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GGRC12 Transportation Geography

Professor Steven Farber

Assignment 1: Describing Transportation and Land Use Patterns

Due in class February 13th

# Introduction:

In this assignment you are going to take on the role of a transportation advisor to the City of Toronto. Specifically, your task is to advise the mayor on the current patterns of land use, transportation infrastructure, and travel behaviour in Toronto, with the intention of making basic policy recommendations for transportation development options. To complete this work, you have been provided a collection of geospatial datasets representing the current transportation infrastructure in the area, and counts of different types of trips for each traffic analysis zone (TAZ) in the region. The assignment is arranged into the 3 tasks below. Note that underlined terms contain hyperlinks to additional learning resources.

The data are combined into the [file geodatabase](http://resources.arcgis.com/en/help/main/10.2/index.html#/What_is_a_geodatabase/003n00000001000000/) named *GGRC12\_Lab\_One*. In it you will find a [Feature Dataset](http://resources.arcgis.com/en/help/main/10.2/index.html#/What_is_a_geodatabase/003n00000001000000/) named *TransportationFiles*. The dataset includes the following [Feature Classes](http://resources.arcgis.com/en/help/main/10.2/index.html#//003n00000005000000):

* *Highways* – A Line feature class containing all the highways in Toronto.
* *Municipalities* – A polygon feature class containing the boundaries of the former Metro Toronto municipalities.
* *TTC Routes* – A line feature class containing all TTC bus, streetcar, and subway lines.
* *TAZ06\_TTS2011\_Toronto* – A polygon feature class containing the boundaries of the City’s TAZs as well as a collection of trip data collected from the [Transportation Tomorrow Survey](http://dmg.utoronto.ca/transportation-tomorrow-survey/tts-reports).
* *TransitStops\_Access\_AM\_Peak* – a polygon feature class showing the number of unique transit trips accessible within a 400m walking trip. This can be considered a transit accessibility indicator for the AM peak period (6am-9am).

You must download and extract the contents of the assignment zip file to a folder which you have write-access to. All of your work should be backed up off of the lab computers at the end of each work session.

## Task 1: Map and Describe the Overall Transportation Infrastructure and Land Use Patterns in Toronto

In this component your objective is to create maps and provide a description of seven basic transportation characteristics in Toronto:

1. The locations of major highways
2. The locations of subway, streetcar, and bus routes
3. The bus frequencies in Toronto
4. The spatial patterns of where people live in the city
5. The spatial patterns of where AM work trips are destined
6. The spatial patterns of where transit trips occur
7. The spatial patterns of where driving trips occur

#### Task 1a: Highways

Let’s begin by [adding some layers](http://resources.arcgis.com/en/help/main/10.2/index.html#//00660000000t000000) for the first map. We will use the *Municipalities* layer as a background and display the *Highways* layer on top. You can change the [order of the layers](http://resources.arcgis.com/en/help/main/10.2/index.html#//006600000006000000) to make sure that the highways are on top of the municipalities.

Next we need to adjust the symbology of the layers. Right click on *Municipalities* in the table of contents and select *Properties*. Choose the [*Symbology*](http://resources.arcgis.com/en/help/main/10.2/index.html#/What_are_symbols_and_styles/00s600000006000000/) tab click on the current symbol being used to enter the *Symbol Selector*. Choose the “tan” [fill symbol](http://resources.arcgis.com/en/help/main/10.2/index.html#/Essential_symbol_and_style_vocabulary/00s600000010000000/) and click OK. Then click the [*Labels*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s800000002000000) tab on the properties dialogue. Check the box for “Label features in this layer” and change the *Label Field* to “Area Name”. You can watch a quick video about labels [here](https://www.youtube.com/watch?v=kXge5y2AI3E&index=6&list=PLFjFuB92lN6kNsvP88W8Jte26PZxNuAbW). Click OK to close the dialogue box. Follow the same steps to change the line symbol used for *Highways* to the ESRI Style Highway Symbol (solid red, 3.40 width).

