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New Sources and Innovations in Constructing National and International Accounts**StatsCannabis: Measuring the price and consumption of
illegal cannabis in Canada****Prepared by Statistics Canada***Summary*

The prospective legalization of cannabis for non-medical purposes in Canada necessitated that the national statistical system is prepared to capture the associated economic and social implications. The paper presents an overview of the different cross-government activities currently being undertaken by Statistics Canada. Given that the production, consumption and distribution of cannabis is currently illegal, the government of Canada has had to rely on non-traditional methods to obtain and estimate the prevalence of use, consumption and production of cannabis. This paper outlines two examples of such non-traditional approaches, namely the use of wastewater analysis to measure drug consumption levels in the general population and crowdsourcing approaches to measure the price of cannabis.

I. Introduction

1. Canada's economy, and society more generally, continue to grow and evolve. Statistics Canada strives to keep its programs up-to-date with changing trends and circumstances to ensure Canadians are well informed about current developments. This means Statistics Canada has to continuously innovate and invest in the statistical system. The prospective legalization of cannabis for non-medical purposes means Statistics Canada needs to start preparing Canada's national statistical system to capture the associated economic and social implications.
2. On April 13, 2017, the Government of Canada tabled the Cannabis Act in Parliament, Bill C-45, "to provide legal access to cannabis and to control and regulate its production, distribution and sale." If legislation is approved by Parliament the drug's new status might come into effect by mid-2018.
3. Health Canada first established regulations on access to cannabis for medical purposes in 2001. These regulations were substantially revised in 2014 and 2016. Non-medical cannabis has been and continues to be illegal, although unlawful transactions in cannabis for non-medical use have undoubtedly existed in Canada for a long time.
4. The non-medical use of cannabis currently exists in Canada but is largely not captured by the statistical system. There is a lack of available information from which to compile reliable estimates. Once cannabis is legalized, Statistics Canada will be able to reliably capture the legal transactions. Currently Statistics Canada is preparing the statistical system to be able to better describe the economic and social activities related to the use of cannabis.
5. Given the fact that significant illegal non-medical use currently exists in Canada, it is incumbent upon the agency to try to measure the production, sale and use pre-legalization—despite the obvious difficulties of doing so—as well as post-legalization in order to provide Canadians, governments and businesses with as clear a picture as possible of the economic and social consequences of the legalization.
6. Statistics Canada is developing data collection instruments and infrastructure to acquire the information that the agency requires to measure the economic and social implications of the legalization of Cannabis. Given the difficulty in obtaining this information pre-legalization and the level of detail required by data users, Statistics Canada is using non-traditional methods to acquire as much information as possible. Two examples of these non-traditional approaches include the use of wastewater analysis to measure drug consumption levels in the general population and crowdsourcing approaches to measure the price of cannabis. This paper outlines both of these examples in detail and presents preliminary results related to the price of cannabis obtained via crowdsourcing.

II. Using wastewater to measure drug use

7. The use of wastewater to measure drug use is not new, having been performed in various countries for over 10 years. The European SCORE network (Sewage analysis CORE group – Europe), established in 2010 for the study of wastewater epidemiology, is both a pioneer and the worldwide authority on the measurement of population consumption of illicit drugs. In 2016, SCORE participants conducted analyses in over 70 cities in more than 28 countries, including Canada, covering various drugs such as cannabis, opioids, cocaine, amphetamines, MDMA/ecstasy and new psychoactive substances. Over time, SCORE has refined its protocols for the collection, handling and analysis of wastewater, including the accreditation of participating laboratories.

8. The methodology is relatively straightforward, at least conceptually. Typically, daily samples are combined over time, to provide a stable measure of drug consumption. In addition, samples may be combined over various wastewater treatment plants serving a metropolitan area, to ensure representative coverage. Samples are collected; the flow at the time of collection is recorded; and the samples are refrigerated, documented and sent to the laboratory for analysis. The results are then fed into a model—using wastewater flow, pharmacokinetic (which determine the fate of drugs in the organism) and population estimates—to arrive at an overall estimate of drug consumption per person. Statistics Canada is adopting this methodology for the measurement of cannabis use by Canadians as well as opioid consumption owing to the urgency of its health impacts.

