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Measuring Trends and Cycles in Homeless Shelter Stays

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EXECUTIVE SUMMARY

Typically used to analyze GDP and unemployment trends, the Hodrick-Prescott (HP) filter can also help community-based organizations and policymakers to understand patterns in homeless shelter use. Using data on homeless shelter use in Calgary, Alberta, this paper demonstrates how the HP filter can be used to separate long-term trends in homeless shelter stays from short-term variations.

People become homeless for many reasons, including mental illness, substance abuse, traumatic childhood experiences and family breakdowns, all of which may be further complicated by a lack of affordable housing, labour market conditions and racial or ethnic prejudice. Some of these reasons contribute to slow-changing trends in shelter use while others give rise to short-term fluctuations. Slow-changing trends and fast-changing fluctuations call for different policy responses. The HP filter's simplicity and accessibility can help community-based organizations decompose a time series for shelter use into long-term trends and shorter, cyclical components and so better understand what shelter strategies and policy responses are most appropriate.

The HP filter requires choosing a smoothing parameter (λ), which determines how much variation is attributed to the trend versus the cycle. However, since standard λ values used for economic data aren't necessarily appropriate for quantifying homeless shelter use, this paper proposes a tailored approach to selecting λ .

The paper discusses two types of homelessness. Structural homelessness develops slowly from persistent conditions such as chronic substance abuse, mental illness, limited housing supply and systemic barriers. Cyclical homelessness is a short-term phenomenon, caused by temporary shocks such as job loss, rising rents or seasonal employment changes. Other variables include factors such as drug-related deaths for structural trends and income-to-rent ratios for cyclical fluctuations. Testing alternative λ values is a way to find the one that best produces trend and cycle estimates consistent with the researcher's expectations, experiences and judgment.

The HP filter's effectiveness relies on informed judgment in parameter choice and interpretation. It is a practical tool for community organizations that must interpret homelessness data but have little or no expertise in statistics, but it is not a substitute for judgment. The homeless-serving sector should focus on its practitioners' insights and experience, with statistical methods used as a complement. Simple tools like the HP filter, when applied thoughtfully, can yield valuable insights into the complex dynamics of homelessness and lead to better decisions around shelter policies and supportive housing initiatives.

1. INTRODUCTION

The causes of homelessness are many and complex.¹ Some are to be found in the personal vulnerabilities of people experiencing homelessness. These include problems of mental health, issues of substance abuse, adverse childhood experiences, relationship breakups and exogenous health events affecting oneself or family members. Still other causes are to be found in the conditions of housing and labour markets, in degrees of prejudice and in seasonality. These many causes mean that a complicated interaction of multiple data-generating processes, which differ in their period, frequencies and degree of randomness, produce data on the number of people experiencing homelessness.

In recognition of the difficulty of modelling the myriad behaviours and choices that lie behind many time series data, methods of time series decomposition that rely on few assumptions about underlying data-generating processes have been used to identify basic characteristics of key variables. In their introduction of the application of time series decomposition to macroeconomic data, Hodrick and Prescott (1997) emphasized that the method relied only on a limited amount of knowledge that is well supported by economic theory. In their application of time series decomposition to understanding trends and cycles in GDP data, they relied only on the maintained hypothesis of economic growth theory that the trend in GDP data varies smoothly over time.

This paper investigates the feasibility of using the Hodrick-Prescott (HP) filter to identify trends and cycles in monthly data describing the use of homeless shelters in Calgary, Alberta. In this application, descriptions of how and why people experience homelessness that are well supported in the literature are relied upon to identify trends and cycles in that measure.

The literature on the use of time series decomposition has grown to develop many alternative approaches varying in their simplicity of use and ease of interpretation.² The choice to apply the HP filter to the examination of homeless shelter use is based on its relative ease of use, making it a potentially useful tool for community-based organizations tasked with understanding local homelessness but without the extensive statistical expertise required to appreciate the challenges of application and interpretation associated with alternative approaches.

In the next section, the HP filter is described and the choice one must make with respect to a smoothing parameter to define a trend and a cycle in sheltered homelessness is discussed. This is followed by a review of the literature describing the underlying causes of sheltered homelessness and a discussion of the meaning and interpretation of a trend and a cycle in these data. Estimates of the cycle in sheltered homelessness that are implied by alternative values of the smoothing parameter are correlated with variables one should expect to be correlated with them. Experimenting with alternative values of the smoothing parameter λ , the value that best captures these characteristics of the data is identified. The paper concludes with a discussion of the limitations of this approach and the implications and uses of the estimates of trends and cycles in homeless shelter use that it produces.

¹ See Nooe and Patterson (2010) for a survey of the myriad factors contributing to homelessness.

² Notable examples include filters proposed by Baxter and King (1999), Christiano and Fitzgerald (2003) and Hamilton (2018).

2. ADAPTING THE HP FILTER TO DATA ON HOMELESSNESS

Economists have long used the Hodrick-Prescott (HP) filter to decompose changes in unemployment and GDP into a trend and a cycle. The challenge of decomposing GDP into a trend and cycle is seemingly herculean since the effort must disentangle the implications for production, employment and consumption of hundreds of daily choices made by tens of millions of individuals, firms and governments. This tool of analysis is popular because it produces calculations of the trend and cycle of GDP that seem reasonable and conform to analysts' priors regarding the amplitude and period of GDP cycles. Its popularity has resulted in calculations using the HP filter being an available option in most statistical toolboxes, including the ubiquitous spreadsheet program, Excel. The ease with which the HP filter can be applied makes it a tool easily and readily accessible to community-based organizations interested in estimates of trends and cycles in the number of people experiencing homelessness.

