

## A MODELING PERSPECTIVE OF JUVENILE CRIMES

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**Abstract.** Youth gang activity is on the rise again since declining from its peak in the early 2000s. We focus on contagion of youth gang membership and delinquency among adolescents who are at risk to peer pressure by creating an epidemiological model with differential equations. The model seeks to examine dynamics of the system through stability analysis. A tipping point that spreads youth gang activity is identified, and sensitivity analysis on the threshold condition is performed to discuss the prevention strategies and the effectiveness of juvenile arrest and sanction. All parameters are approximated and results are also exploited by simulations. Analysis indicates that the system is most sensitive to prevention, early intervention and an effective juvenile system with treatment and rehabilitation.

**Key words.** Epidemiological model, Peer pressure, Stability analysis, Reproductive number, Juvenile crimes

### 1. Introduction

Youth gang activity is a widespread problem across the world. Youth gangs are self-identified, organized groups of adolescents, banded together under common interests and a common leader in activities that typically are regarded as menacing to society or illegal[10]. The Office of Juvenile Justice and Delinquency Prevention (OJJDP) in the U.S. Department of Justice[9] reports that the prevalence rate of youth gangs has been significantly elevated across the United States since declining from its peak in the early 2000s. The National Gang Center estimates that the number of gangs increased by 28 percent, and the number of gang members increased by 6 percent from 2002 to 2008[9].

We define juvenile crimes as assault, robbery, breaking and entering, felony theft, marijuana use, or drug selling. Many researchers have shown that delinquents who are repeat offenders are likely to continue to commit crime into adulthood. Therefore, preventing delinquency is crucial to reducing adult criminality. In this article, the term gangs refers to youth gangs unless otherwise specified, and our adolescents are assumed to be ages 13-18.

It is well known that peers play a central role in adolescence. Many sociologists have found that peer pressure is the most significant predictor of delinquent behavior in early adolescence [6][19][26]. According to Brown[5], susceptibility to peer pressure reaches its highest level in the younger population and in people with low confidence and lack of social interaction skills. "At-risk" youth in this study is defined as adolescents who are in the environment of poverty or ghettos, who have low academic achievement or low school commitment, or who are children of illegal immigrants. There is overwhelming evidence that the prevalence of delinquency among gang youth is much higher than one among non-gang youth[12][18][20]. Troubled youth join a gang for a variety of reasons. Some do so hoping that the gang can protect them[22]. The Associated Press[23] has said, "loosely organized gangs present the biggest concern for law enforcement officials because they are hard to investigate and their members often commit random acts

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of crime out of self-protection.” Siegel and Welsh[16] note that as youths move through adolescence, they gravitate toward cliques that provide support, assurance, protection and direction, and when a group provides the social and emotional basis for antisocial behaviors, the clique is transformed into a gang. Some youths join a gang by thinking that the gang represents their disadvantaged structural position in their community or society, and they justify their delinquent activities as a resolution of their problems[1]. Johnson[15] summarizes the research of Cohen, Ohlin, Miller, Sutherland and Cressey on the effect of delinquent associates: peer approval of the delinquent others is a strong motivation getting into delinquency, which strengthens the belonging and status; the greater the association with delinquent others, the greater the likelihood of being a delinquent. Youth gang members commit more violent crimes and property crimes than their peers who are not in gangs[11]. Thornberry et al.[21] have found that individual gang members are not fundamentally different from nonmembers, but when they are in the gang, the gang facilitates or enhances their involvement in delinquent behavior. Crane[6] has viewed that juvenile crime is contagious because it spreads through peer influence, which is well supported by the theory on delinquency and differential association. Voss[26] argues that the impact of delinquent peers is strengthened by the frequency, duration, priority, and intensity of association with such peers. Therefore, we take an epidemiological approach to youth gangs and delinquency.

In this study, we focus on contagion of gang membership and juvenile crimes among youths who are particularly susceptible to peer pressure. We treat this sociological problem as an epidemic and take a mathematical modeling approach, so the environmental peer pressure is expressed as the mass action terms used in epidemiological models. We construct a deterministic epidemiological model with a system of four nonlinear differential equations to examine the dynamics of the system through stability analysis. We identify a tipping point which is used to discuss strategies for prevention and control of juvenile crimes. All parameters are approximated to apply sensitivity analysis to the threshold condition, and our results are exploited through deterministic simulations.

## 2. Model

Individuals of our system are adolescents of ages between 13 and 18 in the low socioeconomic class. Our model consists of four classes: the at-risk susceptible population ( $S$ ), gang members who are not delinquents ( $G$ ), delinquent gang members, but not arrested ( $D$ ), and delinquents who are arrested and law-enforced ( $L$ ). Individuals of  $S$  who join a gang move to  $G$ , some members of  $G$  move to class  $D$  by committing crimes. When individuals in class  $D$  are arrested, they transit to class  $L$ . We use  $N = S + G + D + L$  to represent the total constant population. The parameter  $\mu$  is the per capita rate at which individuals age into the population,  $S$  and ones age out the system. All transition rates are per capita rate. In our model, a susceptible becomes a gang member due to peer pressure. Therefore, the constant rate  $\alpha$  at which a susceptible individual joins a gang depends on the frequency and intensity of the interaction with gang peers and juvenile delinquents. Youth gang members may learn delinquent behavior from delinquent peers, or their crimes may be motivated by personal issues such as a family problem, girl friend issue or needing money. The former is modeled by the peer pressure rate  $\beta$ , which is directly related to the proportion of delinquents already existing among the peer population, and the latter progression to  $D$  is modeled by the rate  $\gamma$ , so that the overall per capita delinquency rate is  $\beta D/N + \gamma$ . Transition to  $S$  from  $G$  depends