5-24-2009

Substance Abuse, Marginalization, and Homelessness: Bayesian Perspectives on a Persisting Problem

Ben Alexander-Eitzman
Washington University in St. Louis

WASHINGTON UNIVERSITY

Department of Social Work

Dissertation Examination Committee:
Peter Hovmand, Chair
Brett Drake
Jeff Gill
David Gillespie
Carol North
Shanta Pandey

SUBSTANCE ABUSE, MARGINALIZATION, AND HOMELESSNESS

BAYESIAN PERSPECTIVES ON A PERSISTING PROBLEM

by

Benjamin Edwin Alexander-Eitzman

A dissertation presented to the
Graduate School of Arts and Sciences
of Washington University in
partial fulfillment of the
requirements for the degree
of Doctor of Philosophy

August 2009

Saint Louis, Missouri

Acknowledgments and Dedication

Over the past several years as a graduate student at the Brown School of Social Work, I have come to realize the singular importance of collegial conversation. The many accumulated hours of advice, challenging questions, and thoughtful reflection that I have received from my dissertation committee chair Peter Hovmand have provided the foundations for this work and, I am sure, for much of my future work. I want to also acknowledge the rest of the dissertation committee that together represent a level of intellectual brilliance, forward thinking, and kind support that made every part of this process not only stimulating, but actually enjoyable.

The energetic support I have received from the Washington University staff, most notably Lucinda Cobb, the faculty, and fellow graduate students has made everything I have accomplished here possible. I also want to thank the National Institute on Drug Abuse for providing generous financial support during my entire doctoral training and for this dissertation (R36 DA025782).

Finally, I dedicate this work to my wife Judy who has been a consistent voice of common sense and humanity in the midst of long hours of hard work and fickle computer systems. She has helped me keep my ”eyes on prize” every step along this path.

Contents

List of Tables

List of Figures

ABSTRACT OF THE DISSERTATION

Homelessness, Marginalization, and Substance Abuse

Bayesian Perspectives on a Persisting Problem

by

Benjamin Edwin Alexander-Eitzman

Doctor of Philosophy in Social work

Washington University in St. Louis, 2009

Peter Hovmand, Chairperson

This dissertation study examined what role substance abuse plays in the marginalized status of homeless adults and how the combined effects of marginalization and substance abuse impact service use and housing status changes over time. The concept of marginalization is used to describe how isolated an individual is from basic needs such as supportive social contact, a safe environment, and legal income options. Thus, the specific aims of this project were to 1) describe longitudinal patterns of substance abuse and marginalization in a homeless population, 2) examine the combined effects of substance abuse and marginalization on housing status changes over time, and 3) investigate how marginalization and substance abuse impact service use over time.

This dissertation used secondary data collected as part of a NIDA funded longitudinal study of urban homelessness called SUNCODA (DA 10713, PI-Carol North). Four hundred adults in the Saint Louis, Missouri metropolitan area were recruited from shelters and street locations (1999-2001) and interviewed at baseline, then at 1 and 2 year follow ups. Subject-matched service data (including shelter use and contacts with health, substance abuse, and mental health sectors of care) were collected from regional providers over the same time period. These data provided a unique opportunity to explore longitudinal changes in substance abuse, mental health, social contacts, victim-

ization, criminal activity, housing status, service use, and employment among homeless adults.

To understand these complex relationships, a flexible Bayesian framework was adopted to develop Markov transition models of housing state changes and zero inflated Poisson regression models of routine and emergency service counts over two time intervals. Key findings include consistent relationships between living on the streets, alcohol use, and increased marginalization, notably legal problems, shadow work, and victimization. Additionally, at several points, there were distinctions between street based homeless and those who found housing at some point or were episodically in shelters. These results underscore the importance of addressing legal problems and local environments in intervention design, specifically in how we might enhance the most basic aspects of well-being for homeless adults such as safety and housing.

Chapter 1

Introduction

The adult homeless population with drug and alcohol problems is unquestionably one of the most isolated groups in American society. The homeless substance abuser is often pushed out beyond the reach of many of the resources available, at least in theory, to the poorest of the housed such as medical care, a safe locked place to put belongings, freedom of movement, and the ability to provide for basic human needs. Moving from emergency shelters to hospitals to jails and sometimes living under bridges or in parks, this group occupies spaces that are at the margins of what most people consider safe and adequate.

Help for homeless adults with substance abuse problems is often in the form of emergency type services. These emergency visits are complicated by a high prevalence of chronic medical problems, active substance abuse, recent injuries, mental illness, social isolation, and victimization (Burt, 2001, 1999). Additionally, homeless individuals have a much higher likelihood of using crisis and inpatient types of services rather than outpatient, resulting in higher costs and system strain (Salit et al., 1998; Rosenheck & Seibyl, 1998). Service systems and law enforcement can easily get frustrated by repeated emergency contacts with a relatively small group of homeless persons and these individuals

are pushed further out of the very systems that may be able help them gain some stability and a chance for recovery. Promising strategies for intervention with this population are hampered by the very same factors that perpetuate cycles of housing instability, namely longstanding patterns of marginalization in social, legal, and employment domains. Just some of the personal costs of repeated and/or long term episodes of homelessness are high rates of criminal victimization, depression, suicidal thinking, communicable diseases, and mortality. The need for understanding and intervening with these vulnerable populations has been identified as a priority by the US Department of Health and Human Services (2003).

1.1 The Significance of Homelessness in America

Over the past three decades, numerous quantitative and qualitative studies have documented the plight of homeless adults in the United States. Burt's reports from the National Survey of Homeless Assistance Providers and Clients (NSHAPC) paint the picture of a population that is highly vulnerable to major health problems, victimization, social isolation, psychiatric problems, and repeated cycles of hospitalization, incarceration, and housing loss (1999).

The importance of homelessness as an identified social problem in America has changed in response to political climate, demography, visibility of the homeless in urban landscapes, and historical concepts of what homelessness is. At a national level, it may be difficult to visualize what it means when we say that in any given week, over a million people are homeless in the United States (Burt, 2001) or that 14% of a randomly phone-sampled population report being homeless at some point in their lives (Link et al., 1995). This gives one a sense of burden for the entire country, but more useful descriptions may occur at the regional or local level. Diverse population characteristics

and the size of homeless populations in a specific region are determined by factors such as public service accessibility, racial characteristics, and seasonal patterns which are, in turn, indications of the unique context of that particular area (Toro, 1999).

In one example of the public health significance of this problem, Human Immunodeficiency Virus (HIV) and Tuberculosis (TB) are evident in high proportions among homeless adults, particularly among non-white and those with substance abuse problems (Moss et al., 2000; Zolopa et al., 1994). At the same time, treatment and prevention strategies targeted at HIV and TB are hampered by fragmented service delivery systems and the many barriers to care that are part of the lived experience of being homeless both at an individual level and structural level (Brewer et al., 2001). Thus, substance abuse is a common factor in predicting who is at highest risk for infection and who will be the hardest to treat within the homeless population. This combination of high risk, structural barriers, and individual factors produces cyclical patterns that are difficult to surmount and are repeated across social, legal, and employment domains of marginalization.

1.2 Specific Aims

The central question and the motivation for this dissertation study is: What are the links between substance abuse and marginalization and how do these relationships impact housing outcomes and service use over time? By focusing on the dynamics of substance abuse and marginalization, the question takes on both a temporal and a spatial quality. Dynamics are inherently longitudinal in nature and the term marginal, at the most basic level, describes a place at the edges of something, in this case the boundaries of what most people consider adequate in terms of shelter, safety, health, and freedom. Each interaction between the homeless person and his or her family, friends, law enforcement, a local service setting, or other potential resource, becomes an opportunity not only for

simply gaining or losing something in the immediate sense, but affects future interactions and creates a 'history'. These histories are not isolated, but interdependent, and highlight the need for examining the problems of homelessness within the context of person and environment interactions (Toro et al., 1991).

To address the need for developing a more complete understanding of the dynamic interactions between homeless adults and their environments and to establish how substance abuse and marginalization impact housing and service use outcomes, the proposed study has the following aims:

1. Describe longitudinal patterns of substance abuse and the domains of social, legal, and employment marginalization among homeless adults.
2. Examine the combined effects of substance abuse and marginalization on housing status changes over time.
3. Investigate how marginalization and substance abuse impact service use over time.

This research provides important information about the dynamics of housing status changes, service use, marginalization, and substance abuse in an urban sample of homeless adults. Understanding these dynamics will enable researchers, practitioners, and policy-makers to make more informed decisions about how to effectively target help to a very vulnerable and difficult to reach population. The use of Bayesian analytic methods capitalizes on recent improvements in computer processing power and innovations in modeling complex, conditional relationships. This flexible approach incorporates information from prior research and rigorously addresses issues of missing data. This dissertation study is a critical step in the applicant's research trajectory focused on building more comprehensive and realistic ecological models of homelessness using a combination of survey data, Bayesian inference, systems dynamics, and agent-based simulations.

1.3 Organization of Dissertation

Chapters 2 and 3 of this dissertation will provide an overview of the theoretical and empirical literature related to the topic of homeless, substance abuse and marginalization. From this literature review, a conceptual model is developed which guides the analysis and discussion. Chapter 4 outlines the analytic setup including an overview of the data, variable measurement, and the regression model structure for service utilization and housing status changes over time. We will consider issues of missing data, model comparison, and Bayesian inference. Chapters 5 will examine results of the analysis in a systematic manner and these results will be interpreted and considered within the framework of the preceding literature review in the last chapter.

Chapter 2

Theoretical Background

2.1 The Nature of Homelessness and Marginalization

Homelessness can be understood in many different ways, depending on both the context of the problem and the nature of the question. In fact the term homeless does not come into popular usage until just after the turn of the century (DePastino, 2003), but carries meaning from popular conceptions of 'vagabonds', 'tramps', and 'paupers'. Alice Baum insisted that we should not use the word 'homeless' at all because of the political and historical baggage associated with it and her belief that it masks the true causes of homelessness, namely mental health and substance abuse problems (1993). The term and implicit grouping have also been deconstructed in a number of more recent qualitative works (Marcus, 2006; Marvasti, 2003; Wardhaugh, 2000).

The task of forming a research question about the vaguely defined term of homelessness entails a series of a priori beliefs about the problem. For example, the simple question "what are the primary causes of homelessness in America?" already has several associated assumptions. The first assumption is that there is an underlying dynamic associated with homeless persons at the national level (an issue of aggregation); for

example national poverty, housing problems, or deinstitutionalization. Investigations using this paradigm will necessarily examine how system and structural factors affect some generalized population of homeless persons in a similar manner.

Modern conceptions of the nature of homelessness are informed by a number of historical American notions of poverty, place, and illness. In Hopper's words

> the puzzle of American homelessness, that which makes tracing its continuities and discontinuities over time so difficult, is that it is not one thing but many, gathered up under a common heading that masks as much as it discloses (1996, p. 12).

It is this heterogeneity of meaning that we will explore in the next few sections.

2.1.1 Worthy and unworthy poor

As noted earlier, Early American traditions of taking care of the poor hinged on discriminating the poor from the paupers. The 'pauper' was the individual who could work, but who by the definition chose not to work and "plead destitution for purposes of dishonest gain" (Rosner, 1982). The growing urban poor of the mid to late nineteenth century, populated by both new immigrants and victims of the periods of economic crisis in the late part of the century intensified debates about who should be helped or not. In 1904, Hunter described a common classification of poverty in the three categories of "absolutely dependent" (children and physically disabled), "professional vagrant", and "temporary dependent" (1904). These groups were to be treated, in Hunter's view, either by institutionalization, confinement, or rehabilitation, respectively. There was concern at this time that giving relief (shelter, food) indiscriminately would turn the temporarily dependent (which, it should be noted, in Hunter's categories included those with substance abuse problems) into professional vagrants.

That people were categorized so differently yet housed in the same location produced inherent contradictions in care (i.e. a prison for some and a place of care for others),

which by some accounts led to the failure of the institution of the poorhouse by the early 1900's (Katz, 1986). More recently, several authors have drawn parallels between the functions of the poorhouse and the emergency shelter system of modern times as the mechanism of sorting out the worthy and unworthy poor (Kyle, 2005; Marcus, 2006; Marvasti, 2003).

Out of this context came the term 'tramp' which generally had a negative valence describing able-bodied young men who traveled the country, but never really settled down. Tramps were described as "lazy, dishonest, agitators living off the sentimental generosity of soft-hearted women and the public bounty of poorhouses, where they retreated to spend their winters in warmth and comfort" (Katz, 1986, p. 92). This term contains much of the meaning of earlier conceptions of the 'vagrant', the 'rogue', and 'vagabond' as the outsider, the mobile poor male who takes advantage of the resources of his local environment. These individuals, as defined by the Poor Laws of middles ages England, could be 'warned off' of a town's property and in some instances jailed or branded with a 'V' to permanently identify their classification (Wardhaugh, 2000). From 1870 to 1920, the tramp was represented mostly by the relatively young white male looking for work and sometimes organizing with his brothers in protests demanding better work opportunities (Monkkonen, 1984).

2.1.2 Hobo and bum

The term 'hobo' continues to carry much of this meaning and was described in detail by Nels Anderson's book about Chicago skid row residents in the early 1900's. In his classification schema, a hierarchy of hobos had different valuation depending on ability to work, mobility, and drinking patterns (Anderson, 1961).

Probably the most relevant distinction here was between the noble train traveling hobo and the bottom of the caste 'bum'. With the term, comes an additional set of

meanings associated with drinking and age. The 'skid row bum' is the primary topic for many of the books and reports about the homeless from 1930 to 1970. The skid row bum, according to the conception of 1930's, was primarily a Caucasian, older male, living in concentrated skid row sections of a city. He most likely had a long history of drinking, multiple short term unskilled jobs, and generally did not travel-what Hopper calls "an amalgam of old age, poverty, and addiction" (1996). Alcohol use was a primary distinction of this classification and the particularly negative valence of the bum was fueled by historical ambiguity about alcohol use[1].

The modern bum, as described by respondents in Marcus' (2006) ethnography of homeless shelter users, is split further into either the young, racial minority male using crack cocaine (the 'bad') or the residual older, African American male who drinks heavily (the 'ugly', as categorized by his respondents). In both cases substance abuse among the homeless fits neatly into the older dichotomy of worthy and unworthy. If a homeless person is drunk or possibly using drugs, then his problem is of his own making, the more conservative logic goes. As conceptions of substance abuse have changed from a moral problem to a disease, so have ideas about the worthiness of the 'bum'. Instead of incarceration or minimization, he may now need rehabilitation.

2.1.3 Old and new homeless

In the 1980's, several research groups began reporting the emergence of a 'new homeless' group that was different from the 'old' (Rossi & Wright, 1987; Rossi, 1990). The 'old homeless' were the part of the 'skid row bum' grouping mentioned above (older,

[1] As an example of this distinction, contrast the moral illegitimacy of alcohol use during the temperance movement and prohibition during the 1920's with the changing attitudes of the 1960's. Alice Baum (1993) argues that this change in attitudes about drinking and 'unattached lifestyles' is part of the reason for the homeless boom of the 1980's in that skid row alcoholics were first brought into the bohemian fold, then left without moral legitimacy during the much more conservative 1980's, leaving them further marginalized.

white males) and the 'new homeless' were younger, poorer, and included women, children, families, and higher proportions of minorities. This division again has an interesting parallel to worthy/unworthy poor distinction described above. The 'truly needy' have become homeless as a result of situational factors such as the rampant unemployment and/or housing shortages of the early 1980's. The residual category, the 'bums', still retain some of the baggage of earlier conceptions, in that they are considered beyond help or as drains on a limited system of care.

In a number of reviews during the 1980's and 90's, researchers focused on the relatively high rates of mental illness among study samples, adding an additional layer of meaning. An entire history of mental illness, institutionalization, and constructions regarding what it means to be 'crazy' or 'sick' have been part of American ideas of homelessness for more than 200 years, but in the 1980's and following years, these concepts come to the forefront of analysis. Several research groups associated the large increase in visible homeless during the 1980's with the deinstitutionalization movement that started in the late 1950's, by implication identifying the homeless as the mentally ill. In a similar vein, the crack epidemic of the 1980's brought forward new images of the unworthy 'bum', not as the older white male with an alcohol problem, but as the young, black, male (or female) who was using crack cocaine. All three of Hunter's categories are still present, the dependent (families, children) who need relief, the sick (mentally ill) who need treatment, and the bums (crack addicts) who need confinement.

2.2 Categories and Typologies

2.2.1 Functional status

Creating typologies of the homeless has been a recurrent theme in much of the research literature since 1920. These classifications embody the terms listed in the previous

section and often directly reflect the researcher's own views of who is homeless, why they are homeless, and what should be done about it.

Nels Anderson's six fold typology was based on a self-appointed hierarchy of value among his subjects based on occupation, mobility, and drinking patterns. Anderson used skid row vernacular such as 'muckers' and 'beach combers' to describe the functional roles of each of these groups (Anderson, 1961). Bogue expands this system to 12 different categories, but the primary focus here is on who can and cannot be rehabilitated. The three most important classifiers, according to Bogue, are disability status, drinking patterns, and age (1963).

These two examples represent a broader theme in the literature of homelessness, that of functional status of the individual. The homeless person can be classified in this schema on a continuum of functioning within societal institutions such as work, family, and property as laid out more explicitly by the functional sociologists in the 1960's to 70's. Individual spectrums of function are cast as affiliation-disaffiliation (Bahr, 1973) or social isolation-integration (Wallace, 1965). When considered within the context of the homeless populations of 1920-1960, the young, traveling 'hobos' and the older, more entrenched 'skid row bums' provide some of the structure for such a classification schema as they do not fit into the standard norms of the father and breadwinner.

The above classifications became less useful in describing the more heterogeneous homeless groups of the 1980's and 90's. More recent typologies have continued the use of functional status, but with more of a social-psychiatric perspective. So rather than being disaffiliated, homeless persons may be "hostile/psychotic" (Mowbray, Bybee, & Cohen, 1993) or "multi-problem" (Humphreys & Rosenheck, 1995). Functioning in this system is based on diagnostic criteria (substance abuse or mental health), which could be considered a proxy for social functioning, but has been developed in a more medical framework.

2.2.2 Course of homelessness

A second primary dimension of categorization has been duration of homelessness. This follows naturally from the historical context of functional categories-many early studies set up a natural progression from 'new homeless' (less disaffiliated, more functional) to 'long term homeless (disaffiliated, 'bums'). Snow and Anderson (1993) categorized homeless using two similar functional domains (lifestyle, cognitive) and added a temporal dimension. Here, the focus is the progression along a continuum of functional status and homeless move from "recently dislocated" to "straddlers" then to "tramps" or finally "bums". Adding a temporal dimension in this way introduces the concept of a course or pattern of homelessness that changes over time. Momeni (1989) translates this temporal-functional category system into assessments of each groups ability to 'recover' from the homeless state.

Table 2.1: Momeni's Table of Homeless Categories

Duration	**Displacement**	**Economic Condition**	
		Poor	Not Poor
Temporary	Minimum	May Recover	Not Serious
	Extensive	May Not Recover	Least Serious
Permanent	Minimum	Serious	May Pull Out
	Extensive	Most Serious	May Become Serious

One step removed from these functional typologies is grouping using only temporal patterns of homelessness and is typified by the designations "chronic", "episodic", and "transitionally" homeless (Kuhn & Culhane, 1998). These categories were designated using a clustering algorithm based on episode length and frequency of episodes over a 3 year time span, not on any functional status measures or demographics. This classification has had political influence in the past 10 years and figured prominently in the US

Department of Health and Human Services *Blueprint for Change* publication (2003). For example, the chronic homeless category, which represented approximately 10% of Kuhn's sample, has been targeted specifically for funding at the expense of broader programs that address the housing needs of the very poor (Roman, 2006).

Within each of these categorizations is the assumed link between a class, or 'kind' as Dupré (1993) puts it, and some underlying dynamic. Typologies like these are used as either clues to causality or as screening tools for treatment. The "transitionally homeless" subpopulation, for example, are generally considered to be the very poor that have simply had a spell of 'bad luck' whereas the chronic homeless (the "multi-problem" or the "bums") have some combination of individual factors, including history, that primarily determine their homeless state. There is also an assumption that understanding the causes of homelessness for a particular subgroup translates directly into developing the most effective intervention, which is not always the case. Lieberson's caution against simple deterministic thinking in social sciences (1987) has application here in that causal processes are do not always work both ways (i.e. if X is a primary cause of Y, then reducing X will not necessarily reduce Y).

2.2.3 Place and space

There is an interesting irony in the fact that many of the early samples of homeless persons were actually housed and employed. The skid row residents of the early part of the century were living in the lodging houses or 'barrel houses' of big cities, working day jobs handed out at local employment agencies. These residential areas were well defined spatially and often had a lively culture of low income temporary housing, entertainment, and employment options. For the traveling workers, the 'tramp army' of mobile unskilled labor, these areas were the stopping off points between jobs and destinations (DePastino, 2003). So, the homeless population was defined by both *mobility*

and an accepted physical *place* at the same time.

As the physical place occupied by the homeless in Bahr's definition, the skid row was described as uniquely 'set apart' or separated from the rest of urban society. Bahr notes that

> in terms of the ecology of the city, the concentration of institutions and persons with homeless characteristics creates a neighborhood, a context, which is different from other regions of the city both in terms of symbolic nature (how people think about it, treat its residents, and relate to it) and in terms of population composition (1973, p. 53).

The homeless person was marginalized from society on personal level and a geographic level. Even when the individual was considered part of the 'non-migratory' group of homeless persons, he was still separated and isolated by city geography. As Takahashi (1997a) has shown, not only persons, but places can be stigmatized. Skid rows were considered as 'zones of discard' which, via the concentration of facilities for the 'disabled' or 'undeserving' poor, creates a "spatial map of places which the public evaluates as less productive, more dangerous, and personally culpable" (p. 910). This geography of exclusion is a central theme in European definitions of homelessness and is one of three dimensions of the European Union typology of homelessness along with social and legal exclusion (Edgar & Meert, 2005).

The anthropological terms 'abeyance' and 'liminality' (Hopper & Baumohl, 1996; Wardhaugh, 2000) capture some of the underlying assumptions of typologies based on social exclusion. The mobile, 'tramping', male is stuck in limbo and has no real 'place' of his own. He sleeps in public spaces and is thus held in a liminal (in between) state. By excluding groups of individuals spatially, they are held in abeyance, in other words are separated or held apart from normative society. Wolch and colleagues have extended the concepts of social exclusion into the American urban context (1997; 1993).

2.3 The Concept of Homelessness

Definitions are essentially the operationalization of the terms, typologies, and theoretical assumptions of the researcher. The different ways that 'homeless' is defined in the thousand or so published studies carried out over the past 100 years is a testament to the different approaches that investigators have used to understand the problem. Choosing a sample based on a definition that includes only persons that are sleeping literally 'on the street, a park bench, under a bridge, or in some other public space not intended for human habitation' (a place), for 'one week or more' (a time) produces a particular group of persons who will most likely be much different in terms of history, demographics, and trajectories when compared to a definition that includes those that are living in hotels, with friends, parents, or in a violent relationship. The national obsession of the 1980's with counting homeless people brought issues of definition into the public spotlight. Choosing a more inclusive definition resulted in higher counts of homeless people and thus supported advocacy claims for more interventions and money to address the problem. But these competing definitions further confuse attempts to understand the contextual dynamics of how and why people are homeless.

Most modern definitions of homelessness used in sampling include some form of the two dimensions of place and duration. For purposes of comparison, definitions were extracted from a sample of 15 studies of homeless adults and service use (Table 2.2). What is most evident is the great range definitions in both the places occupied and the duration of occupation. There is general agreement that shelter and 'street' residents at the very least qualify as homeless, but then additional place terms such as 'free hotel', 'temporarily doubled up', and 'temporary dwelling' add some ambiguity about who is included. Several researchers redefine the street and shelter residents as the 'literal homeless' (Burt, 1996) or 'visible homeless' (Jencks, 1994) versus 'at-risk'

of becoming homeless or 'precariously housed'. The modern place of the homeless is different than the skid row homeless who were defined by their residence in a particular section of the city rather than their immediate type of accommodation.

Table 2.2: Research Definitions of Homelessness

Author (Year)	**Homeless Definition**
Burt (2001)	1 day in past 7 in shelter, free hotel, streets or temporarily doubled up or 7 full days since housed x 30 days or last period of homelessness over 7 days ago.
Folsom (2005)	No address at the date of the mental health contact
Kertesz (2006)	Chronic: shelter or street more than a year multiple times; transitional: shelter or street single or less than a year.
Koegel (1999)	1 night of past 30 in a shelter, streets, or temporary dwelling.
Kuhn (1998)	Shelter resident
North (1993)	Previous night in shelter, streets, free hotel (less than 30 days).
Padgett (1990)	Previous night in a shelter.
Pollio (2003)	Any of: No current stable address, spent 14 previous nights in shelter or streets, doubled up 6 out of 14 days, no address and hotel for under 30 days.
Robertson (1997)	Previous night in shelter, streets, free hotel, or doubled up.
Rosenheck (1997)	7 of past 14 nights in shelter or streets
Rosenheck (1998)	Previous night in shelter or temporary dwelling or doubled up.
Salit (1998)	Coded as homeless or address matches shelter
Toro (1999)	1 night of past 30 in a shelter, streets, or temporary and self-identified as homeless.
Wenzel (2001)	1 night of past 30 in a shelter, streets, or temporary dwelling.
Wuerker (1997)	Coded at admission as having no address

Sample definitions show much more variation in the duration of residence at the qualifying places. Focusing for the moment on the most common sampling frame, shelter residents, researchers have determined homeless to mean anywhere from the previ-

ous night, 1 night in the past 7 nights, 1 night in the past 30 nights, or 7-14 previous nights. This variation seems to reflect attempts to screen out the 'transitionally' from the 'chronic' or 'episodically' homeless.

Homelessness is both conceptually and physically a definition of access to place (shelter). In some ways this redefines homelessness as more of a 'state' rather than as a 'group' and is considered by many to be too strict a definition. The state definition ranges from simple to complex such as in the European Union designations of the physical, legal, and social domains of exclusion. A critical contextual feature of being homeless is that of socio-spatial exclusion and interactions with the environment. In opposition to a continuum, homelessness may be considered as a 'state' definition which individuals transit in and out of over the course of time. With this approach, the transitions between housing states becomes a focus of interest.