Measures of trend and cycle derived from application of the HP filter are sensitive to the choice of a smoothing parameter, frequently identified by λ . The smoothing parameter is restricted to be equal to $0 \leq \lambda \leq \infty$. Increases in λ reduce variability in the trend and increase variability in the cycle. In the limiting case of $\lambda \rightarrow \infty$, the trend becomes linear and all variation in the data is cyclical.

In applications, analysts choose a value for λ that produces a cycle with period and amplitude that appear to conform with a priori expectations. This choice varies by data frequency. When applied to time series measuring GDP for example, choosing values of λ equal to 100 when using annual data, 1,600 when using quarterly data and 14,400 when using monthly data, frequently provides estimates of GDP cycles that conform to analysts' a priori beliefs. Marcet and Ravn (2004) and Rand and Tarp (2002) have shown that the value of λ that best conforms with a priori judgments can also vary by the source of data. They show, for example, that the choice of λ for measuring trends and cycles in GDP varies by country.

Whether values for λ that are appropriate for application to data on GDP are also appropriate when the HP filter is applied to non-GDP data is an important consideration. As Choudhary et al. (2013) note, the determination of the size of the smoothing parameter varies with the underlying behaviour of economic agents whose choices determine the data's dynamical properties. Simply put, the behaviours of, and constraints on, people and firms whose choices matter for generating data on GDP should not necessarily be expected to be the same as the behaviours and constraints on people whose choices matter for generating data on sheltered homelessness. There should not be an expectation, then, that values of the smoothing parameter appropriate for the analysis of trends and cycles of homeless shelter data should be the same as those used in the analysis of trends and cycles of GDP. In applying the HP filter, or indeed any method of trend-cycle decomposition, analysts should experiment with alternative values and base their choice on experience, judgment and their understanding of the underlying processes that generate homelessness data.

The approach used here for determining the appropriate value of the smoothing parameter λ is first, to define what are understood to be the sources of trend and cycle in homeless shelter use; second, to define observed time series expected to be correlated with data describing cyclical and trend movements in sheltered homelessness; and third, to choose that value of the smoothing parameter λ that produces data describing homelessness cycles and trends that best conform with analysts' a priori expectations.³

³ Fron and Zator (2015) adopt a similar strategy in determining the preferred value of the smoothing parameter in their application of the HP filter to electricity markets.

3. UNDERSTANDING TRENDS AND CYCLES IN HOMELESS SHELTER USE

Data on sheltered homelessness represent the monthly average number of overnight shelter stays. These shelter stays can be summarized as being of two broad types, which will be referred to here as structural homelessness and cyclical homelessness.

Structural homelessness is built on a foundation of prolonged and persistent substance abuse, mental health challenges and prejudice in housing markets that make establishing or transitioning back to housing once lost more difficult. The causes of structural homelessness are found in a combination of personal vulnerabilities, a limited stock of housing available to people with those vulnerabilities and availability of mental health and substance abuse supports that might provide the services required for people to maintain housing while dealing with those personal challenges. Contributing to structural homelessness are family relationship breakdowns resulting in youth homelessness and homelessness resulting from domestic violence. Quilars et al. (2011) emphasize triggers like these mean that homelessness will never be entirely preventable.

Changes in structural homelessness should be expected to be linked to trends in substance abuse, the appearance of new drugs or increased risks of existing drugs, changes in prescribing volumes and demographic shifts in those using these substances. The multiplicity of explanations for changes in substance abuse means trends in drug use, and the consequences of that drug use, may rise and fall over time. Jalal and Burke (2020) note, for example, that the rise and fall in the availability of carfentanil, a very potent synthetic opioid, contributed to a rise and then a fall in drug overdoses in the U.S. They also identify changes in prescription opioid availability as a reason for a temporary decline in overdose deaths in the U.S. in 2018. Ciccarone (2021) reports evidence of a possible fourth wave of high drug-related mortality developing in the U.S., suggesting another change in the homelessness trend. Using drug-related mortality as a proxy for drug use and one of its frequent consequences, homelessness, this evidence suggests non-monotonic changes in structural homelessness.

The inability to escape homelessness may also be associated with racial or cultural prejudice and so structural homelessness may also be sensitive to slowly changing demographic measures. The size and speed of the social safety net's response, particularly as regards trends in the availability of mental health and addiction treatments and facilities, may also play a role. As changes in these policies are frequently slow to develop and implement, so too should one expect their influence on structural homelessness to vary slowly over time.

Cyclical homelessness is the result of changes to incomes and/or expenditures impacting individuals and households with severely constrained budgets. Cyclical homelessness is temporary and occurs when individuals or families first experience and then recover from a housing or personal crisis. This type of homelessness may result from an increase in housing costs or from a temporary change in a person's life circumstances, including unemployment or loss of hours of work, causing them to lose their home and become temporarily homeless. The length of time one experiences cyclical homelessness is in part sensitive to one's own resilience and in part to the speed with which the social safety net provides support to people trying to re-establish housing. Seasonality of employment opportunities is another potential reason for temporary homelessness. For this reason, any measure of seasonality in data on sheltered homelessness should be considered part of cyclical homelessness.