9. Estimates of drug consumption from municipal wastewater have a number of excellent statistical properties including:

- low collection costs;
- no burden on household or business respondents;
- no infringement of personal privacy or confidentiality;
- real-time reporting;
- low or no response bias;
- ability to develop geographically granular estimates;
- ability to detect short-term trends in response to policies and changing conditions; and
- capacity for retrospective analysis for other drugs and metabolites, using stored samples.

10. Data from municipal wastewater can provide high-quality baseline information at the city level, helping to understand regional differences in consumption and its implications.

11. Once cannabis is legalized, these data may provide an indication of the size of the underground economy by subtracting consumption from legal sources from total consumption. Given the recurring and timely nature of these data, municipalities and health authorities will be able to assess the impact of cannabis legalization first as it initially occurs, and, second, as governments make legal various cannabis products such as edibles, concentrates and health and wellness products.

12. As a starting point, Statistics Canada is partnering with a number of municipalities to obtain daily samples, which will then be shipped to the accredited laboratory where they will be tested. The test results will then be sent on to Statistics Canada who, finally, will run the results through its model to calculate population-level estimates of consumption and disseminate the results to Canadians.

13. Owing to the normal uncertainty associated with chemical sampling and analysis, and the assumptions that go into transforming drug concentrations in wastewater into population-level consumption levels, these estimates come with a fairly large degree of uncertainty. These estimates will be compared to other data sources on consumption, obtained principally from social and health surveys of the population. While the estimates of population consumption based on wastewater will involve some uncertainty, it is expected that they will provide, at fairly frequent intervals, a clear indication of time trends in cannabis and opioid use.

14. This information will be complementary to other sources of data on drug use, such as population surveys, where information is gathered on prevalence, frequency of use,

social and demographic characteristics of the drug user, as well as other information surrounding drug consumption and the effects of drug use.

III. StatsCannabis: Using crowdsourcing to measure the price of cannabis

15. On January 25th, 2018 Statistics Canada launched a crowdsourcing web application that allows Canadians to directly and anonymously provide information regarding their purchases of cannabis. The purpose of the project is the collection of information that will allow the agency to estimate the monthly price of illegal cannabis in Canada prior to, and after, legalization of marijuana use for non-medical purposes.

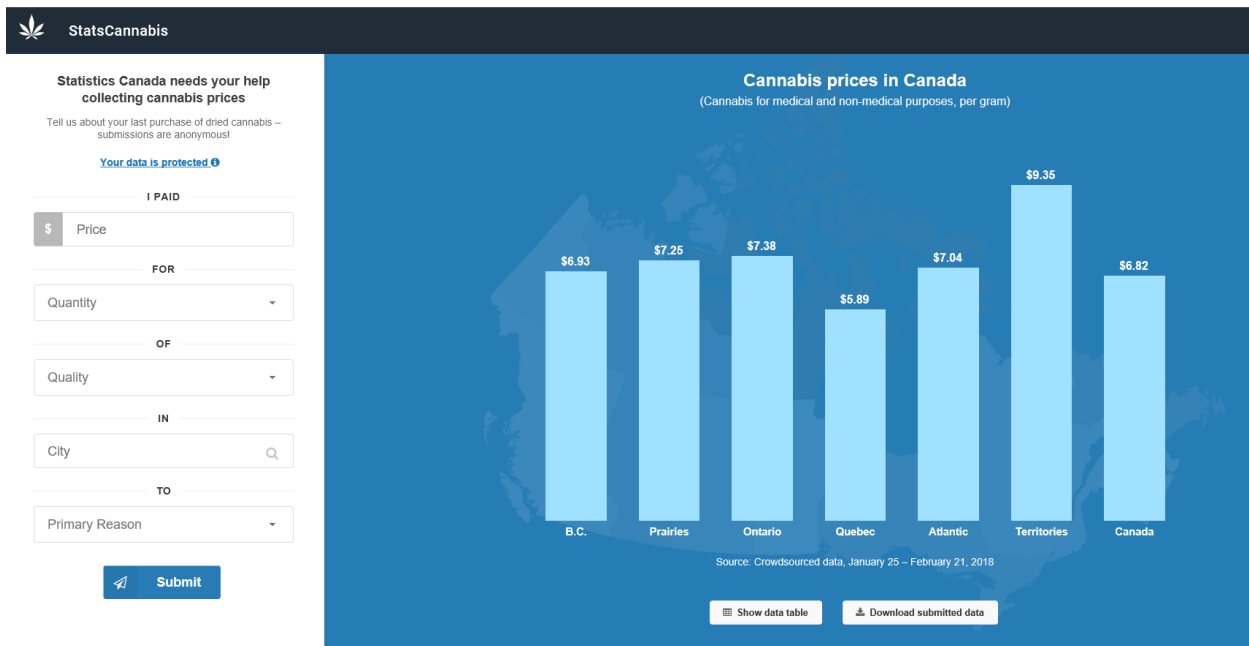
16. The collection instrument developed by Statistics Canada asks respondents about the price of their latest cannabis purchases, the quality of cannabis obtained, the city of purchases, and finally the primary reason (or use) for the cannabis. A set of secondary questions on consumption habits are also posed. Once the respondent submits their information, their reported price is dynamically placed on a figure showing the average price in the major regions of Canada. The purpose of this was to allow respondents to easily compare their purchase price to those at the national level.

