Impact of Cannabis on the Economic and Social Aspects of Canadian Society

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Introduction

As of October 17, 2018, the *Cannabis Act* came into force in Canada, marking the birth of a new industry and the future expansion of the Canadian economy. Cannabis has been banned for almost a century, commencing in 1923, when the Federal Minister of Health at the time argued that cannabis negatively impacts young Canadians. During that time period, cannabis has been legalized for medical use and research purposes, however, recreational usage was strictly prohibited. There has been little research on the societal effects of cannabis except for a few studies conducted with the intent to estimate the impact of the legal market against the current state of the illegal market. Prior research was based largely on assumptions due to the lack of cannabis data available during the time period of when most of this research was conducted. These attempts have fell subject to survey biases; errors in the estimate parameters; unknown population parameters due to the lack of available data in the illicit drug market, and the presence of unpredictable exogenous factors. Post-legalization, it is essential to accurately depict the legal market impacts and the societal effects of the cannabis industry in Canada.

The Canadian Tobacco Alcohol and Drugs survey (CTADS) found that in 2015, cannabis is the most consistently consumed illegal drug in Canada for individuals 15 years and older. The CTADS calculated this number to be 3,701,206 Canadians on average who consistently consume cannabis. With respect to its popularity in Canada, cannabis legalization can potentially bring high economic returns, which include increased tax revenues, reduction in crimes and reduction in legal expenditures. A journal article authored by Amlung and MacKillop (2018) found that the relative value of legal cannabis was greater than the illegal option. In other words, individuals are willing to pay a premium above the illegal price of cannabis to consume the legal option. The study also found that the presence of legal cannabis substantially decreases the demand for illegal cannabis, but the reverse effect is significantly smaller. The availability of legal (illegal) cannabis for consumption increased the price elasticity of illegal (legal) cannabis by 126% (59%). When legal cannabis is priced similar to illegal cannabis, consumer behavior shows that legal cannabis is preferred (Amlung & MacKillop, 2018). In another study, Amlung et al show that the quantity of cannabis consumed is greater when it is legal as opposed to when it is illegal. Their study indicates that there is a 4.5-gram consumption difference per buyer between legal cannabis and illegal cannabis under the assumption that cannabis is free (Amlung, et al., 2019).

Problematic to the economic benefits that arise from cannabis legalization are the private and social costs related to its consumption. In agreement with the Centre of Addiction and Mental Health (CAMH), continuous use of cannabis can result in mental deficiency. The use of cannabis by teenagers reduce their IQ and diminish their cognitive abilities, resulting in lower educational achievements among teenagers and eventually, a lower probability of sustained future employment. The effects on education is the first lagging indicator of cannabis consumption to be observed. This is observed through youth dropping out of school as a result of their increased cannabis consumption in the scope of the study. Educational effects could also be seen in the academic grades of individuals based on their consumption of cannabis; however, there is currently no data that captures this in the scope of Canadian society. In terms of health impacts, these negative observations arise long after the consumption habit was created. Therefore, the effects on education would be the most probable to observe with consideration to the short time period since legalization.

According to the Government of Canada, cannabis-impaired driving doubles the likelihood of having a car accident. Furthermore, the Canadian Centre of Substance Use and Addiction determined that 40% of drivers are mortally wounded due to cannabis compared to 33.3% mortally wounded due to alcohol. In Ontario, 20.2% of the demand for medical assistance is caused by cannabis. Driving under the influence of cannabis endangers the driver and the passengers of the vehicle. There is sparse research on the percentage of people who drive under the influence of cannabis or the percentage of the population who believe cannabis consumption has no affect on their driving.

Greater cannabis consumption entails greater social costs. The social impacts from cannabis can include increased healthcare costs; impact on family members; and lower economical productivity. When the price of cannabis is too low, these external costs can increase exponentially. Consequently, there is a need for government intervention to control the price of cannabis to consumers through taxes or permits so that these social costs are internalized. A publication by W. Hall (2017) had concluded that there have not been any documented cases of cannabis overdose, nor does it have the cancer-causing properties seen in tobacco. These observations lead some to believe that the health risks from cannabis are minimal. However, evidence suggests that cannabis legalization is likely to increase cannabis dependency among the lower income segments of the Canadian economy (Cyrenne & Shanahan, 2018).

The purpose of this study is to analyze the early impacts of the Cannabis Act on the Canadian Economy. The economic benefits will be realized by the change in Gross Domestic Product (GDP) and the employment rate in Canada. These impacts are mainly subject to the transfer of consumption from the illegal market to the legal market. The United Nations Office on Drugs and Crime estimate that “3 to 5% of the global population age 15 -64 have used cannabis at least once in the past year” (Parey & Rasul, 2017). These world consumption estimates preclude potentially significant benefits to derive from legalization of cannabis from the perspective of the Canadian economy. However, included in this policy approach are the private costs absorbed by cannabis users and the social costs embedded in the cannabis market. Private costs arise in the short-term and long-term following cannabis legalization. The short-term costs are associated with educational investment and the long-term costs are associated with health impacts from prolonged or abusive cannabis use. Prior to legalization, social costs associated with the drain on the criminal justice system was significant; Parey and Rasul mention that the social costs of the cannabis market were 1.7% of GDP for the US in 2002 (2017).

The research of this paper will cover the effects of the *Cannabis Act* in all Canadian provinces and will attempt to quantify the following:

- To identify geographic spatial correlation that occurs between prices and quantities of cannabis within different geographical regions.
- To evaluate the costs of the *Cannabis Act* in terms of social costs and private costs using mental health impacts, general health impacts and the costs associated with driving under the influence of cannabis.

- To examine the reduction of the illegal cannabis market through a pricing analysis approach using microdata capturing the change in cannabis prices by individual consumers.

Literature Review

Definition of the Legal Cannabis Market

Individuals over the legal age established in each province and territory can legally purchase fresh or dried cannabis, cannabis oil, and seeds and plants for cultivation. Other products, such as edible cannabis, cannabis extracts and cannabis topicals will be legal for purchase on October 17, 2019, at which time federal regulations for their production and sale will have been developed and implemented (House Government Bill: C-45, The Cannabis Act, n.d.).