Cyclical homelessness is most likely experienced by individuals and families in deep poverty who have previously exhausted attempts to match limited income with expenditures by minimizing housing costs and by increasing their reliance on charities.⁴ Already on the cusp of homelessness, these individuals and families have few remaining resources to absorb new expenses or temporary losses of income. As these kinds of shocks to the personal circumstances of people in poverty are commonplace, so too is cyclical homelessness.

Individuals and families experiencing cyclical homelessness are likely to be resilient to the changes in circumstances causing their homelessness. This judgment is informed by the resilience observed in data on the closely related problem of people moving into and out of poverty. In Calgary, over the period 2015–2022, 47 per cent of low-income spells lasted one year or less and 2/3 lasted less than two years.⁵ Since for most households, poverty is not a permanent state, it is reasonable to anticipate the same being true of homelessness resulting from temporary losses of income or increases in expenses. It is important to note, however, that resilience is dependent in part on the size and speed of the social safety net's response. Lack of an effective social safety net reduces the resilience of individuals and households to the effects of the life changes causing them to experience poverty and cyclical homelessness. The social safety net's characteristics are important for determining whether a shock results in short or long episodes of poverty and homelessness.

Finally, evidence from the literature is that cyclical homelessness should be most closely linked to changes in the ratio of income to rent, where each is represented by measures relevant for individuals with skills that are relatively poorly compensated in labour markets, the income supports they may receive and the market for relatively low-cost rental accommodations.⁶ For individuals and families on the cusp of homelessness, even small changes to these variables can result in the loss of housing and small improvements can enable them to recover it.⁷

4. WHY IT MATTERS

Given their different causes, efforts aimed at addressing cyclical and structural homelessness should also differ. The approaches that community-based organizations take to influence cyclical homelessness include policies that fund rent and utility deposits and rapid re-housing programs, approaches sometimes referred to as shelter diversion policies. Government interventions useful for reducing cyclical homelessness include highly responsive income support programs that provide rapid access to income and other supports.

Policies meant to address structural homelessness require a different set of solutions. Providing mental health supports and implementing effective supportive housing programs are examples of policies of community-based organizations that may reduce structural homelessness.⁸ Government policies purposed with increasing the stock of low-cost housing,

⁴ They have an income below what Kneebone and Wilkins (2024) have recently defined as the Homelessness Income Cut Off (HICO), the minimum income one needs to retain housing after taking advantage of all efforts to reduce expenditures. Jadidzadeh and Kneebone (2025a) have recently shown that entering sheltered homelessness is frequently preceded by growing use of food banks over the previous five years, suggesting deepening poverty and growing risk of homelessness.

⁵ Low income is defined as that below Statistics Canada's low-income measure (LIM). See Statistics Canada (2025).

⁶ See, for example, the survey of U.S. research on the determinants of homelessness rates by Hanratty (2017). For a study confirming this relationship using Canadian data, see Kneebone and Wilkins (2021).

⁷ Research on U.S. housing markets supports this suggestion by showing that even modest efforts to increase the affordability of minimally adequate housing could have significant impacts on homelessness and reduce flows into emergency shelters. See, for example, Quigley et al. (2001) and Khadduri (2010).

⁸ Often referred to as Housing First programs but more generally housing programs providing wrap-around services to aid people in retaining housing while simultaneously dealing with their mental health and substance abuse issues. See Jadidzadeh and Kneebone (2022, 2025b) for evaluations of the effectiveness of such programs in Calgary.

establishing permanently higher levels of income support and funding supports for people dealing with substance abuse and mental health issues are examples of public policies that may impact structural homelessness.

Interventions intended to assist people in cyclical homelessness differ from those for people whose experience with homelessness is structural because these types of homelessness are due to different problems experienced by different people in different circumstances and with different life experiences. It is important to separately measure cyclical and structural homelessness so that testable hypotheses concerning their movements may be investigated. For example, tests of the effectiveness of shelter diversion policies need to be measured against estimates of cyclical homelessness, whereas the effectiveness of policies meant to address mental health issues needs to be measured against estimates of structural homelessness. The goal of this paper is to investigate the potential for producing monthly estimates of cyclical and structural homelessness to facilitate these evaluations.⁹

In the next section, data showing the monthly average number of uniquely identified persons using emergency shelters in Calgary are presented. Alternative values of the Hodrick-Prescott smoothing parameter are then used to generate alternative estimates of structural and cyclical homelessness. Following that, evidence on the question of whether what is being measured can be fairly described as cyclical homelessness is presented. A discussion of the value of these calculations and how they can be used in policy analysis follows.

5. THE DATA

Anonymized administrative data provided by the Calgary Homeless Foundation and the Government of Alberta are used to describe monthly values of cyclical and structural homelessness in emergency shelters operated by four providers: Mustard Seed, Salvation Army, Alpha House and the Calgary Drop-in Centre. These four shelter providers account for 99 per cent of all emergency shelter beds provided for single people in Calgary.¹⁰

The original dataset covers the period from Jan. 1, 2008 to Dec. 31, 2024. However, due to structural breaks caused by the incorporation of two large shelters (Mustard Seed on Nov. 16, 2011 and Alpha House on Jan. 31, 2013), this analysis excludes observations before January 2013. The dataset is purposely ended with observations in December 2019. This is done to avoid changes in homelessness observed in Calgary because of the COVID-19 pandemic.¹¹ The dataset used in this project spans the period from January 2013 to December 2019 and contains 83 monthly observations.

