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Modeling and Analysis of the Interaction of Neutral Populations and Police, Gang and Drug Populations: A Competing Species Model

By

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ABSTRACT
The rise of gang and drug populations throughout the United States has brought concern, debate, and contention to the modern world. The strategies of gangs and druggies are national and are no longer concentrated in a particular location. In recent papers we have looked at models of the interaction between neutral populations and 1) police populations, 2) gang populations and 3) druggy populations individually. These models are unrealistic as all four of these populations exist at one time and in one place. In this paper, we present a dynamical model of the interaction between neutral, police, gang, and druggy populations simultaneously. The formulation is based on models of interactions between competing species type dynamics. An exploration of the long-term dynamics and stability of homogeneous equilibrium solutions and their stability is given. The paper is given in multiple parts. Part two presents the mathematical model. Part three analyzes the current populations. Part four analyzes the situation when an additional number of gang members are added to the population. In section five we analyze an increase in the drug population. In section six we analyze the scenario of an increase in both gang and drug populations. Part eight we analyze a decrease in the gang population. Part nine analyzes a decrease in the drug population. Part ten presents a decrease in the gang and drug population. In part eleven we consider the scenario when gang, drug and police populations decrease.. Conclusions are presented in section twelve.

KEYWORDS
Police, gang, druggy populations competing species model, equilibrium solutions, stability at equilibrium solutions.

Mathematica subject classification: 62J12, 62G99

Computing Classification: I.4

1.0 Introduction

Police, gangs, and druggies are not a new phenomenon. However, there is a marked increase in the growth of gang and druggy populations. Gang and druggies wreak havoc to native citizens. These gangs and druggies affect all areas of the global economy, markets, and political and social policies. In addition, the strength and presence of gang and druggies and their activities create emigration issues. In particular, the rise of the gang and druggy populations has caused one of the largest crisis since the dawn of the Second World War. Consequently, countries are faced with extremely difficult, complex, and contentious political and social decisions regarding gang and druggy populations.

The acceptance of gang and drug populations provides a Trojan horse of issues. Despite these impending threats, there is not much literature that takes a dynamical systems approach to understanding the spread of radicals and undocumented aliens, at a population level. Our primary objective is to bridge the gap.

In our framework, we let P represent the police population. We let G represent the gang population and D represents the druggy population. The native population are called neutral and is denoted by N: N can be viewed as the total documented population of a country. This paper is a first step in providing a mathematical modeling framework to study the evolution and interaction between this neutral radicalized, undocumented and welfare populations. The neutral population is modeled by standard population growth models

Also, we consider the addition to the police population. We also consider the scenarios of increased numbers of gangs as well as a decreased number of gangs. For the druggy population we also consider both increased numbers of druggies as well as decreases in the populations. The paper is organized as follows. In section two, we develop and analyze the time-dependent autonomous immigrant ordinary differential equation (ODE) model. We examine the equilibrium solutions, the stability of the equilibrium solutions and investigate the dynamics numerically.

Again, our purpose is studying the stability of the system under different sizes of the police, gang and drug populations.

Part two presents the mathematical model. Part three analyzes the current populations. Part four analyzes the situation when an additional number of gang members are added to the population. In section five we analyze an increase in the drug population. In section six we analyze the scenario of an increase in both gang and drug populations. Part eight we analyze a decrease in the gang population. Part nine analyzes a decrease in the drug population. Part ten presents a decrease in the gang and drug population. In part eleven we consider the scenario when gang, drug and police populations decrease of both undocumented aliens and welfare recipients. Conclusions are presented in section twelve.

2.0 Neutral, Police, Gang, Drug (N, P, G, D) ODE Model

Consider the mathematical model

$$N = a_1N/(1+d_1G) – a_{NR}NG/(1+d_2N) – b_1N^2 + a_2G/(1+d_3N) – a_{nr}NG/(1+d_2N) + a_2C/(1+d_3N) - a_{nr}NC/(1+d_2N) = 0 \qquad (1)$$

$$P = a_2P/(1+d_3N) – a_{nr}NP/(1+d_2N) – bP^2 + a_2G/(1+d_3N) – a_{nr}NG/(1+d_2G) + a_2P(1+d_3N) – a_{nr}NG/(1+d_2N) = 0 \qquad (2)$$

$$G = a_2G/(1+d_3N) - a_{NR}NG/(1+d_2N) - b_2G^2 + a_1N/(1+d_1P) - a_{NR}NP/(1+d_2N) + a_2D/(1+d_3N) - a_{nr}NC)/(1+d_2N) = 0 \quad (3)$$

$$D = a_2C/(1+d_3N) - a_{nr}ND/(1+d_2N) - bD^2 + a_2P/(1+d_3N) - a_{nr}NP/(1+d_2N) + a_2G/(1+d_3N) - a_2G/(1+d_3N) - a_{nr}NG/(1+d_2N) \quad (4)$$

The populations N, P, G and D represent the populations of the neutral, police, gang and drug populations. The parameters are all assumed to be positive and their descriptions are given in Table 1a.

Table 1a: List of parameters used in the differential equation model

Symbols	**Meaning**
a_1	Growth rate of the neutral population
a_2	Growth rate of the non-neutral population
b_1	Population loss in N due to intra-species competition and natural mortality
b_2	Population loss in G due to intra-species competition and natural mortality
a_{NR}	Maximum per capita loss in N due to non-interest by the neutral
d_1	Measures the effectiveness of P/G/D in disrupting the growth rate of N
d_2	Measures the resilience of N to other populations
d_3	Measures the effectiveness of N in disrupting other populations
d_4	Measures the resilience of P, G, D to strategies by N

In the case of $d_i = b_i = 0$, the mathematical model becomes similar to the competing species model. The parameters d_i influence the carrying capacity of the individual populations. Or instance, if $d_1 >> 1$ then the growth rate of N is reduced. This is interpreted as: highly effective other populations can greatly hinder the growth rate of N. The growth rate of the radical population is by recruiting of more radicals. Notice, that if $d_2 >> 1$ then the recruitment by other populations is small, Also, if $d_3 >> 1$, new members of the other populations are introduced into the other populations is smaller. The values chosen for the variables in this model are listed in Table 1b.

Table1b: Values of parameters

a_1	a_2	b_1	b_2	a_{NR}	d_1	d_2	d_3
2	2	0.5	0.5	2	2	2	3

3.0 Neutral, Police, Gang, Drug (N, P, G, D) ODE Model

Since this system is nonlinear, the first step is linearization using the Jacobian.

