Tutorial for mapping Census 2016 data in Qgis by census tracts

Skills you will learn: How to join a Census 2016 map layer to a Census 2016 non-map layer, based on a common joining field shared by the two tables. The data behind the joined table and the location of the census tracts can be analysed for newsworthy trends.

If you are unfamiliar with the basic functionality of QGIS, such as how to add map layers and other data tables to the map document, please review the tutorial **A Quick Tour of QGIS Desktop**, which you can access by clicking <u>here</u>.

We will be using version 2.18.7. If you're using a different version, there may be some minor differences in the interface, but the functionality remains the same.

Getting started

<u>Census tracts (CTs)</u> are among the smallest of geographic areas that have populations between 2,500 and 8,000 people. The tracts allow journalists looking for Census-related stories to see patterns at the neighborhood level. Census tracts are located in cities, also known as <u>census metropolitan areas</u>, of more than 100,000.

Statistics Canada points out the many ways in which census tracts and the data inside can be used: municipalities evaluating and revising their officials plans; high schools and post-secondary institutions conducting research; companies evaluating areas to conduct marketing campaigns, build recreational facilities or retail outlets. Journalists can use similar research techniques to find stories.

It is for these reasons that Statistics Canada's 2016 Census Program releases are extremely valuable. For instance, knowing the neighborhoods with the fastest growth rates in high- or low-income earners, new housing or, in the case of this tutorial, visible minorities, allows newsrooms to know where to conduct interviews.

So, let's get started!

Add the map layer and the non-geographic layer to the data frame.

For the purposes of this illustration, we are using a shapefile of census tracts in Canada and a dataset of visible minorities from the 2016 census. To obtain the zip folder with these contents, please click <u>here</u>. Be sure to save the file in the folder for this tutorial. Once you've downloaded it into the folder, unzip the file, which will look like this:

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Page 121 of The Data Journalist explains the shape file and its component parts.

This is what the csv table looks like in the data table when we open it in Excel. You can download the table by clicking <u>here</u>. Be sure to save the file in the folder used for this tutorial.

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Importing files into QGIS

Open Qgis and select the "Add Vector Layer" icon.



Browse to the folder that contains the shape file, and choose the layer with the ".shp" extension. Your layer will look like this:



Only parts of the country are represented. Remember, census tracts are geographic areas only located in the country's largest municipalities of more than 100,000 people.

To see the data behind the layer, right-click on its icon in the menu to the left, and select the "Open Attribute Table" from the shortcut menu.



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The first field is the one we will join to the layer that contains the data for visible minorities. Ten characters in length, a <u>CTUID</u> is a unique identifier for a census tract within a census metropolitan area.

Close the attribute table. And use the "Add Delimited Text Layer" option to browse for, and then import our csv file.



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Qgis defaults to the "csv" file format. Text file can also be in other formats like tab delimited, which you can locate by clicking the radio

button to the left of "Custom delimiters".

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But, this is a csv file, so we'll stick with that format, and make sure that the radio button to the left of "No geometry (attribute only table)" option is selected.

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Open the csv layer's attribute table.

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You'll notice that it's identical to the file we opened in Excel.

We join the <u>CT_UID</u> field to the CTUID field in the shape file, but not before we do bit of formatting.

In order to edit the numbers in the csv layer, we have to make a copy.

Return to the menu, right-click on the "Visible Minorities" layer, and select "Save as".



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Make sure the file format is "Comma Separated Value (CSV)". Make sure to add this saved layer to the map.

Browse to the folder for this tutorial and save the file with a name that makes sense. Scroll to the dialogue box's "Layer Options" section, the select the "YES" option from the drop-down menu to the right of

"CREATE_CSVT". The <u>csvt file</u> is a helper file that Qgis creates that will make sure that the numbers are formatted as integers, which will allow us to colour the map based on numeric values later in this tutorial.

Also select the "default" from the drop-down menu to the right of "GEOMETRY".

Make sure the selections in your "save vector layer as" dialogue box match those in the screen shot below.

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Open the attribute table for your new csv file.

Because we don't need the original VisibleMinorities csv layer, we can remove it from the "Layers Panel" by right-clicking and selecting the



"Remove" option, or simply leave it in place.

Before joining two layers, we must reformat the numbers in the census tract identification fields for both layers.

Let's begin with the new csv layer that we created. Open the attribute table and select the "Open field calculator" icon at the top right-hand corner of the table's menu.

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Click the box below "Create virtual field" and type "CT_UID_New" to the right of "Output field name".

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Click the "+" sign for the "Fields and Values" from the menu on the right, and double-click the "CT_UID" column so it appears to the left.

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Click the downward arrow to obtain the drop-down menu to the right of "Output field name" and select "Decimal number (real)"

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3	10011	360	B-Conversions B-Custom
4	10012	445	⊕−Date and Time ⊖−Fields and Values
5	10013	210	
6	10014	140	VISMIN_2016
7	10015.01	310	TOT_PPHH_CHG_11_16
8	10015.02	530	B-General
9	10015.03	695	B-Geometry B-Math
0	10015.04	480	⊕-Operators ⊕-Record
			E-String B-String Variables
C Sh	ow All Features	·J	Output preview: 10001

Leave the "Output length" as 10. Increase the precision from zero to "2".

Before selecting OK, it's important to explain what we've done.

In order to execute a join in Qgis, or any other database program like MySQL or Microsoft's Access, the columns must contain similarly formatted data. For numbers, they must be integers, or for this tutorial, decimal numbers.

So, let's continue.

🌠 Vis	sibleMinoritiesF	orOnlineTutoria	I :: Features tot	al: 5721, filtered	d: 5721, selected	AaB
/ 0		VISMIN 2016	VISMIN 2011	· PPHH CHG 11		Title
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2	10002	265	35	6.57	10002.00	
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4	10003.02	230	35	5.57	10003.02	
5	10004	840	390	1.15	10004.00	
6	10005.01	50	40	0.25	10005.01	
7	10005.02	255	175	0.46	10005.02	aber 15
, o	10005.02	180	175	0.03	10005.02	
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12	10010	75	75	0	10010.00	
13	10011	360	135	1.67	10011.00	
14	10012	445	375	0.19	10012.00	
15	10013	210	85	1.47	10013.00	ОК
16	10014	140	125	0.12	10014.00	
17	10015.01	310	155	1	10015.01	
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19	10015.03	695	395	0.76	10015.03	um like
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	ow All Features					l decir
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Select OK to return to the attribute table.

Our new column is on the far right.