2.4 Theories of Service Utilization

The model used to understand what drives service use provides the basis for defining what a need is, what a service is, and when a disparity exists in the delivery of these services. Most studies of service use among homeless adults that clearly specify any model at all use the Health Behavior model developed by Anderson and Newman (1973). This model is more of a framework for organizing predictor variables than a causal theory (Sosin & Grossman, 2003), but has at least given researchers a common language in this area.

Need variables in the Health Behavior model typically include disability, symptoms, and/or diagnosis. The most common predictor of need in almost all of the studies included in this review is the existence of a mental health or substance use disorder diagnosis either over the previous 12 months or over the lifetime of the subject. This

diagnosis is most often determined by a structured interview such as the Diagnostic Interview Schedule (Robins, Helzer, Croughan, & Ratcliff, 1981). Along with diagnosis, the severity of substance abuse or mental health conditions can be included as an indicator of need (Padgett, Struening, & Andrews, 1990). Some studies ask the respondents if they wanted help but did not get it (Robertson, Zlotnick, & Westerfelt, 1997; Wenzel, Burnam, et al., 2001) as a measure of perceived need versus evaluated need.

On the other side of the model, the outcome variable is service use. Service use definitions among the studies included vary widely in terms of the time period covered and what particular services are measured. Continuous measures of service use such as the number of days of service use or bed days used, while hardly ever utilized, theoretically should result in more accurate statistical tests when compared to dichotomous measures of any contact over a time period. In two studies using the ACCESS dataset (Lemming & Calsyn, 2004; Rosenheck & Lam, 1997b), a hierarchical linear model was used to disentangle the specific variance attributable to different levels of predictors (i.e. predisposing, need, and enabling). An alternative model of service use has been proposed by Sosin and colleagues (2003) which incorporates the individual costs and benefits of services. Evaluation schemas are based on prior experience, the utility of particular services, and the environment (social and service networks). This model may be more useful for understanding the process of how individuals choose between services or stay in services rather than looking at overall disparities in service use. Sosin indicates the need for including dynamic factors in modeling service use such as how the evaluation schema change for an individual over time, but it is unclear at this point how to model these individual determinants.

2.5 Definitions

From the above review, several definitions can be derived which help guide the development of a models of housing status changes and service use among homeless adults. These definitions will be used throughout the remainder of the dissertation study.

2.5.1 Homelessness

Burt suggests that "homelessness is a transient state for many people and that there is not a static 'homeless population' but rather an ever-changing set of people who happen to be homeless at the time a research study tries to contact them" (2001, p. 738). Following Burt's recommendation, homelessness is defined in this study as a transient state. Homeless status is considered as not currently having a stable address and sleeping in parks, cars, temporary hotels or shelters. This definition also reflects the current US federal standard of homelessness (Public Health and Welfare Act, 1988). Since it may be possible that individuals who primarily sleep in shelters represent a different population than those who spend most of their nights in street locations (Snow & Anderson, 1993), these categories were maintained throughout the analysis. Additionally, as a comparative measure, a secondary definition of housing status was used based on each individual's report of 'usual sleeping location' over the previous year.

2.5.2 Substance use disorders

In this dissertation study, the substance abuse and dependence definitions are used based on diagnostic criteria of the Diagnostic and Statistical Manual (DSM) of the American Psychiatric Association (1994). Alcohol dependence in this case is indicated by a "maladaptive pattern of alcohol use, leading to clinically significant impairment or distress" over 12 months and with 3 out of 7 reported symptoms (see Appendix A for examples

of abuse and dependence diagnostic criteria). These criteria have been shown to be valid and reliable for both alcohol, cocaine, and opiod dependence, but less so for the abuse diagnoses (Nelson, Rehm, Bedirhan, Grant, & Chatterji, 1999; Üstün et al., 1997). Since the focus of this study is on any harmful or 'maladaptive' use, any diagnosis of abuse or dependence was taken as an indicator of problem use. For this reason any individual that had a positive urinalysis for either alcohol or cocaine were included in this measure.

2.5.3 Marginalization

Marginalization is defined in this study as isolation from supportive social connections, exposure to legal problems or victimization, and reduced ability to engage in legal employment opportunities. Sleeping under a bridge or in a homeless shelter places an individual at the margins of society in both a literal and figurative sense. Literally, the placement of shelters and areas where homeless individuals can hang out without being moved or harassed defines the 'marginal spaces' in a city which have been ceded to the poor and homeless either by intent or as a matter of course (Dear & Wolch, 1987; Snow & Anderson, 1993; Takahashi, 1997b). This type of spatial marginalization has direct consequences in terms of personal safety as evidenced by the high rate criminal victimization among homeless adults (Burt, 2001; Fitzpatrick, La Gory, & Ritchey, 1993; Kushel, Evans, Perry, Robertson, & Moss, 2003).

Beyond the literal context of the immediate environment, the homeless individual can be isolated from supportive social contacts and employment resources via stigmatization, labeling, and overt discrimination as has been well described in a number of ethnographies (Amster, 2004; Wardhaugh, 2000; Wright, 1997). In Young's view, the "marginals are people the system of labor cannot or will not use" and these people are "expelled from useful participation in social life and thus potentially subjected to severe material deprivation" (1990, p. 53). When individuals are unable to gain access to regu-

lar employment opportunities, survival strategies may include prostitution, panhandling, selling drugs and other types of 'shadow work' (Snow & Anderson, 1993).

2.6 Conclusion

These definitions imply certain relationships among the concepts. For example, as individuals become more marginalized over time, either physically, socially, legally, or economically, they are by definition less able to access the resources needed to maintain stable housing. One of these resources, again by definition, is the array of services that are potentially instrumental in gaining or keeping housing. We might assume that higher levels of service engagement, ceteris paribus, lead to more stable housing arrangements over time and, at the same time, there may be similar links between how marginalized one is and how much services one uses. The concepts of substance abuse, marginalization, housing status, and services use developed above will be examined in light of empirical findings of the past 20 years of research in the next chapter. The final section of Chapter 3 will link the theoretical background and the empirical literature using a working model and a series of hypothetical relationships that are indicated either by the literature or by definitional assumptions made in the preceding chapter.

Chapter 3

Review of Empirical Findings

This section will review reports and studies published since 1990 that address the characteristics of the homeless and factors associated with housing status changes and service utilization among homeless adults. It is important to examine the context of each study to draw any real comparisons so particular attention will be given to the sampling strategies each study used. For example, samples of individuals who are homeless are typically drawn from larger groups of service setting samples (i.e. shelter or soup kitchen records) or from some attempt to randomly sample the entire local population of homeless persons. Service setting samples often use administrative data coding schemas where an address field is coded at admission as 'homeless', 'no address', or matches a known shelter location. A related issue is the sampling frame for these studies. Shelter only studies (i.e. Padgett et al., 1990) have been demonstrated to be different from samples taken from shelters, streets, and kitchens (Toro et al., 1999). The primary point here is that it is important to understand the potential sample bias in making comparisons between these studies.

It is also critical to understand that groups of homeless people are heterogeneous mixtures and include important and unique subgroups. For example, recent federal pro-

grams are targeted at the 'chronically homeless' (U.S.Department of Health and Human Services, 2003) which represent 10% of the total shelter using population (Kuhn & Culhane, 1998). This subgroup has fewer but longer episodes of homelessness and is the group often identified as most difficult to reach and treat due to multiple co-occurring health and mental health problems. Additional subgroups with special needs are runaway youth, homeless with chronic medical conditions and communicable diseases, older homeless populations, women, homeless families, and cultural subgroups (i.e. Native American). Service use and service need may be different in each of these subgroups.

3.1 Prevalence of Homelessness

Reporting numbers of homeless in the United States is often the starting point in explorations of services to this population. At a national level, it may be difficult to visualize what it means when we say that in any given week, over a million people are homeless in the United States (Burt, 2001) or that 14 % of a randomly phone-sampled population report being homeless at some point in their lives (Link et al., 1995). This gives one a sense of the service burden for the entire country, but more useful descriptions may occur at the regional or local level. Diverse population characteristics and the size of homeless populations in a specific region are determined by factors such as public service accessibility, racial characteristics, and seasonal patterns which are, in turn, indications of the intensity and diverse needs of a that region (Toro & Warren, 1999).

Sampling methods and the very definition of homelessness also influence how we characterize this population. Samples of homeless populations over the past 20 years have used many different definitions of homelessness as was shown in Section 2.3. Definitional considerations impact what subjects are included in a service need and utiliza-

tion study, thus creating the possibility of independent sample biases among seemingly comparable studies.

To produce a reasonable estimate of spatial variation of homeless persons, multiple sites samples are required. Several studies have used data from either shelters and shelter residents such as in the National Survey of Homeless Service Providers and Clients (NSHAPC) or Culhane's two city survey of shelter admissions (1996). These data sources produced actual head counts of homeless persons and are generally restricted to the service using homeless population. The 1990 Census counts of homeless persons in shelters and streets provided actual counts, but may have missed significant groups of street homeless. Culhane's study is unique in that it provides period prevalence (1989-1994) rather than a single night point prevalence data which should be less volatile a measure. Others have used the Department of Housing and Urban Development (HUD) estimates of homeless persons based on surveys of local service providers and experts.

There is general agreement that rates of homelessness in urban areas are associated with higher unemployment, a tighter housing market (higher rents and rent to income ratios), and poverty rates. Several studies found that increased expenditures on mental health care (residential and overall funding) were associated with decreased rates. Also, generally warmer areas have higher homelessness rates. Troutman's study (1999), reported what he called "perverse incentive" effects in that higher federal housing assistance funding and rent controls were both associated with *increased* homelessness rates. Both Troutman and Quigley (2001) are economists and interpret their findings to support a model of individual rational choice in determining rates of homelessness across different areas.

3.2 Costs of Homelessness

The burden of the homeless adults with mental health and substance use disorders can be understood from the perspective of the service sectors that are impacted the most. Folsom (2005) found that among all San Diego county mental health patients, homelessness was associated with a ten times higher likelihood of using crisis-residential services and four times higher likelihood of using of inpatient services. Homeless individuals accounted for 30% of all psychiatric emergency room visits in a large urban area study in 1997 (McNiel & Binder, 2005) and had a higher likelihood of subsequent admission to an inpatient unit when compared to housed patients. Similarly, another study determined that the two top predictors of repeat emergency room use were homelessness and substance use disorders (Mandelberg, Kuhn, & Kohn, 2000).

Higher utilization of crisis and inpatient services and concomitant decreased use of outpatient services results in higher costs and burden on the mental health service system. Rosenheck reported a 20% increased annual dollar cost in mental health service use associated with homelessness in over 9000 VA patients admitted in 1995 for mental health and substance abuse problems (1998). He then estimated that the VA alone spends an additional $400 million in mental health care for the homeless (26% of the entire VA budget for mental health). A significant part of the overall increased costs is due to higher inpatient days, as shown by Salit (1998) who reported that homeless psychiatric patients in New York City hospitals had longer stays than housed patients, resulting in an average of over $4000 more per discharge.

3.3 Composition of Homeless Samples

Study samples of individuals who are homeless are typically drawn from service locations or from some attempt to randomly sample the entire local population of homeless

persons. The following empirical review will draw from both types of studies (see Table 3.1). As noted in the previous chapter, identification and characterization of a 'homeless population' has a history spanning 80 or more years. The very act of separating out or defining the population as separate and as people "not like us" (Coston, 1993) reinvents many of the older categories associated with poverty such as worthiness and culpability (Hopper, 1997). The ambiguity that surrounds the boundaries of the homeless population is accentuated by the variety of sample frames used in these studies. With this in mind, we will now look at some of the common associations found in this literature.

Table 3.1: Composition of Selected Homeless Study Samples

Author	Year	Design-Data	Sample Frame	N	Age	Male	AA	Dx	SA	MI
Population Samples										
Bird (2002)	1996	Retrospective administrative data	Houston, TX. Shelters and streets	797	NA	83	58	NA	NA	NA
Burt (2001)	1996	Retrospective administrative data	Nationwide selected shelters, food sites, health, mental health, and other assistance programs.	2,938	NA	68	40	Lifetime	NA	57
Kuhn (1998)	1990	Retrospective administrative data	All admissions to Philadelphia, PA shelter system	27,638	NA	58	NA	NA	25	20
Koegel (1999)	1990	Retrospective survey	LA, CA. Shelters and kitchens.	1,563	37	75	55	Lifetime	71	35
North (1993)	1990	Retrospective survey	St. Louis, MO. Shelters and street.	900	NA	66	74	1 Year	52	24
Padgett (1990)	1985	Retrospective survey	New York City shelters.	823	35	83	71	NA	NA	NA
Pollio (2003)	1998	Prospective administrative data	St. Louis, MO. Shelters and street.	400	41	82	75	Lifetime	77	50

(Continued on next page)

(Table 3.1 continued)

Author	Year	Design-Data	Sample Frame	N	Age	Male	AA	Dx Time	SA	MI
Robertson (1997)	1991	Retrospective survey	Alameda, CA countywide from shelters and food programs.	564	37	78	30	Lifetime	69	NA
Toro (1999)	1992	Retrospective survey	Detroit, MI. Shelters, food kitchens, hospitals, streets.	2,266	36	72	85	Lifetime	75	27
Toro (1999)	1992	Retrospective survey	Buffalo, NY. Shelters, food kitchens, hospitals, streets.	597	32	73	68	Lifetime	70	22
Service Setting Samples										
Folsom (2005)	1999	Retrospective administrative data	SPMI clients of a San Diego, CA mental health center	10,340	40	62	16	Current	60	100
Kertesz (2006)	NA	Prospective	Clients from a Boston area residential alcohol detoxification unit.	274	35	76	53	Current	100	NA
Rosenheck (1997)	1994	Retrospective survey	Clients enrolled in ACCESS program	1,828	38	65	44	Current	57	100

(Continued on next page)

(Table 3.1 continued)

Author	Year	Design-Data	Sample Frame	N	Age	Male	AA	Dx Time	SA	MI
Rosenheck (1998)	1995	administrative data of previous and post 6 mos.	Inpatient admissions to Veterans Adminstration hospitals nationwide	9,108	47	98	30	Current	40	NA
Salit (1998)	1992	Cross-sectional administrative data	All admissions to New York city public hospitals	402,850	NA	81	56	Current	28	23
Wuerker (1997)	1990	Retrospective administrative data	Clients from an LA mental health center with severe and persistent mental illness.	268	40	65	41	Current	NA	100

Dx = Diagnosis; AA = African-American; SA = Substance Abuse; MI = Mental Illness; MH = Mental Health

3.3.1 Demographics

Shelter and street samples of homeless persons are mostly male (58 – 82%) with a mean age ranging from 35 - 40 years old. Many studies also report a majority of African Americans, although this is clearly dependent on regional population composition. Burt's reports on the National Survey of Homeless Assistance Providers and Clients (NSHAPC) conducted in 1987 and then again in 1996 gives probably the broadest view of a national sample of mostly shelter residents (2001). Compared to the U.S. poverty population in 1996, she finds that service using homeless adults have higher proportions of African Americans (40% compared to 23%) and lower proportions of Hispanic individuals (11% versus 20%). Also, the homeless sample population is found primarily in central cities (71%) whereas the U.S. poor population is spread out over central cities (31%), urban fringes (46%), and rural areas (23%). Additionally, she found that homeless adults were more often single (48%), divorced (24%), or separated (15%).

3.3.2 Substance use disorders

Over the past twenty years the prevalence and consequences of substance abuse among homeless persons has been well described. In their review of the literature, Fischer and Breakey (1991), found that rates of substance abuse among homeless persons ranges from two to six times higher than the general population. Robertson's survey of 564 homeless adults reported 69% with any substance abuse disorder, 35% with both an alcohol and a drug problem, and 48% reporting use of multiple drugs (1997). There are also indications that rates of substance abuse and dependence among urban homeless adults are increasing. O'Toole found that over 78% of homeless adults in a 1998 Pennsylvania study had either an alcohol or cocaine diagnosis and that rates of drug abuse and polysubstance dependence were significantly higher than in a similar study com-

pleted ten years earlier (2004). Multivariate analysis indicated that male gender, less than high school education, and stealing for money were independently associated with substance abuse among homeless adults.

Aggregate descriptions of the homeless also diverge from the overall population in rates of substance abuse and mental illness comorbidity. Based on the set of studies in table 3.1, rates of *lifetime* substance abuse diagnosis among the homeless range from 52 - 77%, which greatly exceeds Kessler's general population estimate of any substance use disorder at 14.6% (2005). It is additionally estimated that 77% of mentally ill homeless adults have a co-occurring substance abuse disorder (Koegel, Sullivan, Burnam, Morton, & Wenzel, 1999).

Much of this variation in substance abuse reporting is due to the different methods of capturing substance abuse problems. Some studies like the NSHAPC simply ask respondents if they think they have a problem with alcohol or drugs, whereas others use a diagnostic tool such as the Diagnostic Interview Schedule (Robins et al., 1981). These different methods naturally produce different results, when a complex set of problems related to substance abuse and dependence is compressed into a dichotomous measure of problem or no problem as noted in section 2.5.2.

3.3.3 Mental health

Mental illness also has been associated with homelessness and typical estimates are 30% having any non-substance abuse Axis I disorder. Fisher found that although rates of mental illness may be significantly higher among the homeless, it is rarely cited by the homeless themselves as the primary reason or cause of a particular homeless episode (1991). Carol North found little evidence for a distinct subgroup of the 'mentally ill homeless' and advocated for a broader contextual view of the causes of homelessness (1996); this viewpoint is reflected in other reviews of the causal factors associated with

homelessness (Glasser & Zywiak, 2003).

Lifetime diagnoses of mental illness are found in anywhere from 22 - 50% of representative homeless samples in table 3.1, although a commonly accepted number is somewhere between 20 - 30% for any non-substance abuse Axis I diagnosis. North's figure of 24% with a mental health diagnosis in the previous year (1993) is higher than general population samples where approximately 14% of all individuals have a diagnosable mental disorder in the previous year (Norquist & Regier, 1996). Carol Caton reviewed 14 studies produced during the 1980's, finding similar rates of mental health problems that were generally higher that overall population estimates (1990).

As with substance abuse rates, the variation in rates of mental illness depends on diagnostic criteria and categorization. Additionally, cross-sectional surveys may overestimate the mental health problems in a group of homeless persons who were sampled during a necessarily difficult time in their lives, producing a biased view of the entire population (Snow, Anderson, & Koegel, 1994). One study compared rates of psychiatric disorders in three different population samples taken approximately ten years apart finding that prevalence of serious mental illness and substance use disorders have increased significantly (North, Eyrich, Pollio, & Spitznagel, 2004). This study in particular disputes the typically static representation of the homeless population over time with the implication that there are more complex influences at work in how the composition of these samples changes.

3.3.4 Victimization and incarceration

Homeless persons are victims of violent and non-violent crime at much higher rates than housed populations (Fitzpatrick et al., 1993; Kushel et al., 2003; Lee, 2005). Burt (2001) reported that 22% of adults included in the 1996 National Survey of Homeless Assistance Providers had been physically assaulted while homeless and 7% reported a

history of sexual assault while homeless.

Within an already marginalized population, women and individuals with mental illness appear particularly vulnerable. Homeless women are two to four times more likely to have been physically or sexually assaulted as adults when compared to housed women of similar socioeconomic status (Jasinski, Wesely, Mustaine, & Wright, 2005). In a survey of 1051 adult women living on the streets or in shelters, Nyamathi and company (2000) reported that 28% had been sexually assaulted since they became homeless. Much of this victimization appears relatively recent. For example, 34% of women interviewed in Los Angeles, CA shelters reported being either physically or sexually assaulted in the previous 12 months (Wenzel, Leake, & Gelberg, 2001).

It is clear that victimization can induce or exacerbate mental health problems (Kilpatrick & Acierno, 2003; Sorenson & Golding, 1990) but there is also evidence that persons with mental health problems are at higher risk of being victimized. For example, Hiday and company found that adults interviewed in a psychiatric inpatient unit had more than double the rate of violent victimization in the previous four months compared to the general population (2001). Depression has been found to be a significantly associated with victimization in surveys of homeless women (Goodman, Dutton, & Harris, 1997; Nyamathi, Wenzel, Lesser, Flaskerud, & Leake, 2001; Wenzel, Leake, & Gelberg, 2000). Since most studies of victimization and homelessness are cross-sectional in design and use standard regression methods, it is difficult to distinguish whether mental health problems are ultimately a result or a cause of victimization, or both.

In addition to high levels of victimization, homeless persons have higher rates of previous incarceration or legal problems than the general population. Over 49% of shelter residents in Burt's 1996 survey reported a history of incarceration (2001) and one review reported rates of arrest from 20% to 67% (Eberle, 2001). A study of over 7000 New York City shelter residents reported 23% with a matching New York State

prison record in the previous two years (Metraux & Culhane, 2006). In this study, subjects released from jail (compared to prison) were more likely to have multiple previous homeless episodes, reflecting a 'institutional circuit' from shelters to jails to hospitals.

3.4 Service Utilization

A consistent theme evident in this body of literature is the under-utilization of both mental health and substance abuse services by homeless individuals with identified needs for service. Across the board, only 11 - 34% of individuals who are identified with a substance abuse or mental health problem actually received treatment for the condition in the specified time period of each study (Table 3.2). While it is hard to make comparisons since the time periods of service vary so much, this range includes the 28% service utilization rate Regier (1993) calculated for the general population with mental health or substance abuse diagnoses. The critical difference between homeless and non-homeless groups seems to be in the kind of service used, in particular a shift from outpatient/office services to the more expensive inpatient/residential/crisis settings as was shown by Folsom (2005).

Table 3.2: Service Use in Population Samples

Author	Period	Measure	Services	Utilization
Bird (2002)	Previous 12 months	Any Contact	Inpatient or outpatient	34% of those with SA dx had contact with SA treatment. 43% had contact with criminal justice.
Burt (2001)	Lifetime	Any Contact	Inpatient, outpatient	20% report outpatient MH service use, 8 % inpatient.Two to three times the service use when compared to low income adults for both SA and MH.
Folsom (2005)	1 year period	Any Contact	Crisis residential, inpatient, crisis unit, outpatient, day treatment, case management	When compared to housed, homeless more likely to use emergency and inpatient services and less likely to use outpatient.
Kertesz (2006)	Previous 6 months at each followup (2 yrs)	Any Contact	Inpatient, outpatient, self help group, other.	Homeless more likely to use Inpatient/residential.
Koegel (1999)	Previous 60 days	Any Contact	Residential, outpatient, medication.	77% with MI also have SA problem. 20% with any disorder received appropriate treatment in previous 60 days.
Kuhn (1998)	2 year period	Any Contact	Any MH or SA treatment	11-16% of self-reported serious mental illness cases reported getting treatment.
North (1993)	Previous 12 months	Any Contact, No. of Admissions	Inpatient, outpatient	23% of those with MH dx received tx in past year. 23-35% of those with active MH symptoms said they desired, but could not get tx.

(Continued on next page)

(Table 3.2 continued)

Author	Period	Measure	Services	Utilization
Padgett (1990)	Previous 90 days	Any Contact	Inpatient, outpatient	53% report significant depression while only 13% got help. Typically twice as many report need for services than actually get them.
Pollio (2003)	Lifetime and previous 30 days	Any Contact	Inpatient, outpatient, residential	28% and 17% used SA and MH treatment in past 30 days.
Robertson (1997)	Previoius 12 months	Any Contact Unmet need (Y/N)	MH and SA, inpatient, groups, clinics, treatment centers.	25% of those with drug disorder received tx in past 12 months, most tx was drug tx centers and self-help groups. 43% report unmet needs for treatment.
Rosenheck (1998)	6 months before and 6 months after admission	days of service costs of service	Inpatient, outpatient MH or SA	Homelessness accounts for 13% ($4000) higher costs for MH pts and 18% ($2600) higher costs for SA patients.
Salit (1998)	Current admission	length of stay	Inpatient	80% of homeless admissions had a SA diagnosis, 50% were for SA treatment. Additional costs of $4000 for homeless patients on psychiatric floor.
Toro (1999)	Lifetime	Hospitalized for MH or SA	Inpatient	17% hospitalized for MH, 33% for SA.
Wuerker				

(Continued on next page)

(Table 3.2 continued)

Author	Period	Measure	Services	Utilization
(1997)	2 years after admission	Either not discharged, discharged and no return, or multiple returns	inpatient, outpatient, crisis, day treatment, residential from center.	Approximately half of the clients were readmitted after discharge. These averaged 20 previous admissions (mostly crisis) and 10 new admissions.

Dx = Diagnosis; AA = African-American; SA = Substance Abuse; MI = Mental Illness; MH = Mental Health; Tx = Treatment

No specific non-need factors associated with mental health service utilization were identified in the two St. Louis population samples (North & Smith, 1993; Pollio, North, Eyrich, Foster, & Spitznagel, 2003), while several other studies found that ethnicity, gender, insurance status, and contact with other service sectors were significant predictors of mental health or substance abuse service use. An alternative approach to identifying disparities is to simply survey the homeless themselves about what they feel is important and how difficult it is to get the services they need. Using this approach, Acosta and Toro (2000) found that, contrary to the identification of mental illness and substance abuse among a large proportion of this group, the need for mental health or substance abuse treatment was rated as one of the lowest priorities, well below safety, housing, transportation and education. Being younger, a person of color, or having dependent children predicted lower service use and more difficulty getting services.

3.4.1 Association between service use and substance abuse

When the interdependence of substance abuse and service utilization are considered together, it is not surprising that a disturbingly small proportion of homeless individuals who are identified with a substance abuse problem actually received treatment for the condition (Burt, Aron, Lee, & Valente, 2001; Koegel et al., 1999; Pollio et al., 2003). This is an important finding in light of the above evidence that connections to service systems increase the likelihood of finding and maintaining stable housing. Additionally, help for the homeless with substance abuse problems is often in the form of emergency or tertiary type services. Homelessness constitutes the strongest predictor of repeat emergency room use (Dhossche & Ghani, 1998; Mandelberg et al., 2000). The next strongest predictors of frequent users of this service are poverty and substance abuse. Emergency rooms provide little opportunity for intervention with complex social problems. Typically, psychiatric emergency services do an excellent job at diagnosis and risk

assessment, but then can offer little beyond this except referrals. As Dobscha, Delucchi, and Young (1999) demonstrated, most referrals made by the emergency room to follow up services for homeless persons are not successful. In their study the strongest predictors of non-attendance were, again, housing problems and substance abuse. Homeless individuals have a much higher likelihood of using crisis and inpatient types of services (Folsom et al., 2005) rather than outpatient, resulting in higher costs and system strain (Rosenheck & Seibyl, 1998; Salit et al., 1998).