Table 1: https://www.canada.ca/en/health-canada/services/drugs-medication/cannabis/about.html#a4

Form	Description	Current Legal Status
Fresh or Dried Herbal Material	Flowers and leaves from the cannabis plant	Legal

Form	Description	Current Legal Status
Cannabis Oil	Cannabis extract dissolved in oil. Can be used to make other forms (for example, edibles).	Legal
Chemically Concentrated Extracts (hash oil/shatter/budder/wax)	Highly concentrated cannabis extract dissolved in petroleum-based solvent (for example, butane). Shatter, budder and wax most highly concentrated.	Legal as of October 17, 2019
Physically Concentrated Extracts (hash/kief)	Loose trichomes or pressed resin from the cannabis plant.	Legal as of October 17, 2019
Edibles	Foods and drinks containing extracts of cannabis	Legal as of October 17, 2019
Tinctures and Sprays	Cannabis extract dissolved in a solvent, often alcohol. Can be used to make other products (for example, edibles).	Legal as of October 17, 2019
Creams, Salves, and Liniments	Cannabis extract preparation prepared with alcohol, oil or wax and applied to the skin.	Legal as of October 17, 2019

2017).

Measuring the Market Size for Cannabis before Legalization

Supply Approach

The supply side approach uses data on drug seizures collected by police and border authorities. This method is conducted by dividing the seized cannabis by a seizure rate. However, seizure rates are usually unknown and only an estimate. It is also hard to pinpoint the upper and lower bounds of these rates due to the two exogeneous variables being the efforts by law enforcement and drug traffickers (Parey & Rasul, 2017).

A study conducted by T. Groom estimated the UK cannabis market size to be 1800 tons of cannabis consumed using a supply side estimate and assuming a seizure rate of 10%. The supply side estimates always tend to be higher than the demand side estimates (Parey & Rasul, 2017).

Demand Approach

The demand measurement approach starts with counts of the numbers of people who consume cannabis at varying frequencies and intensities per year. The amount of cannabis per occurrence of consumption is estimated to be between 0.3g – 0.5g. The counts are then multiplied by weighted average rates of cannabis consumption. An alternative expenditure-based approach is a good estimate on how much is spent on drugs but is limited on estimating the actual amount consumed.

Studies validating the demand approach show under reporting rates between 20%-40% based off self reporting usage and biological tests indicating use such as urine samples (Parey & Rasul, 2017).

Forensic Approach

This approach uses reliable data on legal complementary inputs of cannabis, specifically rolling papers and roll your own (RYO) tobacco. The estimates provide a lower bound estimate, assuming individuals consume cannabis through methods other than joints.

The approach assumes two markets: Sector 1, which is the market for rolling papers and RYO tobacco to produce legal cigarettes; and Sector 2, which is the market for rolling papers and RYO tobacco that are combined with cannabis to produce illegal joints. Assuming a constant input quantity of tobacco and cannabis used for illegal joints, the quantity of cannabis consumed is calculated using the implied quantity of rolling papers consumed in Sector 2 (Parey and Rasul, 2017).

Statistical Methods for Law Intervention

Differences in Differences Estimation

Difference in Differences (DD) estimation focuses on comparing the difference in outcomes before and after an identified intervention, which is usually the passage of a law. This method is appropriate when the interventions are random and conditional on time. However, these estimates depend on the interventions being uncorrelated with any factors from the sample groups; if this condition is not met, there will be issues within the standard error of the estimate, causing a biased result.

Some studies use triple-differences (DDD) techniques by determining if there is a significant change in the difference between a controlled group and a treatment group before and after an event occurs. However, Duflo and Mullainathan show that this method does not eliminate serial correlation issues. While using a placebo law, a law that did not exist, they found that the study found a positive effect from the “placebo law” 67.5% of the time. They determined that correlations within the study groups was responsible for the error in estimates (Bertrand, Duflo, & Mullainathan, 2004).

Spatial Fixed Effects from Province Price Differences

The variation of returns in the legal cannabis industry indicates the importance of assessing the cross-sectional independence at the provincial level. Specifically, the price differences of cannabis across provinces in Canada cause variations in the quantity of cannabis demanded in neighboring provinces, and consequently, variations in the violent criminal code violations in neighboring provinces. This is known as the spillover effect. Hao and Cowan (2017) analysed the spillover effect of cannabis legalization in Washington and Colorado. They found that cannabis legalization in these two states increased the number of arrests in neighbor states compared to non-neighbor states. There is also evidence of spatial dependence on cigarette demand in the US.

A study conducted by Michelle Ela tests for spatial dependence in the residuals following two Ordinary Least Squares (OLS) regressions on the consumption of recreational cannabis and total violent crimes committed under the criminal code in Canada. The study constructs spatial weight matrices aimed to capture the spatial correlation between provinces. They found that an increase in price of recreational cannabis results in a decrease in quantity demanded and reduction in criminal activity within the province and its neighboring locations. The spillover effect observed was caused by geographical connections between provinces opposed to cross province migration of people (Ela 2018).

Objective

The study will use difference in differences analysis to determine if there is a significant change in variables representing the social costs, private costs and economic benefits between time periods surrounding implementation date of the *Cannabis Act*. The existence of cross-province and interprovince interactions in Canada will be tested using a matched subjects design correlation analysis. The survey data will be used to determine if there is a significant increase in consumption before and after the implementation date. This will be based off the self-identification of cannabis use within the past 3-months, and also the frequency of use and spending patterns of those whom identified as users. The survey data was collected from 2018 to 2019, and the comparative groups will be divided by the implementation of the Cannabis Act. The analysis will be conducted on an individual analysis. Therefore, I will be assuming that exogeneous factors such as education, tobacco use, age and location will remain relatively constant for each individual over the period of a year.

This study can only focus on the short-term social costs of cannabis. I will use driving under the influence of cannabis indicators to determine if legalization has significantly increased the risks of vehicle accidents in Canada. This is based on the findings of prior research where driving under the influence of cannabis increased the probability of an accident (Caulkins et al. 2012).

Underlying Theory and Expected Results

The purpose of this study is to determine if the legalization of cannabis in Canada has had a significant impact on the Canadian economy. The study also aims to compare against other theories and findings referenced in the literature review. Prior literature was based on scarce data at the time when the market was illegal, whereas this study will be using data captured during both pre-legalization and post-legalization periods.