Now that we have all of the layers on our map displayed properly, we can add map elements such as a [*Legend*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s900000023000000), [*North Arrow*](http://resources.arcgis.com/en/help/main/10.2/index.html#/Map_elements/00s900000002000000/), [*Scale Bar*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s900000002000000), and *Title* to our map by working with the [*layout*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s900000007000000)*.* You can view a brief video on how to make a layout [*here*](https://www.youtube.com/watch?v=M_de2Jaytiw). You will also want to make sure that the paths are stored as [relative paths](http://desktop.arcgis.com/en/arcmap/10.3/tools/supplement/pathnames-explained-absolute-relative-unc-and-url.htm#GUID-0F8BA649-A2AD-49BD-8487-9A009E02B12D). To do so, look under the *File* menu and click *Map Document Properties*. Here you will see an option to “Store relative pathnames to data sources” make sure to click this box. When your map is complete, use [*File, Export* *Map*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00sm00000004000000) to save a copy of the image as a JPG file. You can then paste the JPG into your Word document. Additionally, you should use *File, Save As* to save your work as an [MXD](http://resources.arcgis.com/en/help/main/10.2/index.html#//006600000253000000) file. Choose a name unique to this map, such as *TaskOneHighways* so that you can come back to this exact layout in the future if you ever need to.

Take a look at the map you’ve made and make some notes on the distribution of highway infrastructure around the City of Toronto. Where are the highways? Which areas are well served or underserved?

*Task 1b: Public Transit Routes*

We are next going to repeat these steps for the city’s transit infrastructure provided by the TTC. We can start by saving a copy of the map as *TaskOneTTC* so we don’t lose our highway map from before. We can keep the same background municipalities layer, but you can remove the *Highways* layer by unchecking it in the table of contents or by right clicking it in the table of contents and choosing *Remove*. In its place, add the *TTC\_Routes* layer. We will need to change the symbology to differentiate between subways, streetcars and busses. From the *Symbology* properties, change the type to *Categories*, and select [*Unique Values*](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s50000003m000000). Change the *Value Field* to “rt\_typ\_txt”, which describes the type of route using text. Click “Add All Values” to populate the table with the different types of routes. You can now modify the symbols for each route type with the *Color Ramp*, or by right clicking on individual symbols and choosing “Properties for Selected Symbols”. I recommend using 1 point width for busses, 2 points for streetcars and 3 points for subway. That way the various modes will be more visible. With all the lines on display, the outline colour of the municipal boundaries symbol can be made thicker and brighter to make it more visible.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the distribution of TTC public transportation infrastructure around the City of Toronto. Where are the subways, streetcars and busses? Which areas are more and less served by the 3 modes of public transit?**

*Task 1c: Transit Level of Service*

Create a new copy of your MXD file and call it *TaskOneTransitAccess*. For this task, we can uncheck the TTC layer and add the *TransitStops\_Access\_AM\_Peak* layer. This layer contains 400m walking buffers from each bus, streetcar and subway stop. Additionally, for each polygon, the number of transit trips that can be reached within the AM peak period (6-9am) is recorded. If you right click on the Access layer in the table of contents and select [*Open Attribute Table*](http://resources.arcgis.com/en/help/main/10.2/index.html#//005s00000002000000), you will see two fields, NumTrips and NumTripsPerHr. We will make a map displaying the values of NumTripsPerHr. Our first step is no bring the municipalities layer to the top of the display order, and change the tan fill color to “no color” (i.e. transparent). We are going to make a [*choropleth*](http://resources.arcgis.com/EN/HELP/MAIN/10.2/index.html#/Using_graduated_colors/00s500000029000000/)map using the NumTripsPerHr variable. Bring up the symobology properties for the TransitStops\_Access\_AM\_Peak layer and select *Graduated Colors* under the *Quantities* heading. Set the *value field* to NumTripsPerHr. On the right, we need to set the [classification](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s50000001r000000) method. For now, let’s use Natural Breaks (Jenk’s) with 7 classes. Next, change the *color ramp* to one of monochromatic options (i.e. only 1 color with different degrees of brightness) since we are displaying values from low to high. Next, set the symbol outlines to be transparent. Finally, right click on one of the symbols, and choose *Format Labels*. Select *Number of Decimal Places* and use 0 decimal places. This will round the label values to the bus per hour. Click OK.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the transit accessibility. What locations have access to the most transit trips? Which have the least? Keep in mind that any place outside of a buffer is more than 400 meters from the nearest transit stop.**