17. During the development of the StatsCannabis collection tool, emphasis was placed on developing an application in a style that hopefully optimised the likelihood of a visitor submitting information. This style included:

- Keeping the appearance of the web app sleek and minimising the amount of content not related to the key collection fields or visuals, so as to avoid distracting visitors;
- Developing the web app with handheld devices in mind first, as it was believed that most submissions would come from smartphones;
- Using language and structuring questions in such a manner such that they could be easily understood and completed in short amount of time (around 60 seconds), with little effort.

18. The following figures illustrate the interface developed that is currently being used to collect the information on cannabis prices from visitors.

19. **Figure 1: StatsCannabis** – The initial screen appeals to the respondent’s ‘sense of public duty’ requesting that they help Statistics Canada measure the price of cannabis. The intent of the messaging is to engage the respondent as a partner and stakeholder in the collection activity. The initial screen also shows data on previously submitted information – reinforcing the message that other people have already provided this type of information and anonymity will be respected.



20. **Figure 2: I PAID (expenditure)** – The question collects the total expenditure made during the last purchase. There was some discussion as to whether a per unit price (price per gram / price per ounce) should be collected or the expenditure and quantity purchased should be collected separately. It was decided, after testing the application with a number of respondents, that the concept of expenditure was more readily available and was easier to report than the unit price. That said, a number of people have reported price per unit rather than expenditure for this question and therefore some post-collection editing is required.

21. **Figure 3: FOR (quantity)** – Visitors are asked to enter the quantity purchased. Users can select from a defined list of common quantities or enter ‘other’ which allows them to enter a specific quantity. The majority of the respondents report according to the defined list provided on the application.

Statistics Canada needs your help collecting cannabis prices

Tell us about your last purchase of dried cannabis – submissions are anonymous!

[Your data is protected](#)

I PAID

\$ 10

FOR

Quantity

- 1 gram
- 3.5g (1/8oz)
- 7g (1/4oz)
- 14g (1/2oz)
- 28g (1oz)
- Other - specify

Primary Reason

Submit



22. **Figure 4: OF (quality)** – Visitors are asked to report the quality of the cannabis purchased. In order to keep the application simple, it was assumed that quality can be grouped into three distinct groups – low, medium and high. While these are simplistic assumptions and entirely subjective, as will be seen later, it seems to be well understood and the behaviours we would expect hold are evident in the data.

Statistics Canada needs your help collecting cannabis prices

Tell us about your last purchase of dried cannabis – submissions are anonymous!