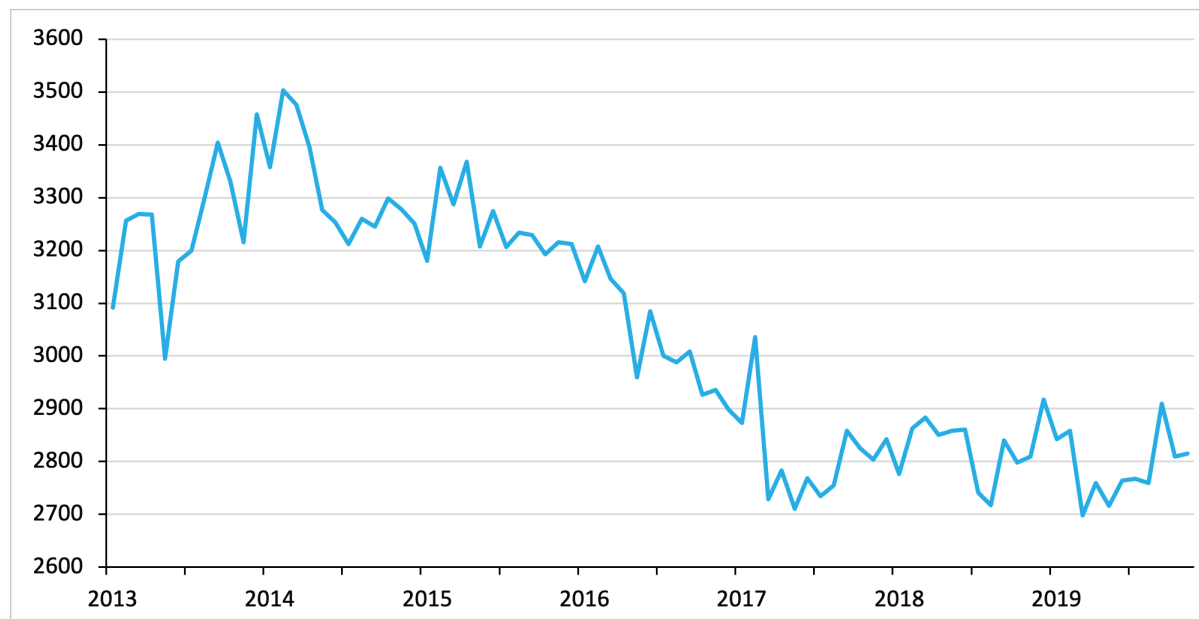
The data profile the use of emergency shelters by 35,584 unique individuals. The client-level data, documenting daily check-ins and check-outs, provide insights into the monthly use patterns of unique individuals. These observations generate a monthly time series, represented in Figure 1. For clarity of presentation, the vertical scale is truncated.

⁹ The focus in this paper is on providing estimates of cyclical and structural sheltered homelessness. Other forms of cyclical and structural homelessness may involve rough sleeping or being provisionally housed with family or friends, sometimes referred to as couch surfing or doubling up.

¹⁰ Based on data as reported in August 2019. See Alberta Government (2025). Data used in this study exclude emergency winter beds and those specifically for use by people escaping domestic violence.

¹¹ The first signs of the pandemic affecting shelter stays appeared in Calgary early in 2020.

Figure 1. Monthly Admissions to the Emergency Shelter: February 2013 to December 2019 (T=83)



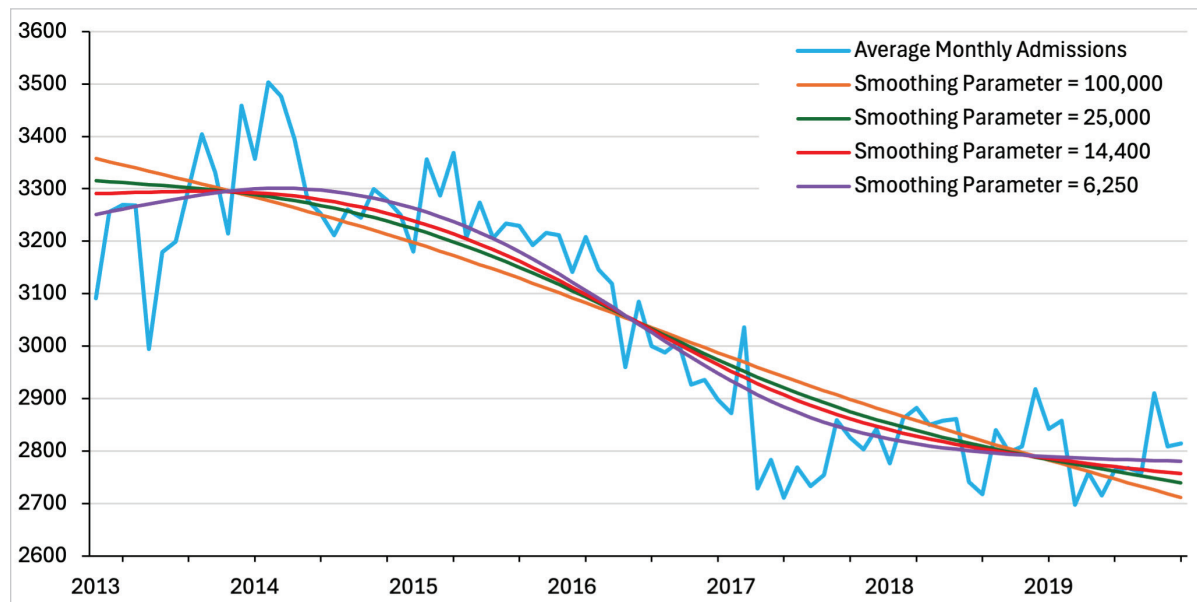
Monthly admissions depict a noticeable variation over time. From February 2013 to May 2016, the average number of unique individuals admitted stood at 3,259. Subsequently, a decline is observed from June 2016 to March 2017, stabilizing at an average of 2,801 monthly unique admissions from April 2017 until the end of the sample in December 2019. This indicates a drop of over 450 unique individuals in monthly admissions during this period, a reduction of roughly 14 per cent.¹²