3.5 Housing Status Changes

To better understand the dynamics of homelessness, it is clear that retrospective and single point cross-sectional studies are inadequate sources of information (Wong & Piliavin, 1997). Building a model of how homeless individuals gain housing or cycle in and out different housing situations requires a perspective that acknowledges the experiences of these individuals as they adapt more or less successfully to their circumstances. Single point cross-sectional surveys tend to oversimplify the causal relationships and cannot account for patterns of change over time (Snow et al., 1994). Empirical and qualitative studies generally agree that homeless status and substance abuse are interdependent in that substance abuse is associated with further episodes of homelessness (Glasser & Zywiak, 2003). Vangeest has most clearly delineated the two different directional relationships between substance abuse and homeless status as representing a 'downward drift' hypothesis (substance abuse leading to homelessness) and an 'adaptation hypothesis' (homelessness inducing more substance abuse behaviors), both of which have found support empirically (2002).

Several studies have used longitudinal designs to identify what factors are related to exits from homeless episodes or subsequent returns to homeless states. These studies

typically use either shelter admission data over a period of several years or alternatively follow a group of individuals over two or more years with several surveys about housing history. Wong and Piliavin found that race (not African-American), age (younger), and gender (female) are associated with shorter episodes of homelessness and a lower likelihood of subsequent returns to homelessness (1997). Among female headed households as opposed to single men or women, they also found that mental illness and substance abuse were associated with returns to homelessness. In addition to race and gender differences, Zlotnick reported that having social support and connection with social services were all associated with exiting the homeless situation at some point over the 15 months of a study of 397 homeless adults (1999). For the subset of individuals using substances, social support and social service connections were not significant predictors of exiting homelessness. Zlotnick interpreted this as an indication that current substance abuse reduces a subject's ability to access or build on social and institutional resources, again suggesting that substance abuse interacts with indicators of marginalized status such as social isolation and service connections.

3.5.1 Association between substance abuse and housing status

Clearly, there are indications that substance abuse can be both a precipitant of housing instability (Coumans & Spreen, 2003) and an adaptation to the homeless state itself (Snow & Mulcahy, 2001). Importantly, Vangeest and Johnson (2002) have shown that substance abuse has indirect influence on becoming homeless, mediated by levels of social isolation and employment status. In this way, substance abuse acts as a catalyst in that it intensifies the marginalized status of homeless adults by decreasing access to social and financial resources while compounding the effects of existing mental health problems (Sosin & Bruni, 1997). Additionally, substance abusing homeless adults tend to have more frequent episodes of homelessness and a higher likelihood of living on the

streets versus in shelters or other institutional settings when compared to those who are not using substances (Booth, Sullivan, Koegel, & Burnam, 2002).

3.6 Summary and Knowledge Gaps

The American urban adult homeless populations described in the literature over the past 30 years have high rates of substance abuse, victimization, legal problems, social isolation, and generally low rates of service use, particularly in the non-emergency mental health and substance abuse service sectors. In describing the dynamics of homelessness over time, there are indications that gender, race, age, health, and substance abuse impact the probability of exiting or returning to the homeless state, although the results in this area are not consistent. Taken individually, many of the descriptions and associations in the literature above show snapshots of how substance abuse interacts with certain domains of marginalization such as social connections, victimization, incarceration, and employment, but offer little in terms of a comprehensive picture of what the combined impact is on two critical outcomes: housing status and services utilization. Perhaps the most the best description of the groups involved in these studies is probably 'marginalized' or 'disadvantaged'. They are pushed, for a variety of reasons, into situations of spatial, social, and resource exclusion. The same structural barriers that pushed them into this state may selectively disadvantage certain groups from regaining housing status such as those with drug or alcohol problems.

To address the need for a more comprehensive model of the dynamics of homelessness, researchers have called for an ecological approach that addresses both individual and environmental factors (Reilly, 1994; Snow & Mulcahy, 2001; Toro et al., 1991). At the same time, simply choosing variables from a larger universe of variables does not necessarily lead to a better understanding of the problems. The 'crud factor' of common

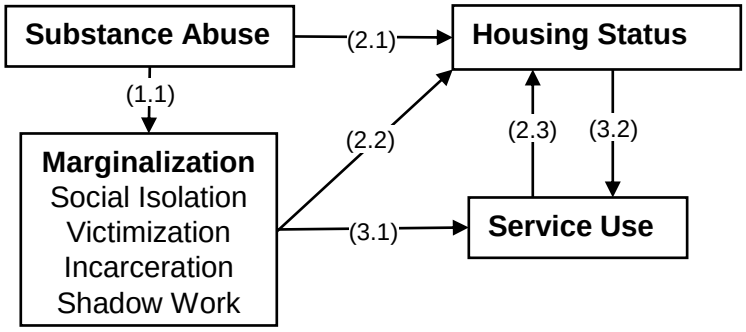
and easily obtainable statistical associations among unrelated variables (Meehl, 1990) should push researchers to look beyond static and single-level associations. While the complex nature of the relationships between homelessness, substance abuse, marginalization, and services to homeless persons is not disputed, the important epistemological question here is how to understand this complexity. A critical next step in the analysis of the problems of recurrent and chronic homelessness requires a perspective that can model changes in multiple domains over time.

3.7 Conceptual Framework

From the above review, a conceptual model is proposed that links substance abuse and indicators of marginalization to housing status changes and service utilization (Figure 3.1). The first assumption of this model is that substance use disorders have a direct effect on each of the domains of marginalization and also on housing status over time. The pervasive effects of substance use disorders on many of these domains have been demonstrated by a number of previous studies as noted above. In an attempt to represent the complex nature of housing status changes over time, this outcome is represented as directly related to changes in substance use disorder status, marginalization, and levels of service use over time. Lastly, there is the very likely possibility of a reciprocal relationship between the two outcomes, housing status changes and service use.

For each aim, a set of hypotheses have been developed that are reflected in existing literature on homelessness and substance abuse. Demographics and Background variables (i.e. previous substance abuse/dependence, homelessness, mental illness, health problems) are also included in modeled relationships as background or control variables.

Figure 3.1: Conceptual Model



3.7.1 Aim 1: Relationships between substance abuse and marginalization

The first aim of this study is to better understand the links between substance abuse and the different domains of marginalization as defined in the Chapters 2 and 3 (social, employment, legal, victimization). It should be noted that these relationships may change over time and may also have interactive effects, but the initial exploration will examine the most direct relationship from a recent substance abuse problem to changes in these marginalization domains over the three time points included in the study. This aim is exploratory in nature, but there are some relationships that may be predicted as stated in hypothesis H1.1.

H1.1: Type of substance dependence will be associated with unique patterns of demographics and marginalization variables. For example, previous studies have indicated that homeless adult alcohol dependent individuals have a lower likelihood of employment and have fewer supportive social contacts.

3.7.2 Aim 2: Housing status transitions

In Aim 2, we examined the probability of making transitions from one housing state to another over the course of the three time points in this study. Although there are no direct precedent to this sort of analysis in the current body of literature on housing status transitions, the literature review above has pointed to some possible relationships as outlined in hypothesis H2.1 to H2.3 below.

H2.1: Past year alcohol or drug use will be associated with a lower likelihood of transitions from homeless to housed states.
H2.2: Individuals who are socially isolated, victimized, have legal problems, and are engaged in shadow work will have higher a higher probability of either remaining homeless or losing housing over the course of the study.
H2.3: Individuals who are more engaged in outpatient and non-emergent types of services will have higher probabilities of moving from homeless to housed states.

3.7.3 Aim 3: Service use

The last aim focused on the same set of covariates, but now with emergency and routine types of services use as the outcome. Services use has typically been treated in this literature in a static manner (single time point, retrospective) or as a simple dichotomous variable. What we are interested in here is how actual service use counts change over the course of two time intervals and what the relationships are between the time-changing marginalization and substance use disorder variables are on these counts. From previous studies, two simple relationships may be reasonably expected to occur (H3.1 and H3.2).

H3.1: Social isolation, victimization, incarceration, and involvement in shadow work will be associated with higher use of inpatient and emergency type services
H3.2: Individuals living on the streets or in shelters will use more inpatient and emergency types of services at later time points. At the same time, gaining housing will result in fewer inpatient and emergency service contacts

The remaining portion of this dissertation will show how these questions were addressed methodologically and how each of these hypotheses stands up in light of the

results from this particular set of data and approach. The discussion section contains a review of each of these aims, the associated hypotheses, and some recommendations for practice and methodology.

Chapter 4

Methods

4.1 Data

This study used longitudinal secondary data collected from the project known as SUNCODA (**S**ervice **U**se, **N**eeds, **C**osts and c**O**nsequences among **D**rug **A**busing homeless). It was sponsored by the National Institute on Drug Abuse (NIDA) and was headed by Drs. Carol North and David Pollio (DA 10713). Four hundred adults homeless individuals residing in shelters and street locations in the city of Saint Louis, Missouri were first recruited in 1999 from shelters and street locations and interviewed at baseline, then at 1 and 2 year follow ups. Subject-matched service data (including shelter use and contacts with health, substance abuse, and mental health sectors of care) were collected from regional providers over the same time period.

4.1.1 Study site

The baseline sampling area encompasses approximately 62 square miles and in 2000, had a overall population of roughly 350 thousand people (51% African-American, 44% Caucasian). Slightly over 24% of individuals in Saint Louis at that time lived in poverty.

Saint Louis city is part of a larger metropolitan area which includes counties in Illinois and Missouri and had a population of over 2.6 million according to year 2000 U.S. Census figures (U.S. Census Bureau, 2000). General estimates of homeless adults in Saint Louis over the course of a year range from 5,000 to 8,000 depending on the source and method used in counting. In 2000, there were 11 primary emergency shelter sites providing around 800 emergency beds at any given time.

4.1.2 Sampling and recruitment methods

North and colleagues recruited adults at 11 city night shelters, one daytime shelter, and along 16 different street routes between 1999 and 2001. At shelter sites, potential subjects were randomly selected from current rosters and briefly screened regarding housing status. Individuals who met inclusion criteria were then informed about the study and consent procedures. For the street population, all adults who were encountered along 16 different street routes known to be areas with concentrations of homeless persons were similarly screened. Included in the study were male and female adults who reported that they had no current stable address *and* at least one of the following: (1) stayed in shelter or street location for at least 14 previous nights (2) stayed with friends or relatives for 6 of the previous 14 nights or (3) stayed in a cheap hotel or motel for less than 30 nights. Of all eligible persons, 92% agreed to participate in the study.

4.1.3 Survey information

All interviews (baseline, year 1 and year 2 followups) included the sociodemographic sections from the National Comorbidity (NCS) study (Kessler et al., 1994), psychiatric diagnostic sections from sections from the Diagnostic Interview Schedule (DIS) (Robins et al., 1981), the alcohol and drug abuse sections of the Composite International Di-

agnostic Interview-Substance Abuse Module (CIDI-SAM) (Cottler, Robins, & Helzer, 1989), along with the residence sections of the DIS homeless supplement (DIS-HS) (North, Eyrich, Pollio, Foster, et al., 2004).

Measures of support from family and friends were designed specifically for the SUNCODA project and are part of the DIS-HS (Eyrich, Pollio, & North, 2003). Interviews lasted approximately 1 1/2 hours with time for debriefing and follow up questions. These were conducted by professional interviewers who had completed formalized training in the instruments used. Locations were chosen to accommodate the subjects of the study, typically at the study drop-in center located in downtown Saint Louis, but also at shelter and street locations.

4.1.4 Services data

In addition to answering survey questions, study subjects also consented to release any information collected from regional service providers for 2 years after the initial baseline contact. Administrative data was collected from three different sources: (1) the city sponsored shelter and transitional housing Management Information System (MIS), (2) manual review of intakes for shelter services not participating in the city MIS, (3) the state Purchase Of Service (POS) databases.

The POS database includes contacts with regional hospitals, emergency rooms, outpatient mental health and substance abuse treatment facilities, and case management services. The combined data set has over 57,000 unique service contacts with the subjects of this study.

4.1.5 Brief description of subjects and attrition

The sample used in the SUNCODA study is similar to several other previous studies of street and shelter populations in large urban areas (as reviewed in Table 3.1) enhancing the generalizability of results of the proposed study. The most common profile from this sample is that of a 40 year old single male staying at a shelter at the time of the baseline interview. Table 4.1 shows a selection of variables from the baseline interview grouped by usual housing status over the previous year. Generally, the street sample has higher proportions of unemployment, lifetime diagnoses of substance dependence and mental illness compared to the shelter sample. Of the 394 subjects with full baseline information, 282 (72%) were interviewed one year later, 279 (71%) two years later, and 251 (64%) were interviewed at all time points. Previous analysis of missing subjects compared to non-missing on baseline demographic variables shows little significant difference between the two groups (North, Pollio, Perron, Eyrich, & Spitznagel, 2005).

Table 4.1: Baseline Demographics by Usual Sleep Location

	N	Housed	Shelters+	Streets	Combined
		$N = 156$	$N = 171$	$N = 67$	$N = 394$
Age	394	31.0 38.5 45.0	37.5 43.0 49.0	36.5 42.0 47.0	35.0 42.0 48.0
Male	394	60% (93)	84% (144)	88% (59)	75% (296)
White	394	11% (17)	19% (32)	34% (23)	18% (72)
Married	394	9% (14)	2% (3)	7% (5)	6% (22)
Employed	394	35% (54)	29% (50)	18% (12)	29% (116)
Lifetime Diagnosis					
Alcohol	394	52% (81)	65% (111)	75% (50)	61% (242)
Cocaine	394	38% (59)	47% (81)	48% (32)	44% (172)
Serious Mental Illness	386	51% (78)	42% (70)	64% (42)	49% (190)

Values given for age indicate first quartile, median, and third quartile. Values in parentheses show frequency counts.

4.2 Measurement

A number of measures derived from the above survey instruments were used as indicators for the different domains of marginalization, substance abuse, housing status, and service use referred to in the primary aims of this dissertation. Table 4.2 shows the constructs and the corresponding variable definitions. These measures will be examined in more detail in the sections below.

4.2.1 Service use and type of service

Service use in this study is considered as a count of either emergency or routine services received in the 12 month intervals between the three time points. Data was screened for any redundant entries or overlapping services that did not constitute unique or separate contacts. For the service use regression models, the service use variables were kept in the original format. As a covariate in the Markov models, the service counts were recoded into two separate variables as 'moderate' (between 1 and 20) or 'high' (over 20) service use for both emergency and routine service types.

Routine services

Routine services were coded as any mental health, substance abuse, or health service that was received as a scheduled or office type contact. This includes individual and group counseling, non-emergent clinic visits, day treatment programs, and case management face to face visits. Because each service type had a unique contact time profile (i.e. some were billed by the 15 minute increment, some were billed as 1 hour contacts), all routine contacts were normalized to a 1 hour contact time such that the resulting measure of routine services is for 'hours of routine service received' over the course of the 12 month period.

Table 4.2: Constructs and Measures

Constructs	Measures	Source	Time Frame	Time Points	Values
Demographics					
Age	Age	NCS	At baseline	BL	centered $((x_i - \bar{x})(sd(x))_{-1})$
Race	Race	NCS	At baseline	BL	white = 1, all others = 0
Gender	Gender	NCS	At baseline	BL	male = 1, female = 0
Education	Diploma	NCS	Lifetime	BL, Y1, Y2	yes = 1, no = 0
Background					
Health History	Health problems	NCS	Past year	BL, Y1, Y2	yes = 1, no = 0
Legal History	Incarceration history	NCS	Lifetime	BL	yes = 1, no = 0
Residential History	Lived continuously in St. Louis	NCS	>1 year	BL	yes = 1, no = 0
Childhood Abuse History	Childhood abuse or neglect	NCS	Lifetime	BL	yes = 1, no = 0
Interview Weather Effect	Average temperature below 40°F.	NCS, NOAA	Current	BL, Y1, Y2	yes = 1, no = 0

(Continued on next page)

(Table 4.2 continued)

Constructs	Measures	Source	Time Frame	Time Points	Values
Substance Abuse and Mental Health					
Alcohol	Abuse or Dependence diagnosis	CIDI-SAM	Lifetime and past year	BL, Y1, Y2	yes = 1, no = 0
Cocaine	Abuse or Dependence diagnosis	CIDI-SAM	Lifetime and past year	BL, Y1, Y2	yes = 1, no = 0
Mental Illness	Serious Mental Illness diagnosis	DIS	Lifetime	BL	yes = 1, no = 0
Marginalization					
Social Connections	Support from family	NCS	Current	BL, Y1, Y2	yes = 1, no = 0
Social Connections	Support from friends	NCS	Current	BL, Y1, Y2	yes = 1, no = 0
Legal Problems	Current or pending charges	NCS	Current	BL, Y1, Y2	yes = 1, no = 0
Legal Problems	Recently detained	NCS	Past month	BL, Y1, Y2	yes = 1, no = 0
Victimization	Robbed	DIS	Past year	BL, Y1, Y2	yes = 1, no = 0
Employment	Currently working for pay	NCS	Past year	BL, Y1, Y2	yes = 1, no = 0
Shadow Work	Money from illegal sources	DIS-HS	Past year	BL, Y1, Y2	yes = 1, no = 0

(Continued on next page)

(Table 4.2 continued)

Constructs	Measures	Source	Time Frame	Time Points	Values
Housing					
Usual Status		DIS-HS	Past year	BL, Y1, Y2	housed = 1, shelters+ = 2, streets = 3
Current Status		DIS-HS	Last night	BL, Y1, Y2	housed = 1, shelters+ = 2, streets = 3
Service Use					
Routine Services	Hours of scheduled outpatient services	MIS	Past year	BL→Y1, Y1→Y2	counts
Emergency Services	Nights of inpatient or contacts with ER	MIS	Past year	BL→Y1, Y1→Y2	counts
Routine-Moderate	$0 < x < 21$	MIS	Past year	BL→Y1, Y1→Y2	yes = 1, no = 0
Routine-High	$20 < x < max$	MIS	Past year	BL→Y1, Y1→Y2	yes = 1, no = 0
Emergency-Moderate	$0 < x < 21$	MIS	Past year	BL→Y1, Y1→Y2	yes = 1, no = 0
Emergency-High	$20 < x < max$	MIS	Past year	BL→Y1, Y1→Y2	yes = 1, no = 0

CIDI-SAM=Composite Interview International Schedule-Substance Abuse Module

DIS=Diagnostic Interview Schedule; DIS-HS=DIS Housing Supplement; NCS=National Comorbidity Study

MIS=Services data management information system

Emergency services

The measure for emergency services included counts of emergency room contacts, nights in an inpatient unit, residential detoxification center, or other emergency setting. These contacts were normalized to the number of contacts such that a single emergency room contact was analogous to a day in the hospital or detoxification center.

4.2.2 Housing status changes over time

As outlined in Section 2.5.1, homelessness can be considered as a transient state. This definition can be further operationalized as one of several states representing qualitatively different housing situations such as 'living on the street', 'living in shelters', and 'housed'. In this study, housing status was categorized in this manner as a nominal and time-changing variable. To obtain recent housing status, at each of the three interview time points subjects were asked "Where did you stay last night?" and "How long have you been staying there?". Answers were categorized into a range of possible answers as shown in Section 6.7 in Appendix A.

Living in one's own apartment or house and living with someone else was categorized as 'housed'. Staying in cheap motels, shelters, boarding houses, hospitals, or jails was considered as 'shelters or other institutions' (or 'shelters+'). Lastly, 'streets' status includes sleeping in parks, cars, abandoned buildings, and similar locations not designated for sleeping in. Subjects were also asked "In the past 12 months, which one of these places was your usual sleeping place?" and the same categorization strategy was used to create a usual housing status variable. As with the service use variables, when used as a covariate the housing status variables were recoded as dichotomous indicators of either shelter or street status (reference group is housed status).

After a number of preliminary analyses, comparing the usual housing status variable

and the recent housing status variable, it was determined that there was little if any difference in results between the two. Since the usual housing status variable was more stable (i.e. asked about the usual status over the previous year, rather than just the previous night or several nights) this was used exclusively in this study.

4.2.3 Demographics and background variables

Demographics

Information about race, gender, age, highest educational attainment, and marital status were collected at all time points when appropriate. The age variable was subtracted from the mean for the entire population and normalized using the standard deviation such that a value of 1.0 is one standard deviation above the mean. This strategy of mean centering can help improve the speed of convergence for complex models.

Background

A number of life history variables were used as background or control variables, following a number of other longitudinal studies that have indicated some relationships between similar constructs and either housing status or service use in homeless populations. Any history of a high school diploma or General Equivalency Diploma (GED) was used as a simple reflection of attending the most basic education. As an indicator of how connected an individual is with St. Louis and the surrounding area (and, by proxy, the local service system), a variable was created from the question "How long have you lived continuously in St. Louis?". Subjects that said they had lived in the St. Louis area for more than a year were considered to be more connected as local residents.

Also, a variable was created to control for weather effects at the time of the interview. It may be possible that the mix of individuals in shelters or on the streets may

have something to do with the temperature being particularly cold on given day. Daily weather data was downloaded from the National Aeronautics and Oceanic Administration (NOAA) for the entire period covered in this study. Interview dates were matched with these daily values and the resulting variable indicates when the daily average temperature below 40°F. Finally, a variable reporting any health problems that required treatment (over the past year) was included in the service use models.

4.2.4 Substance abuse and mental illness

Subjects who had an alcohol or cocaine diagnosis (abuse or dependence) were coded as 1 in for both lifetime and recent diagnosis variables. The lifetime measure of any diagnosis was used as a control variable and the changes over time were indicated by the measure of any diagnosis over the past year. This is a generally broad measure of substance abuse and should capture most individuals who are actively using while controlling for any past history of use. Also, the psychiatric definition of 'serious mental illness' was used to control for the influence of any lifetime history of a major affective disorder (i.e. Major Depression, Bipolar Disorder) or thought disorder (i.e. Schizophrenia) as defined by the DSM IV.

4.2.5 Marginalization variables

Indicators of marginalization are divided into three primary domains as outlined in Section 2.5.3. It should be noted that these domains are loose designations for the purpose of organization and inference, but are not, treated as latent constructs or even as necessarily separate processes.

Social

Current connections to family and friends are captured by the questions "Can you count on any of your relatives for help?" and "Do you have any friends you can count on for help?". These questions cover *current* social support at each interview time point. Also included is a measure of serious interpersonal conflicts experienced over the past year.

Legal problems and victimization

Questions about recent legal problems included current-pending charges and any detention (by law enforcement) reported over the previous month. Both of these questions are asked at all time points. Victimization refers to instances where the subject has been robbed over the past year. The robbery question was indicated as positive if the subject reported being robbed or mugged in the DIS interview or the legal history interviews, both of which ask similar questions. Unfortunately, there was no way to identify past year assault or rape history at baseline the question was stated slightly differently than for robbery, covering only lifetime assault and rape history.

Employment

Current connections with legal employment are indicated by two measures "currently working for pay" and, on the other side of the same concept, a question about all the sources of recent income. Illegal or non-standard sources of income such as selling drugs, prostitution, stealing, or panhandling were coded as 'shadow work'.

4.3 Analysis

Analysis of Aim 1 will examine the nature of marginalization and substance abuse within the adult homeless sample and bivariate associations with demographics and

background factors at each time point. Additionally, for each variable and time point, the number and patterns of missing variables are examined. These descriptive analyses provide valuable information for setting up the Bayesian models in later steps. Multi-state Markov models and count regression models were used to examine the hypothesized relationships related to Aims 2 and 3. The following sections provide a brief methodological overview.

4.3.1 Overview of Bayesian methods

Bayesian inference is at its most basic, a means to estimate the probability distribution for the parameters of interest (called the posterior distribution), conditional on the data, i.e. $p(\theta|D)$. This is the opposite of most frequentist types of statistical inference where p-values are used to determine the probability that the data occurred, conditional on a predetermined set of parameters and on the assumption that the observed data are one of many samples from the true population. The Bayesian posterior distribution is estimated as a combination of prior information about the parameters, $p(\theta)$, and the likelihood function, $p(D|\theta)$. One implication of this is that as the information from the data increases, the effect of the prior naturally becomes less influential and approaches the standard likelihood based estimates.

The inclusion of the prior probability term allows the researcher to both include information from previous research and to update the posterior distribution as new information is obtained. Additionally, the prior distribution for each parameter can be 'tailor fit' to accommodate a huge array of data and parameter types beyond the classic bell-shaped normal distribution. The information obtained from Bayesian methods is in the form of probability statements, reflecting the uncertainty inherent in the investigation of sociological processes. The utility of these methods have been demonstrated in a wide range of research applications and the methods have been outlined in a number

of excellent texts on the subject (Congdon, 2003, 2005; Gelman, 2004; Gill, 2002)

To explore each of the hypothesized relationships indicated above, a common three step process was employed (Gelman, 2004): (1) define the probability model to include observed and unobserved quantities of interest, (2) calculate the posterior distribution conditional on the data from the SUNCODA study, (3) evaluate convergence and model fit, (4) interpret parameter estimates.

4.3.2 Evaluation of convergence

Before interpreting parameter estimates produced from a Markov Chain Monte Carlo (MCMC) algorithm, we must first determine that the samples from the posterior distribution have converged properly. While there is no direct 'proof' of convergence, there are several indicators of non-convergence. Two common indicators of nonconvergence used in this study are Gelman and Rubin's multiple chain diagnostic (1992) and the Geweke Time-Series diagnostic (1992). Additionally, visual inspection of trace plots and autocorrelation plots and values can help with identification of non-convergence.

Gelman and Rubin's diagnostic calculates a 'shrink factor' for each monitored parameter that is essentially a form of ANOVA comparison of within chain variance and between chain variation. Shrink factor values approaching 1.0 indicate that both MCMC chains, after having started at different initial values and run for some number of cycles, are both sampling from the same distribution. This statistic can be produced for each parameter and as a summary for all the parameters in the model. Geweke's diagnostic evaluates single chains, comparing a window of samples from the beginning of the chain with those from the end of the chain using a simple comparison of means. The sample windows are typically drawn from the first 10% and the last 50% of the full sample chain.

4.3.3 Evaluation of model fit

Gelman (1996) proposed a simple comparison between the observed and predicted values for the outcome, called the 'posterior predictive check' (PPC). Values for this statistic that are at the close to the extremes of the zero to one range (i.e. below 0.1 or above 0.9) indicate that the new samples from the posterior density are not good matches with the observed values. This calculation can be done within the WinBUGS model. Probably the most used statistic used to compare models is the Deviance Information Criterion (DIC) as developed by Spiegelhalter (2002) and others. Like the Bayesian Information Criterion, the DIC is a correction of the unstandardized deviance ($-2\log[p(y|\theta]$) that uses an estimate of the total number of effective parameters in the model which often is not a simple count for complex or hierarchical models (Congdon, 2006).