The Jacobian for this system is defined as

$$J = \begin{vmatrix} \partial N/\partial N & \partial N/\partial P & \partial N/\partial G & \partial N/\partial D \\ \partial P/\partial N & \partial P/\partial P & \partial P/\partial G & \partial P/\partial D \\ \partial G/\partial N & \partial G/\partial P & \partial G/\partial G & \partial D/\partial D \\ \partial D/\partial N & \partial D/\partial P & \partial D/\partial G & \partial D/\partial D \end{vmatrix}$$

The partial derivatives are:

$\partial N/\partial N = a_1/(1+d_1G) – [a_{nr}G(1+d_1N) – a_{nr}d_1GN]/(1+d_1N)^2 + a_1/(1+d_1D) – [a_{nr}D(1+d_1N) – a_{nr}d_1DN]/(1+d_1N)^2 + a_1/(1+d_1C) – [a_{nr}C(1+d_1N) – a_{nr}d_1CN]/(1+d_1N)^2 – 2b_1N;$

$\partial N/\partial G = -a_1d_1N/(1+d_1G)\text{^}2 – a_{nr}N/(1+d_1N)$

$\partial N/\partial D = -a_1d_1N/(1+d_1D)\text{^}2 – a_{nr}N/(1+d_1N)$

$\partial N/\partial C = -a_1d_1N/(1+d_1C)\text{^}2 – a_{nr}N/(1+d_1N)$

$\partial G/\partial N = -a_2d_3G/(1+d_3N)\text{^}2 – [a_{nr}G(1+d_2N) – a_{nr}d_2GN]/(1+d_2N)^2$

$\partial G/\partial G = a_1/(1+d_3N) - a_{nr}N(1+d_1N) + a_1/(1+d_1D) – a_{nr}D/(1+d_4D) + a_1/(1+d_4C) – a_{nr}C/(1+d_4C) -2b_2G$

$\partial G/\partial D = - a_1d_4G/(1+d_4D)^2 - [a_{nr}G(1+d_4D) – a_{nr}d_4GD]/(1+d_4D)^2$

$\partial G/\partial C = - a_1d_4G/(1+d_4C)^2 - [a_{nr}G(1+d_4C) – a_{nr}d_4GC]/(1+d_4C)^2$

$\partial D/\partial N = -a_1d_3D/(1+d_3N)\text{^}2 – [a_{nr}D(1+d_2N) – a_{nr}d_4DG]/(1+d_4G)^2$

$\partial D/\partial G = - a_1d_1D/(1+d_1G)^2 - [a_{nr}D(1+d_4G) – a_{nr}d_4DG]/(1+d_4G)^2$

$\partial D/\partial D = a_1/(1+d_3N) - a_{nr}N/(1+d_2N) + a_1/(1+d_4G) – a_{nr}G/(1+d_4G) + a_1/(1+d_4C) – a_{nr}C/(1+d_4C) – 2b_2D$

$\partial D/\partial C = - a_1d_4D/(1+d_4C)^2 - [a_{nr}D(1+d_4C) – a_{nr}d_4DC]/(1+d_4C)^2$

$\partial C/\partial N = -a_2d_3C/(1+d_3N)\text{^}2 – [a_{nr}C/(1+d_2N) – a_{nr}d_2CN]/(1+d_2N)^2$

$\partial C/\partial G = - a_1d_1C/(1+d_1G)^2 - [a_{nr}C/(1+d_4G) – a_{nr}d_4CG]/(1+d_4G)^2$

$\partial C/\partial D = - a_1d_1C/(1+d_1D)^2 - [a_{nr}C/(1+d_4D) – a_{nr}d_4CD]/(1+d_4D)^2$

$\partial C/\partial C = a_2/(1+d_3N) - a_{nr}N(1+d_2N) + a_1/(1+d_1G – a_{nr}G(1+d_4G) + a_1/(1+d_1D\_ - a_{nr}D/(1+d_4D) – 2b_2C$

The Jacobian now looks like

J =

| $a_1/(1+d_1G) – [a_{nr}G(1+d_1N) – a_{nr}d_1GN]/(1+d_1N)^2 + a_1/(1+d_1D) – [a_{nr}D(1+d_1N) – a_{nr}d_1DN]/(1+d_1N)^2 + a_1/(1+d_1C) – [a_{nr}C(1+d_1N) – a_{nr}d_1CN]/(1+d_1N)^2 – 2b_1N$ |

| $-a_1d_1N/(1+d_1G)^2 – a_{nr}N/(1+d_1N)$ |

| $-a_1d_1N/(1+d_1D)^2 – a_{nr}N/(1+d_1N)$ |

| $-a_1d_1N/(1+d_1C)^2 – a_{nr}N/(1+d_1N)$ |

| $-a_2d_3G/(1+d_3N)^2 – [a_{nr}G(1+d_2N) – a_{nr}d_2GN]/(1+d_2N)^2$ |

| $a_1/(1+d_3N) - a_{nr}N(1+d_1N) + a_1/(1+d_1D) – a_{nr}D/(1+d_4D) + a_1/(1+d_4C) – a_{nr}C/(1+d_4C) -2b_2G$ |

| $- a_1d_4G/(1+d_4D)^2 - [a_{nr}G(1+d_4D) – a_{nr}d_4GD]/(1+d_4D)^2$ |

| $- a_1d_4G/(1+d_4C)^2 - [a_{nr}G(1+d_4C) – a_{nr}d_4GC]/(1+d_4C)^2$ |

| $-a_1d_3D/(1+d_3N)^2 – [a_{nr}D(1+d_2N) – a_{nr}d_4DG]/(1+d_4G)^2$ |

| $- a_1d_1D/(1+d_1G)^2 - [a_{nr}D(1+d_4G) – a_{nr}d_4DG]/(1+d_4G)^2$ |

| $a_1/(1+d_3N) - a_{nr}N/(1+d_2N) + a_1/(1+d_4G) – a_{nr}G/(1+d_4G) + a_1/(1+d_4C) – a_{nr}C/(1+d_4C) – 2b_2D$ |

| $- a_1d_4D/(1+d_4C)^2 - [a_{nr}D(1+d_4C) – a_{nr}d_4DC]/(1+d_4C)^2$ |

| $-a_2d_3C/(1+d_3N)^2 – [a_{nr}C/(1+d_2N) – a_{nr}d_2CN]/(1+d_2N)^2$ |

| $- a_1d_1C/(1+d_1G)^2 - [a_{nr}C/(1+d_4G) – a_{nr}d_4CG]/(1+d_4G)^2$ |

| $- a_1d_1C/(1+d_1D)^2 - [a_{nr}C/(1+d_4D) – a_{nr}d_4CD]/(1+d_4D)^2$ |

| $a_2/(1+d_3N) - a_{nr}N(1+d_2N) + a_1/(1+d_1G – a_{nr}G(1+d_4G) + a_1/(1+d_1D\_ - a_{nr}D/(1+d_4D) – 2b_2C$ |