6. ALTERNATIVE ESTIMATES OF STRUCTURAL HOMELESSNESS

Figure 2 presents alternative values of the trend identified in the data on shelter stays. These represent estimates of the monthly number of shelter stays by individuals dealing with structural homelessness. Five estimates are presented, each based on an alternative assumption regarding the size of the Hodrick-Prescott smoothing parameter, λ . The five values of the smoothing parameter chosen for consideration provide a wide range of values of structural sheltered homelessness.

¹² The application of the HP filter requires that the data series satisfy certain statistical properties; namely, that they be non-stationary in its level and stationary after first differencing. The series presented in Figure 1 satisfies these conditions. See Appendix A for an analysis testing for these conditions.

Figure 2. Estimates of Structural Homelessness for Alternative Values of the Smoothing Parameter



The HP filter is popular because it can generate estimates of the trend and cycle in a time series that satisfy a priori expectations of how those trends and cycles should look. Discussion earlier in the paper suggested that candidates for explaining structural homelessness include trends observed in substance abuse and mental health issues and it was speculated that the comings and goings of different types of drugs and their levels of toxicity may play a role. This speculation encourages a preference for estimates of structural homelessness that are non-monotonic and rejects those that are linear or nearly so. For this reason, estimates derived by assuming $\lambda = 100,000$ and represented in Figure 2 by the nearly linear orange line are rejected. The remaining candidates vary by the degree of optimism regarding the speed with which structural homelessness was falling during 2019. That optimism grows with the size of the smoothing parameter. An analyst preferring a cautious evaluation of the evidence regarding structural homelessness might therefore lean toward a smaller value of the smoothing parameter.

To further narrow the search for a preferred value of the smoothing parameter, a priori expectations regarding patterns in cyclical shelter use are considered next.

7. DRIVERS OF CYCLES IN SHELTERED HOMELESSNESS

The purpose of the social safety net is to catch those who fall, perhaps out of employment, out of a stable relationship or out of a stable condition of health and sobriety. By preventing that fall from being so damaging that recovery is impossible, the social safety net provides the opportunity for people to recover. The existence and design of the social safety net are relevant for understanding the reasons for, and the causes of, cyclical homelessness.

In the absence of a social safety net, or in the presence of one with large holes that make it ineffective, cyclical homelessness should be expected to be highly correlated with labour market conditions. To lose employment in the absence of unemployment insurance or income supports sets in motion a relatively short period of struggle to retain housing until it is lost. Duke et al. (2025) cite research suggesting this characterizes the U.S., where there are fewer labour protections, income supports and wage guarantees than in other wealthy, industrialized nations.

Plus, most workers in the U.S. have insufficient savings to cope with periods of job loss and under-employment and, even when fully employed, low-wage workers typically face substantial rent burdens, putting them at high risk of homelessness during economic downturns (Board of Governors of the Federal Reserve System 2023). Therefore, cyclical homelessness in the U.S. might be expected to be highly correlated with the business cycle. If so, it might be reasonable to assume a choice for the value of λ that corresponds to the value used by business cycle analysts when using monthly data, namely, $\lambda = 14,000$. That is, the same value of λ appropriate for decomposing GDP data into trend and cyclical components may be appropriate for decomposing data on sheltered homelessness into cyclical and structural homelessness.

Canada's significantly more comprehensive social safety net suggests that one should expect cyclical homelessness to be less sensitive to measures of the business cycle. Labour and wage protections and income supports somewhat insulate incomes from the effects of the business cycle. A relatively high minimum wage, for example, protects those with relatively low skills or with weak labour market attachment from suffering wage cuts during an economic downturn. Similarly, income supports are sufficiently large to enable individuals and families to maintain housing during periods of temporary unemployment and temporarily lower income. They also provide support in the event of family or personal crises or the development of disabilities. These features of the safety net suggest that in jurisdictions where they are robust, one should expect a weaker correlation of cyclical homelessness with the business cycle and a stronger correlation with measures of the social safety net's ability to enable people to retain housing. In jurisdictions with a social safety net capable of catching individuals and families before they lose housing, the appropriate smoothing parameter may differ from that used to produce estimates of GDP cycles.

To investigate these issues, simple regressions are estimated where the dependent variable is the estimate of cyclical homelessness obtained by applying the HP filter to data on the monthly number of unique individuals staying in homeless shelters, using various values of the smoothing parameter (λ). The four values of the smoothing parameter examined earlier that produced non-monotonic estimates of structural homelessness are considered. A summary of the results is presented in Table 1.