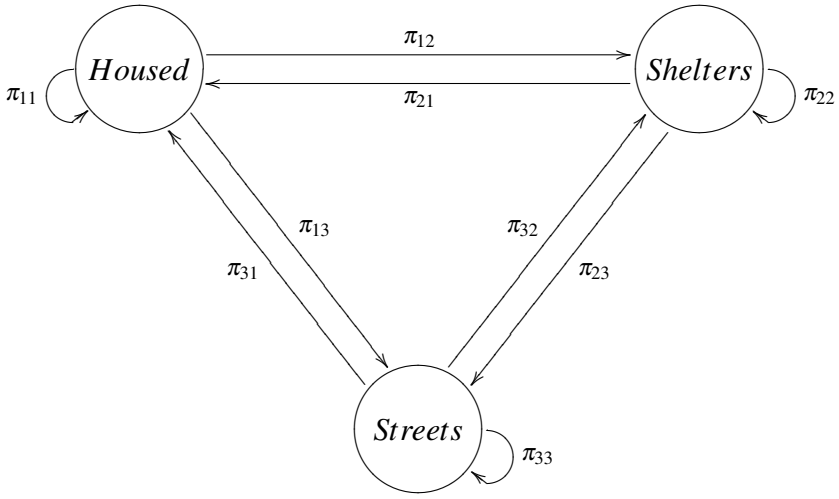
4.3.4 Multi-state Markov models

Transitions between homeless states such as living in shelter or on the streets to housed states can be investigated as a process of moving between one of a few discretely defined states for which information is observed at defined intervals. Multi-state transition models have been used to examine what factors affect the probability of going from a non-diseased to a diseased state or vise versa (Jackson, Sharples, Thompson, & Duffy, 2003; Hougaard, 1999; Congdon, 2005; Diggle, 2002).

The primary goal of this analysis is to investigate the transitions between housing status categories. The multi-state Markov model estimates the probability of making transitions between different states over some time period and the impact of covariates on these transition probabilities (Diggle, 2002; Frees, 2004). Transitions between different housing states (housed, streets, shelters) are assumed to follow a simple first-order Markov process with no constraints on transitions between the states in the the model,

meaning that individuals may move from any state to any other state in the two intervening time periods (see Figure 4.1). This is somewhat different than in many disease models where death of the individual represents and 'absorbing' state, so for example, finding independent housing may only be an intermittent state not necessarily the final and stable destination.

Figure 4.1: Housing State Transitions



When observations are made about the housing status y_{ij} of an individual i at some time j, the probability of making a transition between any two housing states (k, l) can be represented in a transition matrix:

$$P_{kl} = \begin{pmatrix} \pi_{11} & \pi_{12} & \pi_{13} \\ \pi_{21} & \pi_{22} & \pi_{23} \\ \pi_{31} & \pi_{32} & \pi_{33} \end{pmatrix}$$

Individual transition probabilities are contingent on the set of covariates in X_{ij} and the influence of these covariates can be estimated using a multinomial regression:

$$Multinomial\ Logit(\pi_{kl}) = X_{ij} \times B_{kl}$$
$$\pi_{kl} = Pr(y_{ij} = l | y_{ij-1} = k)$$

Because of the high likelihood of correlation between parameters for all the different combinations of transition probabilities, instead of a standard normal prior for parameters in the B_{kl} matrix, a multivariate normal prior is used with a fairly non-informative covariance term which is, in turn, drawn from a Wishart prior. This is similar to Sung's strategy for modeling mental health status changes over time (2007).

$$B_{kl} \sim MVN(\mu_{ij}, W_{kl})$$
$$W_{kl} \sim Wishart(R, 3)$$

Where R is a scale matrix for the Wishart prior and was assumed to be diag(0.01, 0.01, 0.01) which indicates a relatively high degree of uncertainty about the covariance between parameters in the model.

4.3.5 Regression models for count data

The most common way to account for the skewed distribution of count data is to use a Poisson regression model. In the current study, service counts, y_{ij}, could be understood as coming from a Poisson distribution with parameter λ_{ij} which is related to covariates

X_{ij} and to a set of estimated parameters B by a log linked general linear model. For all the following model statements i indexes the subject and j indexes the time point.

$$y_{ij} \sim \text{Poisson}(\lambda_{ij})$$

$$\log(\lambda_{ij}) = X_{ij} \times B$$

The Poisson model is based on the assumption that the λ_{ij} parameter of counts is equal to the variance, which is very unlikely considering both the hierarchical nature of the data over two time points and the high number of zero values in the data. When the variance exceeds λ_{ij} , this is referred to as over dispersion and can often be appropriately handled via a number of alternative parameterizations such as the negative binomial (NB), poisson-gamma (PG), or zero-inflated versions of the NB and PG models. A brief examination of the routine and emergency service counts over both time periods show anywhere from 41% to 76% of the subjects had no services that were accounted for in the MIS administrative database.

While a large portion of these zero counts may be due to the fact that these individuals received no services at all during the time interval in question, another possible explanation is that the service use of these individuals was not captured by the MIS database. For example, subjects may have been in prison, moved away, or used services that are not part of the database. These zero counts are considered 'excess zeros' in that they are in excess of what would be expected for this population assuming a standard poisson-gamma distribution of counts (Congdon, 2005). Just as covariates may be included as predictors of overall service counts, the probability of an excess zero may be associated with covariates as well. In this case, the most likely cause is attrition, so a variable is included that indicates whether a subject was interviewed at the time point at the end of the one year interval for the service count. The standard poisson model

can the be considered as a mixture of a bernoulli probability of excess zeros (π_{ij}) and normal poisson counts (Ghosh, Mukhopadhyay, & Lu, 2006; Ntzoufras, 2009).

One of the advantages of working within a Bayesian framework is that the same model can be specified in a number of ways; first by changing prior distributions and second by adding levels of analysis (i.e. hierarchical models). In the example of the over-dispersed Poisson model, the λ_{ij} parameter can be considered as coming from a gamma distribution, resulting in the Poisson-gamma model (Congdon, 2005). Using the gamma distribution at the second level allows specification of a separate parameter δ that may vary at the individual level or between time points. As delta approaches the value of 1, this model becomes a simple Poisson model. Additionally, the gamma distribution is considered a conjugate prior for the Poisson distribution, meaning that the posterior and the prior come from the same distributional family, resulting in an analytically tractable solution[1]. The inverse of δ is analogous to the dispersion parameter reported in other software packages that use a 'quasi-poisson' model.

[1]The values that determine the shape of the Gamma distribution of δ_j values, Gamma(C, D) were used in this case as 'tuning parameters' rather than as broadly uninformative priors. A range of values were used for C and D. Final values were chosen that reduce the likelihood of producing sampling errors and that also improved overall model fit

Combining the Poisson-gamma and the zero-inflated models can be done in the following way:

$$
\begin{aligned}
y_{ij} &\sim \text{Poisson}(\mu_{ij}) \\
\mu_{ij} &= (1-u_{ij}) \times \lambda_{ij} \\
u_{ij} &\sim \text{Bernoulli}(\pi_{ij}) \\
logit(\pi_{ij}) &= c \times interviewed_{ij} \\
\lambda_{ij} &\sim \text{Gamma}(\nu_{ij}\delta_j, \delta_j) \\
\log(\nu_{ij}) &= X_{ij} \times B \\
\delta_j &\sim \text{Gamma}(C, D)
\end{aligned}
$$

This model allows the different time points to have different levels of dispersion indicated by δj as well as allowing for the possibility of zero-inflation for any individual and time point. Again, the covariates are assumed to have a log-linear relationship with the count parameter (ν_{ij}). The utility of the Poisson, and a number of other models including the PG, the ZIPG, the NB, and the ZINB were considered and compared using the Deviance Information Criterion and the PPC when possible.

4.3.6 Missing data

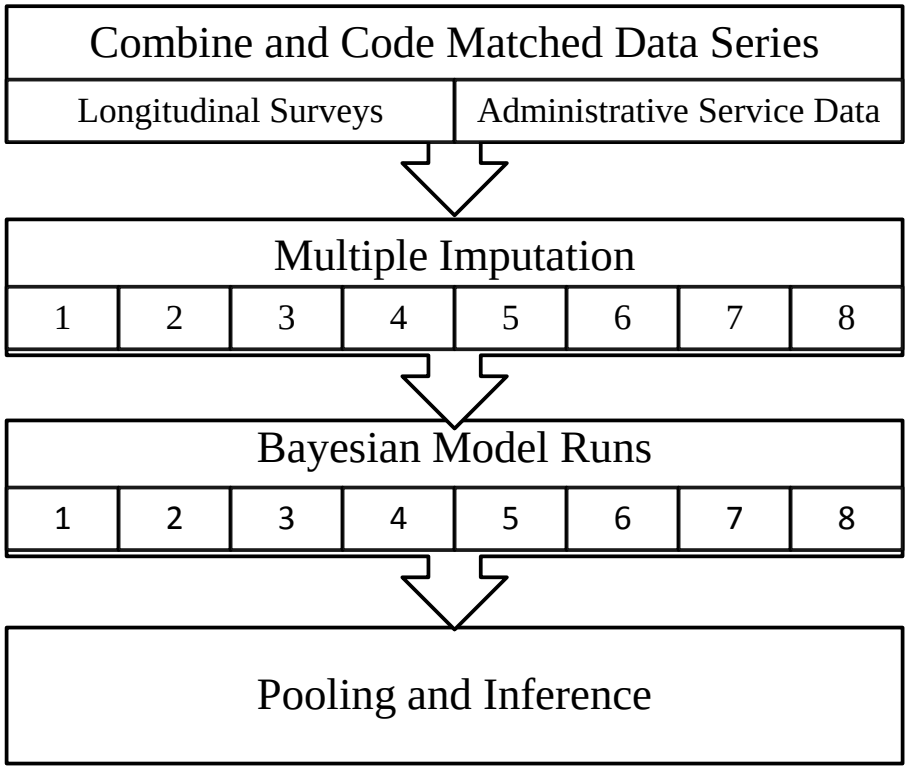
Most methods for parameter estimation assume that any missing data is missing completely at random (MCAR) and therefore can be safely ignored in the estimation process. When this assumption is violated, biased estimates can result (Little & Rubin, 1987). Missing data can then be handled directly as part of the Markov chain Monte Carlo (MCMC) algorithms used for estimating the Bayesian models or via multiple im-

putation as outlined in Schafer (1997).

Due to the complexity of the models shown above, a multiple imputation approach was adopted as a way of handling missing covariate information. Direct incorporation of a missingness mechanism for covariates into the WinBugs models requires the designation of an appropriate multivariate distribution that includes every covariate along with the outcome which would make for an unduly complex and intractable model. The R package `mice` (Multivariate Imputation by Chained Equations) was used to generate 8 imputed datasets from the original data. This program uses a Gibbs sampler to produce random samples for each missing value fully conditional on all the other included covariates (Van Buuren & Oudshoorn, 2000).

The process starting with data screening and recoding, imputation, analysis, and then inference is shown in Figure 4.2. Regression models are independently run on each imputed data set and then the imputation results are pooled into a single set of estimates and standard error estimates which are corrected to reflect what is essentially the variance of all the variances of all of the imputations.

Figure 4.2: Overview of Analysis Plan



4.3.7 Software

Recoding, descriptive analysis, and other data manipulation was completed using the `R` statistical language, version 2.7.0 (Ihaka & Gentleman, 1996) and Bayesian analysis used the WinBUGS, version 1.4.3 software where appropriate (Spiegelhalter, Thomas, Best, & Lunn, 2003) or another Gibbs sampling based program called `JAGS` which operates in a unix environment (Plummer, 2003).

Chapter 5

Results

This chapter will present the results for the data assessment and screening process along with the formal regression models. Additional information about model development, convergence, and output, including examples of programming code can be found in Appendix A.

5.1 Missing data

Data can be missing for a number of reasons, here we address the two primary issues with this longitudinal data set: missing interviews at particular time points (attrition) and missing values at each time point for subjects that were interviewed (Non-response). Regarding attrition, it should be noted that a number of subjects missing for the year 1 interview ($n = 112$ or 71.2% of total) were later interviewed at Year 2 ($n = 28$ or 25% of year 1 missing). As noted in (North et al., 2005), there were no significant differences among demographic variables when comparing missing with non-missing subjects in this data set. This is also reflected in Table 5.1 which shows little difference in the demographic and background profiles of the subjects that were interviewed at each time

point compared to baseline.

Table 5.1: Baseline Demographics by Interview for Non-imputed Data

	Baseline	Year 1	Year 2
	$N = 394$	$N = 282$	$N = 279$
White	18% (72)	17% (48)	19% (53)
Male	75% (296)	73% (207)	73% (204)
Age	35 42 48	35 42 48	36 42 48
Married	6% (22)	3% (9)	6% (17)
Diploma	53% (209)	54% (152)	52% (146)
Local Resident	86% (339)	90% (254)	91% (253)
Alcohol Diagnosis Hx	61% (242)	60% (170)	61% (170)
Cocaine Diagnosis Hx	44% (172)	46% (130)	45% (126)
Serious Mental Illness Hx	50% (196)	50% (141)	49% (138)
Abuse-Neglect Hx	29% (113)	29% (83)	29% (81)
Conviction	54% (211)	56% (157)	54% (150)

Hx = Lifetime History

It is also important to look at response patterns among the variables for those that were interviewed. Generally, non-response rates were relatively low for all variables used in these models with the exception of the 'support from friends' variable (30% overall rate of non-response), 'lifetime history of panhandling' (12% overall rate of non-response), and the 'history of abuse or neglect' variable (8% overall rate of non-response). Table B-1 in Appendix B shows univariate proportions of each variable at each time point only for individuals that were interviewed (i.e. did not drop out) including the proportion of non-responders to that particular question in the survey.

Since there are missing covariates for some of the variables included in the regression models, eight imputed data sets were simulated using a multivariate chained equa-

tion (mice) program. For imputation at each time point, all baseline demographic variables were entered into the mice sampler along with other modeled variables for that particular time point. These imputed data sets matched the overall univariate proportions at each time point almost perfectly for all the modeled covariates (see Table B-2 in Appendix B).

5.2 Variable Descriptions

As noted all the covariates used here are dichotomous (coded 0-1) with the exception of the Age variable and the outcome variables (service counts and housing states). Regarding the baseline demographic and background variables a few patterns were evident. First, a high proportion of these subjects have a lifetime diagnosis histories of alcohol (61%), cocaine (44%), or serious mental illness (49%). Additionally, a significant proportion have a history of being robbed (27%) in the year prior to the baseline interview. Anywhere from 6% to 9% had pending charges at the time of interview, 45% had a lifetime history of felony convictions, and anywhere from 7% to 11% of subjects reported being detained in the past month. These values can be seen the descriptions of imputed data (Table B-1) in Appendix B.

5.2.1 Housing status

Table 5.2 shows the proportion of subjects in each housing state for all three time points. Over 80% of subjects were interviewed in shelters at baseline, but only half of that number were in shelters over the previous year. There is a clear trend towards housing for all individuals in the study, although these may be transient changes as the numbers that remain in shelters as their usual residence over the three interviews is relatively stable.

Table 5.2: Past Year Housing States at all Interviews

	BL	Y1	Y2
Housed	40%	49%	60%
Shelters+	43%	40%	30%
Streets	17%	12%	10%

5.2.2 Service utilization

The service use count variables for routine and emergency type services were not imputed since they cover the entire time period and do not depend on whether interviews were completed or not. Service counts represent counts between two 12 month time intervals, Baseline to Year 1 ($BL \rightarrow Y1$) and Year 1 to Year 2 ($Y1 \rightarrow Y2$). Mean, variance, maximum values, and the proportion of zero values are shown in Table 5.3. Generally, service counts are lower in the second time interval compared to the first for both emergency and routine services. The variance is much higher than the mean values in all cases and the maximum values are also very dispersed.

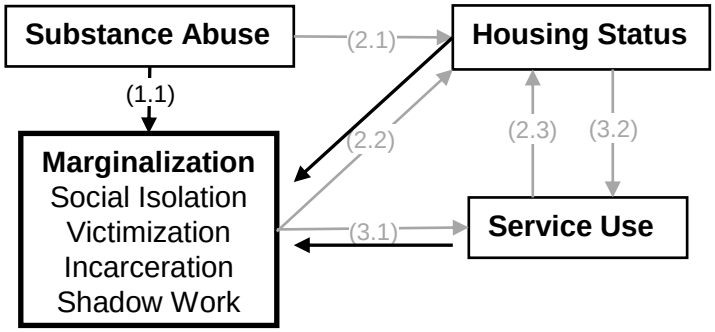
Table 5.3: Descriptive Statistics for Routine and Emergency Services

	Routine		Emergency	
	$BL \rightarrow Y1$	$Y1 \rightarrow Y2$	$BL \rightarrow Y1$	$Y1 \rightarrow Y2$
Mean	11.71	3.84	4.55	1.59
Variance	838.35	157.50	138.31	37.96
Maximum	274	143	91	57
Proportion Zeros	0.41	0.61	0.59	0.76

5.3 Aim 1: Substance Abuse and Marginalization

The first set of analyses focuses on relationships between recent substance abuse and the identified domain of marginalization discussed in Chapters 1-3.

Figure 5.1: Modeled Relationships for Aim 1



Convergence and model fit

Individual logistic regression models were developed using each of the marginalization variables as outcomes to determine what, if any, associations exist between cocaine and alcohol abuse and these domains of marginalization. After an initial burn-in period of 10,000 iterations, an additional 5,000 samples were collected from each posterior. Every model ran relatively quickly and showed no signs of non-convergence using the Gelman-Rubin or Geweke statistics. As with all the regression models, this process was repeated for each imputed data set and the results presented here are for the pooled parameter estimates and corrected standard errors. Values for the Posterior Predictive Checks ranged from 0.50 to 0.53, indicating a close match between the observed data and the predicted values from each logistic model.

5.3.1 Inference from pooled imputations

Parameter estimates for the logistic regression of marginalization and background variables on shadow work and conflicts are shown in Figures 5.2 and 5.3. Points in these figures represent the mean and bars represent the 95% credible regions around the mean of the pooled estimates. The regression results for the other marginalization variables (employment, support, legal problems, and victimization) are located in Appendix B. Only parameters that have credible intervals not including zero are reported and to simplify inference, the values reported below are exponentiated values (e^{β}).

Recent diagnosis of an alcohol use disorder approximately doubled the probability of several of the marginalization variables including interpersonal conflicts (probability increased by a factor of 2), pending charges (↑ 2.09), being detained (↑ 1.90), being robbed (↑ 2.21), and engaging in shadow work (↑ 1.99). The cocaine use disorder variable typically had higher variance values and was consequently only an important predictor of pending charges (↑ 1.79) and shadow work (↑ 2.19). With the exception of a recent cocaine diagnosis there was little or no association between substance abuse and reported support from family or friends. A recent cocaine diagnosis decreased probability of reported support from family members by about 30%.

Beyond the effects of alcohol and cocaine, the variable indicating a subject was living on the streets was associated with a number of marginalization variables including higher probabilities of pending charges (probability increased by a factor of 2.93), being detained (↑ 1.85), and shadow work (↑ 6.90). This same variable was associated with lower probabilities of standard employment (decrease of 76%), support from family members (↓ 54%) , and interpersonal conflicts (↓ 44%).

Figure 5.2: Impact of Recent Substance Abuse on Shadow Work

	Estimate	SE
Alcohol Diagnosis	0.6878	0.0247
Cocaine Diagnosis	0.7817	0.2764
Age	−0.5673	0.0633
White	−0.7399	0.1946
Male	0.0236	0.1830
Diploma	−0.1674	0.1448
Married	−0.1051	0.2198
Abused as Child	0.5684	0.0195
Local Resident	−1.0589	0.1610
Alcohol Diagnosis Hx	0.4275	0.1166
Cocaine Diagnosis Hx	1.0682	0.2029
Serious Mental Illness Hx	−0.3568	0.1321
Health Problems	0.0826	0.1157
Conviction Hx	1.4450	0.2195
Living on the Streets	1.9310	0.3429
Living in Shelters	0.5615	0.2750

PPC = 0.53; Deviance = 418
Dark lines represent 95% credible region

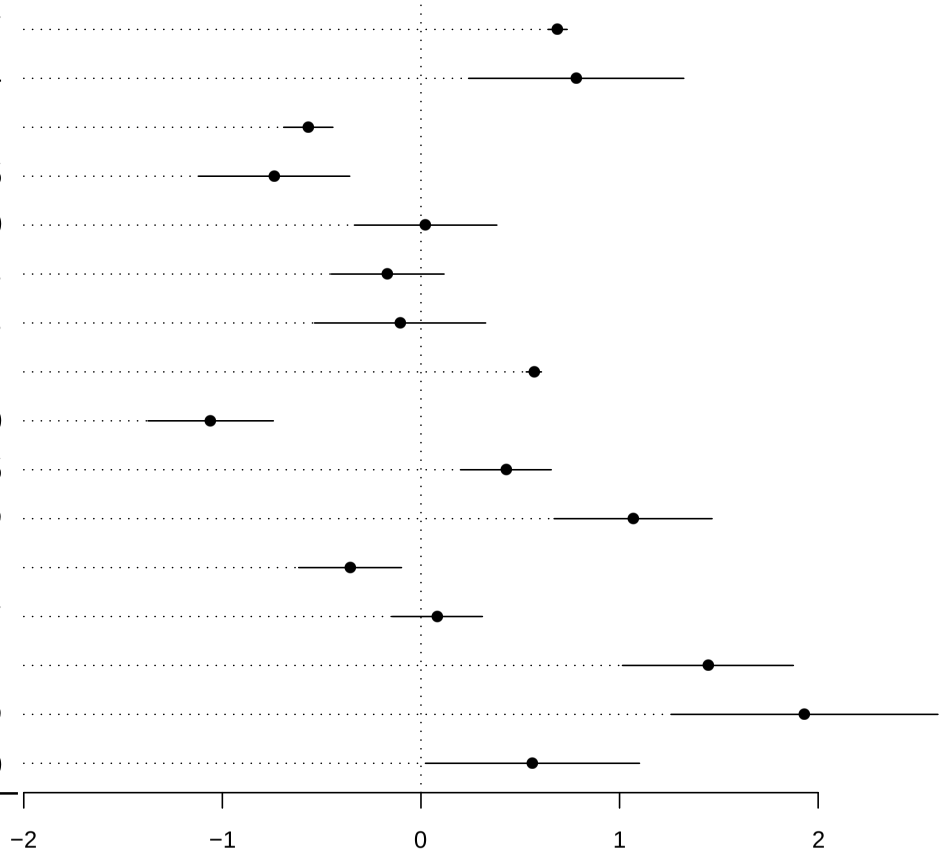
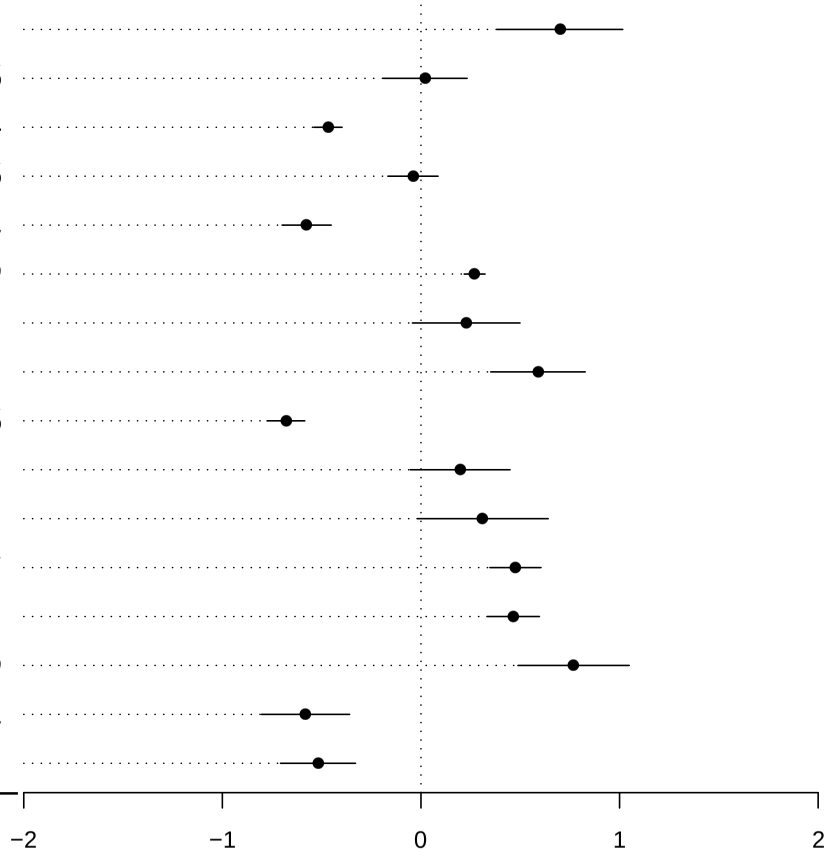


Figure 5.3: Impact of Recent Substance Abuse on Interpersonal Conflicts

	Estimate	SE
Alcohol Diagnosis	0.6996	0.1615
Cocaine Diagnosis	0.0215	0.1076
Age	−0.4682	0.0364
White	−0.0401	0.0646
Male	−0.5756	0.0632
Diploma	0.2703	0.0269
Married	0.2279	0.1383
Abused as Child	0.5892	0.1215
Local Resident	−0.6800	0.0486
Alcohol Diagnosis Hx	0.1974	0.1283
Cocaine Diagnosis Hx	0.3104	0.1685
Serious Mental Illness Hx	0.4759	0.0657
Health Problems	0.4644	0.0675
Conviction Hx	0.7686	0.1429
Living on the Streets	−0.5810	0.1132
Living in Shelters	−0.5183	0.0965

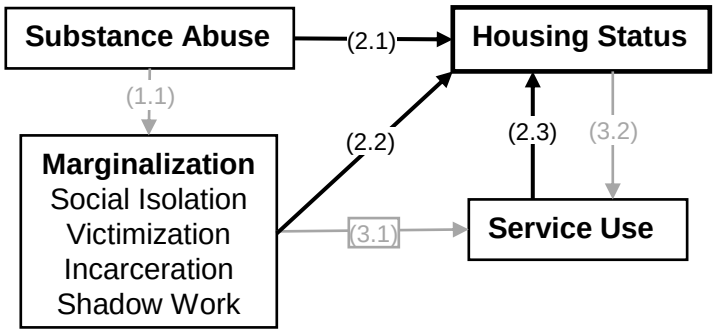
PPC = 0.51; Deviance = 1204
Dark lines represent 95% credible region



5.4 Aim 2: Housing Status Changes

This section reports results from looking at how subjects in this study moved between street, shelter, and housed states over course of two years. The probability of each type of state to state transition has been modeled and regressed on covariates related to substance abuse, marginalization, and services use as seen in figure 5.4 below.