4.0 Current Populations

4.1 Equilibrium Points

Using the Maple CAS from Maplesoft, we obtained the following real valued equilibrium points

{d=0.,g=0.,n=0.,p=0.},
{d=-1.097004551,g=-1.525386305,n=1.525386305,p=1.097004551},
{d=0.4621168143,g=0.04440113176,n=-0.04440113176,p=-0.4621168143},
{d=-0.1194570727,g=0.4343491820,n=-0.4343491820,p=0.1194570727},
{d=0.6129702633,g=0.4365980648,n=-0.4365980648,p=-0.6129702633},

{d=8.344125927,g=0.4933968329,n=-0.4933968329,p=-8.344125927},
{d=1.737716148,g=-0.3871585887,n=0.3871585887,p=1.737716148},
{d=0.6859851047,g=-0.5172596295,n=0.5172596295,p=0.6859851047},
{d=-1.565311824,g=-1.222895099,n=1.222895099,p=-1.565311824},
{d=0.6457117284,g=-1.747461908,n=1.747461908,p=0.6457117284},

{d=-4.509223111,g=-4.405052022,n=4.405052022,p=-4.509223111},
{d=-0.1021722488,g=0.2052291235,n=-0.2052291235,p=-0.1021722488},
{d=-17.91166536,g=0.4078004447,n=-0.4078004447,p=-17.91166536},
{d=-0.6087147846,g=0.4329445925,n=-0.4329445925,p=-0.6087147846},
{d=0.1194166854,g=0.4343170008,n=-0.4343170008,p=0.1194166854},

{d=-1.643425253,g=2.430470805,n=-2.430470805,p=-1.643425253},
{d=-2.681650416,g=2.910731948,n=-2.910731948,p=-2.681650416},
{d=1.394526555,g=0.5031995222,n=0.5031995222,p=1.394526555},
{d=0.9406662430,g=0.5915185868,n=0.5915185868,p=0.9406662430},
{d=-17.70756911,g=-0.4086594092,n=-0.4086594092,p=-17.70756911},

{d=-0.6095185931,g=-0.4336357046,n=-0.4336357046,p=-0.6095185931},
{d=0.1190922207,g=-0.4340584313,n=-0.4340584313,p=0.1190922207},
{d=0.2759314011,g=-0.5547596397,n=-0.5547596397,p=0.2759314011},
{d=-7.061422213,g=-7.116520194,n=-7.116520194,p=-7.061422213},
{d=-0.5778401412,g=0.4578301790,n=0.4578301790,p=0.5778401412},

{d=0.6074629882,g=-0.4318673495,n=-0.4318673495,p=-0.6074629882},
{d=-0.1192298499,g=-0.4341681162,n=-0.4341681162,p=0.1192298499},
{d=7.574969617,g=-0.5097073206,n=-0.5097073206,p=-7.574969617},
{d=2.511151327,g=-0.8544107172,n=-0.8544107172,p=-2.511151327},
{d=-2.912991512,g=-2.884112971,n=-2.884112971,p=2.912991512},

{d=3.010550875,g=-3.194597645,n=-3.194597645,p=-3.010550875},

4.2 Analyzing Equilibrium Points For Stability

In this section we use the equilibrium points to generate the eigenvalues for the system and establish whether the equilibrium point is stable or unstable.

Table 2 summarizes the results for the current population levels.

Table 2 – Results for Current Population Levels

Equilibrium Point	Eigen values	Stability
{d=0., g=0., n=0., p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-1.097004551 g=-1.525386305, n=1.525386305, p=1.097004551},	-.879673058473556+1.95206705606621*I, -.879673058473556-1.95206705606621*I, 2.03167469728499, 1.15538623056212	Unstable
{d=0.4621168143, g=-.04440113176 n=-0.04440113176 p=-.4621168143},	27.2826797778074, -6.62121875678745, 11.6393897143219, -.433260045741832	Unstable
{d=-.1194570727, g=0.4343491820, n=-0.4343491820, p=0.1194570727},	49.9292990955322, 32.7600557954403, -.323034201182836, .100388088910375	Unstable
{d=0.6129702633, g=0.4365980648, n=-0.4365980648, p=-.6129702633}	45.2307977088385, 32.2895813559389, -.260808322438675+.255441899220537*I, -.260808322438675 -.255441899220537*I	Unstable
{d=8.344125927, g=0.4933968329, n=-0.4933968329, p=-8.344125927},	4.93396832900000*10^9, 2.92536541290446+8954.75102871741*I, 2.92536541290446-8954.75102871741*I, -8.34412765875793	Unstable
{d=1.737716148, g=-0.3871585887, n=0.3871585887, p=1.737716148}	-8.59823576745649, 2.95447980019893, .766357134423232, -1.76980612126568	Unstable
{d=0.6859851047, g=-0.5172596295, n=0.5172596295, p=0.6859851047},	-2.58737130882691, 1.81676009218371, .577294743447316, -.653814345904117	Unstable
{c=-1.565311824, g=-1.222895099, n=1.222895099, p=-1.565311824},	-4.09403165449281, 6.98768608975728, 1.92600045102153, 1.43393763931399	Unstable
{d=0.6457117284, g=-1.747461908, n=1.747461908, p=0.6457117284},	2.00128003623936, -1.14034784638713+1.29357410330275*I, -1.14034784638713-1.29357410330275*I, -.443666133965113	Unstable
{d=-4.509223111, g=-4.405052022, n=4.405052022, p=-4.509223111},	-7.15734703391316, 10.2139078285318, 5.05479015022406, 4.46365623015727	Unstable
{d=-.1021722488, g=0.2052291235,	-7.15734703391316, 10.2139078285318,	Unstable

