GENUINE: GENtrification, Urban Interventions, and Equity

A map-based gentrification tool for Canadian cities by INTEventions, Research, and Action in Cities Team (INTERACT)

Technical Document

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BACKGROUND

The phenomenon of gentrification is often operationalized through measuring changes in neighbourhood features, housing, and the composition of residents over a period of time. For example, neighbourhood changes are often measured in 10-year intervals to align with U.S. census data collection. There is no consensus on which factors to include in a gentrification measure, or how to combine or group these factors.(1) Indeed, foundational work on the 'geography of gentrification' calls into question the use of 'one size fits all' gentrification measures, which do not consider the different spatial contexts or the timing of gentrification processes.(2) Still, quantitative gentrification measures enable reproducibility and facilitate comparisons between cities.(3)

Most researchers use a rule-based approach that focuses on a set of comparative characteristics. Rule-based approaches typically rely on a two-step process that first divides neighbourhoods into 1) higher socioeconomic status (SES) areas, not eligible for gentrification, and 2) areas of lower SES, considered gentrifiable. The second step then determines which of the potentially gentrifiable areas have undergone changes that meet a given threshold for gentrification.(4)

In pursuit of designing healthy cities for all, policy makers and researchers need local data tools. To date, gentrification measures and health impact studies have largely focused on gentrification outside of Canada - in large US cities. Given substantial differences in historical and sociopolitical contexts, there is need to bring a spotlight to Canadian cities. The Gentrification, Urban Interventions, and Equity (GENUINE) Tool is a map-based gentrification tool for Canadian metro areas.

KNOWLEDGE PRODUCTS

We have published a 1) GIS-based data set for all Canadian Census Metropolitan Areas (CMAs) on CANUE (see Table 2 for data dictionary). 2) GENUINE maps for each CMA are published online. The mapping platform simultaneously shows four gentrification measures for each CMA, facilitating comparisons between measures.

INTENDED AUDIENCE

This tool is for knowledge users who are interested in identifying areas at risk of gentrification, or areas that have recently undergone gentrification within Canadian cities. We do not recommend using one specific gentrification measure over another. Instead, we provide four options for the user to integrate into their work. An overview of each measure is provided below along with references. We envision this tool being applied to scenarios such as policy evaluations, or studies assessing the potential health impacts of gentrification processes.

METHODOLOGY

Study setting

We developed GENUINE to integrate gentrification measures relevant to the Canadian context, adapting four published gentrification measures that have been applied to U.S. and Canadian census data. We computed these measures for all 36 Canadian CMAs to illustrate where gentrification occurred between 2006 and 2016. The unit of analysis was census tracts, relatively small and stable areas with populations of 2,500 to 8,000 citizens (average of 4,000).(5) A CMA consists of one or more neighbouring municipalities with a total population of at least 100,000 where at least 50,000 people live within the core.(6) The geographic boundaries for census tracts are developed using a committee of local stakeholders and Statistics Canada to ensure they follow permanent physical features, and maximize alignment with local neighbourhood limits when possible.(5) As of 2016, 70.4% of Canadians live in CMAs.(7)

Gentrification measures

Two of the gentrification measures adapted for GENUINE were developed in Canada (Grube-Cavers,(8) Steinmetz-Wood(9)) and the other two in the U.S. (Freeman,(10) Ding(11)). We chose these four measures as they are well cited in population health literature. These measures have been used to study the effects of gentrification on general health status,(12) (13) mental health,(14) violent crime,(15) credit scores,(16) collective efficacy,(9) and on built environment features in gentrified areas such as rail transit lines(8) and bike lanes.(17) A summary of the original gentrification measures and adaptations made to develop GENUINE are presented in Table 1. Below we describe the original development and rule-based approach for each measure, followed by the approach for GENUINE.

Freeman (2005) was developed in U.S. to examine the association between displacement and gentrification in metro regions across the country.(10) Gentrification was identified from census data that measured changes during intercensal periods 1980-1990 and 1990-2000. Census tracts were classified as 'gentrifiable' if the median income was below that of the metro area at the beginning of the intercensal period and the proportion of housing built in the past 20 years was lower than that of the metro area. Gentrifiable census tracts became 'gentrified' if: a) there was a percentage increase in educational attainment greater than that for the metro area *and* b) there was an increase in real housing prices over the intercensal period.