Figure 5.4: Modeled Relationships for Aim 2



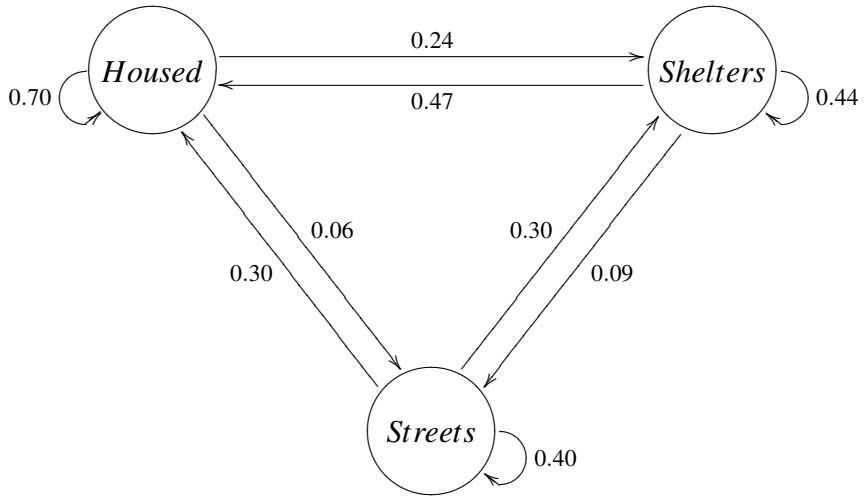
5.4.1 Base model of transition probabilities

Before looking at multivariate models of housing status changes over time, a base model predicting the probability of each transition was estimated using the marginalized table of all possible transitions. This model converges quickly and produced consistent results whether using imputed data or the original non-imputed data for housing status changes over the three time periods.

Probabilities for each transition state change for the reported usual housing statues over for the prior year are shown in Figure 5.5. Over time, there was a general movement towards housing (state 1) as is seen in the higher probabilities for going from shelters (state 2) and streets (state 3) to housing ($\pi_{21} = 0.47$ and $\pi_{31} = 0.30$, respectively) and a

high probability of staying housed ($\pi_{11} = 0.70$). There was a relatively small probability of anyone moving to the streets during the two years of the study. Individuals who were already on the streets or in shelters, generally had a slightly less than 50% chance of staying in their current homeless states.

Figure 5.5: Base Model of Housing State Transitions



5.4.2 Markov models with covariate dependance

Covariates related to substance abuse, marginalization and background information were then added in as predictors for each of these transition probabilities in another series of multinomial regressions on each of the imputed data sets independently. After the Markov chains were evaluated as stable, parameter estimates were pooled. Assessment of parameters will focus primarily on the transitions of interest: movement towards housing, to the streets, and staying homeless (streets or shelters).

5.4.3 Convergence and model fit

Overall convergence rates were slow with these models, primarily due to the very high dimensionality of the parameters to be estimated. Considering that all transitions were allowed in the proposed models, the resulting transition matrix has 3^3 possible transitions multiplied by 25 covariates gives 225 modeled parameters just in the B matrix. As might be expected there was a moderately high degree of covariance between these parameters for very similar transitions (i.e. streets to shelters and staying on the streets) which can also slow convergence due to the many possibilities for autocorrelation. The addition of a multivariate prior on all of the parameters which allows some degree of covariance did improve the chain convergence rates.

Each of the imputed data sets was run separately and evaluated for convergence. All models showed stability after a 30,000 initial burn-in period. After this, 5000 additional samples were collected and pooled for inference. The Gelman-Rubin shrink factors for all parameters were below 1.10. There were a few parameters that showed some significant autocorrelation (i.e. between 0.2 and 0.5), but running the model 50,000 or 100,000 more iterations had little effect on these parameter values. To reduce autocorrelation and improve mixing, the 'over relax' feature was used in WinBUGS for the last set of samples used for inference. This algorithm takes multiple samples at each iteration and chooses the sample with a low amount of correlation with the previous sample for that parameter (Neal, 1998).

5.4.4 Inference from pooled imputations for usual housing status

Inference will focus on the particular transitions of interest described in the aims of this study. First looking at transitions to housing from homeless states and staying housed, we find little if any effect of recent alcohol or cocaine abuse. Subjects moving from

shelters to housing over the the two years tend to have more family support and use a higher level of routine services. Staying housed is associated with having a diploma, being from the local area, and having no lifetime history of convictions.

Transitions in the opposite direction (towards the streets or staying on the streets) have a very different profile. Not being from the local area, not having friends or family to count on, being unemployed, and using alcohol or cocaine are all associated with moving from the housed to street status. Figures 5.6 and 5.7 show parameter estimates for transitions to street status. As above, the remaining tables can be found in Appendix B.

Figure 5.6: Probability of Moving from Housing to Streets

	Estimate	SE
Recent Alcohol Diagnosis	0.1379	0.0551
Recent Cocaine Diagnosis	0.3111	0.1523
Count on Friends	−0.6956	0.1375
Count on Family	−0.5146	0.1637
Conflicts	−0.3570	0.2372
Employed	−0.6556	0.1169
Shadow Work	0.3891	0.2830
Charges Pending	0.2504	0.1285
Detained	−0.0972	0.1318
Robbed	0.0951	0.2075
Routine Services (L)	0.0749	0.1425
Routine Services (H)	−0.1019	0.0970
Emergency Services (L)	0.0980	0.1497
Emergency Services (H)	−0.1956	0.0374

Dark lines represent 95% credible region

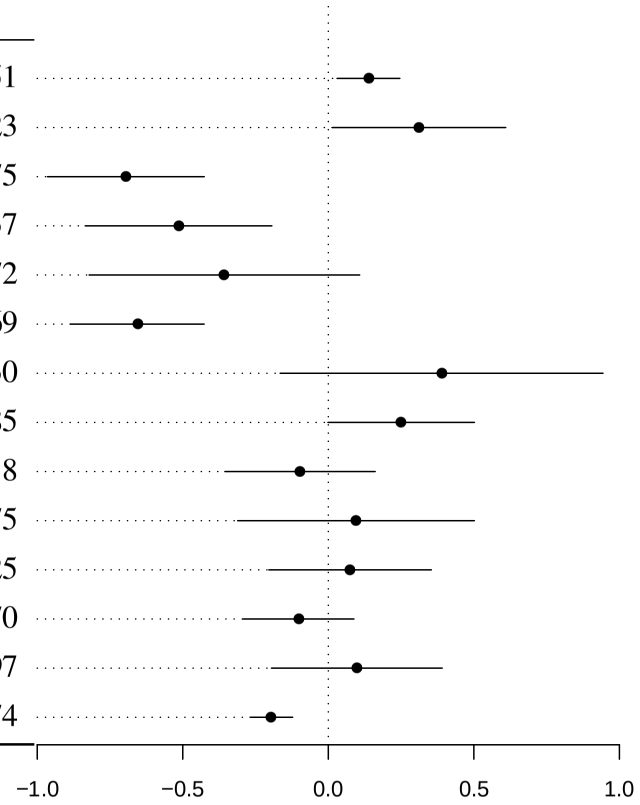
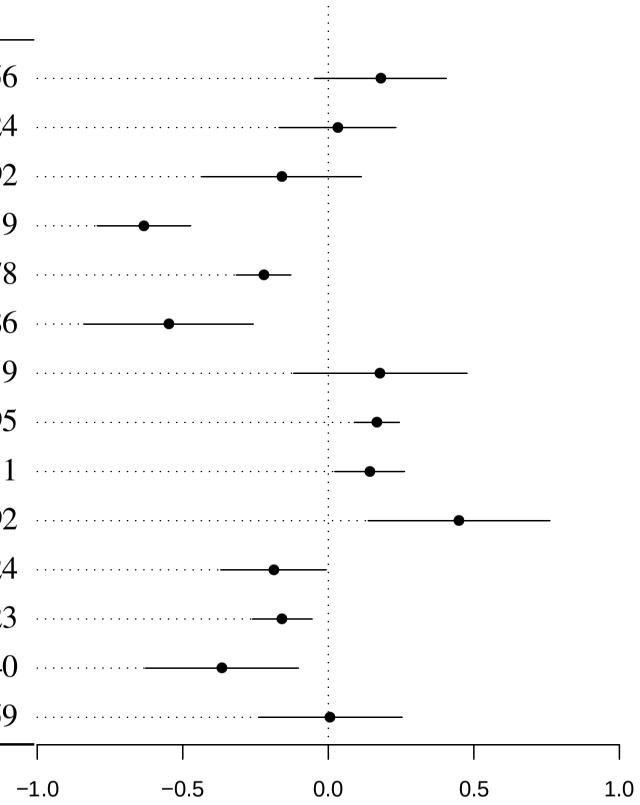


Figure 5.7: Probability of Moving from Shelters to Streets

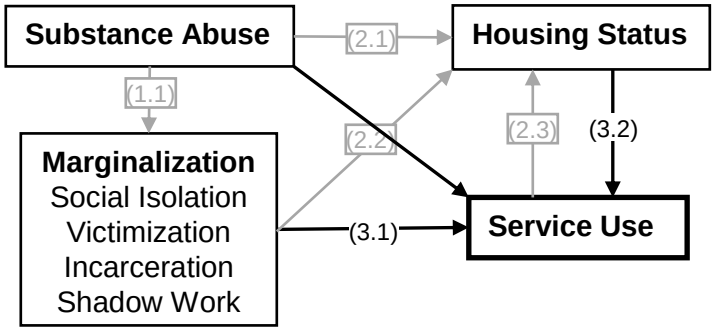
	Estimate	SE
Recent Alcohol Diagnosis	0.1792	0.1156
Recent Cocaine Diagnosis	0.0315	0.1024
Count on Friends	−0.1593	0.1392
Count on Family	−0.6334	0.0819
Conflicts	−0.2225	0.0478
Employed	−0.5490	0.1486
Shadow Work	0.1789	0.1519
Charges Pending	0.1668	0.0395
Detained	0.1419	0.0611
Robbed	0.4491	0.1592
Routine Services (L)	−0.1883	0.0924
Routine Services (H)	−0.1580	0.0523
Emergency Services (L)	−0.3652	0.1340
Emergency Services (H)	0.0070	0.1259

Dark lines represent 95% credible region



5.5 Aim 3: Models of Service Use

The multivariate models for emergency and routine service used a similar set of predictors as the Markov models above with a few notable exceptions. First, the service covariates were replaced with indicators for shelter or street status (usual-past year) and an extra background variable was included indicating whether subjects reported any health problems over the previous year.



5.5.1 Model testing and comparison

Starting with a base model of service counts regressed on background covariates using a Poisson log-linear model, several models were tested for how well they fit the data. As indicated by smallest values for the Deviance Information Criterion and Posterior Predictive Check values well away from the extremes of 0 or 1 ($PPC = 0.33$), the zero inflated version of the Poisson Gamma (PG) model was the best fit for the over-dispersed service count data when compared to the Poisson, the negative binomial (NB) or the zero inflated negative binomial (ZINB) models. A large negative value for the 'Interviewed' parameter ($\beta = -9.0$) indicated that attrition has a strong impact on the probability of excess zero values beyond that predicted by the Poisson Gamma distribution alone. Further analysis of the count data for both routine and emergency services will be using

the zero inflated Poisson Gamma model (ZIPG).

5.5.2 Convergence and model fit

The ZIPG models performed well and all the monitored parameters converged to stable values within 20,000 iterations. Models were run for an additional 20,000 iterations and samples collected for the parameters of interest, the zero inflation parameter, dispersion parameters, and the PPC. The Gelman-Rubin statistics were all close to 1.0 and the Geweke diagnostics were within the acceptable range, indicating a high probability of stationary posterior densities. The PPC values ($PPC_{Routine} = 0.32$ and $PPC_{Emergency} = 0.42$) were also within the acceptable range, indicating that the posterior samples matched the observed data fairly well.

As expected from the initial exploratory analysis, there was a high amount of overdispersion which was confirmed by the high α values for each time point for routine services ($\alpha_1 = 33$ and $\alpha_2 = 54$) and for emergency services ($\alpha_1 = 21$ and $\alpha_2 = 39$). Finally, the single parameter predicting a probability of excess zeros (interview status) had relatively high values for both routine and emergency service counts, adding support to the choice of the zero inflated model.

5.5.3 Inference from pooled imputations

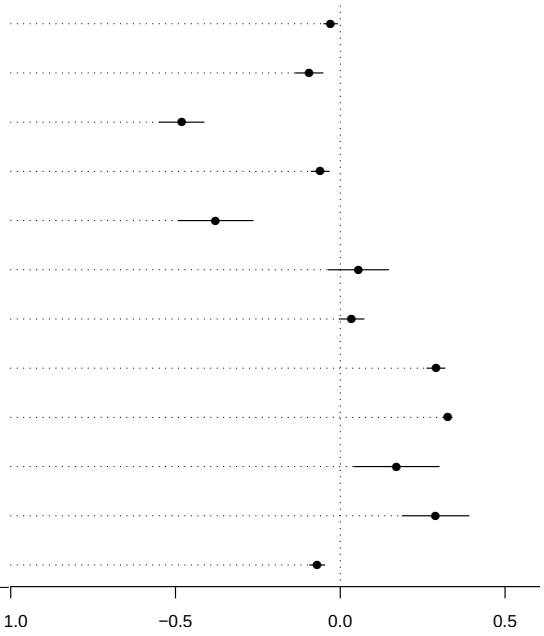
Routine services

When adjusting for the background variables, both of the recent substance use disorder variables were related to routine services used. A recent alcohol use disorder was associated with around a 11% decrease in routine services use and a recent cocaine use disorder diagnosis with a 35% increase. Beyond the effects of recent substance use disorders, several other variables were associated with *lower* levels of engagement in

routine services including being engaged in shadow work (↓ 26%) , living on the streets (↓ 25%) , and having support from relatives (↓ 15%) . The parameter estimates and associated 95% credible regions can be seen in Figures 5.8 and 5.9.

Figure 5.8: Background Parameter Estimates for Routine Service Counts

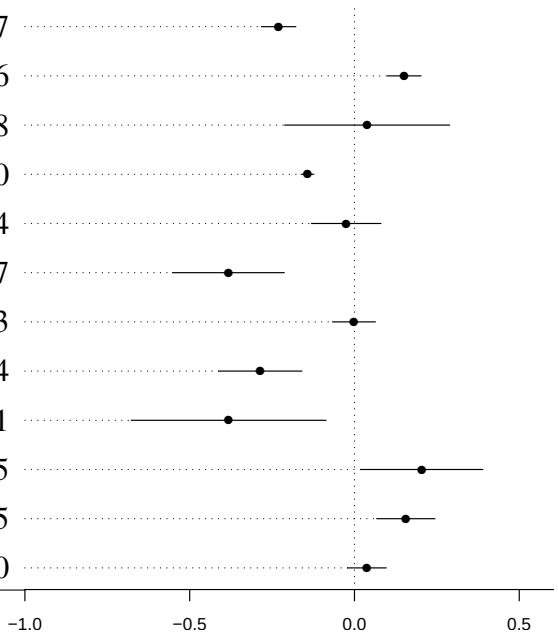
	Estimate	SE
Age	-0.029	0.010
White	-0.094	0.021
Male	-0.481	0.034
Diploma	-0.061	0.014
Married	-0.378	0.058
Abused as Child	0.055	0.047
From Local Area	0.034	0.019
Alcohol Diagnosis Hx	0.290	0.014
Cocaine Diagnosis Hx	0.326	0.007
Mental Health Hx	0.171	0.066
Health Problems	0.289	0.052
Conviction Hx	-0.070	0.012



PPC = 0.33; Deviance = 1912; $\alpha_1 = 33.0$, $\alpha_2 = 53.0$
Dark lines represent 95% credible regions

Figure 5.9: Parameter Estimates for Routine Service Counts

	Estimate	SE
Recent Alcohol Diagnosis	-0.230	0.027
Recent Cocaine Diagnosis	0.151	0.026
Count on Friends	0.039	0.128
Count on Family	-0.142	0.010
Employed	-0.025	0.054
Shadow Work	-0.383	0.087
Living in Shelters	-0.002	0.033
Living on the Streets	-0.286	0.064
Detained	-0.382	0.151
Charges Pending	0.204	0.095
Conflicts	0.156	0.045
Robbed	0.038	0.030



Emergency services

A recent cocaine diagnosis (but not alcohol diagnosis) predicted a 25% increase in emergency service contacts. Lower emergency services use, on the other hand, was associated with being employed (↓ 14%) , engaging in shadow work (↓ 45%) , living on the streets (↓ 26%) or shelters (↓ 15%) , and having pending charges (↓ 34%). As with routine services, recent health problems and lifetime histories of alcohol, cocaine, or serious mental illness all were associated with higher emergency services use. These parameter estimates can be seen in Figures 5.10 and 5.11. All of these relationships take into account control variables for demographics, previous substance use disorders, previous mental health and other health problems.

Figure 5.10: Background Parameter Estimates for Emergency Service Counts

	Estimate	SE
Age	-0.156	0.011
White	-0.061	0.016
Male	0.072	0.021
Diploma	0.070	0.014
Married	-0.160	0.073
Abused as Child	0.159	0.041
From Local Area	0.217	0.024
Alcohol Diagnosis Hx	0.109	0.035
Cocaine Diagnosis Hx	0.039	0.025
Mental Health Hx	0.458	0.026
Health Problems	0.282	0.058
Conviction Hx	-0.166	0.030

PPC = 0.42; Deviance = 1199; $\alpha_1 = 21.0$, $\alpha_2 = 39.0$

Dark lines represent 95% credible regions

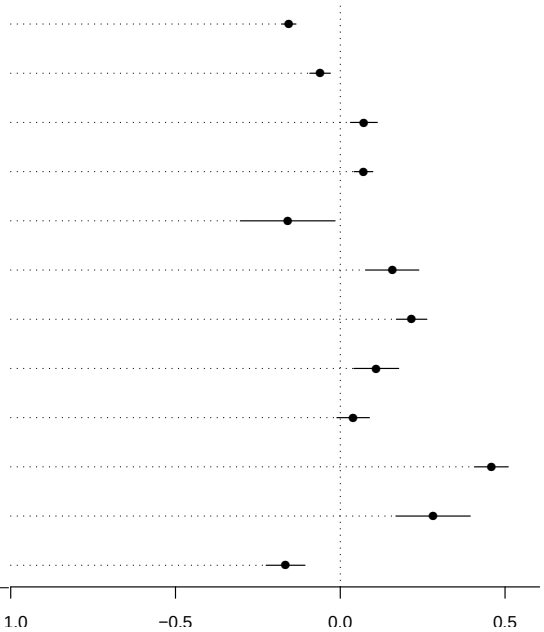
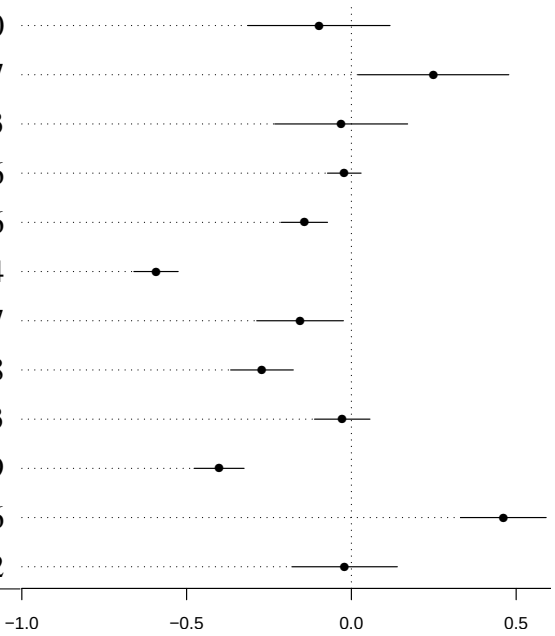


Figure 5.11: Parameter Estimates for Emergency Service Counts

	Estimate	SE
Recent Alcohol Diagnosis	-0.098	0.110
Recent Cocaine Diagnosis	0.249	0.117
Count on Friends	-0.031	0.103
Count on Family	-0.021	0.026
Employed	-0.142	0.036
Shadow Work	-0.593	0.034
Living in Shelters	-0.156	0.067
Living on the Streets	-0.271	0.048
Detained	-0.028	0.043
Charges Pending	-0.401	0.039
Conflicts	0.461	0.066
Robbed	-0.020	0.082



5.6 Summary

We have looked at the relationships between homelessness, marginalization, and substance abuse at a univariate and multivariate level, at each point taking into account changes over time. The complex nature of the data series, non-standard distributional assumptions, and missing data have been addressed through the use of a Bayesian modeling strategy and multivariate imputation. Although these models are fairly robust in terms of the consistency of results over multiple runs and imputed data sets, there are a number of limitations which will be discussed in the next chapter.

Chapter 6

Discussion

The overarching aim of this study is to investigate the complex relationships between substance abuse and marginalization, and how these impact service use and housing status changes over time. A Bayesian modeling strategy was adopted as it provided a flexible and transparent framework for addressing highly dimensional and hierarchical relationships. This discussion will focus on results which are relevant to both practice and methodology. First we will examine some of the hypothesized relationships that were initially proposed for each aim and then discuss the implications for future research and practice.

6.1 Aim 1: Marginalization and substance abuse

H1.1: Type of substance dependence will be associated with unique patterns of demographics and marginalization variables. For example, previous studies have indicated that alcohol dependent individuals tend have a lower likelihood of employment and have fewer supportive social contacts.

6.1.1 Alcohol and cocaine abuse

Results from this series of logistic regressions reiterated the notion that alcohol abuse is broadly associated with many of the legal and interpersonal problems that are attached to homeless states. Homeless adults who abuse alcohol seem to be more marginalized within the legal system that surrounds them. Engaging in shadow work such as panhandling, prostitution, and selling drugs most likely goes hand in hand with increased scrutiny and involvement with law enforcement resulting in the reported higher rates of being detained and having pending charges. These results match O'Toole's finding that stealing for money is associated with higher rates of alcohol use among homeless adults (2004).

It would be difficult to disentangle the causal relationship between alcohol use and shadow work, even with multiple time point data due, in part, to the necessarily spatial quality of the homeless state. As Snow has pointed out, much of the criminal activity associated with being homeless (especially living on the streets) may be survival strategies that are necessitated by the same harsh and stressful environment that, he says, induce higher rates of alcohol and drug use as coping mechanisms (1993). In the current study, recent alcohol abuse was also associated with a higher probability of being victimized by robbery over time which by many accounts can be the second side of the same coin-namely a less secure environment across all the domains indicated earlier (physical, social, legal, and financial).

There were clear differences in the effects of alcohol and cocaine on different domains of marginalization. A recent alcohol abuse or dependance diagnosis was associated with a number of marginalization indicators *except* support from friends and family and standard employment (quite different than the above speculation in H1.1). Interestingly, alcohol abuse did predict higher probabilities of reporting interpersonal conflicts. It is unclear why alcohol use might predict higher rates of interpersonal conflict, but

have no direct effect on reports of social support from friends or family. It may be that alcohol use changes the nature of the social relationship (i.e. more conflicts), not necessarily the frequency or existence of basic supportive relationships. So, to summarize, there were distinct patterns as predicted, but not necessarily in line with some prior reports about the relationship between alcohol use and social support or employment.

6.1.2 Demographics, background, and housing

Living on the streets or in shelters both predicted lower probabilities of reporting support from family or friends over the course of the study period. These results are similar to much of the early work on homeless populations of the 1960's and 1970's where homelessness was essentially defined as primarily a state of disaffiliation and social isolation (Bahr, 1973; Wallace, 1965).

When comparing different effects across all the different domains of marginalization modeled in this study, living on the streets (and to a lesser extent living in shelters) was the most consistently significant predictor. Living on the streets was associated with unemployment, social isolation, pending charges, recent detainment, shadow work, and conflicts when controlling for a number of other background and demographic factors. This suggests a unique population living on the streets when compared to the 'transiently homeless' that may cycle in and out of housing states over time. A number of studies have underlined the importance (and difficulties) of understanding and reaching the 'chronically homeless' and recent mandates have focused on increasing the effectiveness of services for this subpopulation (U.S.Department of Health and Human Services, 2003).

6.2 Aim 2: Housing Status Changes

H2.1: No recent alcohol or drug use will be associated with a higher likelihood of transitions from homeless to housed states.
H2.2: Individuals who have higher indicators of marginalization such as social isolation, victimization, incarceration, and involvement in shadow work will have higher a higher probability of either remaining homeless or losing housing over the course of the study.
H2.3: Individuals who are more engaged in outpatient and non-emergent types of services will have higher probabilities of moving from homeless to housed states.

In the current study, there is no support for hypothesis H2.1, that the parameters for recent substance abuse would be clearly negative as covariates for predicting transitions to housing. The finding that recent diagnosis of cocaine or alcohol abuse was *not* associated with transitions to streets or shelters from housed states is somewhat surprising, given prior literature (Booth et al., 2002; Coumans & Spreen, 2003; VanGeest & Johnson, 2002) reporting some connections between substance use disorders and losing housing. This may be due to the differences in sample populations between these studies as each study was looking at somewhat different trends. For example, Coumans was interested in changes in housing stability not housing status. Given that the current study starts with a shelter and street based population that are, by design, in an unstable housing situation, these two results may not be exactly comparable.

At the same time, no recent cocaine and alcohol abuse predicted a higher probability of *staying housed*, even when controlling for prior substance abuse and mental health problems. This might reflect a separate processes for two subgroups-a group that gains housing and keeps it and group that cycles in and out of different housing states. Using a cluster analysis of unique shelter admission patterns, Kuhn and Culhane found that there were distinct differences between what they called the 'transitionally' or 'episodically' homeless and the 'chronically' homeless, the latter having much higher rates of substance abuse and other problems (1998).

Regarding hypothesis H2.2, the results for the other marginalization variables followed a similar pattern as with substance abuse: staying housed was associated with being able to count on friends and family and not having pending charges, but transitions from housing to streets or shelters were not associated with any of these variables. So again there may be a process associated with staying housed versus returning to shelters and streets.