n=-0.2052291235, p=-.1021722488},	5.05479015022406, 4.46365623015727	
{d=-17.91166536, g=0.4078004447, n=-0.4078004447, p=-17.91166536},	-1385.60173377096, 113.665370016680, 28.9637189718698, -5.56759905258651	Unstable
{d=-.6087147846, g=0.4329445925, n=-0.4329445925, p=-.6087147846},	-73.1353226169753, 43.7380980900024, -.0782602564462342, .397518509519243	Unstable
{d=0.1194166854, g=0.4343170008, n=-0.4343170008, p=0.1194166854},	1.52840269210565+.860966742495369*I, 1.52840269210565-.860966742495369*I, -.0444328075309797, -.119397179480317	Unstable
{d=-1.643425253, g=2.430470805, n=-2.430470805, p=-1.643425253},	-3.66047057424518+1.41386537870883*I, -3.66047057424518-1.41386537870883*I, 2.61170733866524, 1.39466534282512	Unstable
{c=-2.681650416, g=2.910731948, n=-2.910731948, p=-2.681650416},	-6.75439196728347, 1.26039484282851+1.31091675223893*I, 1.26039484282851-1.31091675223893*I, 3.64838499662644	Unstable
{d=1.394526555, g=0.5031995222, n=0.5031995222, p=1.394526555},	45.2307977088385, 32.2895813559389, -.260808322438675+.255441899220537*I, -.260808322438675-.255441899220537*I	Unstable
{d=0.9406662430, g=0.5915185868, n=0.5915185868, p=0.9406662430},	-7.04446087125393, 2.31979355966010, -.406480168489017, -.905949831117160	Unstable
{d=-17.70756911, g=-0.4086594092, n=-0.4086594092, p=-17.70756911},	-1337.44352889663, 113.580128261098, 28.7283022743052, -4.32625056577675	Unstable
{d=-.6095185931, g=-0.4336357046, n=-0.4336357046, p=-.6095185931},	-88.8139094753968, 44.0272658176063, .0572638776256839, .542155887864874	Unstable
{c=0.1190922207, g=-0.4340584313, n=-0.4340584313, p=0.1190922207},	42.9741658718664+5.40419207782512*I, 42.9741658718664-5.40419207782512*I, -.172802981280934, .426432372148180	Unstable
{d=0.2759314011, g=-0.5547596397, n=-0.5547596397, p=0.2759314011},	-45.9423506215179, 16.4862959452533, -11.0853722067468, .100535643011398	Unstable
{d=-7.061422213, g=-7.116520194, n=-7.116520194, p=-7.061422213},	2.21612080003316+9.88607066750840*I, 2.21612080003316-9.88607066750840*I, 7.76916432499361, 7.09220654094006	Unstable
{d=-.5778401412, g=0.4578301790, n=0.4578301790, p=0.5778401412},	-2.00558122921231, .372750254358792+.374343727311665*I, . 372750254358792-.374343727311665*I, .722584689494727	Unstable
{d=0.6074629882,	43.2153454141804,	Unstable

g=-0.4318673495, n=-0.4318673495, p=-.6074629882},	16.6404257111922, 1.02526107500163, -1.82214846287424	
{d=-.1192298499, g=-0.4341681162, n=-0.4341681162, p=0.1192298499},	39.6930277123546, 25.7292667247948, .529262375430315, .136574861520330	Unstable
{d=7.574969617, g=-0.5097073206, n=-0.5097073206, p=-7.574969617},	-2958.31156649879, 2.15843407815945, .802038253251798, -142.516167452618	Unstable
{d=2.511151327, g=-0.8544107172, n=-0.8544107172, p=-2.511151327},	-17.1611873756245, .386234271828064+2.38354640555869*I, .386234271828064-2.38354640555869*I, 3.10851068296830	Unstable
{d=-2.912991512, g=-2.884112971, n=-2.884112971, p=2.912991512},	-4.86041374249595, 1.34108883982673+2.27364611339438*I, 1.34108883982673-2.27364611339438*I, 2.89900650284249	Unstable
{d=3.010550875, g=-3.194597645, n=-3.194597645, p=-3.010550875},	-6.70017093478081, 2.08345167284194+2.23094903560400*I, 2.08345167284194-2.23094903560400*I, 3.33998675909693	Unstable

5.0 Growth of the Gang Population

In this section, we consider the situation where the gang population grows by 25%.

Using the Maple CAS on (1-4) and obtained the following real valued equilibrium points.

{d = 0., g = 0., n = 0., p = 0.},
{d = -1.097004551, g = -1.220309044, n = 1.525386305, p = 1.097004551},
{d = .4621168143, g = .03552090540, n = -.04440113176, p = -.4621168143},
{d = -.1194570727, g = .3474793456, n = -.4343491820, p = .1194570727},
{d = .6129702633, g = .3492784518, n = -.4365980648, p = -.6129702633},

{d = 8.344125927, g = .3947174663, n = -.4933968329, p = -8.344125927},
{d = 1.737716148, g = -.3097268710, n = .3871585887, p = 1.737716148},
{d = .6859851047, g = -.4138077036, n = .5172596295, p = .6859851047},
{d = -1.565311824, g = -.9783160795, n = 1.222895099, p = -1.565311824},
{d = .6457117284, g = -1.397969527, n = 1.747461908, p = .6457117284},

{d = -4.509223111, g = -3.524041618, n = 4.405052022, p = -4.509223111},
{d = -.1021722488, g = .1641832988, n = -.2052291235, p = -.1021722488},
{d = -17.91166536, g = .3262403558, n = -.4078004447, p = -17.91166536},
{d = -.6087147846, g = .3463556740, n = -.4329445925, p = -.6087147846},
{d = .1194166854, g = .3474536006, n = -.4343170008, p = .1194166854},

{d = -1.643425253, g = 1.944376644, n = -2.430470805, p = -1.643425253},
{d = -2.681650416, g = 2.328585559, n = -2.910731948, p = -2.681650416},
{d = 1.394526555, g = .4025596178, n = .5031995222, p = 1.394526555},

{d = .9406662430, g = .4732148694, n = .5915185868, p = .9406662430},
{d = -17.70756911, g = -.3269275273, n = -.4086594092, p = -17.70756911},

{d = -.6095185931, g = -.3469085637, n = -.4336357046, p = -.6095185931},
{d = .1190922207, g = -.3472467450, n = -.4340584313, p = .1190922207},
{d = .2759314011, g = -.4438077118, n = -.5547596397, p = .2759314011},
{d = -7.061422213, g = -5.693216155, n = -7.116520194, p = -7.061422213},
{d = -.5778401412, g = .3662641432, n = .4578301790, p = .5778401412},

{d = .6074629882, g = -.3454938796, n = -.4318673495, p = -.6074629882},
{d = -.1192298499, g = -.3473344930, n = -.4341681162, p = .1192298499},
{d = 7.574969617, g = -.4077658565, n = -.5097073206, p = -7.574969617},
{d = 2.511151327, g = -.6835285737, n = -.8544107172, p = -2.511151327},
{d = -2.912991512, g = -2.307290377, n = -2.884112971, p = 2.912991512},

{d = 3.010550875, g = -2.555678116, n = -3.194597645, p = -3.010550875}

5.1 Analyzing equilibrium points for stability

In this section we use the equilibrium points to generate the eigenvalues for the system and establish whether the equilibrium point is stable or unstable.