We must perform the same task with our csv layer.

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	1	ct 000a16a e -	Features total:	5721 filt	ared: 5721 selected: 0		8	-		
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K UUUAIDA E	3	5370120.02	0120.02	35	Only update 0 select	ted rectures				
	4	0010006.00	0006.00	10	Create a new held	3		Update ext	isting heid	
	5	0010007.00	0007.00	10	Output field name	UTD NEW				
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	14	2050002.00	0002.00	12					B Date and Time B Fields and Values	
	15	2050003.00	0003.00	12					CTUID	
	16	5350422.06	0422.06	35	1				NULL	
	17	2050005.00	0005.00	12	1				PRNAME	
	18	0010014.00	0014.00	10					- CMAUID	
	19	5370140.03	0140.03	35					CMANAME	
			0140.04	25					Fuzzy Matching General	

Open the attribute table, and repeat the same steps.

Edit View Layer Settings Elugins Vector	Baster Dat	tabase <u>W</u> eb M	IMQGIS Progess	ing <u>H</u> elp						
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1	1	ct_000a16a_e ::	Features total:	5721, filtered: 5	721, selected: 0					
i tauar David	# /		6 6 6	5 5 7 2	* P 8 B	局局員				
ayesreen ar di ≋ ♥ & ♥ ₩ ₩ □.		CTUD	CTNAME	PRUID	PRINAME	CMAUD	CMAPUID	CMANAME	CMATYPE	CTUID_NEW
VisibleMinoritiesForOnlineTutorial	1	0010002.00	0002.00	10	Newfoundland	001	10001	St. John's	8	10002.00
X kt 000a16a e	2	5370001.09	0001.09	35	Ontario	537	35537	Hamilton	8	5370001.09
	3	5370120.02	0120.02	35	Ontario	537	35537	Hamilton	8	5370120.02
	4	0010006.00	0006.00	10	Newfoundland	001	10001	St. John's	в	10006.00
	5	0010007.00	0007.00	10	Newfoundland	001	10001	St. John's	в	10007.00
	6	0010008.00	0008.00	10	Newfoundland	001	10001	St. John's	8	10008.00
	7	0010009.00	0009.00	10	Newfoundland	001	10001	St. John's	8	10009.00
	8	0010010.00	0010.00	10	Newfoundland	. 001	10001	St. John's	8	10010.00
	9	0010011.00	0011.00	10	Newfoundland	001	10001	St. John's	в	10011.00
	10	0010012.00	0012.00	10	Newfoundland.	001	10001	St. John's	8	10012.00
	11	0010013.00	0013.00	10	Newfoundland	001	10001	St. John's	8	10013.00
	12	5320015.02	0015.02	35	Ontario	532	35532	Oshawa	в	5320015.02
	13	2050001.00	0001.00	12	Nova Scotia /	205	12205	Halifax	в	2050001.00
	14	2050002.00	0002.00	12	Nova Scotia /	205	12205	Halifax	8	2050002.00
	15	2050003.00	0003.00	12	Nova Scotia /	205	12205	Halifax	в	2050003.00
	16	5350422.06	0422.06	35	Ontario	535	35535	Toronto	в	5350422.06
	17	2050005.00	0005.00	12	Nova Scotia /	205	12205	Halifax	8	2050005.00
	18	0010014.00	0014.00	10	Newfoundland.	. 001	10001	St. John's	8	10014.00
	19	5370140.03	0140.03	35	Ontario	537	35537	Hamilton	8	5370140.03

Now we have two matching census tract identifications fields.

Return to the Qgis "Layers Panel" menu, and select your shape file.

X III Ict 000a16a e	

Right-click, and select "Properties" from the short-cut menu.



Select the "Joins" option.

R	🛒 L	ayer Properties - Io	t_000a16a_e Jo	bins	
	X	General	Join layer	Join field	Target field
Pai	~	Style			
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		Diagrams			
		Metadata			
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The layer identified in the "Add vector join" dialogue box is the csv file we're about to join to the shape file.

All that's left is to tell Qgis which fields we want to join, which will be the new ones we've created. Select the CT_UID_NEW field from the

drop-down menu.

Join layer	VisibleMinoritiesForOnlineTutorial
Join field	•
Target field X Cache join layer in virtual memory	1.2 CT_UID 123 VISMIN_2016 123 VISMIN_2011
Create attribute index on join field Choose which fields are joined Custom field name prefix VisibleMinoritiesForOnlineTutorial_	1.2 TOT_PPHH_CHG_11_16 1.2 CT_UID_NEW
	OK Cancel

And the CTUID	_NEW	field	from	our	shape	file.
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You should now have the two matching fields to be joined.

loin layer	VisibleMinoritiesForOnlineTutorial 💌
loin field	1.2 CT_UID_NEW
Farget field	1.2 CTUID_NEW
🗙 Cache join layer in virtual memory	
Create attribute index on join field	
Choose which fields are joined	
Custom field name prefix	
VisibleMinoritiesForOnlineTutorial_	
]
	OK Cancel

Select "OK".

n Layer Properties - ю	CUUUAIDA_e Joins				1.0	99-08	0 P				a
🔀 General	Join layer	Join field	Target field	Memory cache	Prefix	Joined fields					
😽 Style	VisibleMinoritiesForOnlineTutoria	I CT_UID_NEW	CTUID_NEW	1		all					
abels											
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Select "Apply" and "OK".

Open the attribute table to see the joined tables.

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Styles •
<u>Open Attribute Table</u>
🥖 Toggle Editing
Save As
Save As Layer Definition File
Eilter
Show Feature Count
Properties
Pename