[Your data is protected](#)

I PAID

\$ 10

FOR

1 gram

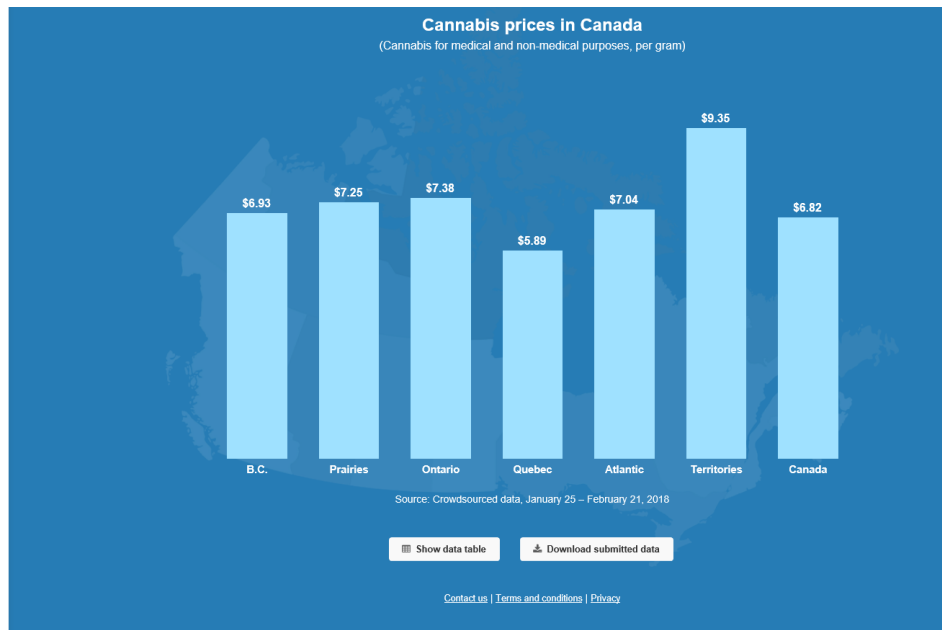
OF

Quality

- Low quality cannabis
- Medium quality cannabis
- High quality cannabis

Primary Reason

Submit



23. **Figure 6: CITY (location)** – Visitors are asked to enter the city where they made the purchase. Once they begin typing the name of the city, the application presents them with a list of cities with similar spelling, from which they make a selection. This ensures that geographic information is consistent from one respondent to another.



24. **Figure 7: TO (purpose)** – Visitors are asked to report the purpose of their purchase. They are provided with three choices: medical purposes (with a document), non-medical purposes (without a document) and recreational purposes. In Canada, it is legal to purchase and consume cannabis if you have been issued a medical document. Responses other than ‘Medicate – with a medical document’ are considered to signify illegal purchases.



25. **Figure 8: YOU (average price)** – Once the visitor submits their information they are presented their price (price per gram defined as expenditure/quantity) relative to the

average of all other posted prices. The posted prices represent an edited price computed by Statistics Canada using only the information provided from the crowdsourcing application.



26. **Figure 9: ON AVERAGE (usage)** – After submitting data related to price, visitors are asked two additional questions about their usage and consumption. Respondents are asked to indicate if they are daily, weekly, monthly or annual users. This question is structured in the same way Statistics Canada health surveys are structured and therefore provides some ability to link this information to previously reported data.



27. **Figure 10: ON AVERAGE (consumption)** – Finally visitors are asked to report the amount of cannabis they consumed in the last month. This will permit Statistics Canada to produce estimates of average cannabis consumed per day, depending on the frequency of consumption, and by combining this information with other sources, enable the agency to eventually derive volume measures of cannabis consumption for all of Canada.



28. The application was designed to produce minimal response burden, is completely mobile friendly and provides the respondent with some information – both the average prices across Canada as well as their price relative to the average prices. Designing anonymity directly within the collection tool also enabled the agency to easily disseminate the data collected at a micro-level. The data are downloadable directly from the crowdsourcing application.

29. While this approach to collecting data is neither scientific nor entirely sustainable, it does have a number of statistical and economic properties that one would associate with high quality data. Depending on the envisioned use of the end data, this collection approach presents a potentially cost effective and efficient manner to gather that informational needs used in producing official statistics.