Table 1. Statistical Significance of Possible Correlates with Cyclical Homelessness

	$\lambda = 1,600$	$\lambda = 6,250$	$\lambda = 14,400$	$\lambda = 25,000$
Unemployment Rate	-1.98 (4.35)	-6.39 (4.97)	-9.93 (5.63)	-12.103 (6.12)
Unemployment Duration	-2.58 (5.77)	-7.14 (6.61)	-9.96 (7.53)	-11.49 (8.23)
Vacancy Rate	-1.62 (3.60)	-4.86 (4.12)	-7.30 (4.68)	-8.71 (5.10)
Income to Rent	-1.27 (1.73)	-4.93* (1.92)	-8.34** (2.05)	-10.57** (2.18)

Notes: * and ** denote statistical significance at the five-per-cent and one-per-cent levels. N = 83. All regressions include monthly dummy variables to control for seasonality in sheltered homelessness. Signs + and - indicate the variable has an estimated positive or negative correlation with the estimate of cyclical homelessness. Standard errors are in parentheses below the estimated coefficient. Due to a large increase in social assistance income in April 2019, the regression in the fourth row includes a dummy variable equal to one for each month from that date forward.

Two regressions are estimated in which the independent variable is a measure of the business cycle in Calgary. In one, the local unemployment rate is used and in the other, a measure of the duration of unemployment.¹³ As the first two rows of Table 1 show, these variables had statistically insignificant relationships with estimates of cyclical homelessness, a result consistent with an expectation that in a jurisdiction like Calgary, which has a relatively effective social safety net, cyclical homelessness may not be sensitive to the business cycle.¹⁴

The results in the third and fourth rows of Table 1 report the sensitivity of estimates of cyclical homelessness to measure conditions that affect the ability of low-income individuals to regain housing once it is lost. In the third row, the vacancy rate on one-bedroom rental units in Calgary is used. A higher vacancy rate characterizes a rental market with lower prices and increased availability to clients with weaker credit and rental histories. Thus, one should expect a negative relationship of the vacancy rate with an estimate of cyclical homelessness. Although the signs of these coefficients are as expected, none approaches statistical significance.

The results reported in the last row of Table 1 examine the question of whether what matters for cyclical homelessness is not just the state of the rental market but also the level of income available to pay rent. For this purpose, a measure of the amount of income support available to a single person deemed to be able to work is used. The ratio of income to rent is frequently hypothesized as an important determinant of rates of homelessness because as its value falls — either because rents increase or incomes fall — less disposable income remains for the purchase of other necessities. If the ratio falls sufficiently, it becomes inevitable that homelessness, perhaps in the form of couch surfing with friends or family, becomes a rational choice. As noted earlier, in empirical analyses, the ratio of income to rent is commonly reported as exhibiting a statistically significant relationship with rates of homelessness determined in point-in-time counts.

The empirical results reported in the fourth row of Table 1 confirm a strong relationship between the income-to-rent ratio and estimates of cyclical homelessness generated from three of the four values of λ . They support suggestions that a social safety net providing income support or rent subsidies can reduce cyclical homelessness by making it possible for people to retain housing even when faced with temporary job loss or private crises. The exception is estimates of cyclical homelessness generated by imposing a smoothing parameter of $\lambda = 1,600$, which produces a statistically insignificant correlation with income to rent.

The empirical measures in Table 1 are consistent with an explanation that cyclical homelessness is sensitive to the generosity of the social safety net. The estimates support a preference for one of three values of the smoothing parameter; namely, $\lambda = 6,250$, $14,400$ or $25,000$. As noted earlier, optimism regarding progress in reducing structural homelessness during 2019 grows with the size of the smoothing parameter. A cautious approach may therefore encourage adoption of lower values of the smoothing parameter, either $\lambda = 6,250$ or $\lambda = 14,400$.

Before leaving this section, it is important to emphasize the need for more research into understanding the causes of cyclical and structural homelessness and stress that the simple empirical approach used here for evaluating estimates generated by alternative values of the smoothing parameter is just that — simple. A more thorough examination is made challenging by an issue emphasized by Jadidzadeh, Kneebone et al. (2024); namely, that shocks to household

¹³ See Appendix B for details on sources of data and the use of methods of interpolation to generate monthly series of annual data. Data on vacancies and rent pertain to one-bedroom apartments renting at the low end of the distribution of rents in Calgary. Income is represented by the level of income support provided to a single person designated as expected to work by Alberta's program of income support.