Underlying economic theory and prior research suggest that the introduction of a legal cannabis market will increase the quantity of cannabis consumed and transfer market share from the illegal market to the legal market due to consumer preference. Due to the uniform and strict regulations implemented by the *Cannabis Act*, the cost of selling illegal cannabis has increased as a result of the increased severity of legal sanctions. Underlying utility theory suggests that illegal suppliers will now demand a higher price for illegal cannabis to account for the risks involved in selling on the black market. The introduction of legal cannabis as a substitute should also reduce the demand for illegal cannabis assuming constant or increasing prices. My results should support the variations of price elasticity caused by the interactions between the legal and illegal market as observed by Amlung et al. As a result, the legal market should crowd out the illegal market.

Data Sources

My analysis is based off the National Cannabis Survey (NCS) in which Statistics Canada has current functional ownership. The NCS is an online conducted survey with intent to gain further insight on the effects of cannabis within Canadian society. Its inception date was three calendar quarters before the implementation of the Cannabis Act, providing a panel data set that includes pre and post cannabis legalization data. The target population for this survey is people 15 years of age or older situated in a residential area. The sample was a stratified random sample by province where randomly chosen dwellings were selected independently within each province. Population weights are generated using the Generalized Estimation System (G-Est). The NCS contains the most recent and most representative Canadian cannabis data to date, allowing me to analyze many impacts caused by the legalization of cannabis within Canada. However, each wave had a response rate close to 50% possibly causing survey bias under the assumption that the non-responses were not random. The NCS bias adjustments do not account for this issue. They assume that the non-respondents do not differ from the rest of the sample.

A supplementary data set used was the Postal Code Conversion File Plus (PCCP+). This file is maintained by Canada Post and provides a key between six-character postal codes and census geography. Specifically, I used this file to convert all postal codes reported by NCS survey respondents into longitude and latitude coordinates. The geographic coordinates, which represent the standard geostatistical areas linked to each postal code on the PCCF+, are used to map the distribution of data for spatial analysis. When the link between a postal code and a census geography is not unique, the PCCF+ will assign a geocoordinate using proportional allocation based on the population count (Statistics Canada, 2015).

Data Preparation

I retrieved my data from the National Cannabis Survey (NCS) prepared by Statistics Canada. The data is collected in waves using the same survey participants. All participants are assigned an identifier enabling each participant to be tracked over all survey waves. Each wave is collected on a quarterly basis with the first wave beginning January 2018 and the last wave ending January 2019. All variables used within the analysis were present in all five survey waves. Postal codes in all survey waves were geotagged using the PCCF+; the PCCF+ tagged all postal codes with a 99% success rate and removed all observations whose postal code was linked to a commercial address or a retired postal code. Most respondents resided in semi-detached or detached homes, accounting for approximately 59% of the sample. Respondents who resided in an apartment complex accounted for approximately 38% of the sample.

Spatial Correlation Data Preparation: Two tables were created with purpose to analyze the spatial correlation pre-legalization and post-legalization. Table 1 contained data within the time period Q1 2018 to Q3 2018. Table 2 contained data within the time period Q4 2018 to Q1 2019. Each table was filtered to only include dry leaf cannabis users. The quantity and price of dry leaf cannabis consumed had various units of measurement including grams, ¼ of an ounce, ½ of an ounce, ounce, and joint. With reference to prior research, each joint was assumed to hold 0.4 grams of cannabis (Parey & Rasul, 2017). Each quantity and price were transformed into grams from its original unit of measurement. Each cannabis user was matched up with other cannabis users that exhibited the same traits. These traits included: the same unit of measurement stated, the same survey response date, the same frequency of consumption, and the same sources of cannabis. The sources of cannabis include self-grown, growth by other, authorized retailer, dispensary, online licenced producer, other online source, shared among group of friends, acquaintance, family member or friend, or drug dealer. As with quantity of cannabis consumed, most cannabis users exhibited either a heavy pattern of consumption (above 100 grams in three months) or a light pattern of consumption (less than 10 grams in three months. Very few respondents fell between this range of cannabis consumed. All quantities of dry cannabis consumed above 1000 grams every three months were removed as outliers. These outliers could either be identified as extreme cases of cannabis consumption, errors in the survey, or cases where the cannabis is purchased and then resold to other consumers. If the last purchase price of dry cannabis consumed within the last three months was above $40 a gram, the observation was removed as an outlier. There were few occurrences of price outliers which were assumed to be a mistake or abnormality in the survey responses. After matching each respondent with others exhibiting similar traits, I used the postal codes provided within the survey to convert into longitude and latitude coordinates. I then calculated the geodetic distance **(D)** between respondents using the SAS function GEODIST. I then categorize each distance into six groups (

Figure 1). I also determine if a pair of respondents are neighbors within the same province **(P1 = P2)**, neighbors within different provinces **(P1≠ P2),** or not neighbors at all. Neighbor is defined as two respondents being at most 500km apart (

Figure 2).

Figure 1

Distance_Group	Distance Range in Kilometers
1	D ≤ 100km
2	100km < D ≤ 250km
3	250km < D ≥ 500km
4	500km < D ≥ 1000km

5	1000km < D ≥ 2000km
6	D > 2000km

Figure 2

IsNeighbor	Description
1	P1 = P2 and D ≤ 500km
2	P1 ≠ P2 and D ≤ 500km
3	D ≥ 500km

Time Series Frequency Analysis Data Preparation: The NCS surveyed the same respondents throughout each wave by assigning them a master identifier (**MASTERID**), therefore permitting behavioral and consumer preference analysis of each individual over time. With the purpose of minimizing the effects of autocorrelation, Q1 2018 and Q1 2019 were used in the frequency analysis. These time periods were chosen to capture the before and after effect of cannabis legalization on consumer behavior and preference. These two time periods lie furthest from the point of legalization, intending to minimize the effects of autocorrelation as mentioned above. Table 3 merged each respondent's Q1 2018 and Q1 2019 responses into a single observation and was constructed by merging the Q1 2018 table and the Q1 2019 table together using the MASTERID **(i)**. There were 7 new variables created by transforming the variables from Table 3 (Figure 3). The newly calculated variables capture the change in consumption and behavioral patterns of an individual following the legalization of cannabis. Two of these variables included the change in quantity consumed **(**Equation 2**)** and change in last price paid **(**Equation 3**)** in terms of dry leaf cannabis. These variables could only be measured using the portion of the respondents who were consuming cannabis prior to and after the legalization of cannabis. This subgroup was a small percentage of the entire sample, which resulted in many missing values when calculating these measures. In its entirety, only 15% of respondents said they used cannabis within the last three months during the Q1 2018 wave out of the 5500 total respondents. This might limit the ability of CAN_40AA_Chg and CAN_45AA_Chg to provide an unbiased statistic due to the nature of the sample size, however, these effects remained absent in the other calculated measures.