IV. Some preliminary results: cannabis prices 2018

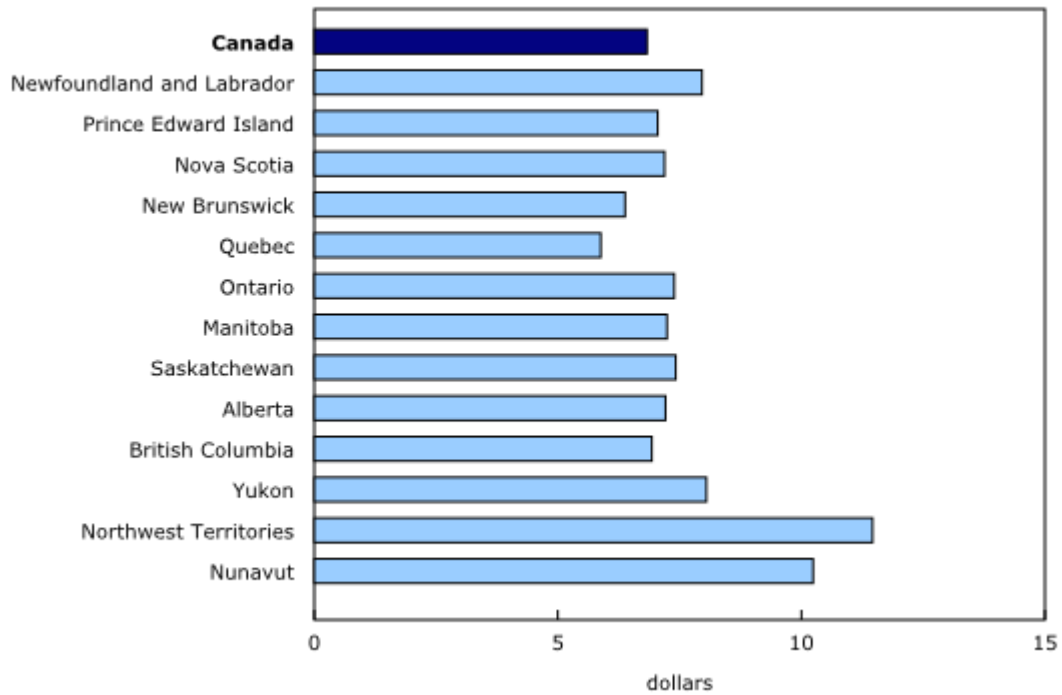
30. One way to test the quality of the information provided is to aggregate it, analyze the aggregated results and see if the trends, distributions and relationships adhere to basic economic models and are in line with existing information. Based on the information submitted from January 25 to February 28, 2018 the average price of cannabis was \$6.83 per gram. This estimate is based on 17,139 responses whose prices fell between \$2 per gram and \$20 per gram; prices outside this range were treated as outliers. The \$6.83 per gram price estimate is consistent with the estimate of approximately \$7.50 derived by Statistics Canada for 2017 using various sources of information including prices extracted from licenced and unlicensed producer websites. The analysis that follows makes use of the data for the same 17,139 responses mentioned above.

31. Analysing the data showed that prices varied across regions, with prices in Quebec and New Brunswick below the national average and prices in all other provinces and

territories above the national average. Average prices were particularly high in the territories where transportation costs may have a relatively larger impact on overall price compared with other regions – which is consistent with what would be expected.