	CTUID	CTNAME	PRUID	PRNAME	CMAUID	CMAPUID	CMANAME	CMATYPE	jesForOnlineTut	ForOnlineTutoria	ForOnlineTutoria	nlineTutorial_TC	CTUID_NEW	
	0010002.00	0002.00	10	Newfoundland	001	10001	St. John's	8	10002	265	35	6.57	10002.00	
	5370001.09	0001.09	35	Ontario	537	35537	Hamilton	в	5370001.09	1670	1020	0.64	5370001.09	
	5370120.02	0120.02	35	Ontario	537	35537	Hamilton	в	5370120.02	170	40	3.25	5370120.02	
	0010006.00	0006.00	10	Newfoundland	001	10001	St. John's	в	10006	180	175	0.03	10006.00	
	0010007.00	0007.00	10	Newfoundland	001	10001	St. John's	в	10007	130			10007.00	
	0010008.00	0008.00	10	Newfoundland	001	10001	St. John's	в	10008	110	25	3.4	10008.00	
	0010009.00	0009.00	10	Newfoundland	001	10001	St. John's	в	10009	10	0		10009.00	
	0010010.00	0010.00	10	Newfoundland	001	10001	St. John's	в	10010	75	75	0	10010.00	
	0010011.00	0011.00	10	Newfoundland	001	10001	St. John's	8	10011	360	135	1.67	10011.00	
0	0010012.00	0012.00	10	Newfoundland	001	10001	St. John's	в	10012	445	375	0.19	10012.00	
1	0010013.00	0013.00	10	Newfoundland	001	10001	St. John's	8	10013	210	85	1.47	10013.00	
2	5320015.02	0015.02	35	Ontario	532	35532	Oshawa	в	5320015.02	620	460	0.35	5320015.02	
3	2050001.00	0001.00	12	Nova Scotia /	205	12205	Halifax	в	2050001	550	535	0.03	2050001.00	
4	2050002.00	0002.00	12	Nova Scotia /	205	12205	Halifax	в	2050002	610	495	0.23	2050002.00	
5	2050003.00	0003.00	12	Nova Scotia /	205	12205	Halifax	в	2050003	705	540	0.31	2050003.00	
6	5350422.06	0422.06	35	Ontario	535	35535	Toronto	в	5350422.06	2395	2055	0.17	5350422.06	
7	2050005.00	0005.00	12	Nova Scotia /	205	12205	Halifax	в	2050005	190	115	0.65	2050005.00	
8	0010014.00	0014.00	10	Newfoundland	001	10001	St. John's	в	10014	140	125	0.12	10014.00	
9	5370140.03	0140.03	35	Ontario	537	35537	Hamilton	в	5370140.03	675	405	0.67	5370140.03	
0	5370140.04	0140.04	35	Ontario	537	35537	Hamilton	в	5370140.04	190	330	-0.42	5370140.04	
21	5410002.07	0002.07	35	Ontario	541	35541	Kitchener - Ca	в	5410002.07	1320	1205	0.1	5410002.07	
2	5550204.01	0204.01	35	Ontario	555	35555	London	в	5550204.01	145	210	-0.31	5550204.01	
3	5550204.02	0204.02	35	Ontario	555	35555	London	в	5550204.02	205	355	-0.42	5550204.02	
4	5320202.11	0202.11	35	Ontario	532	35532	Oshawa	в	5320202.11	905	455	0.99	5320202.11	
5	5350420.13	0420.13	35	Ontario	535	35535	Toronto	в	5350420.13	4010	4100	-0.02	5350420.13	

Before assigning colours to values, give some thought to the focus of your story. If you're in a particular city, you'd want to colour-code the census tracts for that area in order to spot the neighborhoods of interest – fastest growth, zero growth, declines, and so on. For instance, we may choose to do a story about an area of the city were visible minorities are leaving.

For this tutorial, we'll focus on the nation's capital, Ottawa. However, the same steps can be followed to highlight any other city such as Vancouver, Toronto, Montreal, Halifax or St. John's.

Leave the attribute table open. We'll use an SQL query to select the Ottawa census tracts, which we will save as a new layer.

Sort the CMANAME column in descending order and scroll down to Ottawa. Because the national capital region spans both sides of the Ottawa River to take in Ontario and Quebec, we only want the Ontario section. To the left of the CMANAME column is the CMAPUID for the region, which is 35505.

Now we can run a query that will select the CMAs, or Census Metropolitan Areas, numbered 35505. Hover your mouse over the "Select features using an expression" icon above the table towards the left-
						900 C	
	CTUID	CTI	t features using	an expression	CMAUID	CMAPUID	CMANAME
2681	5320202.09	0202.09	35	Ontario	532	35532	Oshawa
2682	5050030.00	0030.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2683	5050031.00	0031.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2684	5050005.00	0005.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2685	5050006.00	0006.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2686	5050008.00	0008.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2687	5050138.00	0138.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2688	5050171.09	0171.09	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2689	5050003.00	0003.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2690	5050004.00	0004.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2691	5050015.00	0015.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2692	5050025.00	0025.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2693	5050026.00	0026.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2694	5050027.00	0027.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2695	5050028.00	0028.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2696	5050029.00	0029.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
2697	5050132.00	0132.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)
698	5050133.00	0133.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)

Click the "+" sign to the left of "Fields and Values" on the dialogue box's right-hand side.





Click the "=" tab above "CMAPUID", and then 35505, bracketed by single quotes.

Click the "Select" tab a the bottom right.

 NULL PRUID PRNAME CMAUID CMAPUID CMANAME CMATYPE VisibleMinorities VisibleMinorities VisibleMinorities VisibleMinorities CTUID_NEW Puzzy Matching General Geometry Manute 	ForOnlineTutorial_CT_UID ForOnlineTutorial_VISMIN ForOnlineTutorial_VISMIN ForOnlineTutorial_TOT_PP	0 4_2016 4_2011 9HH_CHG_11_16	
		Select Close	
		🔄 Select	
В	9320011	Add to selection	
В	9320105		n
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В	9320202	1020	

You'll notice that all the rows with the CMAPUID number 35505 have been selected.

CTUID	CTNAME	PRUID	PRNAME	CMAUED	CMAPUID	CMANAME	/ CMATYPE	jesForOnlineTut	ForOnlineTutoria For
681 5320202.09	0202.09	35	Ontario	532	35532	Oshawa	в	5320202.09	250
682 5050030.00	0030.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)	8	5050030	1495
683 5050031.00									805
584 5050005.00									
685 5050006.00	0005.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)	B	5050006	695
Select by expres	sion - lct_000a1	16a_e							? X
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= + - /	• • 11 (3 14				Search			
utput preview: 0						Conversions Custom Custom Date and Time Fields and Values - CTUID - CTNAME - NULL - PRUID - PRNAME - CMAUID - CMAUID - CMAUID - CMAPUID - CMAPUID - CMANAME - CMAITPE - VisibleMinorities - VisibleMinorities	ForOnlineTutorial_CT_UI ForOnlineTutorial_VISMI orOnlineTutorial_VISMI	D N_2016 N_2011	
704 5050021.00	0021.00	35	Ontario	505	35505	Ottawa - Gatineau (Ontario part / partie de l'Ontario)	8	Select •	Close

Close the dialogue box.

Now we want to save a new layer with only those selected identification numbers.

Right-click on the layer, and select "Save As" from the short-cut menu.