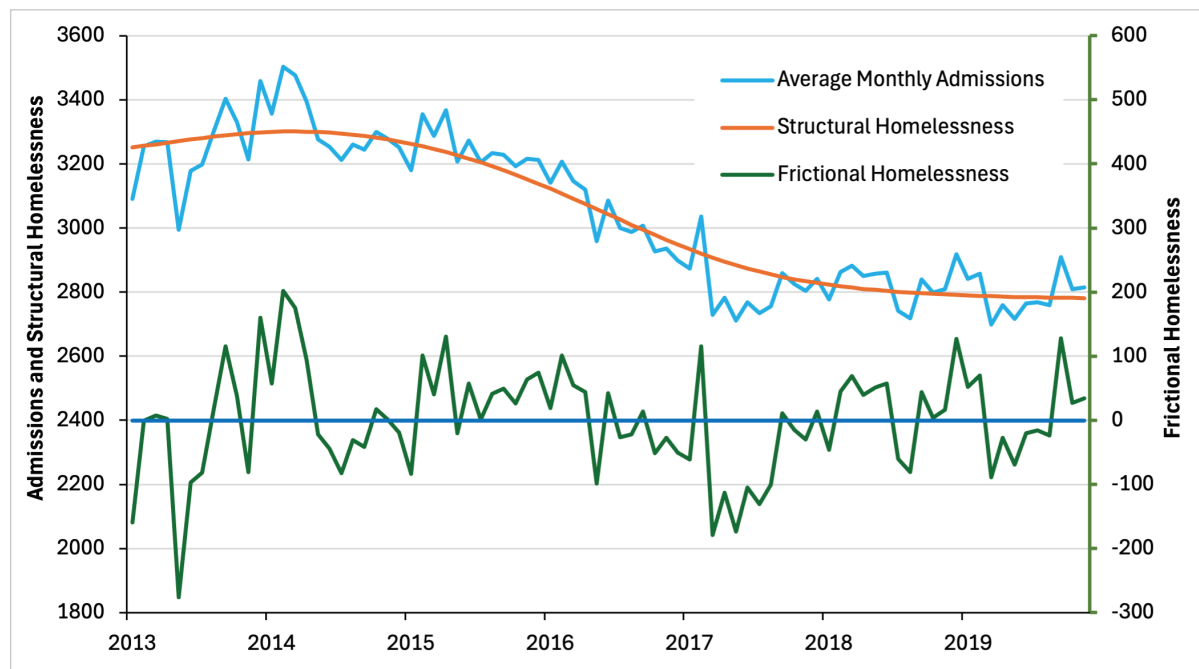
¹⁴ As well as being insignificantly different from zero, the signs on these coefficients are also opposite to what one would expect were cyclical homelessness sensitive to the business cycle.

incomes and shocks to the costs of necessities like rent and food likely affect the possibility of homelessness with what may be a long and variable lag. Depending on the shock's size and on the household's resilience, a loss of housing may follow only with a considerable lag during which the household absorbs the shock by increasing its reliance on charities and by increasingly going without. As evidence of this, Jadidzadeh and Kneebone (2025a) have recently shown that the date when households lose housing and enter homeless shelters is preceded by years of increasing reliance on food banks, which the authors interpret as a growing effort to retain housing. In these ways, the correlation between data measuring cyclical homelessness and data measuring how comprehensive the social safety net is, will be difficult to establish and will require a careful investigation of distributed lags and controlling for household heterogeneity using high-frequency data. In the absence of such data, community-based organizations must rely on best judgments for determining which value of the smoothing parameter produces estimates of structural and cyclical homelessness that best satisfy their a priori beliefs.

8. THE ESTIMATES AND THEIR MEANING

Figure 3 presents estimates of cyclical and structural homelessness resulting from setting the value of the smoothing parameter to 6,250.

Figure 3. Trend and Cycle in Emergency Shelter Admissions
(February 2013 to December 2019, $T=83$). The Smoothing Parameter (λ) = 6,250.



Note: Unique admissions and the HP trend (structural homelessness) are shown on the left vertical axis, while the HP cycle (cyclical homelessness) with zero line is shown on the right vertical axis. The zero line is included as a reference point.

The light blue line plots data on the average number of monthly stays in homeless shelters. The smooth orange line shows the trend in these values, a trend associated with structural homelessness. The values associated with the green line (reported on the right axis) show the deviations of observed values of shelter stays from the orange trend line. They represent changes in the number of homeless shelter stays due to reasons associated with cyclical homelessness.

An important characteristic of these estimates of cyclical and structural homelessness is that the two series are not always closely correlated. While shelter stays associated with structural homelessness fell steadily from 2014 to 2019, cyclical homelessness has at times fallen and at other times increased. This is important to note as it means that any test of the effectiveness of policies or programs to reduce cyclical homelessness will have less statistical power if it is tested against data describing total admissions, as opposed to data on cyclical homelessness. In less technical terms, the fact that data on shelter stays were flat from 2018–19 might be perplexing to an analyst noting a significant increase in the income-to-rent ratio over this period. What the data decomposition shows is that data on shelter stays over this period hid increases in cyclical homelessness consistent with a rising income-to-rent ratio.

The decomposition into a trend and a cycle is useful for homeless serving sectors to better understand the drivers of shelter stays. If we accept the idea of trends in homeless shelter stays being due to slowly evolving changes in variables describing demographic characteristics and measures of the prevalence of mental health and substance abuse issues, then the results shown in Figure 3 indicate that over the period 2013 to 2019, the key drivers of change in shelter use in Calgary were due to improvements in those measures. These improvements might be due to external changes — fewer or less toxic substances and better mental health treatments, for example — or due to community-based organizations being better able to help people with these issues stay out of shelters and in supportive housing. The two explanations might be complementary if improvements outside the homeless serving sector contribute to increased effectiveness of supportive housing programs.

The results shown in Figure 3 also indicate that the deviations from trend, what we identify with cyclical homelessness, have not become noticeably larger or smaller. If we accept the idea of cyclical homelessness being due to the impacts of poverty on peoples' ability to keep housing, then this evidence suggests that less progress has been made in this regard. The simple regression results reported in Table 1 are evidence that these movements are correlated with the ratio of income to the cost of housing. Were governments better able to support people in keeping their housing by increasing that ratio, the amplitude of these cycles would be less.