*Task 1d: City Population*

Create a new copy of your MXD file and call it *TaskOnePopulation*. For this task, we can uncheck the TTC layers and add the *TAZ06\_TTS2011\_Toronto*. This layer contains the TAZs for the City of Toronto and a series of transportation variables associated with each zone. Our first step is to bring the municipalities layer to the top of the display order, and change the tan fill color to “no color” (i.e. transparent). Next, right click on the TAZ layer and select [*Open Attribute Table*](http://resources.arcgis.com/en/help/main/10.2/index.html#//005s00000002000000). The table contains a listing of all the TAZ *records* and their unique identification numbers in a *field* called *GTA06.* The other fields in the table are as follows:

|  |  |
| --- | --- |
| Field | Description |
| GTA06 | TAZ ID for 2006 TAZ definitions |
| num\_pers | TAZ population |
| wrkdestamp | Total number of work trips arriving in TAZ during AM peak |
| drvpro24h | Total number of daily driving trips leaving from TAZ |
| psgpro24h | Total number of daily car passenger trips leaving from TAZ |
| trnpro24h | Total number of daily transit trips leaving from TAZ |
| othpro24h | Total number of daily trips by all other modes leaving from TAZ |
| totpro24h | Total number of daily trips by all modes leaving from TAZ |
| Hectares | Area of TAZ measured in Hectares |

In this step, we want to visualize the pattern of where people live in the city. To do this, we are going to make a [*choropleth*](http://resources.arcgis.com/EN/HELP/MAIN/10.2/index.html#/Using_graduated_colors/00s500000029000000/)map using the num\_pers variable. Bring up the symobology properties for the TAZs and select *Graduated Colors* under the *Quantities* heading. Set the *value field* to num\_pers, and the *normalization field* to Hectares. This will produce a map of population per hectare, or in other words, a population density map. On the right, we need to set the [classification](http://resources.arcgis.com/en/help/main/10.2/index.html#//00s50000001r000000) method. For now, let’s use Natural Breaks (Jenk’s) with 7 classes. Next, change the *color ramp* to one of monochromatic options (i.e. only 1 color with different degrees of brightness) since we are displaying values from low to high. Next, set the symbol outlines to be transparent. Finally, right click on one of the symbols, and choose *Format Labels*. Select *Number of Decimal Places* and use 0 decimal places. This will round the label values to the nearest person. Click OK.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the population density distribution in the City of Toronto. Where are the densest neighbourhoods? Where are the least dense? What pattern does the density distribution display? Are any of the theoretical models apparent (ie: perfectly monocentric, polycentric, flat)? How does the revealed pattern differ from or mimic the theoretical patterns?**

Task 1e: Work Destinations

Create a new copy of your MXD file and call it *TaskOneWorkPlaces*. For this task, we are going to continue working with the *TAZ06\_TTS2011\_Toronto* layer. In fact, all we need to do is change the *value field* in the symbology properties from num\_pers to wrkdestamp. Make sure you are still normalizing by Hectares and using 7 classes in a natural breaks classification.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the work trip destination density distribution in the City of Toronto. We can consider this map to be an indication of where jobs are located throughout the city. Where are the densest employment neighbourhoods? Where are the least dense? What pattern does the employment density distribution display? Are any of the theoretical models apparent (ie: perfectly monocentric, polycentric, flat)? How does the revealed pattern differ from or mimic the theoretical patterns?**

*Task 1f: Transit Mode Share*

Create a new copy of your MXD file and call it *TaskOneTransitTrips*. For this task, we are going to continue working with the *TAZ06\_TTS2011\_Toronto* layer. In fact, all we need to do is change the *value field* in the symbology properties to trnpro24h, and normalize by totpro24h. This produces a map of transit mode share for each zone. More specifically this is the total number of transit trips originating from each zone (all day) divided by the total number of trips originating from each zone (all day). Make sure you are still using 7 classes in a natural breaks classification.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the transit mode share pattern across the city. Where is transit mode share highest? Where is it the lowest? What is the overall shape of the spatial distribution? Do you see any outliers in the distribution (high areas surrounded by low, or vice versa)? Where are they? Can you explain why they exist?**