One set of predictors that was associated with transitions to housed states from homeless states were the service use variables. When compared to no service use at all, routine service counts between 1 and 20 over a 12 month period (referred to as 'low') were associated with a higher probability of getting off the streets while higher routine service use and some use of emergency services (1 to 20 nights or ER visits) was associated with moving from shelters to housed situations. It should be somewhat encouraging that services use overall would be associated with transitions towards housing in population. The difference in service use indicated in these relationships mirrors what was found in the Aim 1 section, in that the street population has a unique service use pattern when compared to shelter population, again implying that this more marginalized group seems to have overall fewer service contacts of any sort. In summary, there is some support for H3.1 as movements towards housing are associated with routine services use (as opposed to no service use) and, in the case of transitions from shelters to housing, some emergency services use as well (which was not predicted by H3.1).

Finally, when looking at predictors of all transitions to street status, we find a consistent pattern of not being able to count on family for help and unemployment. The specific transition from housed to street status was additionally associated with cocaine and alcohol abuse and no support from friends. Taken together, these reinforce importance of social isolation and employment problems that play a part in movements towards living on the streets.

6.3 Aim 3: Service Use

H3.1: Social isolation, victimization, incarceration, and involvement in shadow work will be associated with higher use of inpatient and emergency type services

H3.2: Individuals living on the streets or in shelters will use more inpatient and emergency types of services at later time points. At the same time, gaining housing will result in fewer inpatient and emergency service contacts

Reflecting on the complexity of the issues surrounding homelessness and marginalization, the results from Aim 3 point to a much different view of who gets more emergency services than was originally expected. The initial presupposition in H3.1 assumed a higher use of emergency services by individuals with more severe needs who may have been pushed out or unable to attend routine types of services, but quite the opposite was the case. Living on the streets and engaging in shadow work together predicted lower levels of both routine and emergency types of service use. In a similar manner, social isolation (i.e. not being able to count on family for help) predicted lower rates of routine service use.

The finding that street (and to some extent shelter) status is associated with *lower* and not higher rates of emergency services use contradicts the assumptions made in H3.1 and H3.2. It seems that those individuals who we assume are most in need and would most likely adopt any type of help offered are actually those that, in fact, are not receiving these services. When examined in light of Sosin's social-rational choice theory of service use (Section 2.4) , we might wonder if the same series of choices (i.e. of necessity) leading one into the unique street environment are replicated in rational choices to avoid the service system as a whole (2003). Alternatively, this might be a simple issue of reduced access to services for people who are living under bridges, parks, and cycling in and out of shelter on a short term basis. A number of studies have underscored the difficulty in reaching these groups through the standard means of office based or agency based services.

6.4 Limitations

There are limitations in this study which should be clearly defined as they affect both the generalization and basic validity of the results and inferences presented above. These limitations can be broadly categorized into issues related to measurement, sampling, longitudinal design, and model specification.

6.4.1 Measurement

The measurement of substance abuse in this study is a simple dichotomous measure of an abuse or dependance diagnosis over the past year or lifetime as determined by the Diagnostic Interview Schedule survey. This measure does not tell us anything about how much someone is using, how often, and does not distinguish (in this study) between dependance and abuse. A more nuanced measure of substance abuse taken at multiple time points would give the researcher much more information about the important relationships between substance abuse, homeless states, and marginalization. While this measure has been commonly used in many large, national surveys over the past 20 years, there are limits to how much information we get from the simple dichotomous measure (Muthen, 2006). Additionally, measures of marginalization variables such as social support may miss much of the secondary aspects social support beyond looking for either the absence or presence of support.

6.4.2 Sampling

The original SUNCODA study was designed to capture a probability sample of homeless individuals in an urban setting but, of course, does not necessarily represent other regions or homeless populations such as those in the deep south, or populations in more dispersed rural settings. The St. Louis area has a unique service environment, as does

just about any large city, that most likely has a great effect on who gets services, where they get services, and what kinds of services they get. The spatial environment is also unique in that certain areas that house shelters or concentrations of street living homeless people are spatially distinct and are most likely very different in terms of services, weather, employment opportunities, etc. when compared to say Los Angeles, CA or New York, NY. On should consider the possibility that there may be different patterns of marginalization, housing status changes, and service use in different regions of the country.

The fact that this population was a sample of adults who were at homeless at baseline (by definition) should also be considered in the interpretation of the housing status transition models in particular. From baseline to Year one, for example, there can be no transitions from housed to any state since there are no housed subjects at baseline by definition. This essentially reduces the effective sample size used to estimate this particular set of relationships compared to transitions from homeless states to other states. The limitations due to sampling are, to some degree, accounted via the use of a range of control and background variables as noted in Chapter 4, but are still important to keep in mind when making inferences based on this dataset.

6.4.3 Design

The original data was collected over three separate interviews, one year apart and the analytic approach has capitalized on this design to develop the time-varying relationships described above. When treated as a time series, there is an implicit assumption that the processes that are being examined (i.e. changes in housing status or marginalization) actually have real meaning when surveyed at one year intervals. For example, housing status may change multiple times over the course of a year, revealing a very unstable pattern, but the overall 'usual' housing status may still be marked as 'housed'.

Attempts were made to incorporate reports that cover either past year or past month reports rather than current status to reduce volatility of these measures, but the trade-off is less information about patterns of change.

6.4.4 Model specification

Lastly, the models as specified here, while based on a thorough literature review, also represent the researcher's own best guesses about the very complex set of relationships related to homelessness, substance abuse and marginalization. A number of hypothesized relationships were either not supported or directly contradicted by the results of this study. As with any empirical study, and in particular with a Bayesian approach, all the findings here provide information for future research and even results that contradict commonly held assumptions should be reported and incorporated into ongoing model development.

6.5 Implications for Social Work

With these caveats in mind, there a number of implications for working with people who become homeless, particularly in large urban settings. First, we should be aware of the possibility of distinct patterns of social, spatial, and economic isolation related to living on the streets in particular. Service providers and planners need to look beyond the 'one size fits all' combination of services typical to most urban areas over the past 30 or more years. For some adults, shelters and case management may provide just the sort of setting needed to return to housed states but for other groups who live in the social, economic, and legal vacuums described above, new pathways are needed that can provide some sense of movement away from these harsh environments. Particular attention should be paid to the legal consequences or necessities of time spent on the

streets such as legal charges, detainment, shadow work, victimization.

For the most marginalized and isolated, 'housing first' models may be most appropriate as a way to deal with basic issues of security and isolation. These programs provide housing that is not necessarily contingent on remaining clean and sober (Padgett, Gulcur, & Tsemberis, 2006; Tsemberis, 2005). Typically additional services are offered with the housing such as Assertive Community Treatment or (ACT) teams which provide health and psychiatric care on-site (Calsyn, Morse, Klinkenberg, Trusty, & Allen, 1998; Dixon, Krauss, Kernan, Lehman, & Deforge, 1995). Both of these programs have been shown to be effective in alleviating some of the most persistent problems associated with chronic homelessness such as psychiatric problem, substance abuse problems, and housing instability. The finding that living on the streets predicted lower use of both routine and emergency services should underscore the need to find more creative and effective ways to reach out to these groups.

In rethinking service systems to unique subpopulations of homeless adults, we must also try and understand more about the unique structures that are driving the legal, economic, and social problems associated with becoming and remaining homeless in an urban setting. As mentioned earlier, the necessities of surviving on the streets most likely the very things that reinforce a cycle of unstable housing, unemployment, victimization, and social isolation. Urban and service system planners and administrators should be repeatedly thinking about how system policies and processes can produce feedback and unintended consequences. A system dynamics perspective (?, ?) is useful in this regard both for qualitative insights and quantitative modeling of how complex systems work together (or don't work together).

6.6 Future Research Directions

As with any research project, we are left with at least as many questions and ideas for future work as we are with answers. The limitations listed above provide some impetus to designing more focused studies of the issues surrounding homelessness and marginalization as well as some possible pathways to improved methodology.

6.6.1 Bayesian methods

The Bayesian framework proved to be very flexible and almost boundless in the types of complex models that can be accommodated. There are costs to this flexibility such as the need for more computing resources, a working knowledge of some fairly complicated mathematics, and knowing when to use what approach. As one researcher put it, using a Bayesian approach can sometimes feel like "using sledgehammer to kill a fly", but the costs are almost always worth it in terms of the information produced and the transparency of the modeling process. Incorporating Bayesian approaches into the standard social work researcher's toolbox would expand the possible avenues of theory building and evaluation.

6.6.2 Study design

A number of lessons from this project could be built into future studies of homelessness. First, the Markov modeling strategy has much more potential for helping us understand what plays into housing status transitions over time. Longer time series and improvements in making multiple time point assessments would add greatly to the information gained, providing the opportunity to expand the Markov models to include hidden states and non-homogenous time intervals. These models don't assume that state changes are necessarily happening at the allotted one year intervals, but that the patterns of switching

can be inferred from the multiple data points which was not possible with the limited data available here.

Another important design component to consider for future projects is incorporating specific (i.e. GPS coded) spatial data to the time series. A better understanding of how and why certain individuals become increasingly isolated and don't respond to the standard set of service options will require some repeat assessment of the local environment both on multiple, related levels (spatial, social, economic). Spatial data has been used in a number of modeling formats including Bayesian Markov models (see, for example, Green & Richardson, 2002). This approach will hopefully also inform local policy makers regarding *where* to focus service instead of just who gets them or what services to provide.

6.7 Conclusions

This study has provided several insights into the nature of marginalization among homeless adults. Using a Bayesian modeling approach, housing status changes and services use have been examined in a probability sample from shelters and streets. Key findings include consistent relationships between living on the streets, alcohol use, and increased marginalization, notably legal problems, shadow work, and victimization. This highlights the importance of addressing these issues in intervention design, specifically in how we might provide the most basic aspects of well-being such as safety and housing. Additionally, individuals who did make transitions to housing or that stayed in housing had higher routine and emergency services use, giving some indication that at least a subpopulation of those needing help are getting it and perhaps benefiting from it. At several points, there were distinctions in street based homeless and those who found housing at some point or were episodically in shelters. The differences in these groups

should be recognized and addressed in practice and future research design. This project has just touched on several potentially useful methodologies such as Bayesian modeling, Markov transition models, and zero-inflated poisson regression, all of which offer new tools for the social work researcher.

References

Acosta, O., & Toro, P. (2000). Let's ask the homeless people themselves: A needs assessment based on a probability sample of adults. *American Journal of Community Psychology*, *28*(3), 343–366.

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (Revised 4th ed.) [Computer software manual]. Washington, DC.

Amster, R. (2004). *Street people and the contested realms of public space*. El Paso, TX: LFB Scholarly Pub.

Andersen, R., & Newman, J. (1973). Societal and individual determinants of medical care utilization in the united states. *Milbank Quarterly*, *51*, 95–124.

Anderson, N. (1961). *The hobo: the sociology of the homeless man*. Chicago: University of Chicago Press.

Bahr, H. M. (1973). *Skid row: an introduction to disaffiliation*. New York: Oxford University Press.

Baum, A. S., & Burnes, D. W. (1993). *A nation in denial: the truth about homelessness*. Boulder: Westview Press.

Bird, C., Jinnett, K., Burnam, M., Koegel, P., Sullivan, G., Wenzel, S., et al. (2002). Predictors of contact with public service sectors among homeless adults with and without alcohol and other drug disorders. *Journal of studies on alcohol.*, *63*(6), 716–725.

Bogue, D. J. (1963). *Skid row in american cities*. Chicago: Community and Family Study Center, University of Chicago.

Booth, B., Sullivan, G., Koegel, P., & Burnam, A. (2002). Vulnerability factors for homelessness associated with substance dependence in a community sample of homeless adults. *American Journal of Drug and Alcohol Abuse*, *28*(3), 429–452.

Brewer, T., Heymann, S., Krumplitsch, S., Wilson, M., Colditz, G., & Fineberg, H. (2001). Strategies to Decrease Tuberculosis in US Homeless Populations A Computer Simulation Model. *JAMA*, *286*(7), 834–842.

Burt, M. (1996). Homelessness: definitions and counts. In J. Baumohl (Ed.), *Homelessness in america* (pp. 15–23). Phoenix: Oryx Press.

Burt, M. (1999). *Homelessness: programs and the people they serve*. Washington, D.C.: Interagency Council and Institute on the Homeless.

Burt, M. (2001). Homeless families, singles, and others: Findings from the 1996 national survey of homeless assistance providers and clients. *Housing Policy Debate*, *12*(4), 737–780.

Burt, M., Aron, L., Lee, E., & Valente, J. (2001). *Helping america's homeless: emergency shelter or affordable housing?* Washington, D. C.: The Urban Institute Press.

Calsyn, R., Morse, G., Klinkenberg, W., Trusty, M., & Allen, G. (1998). The impact of assertive community treatment on the social relationships of people who are homeless and mentally ill. *Community Mental Health Journal*, *34*(6), 579–593.

Caton, C. (1990). *Homeless in america*. New York: Oxford University Press.

Congdon, P. (2003). *Applied bayesian modelling*. Chichester, UK: Wiley.

Congdon, P. (2005). *Bayesian models for categorical data*. New York: Wiley.

Congdon, P. (2006). *Applied bayesian modelling* (2nd ed.). Chichester, UK: Wiley.

Coston, C. (1993). Worries about crime - rank-ordering survival concerns among urban

transient females. *Deviant Behavior*, *14*(4), 365–376.

Cottler, L., Robins, L. N., & Helzer, J. E. (1989). The reliability of the cidi-sam: A comprehensive substance abuse interview. *British Journal of Addictions*, *84*(7), 801–814.

Coumans, M., & Spreen, M. (2003). Drug use and the role of homelessness in the process of marginalization. *Subst Use Misuse*, *38*(3-6), 311–338.

Culhane, D., Lee, C., & Wachter, S. (1996). Where the homeless come from: A study of the prior address distribution of families admitted to public shelters in new york city and philadelphia. *Housing Policy Debate*, *7*(2), 327–365.

Dear, M., & Wolch, J. R. (1987). *Landscapes of despair: from deinstitutionalization to homelessness*. Princeton, N.J: Princeton University Press.

DePastino, T. (2003). *Citizen hobo: how a century of homelessness shaped america*. Chicago: University of Chicago Press.

Dhossche, D., & Ghani, S. (1998). A study on recidivism in the psychiatric emergency room. *Annals of Clinical Psychiatry*, *10*(2), 59–67.

Diggle, P. (2002). *Analysis of longitudinal data*. New York: Oxford University Press.

Dixon, L., Krauss, N., Kernan, E., Lehman, A., & Deforge, B. (1995). Modifying the pact model to serve homeless persons with severe mental-illness. *Psychiatric Services*, *46*(7), 684–688.

Dobscha, S., Delucchi, K., & Young, M. (1999). Adherence with referrals for outpatient follow-up from a VA psychiatric emergency room. *Community Mental Health Journal*, *35*(5), 451–458.

Dupré, J. (1993). *The disorder of things: metaphysical foundations of the disunity of science*. Cambridge, Mass: Harvard University Press.

Eberle, M. (2001). *Homelessness, causes and effects: The relationship between homelessness and the health, social services and criminal justice systems: Review of*

the literature. Vancouver, British Columbia: Ministry of Social Development and Economic Security.

Edgar, B., & Meert, H. (2005). *Fourth review of statistics on homelessness in europe: the ethos definition of homelessness.* Brussels, Belgium: European Federation of National Associations Working with the Homeless.

Eyrich, K., Pollio, D., & North, C. (2003). An exploration of alienation and replacement theories of social support in homelessness. *Social Work Research*, *27*(4), 222–231.

Fischer, P., & Breakey, W. (1991). The epidemiology of alcohol, drug, and mental-disorders among homeless persons. *American Psychologist*, *46*(11), 1115–1128.

Fitzpatrick, K. M., La Gory, M., & Ritchey, F. (1993). Criminal victimization among the homeless. *Justice Quarterly*, *10*(3), 353–368.

Folsom, D., Hawthorne, W., Lindamer, L., Gilmer, T., Bailey, A., Golshan, S., et al. (2005). Prevalence and risk factors for homelessness and utilization of mental health services among 10,340 patients with serious mental illness in a large public mental health system. *American Journal of Psychiatry*, *162*(2), 370–376.

Frees, E. (2004). *Longitudinal and panel data: Analysis and applications in the social sciences*. Cambridge: Cambridge University Press.

Gelman, A. (2004). *Bayesian data analysis*. Boca Raton, FL: CRC press.

Gelman, A., & Meng, X. (1996). Model checking and model improvement. In W. Gilks, S. Richardson, & D. Spiegelhalter (Eds.), *Markov chain monte carlo in practice.* (pp. 189–202). Suffolk, UK: Chapman & Hall.

Gelman, A., & Rubin, D. (1992). Inference from iterative simulation using multiple sequences. *Statistical science*, 457–472.

Geweke, J. (1992). Evaluating the accuracy of sampling-based approaches to calculating posterior moments. In J. Bernardo, J. Berger, A. Dawid, & A. Smith (Eds.),

Bayesian statistics (Vol. 4, pp. 169–194). Oxford, UK: Clarendon Press.

Ghosh, S., Mukhopadhyay, P., & Lu, J. (2006). Bayesian analysis of zero-inflated regression models. *Journal of Statistical Planning and Inference*, *136*(4), 1360–1375.

Gill, J. (2002). *Bayesian methods: A social and behavioral sciences approach*. Boca Raton, FL: Chapman & Hall/CRC.

Glasser, I., & Zywiak, W. (2003). Homelessness and substance misuse: A tale of two cities. *Substance Use & Misuse*, *38*(3), 551–576.

Goodman, L. A., Dutton, M., & Harris, M. (1997). The relationship between violence dimensions and symptom severity among homeless, mentally ill women. *Journal of Traumatic Stress*, *10*(1), 51–70.

Green, P., & Richardson, S. (2002). Hidden Markov models and disease mapping. *Journal of the American Statistical Association*, *97*(460), 1055–1070.

Hiday, V., Swanson, J., Swartz, M., Borum, R., & Wagner, H. (2001). Victimization: A link between mental illness and violence? *International Journal of Law and Psychiatry*, *24*(6), 559–572.

Hopper, K. (1997). Homelessness old and new: A matter of definition. In D. Culhane & P. Hornburg (Eds.), *Understanding homelessness: New policy and research perspectives* (pp. 9–68). Washington, DC: Fannie Mae Foundation.

Hopper, K., & Baumohl, J. (1996). Redefining the cursed word: a historical interpretation of american homelessness. In J. Baumohl (Ed.), *Homelessness in america* (pp. 3–14). Phoenix: Oryx Press.

Hougaard, P. (1999). Multi-state models: a review. *Lifetime Data Analysis*, *5*(3), 239–264.

Humphreys, K., & Rosenheck, R. (1995). Sequential validation of cluster analytic subtypes of homeless veterans. *American Journal of Community Psychology*, *23*(1),

75–98.

Hunter, R. (1904). *Poverty*. London: Macmillan.

Ihaka, R., & Gentleman, R. (1996). R: A language for data analysis and graphics. *Journal of Computational and Graphical Statistics*, *5*(3), 299–314.

Jackson, C., Sharples, L., Thompson, S., & Duffy, S. (2003). Multistate Markov models for disease progression with classification error. *The Statistician*, 193–209.

Jasinski, J. L., Wesely, J., Mustaine, E., & Wright, J. (2005). *The experience of violence in the lives of homeless women: A research report*. Washington, DC: National Institute of Justice.

Jencks, C. (1994). *The homeless*. Cambridge, Mass: Harvard University Press.

Katz, M. B. (1986). *In the shadow of the poorhouse: a social history of welfare in america*. New York: Basic Books.

Kertesz, S., Larson, M., Cheng, D., Tucker, J., Winter, M., Mullins, A., et al. (2006). Need and non-need factors associated with addiction treatment utilization in a cohort of homeless and housed urban poor. *Medical Care*, *44*(3), 225–233.

Kessler, R., Berglund, P., Demler, O., Jin, R., & Walters, E. (2005). Lifetime prevalence and age-of-onset distributions' of dsm-iv disorders in the national comorbidity survey replication. *Archives of General Psychiatry*, *62*(6), 593–602.

Kessler, R., Mcgonagle, K., Zhao, S., Nelson, C., Hughes, M., Eshleman, S., et al. (1994). Lifetime and 12-month prevalence of dsm-iii-r psychiatric-disorders in the united-states - results from the national-comorbidity-survey. *Archives of General Psychiatry*, *51*(1), 8–19.

Kilpatrick, D. G., & Acierno, R. (2003). Mental health needs of crime victims: Epidemiology and outcomes. *Journal of Traumatic Stress*, *16*(2), 119–132.

Koegel, P., Sullivan, G., Burnam, A., Morton, S., & Wenzel, S. (1999). Utilization of mental health and substance abuse services among homeless adults in los angeles.

Medical Care, *37*(3), 306–317.

Kuhn, R., & Culhane, D. (1998). Applying cluster analysis to test a typology of homelessness by pattern of shelter utilization: Results from the analysis of administrative data. *American Journal of Community Psychology*, *26*(2), 207–232.

Kushel, M. B., Evans, J., Perry, S., Robertson, M., & Moss, A. (2003). No door to lock - victimization among homeless and marginally housed persons. *Archives of Internal Medicine*, *163*(20), 2492–2499.

Kyle, K. (2005). *Contextualizing homelessness: critical theory, homelessness, and federal policy addressing the homeless*. New York: Routledge.

Lee, B. (2005). Danger on the streets - marginality and victimization among homeless people. *American Behavioral Scientist*, *48*(8), 1055–1081.

Lemming, M., & Calsyn, R. (2004). Utility of the behavioral model in predicting service utilization by individuals suffering from severe mental illness and homelessness. *Community Mental Health Journal*, *40*(4), 347–364.

Lieberson, S. (1987). *Making it count: the improvement of social research and theory*. Los Angeles, CA: University of California Press.

Link, B., Phelan, J., Bresnahan, M., Stueve, A., Moore, R., & Susser, E. (1995). Lifetime and 5-year prevalence of homelessness in the united-states - new evidence on an old debate. *American Journal of Orthopsychiatry*, *65*(3), 347–354.

Little, R., & Rubin, D. (1987). *Statistical analysis with missing data.* New York: John Wiley & Sons.

Mandelberg, J., Kuhn, R., & Kohn, M. (2000). Epidemiologic analysis of an urban, public emergency department's frequent users. *Academic Emergency Medicine*, *7*(6), 637–646.

Marcus, A. (2006). *Where have all the homeless gone? the making and unmaking of a crisis*. New York: Berghahn Books.

Marvasti, A. B. (2003). *Being homeless: textual and narrative constructions*. Lanham, Md: Lexington Books.

McNiel, D. E., & Binder, R. L. (2005). Psychiatric emergency service use and homelessness, mental disorder, and violence. *Psychiatr Serv*, *56*(6), 699–704.

Meehl, P. (1990). Why summaries of research on psychological theories are often uninterpretable. *Psychological Reports*, *66*(1), 195–244.

Metraux, S., & Culhane, D. (2006). Recent incarceration history among a sheltered homeless population. *Crime & Delinquency*, *52*(3), 504–517.

Momeni, J. A. (1989). *Homelessness in the united states* (Vol. no. 73). New York: Greenwood Press.

Monkkonen, E. (1984). *Walking to work: Tramps in america, 1790-1935*. Lincoln, NE: University of Nebraska Press.

Moss, A., Hahn, J., Tulsky, J., Daley, C., Small, P., & Hopewell, P. (2000). Tuberculosis in the Homeless A Prospective Study. *American Journal of Respiratory and Critical Care Medicine*, *162*(2), 460–464.

Mowbray, C., Bybee, D., & Cohen, E. (1993). Describing the homeless mentally-ill - cluster-analysis results. *American Journal of Community Psychology*, *21*(1), 67–93.

Muthen, B. (2006). Should substance use disorders be considered as categorical or dimensional? *Addiction*, *101*, 6.

Neal, R. (1998). Suppressing radom walks in markov chain monte carlo using ordered overrelaxation. In M. Jordon (Ed.), *Learning in graphical models* (pp. 205–228). Dordrecht: Kluwer Academic Press.

Nelson, C., Rehm, J., Bedirhan, T., Grant, B., & Chatterji, S. (1999). Factor structures for DSM-IV substance disorder criteria endorsed by alcohol, cannabis, cocaine and opiate users: results from the WHO reliability and validity study. *Addiction*,

94(6), 843–855.

Norquist, G., & Regier, D. (1996). The epidemiology of psychiatric disorders and the de facto mental health care system. *Annual Review of Medicine*, *47*, 473–479.

North, C., Eyrich, K., Pollio, D., Foster, D., Cottler, L., & Spitznagel, E. (2004). The Homeless Supplement to the Diagnostic Interview Schedule: test-retest analyses. *International Journal of Methods in Psychiatric Research*, *13*(3).

North, C., Eyrich, K., Pollio, D., & Spitznagel, E. (2004). Are rates of psychiatric disorders in the homeless population changing? *American Journal of Public Health*, *94*(1), 103–108.

North, C., Pollio, D., Perron, B., Eyrich, K., & Spitznagel, E. (2005). The role of organizational characteristics in determining patterns of utilization of services for substance abuse, mental health, and shelter by homeless people. *Journal of Drug Issues*, *35*(3), 575–591.

North, C., & Smith, E. (1993). A systematic study of mental-health-services utilization by homeless men and women. *Social Psychiatry and Psychiatric Epidemiology*, *28*(2), 77–83.

North, C., Smith, E., Pollio, D., & Spitznagel, E. (1996). Are the mentally ill homeless a distinct homeless subgroup? *Ann Clin Psychiatry*, *8*(3), 117–128.

Ntzoufras, I. (2009). *Bayesian modeling using Winbugs*. Hoboken, NJ: Wiley-Blackwell.

Nyamathi, A. M., Leake, B., & Gelberg, L. (2000). Sheltered versus nonsheltered homeless women - differences in health, behavior, victimization, and utilization of care. *Journal of General Internal Medicine*, *15*(8), 565–572.

Nyamathi, A. M., Wenzel, S., Lesser, J., Flaskerud, J., & Leake, B. (2001). Comparison of psychosocial and behavioral profiles of victimized and nonvictimized homeless women and their intimate partners. *Research in Nursing & Health*, *24*(4), 324–

335.

O'Toole, T., Conde-Martel, A., Gibbon, J., Hanusa, B., Freyder, P., & Fine, M. (2004). Substance-abusing urban homeless in the late 1990s: How do they differ from non-substance-abusing homeless persons? *Journal of Urban Health-Bulletin of the New York Academy of Medicine*, *81*(4), 606–617.

Padgett, D., Gulcur, L., & Tsemberis, S. (2006). Housing first services for people who are homeless with co-occurring serious mental illness and substance abuse. *Research on Social Work Practice*, *16*(1), 74–83.