Methodology

Using Table 1 and Table 2, I generated four grouped correlation matrices using CAN_40AAi CAN_40AAj CAN_45AAi and CAN_45AAj that are classified within two sets. Subscript i and j represent two different respondents with similar characteristics. Set 1 contains correlation matrices on pre-legalization NCS data from Table 1 and Set 2 contains correlation matrices on post-legalization NCS data from Table 2. Each set contains two grouped matrices. Matrix 1 is grouped by IsNeighbor (

Figure 2) and Matrix 2 is grouped by Distance_Group (

Figure 1). Matrix 1 analyzes the intraprovincial and interprovincial correlation between consumption-based prices and quantities of dry leaf cannabis in Canada given a geodetic distance constant that identifies neighboring regions. Matrix 2 analyzes the geospatial correlation between consumption-based prices and quantities of dry leaf cannabis in Canada given a grouped set of distances.

Table 3 was used to generate frequency statistics on the difference in respondent behavior following the implementation of the *Cannabis Act*. I generated two population weighted frequency sets using the variables: CANUSER_Chg, CAN_40AA_Chg, CAN_45AA_Chg, CAN_D35_Chg, CAN_52_Chg, CAN_60A_Chg and CAN_60B_Chg. The population weights were provided for each wave; however, I chose to use the Q1 2018 population weights for my frequency analysis as opposed to the Q1 2019 population weights as they produced more comparable results to the unweighted frequencies. Set 1 contains the ungrouped frequencies of the entire sample. Set 2 is grouped by CANUSER_Chg with reason to analyze the social, private and economic impacts based on a given respondent's decision to consume or not consume cannabis in either period. These social, private and economic impacts include changes in mental health effects, general health effects, driving after cannabis use, cannabis price elasticity, cannabis consumption, and cannabis expenditure.

Figure 3

Name	Definition
CANUSER	Use of cannabis in past 3 months
CAN_40AA	Quantity used past 3 months - dried flower or leaf
CAN_45AA	Price paid for last purchase - dried flower or leaf
CAN_D35	Amount spent on cannabis in past 3 months
CAN_52	Driven within 2 hours of using cannabis - past 3 months
CAN_60A	General health rating
CAN_60B	Mental health rating

Equation 1

$$CANUSER_{i\,t=2} - CANUSER_{i\,t=1} = CANUSER\_Chg_i$$

Equation 2

$$CAN\_40AA_{i\,t=2} - CAN\_40AA_{i\,t=1} = CAN\_40AA\_Chg_i$$

Equation 3

$$CAN\_45AA_{i\,t=2} - CAN\_45AA_{i\,t=1} = CAN\_45AA\_Chg_i$$

Equation 4

$$CAN\_D35_{i\,t=2} - CAN\_D35_{i\,t=1} = CAN\_D35\_Chg_i$$

Equation 5

$$CAN\_52_{i\,t=2} - CAN52_{i\,t=1} = CAN\_52\_Chg_i$$

Equation 6

$$CAN\_D60B_{i\,t=2} - CAN\_D60B_{i\,t=1} = CAN\_D60B\_Chg_i$$

Equation 7

$$CAN\_D60A_{i\,t=2} - CAN\_D60A_{i\,t=1} = CAN\_D60A\_Chg_i$$

Estimation Results

Matched Subjects Design Correlation Analysis

I present my spatial correlation results in two tables. The Distance_Group correlation matrix is displayed in Table 2 and the IsNeighbor correlation matrix is displayed in Table 3. Each table is split into a pre-legalization period and a post-legalization period in order to determine the effects of the Cannabis Act. Included with each correlation table is a covariance matrix. All correlation coefficients are calculated using the Pearson correlation formula.

Distance Group Correlation Matrix

The correlation between the quantities of dry leaf cannabis consumed (CAN_40AA) by similar consumers within the last three months is stronger in the post-legalization period as opposed to the pre-legalization period when the distance between consumers in two regions is less than 100 kilometers (Distance_Group=1). The correlation coefficients of CAN_40AA for the pre-legalization period and post-legalization period are .49710 and .72661 respectively. The correlation between the last purchase prices of dry leaf cannabis (CAN_45AA) of similar consumers belonging to Distance_Group=1 also shows similar results with correlation values of .21492 and .29051 for the pre-legalization period and the post-legalization period respectively.

The null hypothesis for both CAN_40AA and CAN_45AA in both periods can be rejected at a .01 significance level. The strength of correlation drastically declines for both variables as the distance between consumers fall between 100 and 250 kilometers (Distance_Group=2). The correlation of CAN_40AA drops to .29636 in the pre-legalization period and to 0.14555 in the post-legalization period, both values holding significance at a .01 significance level. The relationship between the purchase prices (CAN_45AA) of similar consumers fails to reject the null hypothesis at even a .33 significance level for Distance_Group=2 in both periods. Referring to all Distance_Groups apart from Distance_Group=1, the correlations between CAN_40AA are larger in the pre-legalization period. The post-legalization period indicates that there is a strong decrease in correlation across distances greater than 100 kilometers.

The correlation between CAN_45AA shows greater consistency in the post-legalization period when excluding Distance_Group=2 as this is the only value where the null hypothesis was not rejected at a .01 significance level. I can conclude that there is a positive relationship between similar cannabis consumers with respect to the price paid for dry leaf cannabis. This relationship grows weaker over greater distances. This relationship was not observed in the pre-legalization period with all but Distance_Group=1 and Distance_Group=4 failing to reject the null hypothesis at a .1 significance level.

The covariance was calculated for both CAN_40AA and CAN_45AA to determine the spread of values from their mean. The correlation is derived by correlating a variable within itself using two different observations. Therefore, the covariance is calculated using the same scale of measurement, dismissing the need to standardize the data. Interestingly, in terms of CAN_45AA, the covariance is larger for all distance groups during the post-legalization period

(Appendix A). This observation may indicate that there are price differentials between the legal and illegal market, causing the higher covariance values in the post-legalization matrix. When further analyzing the covariance matrices, I conclude that there is no apparent trend in the covariance values of CAN_40AA.