Table 3 summarizes the results for an increased gang population level.

Table 3 – Results for Increased Gang Population Levels

Equilibrium Points	Eigen values	Stability
{d = 0. g = 0. n = 0, p = 0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d = -1.097004551, g = -1.220309044, n = 1.525386305, p = 1.097004551},	-.949046147007913+1.84663286656022*I, -.949046147007913-1.84663286656022*I, 1.58614308330792, 1.11164847900790	Unstable
{d = .4621168143, g = .03552090540, n = -.04440113176, p = -.4621168143},	26.0452041894988, 12.0813188011764, -6.69741533022829, -.438003997846947	Unstable
{d = -.1194570727, g = .3474793456, n = -.4343491820, p = .1194570727},	48.5142543294269, 32.4435535789144, -.267385280916045, .107368417674764	Unstable
{d = .6129702633, g = .3492784518, n = -.4365980648, p = -.6129702633},	45.3642080941995, 29.3913994051917, -.158589468245629+.298170267772160*I, -.158589468245629-.298170267772160*I	Unstable
{d = 8.344125927,	4625.55669093671,	Unstable

g = .3947174663, n = -.4933968329, p = -8.344125927},	232.039967162870, -.987145178170275, 5.09089075859228	
{d = 1.737716148, g = -.3097268710, n = .3871585887, p = 1.737716148},	-8.83775902779750, 3.01805211288287, .639868505280364, -1.76961024216574	Unstable
{d = .6859851047, g = -.4138077036, n = .5172596295, p = .6859851047},	-2.85471751333970, 1.82908623369232, .480894816751040, -.654578360803658	Unstable
{d = -1.565311824, g = -.9783160795, n = 1.222895099, p = -1.565311824},	-3.94921449521082, 6.58599627460519, 1.82295118210864, 1.23923602859699	Unstable
{d = .6457117284, g = -1.397969527, n = 1.747461908, p = .6457117284},	1.69520271133345, -1.34490885542562+.730085255671676*I, -1.34490885542562-.730085255671676*I, -.408187195682211	Unstable
{d = -4.509223111, g = -3.524041618, n = 4.405052022, p = -4.509223111},	1.69520271133345, -1.34490885542562+.730085255671676*I, -1.34490885542562-.730085255671676*I, -.408187195682211	Unstable
{d = -.1021722488, g = .1641832988, n = -.2052291235, p = -.1021722488},	16.7380551193829, -.0176963867042361, 2.00768254724956, -6.08277442792824	Unstable
{d = -17.91166536, g = .3262403558, n = -.4078004447, p = -17.91166536},	-1379.33336057657, 114.122393868782, 28.9919444798763, -5.46245751808493	Unstable
{d = -.6087147846, g = .3463556740, n = -.4329445925, p = -.6087147846},	-74.3007299648863, 43.7436577951601, -.0616629262128351, .399069680539107	Unstable
{d = .1194166854, g = .3474536006, n = -.4343170008, p = .1194166854},	62.5859067557151, 38.6829204808126, -.0729992891397810, -.285218595387983	Unstable
{d = -1.643425253, g = 1.944376644, n = -2.430470805, p = -1.643425253},	-5.94566417557804, 2.95841241994723, -.469549091756190, 1.30389943438700	Unstable
{d = -2.681650416, g = 2.328585559, n = -2.910731948, p = -2.681650416},	-6.50298977942751, 1.18125849851316+1.39849978158192*I, 1.18125849851316-1.39849978158192*I, 3.66277709640120	Unstable
{d = 1.394526555, g = .4025596178, n = .5031995222, p = 1.394526555},	-8.95464945062803, 2.81596297719057, -1.36298202451556, -.314989189446982	Unstable
{d = .9406662430, g = .4732148694, n = .5915185868, p = .9406662430},	-6.70694223758260, 2.27157014248426, -.324614742000819, -.899479465700847	Unstable

{d = -17.70756911, g = -.3269275273, n = -.4086594092, p = -17.70756911},	-1343.43403656462, 113.128474253941, 28.7002277026337, -4.43224120095586	Unstable
{d = -.6095185931, g = -.3469085637, n = -.4336357046, p = -.6095185931},	-87.3919431430631, 44.0406536789469, .0488764779824119, .513705372933878	Unstable
{d = .1190922207, g = -.3472467450, n = -.4340584313, p = .1190922207},	43.8006021938967+4.02770245997856*I, 43.8006021938967-4.02770245997856*I, -.163608515579398, .322422506085896	Unstable
{d = .2759314011, g = -.4438077118, n = -.5547596397, p = .2759314011},	26.3699174455509, -37.3143776799653, -8.60669752537585, .0435110097902171	Unstable
{d = -7.061422213, g = -5.693216155, n = -7.116520194, p = -7.061422213},	26.3699174455509, -37.3143776799653, -8.60669752537585, .0435110097902171	Unstable
{d = -.5778401412, g = .3662641432, n = .4578301790, p = .5778401412},	-1.75623128049549, .336334732521029+.489579392691555*I, . 336334732521029-.489579392691555*I, 876447263453432	Unstable
{d = .6074629882, g = -.3454938796, n = -.4318673495, p = -.6074629882},	43.1967893032754, 17.6863455132056, .764471752324246, -1.83803423120526	Unstable
{d = -.1192298499, g = -.3473344930, n = -.4341681162, p = .1192298499},	40.2431963820469, 26.9203936311638, .394153557557737, .130157420131530	Unstable
{d = 7.574969617, g = -.4077658565, n = -.5097073206, p = -7.574969617},	-2400.18966120510, 3.74591362696839, .0563936293542266, -141.857116131226	Unstable
{d = 2.511151327, g = -.6835285737, n = -.8544107172, p = -2.511151327},	-16.2701716599264, 3.40128075300421, . 321388305461081+2.19523666351516*I, . 321388305461081-2.19523666351516*I	Unstable
{d = -2.912991512, g = -2.307290377, n = -2.884112971, p = 2.912991512},	-4.79955414168717, 1.42224373377074+1.71759798789858*I, 1.42224373377074-1.71759798789858*I, 2.57454171314568	Unstable
{d = 3.010550875, g = -2.555678116, n = -3.194597645, p = -3.010550875}	-6.46652681352326, 1.90834224872301+1.76445407501044*I, 1.90834224872301-1.76445407501044*I, 3.28383385607724	Unstable