Format	Comma Separated Value [CSV]		
ormat	Atlas BNA		
File name	AutoCAD DXF		
	Comma Separated Value [CSV]		
ayer name	GPS eXchange Format [GPX]		
CRS	GeoJSON		
	GeoPackage		
-	Geoconcept		
encoung	Geography Markup Language [GML]		
Save on	ly selected features		
Select	fields to export and their export opt	ons	
	Name	Tyne	
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		Select All	
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Add sav	ed file to map		
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The new layer's format will be a shape file, so make sure that option is selected.

Browse to the folder for this tutorial and name the file something like "Visible_Minorities_In_Ottawa".

Be sure to select "Save only selected features".

Save vecto	or layer as
Format	ESRI Shapefile
File name	Visible_Minorities_In_Ottawa
Layer name	
CRS	Selected CRS (EPSG:3347, NAD83 / Statistics Canad
Encoding	
X Save on	ly selected features
▼ Select	ields to export and their export options
Name	Туре

Neglecting to check this box is an easy mistake to make. However, if you don't select it, then you simply end up re-saving the entire file.

In the "Select fields to export and their export options" section, you can deselect the columns that you don't want to appear in your new layer.

5	ave only se	lected re	atures
r s	Name	s to exp	bort and their export options
×		String	
x	CTNAME	String	
×	PRUID	String	
×	PRNAME	String	
×	CMAUID	String	
×	CMAPUID	String	
			Select All

Let's just leave all the fields selected.

Before saving, make sure that the box to the left of "Add saved file to map" layer is checked off.

Double check all of your steps (a good habit to get into for each step in the process) before selecting the OK tab.



A message indicating success will briefly appear. To your left, you'll notice the new layer.

Deslect the first layer, right-click on your new layer, and choose the "Zoom to layer" option in order to see the Ottawa census tracts.

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		Set Layer Scale Visibility
- 💱		Set Layer CRS
9		Set Project CRS from Layer
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Note, your default colour will likely be different.

The uniform colour might make you think nothing has happened. However, that's because we must symbolize, or create a colour scheme that assigns colours on a grid to specific ranges of values.

Before we assign values to differentiate census tracts, we'll have to clean up the numbers in our new layer's attribute table, add a new column, and then rename some columns.

Open the attribute table.

1	ISIDIC_IVII IOITU	cs_in_onana_	Catures total. 2	wy, million 20	, sciected. o	Sector 1	longer and						
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	CTUD	CTNAME	PRUID	PRNAME	CMAUID	CMAPUID	CMANAME	CMATYPE	VisibleMin	VisibleM_1	VisibleM_2	VisibleM_3	CTUID_NEW
	5050004.00	0004.00	35	Ontario	505	35505	Ottawa - Gati	В	5050004.0000	965	950	0.0200000000000000000000000000000000000	5050004.00
	5050015.00	0015.00	35	Ontario	505	35505	Ottawa - Gati	В	5050015.0000	1685	1115	0.510000000000000	5050015.00
	5050300.00	0300.00	35	Ontario	505	35505	Ottawa - Gati	в	5050300.0000	715	540	0.320000000000000	5050300.00
	5050025.00	0025.00	35	Ontario	505	35505	Ottawa - Gati	в	5050025.0000	665	810	-0.180000000000000	5050025.00
	5050026.00	0026.00	35	Ontario	505	35505	Ottawa - Gati	в	5050026.0000	1360	1180	0.150000000000000	5050026.00
	5050027.00	0027.00	35	Ontario	505	35505	Ottawa - Gati	в	5050027.0000	945	880	0.0700000000000000	5050027.00
	5050028.00	0028.00	35	Ontario	505	35505	Ottawa - Gati	в	5050028.0000	2495	2545	-0.020000000000000000000000000000000000	5050028.00
	5050126.05	0126.05	35	Ontario	505	35505	Ottawa - Gati	в	5050126.0499	1305	1130	0.15000000000000	5050126.05
	5050029.00	0029.00	35	Ontario	505	35505	Ottawa - Gati	в	5050029.0000	1920	1855	0.0400000000000000000000000000000000000	5050029.00
0	5050126.06	0126.06	35	Ontario	505	35505	Ottawa - Gati	в	5050126.0599	1925	1370	0.41000000000000	5050126.06
1	5050132.00	0132.00	35	Ontario	505	35505	Ottawa - Gati	В	5050132.0000	2100	2100	0.0000000000000000000000000000000000000	5050132.00
2	5050133.00	0133.00	35	Ontario	505	35505	Ottawa - Gati	в	5050133.0000	1220	525	1.32000000000000	5050133.00
3	5050134.00	0134.00	35	Ontario	505	35505	Ottawa - Gati	в	5050134.0000	660	475	0.39000000000000	5050134.00
4	5050151.09	0151.09	35	Ontario	505	35505	Ottawa - Gati	в	5050151.0899	135	55	1.45000000000000000000000000000000000000	5050151.09
5	5050016.00	0016.00	35	Ontario	505	35505	Ottawa - Gati	в	5050016.0000	415	345	0.2000000000000000000000000000000000000	5050016.00
6	5050017.00	0017.00	35	Ontario	505	35505	Ottawa - Gati	в	5050017.0000	520	305	0.7000000000000000	5050017.00
7	5050018.00	0018.00	35	Ontario	505	35505	Ottawa - Gati	в	5050018.0000	405	460	-0.12000000000000	5050018.00
8	5050019.00	0019.00	35	Ontario	505	35505	Ottawa - Gati	в	5050019.0000	440	375	0.1700000000000000	5050019.00
9	5050021.00	0021.00	35	Ontario	505	35505	Ottawa - Gati	в	5050021.0000	1510	1760	-0.140000000000000	5050021.00
0	5050022.00	0022.00	35	Ontario	505	35505	Ottawa - Gati	в	5050022.0000	2000	1980	0.0100000000000000000000000000000000000	5050022.00
1	5050171.10	0171.10	35	Ontario	505	35505	Ottawa - Gati	в	5050171.0999	2745	2140	0.28000000000000	5050171.10
2	5050024.00	0024.00	35	Ontario	505	35505	Ottawa - Gati	в	5050024.0000	535	380	0.41000000000000	5050024.00
3	5050009.00	0009.00	35	Ontario	505	35505	Ottawa - Gati	в	5050009.0000	520	775	-0.33000000000000	5050009.00
4	5050010.00	0010.00	35	Ontario	505	35505	Ottawa - Gati	в	5050010.0000	2035	1580	0.29000000000000	5050010.00
5	5050012.00	0012.00	35	Ontario	505	35505	Ottawa - Gati	в	5050012.0000	1935	1865	0.0400000000000000000000000000000000000	5050012.00

There are too many decimal points in the percent difference column, which Qgis has renamed "VisibleM_3". (more on the reason for this a bit later in this tutorial).

