus (10 marks):** Demonstrate your ability to employ methods beyond what you had learned in class to gain insights from the data. The methods used must be geospatial in nature.

## Submission Instructions

* The write-up of the take-home exercise must be in **Quarto html document** format. You are required to publish the write-up on [**Netlify**](https://www.netlify.com/).
* The R project of the take-home exercise must be pushed onto your [Github](https://github.com/) repository.
* You are required to provide the links to Netlify service of the take-home exercise write-up and github repository on eLearn.

## Due Date

12th February 2023 (Sunday), 11.59pm (midnight).

## Learning from senior

You are advised to review these sample submissions prepared by your seniors.

* [Take-home Exercise 1: Geographic Analysis of the Supply and Demand of Childcare Services in Singapore](https://rpubs.com/xiaorongw/IS415_Take-home_Ex01) by Xiao Rong Wong.
* [Take-Home Exercise 2: Spatial Point Patterns Analysis of Airbnb Listings in Singapore](https://is415-msty.netlify.app/posts/2021-09-19-take-home-exercise-2/) by MEGAN SIM TZE YEN.
* [Interactive Plotting of Second-order Spatial Point Patterns Analysis: Childcare Centres in Singapore](https://rpubs.com/deniseadele/secondorder_pointpattern) by Denise Adele Chua.

## Q & A

Please submit your questions or queries related to this take-home exercise on Piazza.

## Peer Learning

* [AILYS TEE XYNYN](https://is415-ailystee.netlify.app/take-home_ex/take-home_ex01/take-home_ex01#nigeria-osun-state)
* [ALANIS ZOE CHIA HUI LIN](https://is415-zoechia.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [ANNA TSENG RUI-WEN](https://annatrw-is415.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [CELINE NG SI LIN](https://is415-gaa.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [CHEN HAO XIAN](https://is415-gaa-hxchen.netlify.app/lessons/take-home/take-home_ex1/take-home_ex1)
* [DANIEL CHNG CHONG YEE](https://celebrated-truffle-4b528c.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [DEREK POH YONG JIE](https://derekpoh-is415.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [ESWARA LAKSHMANAN ABISHEK](https://is415-elabishek.netlify.app/takehome_exercise/takehome1/takehome_ex1)
* [HARITH OH YEE CHOON](https://is415-harith.netlify.app/take-home_ex/take-home_ex01/take-home_ex1)
* [HO YONG QUAN](https://is415-gaa-yongquan.netlify.app/take-home_ex/take-home_ex01/take-home_ex01#setting-the-scene)
* [HOW XIN YEE](https://is415-xinyeehow.netlify.app/Take-Home_Ex/Take-Home_Ex01/Take-Home_Ex01.html)
* [JENNIFER POERNOMO](https://jenpoer-is415-gaa-exercises.netlify.app/take-home-exercises/exe-01/the1)
* [KUMARAPANDIAN YASHICARAMYA](https://is415-gaa-xtc0.netlify.app/take-home_ex/take_home_ex01/take-home_ex01)
* [KWANG KAI XUAN BELLE](https://melodious-kelpie-bd4c0d.netlify.app/take_home_ex/the1/the1)
* [KWEK MING RONG](https://is415-gaa-kwekmingrong.netlify.app/take_home_ex/take_home_ex1)
* [LEE CHIA MIN MICHELLE FAITH](https://is415-gaa-michellefaith.netlify.app/take-home_ex/take-home_ex01)
* [LEON TAN LI YANG](https://capable-arithmetic-46d74a.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [LU QUANFANG](https://is415quanfang.netlify.app/takehome_exercise/takehome_exercise1/takehome_ex01)
* [MICHELLE LEONG HWEE-LING](https://is415-shelle-mim.netlify.app/take-home_exercise/th1/th_ex1)
* [NGUYEN MAI PHUONG](https://is415-gaa-tiffanik.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [PENG YOU YUN](https://youyunpeng-is415.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [PIERRE JEAN MICHEL HAAS](https://is415-pierrehaas.netlify.app/take-home_ex/take-home_ex01/take-home_ex1)
* [RHONDA HO KAH YEE](https://rhondaho-is415.netlify.app/take-home_assgn/take-home_assgn1/take-home_assgn1)
* [S GUGANESH](https://is415-gaa-guganesh.netlify.app/take-home_ex/take-home_ex01/take-home_ex01.html)
* [SALUNKE MAYURI MILIND](https://is415-mayurims.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [SHAMBHAVI GOENKA](https://shambhavig.netlify.app/take_home_ex/take_home_ex01/take_home_ex01.html)
* SHAYTHURAM SO ELANGKOVAN
* [SHERRY NG SHEA LI](https://cosmic-muffin-95669c.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* TAN WEI SHING
* [TAN WEN YANG](https://is415-gaa-wy.netlify.app/take-home-ex/take-home-ex01/take-home-ex01.html)
* [TAN YAN LIN VALENCIA](https://is415-gaa-valtyl.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [TEH JIA HUI GAIL](https://is415-gaa-gailteh.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [TEO JUN HAO](https://is415-gaa-junhao.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [TEO REN JIE](https://renjieteo-is415.netlify.app/exercises/thex01.html)
* [TONG XUE YU KATHY](https://is415-gaa-kathy.netlify.app/take-home_ex/take-home_ex01/take-home_ex01)
* [WONG KELLY](https://is415kellysite.netlify.app/take_home_ex/take_home_ex01/take_home_ex01)