Neighboring Observations Correlation Matrix

The IsNeighbor matrix shows a positive correlation across the quantities of dry leaf cannabis consumed (CAN_40AA) for all IsNeighbor groups. The pre-legalization period, however, indicates a stronger correlation between CAN_40AA overall ($\rho = 0.43771$, 0.69257, 0.36843). The strongest correlation value of CAN_40AA for both periods is the IsNeighbor=2 group, measuring the correlation between consumers who are within 500 kilometers of each other and fall within different provinces. The correlation coefficients are 0.69257 and 0.21768 for pre-legalization and post-legalization respectively. Interestingly, consumers in the post-legalization period that fall within the same province and are within 500 kilometers of each other (IsNeighbor=1) show a weak correlation between CAN_40AA in comparison with the rest of the IsNeighbor groups. The CAN_40AA correlation values for all IsNeighbor groups have small variation between them during the post-legalization period. Inversely, the pre-legalization period has high variation between the correlation values. All correlation values for CAN_40AA rejected the null hypothesis at a .01 significance level during both the pre-legalization and the post-legalization period.

The correlations between CAN_45AA are much weaker than the correlations between CAN_40AA. However, I observed that the relationship between purchase prices of dry leaf cannabis (CAN_45AA) for neighboring respondents living within the same province (IsNeighbor=1) have a stronger correlation in the post-legalization period in comparison to the pre-legalization period. All other values for CAN_45AA in the pre-legalization period, apart from IsNeighbor=1, are not significant at a .05 significance level. This causes difficulty when attempting to compare the correlations of CAN_45AA in the pre-legalization period with the correlations of CAN_45AA in the post-legalization period. In the post-legalization period, only IsNeighbor=2 fails to reject the null hypothesis with a p-value of .1615. I observe that the purchase prices of cannabis tend to only be correlated in neighboring regions within the same province before the legalization period. However, in the post-legalization period, purchase prices of cannabis are also correlated in non-neighboring regions (IsNeighbor=3) with a correlation value of .14272 and a p-value less than .0001.

The IsNeighbor correlation matrix also exhibits similar covariance behavior in terms of CAN_45AA. The covariance values are significantly smaller during the pre-legalization period in comparison to the post-legalization period, with the pre-legalization covariance values for all groups being (2.07, 0.50, 0.31) and the post-legalization covariance values for all groups being (6.31, 1.67, 2.07). There is no inherent trend in the CAN_40AA covariance values within the IsNeighbor matrix, similar to what was observed in the Distance_Group matrix.

Table 2

	Pre-Legalization Period		Post-Legalization Period	
Distance_Group	**CAN_40AA ρ** (Quantity used Past 3 Months)	**CAN_45AA ρ** (Last Purchase Price)	**CAN_40AA ρ** (Quantity used Past 3 Months)	**CAN_45AA ρ** (Last Purchase Price)
1	0.49710	0.21492	0.72661	0.29051
2	0.29636	-0.05019	0.14555	-0.04822
3	0.56449	0.08173	0.12327	0.27894

4	0.47666	0.17346	0.28572	0.14774
5	0.28984	-0.00085	0.18071	0.13780

Table 3

	Pre-Legalization Period		Post-Legalization Period	
IsNeighbor	**CAN_40AA ρ** (Quantity used Past 3 Months)	**CAN_45AA ρ** (Last Purchase Price)	**CAN_40AA ρ** (Quantity used Past 3 Months)	**CAN_45AA ρ** (Last Purchase Price)
1	0.43771	0.14519	0.19631	0.22610
2	0.69257	0.05868	0.21768	0.07895
3	0.36843	0.02193	0.20096	0.14272

One-Way Frequencies

The first set of frequency tables show the overall frequencies of the sample. The second set of frequencies are grouped by CANUSER_Chg (Figure 4) to show the effects of cannabis usage on the general health and mental health of respondents. Each change measure is calculated on an individual basis and then aggregated into one-way frequencies. The code values for each change variable is given below.

Figure 4

CANUSER_Chg	Cannabis User
1	Consumed cannabis in Q1 2018 and Q1 2019
2	Did not consume cannabis in Q1 2018 and Q1 2019
3	Did not consume cannabis in Q1 2018 but consumed cannabis in Q1 2019

Figure 5

CAN_40AA_Chg	Quantity of Cannabis Consumed (Where CANUSER_Chg=1)
1	$CAN\_40AA_{2019} > CAN\_40AA_{2018}$
2	$CAN\_40AA_{2019} \leq CAN\_40AA_{2018}$

Figure 6

CAN_45AA_Chg	Last Price Paid for Dry Leaf Cannabis (Where CANUSER_Chg=1)
1	$CAN\_45AA_{2019} > CAN\_45AA_{2018}$
2	$CAN\_45AA_{2019} \leq CAN\_45AA_{2018}$

Figure 7

CAN_D35_Chg	Amount Spend on Cannabis (Where CANUSER_Chg=1)
1	$CAN\_D35_{2019} > CAN\_D35_{2018}$
2	$CAN\_D35_{2019} < CAN\_D35_{2018}$
3	$CAN\_D35_{2019} = CAN\_D35_{2018}$

Figure 8

CAN_D52_Chg	Driven While Using Cannabis
1	Driven within 2 hours of using cannabis in Q1 2019 but not in Q1 2018
2	Driven within 2 hours of using cannabis in Q1 2018 but not in Q1 2019
3	Driven within 2 hours of using cannabis in both Q1 2018 and Q1 2019

Figure 9

CAN_D60B_Chg	Mental Health Rating
1	Mental health decreased between Q1 2018 and Q1 2019
2	Mental health increased between Q1 2018 and Q1 2019
3	Mental health remained the same between Q1 2018 and Q1 2019

Figure 10

CAN_D60A_Chg	General Health Rating
1	General health decreased between Q1 2018 and Q1 2019
2	General health increased between Q1 2018 and Q1 2019
3	General health remained the same between Q1 2018 and Q1 2019