Select the "Open field calculator" icon.

01	116 116 🗮] 🖷						
AME	CMAUID	Open field calcu	lator (Ctrl+I)	CMATYPE	VisibleMin	VisibleM_1	VisibleM_2	VisibleM_3
	505	35505	Ottawa - Gati	в	5050004.0000	965	950	0.0200000000000000000000000000000000000
	505	35505	Ottawa - Gati	В	5050015.0000	1685	1115	0.5100000000000000
	505	35505	Ottawa - Gati	В	5050300.0000	715	540	0.3200000000000000000000000000000000000
	505	35505	Ottawa - Gati	в	5050025.0000	665	810	-0.1800000000000000000000000000000000000
	505	35505	Ottawa - Gati	в	5050026.0000	1360	1180	0.1500000000000000000000000000000000000

Give your field a new name, make the field type a decimal number with a precision of 2, and select the "VisibleM_3" column.

£

X Create virtual field				7.
Output field hme Doci	t_11-1	CTUID		- B.
Output field length 10	Precision 2			5.
Expression Function	on Editor	1		9.
= + - / *	^ () '\n'		Search	5.
"VisibleM 3"			NULL	•
			PRNAME	
			- CMAUID - CMAPUID	Ĥ
		:	CMANAME	
			- CMATYPE - VisibleMin	5.
			VisibleM_1	7.
			VisibleM_2	
			CTUID_NEW	
		1	Source State	
			I General	1.
			Geometry Math	2.
			Operators	
		• •	E- String	
Output provious: 0.02			🕀 Variables	· 1

10.0			
_2	VisibleM_3	CTUID_NEW	%Diff_11-1
950	0.0200000000000000	5050004.00	0.02
1115	0.5100000000000000	5050015.00	0.51
540	0.320000000000000	5050300.00	0.32
810	-0.1800000000000000	5050025.00	-0.18
1180	0.1500000000000000	5050026.00	0.15
880	0.070000000000000	5050027.00	0.07
2545	-0.020000000000000	5050028.00	-0.02
1130	0.1500000000000000	5050126.05	0.15
1855	0.0400000000000000	5050029.00	0.04
1370	0.4100000000000000	5050126.06	0.41
2100	0.0000000000000000000000000000000000000	5050132.00	0.00
525	1.32000000000000000	5050133.00	1.32
475	0.3900000000000000	5050134.00	0.39

If your dialogue box looks like this, select the OK tab to return to the attrbute table.

Now we can fix the column titles for our 2011 and 2016 visible minorities' numeric values.

VisibleM_1	VisibleM_2	VisibleM_3
965	950	0.020000000000000
1685	1115	0.5100000000000000
715	540	0.320000000000000
665	810	-0.180000000000000
1360	1180	0.150000000000000

The first column to the left represents the 2016 values. The second, 2011. The third is the field that contains the percent difference, which was refomatted with two decimal places in the previous step.

🎸 🥼 🔍 ү 🗞 👻	s 🕆 🗔
VisibleMinorities	orOnlineTutorial
Lt_000a16a	🔎 Zoom to Layer
	Show in Overview
	- Remove
	🔄 Duplicate
	Set Layer Scale Visibility
	Set Layer CRS
	Set Project CRS from Layer
	Styles
	Open Attribute Table
	🖉 Toggle Editing
	Save As
	Save As Layer Definition File
	Filter
	Show Feature Count
	Properties
l	Kename

Close the attribute table, right click on the layer. Go to "Properties".

🧊 Style	▼ Fields							
abc Labels								
Fields	Id 🛆	Name	Edit widget	Alias	Туре	Type name	Length	Precision
🎸 Rendering	abc 0	CTUID	Text Edit		QString	String	10	0
🧭 Display	abc 1	CTNAME	Text Edit		QString	String	7	0
Actions	abc 2	PRUID	Text Edit		QString	String	2	0
1 loine	abc 3	PRNAME	Text Edit		QString	String	100	0
	abc 4	CMAUID	Text Edit		QString	String	3	0
Diagrams	abc 5	CMAPUID	Text Edit		QString	String	5	0
🥡 Metadata	abc 6	CMANAME	Text Edit		QString	String	100	0
2 Variables	abc 7	CMATYPE	Text Edit		QString	String	1	0
E Legend	1.2 8	VisibleMin	Text Edit		double	Real	23	15
	123 9	VisibleM_1	Text Edit		qlonglong	Integer64	10	0
	123 10	VisibleM_2	Text Edit		qlonglong	Integer64	10	0
	1.2 11	VisibleM_3	Text Edit		double	Real	23	15
	1.2 12	CTUID_NEW	Text Edit		double	Real	10	2
	ε 13	%Diff_11-1	Text Edit		double	double	10	2

Select the "Fields" icon.

We will rename VisibleM_1 and Visible_2. Double-click the cell in the Alias column and type 2016 and 2011, respectively.

🕺 Layer Properties - \	visible_Mino	rities_In_Otta	awa Fields	1 1 1		
🔀 General	Attribute edit	tor layout: Au	togenerate			
💸 Style	▼ Fields					
(abc Labels] 🕖 🔛]			
Fields	Td 🛆	Name	Edit widget	Alias	Туре	Τ
≼ Rendering	abc 0	CTUID	Text Edit		QString	St
🧭 Display	abc 1	CTNAME	Text Edit		QString	St
Actions	abc 2	PRUID	Text Edit		QString	St
10ins	abc 3	PRNAME	Text Edit		QString	St
	abc 4	CMAUID	Text Edit		QString	St
Diagrams	abc 5	CMAPUID	Text Edit		QString	St
🧃 Metadata	abc 6	CMANAME	Text Edit		QString	St
Variables	abc 7	CMATYPE	Text Edit		QString	St
Eegend	1.2 8	VisibleMin	Text Edit		double	Re
	123 9	VisibleM_1	Text Edit	2016	qlonglong	In
	123 10	VisibleM_2	Text Edit	2011	qlonglong	In
	1.2 11	VisibleM_3	Text Edit		double	Re
	1.2 12	CTUID_NEW	Text Edit		double	Re
	ε 13	%Diff_11-1	Text Edit		double	dc

	EI:	1 P (2)	. 8	l	
,	2016	2011	VisibleM_3	CTUID_NEW	%Diff_11-1
)0	965	950	0.0200000000000000000000000000000000000	5050004.00	0.02
)0	1685	1115	0.5100000000000000000000000000000000000	5050015.00	0.51
0	715	540	0.3200000000000000	5050300.00	0.32
0	665	810	-0.1800000000000000	5050025.00	-0.18
0	1360	1180	0.1500000000000000000000000000000000000	5050026.00	0.15
0	945	880	0.07000000000000000	5050027.00	0.07
)0	2495	2545	-0.02000000000000	5050028.00	-0.02

Select "Apply" and "OK". Return to the attribute table to see the renamed columns.