6.0 Growth of the Drug Population

In this section, we consider the situation where the drug population is increased by 25%

Using the Maple CAS we executed the command solve on (1-4) and obtained the following equilibrium points

{d=0.,g=0.,n=0.,p=0.},
{d=-0.8776036411,g=-1.525386305,n=1.525386305,p=1.097004551},
{d=0.3696934514,g=0.04440113176,n=-0.04440113176,p=-0.4621168143},
{d=-0.09556565816,g=0.4343491820,n=-0.4343491820,p=0.1194570727},
{d=0.4903762106,g=0.4365980648,n=-0.4365980648,p=-0.6129702633},

{d=6.675300742,g=0.4933968329,n=-0.4933968329,p=-8.344125927},
{d=1.390172919,g=-0.3871585887,n=0.3871585887,p=1.737716148},
{d=0.5487880838,g=-0.5172596295,n=0.5172596295,p=0.6859851047},
{d=-1.252249459,g=-1.222895099,n=1.222895099,p=-1.565311824},
{d=0.5165693828,g=-1.747461908,n=1.747461908,p=0.6457117284},

{d=-3.607378489,g=-4.405052022,n=4.405052022,p=-4.509223111},
{d=-0.08173779902,g=0.2052291235,n=-0.2052291235,p=-0.1021722488},
{d=-14.32933229,g=0.4078004447,n=-0.4078004447,p=-17.91166536},
{d=-0.4869718277,g=0.4329445925,n=-0.4329445925,p=-0.6087147846},
{d=0.09553334830,g=0.4343170008,n=-0.4343170008,p=0.1194166854},

{d=-1.314740203,g=2.430470805,n=-2.430470805,p=-1.643425253},
{d=-2.145320333,g=2.910731948,n=-2.910731948,p=-2.681650416},
{d=1.115621244,g=0.5031995222,n=0.5031995222,p=1.394526555},
{d=0.7525329944,g=0.5915185868,n=0.5915185868,p=0.9406662430},
{d=-14.16605529,g=-0.4086594092,n=-0.4086594092,p=-17.70756911},

{d=-0.4876148745,g=-0.4336357046,n=-0.4336357046,p=-0.6095185931},
{d=0.09527377659,g=-0.4340584313,n=-0.4340584313,p=0.1190922207},
{d=0.2207451208,g=-0.5547596397,n=-0.5547596397,p=0.2759314011},
{d=-5.649137771,g=-7.116520194,n=-7.116520194,p=-7.061422213},
{d=-0.4622721130,g=0.4578301790,n=0.4578301790,p=0.5778401412},

{d=0.4859703906,g=-0.4318673495,n=-0.4318673495,p=-0.6074629882},
{d=-0.09538387995,g=-0.4341681162,n=-0.4341681162,p=0.1192298499},
{d=6.059975693,g=-0.5097073206,n=-0.5097073206,p=-7.574969617},
{d=2.008921062,g=-0.8544107172,n=-0.8544107172,p=-2.511151327},
{d=-2.330393210,g=-2.884112971,n=-2.884112971,p=2.912991512},

{d=2.408440700,g=-3.194597645,n=-3.194597645,p=-3.010550875},

6.1 Analyzing Equilibrium Points for Stability

In this section we use the equilibrium points to generate the eigenvalues for the system and establish whether the equilibrium point is stable or unstable.

Table 4 summarizes the results for a decreased undocumented population level.

Table 4 – Results for Increased Drug Population Levels

Equilibrium Point	Eigen values	Stability
{d=0., g=0., n=0., p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-0.8776036411, g=-1.525386305, n=1.525386305, p=1.097004551},	-.914825681523893+1.86889708597935*I, -.914825681523893-1.86889708597935*I, 1.94823569938933, .899820679658456	Unstable
{d=0.3696934514, g=0.04440113176, n=-0.04440113176, p=-0.4621168143},	26.6069746664303, -6.67314247619072, 11.5858019454947, -.350403467134257	Unstable
{d=-0.09556565816, g=0.4343491820, n=-0.4343491820, p=0.1194570727},	50.9686577276165, 33.7592966994848, -.324746035115852, .0833826122146263	Unstable
{d=0.4903762106, g=0.4365980648, n=-0.4365980648, p=-0.6129702633},	45.3778268897685, 20.8099413912232, -.223982144195819+.0317396140101659*I, -.223982144195819-.0317396140101659*I	Unstable
{d=6.675300742, g=0.4933968329, n=-0.4933968329, p=-8.344125927},	-12906.6291982995, 237.855131969881, 1.94923904956331, -2.40834520995892	Unstable
{d=1.390172919, g=-0.3871585887, n=0.3871585887, p=1.737716148},	-7.67498575021939, 2.67123465816085, .797117841683996, -1.53031949452546	Unstable
{d=0.5487880838, g=-0.5172596295, n=0.5172596295, p=0.6859851047},	-2.26466575901192, 1.71801649899188, .592013400181288, -.551849947361245	Unstable
{d=-1.252249459, g=-1.222895099, n=1.222895099, p=-1.565311824},	-3.91840392341819, 6.44856550261292, 1.85579969946328, 1.24388765954200	Unstable
{d=0.5165693828, g=-1.747461908, n=1.747461908, p=0.6457117284},	-1.06070422222568+1.44683543180908*I, -1.06070422222568-1.44683543180908*I, 1.99776479690423, -.368156587952867	Unstable
{d=-3.607378489, g=-4.405052022, n=4.405052022, p=-4.509223111},	-6.87949615018552, 9.44132705538950, 4.94060738012163, 3.82174548767439	Unstable
{d=-0.08173779902,	13.7852987672791,	Unstable