Overall One-Way Frequencies

In Table 4, we analyze the overall frequencies of each change variable. In respect to the change in cannabis usage (CANUSER_Chg , Figure 4), 85.98% of respondents who did not use cannabis in the first quarter of 2018 (Q1 2018) continued to not use cannabis in Q1 2019; 14.02% of respondents who did not use cannabis in Q1 2018 decided to start using cannabis in Q1 2019. This could indicate an approximate increase in new cannabis users following the point of legalization under the assumption that respondents did not lie about their use in Q1 2018. These respondents make up 85.98% of the sample group. Furthermore, 15.37% of the entire sample used cannabis in Q1 2018 and continued to use cannabis in Q1 2019, with a grand total of 26.94% and 15.37% of the sample using cannabis in 2019 and 2018 respectively. A small percentage of the sample (2.11%) did not state an answer in either one or both periods; as a result, I could not calculate the change in cannabis use for this portion of the sample. An even smaller fraction of respondents reported that they used cannabis in Q1 2018 and did not use cannabis in Q1 2019. I was unable to include this group due to restrictions on the survey. However, this group accounted for less than 1% of the sample.

In reference to Table 4, the majority of consumers have increased their dollar spending on cannabis (52.86%), while the rest of consumers have either decreased their spending or kept their spending constant. Interestingly, between Q1 2018 and Q1 2019, most consumers (58.56%) have either decreased or maintained their quantity of cannabis consumed, after accounting for the observed increase in spending. This observation may be explained through 55% of consumers paying a higher price for dry leaf cannabis in 2019 compared to their purchase price of dry leaf cannabis in 2018.

I would like to point out how driving under the influence of cannabis has changed following the point of legalization. In Q1 2019, 11.25% of respondents indicated a change in behavior from Q1 2018 and started driving under the influence of cannabis. Whereas 8.57% of respondents displayed an inverse behavioral change from Q1 2018 and stopped driving under the influence of cannabis. The remaining respondents (80.18%) maintained their current behavior, indicating that they continued to drive under the influence of cannabis or did not drive under the influence of cannabis at all in Q1 2018 and Q1 2019.

Table 4

Change Variables	Value = 1	Value = 2	Value = 3
CANUSER_Chg	15.37 %	70.95 %	11.57 %
CAN_40AA_Chg	41.44 %	58.56 %	—
CAN_45AA_Chg	55.18 %	44.82 %	—
CAN_D35_Chg	52.86 %	23.41 %	23.73 %
CAN_D52_Chg	11.25 %	8.57 %	80.18 %
CAN_D60A_Chg	32.41 %	18.45 %	49.14 %
CAN_D60B_Chg	25.77 %	17.39 %	56.83 %

Grouped One-Way Frequencies

Table 5, 6, and 7 show the frequencies using the change in mental and general health self-reported by respondents. These frequencies are grouped according to the change in each respondent's cannabis usage (CANUSER_Chg, Figure 4) between the periods Q1 2018 and Q1 2019. As expected, the greatest number respondents who indicated a decline in their mental health and general health were consuming cannabis in Q1 2018 and Q1 2019 (CANUSER_Chg=1), where 42.36% experienced a decline in their general health and 38.41% experienced a decline in their mental health (Table 5). Contrary to the observations in

CANUSER_Chg=1, a large percentage of respondents who only consumed cannabis in Q1 2019 (CANUSER_Chg=3) experienced an incline in both their general health and mental health being 21.61% and 26.12% respectively (Table 7). The percentage of respondents who experienced a mental and general health increase in CANUSER_Chg=3 was even greater than the group who did not consume cannabis in either period (CANUSER_Chg=2). The respondents within CANUSER_Chg=2 exhibited the greatest mental and general health stability as 50.42% of respondents showed no change in their general health and 58.89% of respondents showed no change in their mental health.

Table 5

CANUSER_Chg = 1 (Used Cannabis in t_{2018} and t_{2019})

Change Variables	Decline in Health	Improvement in Health	No Change in Health
CAN_D60A_Chg	42.36 %	16.04 %	41.60 %
CAN_D60B_Chg	38.41 %	13.87 %	47.72 %

Table 6

CANUSER_Chg = 2 (Did Not Use Cannabis in t_{2018} and t_{2019})

Change Variables	Decline in Health	Improvement in Health	No Change in Health
CAN_D60A_Chg	30.96 %	18.62 %	50.42 %
CAN_D60B_Chg	24.16 %	16.95 %	58.89 %

Table 7

CANUSER_Chg = 3 (Did Not Use Cannabis in t_{2018} but Used Cannabis in t_{2019})

Change Variables	Decline in Health	Improvement in Health	No Change in Health
CAN_D60A_Chg	28.48 %	21.61 %	49.91 %
CAN_D60B_Chg	18.47 %	26.12 %	55.41 %

Policy Implications

My study suggests that there is positive geo-spatial correlation between quantities of dry leaf cannabis consumed. This relationship is strongest between consumers at close distances (< 250km) and becomes weaker as the distance between consumers increases. The spatial relationship regarding the quantities consumed existed prior to the implementation of the cannabis act and persisted at a weaker extent, after the passage of the act. Interestingly, the correlation between the quantities of cannabis consumed by respondents living in different provinces was the strongest within the post-legalization period. Due to the varying provincial tax rates across Canada, respondents residing close to provincial borders might purchase their cannabis cross border depending on the differences in prices, explaining these stronger correlation values. My study also indicates positive geo-spatial correlation among the prices of dry leaf cannabis. However, this relationship only held when the distance between consumers was less than 500 kilometers. The spatial matrices showed a stronger correlation in post-legalization prices in comparison with pre-legalization prices. This may suggest the standardization of cannabis prices imposed by the Cannabis Act, resulting in uniform pricing practices across provincial borders. The high covariance values associated with each post-legalization price correlation matrix suggests that there are large differences in the price paid for dry leaf cannabis between consumers. This trend is not observed in the pre-legalization period suggesting that the introduction of legal cannabis has created a large price gap between the price of illegal cannabis and the price of legal cannabis. This assumption would explain why the covariance values are much larger in the post-legalization period.