So far, for each census tract, we have visible minority numbers for 2016, 2011 and the percent differences. This means that we can eventually assign column colours based on numeric values in each of these fields. However, before doing this, let's create one more column -- the growth or decrease from 2011 to 2016. In a spreadsheet, we would just create a new column, and use a calculation using the "-" operator to obtain the difference.

In Qgis, we can do the same thing, using an SQL expression .

Create a new field Update ex Create virtual field	isting field	
Dutput field tree Whele number (integer) CTUID CTUID		Ŧ
Dutput field length 10 Precision 0		
Expression Function Editor		
- + - / * ^ () ''n'	Search	
() utput preview:		•
You are editing information on this layer but the layer is cur automatically be turned on.	rently not in edit mode. If you click Ok, edit mode	will

Select the "Open field calculator" to obtain the dialogue box.

Call the new field "Diff-11-16."

Select "VisibleM_1" the "-" operator, and then "VisibleM_2". (NOTE: The field calculator dialogue box does not retain the aliases we created in the previous step.)

Create a new field Update	existing field	000
Create virtual neid		
Output field type Whole number (integer 64 bit)		-
Dutput field length 10 🜩 Precision 0 🜩		000
Expression Eurotion Editor		000
	Grand	000
= + - / * ^ () '\n'	Search	000
"VisibleM_1" - "VisibleM_2"	- CTUID - CTNAME	000
		000
	PRNAME	000
	- CMAUID CMAPUID	000
	CMANAME	000
	- VisibleMin	000
	VisibleM_1	000
	VisibleM_3	000
	%Diff_11-1	000
	B - General	000
	⊕-Geometry ⊕-Math	000
	Operators	000
utput preview: 15	C Record	000

Return to the attribute table.

2016	2011 🛆	VisibleM_3	CTUID_NEW	%Diff_11-1	Diff-11-16
			5050140.01	NULL	NULL
10			5050125.03	NULL	NULL
170	100	0.7000000000000000000000000000000000000	5050050.00	0.70	70
1025	1010	0.0100000000000000000000000000000000000	5050014.00	0.01	15
975	1010	-0.030000000000000	5050100.00	-0.03	-35
1120	1020	0.1000000000000000000000000000000000000	5050121.01	0.10	100
1220	1020	0.2000000000000000000000000000000000000	5050056.00	0.20	200
1435	1030	0.3900000000000000	5050120.03	0.39	405
1015	1030	-0.010000000000000	5050161.03	-0.01	-15
1310	1035	0.27000000000000	5050130.02	0.27	275
1100	1040	0.0600000000000000000000000000000000000	5050160.04	0.06	60
1360	1060	0.28000000000000000	5050048.00	0.28	300
1060	1060	0.0000000000000000000000000000000000000	5050127.00	0.00	0
1660	1060	0.570000000000000	5050171.05	0.57	600
1420	1070	0.3300000000000000000000000000000000000	5050013.00	0.33	350
1440	1080	0.3300000000000000000000000000000000000	5050151.07	0.33	360
1175	1095	0.07000000000000	5050170.13	0.07	80
1245	1095	0.1400000000000000	5050125.07	0.14	150
70	110	-0.3600000000000000	5050181.02	-0.36	-40
1055	1100	-0.0400000000000000	5050125.08	-0.04	-45

Now we have a new column with the raw differences between 2011 and 2016.

We are ready to symbolize or assign colours to our values we choose to write about.

Close the attribute table, right-click on your layer, chose "Properties" from the short-cut menu to produce your "Layer Properties" dialogue box, and then the "Style" section.

🕺 Layer Properties - 1	Visible_Minorities_In_Ottawa Style
🔀 General	Single symbol
style	Fill Simple fill
 Labels Fields Rendering Display Actions Joins 	Unit Millimeter Transparency 0% Color
Diagrams	
🗧 Variables	Symbols in group
- Legend	corners diagon; dotted green land water wine
	Layer rendering
	Layer blending mode
	Feature blending mode
	Draw effects

🔀 General	🚍 Single symbol
💉 Style	No symbols
- Style	
abc Labels	Graduated
	Rule-based
Fields	2.5 D
🎸 Rendering	
🗭 Display	
A	Unit Millimeter
Actions	Transparency 0% 🗇
┥ Joins	Color
🐖 Diagrams	
····	

Just below the "Single symbol" option at the top, click the arrow to obtain the drop-down menu.

Choose "Graduated". And click the arrow to right of the rectangular box beside "Column" to obtain a drop-down menu.

General	Graduated		() Sync	 	44-50
Style	Column Symbol Legend Forma Method Color ramp	1.2 VisibleM 123 2016 123 2011 1.2 VisibleM 1.2 CTUID 1.2 %Diff_1 123 Diff-11-	1in 1_3 NEW 11-1 16		Change
Joins	Classes	Histogram			
👿 Diagrams	Symbol	Values	Legend		
 Metadata Variables Legend 					

meral	Graduated	L'Ottawa Style			
tvie			-		
hale	Column	,2 %D/ff_11-1		• 5	
	Symbol			Change	
eids	Legend Format	61 - %2			Precision 4 🖨 🗌 Trim
ndering	Method C	slor			
splay	Color ramp	Blues			▼ Edit Invert
tions					
	Classes His	logram			
agrams	Symbol 🗸	/alues Legend			
tadata					
riables					
nand					
,c					
	Mode Equal Inter	al -			Classes 5
	Classify	🖶 💳 Delete all			Advanced •
	X Link class bour	daries			
	▼ Layer renderin	g			
	Layer transparency		0		0
	Layer blending mod	1	Normal	-	
		4.	Nermal	-	
	Feature blending me	ioe	Normal	·	

Qgis defaults to five "Classes" or categories, which we can increase or decrease.

Select the "Classify" tab.