9. DISCUSSION AND CONCLUSION

The introduction noted something that is well known to people working in homeless-serving sectors; namely, that the causes of homelessness are many and complex. Governments and the sector use data, such as the number of people using homeless shelters, to measure progress and to evaluate policy changes. But the complexity of homelessness means these data need to be carefully interpreted. The data are the product of many data-generating processes, some of which are offsetting and some of which are additive at different points in time. A data time series on shelter stays is the product of a mishmash of influences. Decomposing a time series into the data representing different reasons for people experiencing homelessness is important for the proper understanding and evaluation of the causes and potential solutions to homelessness.

The analysis in this paper has evaluated the potential for applying a popular method of time series decomposition to measure trends and cycles in sheltered homelessness. The focus has been on the Hodrick-Prescott (HP) filter because non-experts can easily use it in an Excel workbook and because it produces data that analysts recognize as reasonable estimates of data describing slowly changing trends and more frequently changing cycles. Interpretations of these trends and cycles — what can be referred to as structural and cyclical homelessness — have been provided that correspond with the homeless-serving sector's understanding of the sources of homelessness.

Other data decomposition approaches can be applied to time series data on homelessness, but these require more demanding levels of statistical analysis. This does not mean those other approaches should not be investigated. On the contrary, investigating the implications of those other approaches is a worthwhile research agenda. The goal in this paper has been to provide insights into the use of a statistical tool that is well within the reach of community-based organizations, to offer a guide into how best to employ this tool and to suggest interpretations of the data generated by this approach of data decomposition. An important insight worth emphasizing is that the best judgment of community-based organizations is essential for choosing the size of key parameters that determine how any statistical filter separates trend from cycle and structural from cyclical homelessness. Statistical approaches are not a substitute for judgment and experience. Indeed, the application of judgment and experience is essential for the productive use of this approach.

APPENDIX A: TESTS OF STATIONARITY

Application of the HP filter requires that the data used in its application satisfy certain statistical properties. Table A1 reports the unit root test results for the time series variable, unique admissions denoted here as y_t . The augmented Dickey-Fuller (ADF) test statistics, using OLS detrending with a constant, indicate that y_t is non-stationary in its levels (i.e., $y_t \sim I(1)$), but it exhibits stationarity after first differencing (i.e., $\Delta y_t \sim I(0)$). This characteristic enables one to decompose y_t into the stochastic trend and stationary cyclical component that are interpreted in the text as data describing structural and cyclical homelessness, respectively.

**Table A1. Results of the Augmented Dickey-Fuller (ADF)
Unit Root Test for Unique Admissions (y_t) and its First Difference (Δy_t)**

		Critical Values			
	ADF-OLS Test Statistics	1%	5%	10%	Result
y_t	-1.016	-3.43	-2.86	-2.57	I(1)
Δy_t	-3.116	-3.43	-2.86	-2.57	I(0) in 5%

Notes: ADF-OLS is the augmented Dickey-Fuller (ADF) t-statistic based on OLS detrending. Only constant term is considered in the tests.

APPENDIX B: DATA SOURCES

The regression results presented in Table 1 use annual data on rents, vacancy rates, unemployment and unemployment duration. The dependent variable in these regressions is monthly data describing homeless shelter use. In this appendix, the sources of these annual data are identified and it is explained how these data were adjusted to facilitate a regression using monthly data.

Data on rent and data on the vacancy rate are measures relevant for a one-bedroom apartment renting at the top of the first quartile of the rent distribution in Calgary over the period 2012–2020. These data are available from CMHC (2023). Initially, these reports were issued in April and October each year until 2016. Since 2016, they have consistently been published in October. These data are annual values.

Data on social assistance income are defined as the amount paid to a single person identified as expected to work by the Government of Alberta. These annual data are available from Laidley and Aldridge (2020).

The monthly unemployment rate for Calgary is obtained from Statistics Canada (2026a), covering the last five months.

Data on the duration of unemployment were obtained from Statistics Canada (2026b), which reports annual figures (in weeks) for individuals in Alberta aged 15 to 24 years, both sexes, and single (not living common-law), for the period 1997–2019. To convert the series to a monthly frequency, each annual value was divided by 12 to estimate the average monthly duration of unemployment. The resulting values were then multiplied by seven to express duration in terms of days per month. To create a continuous monthly series, the data were interpolated. As city-level data were unavailable, the Alberta series was employed as a proxy for the duration of unemployment in Calgary.

Given the need for monthly data in this analysis, the gaps between reporting periods are addressed using cubic (or Hermite) spline interpolation methods. Cubic interpolation involves estimating an exact cubic through the four points at each end of the data, leveraging the pattern established by existing data points.

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Ron Kneebone is Professor Emeritus in Economics at the University of Calgary. From 2006 to 2009 he was Director of the Institute for Advanced Policy Research at the University of Calgary. In 2009, he joined the newly established School of Public Policy, where his initial focus was on research into the finances of Canadian provincial governments. While Prof. Kneebone continues to work closely with co-authors to study the political economy of provincial budgetary choices, for the past 15 years, he has also engaged with community organizations to investigate issues of homelessness, poverty, and domestic violence. This close engagement includes serving on the Board of Directors of the Calgary Homeless Foundation from 2016 to 2019. Professor Kneebone is currently a Research Fellow with the School of Public Policy.

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