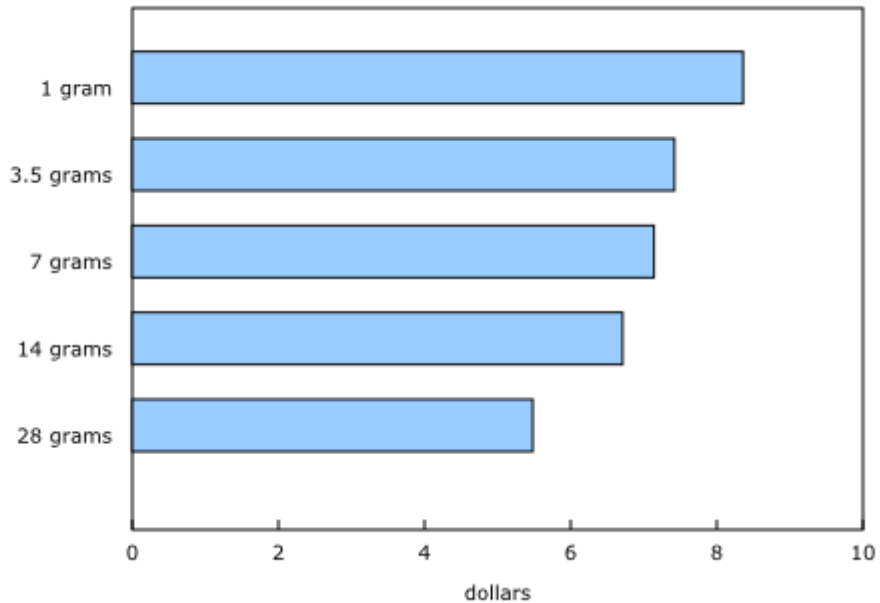
Chart 1

Average price per gram by province and territory, February 2018



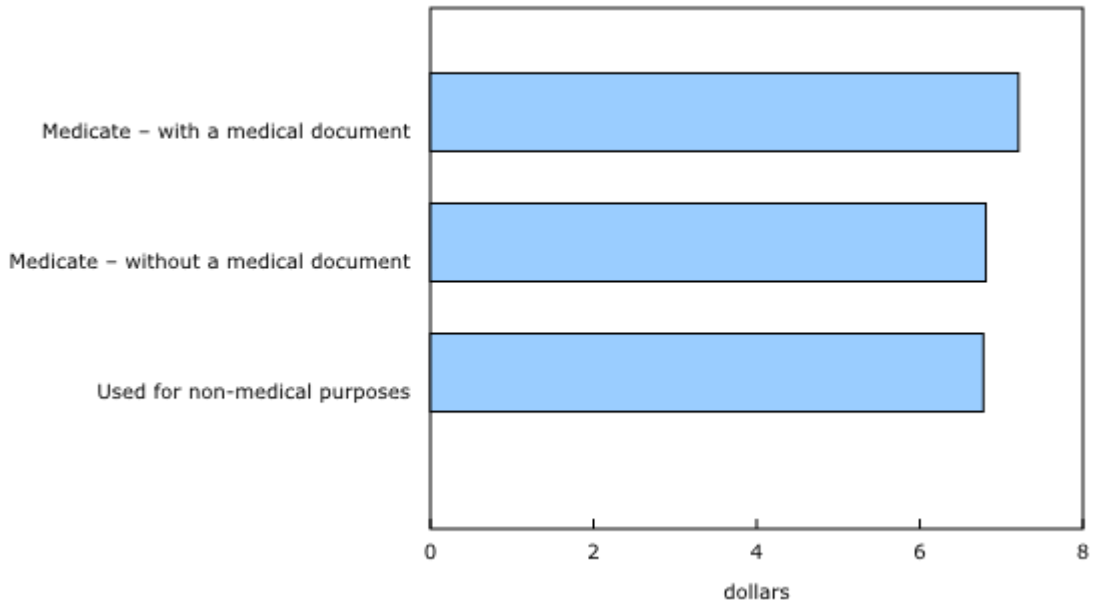
32. The data also shows that, the greater the volume of cannabis purchased, the lower the implicit per gram price is. The average price reported by respondents who purchased 1 gram was \$8.36 per gram, whereas it was \$5.48 for those purchasing 28 grams – illustrating price discounts for bulk purchases, which is consistent with what could be expected.

Chart 2
Average prices by quantity purchased, February 2018



33. Price differentials according to type of *use* were also found. The average price of cannabis used for medical purposes with a medical document was \$7.21, whereas the average price of cannabis used for non-medical purposes was \$6.78. This could be an indication that medical users were more concerned about quality and safety and that they paid a higher prices for quality and safety.