	늘 Graduated			
tyle	Column	1.2%Diff_11-1	3 -	
bels	Symbol		Change	
elds	Legend Format	%1 - %2		Precision 2 🚖 🗌 Trim
ndering	Method	Color		•
play 	Color ramp	[source]		▼ Edit Invert
ns	Classes	Histogram		
grams	Symbol 🔽	Values Legend		
tadata riables	XXXXX	-0.7200 - 0.7480 - 0.7200 - 0.7480 0.2480 - 1.2160 1.2160 - 2.1840 - 1.2160 1.2160 - 2.1840 - 3.1520 2.1840 - 3.1520 3.1520 - 4.1200 3.1520 - 4.1200		
yend				
	Classify	Terval		Classes 5 -
	X Link class be	oundaries		
	▼ Layer rende	ering		

Qgis defaults to the blue colour ramp, which you can change by clicking on the colour to the right of "Colour ramp". We can also change the intervals between the numbers so that the census tracts with the negative growth are one category.

Qgis will only display the columns with numeric values. In this step, the aliases we've created for the new columns have been preserved, making it easier to determine which column contains the values we want to display on our map. Let's choose the percent differences, which will allow us to symbolize, or colour-code, the census tracts that experienced the fastest growth between 2011 and 2016.

If we're happy with our choice, select "Apply", and then "OK".



Let's add an OpenStreetLayers base map. If you don't have it, go to the "Plugins" section of the menu, select "Manage and Install Plugins...", and search for "OpenLayers" and "Quick Finder." Click "Install plugin."





Click on the "OpenStreetMap" layer label and drag it to the bottom of the menu.





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The darkest colours are the areas with the highest growth. To see the actual data, select the "Identify Features" icon above the map.



Make sure the Visible_Minorities_In_Ottawa layer is highlighted, then click the dark blue census tract.

The census tract's information is located in the "Identify Results" section to the left.

Because we have renamed the key number fields, it's easy to spot the "%Diff", which is the difference expressed as decimal number. From the "Diff_11-16", we can also see that the number of visible minorities in this census tract also increased significantly, which is also obvious by looking at the values in 2011 and 2016.

We will eventually export this layer to ArcGIS Online, which we learn in the tutorial, <u>Building Maps with</u> <u>ArGIS Online</u>.

But before we're done, we have one more layer to import which will help with our analysis, Ottawa's municipal ward boundaries. They will help us identify the city politicians whose wards contain the kind of growth that we want to write about. In this case, it could be the ward with the fastest visible minority growth rate.

Click <u>here</u> to obtain the zipped folder that contains Ottawa's wards.



Unzip the folder and use the "Add Vector Layer" icon to import the shape file into Qgis.

-

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B-Visible_Minorities_L..

Value

Feature

Image: Construction of the second		100	Add vector layer Add vector layer Open an OGR Supported Vector Layer Comparison Documents My Documents Stati				
			Favorites		Documents library Ottawa Wards		
	Identify Results	1	 Dropbox Recent Places OneDrive 	-	 wards-2010-2.dbf wards-2010-2.prj wards-2010-2.sbn 		
l == 🔒	S ↔ Value		Libraries	-	wards-2010-2.sbx		
Minorities_I AME Derived) Actions)	5050126.04		Music		wards-2010-2.shp.xml wards-2010-2.shp.zip wards-2010-2.shx		
TNAME RUID RNAME MAUID MAUID	0126.04 35 Ontario 505 35505	1	Videos Computer Local Disk (C)				





Move the wards layer to the bottom.



Now we want to make the ward boundaries tranparent, display the ward names, and thicken the boundaries to make them easy to see where the census tracts lay.

General	Single symbol				
Style	B- Fill			_	
Labels					
Fields					
Rendering					
Display					
	Unit Millimeter				
Joins	Color				
Diagrams					
Metadata					
Variables	Sumbole in group				• One Libra
Legend	corner: diagon, dotted green lan	d water wine			
					Save Advanced
	▼ Layer rendering				
	Layer transparency	0			0
	Layer blending mode	Normal	•		
	Feature blending mode	Normal	•		
	Draw effects				
	Draw effects Control feature rendering order				A R

Right click on the "wards=2010-2" layer and select properties from the short-cut menu.

Click "Sample Fill" (your colour may be different). If it isn't already chosen, select the colour black for your "Outline."

🕺 Layer Properties - v	wards-2010-2 Style						
🔀 General	General Single symbol						
😻 Style	E Fill Simple fill						
(abc Labels							
Fields							
🞸 Rendering							
🤛 Display	Combal Javas has						
Sctions	Symbol layer type						
• 🐳 Joins	Fill						
Diagrams	Outline						
🥡 Metadata	Fill style Solid						
S Variables	Outline style Solid Line						
	Join style 🔊 Bevel						
	Outline width 0.260000						
	0.000000						
	0.000000						

Make the "Fill" colour transparent from the selection in the drop-down menu.

General Single symbol Style Fill Labels Fill Fields Symbol layer type Style Symbol layer type Display Symbol layer type Stateata Outine Display Symbol layer type Stateata Outine Variables Outine style Join style Symbol layer type Cutine width Symbol layer type Variables Outine style Join style Single fill Ottine width Symbol layer type Style Symbol layer type Stripe fill Symbol layer type Fill style Outine style Outine width Symbol layer type Utine width Symbol layer type Style Symbol layer type Layer rend Sendard colors Feature blending Sendard colors Paste color Paste color Paste color Paste color Paste color Paste color			
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 Display Actions Symbol layer type Simple fill Joins Fill Outline Fill style Outline style Join style Outline width Offset X,Y Kecent colors Layer rend Recent colors Recent colors Feature blending Standard colors Feature blending Copy color Paste color Pick color	🎸 Rendering		
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Metadata Fill style Variables Outline style Join style Outline width Offset X,Y Layer rend Recent colors Layer transpare Layer transpare Feature blendin Copy color Paste color Draw effects Ochron feat Pick color Pick color Pick color Pick color Choose color	Diagrams Outline	Transparent fill	
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Layer rend Layer transpare Layer blending Feature blendin □ Draw effects □ Copy color □ Control feat □ Draw color: □ Control feat □ Draw color: □ Draw effects □ Draw effects	Offset X,Y		▼ Minimeter ▼ ▲
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Layer blending Standard colors	Layer transp	oarei	0 🗘
Feature blendin Copy color Draw effects Paste color Control feat Pick color Choose color Division of the pick color of the pick color	Layer blend	ing Standard colors	•
Draw effects Copy color Paste color Control feat Pick color Choose color	Feature bler	ndin 📕 📕 📕	•
Control feat Pick color 24	Draw ef	fects Copy color	
Choose color	Control	feat Pick color	24
Child W Connect Analysis Hall		Choose color	
OK Cancel Appry Herp	Style	•	OK Cancel Apply Help

Increase the "Outline width" to 2 millimetres.