The implementation of the Cannabis Act has caused more respondents to consume cannabis, in which most of these respondents are now paying a higher price for cannabis. The majority of respondents that were consuming cannabis before the act now consume less; this may have been caused by the higher price tag of legal cannabis in comparison to the price tag of illegal cannabis before legalization assuming that these consumers transitioned to legal consumption. A higher price seems to discourage consumers to consume larger quantities of cannabis. There is a marginal increase in the percentage of respondents who started to drive under the influence of cannabis, even after accounting for the respondents who stopped driving under the influence. This topic may need further attention in the future when the popularity of cannabis grows; it is considered a negative social cost that should be addressed by the Cannabis Act. My observations on the general health and mental health of persistent cannabis users suggest that there may be negative health impacts associated with the long-term use of cannabis. The results were capturing respondents who have consumed cannabis for at least a year, however, some of these respondents might have been consuming long before the National Cannabis Survey was implemented. Short-term consumption of cannabis seems to have a positive impact on the respondent's mental and physical health, more so than the other respondents that didn't consume cannabis at all. However, there was no control for other exogeneous factors including pre-existing health conditions, standard of living, and lifestyle.

More data would be required to verify the influence of cannabis on individual health.

Appendix A

Correlation Analysis Pre-Legalization Period

Distance_Group=1

Covariance Matrix, DF = 349			
		CAN_40AA$_0$	**CAN_45AA$_0$**
CAN_40AA$_1$	**Quantity of Cannabis Converted into Grams**	2780.164715	-17.069034
CAN_45AA$_1$	**Price of Cannabis Converted into Grams**	-17.069034	3.335429

Pearson Correlation Coefficients, N = 350 Prob > |r| under H0: Rho=0		
	CAN_40AA$_0$	**CAN_45AA$_0$**
CAN_40AA$_1$ Quantity of Cannabis Converted into Grams	0.49710 <.0001	-0.05794 0.2797
CAN_45AA$_1$ Price of Cannabis Converted into Grams	-0.05794 0.2797	0.21492 <.0001

Distance_Group=2

Covariance Matrix, DF = 183			
		CAN_40AA$_0$	**CAN_45AA$_0$**
CAN_40AA$_1$	**Quantity of Cannabis Converted into Grams**	596.3242656	14.2243763
CAN_45AA$_1$	**Price of Cannabis Converted into Grams**	14.2243763	-0.5388777

Pearson Correlation Coefficients, N = 184 Prob > |r| under H0: Rho=0		
	CAN_40AA0	**CAN_45AA0**
CAN_40AA1 Quantity of Cannabis Converted into Grams	0.29636 <.0001	0.09677 0.1913
CAN_45AA1 Price of Cannabis Converted into Grams	0.09677 0.1913	-0.05019 0.4987

Distance_Group=3

Covariance Matrix, DF = 221			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	2346.934787	10.165593
CAN_45AA_1	**Price of Cannabis Converted into Grams**	10.165593	0.819923

Pearson Correlation Coefficients, N = 222 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.56449 <.0001	0.04977 0.4606
CAN_45AA_1 Price of Cannabis Converted into Grams	0.04977 0.4606	0.08173 0.2252

Distance_Group=4

Covariance Matrix, DF = 591			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	3128.093192	7.733205
CAN_45AA_1	**Price of Cannabis Converted into Grams**	7.733205	1.554121

Pearson Correlation Coefficients, N = 592 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.47666 <.0001	0.03189 0.4386
CAN_45AA_1 Price of Cannabis Converted into Grams	0.03189 0.4386	0.17346 <.0001

Distance_Group=5

Covariance Matrix, DF = 997			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	712.6618330	9.9913473
CAN_45AA_1	**Price of Cannabis Converted into Grams**	9.9913473	-0.0099178

Pearson Correlation Coefficients, N = 998 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.28984 <.0001	0.05886 0.0631
CAN_45AA_1 Price of Cannabis Converted into Grams	0.05886 0.0631	-0.00085 0.9787

IsNeighbor=1

Covariance Matrix, DF = 547			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	2005.424320	-1.294277
CAN_45AA_1	**Price of Cannabis Converted into Grams**	-1.294277	2.067416

Pearson Correlation Coefficients, N = 548 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.43771 <.0001	-0.00507 0.9058
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.00507 0.9058	0.14519 0.0007

IsNeighbor=2

Covariance Matrix, DF = 213			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	2557.665366	0.892258
CAN_45AA_1	**Price of Cannabis Converted into Grams**	0.892258	0.500273

Pearson Correlation Coefficients, N = 214 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.69257 <.0001	0.00503 0.9417
CAN_45AA_1 Price of Cannabis Converted into Grams	0.00503 0.9417	0.05868 0.3930

IsNeighbor=3

Covariance Matrix, DF = 3701			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	1274.671330	14.473087
CAN_45AA_1	**Price of Cannabis Converted into Grams**	14.473087	0.304804

Pearson Correlation Coefficients, N = 3702 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.36843 <.0001	0.06601 <.0001
CAN_45AA_1 Price of Cannabis Converted into Grams	0.06601 <.0001	0.02193 0.1821

Correlation Analysis Post-Legalization

Distance_Group=1

Covariance Matrix, DF = 231			
		CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	414.7265330	1.4537039
CAN_45AA_1	**Price of Cannabis Converted into Grams**	1.4537039	9.8979667

Pearson Correlation Coefficients, N = 232 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.72661 <.0001	0.01042 0.8745
CAN_45AA_1 Price of Cannabis Converted into Grams	0.01042 0.8745	0.29051 <.0001

Distance_Group=2

Covariance Matrix, DF = 245			
		CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	401.1507835	-4.0578152
CAN_45AA_1	**Price of Cannabis Converted into Grams**	-4.0578152	-0.9555400

Pearson Correlation Coefficients, N = 246 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.14555 0.0224	-0.01736 0.7864
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.01736 0.7864	-0.04822 0.4515

Distance_Group=3

Covariance Matrix, DF = 211			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	322.8235438	-5.1276001
CAN_45AA_1	**Price of Cannabis Converted into Grams**	-5.1276001	4.6458441

Pearson Correlation Coefficients, N = 212 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.12327 0.0733	-0.02455 0.7223
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.02455 0.7223	0.27894 <.0001

Distance_Group=4

Covariance Matrix, DF = 607			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	642.2346811	-11.4121781
CAN_45AA_1	**Price of Cannabis Converted into Grams**	-11.4121781	5.9211851

Pearson Correlation Coefficients, N = 608 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.28572 <.0001	-0.03802 0.3493
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.03802 0.3493	0.14774 0.0003