Ding (2016) was developed in U.S. to study how gentrification in the city of Philadelphia impacted financial health (i.e., credit scores).(16) The measure used census data from 2000 and American Community Survey 5-year estimates for 2009-2013. A census tract was 'gentrifiable' if the median household income was below that of the city's and a gentrifiable census tract was classified as 'gentrified' if: a) the median gross rent or median home value increased more than citywide increases *and* b) the proportion of college-educated residents increased more than citywide increases. The Ding measure is unique in that there are indicators for gentrification severity and gentrification continuation. Gentrification severity is defined as 'weak' (gentrifying tracts where increases in rent or housing value from 2006 to 2016 were ≤25th percentile),

'moderate' (where rent or housing value increased with the 25th–75th percentile), or 'intense' (increases >75th percentile). The gentrification continuation measure describes processes over a longer time period, demarking census tracts where processes are continued or stalled relative to results from the previous intercensal period. In GENUINE we do not focus on this gentrification continuation measure, although future GENUINE updates could incorporate measures that examine more long-term neighbourhood changes.

Grube-Cavers (2015) was developed in Canada to study the relationship between rapid transit infrastructure and gentrification in Vancouver, Toronto, and Montreal metropolitan areas.(8) The measure used census data from 1961, 1971, 1981, 1986, 1991, 1996, 2001, and 2006 for Toronto and Montreal and from 1986 onward for Vancouver. The measure identifies a census tract as 'gentrifiable' if: a) the average family income *and* b) the percent of college degrees are below the metropolitan average. An area is identified as 'gentrified' if in the next census, **all** of the five following indicators experienced a greater increase than the metropolitan area: average monthly rent, family income, percent of degrees, percent of owner-occupied dwellings, and percent of people in professional occupations.

Steinmetz-Wood (2017) was developed in Canada and used to study the effects of gentrification on neighbourhood collective efficacy in Montreal.(9) This measure was adapted from Grube-Cavers,(8) by replacing the 'gentrified' criteria of percent of professional occupation with two variables: increases in percent of residents aged 30-44 years and a decrease in percent low income households. For a census tract to be classified as 'gentrified' it had to be a) a gentrifiable area *and* b) by the next census experience increases in all five variables (average monthly rent, family income, percent of degrees, percent of owner-occupied housing, and percent of residents aged 30-44 years) that were greater than increases of the metropolitan area *and* c) a decrease in percent of low income households that was greater than that of the metropolitan area. In the original paper, gentrification was measured between 1996 and 2006.

Each measure was adapted for Canadian cities (Table 1) and calculated for the 2006 to 2016 period. Each measure compares census tract values to a larger geographic area. For sake of uniformity, all measures were computed by comparing census tract values to the CMA average (e.g., median income of a census tract compared to the median income for the CMA). A few minor adaptations to the original measures had to be made. These typically related to modifications from U.S. to Canada data, or to account for changes in the availability of census variables. One example is the Freeman measure which in the U.S. included real housing price (e.g. housing value adjusted for inflation); this variable does not exist in Canadian census, so median housing value was used instead.

Statistical methods

We calculated the four gentrification measures for the 2006-2016 period using Canadian census data. We retrieved census data from Statistics Canada using the R cancensus package 0.2.1 for all CMAs at the census tract-level for 2006 and 2016 census years.(18) We calculated descriptive statistics for each variable used to measure gentrification in R 3.6.1 and Stata/SE

16.1. Gentrification measures and maps were created in R using the following packages: Hmisc 4.3-1, janitor 1.2.1, cowplot 1.0.0, ggplot2 3.3.0, sf 0.9-4, stringr 1.4.0, tidyr 1.1.0, dplyr 1.0.0, and the corresponding script is available online (https://github.com/TeamINTERACT/GENUINE_paper). The available GENUINE data set includes variables listed in Table 2.