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symbol layer ty	ре	Simple fill			-		
Fill					G		
Outline					€		
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Outline style	Solid Line			-	€.		
Join style	Revel			-	€		
Outline width	2.00000			Millimeter 💌	€.		
Offeret V V	0.000000		•	Millimeter -			
Lavor rond	oring						
r Layer rendering							

Leave the transparancy at zero, which now means that only the bondary outlines will appear





To make the ward boundaries easier to see, we'll need to make the colours for the census tracts more transparent.
Right-click on the visible minorities layer, select properties.

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	tels Symbol Ot	ange
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VisibleMinoritiesForOnlineTutorial	olay Color ramp [source]	Edit Invert
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X 2.1440-3.1520 X 3.1520-4.1200 X ards-2010-2 X 0penStreetMap kt_000a16a_e	Symbol Values Lagend exceta -	
identiγReads		
eature Value	Mode Liqual Unterval	Classes 5
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To increase the transparency, use your cursor to slide the arrow on the bar to the right of the "Layer rendering" label to the 50% mark.

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Select "Apply" and "OK".



It would help to have the ward labels displayed on the map.

Right-click the wards layer, select properties and the "Labels" tab.

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Select the "Show labels for this layer" option.

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"Description" is the field that contains the ward names. You can also change the font, point size, colour and transparency.

Select "Apply" and "OK".



If we zoom to the high-growth area still highlighted, we can see that the tracts fall within three wards, located on the outskirts of Ottawa. Now we know which councillors to interview for our story.

What we have created is a choropleth map, which as we learned on page 156 in The Data Journalist's chapter seven, "applies a number of colours to polygons to show variations in the values of a particular numeric value."

For the positive values, it's best to use a colour grid. We can stick with blue, Qgis' default grid.

For zero values, we can use yellow.

And for negative values, we can use another contrasting colour like red.

We can begin by increasing the number of classes from five to a greater number. Since our range of values is fairly limited, we can stick with five classes: one for negative; one for zero; and the remaining three colours on the blue colour ramp for positive values. This red-yellow-blue combination creates a nice contrast that helps distinguish the different ranges at first glance.

Right-click on the visible minorities layer, go to properties and select "Style". Change the precision – number of decimal points" from 2 to one.

eral	Graduated				
e	Column 1.2 %Diff_11-1		- 8		
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	Legend Format %1 - %2				Precision 2 🚔 🗌 Tri
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	The second

To get an idea of your range of values, open the attribute table, and sort the percent difference column in descending order.

%DIT_11-1 /
NULL
NULL
-0.72
-0.43
-0.36
-0.33
-0.33
-0.32
-0.31
-0.28
-0.27
-0.24
-0.21
-0.21
-0.20
-0.19
-0.18
-0.18
-0.17
-0.16
1

The values in the negative column go from (ignore the NULL values) from -0.72 -0.01.

-0.02
-0.02
-0.01
-0.01
-0.01
-0.01
-0.01

So your negative range will be -0.72 to -0.01.

Double-click on the first number range in the "Values" column to obtain a dialogue box where we will type "-0.0100" beside the "Upper value."

🥖 Enter class bo.	
Lower value -0.72 Upper value -0.02	20
ОК	Cancel

Double-click on the corresponding numbers in the "Legend" (which does not produce a dialogue box) and plug in the same number for the upper value of the range.



Select OK.

To change the colour, click the first coloured square under "Symbol" to obtain the "Symbol selector" dialogue box.

Simple fill		
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corner: diagon dotted green land water wine	▼ Open Li	bran
iymbols in group corner: diagon dotted green land water wine	Open Li Save Advance	braŋ ed

Click the arrow to the far right.

Click the "Choose color" option.

Symbol selector	
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Unit Millimeter	▼
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	Save Advanced •
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Select red.

General Style	Graduated	Select color	•
Labels	Symbol		3594
Fields	Legend Format %1 - %2	Recent colors • ···· O S	89% 🕤 🗖 Trim
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Display Actions	Color ramp [source]	#000100 #ffffff	227 🗘 Invert
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			50 \$
corner:	diagon dotted green land water wine		

Once the red has been selected, click OK to return to the "Layer Properties" dialogue box to change the next value range for the census tracts where growth was between -0.0010 and 0.000, basically zero

-0.010 - 0.000 -0.010 - 0.000	0.010 - 0.000	-0.010 - 0.000	
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growth.

Using the same process used to colour code the negative-growth census tracts, make this range yellow.

General	E Graduated		
Style	Column 1.2 %Diff_11-1	A Select color	2 X
Labels	Symbol	С н	60° 🗘
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Transparenc	y 0% ()		5985 5
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Symbols in a	TOUD		OK
			50

Click OK to return to the map.



Let's change the value range in the lowest category of the positive growth census tracts.

Return to properties. And using our attribute table as a reference, choose a range for the census tracts with the lowest growth rate, 0.010-1.040.

For this range, we want a blue colour, but the lightest shade possible to contrast with the remaining two colours that will symbolize more robust growth.

Symbol	Values Legend	
×	-0.7200.010 -0.7 - 0.0	
×	-0.010 - 0.010 0.0 - 0.0	
×	0.010 - 1.040 0.010 - 1.040	
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Classify	Unit Millimeter	•
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Draw effects		
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	corner: diagon dotted green land water wine	
Style 🔻		

Select "Apply" and "OK" to return to your map.



Symbol	Values	Legend
×	-0.7200.010	-0.7 - 0.0
×	-0.010 - 0.010	0.0 - 0.0
X	0.010 - 1.040	0.010 - 1.040
×	1.040 - 3.152	1.040 - 3.152
X	3.152 - 4.120	3.152 - 4.120

For the remaining two upper ranges, leave the shades of blue as they are, and adjust the ranges.



The red, yellow and blue create a nice contrast that allows the viewer to quickly distinguish between the areas of town with positive and negative growth of visible minorities.

You'll also notice the the map contains bare polygons. These represent the tracts with the NULL values for the percent change column.

	%Diff_11-1 🛆	
)1	NULL	
)3	NULL	
_		

If you wanted to symbolize the map using another value, numbers of 2016, or the difference in raw numbers between 2011 and 2016, you can select the appropriate columns and repeat this steps to produce your choropleth map.