g=0.2052291235, n=-0.2052291235, p=-0.1021722488},	-6.15260463767192, 3.28339063874961, -.0630975623568408	
{d=-14.32933229, g=0.4078004447, n=-0.4078004447, p=-17.91166536},	-1245.73530956155, 109.369838547196, 23.1285642737928, -5.88723516444035	Unstable
{d=-0.4869718277, g=0.4329445925, n=-0.4329445925, p=-0.6087147846},	-63.3056835719846, 43.7264118510637, -.0315167598116999, .317706149932570	Unstable
{d=0.09553334830, g=0.4343170008, n=-0.4343170008, p=0.1194166854},	30.6485155341241, -14.6741328494673, -2.82528640010083, -.225512813555899	Unstable
{d=-1.314740203, g=2.430470805, n=-2.430470805, p=-1.643425253},	-5.54887171089961, 2.57330188167515, 1.46690946213183, -.579263816507370	Unstable
{d=-2.145320333, g=2.910731948, n=-2.910731948, p=-2.681650416},	-6.49454368453454, 1.15985931139333+.855782642359187*I, 1.15985931139333-.855782642359187*I, 3.54437260074788	Unstable
{d=1.115621244, g=0.5031995222, n=0.5031995222, p=1.394526555},	-8.54293542115683, 2.63784198560033, -1.15849815771518, -.403848700128327	Unstable
{d=0.7525329944, g=0.5915185868, n=0.5915185868, p=0.9406662430},	-6.58477816480027, 2.16223312982869, -.410553628170977, -.750100885457429	Unstable
{d=-14.16605529, g=-0.4086594092, n=-0.4086594092, p=-17.70756911},	-1196.24752385960, 109.637599151356, 22.9561319482277, -4.65231398298422	Unstable
{d=-0.4876148745, g=-0.4336357046, n=-0.4336357046, p=-0.6095185931},	-78.6599137658710, 44.0274129800156, .0211580833880359, .467863791567292	Unstable
{d=0.09527377659, g=-0.4340584313, n=-0.4340584313, p=0.1190922207},	41.9636249783647+5.55152441639508*I, 41.9636249783647-5.55152441639508*I, -.143798242572428, .425909924543100	Unstable
{d=0.2207451208, g=-0.5547596397, n=-0.5547596397, p=0.2759314011}	-51.8357152401532, 12.4444461379536, -12.3451449541193, .133174716318919	Unstable
{d=-5.649137771, g=-7.116520194, n=-7.116520194, p=-7.061422213},	2.21095921804289+9.12041162621114*I, 2.21095921804289-9.12041162621114*I, 6.26129699405864, 7.64113897385557	Unstable
{d=-0.4622721130, g=0.4578301790, n=0.4578301790, p=0.5778401412},	-2.25888090194342, .584300982445759+.185082299365885*I,. 584300982445759-.185082299365885*I, .258886794851903	Unstable

{d=0.4859703906, g=-0.4318673495, n=-0.4318673495, p=-0.6074629882},	43.2113448947907, 7.24194402165352, 1.47151609566099, -2.26414445720516	Unstable
{d=-0.09538387995, g=-0.4341681162, n=-0.4341681162, p=0.1192298499},	39.3429725426546, 28.1329711255181, .511412990950463, .103616905026805	Unstable
{d=6.059975693, g=-0.5097073206, n=-0.5097073206, p=-7.574969617},	-11302.4521805468, -144.810137286751, .0717710717934006+1.81110723825072*I, .0717710717934006-1.81110723825072*I	Unstable
{d=2.008921062, g=-0.8544107172, n=-0.8544107172, p=-2.511151327},	3.56508954830901, -2.66197620334364+1.52378151728849*I, -2.66197620334364-1.52378151728849*I, .638487346778275	Unstable
{d=-2.330393210, g=-2.884112971, n=-2.884112971, p=2.912991512},	-4.81385054079530, 1.46612408377540+1.73041951854844*I, 1.46612408377540-1.73041951854844*I, 2.55975733524449	Unstable
{d=2.408440700, g=-3.194597645, n=-3.194597645, p=-3.010550875},	-6.35696875258326, 1.96433407205167+2.27825330716428*I, 1.96433407205167-2.27825330716428*I, 3.34876547147991	Unstable

7.0 Increase of Gang and Drug Population

In this section, we consider the situation where the gang and drug population is increased by 25%.

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points

{d=0.,g=0.,n=0.,p=0.},
{d=-0.8776036411,g=-1.220309044,n=1.525386305,p=1.097004551},
{d=0.3696934514,g=0.03552090540,n=-0.04440113176,p=-0.4621168143},
{d=-0.09556565816,g=0.3474793456,n=-0.4343491820,p=0.1194570727},
{d=0.4903762106,g=0.3492784518,n=-0.4365980648,p=-0.6129702633},

{d=6.675300742,g=0.3947174663,n=-0.4933968329,p=-8.344125927},
{d=1.390172919,g=-0.3097268710,n=0.3871585887,p=1.737716148},
{d=0.5487880838,g=-0.4138077036,n=0.5172596295,p=0.6859851047},
{d=-1.252249459,g=-0.9783160795,n=1.222895099,p=-1.565311824},
{d=0.5165693828,g=-1.397969527,n=1.747461908,p=0.6457117284},

{d=-3.607378489,g=-3.524041618,n=4.405052022,p=-4.509223111},
{d=-0.08173779902,g=0.1641832988,n=-0.2052291235,p=-0.1021722488},
{d=-14.32933229,g=0.3262403558,n=-0.4078004447,p=-17.91166536},
{d=-0.4869718277,g=0.3463556740,n=-0.4329445925,p=-0.6087147846},
{d=0.09553334830,g=0.3474536006,n=-0.4343170008,p=0.1194166854},

{d=-1.314740203,g=1.944376644,n=-2.430470805,p=-1.643425253},
{d=-2.145320333,g=2.328585559,n=-2.910731948,p=-2.681650416},
{d=1.115621244,g=0.4025596178,n=0.5031995222,p=1.394526555},
{d=0.7525329944,g=0.4732148694,n=0.5915185868,p=0.9406662430},

{d=-14.16605529,g=-0.3269275273,n=-0.4086594092,p=-17.70756911},

{d=-0.4876148745,g=-0.3469085637,n=-0.4336357046,p=-0.6095185931},
{d=0.09527377659,g=-0.3472467450,n=-0.4340584313,p=0.1190922207},
{d=0.2207451208,g=-0.4438077118,n=-0.5547596397,p=0.2759314011},
{d=-5.649137771,g=-5.693216155,n=-7.116520194,p=-7.061422213},
{d=-0.4622721130,g=0.3662641432,n=0.4578301790,p=0.5778401412},

{d=0.4859703906,g=-0.3454938796,n=-0.4318673495,p=-0.6074629882},
{d=-0.09538387995,g=-0.3473344930,n=-0.4341681162,p=0.1192298499},
{d=6.059975693,g=-0.4077658565,n=-0.5097073206,p=-7.574969617},
{d=2.008921062,g=-0.6835285737,n=-0.8544107172,p=-2.511151327},
{d=-2.330393210,g=-2.307290377,n=-2.884112971,p=2.912991512},

{d=2.408440700,g=-2.555678116,n=-3.194597645,p=-3.010550875},

7.1 Analyzing equilibrium points for stability

In this section we use the equilibrium points to generate the eigenvalues for the system and establish whether the equilibrium point is stable or unstable.

Table 5 summarizes the results for a 25% increase in both gang and drug populations in the undocumented population level.