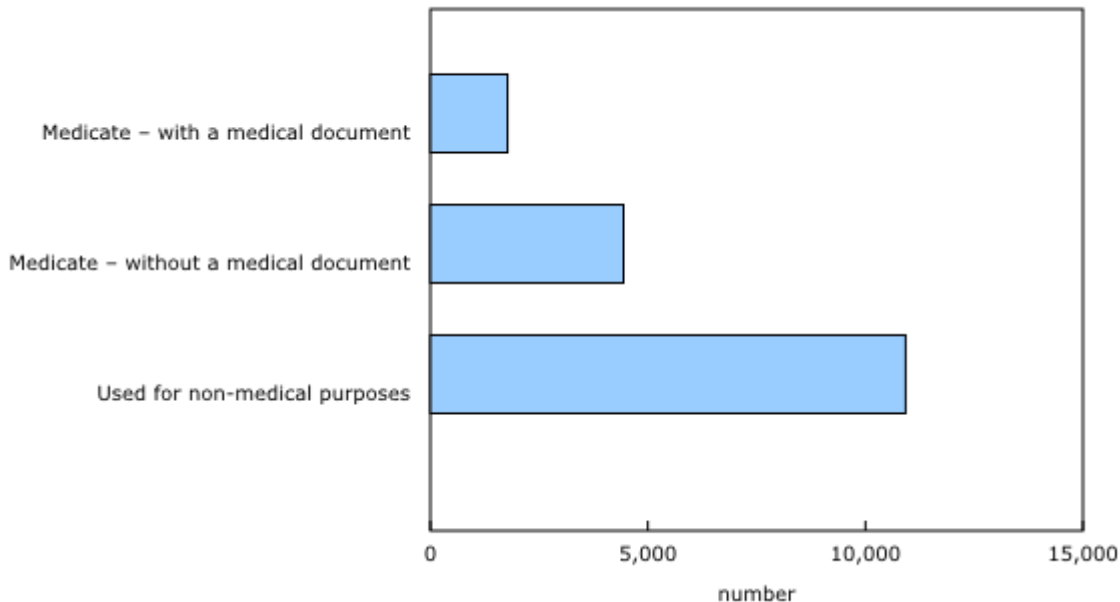
Chart 3
Average price by purpose of use, February 2018



34. Respondents reported that, in the vast majority of cases, they consumed cannabis for non-medical purposes, even though consumption for non-medical purposes is illegal. Around two-thirds (63%) of respondents reported using cannabis for non-medical purposes.

Interestingly, more individuals reported consuming cannabis for medical purposes without a document (26%)—that is, illegally—than with a document (10%).