Distance_Group=5

Covariance Matrix, DF = 647			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	Quantity of Cannabis Converted into Grams	266.6362667	1.7748689
CAN_45AA_1	Price of Cannabis Converted into Grams	1.7748689	4.7997732

Pearson Correlation Coefficients, N = 648 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.18071 <.0001	0.00783 0.8423
CAN_45AA_1 Price of Cannabis Converted into Grams	0.00783 0.8423	0.13780 0.0004

IsNeighbor=1

Covariance Matrix, DF = 407			
		CAN_40AA_0	CAN_45AA_0
CAN_40AA_1	Quantity of Cannabis Converted into Grams	434.0513852	-1.5297838
CAN_45AA_1	Price of Cannabis Converted into Grams	-1.5297838	6.3112627

Pearson Correlation Coefficients, N = 408 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	CAN_45AA_0
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.19631 <.0001	-0.00616 0.9013
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.00616 0.9013	0.22610 <.0001

IsNeighbor=2

Covariance Matrix, DF = 315			
		CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	331.6215529	3.5467367
CAN_45AA_1	**Price of Cannabis Converted into Grams**	3.5467367	1.6670904

Pearson Correlation Coefficients, N = 316 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.21768 <.0001	0.01977 0.7262
CAN_45AA_1 Price of Cannabis Converted into Grams	0.01977 0.7262	0.07895 0.1615

IsNeighbor=3

Covariance Matrix, DF = 2633			
		CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1	**Quantity of Cannabis Converted into Grams**	363.1306059	-0.8644360
CAN_45AA_1	**Price of Cannabis Converted into Grams**	-0.8644360	4.9648259

Pearson Correlation Coefficients, N = 2634 Prob > |r| under H0: Rho=0		
	CAN_40AA_0	**CAN_45AA_0**
CAN_40AA_1 Quantity of Cannabis Converted into Grams	0.20096 <.0001	-0.00345 0.8596
CAN_45AA_1 Price of Cannabis Converted into Grams	-0.00345 0.8596	0.14272 <.0001

Appendix B

One-Way Frequencies Overall Results

Change of Mental Health between 2018 Q1 and 2019 Q1				
CAN_D60B_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	7305022	25.77	7305022	25.77
2	4930540	17.39	12235563	43.17
3	16109118	56.83	28344680	100.00
Frequency Missing = 407956.9205				

Change of General Health between 2018 Q1 and 2019 Q1				
CAN_D60A_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	9255965	32.41	9255965	32.41
2	5267861	18.45	14523826	50.86
3	14032630	49.14	28556456	100.00
Frequency Missing = 196181.098				

Change of Cannabis Driving between 2018 Q1 and 2019 Q1				
CAN_D52_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	58720.31	11.25	58720.31	11.25
2	44727.81	8.57	103448.1	19.82
3	418440.1	80.18	521888.2	100.00
Frequency Missing = 28230749.054				

Change of Cannabis Use between 2018 Q1 and 2019 Q1				
CANUSER_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	4419771	15.37	4419771	15.37
2	20399850	70.95	24819622	86.32
3	3325421	11.57	28145043	97.89
9	607594.3	2.11	28752637	100.00

Change in Quantity Consumed 3 month between Q1 2018 and Q1 2019				
CAN_40AA_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	150949.1	41.44	150949.1	41.44
2	213290.7	58.56	364239.8	100.00
Frequency Missing = 28388397.427				

Change in Price per Gram between Q1 2018 and Q1 2019				
CAN_45AA_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	67929.09	55.18	67929.09	55.18
2	55183.8	44.82	123112.9	100.00
Frequency Missing = 28629524.37				

Change in Cannabis Spending between 2018 Q1 and 2019 Q1				
CAN_D35_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	319240.6	52.86	319240.6	52.86
2	141367	23.41	460607.6	76.27
3	143314.4	23.73	603922	100.00
Frequency Missing = 28148715.284				

One-Way Frequencies Grouped by CANUSER_Chg
Results

The FREQ Procedure
Change of Cannabis Use between 2018 Q1 and 2019 Q1=1

Change of Mental Health between 2018 Q1 and 2019 Q1				
CAN_D60B_Chg	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	1666625	38.41	1666625	38.41
2	601980.2	13.87	2268605	52.28
3	2070563	47.72	4339167	100.00
Frequency Missing = 80604.0288				

Change of General Health between 2018 Q1 and 2019 Q1				
CAN_D60A_Chg	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	1867183	42.36	1867183	42.36
2	707097.5	16.04	2574280	58.40
3	1833550	41.60	4407831	100.00
Frequency Missing = 11940.8544				

Change in Price per Gram between Q1 2018 and Q1 2019				
PriceChg	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	67929.09	55.18	67929.09	55.18
2	55183.8	44.82	123112.9	100.00
Frequency Missing = 4296658.5692				

Change in Quantity Consumed 3 month between Q1 2018 and Q1 2019				
QuantChg	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	150949.1	41.44	150949.1	41.44
2	213290.7	58.56	364239.8	100.00
Frequency Missing = 4055531.6261				

The FREQ Procedure

Change of Cannabis Use between 2018 Q1 and 2019 Q1=2

Change of Mental Health between 2018 Q1 and 2019 Q1				
CAN_D60B_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	4871160	24.16	4871160	24.16
2	3418139	16.95	8289298	41.11
3	11876327	58.89	20165625	100.00
Frequency Missing = 234225.0687				

Change of General Health between 2018 Q1 and 2019 Q1				
CAN_D60A_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	6273008	30.96	6273008	30.96
2	3774034	18.62	10047041	49.58
3	10217392	50.42	20264434	100.00
Frequency Missing = 135416.9419				

The FREQ Procedure

Change of Cannabis Use between 2018 Q1 and 2019 Q1=3

Change of Mental Health between 2018 Q1 and 2019 Q1				
CAN_D60B_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	602569.6	18.47	602569.6	18.47
2	851954.3	26.12	1454524	44.59
3	1807793	55.41	3262317	100.00
Frequency Missing = 63103.9069				

Change of General Health between 2018 Q1 and 2019 Q1				
CAN_D60A_Chg	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
1	940198.5	28.48	940198.5	28.48
2	713179.2	21.61	1653378	50.09
3	1647404	49.91	3300782	100.00
Frequency Missing = 24639.1125				

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