Padgett, D., Struening, E., & Andrews, H. (1990). Factors affecting the use of medical, mental-health, alcohol, and drug-treatment services by homeless adults. *Medical Care*, *28*(9), 805–821.

Plummer, M. (2003). *Jags: A program for analysis of bayesian graphical models using gibbs sampling.*

Pollio, D., North, C., Eyrich, K., Foster, D., & Spitznagel, E. (2003). Modeling service access in a homeless population. *Journal of Psychoactive Drugs*, *35*(4), 487–495.

Public Health and Welfare Act. (1988).

42 U.S.C. §11302.

Quigley, J., Raphael, S., & Smolensky, E. (2001). Homeless in america, homeless in california. *Review of Economics and Statistics*, *83*(1), 37–51.

Regier, D., Farmer, M., Rae, D., Myers, J., Kramer, M., Robins, L., et al. (1993). One-month prevalence of mental-disorders in the united-states and sociodemographic characteristics - the epidemiologic catchment-area study. *Acta Psychiatrica Scandinavica*, *88*(1), 35–47.

Reilly, F. (1994). An ecological approach to health risk - a case-study of urban elderly homeless people. *Public Health Nursing*, *11*(5), 305–314.

Robertson, M., Zlotnick, C., & Westerfelt, A. (1997). Drug use disorders and treatment

contact among homeless adults in alameda county, california. *American Journal of Public Health*, *87*(2), 221–228.

Robins, L., Helzer, J., Croughan, J., & Ratcliff, K. (1981). National institute of mental health diagnostic interview schedule. its history, characteristics, and validity. *Archives of General Psychiatry*, *38*(4), 381–389.

Roman, N. (2006). President's budget offers mixed news for ending homelessness. *National Alliance to End Homelessness Newsletter*. (Washington, DC)

Rosenheck, R., & Lam, J. (1997a). Homeless mentally ill clients' and providers' perceptions of service needs and clients' use of services. *Psychiatric Services*, *48*(3), 381–386.

Rosenheck, R., & Lam, J. (1997b). Individual and community-level variation in intensity and diversity of service utilization by homeless persons with serious mental illness. *Journal of Nervous and Mental Disease*, *185*(10), 633–638.

Rosenheck, R., Morrissey, J., Lam, J., Calloway, M., Johnsen, M., Goldman, H., et al. (1998). Service system integration, access to services, and housing outcomes in a program for homeless persons with severe mental illness. *American Journal of Public Health*, *88*(11), 1610–1615.

Rosenheck, R., & Seibyl, C. (1998). Homelessness: health service use and related costs. *Medical care*, *36*(8), 1256–1264.

Rosner, D. (1982). Health care for the "truly needy": Nineteenth-century origins of the concept. *The Milbank Quarterly*, *60*(3), 355–385.

Rossi, P. (1990). The old homeless and the new homelessness in historical perspective. *Am Psychol*, *45*(8), 954–959.

Rossi, P., & Wright, J. (1987). The determinants of homelessness. *Health Affairs*, *6*(1), 19–32.

Salit, S., Kuhn, E., Hartz, A., Vu, J., & Mosso, A. (1998). Hospitalization costs as-

sociated with homelessness in new york city. *New England Journal of Medicine*, *338*(24), 1734–1740.

Schafer, J. (1997). *Analysis of incomplete multivariate data*. Boca Raton, FL: Chapman & Hall/CRC.

Snow, D., & Anderson, L. (1993). *Down on their luck: A study of homeless street people*. Berkely, CA: University of California Press.

Snow, D., Anderson, L., & Koegel, P. (1994). Distorting tendencies in research on the homeless. *American Behavioral Scientist*, *37*(4), 461–475.

Snow, D., & Mulcahy, M. (2001). Space, politics, and the survival strategies of the homeless. *American Behavioral Scientist*, *45*(1), 149–169.

Sorenson, S. B., & Golding, J. (1990). Depressive sequelae of recent criminal victimization. *Journal of Traumatic Stress*, *3*(3), 337–350.

Sosin, M. (2003). Explaining adult homelessness in the us by stratification or situation. *Journal of Community & Applied Social Psychology*, *13*(2), 91–104.

Sosin, M., & Bruni, M. (1997). Homelessness and vulnerability among adults with and without alcohol problems. *Substance Use & Misuse*, *32*(7-8), 939–968.

Sosin, M., & Grossman, S. (2003). The individual and beyond: A socio-rational choice model of service participation among homeless adults with substance abuse problems. *Substance Use & Misuse*, *38*(3-6), 503–549.

Spiegelhalter, D., Best, N., Carlin, B., & Linde, A. van der. (2002). Bayesian measures of model complexity and fit. *Journal of the Royal Statistical Society. Series B, Statistical Methodology*, 583–639.

Spiegelhalter, D., Thomas, A., Best, N. G., & Lunn, D. (2003). Winbugs version 1.4 user manual [Computer software manual]. Cambridge, UK.

Sung, M., Soyer, R., & Nhan, N. (2007). Bayesian analysis of non-homogeneous Markov chains: Application to mental health data. *Statistics in medicine*, *26*(15).

Takahashi, L. (1997a). Representation, attitudes, and behavior: Analyzing the spatial dimensions of community response to mental disability. *Environment and Planning A*, *29*(3), 501–524.

Takahashi, L. (1997b). The socio-spatial stigmatization of homelessness and hiv/aids: Toward an explanation of the nimby syndrome. *Social Science & Medicine*, *45*(6), 903–914.

Toro, P. (1999). Advances in research on homelessness: An overview of the special issue. *Journal of Community Psychology*, *27*(2), 115–117.

Toro, P., Trickett, E., Wall, D., & Salem, D. (1991). Homelessness in the united-states - an ecological perspective. *American Psychologist*, *46*(11), 1208–1218.

Toro, P., & Warren, M. (1999). Homelessness in the united states: Policy considerations. *Journal of Community Psychology*, *27*(2), 119–136.

Toro, P., Wolfe, S., Bellavia, C., Thomas, D., Rowland, L., Daeschler, C., et al. (1999). Obtaining representative samples of homeless persons: A two-city study. *Journal of Community Psychology*, *27*(2), 157–177.

Troutman, W., Jackson, J., & Ekelund, R. (1999). Public policy, perverse incentives, and the homeless problem. *Public Choice*, *98*(1), 195–212.

Tsemberis, S. (2005). Providing housing first and recovery services for homeless adults with severe mental illness. *Psychiatric Services*, *56*(10), 1303–1305.

U.S. Census Bureau. (2000). *Census 2000 summary file 3 (sf3).* Available from http://factfinder.census.gov (Retrieved 4 March 2006 from U.S. Census)

U.S.Department of Health and Human Services. (2003). *Blueprint for change: ending chronic homelessness for persons with serious mental illnesses and/or co-occuring substance use disorders*. Rockhill, MD: Substance Abuse and Mental Health Services Association.

Üstün, B., Compton, W., Mager, D., Babor, T., Baiyewu, O., Chatterji, S., et al. (1997).

WHO study on the reliability and validity of the alcohol and drug use disorder instruments: overview of methods and results. *Drug and Alcohol Dependence*, *47*(3), 161–169.

Van Buuren, S., & Oudshoorn, C. (2000). *Multivariate imputation by chained equations: Mice v1.0 user's manual.* (Tech. Rep.). Leiden, The Netherlands:: TNO Prevention Center.

VanGeest, J., & Johnson, T. (2002). Substance abuse and homelessness: Direct or indirect effects? *Annals of Epidemiology*, *12*(7), 455–461.

Wallace, S. E. (1965). *Skid row as a way of life*. Totowa, N.J.: Bedminster Press.

Wardhaugh, J. (2000). *Sub city: young people, homelessness and crime*. Aldershot, UK: Ashgate.

Wenzel, S., Andersen, R., Gifford, D., & Gelberg, L. (2001). Homeless women's gynecological symptoms and use of medical care. *Journal of Health Care for the Poor and Underserved*, *12*(3), 323–341.

Wenzel, S., Burnam, M., Koegel, P., Morton, S., Miu, A., Jinnett, K., et al. (2001). Access to inpatient or residential substance abuse treatment among homeless adults with alcohol or other drug use disorders. *Medical Care*, *39*(11), 1158–1169.

Wenzel, S., Leake, B., & Gelberg, L. (2000). Health of homeless women with recent experience of rape. *Journal of General Internal Medicine*, *15*(4), 265–268.

Wenzel, S., Leake, B., & Gelberg, L. (2001). Risk factors for major violence among homeless women. *Journal of Interpersonal Violence*, *16*(8), 739–752.

Wolch, J., & Li, W. (1997). Shifting margins of housing status in los angeles. *Social Science Research*, *26*(3), 309–330.

Wolch, J., Rahimian, A., & Koegel, P. (1993). Daily and periodic mobility patterns of the urban homeless. *Professional Geographer*, *45*(2), 159–169.

Wong, Y., Culhane, D., & Kuhn, R. (1997). Predictors of exit and reentry among family

shelter users in new york city. *Social Service Review*, *71*(3), 441–462.

Wong, Y., & Piliavin, I. (1997). A dynamic analysis of homeless-domicile transitions. *Social Problems*, *44*(3), 408–423.

Wright, T. (1997). *Out of place: homeless mobilizations, subcities, and contested landscapes*. Albany: State University of New York Press.

Wuerker, A. (1997). Factors in the transition to homelessness in the chronically mentally ill. *Journal of Social Distress and the Homeless*, *6*(3), 251–260.

Wuerker, A., & Keenan, C. (1997). Patterns of psychiatric service use by homeless mentally ill clients. *Psychiatric Quarterly*, *68*(2), 101–116.

Young, I. (1990). Five faces of oppression. In *Justice and the politics of difference* (pp. 39–65). Princeton, NJ: Princeton University Press.

Zlotnick, C., Robertson, M., & Lahiff, M. (1999). Getting off the streets: Economic resources and residential exits from homelessness. *Journal of Community Psychology*, *27*(2), 209–224.

Zolopa, A., Hahn, J., Gorter, R., Miranda, J., Wlodarczyk, D., Peterson, J., et al. (1994). HIV and tuberculosis infection in San Francisco's homeless adults. Prevalence and risk factors in a representative sample. *JAMA*, *272*(6), 455–461.

Appendix A: Measurement and WinBUGS code

Substance Abuse and Dependence Criteria

These criteria are taken from the Diagnostic and Statistical Manual of the American Psychiatric Association (1994).

Example-Alcohol Abuse

1. A maladaptive pattern of alcohol abuse leading to clinically significant impairment or distress, as manifested by one or more of the following, occurring within a 12-month period:

    - Recurrent alcohol use resulting in failure to fulfil major role obligations at work, school, or home (e.g., repeated absences or poor work performance related to substance use; substance-related absences, suspensions or expulsions from school; or neglect of children or household).
    - Recurrent alcohol use in situations in which it is physically hazardous (e.g., driving an automobile or operating a machine).
    - Recurrent alcohol-related legal problems (e.g., arrests for alcohol-related disorderly conduct).
    - Continued alcohol use despite persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the alcohol (e.g., arguments with spouse about consequences of intoxication or physical fights).

2. These symptoms must never have met the criteria for alcohol dependence.

Example-Alcohol Dependence

A maladaptive pattern of alcohol use, leading to clinically significant impairment or distress, as manifested by three or more of the following seven criteria, occurring at any time in the same 12-month period:

1. Tolerance, as defined by either of the following:
    - A need for markedly increased amounts of alcohol to achieve intoxication or desired effect.
    - Markedly diminished effect with continued use of the same amount of alcohol.
2. Withdrawal, as defined by either of the following:
    - The characteristic withdrawal syndrome for alcohol (refer to DSM-IV for further details).
    - Alcohol is taken to relieve or avoid withdrawal symptoms.
3. Alcohol is often taken in larger amounts or over a longer period than was intended.
4. There is a persistent desire or there are unsuccessful efforts to cut down or control alcohol use.
5. A great deal of time is spent in activities necessary to obtain alcohol, use alcohol or recover from its effects.
6. Important social, occupational, or recreational activities are given up or reduced because of alcohol use.
7. Alcohol use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the alcohol (e.g., continued drinking despite recognition that an ulcer was made worse by alcohol consumption).

Housing status categories and coding

Original Category	Status Coding
In your own apartment or home?	Housed
In your family's home?	Housed
In your girlfriend's or boyfriend's home?	Housed
In another friend's home?	Housed
In a cheap motel or hotel?	Shelters+
In a shelter?	Shelters+
On the streets with no stable residence?	Streets
In a hospital?	Shelters+
In jail?	Shelters+
Other?	Shelters+
Transitional housing, boarding house, or treatment center	
Nursing home or retirement home	
Work	

WinBUGS Model Code

First Order Markov Model of Housing Transitions

```
model{
    for (i in 1:N) {
        for (j in 2:3) {

#categorical likelihood for each state at
# each time point conditional on previous state

hstusyr[i, j] ~ dcat(p[i, j, hstusyr[i, j - 1], 1:3])

}  }
    for (i in 1:N) {
        for (j in 2:3) {
            for (k in 1:3) {
                for (l in 1:3) {
```

```
#probability of every possible transition from k to l state
# at j time point and for i individual

p[i, j, k, l] ← e[i, j, k, l]/sum(e[i, j,k, ])

}  } } }

    for (i in 1:N) {
        for (j in 2:3) {
            for (k in 1:3) {
                for (l in 1:3) {

#log linear model

log(e[i, j, k, l]) ← d[1, k, l] * white[i]

# All covariates entered here giving d[1:25,1:3,1:3]

}  }   }  }

#priors
    for (m in 1:25) {
        for (k in 1:3) {
#multivariate normal prior on parameters
            d[m, k, 1:3] ~ dmnorm(mn[1:3], W.d[1:3, 1:3])
} }

#wishart prior for covariance
    W.d[1:3, 1:3] ~ dwish(R[1:3, 1:3], 3)
}
```

Two Time Point Zero-Inflated Poisson Gamma

```
model{
    for (i in 1:N) {
        for (j in 1:2) {
               y[i, j] ~ dpois(mu[i, j])

 #second sample from posterior for comparison
            ynew[i, j] ~ dpois(mu[i, j])
```

```
#counts excluding excess zeros
            mu[i, j] ← (1 - u[i, j]) * lambda[i, j]

#probability of being an excess zero associated with
# whether individual was interviewed (attrition status).
            u[i, j] ~ dbern(p0[i, j])
            logit(p0[i, j]) ← c * interviewed[i, j]

#poisson-gamma mixture model for counts
            lambda[i, j] ~ dgamma(A[i, j], delta[j])
            A[i, j] ← nu[i, j] * delta[j]

#log-linear regression
            log(nu[i, j]) ← b[1]

# All covariates entered here giving b[1:25]

} }

#posterior predictive criterion

PPC ← step(CV[2] - CV[1])
Var[1] ← pow(sd(y[, ]), 2)
    M[1] ← mean(y[, ])
Var[2] ← pow(sd(ynew[, ]), 2)
    M[2] ← mean(ynew[, ])
for (j in 1:2) { CV[j] ← Var[j]/M[j]}

#dispersion parameter varies by time interval
for (k in 1:2) {alpha[k] ← 1/delta[k] }

#priors
for (j in 1:2) {delta[j] ~ dgamma(0.001, 0.001)}
for (m in 1:24) {b[m] ~ dnorm(0, 0.01)}
c ~ dnorm(0, 0.01)
}
```

Appendix B: Additional tables and figures

Table B-1: Substance Abuse and Marginalization Variables by Interview

	Baseline $N = 394$	Year 1 $N = 282$	Year 2 $N = 279$
Recent Alcohol Dx : 0	56% (222)	73% (206)	76% (213)
1	42% (164)	27% (75)	22% (61)
NR	2% (8)	0% (1)	2% (5)
Recent Cocaine Dx : 0	68% (268)	80% (225)	84% (233)
1	32% (125)	20% (56)	15% (41)
NR	0% (1)	0% (1)	2% (5)
Employed : 0	71% (278)	66% (186)	65% (180)
1	29% (116)	34% (95)	34% (94)
NR	0% (0)	0% (1)	2% (5)
Shadow Work : 0	93% (366)	94% (265)	93% (259)
1	7% (28)	6% (16)	5% (15)
NR	0% (0)	0% (1)	2% (5)
Support From Family : 0	44% (173)	32% (90)	33% (92)
1	56% (220)	68% (191)	65% (182)
NR	0% (1)	0% (1)	2% (5)
Support From Friends : 0	12% (47)	11% (30)	11% (31)
1	55% (216)	63% (177)	61% (169)
NR	33% (131)	27% (75)	28% (79)
Charges Pending : 0	91% (360)	91% (258)	92% (256)
1	9% (34)	8% (23)	6% (18)
NR	0% (0)	0% (1)	2% (5)
Recently Detained : 0	93% (367)	89% (251)	90% (252)
1	7% (27)	11% (30)	8% (22)
NR	0% (0)	0% (1)	2% (5)
Robbed : 0	72% (285)	83% (234)	85% (238)
1	27% (108)	17% (47)	13% (36)
NR	0% (1)	0% (1)	2% (5)

Dx = Diagnosis; NR = Proportion of non-response at that time point

Table B-2: Comparison of Non-imputed and Imputed Values by Time Point

	Baseline		Year 1		Year 2		Combined	
	Original	Imputed	Original	Imputed	Original	Imputed	Original	Imputed
White	18%	18%	18%	18%	18%	18%	18%	18%
Male	75%	75%	75%	75%	75%	75%	75%	75%
Diploma	53%	53%	53%	53%	53%	53%	53%	53%
Married	6%	6%	3%	3%	6%	6%	5%	5%
Abuse-Neglect	31%	30%	31%	30%	31%	30%	31%	30%
Alcohol Diagnosis	61%	61%	61%	61%	61%	61%	61%	61%
Cocaine Diagnosis	44%	44%	44%	44%	44%	44%	44%	44%
Serious Mental Illness	49%	49%	49%	49%	49%	49%	49%	49%
Local Resident	86%	86%	86%	86%	86%	86%	86%	86%
Conviction	45%	45%	45%	45%	45%	45%	45%	45%
Recent Alcohol Diagnosis	43%	42%	27%	27%	22%	22%	31%	32%
Recent Cocaine Diagnosis	32%	32%	19%	20%	15%	15%	22%	23%
Employed	29%	29%	34%	34%	36%	34%	33%	32%
Shadow Work	7%	7%	5%	6%	5%	5%	6%	6%
Support From Family	56%	56%	67%	68%	66%	66%	63%	63%
Support From Friends	82%	82%	85%	86%	84%	84%	83%	84%

(Continued on next page)

(Table B-2 continued)

	Baseline		Year 1		Year 2		Combined	
	Original	Imputed	Original	Imputed	Original	Imputed	Original	Imputed
Charges Pending	9%	9%	8%	8%	6%	7%	8%	8%
Recent Detention	7%	7%	11%	11%	8%	8%	8%	8%
Victimization-Robbery	27%	28%	17%	17%	13%	12%	19%	20%
Housing (usual): Housed	40%	40%	48%	49%	62%	60%	49%	50%
Shelters+	43%	43%	40%	40%	28%	30%	38%	38%
Streets	17%	17%	12%	12%	10%	10%	13%	13%
Housing (recent): Housed	5%	5%	57%	56%	67%	67%	38%	43%
Shelters+	83%	83%	35%	35%	26%	26%	52%	48%
Streets	12%	12%	9%	9%	8%	7%	10%	9%

Imputed values are average of eight imputations

Figure B-1: Impact of Recent Substance Abuse on Employment

	Estimate	SE
Alcohol Diagnosis	−0.0487	0.0889
Cocaine Diagnosis	−0.1400	0.1795
Age	−0.3402	0.0276
White	0.1272	0.1637
Male	0.6182	0.0784
Diploma	0.5193	0.0793
Married	−0.0160	0.1519
Abused as Child	−0.0751	0.0194
Local Resident	−0.3202	0.1851
Alcohol Diagnosis Hx	0.1193	0.1112
Cocaine Diagnosis Hx	0.3750	0.1126
Serious Mental Illness Hx	−0.4019	0.0594
Health Problems	−0.2376	0.0516
Conviction Hx	−0.2720	0.1268
Living on the Streets	−1.4229	0.1334
Living in Shelters	−0.6953	0.1263

PPC = 0.51; Deviance = 1387
Dark lines represent 95% credible region

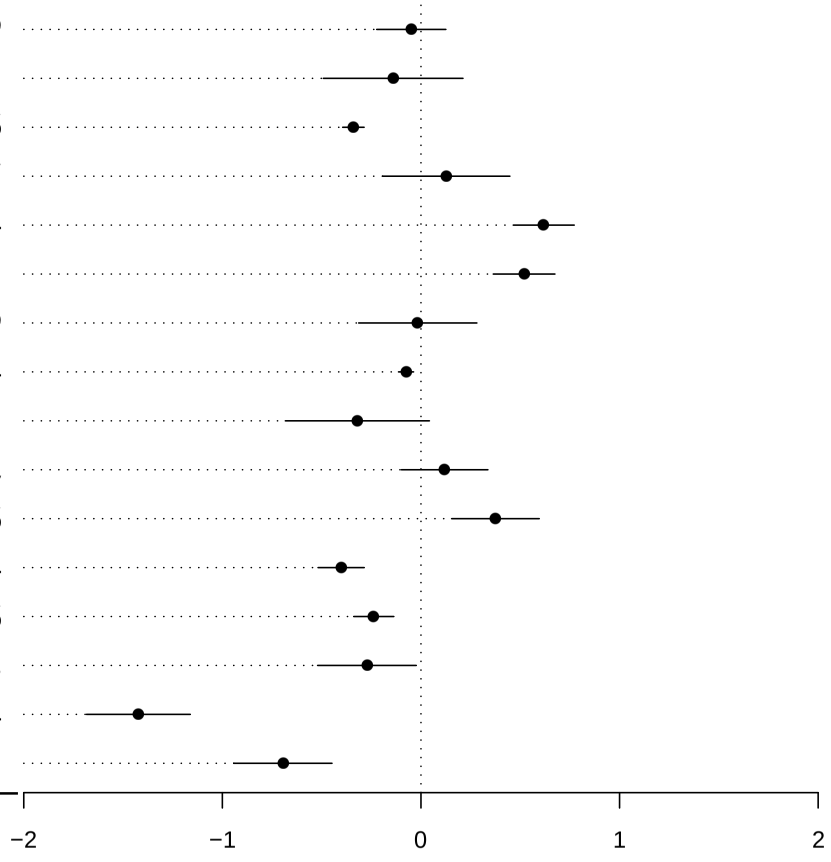


Figure B-2: Impact of Recent Substance Abuse on Support from Friends

	Estimate	SE
Alcohol Diagnosis	−0.1831	0.2915
Cocaine Diagnosis	0.0694	0.0877
Age	−0.1937	0.0348
White	−0.4989	0.0735
Male	0.1948	0.1424
Diploma	0.2298	0.1433
Married	−0.3637	0.1774
Abused as Child	0.3487	0.1955
Local Resident	−0.2577	0.2072
Alcohol Diagnosis Hx	0.0142	0.1692
Cocaine Diagnosis Hx	0.1917	0.1100
Serious Mental Illness Hx	0.0967	0.1274
Health Problems	0.0516	0.0717
Conviction Hx	0.0702	0.2458
Living on the Streets	−0.4526	0.2145
Living in Shelters	−0.2986	0.1166

PPC = 0.50; Deviance = 1038
Dark lines represent 95% credible region

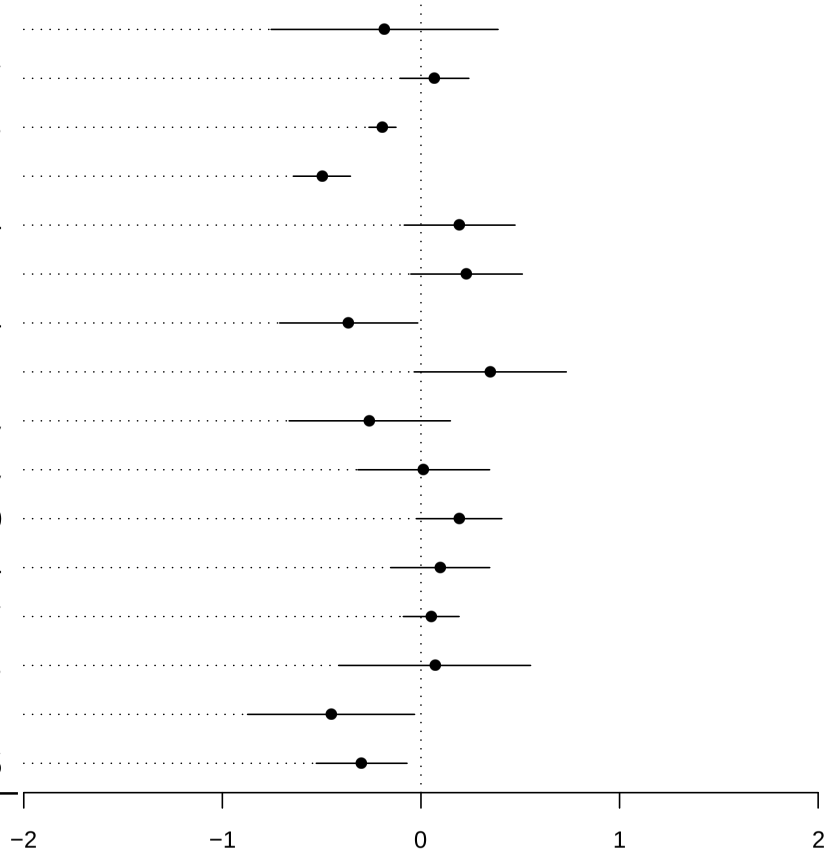


Figure B-3: Impact of Recent Substance Abuse on Support from Family

	Estimate	SE
Alcohol Diagnosis	−0.1303	0.0734
Cocaine Diagnosis	−0.3630	0.1069
Age	−0.1221	0.0385
White	−0.4495	0.0252
Male	0.1156	0.0884
Diploma	−0.0676	0.0992
Married	0.0710	0.0765
Abused as Child	−0.5215	0.0731
Local Resident	0.1592	0.1329
Alcohol Diagnosis Hx	−0.1521	0.1117
Cocaine Diagnosis Hx	0.4440	0.1189
Serious Mental Illness Hx	−0.0324	0.0730
Health Problems	−0.0029	0.0746
Conviction Hx	0.0447	0.0899
Living on the Streets	−0.7731	0.1326
Living in Shelters	−0.4103	0.1224