Chart 4
Respondents by purpose of use, February 2018

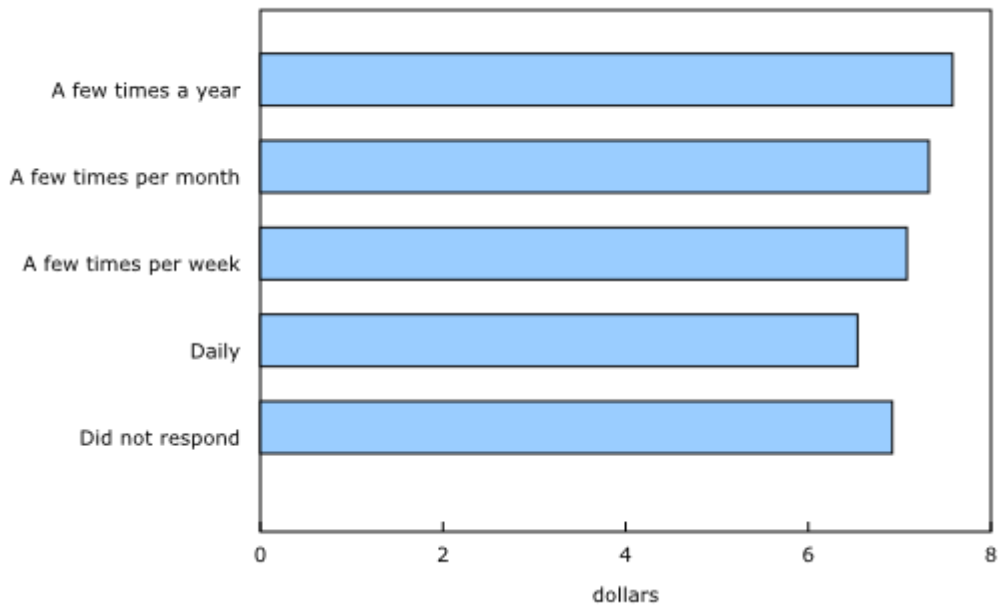


35. Visitors to the web application were asked to report if they use cannabis on a daily, weekly, monthly or annual basis. The majority who reported information indicated that they consume cannabis on a daily basis. This estimate, like the others reported here, applies only to the individuals who reported data on the crowdsourcing application and does not apply to the entire population of cannabis consumers.

36. The individuals who reported daily use indicated that they consume an estimated 28.0 grams of cannabis per month, about one gram per day. Individuals who consume less than once per day indicated that they consume 6.3 grams of cannabis per month.

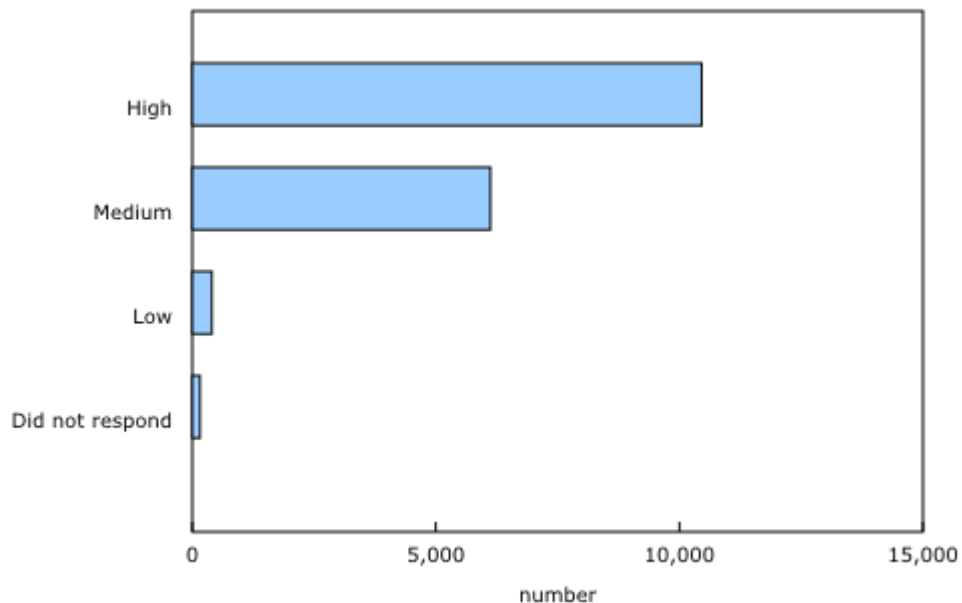
37. The prices paid by individuals reporting daily use was \$6.54, while the price paid by individuals reporting monthly use was \$7.32. The lower price paid by daily users may be an indication that they are purchasing larger volumes which have a price discount, which is again consistent with what could be expected.

Chart 5
Average price by frequency of use, February 2018



38. Visitors were asked to report the quality of the cannabis they purchased. This was a self-assessment where individuals were asked to report if they purchased high quality, medium quality or low quality cannabis. The majority of respondents (61%) indicated purchasing high quality cannabis. Very few respondents indicated they were purchasing low quality cannabis. The results were consistent from one province to another.

Chart 6
Number of respondents by quality of cannabis purchased, February 2018



V. Conclusion

39. The world of data is changing. Most of human activity is now being recorded digitally somewhere by some machine, sensor, website, or application. With declining response rates for traditional collection methods and increasing demands for data of all kinds, standard survey methodology and data sources may soon become the exception rather than the norm. National Statistical Offices will increasingly have to find new ways to collect the data needed to produce timely and relevant information. The two examples above illustrates two approaches that could be used to meet the data demands of the future and fill the space being created by fading traditional collection methods.