*Task 1g: Driving Mode Share*

Create a new copy of your MXD file and call it *TaskOneDrivingTrips*. For this task, we are going to continue working with the *TAZ06\_TTS2011\_Toronto* layer. In fact, all we need to do is change the *value field* in the symbology properties to drvpro24h, and normalize by totpro24h. This produces a map of driving mode share for each zone. More specifically this is the total number of driving trips originating from each zone (all day) divided by the total number of trips originating from each zone (all day). Make sure you are still using 7 classes in a natural breaks classification.

Follow the steps in Task 1a to produce and export a layout to jpg and save your MXD file.

**Take a look at the map you’ve made and make some notes on the driving mode share pattern across the city. Where is driving mode share highest? Where is it the lowest? What is the overall shape of the spatial distribution? Do you see any outliers in the distribution (high areas surrounded by low, or vice versa)? Where are they? Can you explain why they exist?**

## Task 2: Combining Infrastructure, Land Uses and Travel Behaviour

The goal of this task is to describe the relationship between transport infrastructure supply, land uses, and travel behaviour. To do this, your job will be to produce overlays of the various maps we’ve created so far, or create side-by-side comparisons of maps when appropriate. In general, the idea is to look at relationships between transportation supply, population and workplace density, and mode share characteristics. You should be making the following comparisons:

* Highway locations & driving mode share
* Transit supply & transit mode share
* Transit accessibility & transit mode share
* Population density & driving mode share
* Population density & transit mode share
* workplace density & driving mode share
* workplace density & transit mode share

You may choose to compare maps side by side simply by inserting JPGs at similar spatial scales into a word document, but in many cases, it will be better to overlay line features on top of choropleth maps to discover the spatial relationships. You now have the skills to explore your different mapping options freely. Based on the readings and lectures we’ve discussed in class, specifically those pertaining to transportation/land use relationships, discuss your comparisons in terms of hypothesized and observed relationships between transportation and land use characteristics.

## Task 3: Planning for the Future… (1-2 pages)

For this task, you should review your discoveries in order to make recommendations for future transportation initiatives or land-use initiatives that should impact transportation patterns in the city. Using Metrolinx’s most recent [Regional Transportation Plan Draft](https://www.metrolinxengage.com/sites/default/files/draft_rtp.pdf) and/or the Province’s [Growth Plan](http://placestogrow.ca/images/pdfs/ggh2017/en/growth%20plan%20%282017%29.pdf) select three transportation or land use policy or infrastructure initiatives, explain why they are needed, and provide a statement of their expected impact on transportation patterns. Make sure that your discussions of the initiatives are justified by the patterns you see in your maps, and that the expected impacts are justified by theories covered in the course, especially the land-use/transportation cycle.

## Deliverables

Your write-up for this assignment should be in the format of a report to the Mayor of Toronto. It should have a brief introduction, followed by separate sections for Tasks 1-3. For Task 1, your report should describe the transportation and land use patterns in the city consisting of the 7 maps made for tasks 1a-1g as well as your descriptions of the patterns of transportation and land uses you observed. You are expected to write a brief paragraph to describe each map. Similarly, for Task 2, you should report on the 7 recommended comparisons with a map (or pair of maps) and a short paragraph for each. For Task 3, you should write about 1 paragraph for each of your three 3 hypothesized initiatives.

## Formatting

Your report must be written using a word processor, and all maps should be inserted into the appropriate locations in the document. All figures must have numbered captions and be referenced in text. Printouts should be in colour and must include a cover page with your name, student number, and assignment title. You are responsible for making sure that all colours and fonts chosen for your maps are easily interpretable on the printed versions. Your document should be double-spaced, 12 point font, 1 inch margins. You should use APA 6th edition for references and in-text citations.

## Grading

Task 1: 28 points. 1 points for each map and 3 points for each description.

Task 2: 28 points. 1 points for each comparison and 3 points for each description.

Task 3: 30 points. 10 points for each hypothesized infrastructure improvement.

Writing and Presentation: 14 points.