PPC = 0.51; Deviance = 1492
Dark lines represent 95% credible region

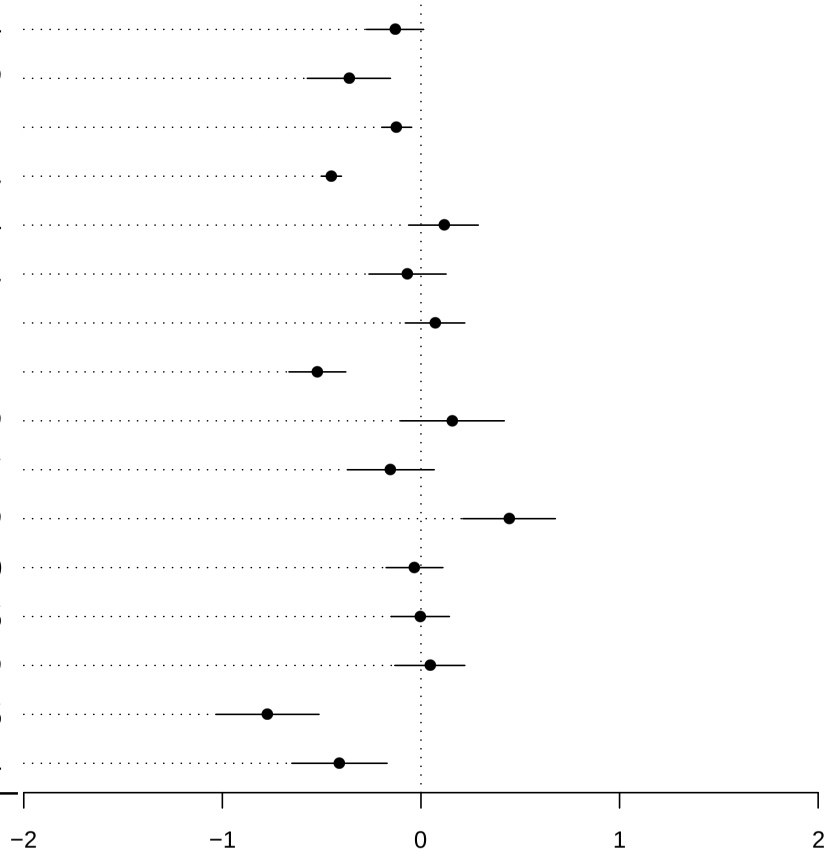


Figure B-4: Impact of Recent Substance Abuse on Being Detained

	Estimate	SE
Alcohol Diagnosis	0.6431	0.0646
Cocaine Diagnosis	−0.3199	0.2024
Age	−0.2822	0.0625
White	−0.1690	0.1700
Male	0.6756	0.0787
Diploma	−0.0892	0.1164
Married	−1.0760	0.4240
Abused as Child	0.2214	0.2477
Local Resident	0.2595	0.3435
Alcohol Diagnosis Hx	0.1333	0.0483
Cocaine Diagnosis Hx	0.2505	0.1426
Serious Mental Illness Hx	−0.1398	0.1899
Health Problems	0.1955	0.2454
Conviction Hx	0.7358	0.3208
Living on the Streets	0.6162	0.1930
Living in Shelters	0.5301	0.0888

PPC = 0.52; Deviance = 644

Dark lines represent 95% credible region

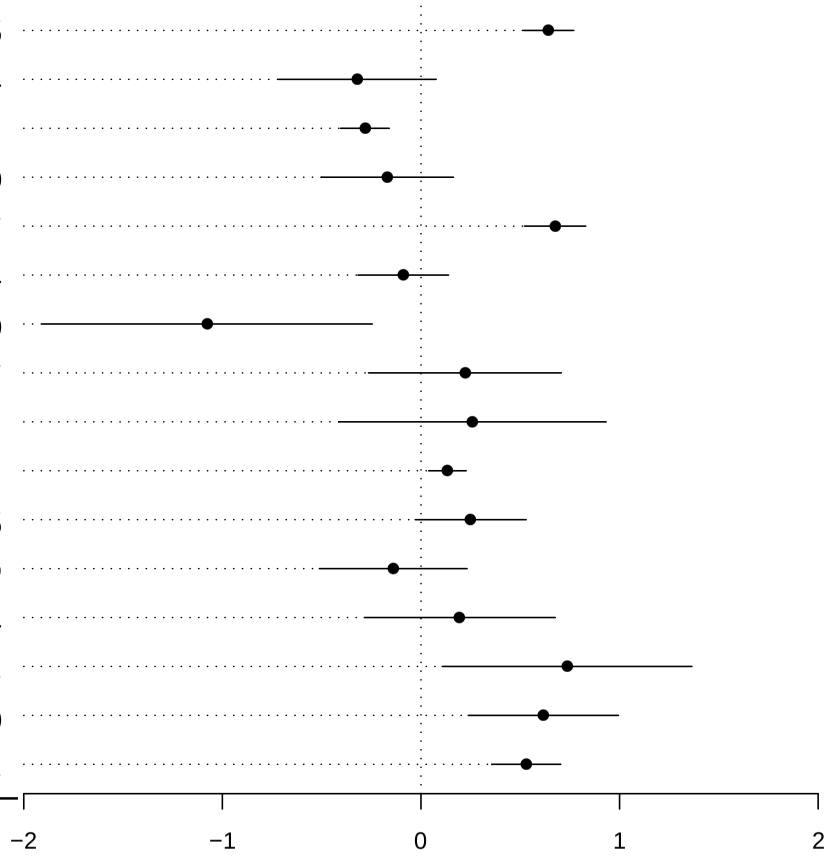


Figure B-5: Impact of Recent Substance Abuse on Pending Charges

	Estimate	SE
Alcohol Diagnosis	0.7348	0.0478
Cocaine Diagnosis	0.5807	0.2664
Age	−0.4930	0.0484
White	−0.4035	0.0615
Male	0.7223	0.2270
Diploma	0.2559	0.0248
Married	−0.6468	0.3361
Abused as Child	0.2143	0.1178
Local Resident	0.3891	0.1534
Alcohol Diagnosis Hx	−0.3052	0.1257
Cocaine Diagnosis Hx	0.3032	0.0495
Serious Mental Illness Hx	−0.3877	0.0274
Health Problems	0.3702	0.2103
Conviction Hx	0.5443	0.3480
Living on the Streets	1.0764	0.1050
Living in Shelters	0.3590	0.1191

PPC = 0.52; Deviance = 593

Dark lines represent 95% credible region

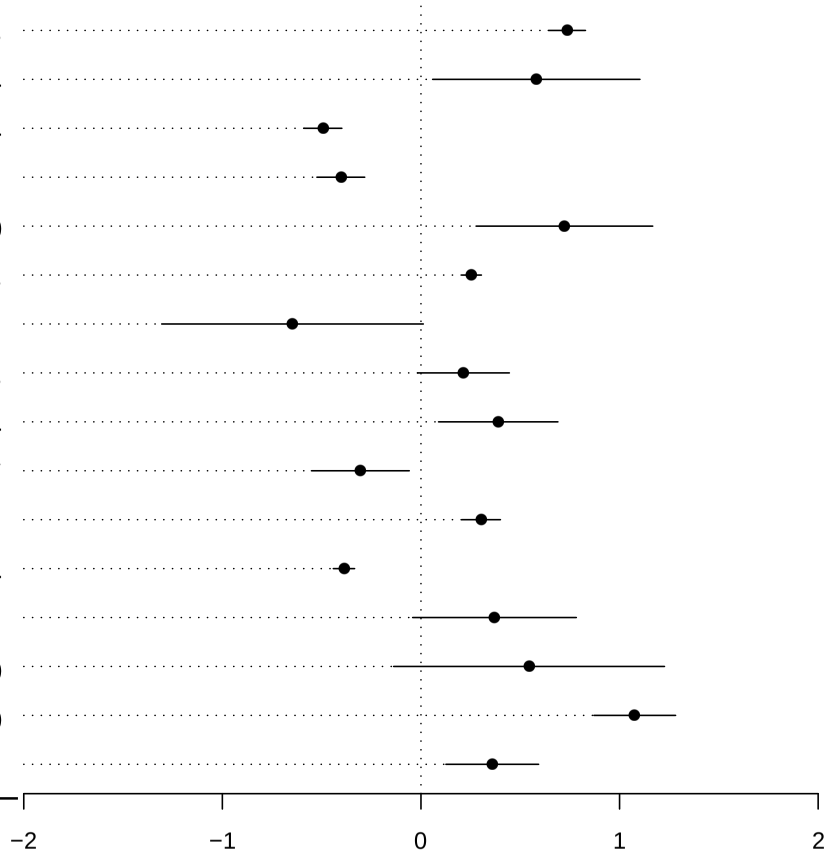


Figure B-6: Impact of Recent Substance Abuse on Being Robbed

	Estimate	SE
Alcohol Diagnosis	0.7940	0.0838
Cocaine Diagnosis	−0.1478	0.0930
Age	0.0352	0.0270
White	0.7599	0.1920
Male	0.4427	0.0699
Diploma	−0.2352	0.0909
Married	0.0891	0.2536
Abused as Child	0.4911	0.0940
Local Resident	−0.2292	0.1139
Alcohol Diagnosis Hx	−0.0143	0.0751
Cocaine Diagnosis Hx	−0.1523	0.0711
Serious Mental Illness Hx	0.2431	0.0941
Health Problems	−0.0556	0.0955
Conviction Hx	0.1525	0.0622
Living on the Streets	0.4464	0.1746
Living in Shelters	0.2359	0.1302

PPC = 0.52; Deviance = 1065

Dark lines represent 95% credible region

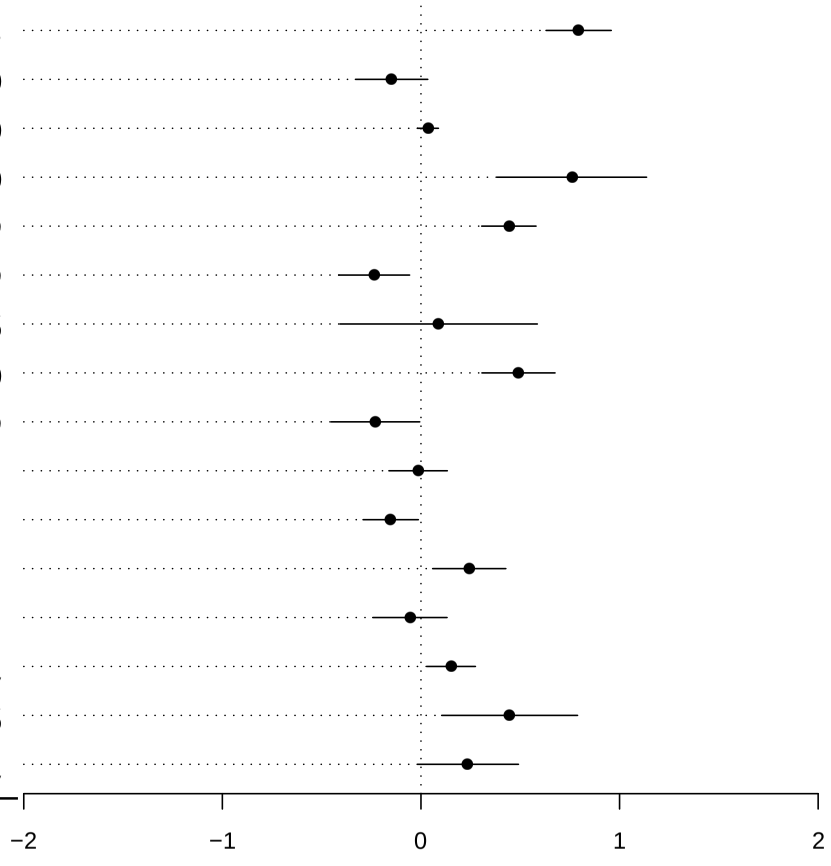


Figure B-7: Parameter Estimates for Probability of Staying Housed

	Estimate	SE
Recent Alcohol Diagnosis	−0.1690	0.0758
Recent Cocaine Diagnosis	−0.2894	0.0981
Count on Friends	0.5401	0.2491
Count on Family	0.3731	0.1597
Conflicts	0.3962	0.2112
Employed	0.5441	0.3880
Shadow Work	−0.2504	0.1679
Charges Pending	−0.2630	0.0674
Detained	−0.0288	0.1410
Robbed	−0.1423	0.1058
Routine Services (L)	−0.1428	0.1549
Routine Services (H)	0.0238	0.0319
Emergency Services (L)	−0.1156	0.1347
Emergency Services (H)	0.1376	0.1160

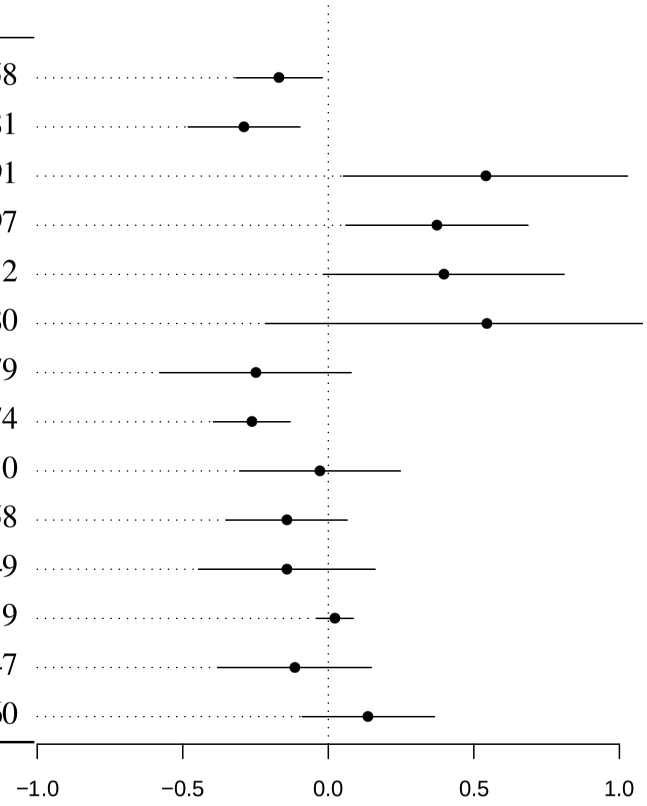


Figure B-8: Parameter Estimates for Probability of Moving from Housed to Shelters

	Estimate	SE
Recent Alcohol Diagnosis	0.0720	0.0860
Recent Cocaine Diagnosis	0.0488	0.1152
Count on Friends	−0.0476	0.2158
Count on Family	0.0089	0.1832
Conflicts	−0.0526	0.1339
Employed	0.0014	0.1558
Shadow Work	−0.0206	0.1239
Charges Pending	0.1231	0.0850
Detained	0.1190	0.0893
Robbed	0.0978	0.0932
Routine Services (L)	0.0577	0.0986
Routine Services (H)	0.1035	0.0323
Emergency Services (L)	−0.0570	0.0948
Emergency Services (H)	−0.0219	0.0663

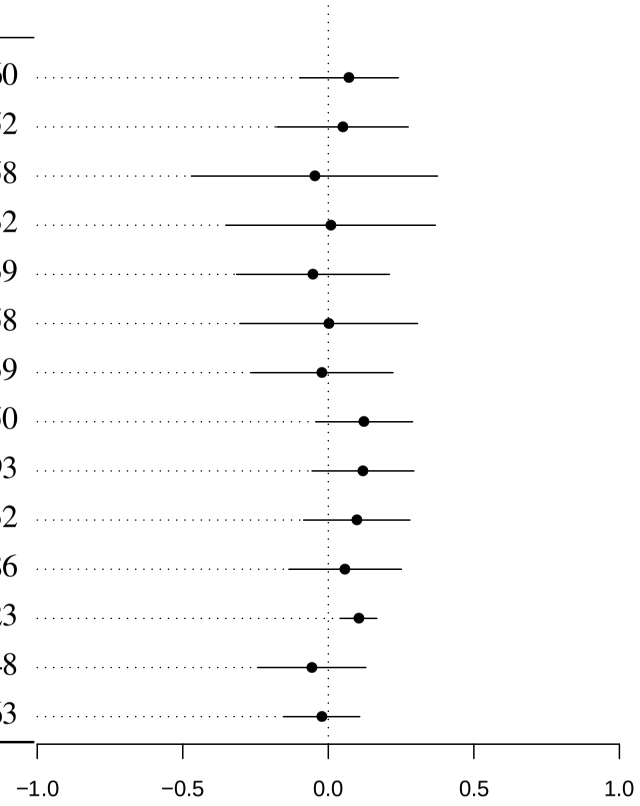


Figure B-9: Parameter Estimates for Probability of Moving from Shelters to Housing

	Estimate	SE
Recent Alcohol Diagnosis	−0.1270	0.1024
Recent Cocaine Diagnosis	−0.0960	0.1694
Count on Friends	0.0775	0.1275
Count on Family	0.5286	0.2631
Conflicts	0.1639	0.1007
Employed	0.4147	0.2200
Shadow Work	−0.1166	0.1179
Charges Pending	−0.1059	0.0822
Detained	−0.1345	0.0692
Robbed	−0.3179	0.1404
Routine Services (L)	−0.0360	0.0858
Routine Services (H)	0.1908	0.0849
Emergency Services (L)	0.2853	0.1018
Emergency Services (H)	−0.0643	0.1251

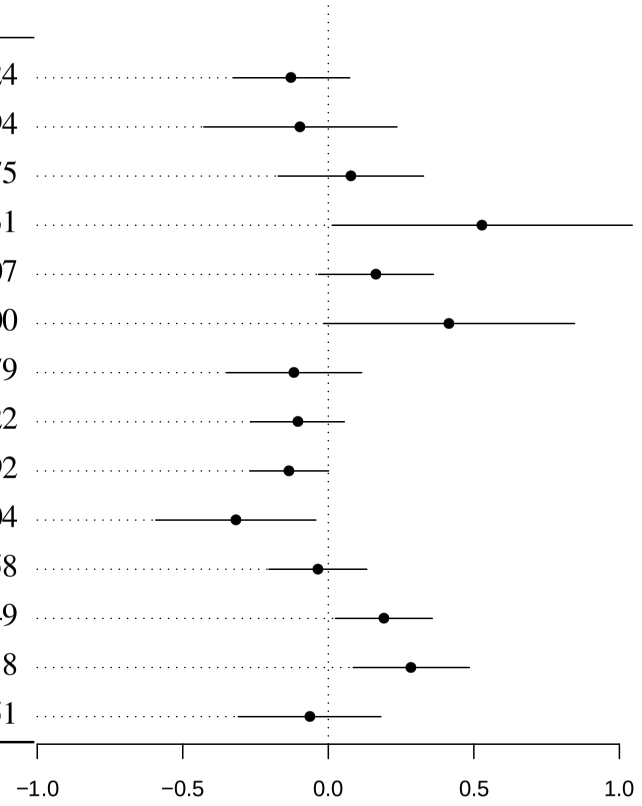


Figure B-10: Parameter Estimates for Probability of Staying in Shelters

	Estimate	SE
Recent Alcohol Diagnosis	0.0821	0.1057
Recent Cocaine Diagnosis	0.0431	0.0492
Count on Friends	0.0834	0.0766
Count on Family	−0.0026	0.1891
Conflicts	−0.0672	0.1295
Employed	−0.0402	0.1705
Shadow Work	0.0133	0.0428
Charges Pending	−0.0339	0.0719
Detained	0.0386	0.0619
Robbed	0.0358	0.1750
Routine Services (L)	0.2151	0.0672
Routine Services (H)	−0.0255	0.0555
Emergency Services (L)	−0.0439	0.1058
Emergency Services (H)	0.0413	0.0386

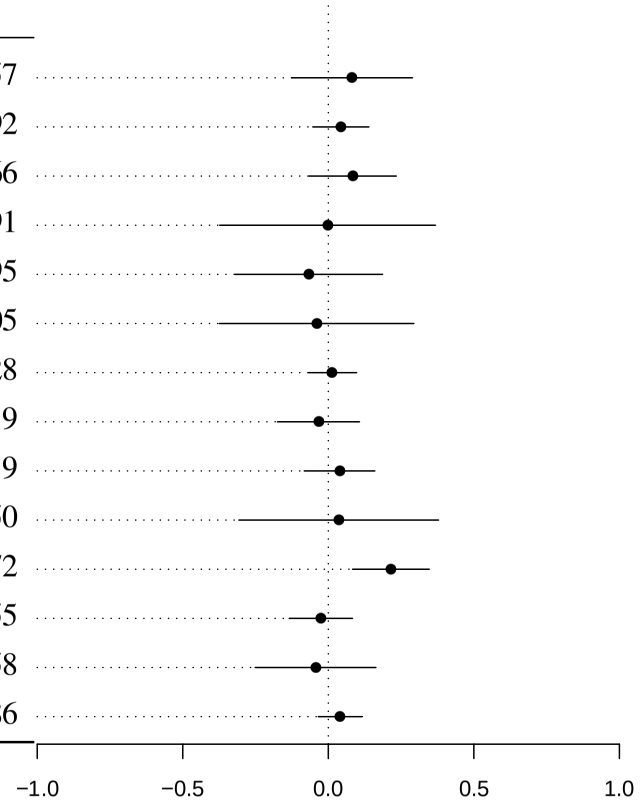


Figure B-11: Parameter Estimates for Probability of Moving from Streets to Housing

	Estimate	SE
Recent Alcohol Diagnosis	0.1038	0.0930
Recent Cocaine Diagnosis	−0.0985	0.0922
Count on Friends	0.1595	0.0989
Count on Family	0.1003	0.1063
Conflicts	0.2151	0.1733
Employed	0.2536	0.1609
Shadow Work	−0.3342	0.2264
Charges Pending	−0.0878	0.0634
Detained	0.0339	0.0527
Robbed	−0.0514	0.0815
Routine Services (L)	0.2584	0.1055
Routine Services (H)	−0.1452	0.1137
Emergency Services (L)	0.0253	0.0506
Emergency Services (H)	−0.0855	0.1120

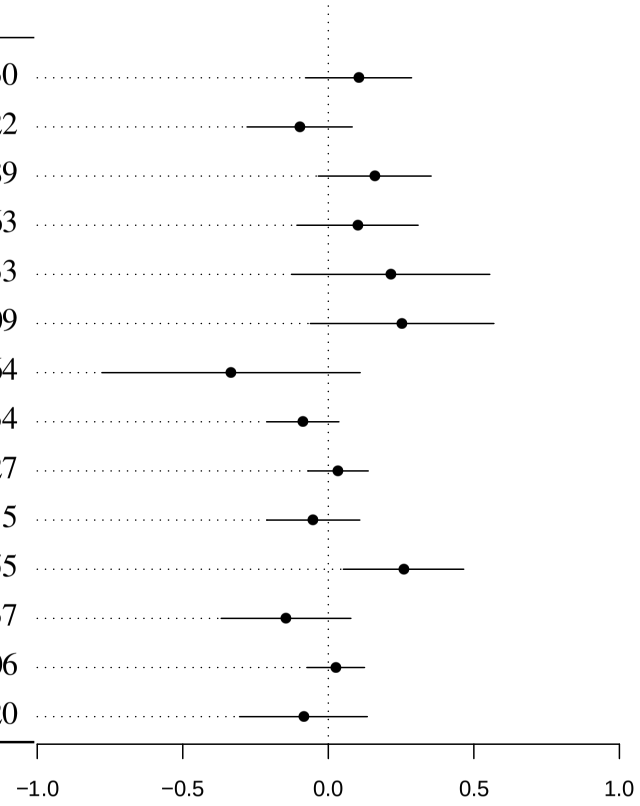


Figure B-12: Parameter Estimates for Probability of Moving from Streets to Shelters

	Estimate	SE
Recent Alcohol Diagnosis	−0.0230	0.0612
Recent Cocaine Diagnosis	0.0121	0.0729
Count on Friends	0.0848	0.1092
Count on Family	0.0873	0.0559
Conflicts	−0.0033	0.1285
Employed	−0.0001	0.0996
Shadow Work	−0.0235	0.1049
Charges Pending	0.0021	0.0451
Detained	−0.0201	0.0338
Robbed	0.0411	0.0550
Routine Services (L)	0.0237	0.1082
Routine Services (H)	0.0182	0.0613
Emergency Services (L)	0.0530	0.0516
Emergency Services (H)	−0.0285	0.0374

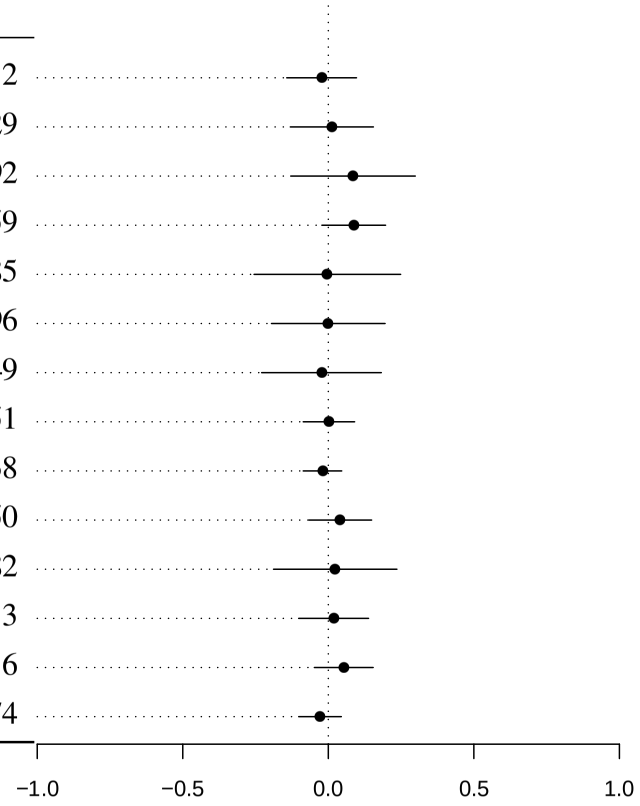


Figure B-13: Parameter Estimates for Probability of of Staying on the Streets

	Estimate	SE
Recent Alcohol Diagnosis	−0.0860	0.1376
Recent Cocaine Diagnosis	0.0149	0.1422
Count on Friends	−0.2975	0.0872
Count on Family	−0.1341	0.1355
Conflicts	−0.2492	0.1345
Employed	−0.2864	0.1179
Shadow Work	0.4100	0.1447
Charges Pending	0.1816	0.0831
Detained	−0.0024	0.0240
Robbed	−0.0010	0.1526
Routine Services (L)	−0.3107	0.0525
Routine Services (H)	0.2039	0.0556
Emergency Services (L)	−0.0808	0.0723
Emergency Services (H)	0.0730	0.1262