Table 1. Gentrification measures in Gentrification, Urban Interventions, and Equity (GENUINE) tool for Canadian cities

Gentrifiable (2006)

	Freeman		Ding		Grube-Cavers		Steinmetz-Wood	
	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations
Spatial areas	Census tracts in central cities in the U.S.	Census tracts in all Canadian Census Metropolitan Areas (CMA)	Census tracts with 50+ people and housing units in the U.S.	Census tracts in all Canadian Census Metropolitan Areas (CMA)	Census tracts in Vancouver, Toronto, Montreal	Census tracts in all Canadian Census Metropolitan Areas (CMA)	Census tracts in Montreal	Census tracts in all Canadian Census Metropolitan Areas (CMA)
Gentrification eligibility	1. Median income below 40th percentile of the metropolitan area 2. Proportion of housing built ≤20 years was below 40th percentile of the metropolitan area	1. Median household income < median of CMA 2. Proportion of housing built since 1990 < median for CMA	Median income below the median for the city	Median household income < median of CMA	1. Average family income < CMA average 2. Number college degrees per capita < CMA average	No adaptation	1. Z-score median household income < 0 2. Z-score university degree < 0 3. Z-score average renting costs <0 4. Z-score low income households < 0	No adaptation

Gentrified (2016)

	Freeman		Ding		Grube-Cavers		Steinmetz-Wood	
	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations	Original measure	GENUINE adaptations
Income	n/a	n/a	n/a	n/a	Increase in family income > CMA average	No adaptation	Z-score difference (between 2006 to 2016) of median household income > 0	No adaptation
Education attainment	Increase in college graduates greater than that of metro area	Increase university degrees > median for CMA	Increase in college educated residents above median for the city	Increase university degrees > median for CMA	Increase in proportion of degrees per capita > CMA average	Increase in proportion of university degrees > CMA average	Z-score difference in university degree > 0	No adaptation
Housing	Increase in real housing prices	Increase in housing value > median for CMA	Increase in gross rent or median home value above median for the city	Increase in housing value > median for CMA **OR** Increase in renting costs > median for CMA	1. Increase in average monthly rent > CMA average 2. Increase in proportion of owner-occupied dwellings > CMA average	No adaptation	Z-score difference in average renting costs > 0	No adaptation
Age	n/a	n/a	n/a	n/a	n/a	n/a	Z-score for proportion of adults aged 30-44 years > 0	No adaptation
Occupation	n/a	n/a	n/a	n/a	Increase in proportion of professional occupation > CMA average	No adaptation	n/a	n/a
Poverty	n/a	n/a	n/a	n/a	n/a	n/a	Z-score difference in proportion of low income households < 0	No adaptation

Table 2. Data fields in Gentrification, Urban Interventions, and Equity (GENUINE) tool

Field name	Description
GeoUID	Census Tract unique ID
CMA_UID	Census Metropolitan Area unique ID
Population2016	Total population in census tract in 2016
Region_name	Region name
Freeman_cma_gentrifiable	Gentrifiable census tract according to Freeman in 2006 (1=gentrifiable, 0 otherwise)
Freeman_cma _gentrified	Gentrified census tract according to Freeman in 2016 (1=gentrified, 0 otherwise)
ding_cma_gentrifiable	Gentrifiable census tract according to Ding in 2006 (1=gentrifiable, 0 otherwise)
ding__cma_gentrified	Gentrified census tract according to Ding in 2016 (1=gentrified, 0 otherwise)
ding_cma_gentrified_category	Pace of gentrification in the census tract (3 categories: intense, moderate, weak)
grube_cma__gentrifiable	Gentrifiable census tract according to Grube-Cavers in 2006 (1=gentrifiable, 0 otherwise)
grube_cma_gentrified	Gentrified census tract according to Grube-Cavers in 2016 (1=gentrified, 0 otherwise)
rania_cma_gentrifiable	Gentrifiable census tract according to Steinmetz-Wood in 2006 (1=gentrifiable, 0 otherwise)
rania_cma_gentrified	Gentrified census tract according to Steinmetz-Wood in 2016 (1=gentrified, 0 otherwise)

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