Table 5 – Results for Increased Gang and Drug Population Levels

Equilibrium Point	Eigen values	Stability
{d=0., g=0., n=0., p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-0.8776036411, g=-1.220309044, n=1.525386305, p=1.097004551},	-.997609876419546+1.73269915906291*I, -.997609876419546-1.73269915906291*I, 1.51826700089502, .867342110144075	Unstable
{d=0.3696934514, g=0.03552090540, n=-0.04440113176, p=-0.4621168143},	26.7424357205043, 11.5387207853094, -6.66467676410457, -.349861626109107	Unstable
{d=-0.09556565816, g=0.3474793456, n=-0.4343491820, p=0.1194570727},	49.4450891415276, 33.5519065209929, -.268053389890679, .0887309979701558	Unstable
{d=0.4903762106, g=0.3492784518, n=-0.4365980648, p=-0.6129702633},	45.4294509696264, 17.9078557293235, -.0789182816750016+.198225686834189*I, -.0789182816750016-.198225686834189*I	Unstable
{d=6.675300742, g=0.3947174663, n=-0.4933968329,	45.4294509696264, 17.9078557293235, -.0789182816750016+.198225686834189*I,	Unstable

p=-8.344125927},	-.0789182816750016-.198225686834189*I	
{d=1.390172919, g=-0.3097268710, n=0.3871585887, p=1.737716148},	-7.91031515956074, 2.73351519384321, .667217560360248, -1.52961403524271	Unstable
{d=0.5487880838, g=-0.4138077036, n=0.5172596295, p=0.6859851047},	-2.52665532755700, 1.71992955218598, .499840677036536, -.551784713365518	Unstable
{d=-1.252249459, g=-0.9783160795, n=1.222895099, p=-1.565311824},	-3.77700491582304, 6.05558674896747, 1.66244853477930, 1.13419503477628	Unstable
{d=0.5165693828, g=-1.397969527, n=1.747461908, p=0.6457117284},	1.68042062890382, -1.25151513156686+.997570088269748*I, -1.25151513156686-.997570088269748*I, -.348911005770112	Unstable
{d=-3.607378489, g=-3.524041618, n=4.405052022, p=-4.509223111},	-6.62327475000151, 8.73563263438649, 4.39576148508190, 3.56797777853312	Unstable
{d=-0.08173779902, g=0.1641832988, n=-0.2052291235, p=-0.1021722488},	15.8756770838067, 2.87761088353145, -.0412725382010487, -6.10824113813713	Unstable
{d=-14.32933229, g=0.3262403558, n=-0.4078004447, p=-17.91166536},	-1239.45042360137, 109.815127408135, 23.1552582528538, -5.78533987561516	Unstable
{d=-0.4869718277, g=0.3463556740, n=-0.4329445925, p=-0.6087147846},	-64.4632889475775, 43.7339971019558, -.0248059366693074, .319316289990913	Unstable
{d=0.09553334830, g=0.3474536006, n=-0.4343170008, p=0.1194166854},	60.8259301065730, 38.4074112063003, -.0570121654526374, -.282561298320636	Unstable
{d=-1.314740203, g=1.944376644, n=-2.430470805, p=-1.643425253},	-5.66627994649352, 2.84097735190653, 1.26259657143777, -.534258772850783	Unstable
{d=-2.145320333, g=2.328585559, n=-2.910731948, p=-2.681650416},	-6.27557461783400, 1.09032056718772+1.02197095703121*I, 1.09032056718772-1.02197095703121*I, 3.57200262045856	Unstable
{d=1.115621244, g=0.4025596178, n=0.5031995222, p=1.394526555},	-8.24145967809176, 2.59110180732595, -1.16053233955160, -.309395135682585	Unstable
{d=0.7525329944, g=0.4732148694, n=0.5915185868, p=0.9406662430},	-6.24692054428690, 2.11515236933050, -.324715310696887, -.749085052546706	Unstable
{d=-14.16605529, g=-0.3269275273,	-1202.24983686502, 109.193743737464,	Unstable

n=-0.4086594092, p=-17.70756911},	22.9297332294219, -4.75597372687100	
{d=-0.4876148745, g=-0.3469085637, n=-0.4336357046, p=-0.6095185931},	-77.2419709332976, 44.0404580829270, .0182148724276378, .438335346142938	Unstable
{d=0.09527377659, g=-0.3472467450, n=-0.4340584313, p=0.1190922207},	42.7911633718497+4.41568872582793*I, 42.7911633718497-4.41568872582793*I, -.140095436501511, .325187575202029	Unstable
{d=0.2207451208, g=-0.4438077118, n=-0.5547596397, p=0.2759314011},	-41.0426086126492, 20.0756493016438, -9.77903451013822, .0759989811435658	Unstable
{d=-5.649137771, g=-5.693216155, n=-7.116520194, p=-7.061422213},	2.14048401467156+8.37367341765576*I, 2.14048401467156-8.37367341765576*I, 7.37418180726520, 5.67176131539169	Unstable
{d=-0.4622721130, g=0.3662641432, n=0.4578301790, p=0.5778401412},	-1.99888942883187, .738642815077935, .379617975176969+.303153693180769*I, .379617975176969-.303153693180769*I	Unstable
{d=0.4859703906, g=-0.3454938796, n=-0.4318673495, p=-0.6074629882},	43.2007743192352, 8.52940876322072, .982379763324158, -2.30121369078009	Unstable
{d=-0.09538387995, g=-0.3473344930, n=-0.4341681162, p=0.1192298499},	39.9780287778442, 29.2309148374881, .383296129924016, .0985035636937720	Unstable
{d=6.059975693, g=-0.4077658565, n=-0.5097073206, p=-7.574969617},	-10742.8901542004, -144.776685360871, .0854312056328804+1.64079269461558*I, .0854312056328804-1.64079269461558*I	Unstable
{d=2.008921062, g=-0.6835285737, n=-0.8544107172, p=-2.511151327},	-19.3654214263982, . 125338134191315+2.29751973103497*I, . 125338134191315-2.29751973103497*I, 2.55747668101554	Unstable
{d=-2.330393210, g=-2.307290377, n=-2.884112971, p=2.912991512},	-4.73130277911495, 1.49472790045713+1.06431253709997*I, 1.49472790045713-1.06431253709997*I, 2.31870653820068	Unstable
{d=2.408440700, g=-2.555678116, n=-3.194597645, p=-3.010550875},	-4.73130277911495, 1.49472790045713+1.06431253709997*I, 1.49472790045713-1.06431253709997*I, 2.31870653820068	Unstable

8.0 Increase in Gang, Drug and Police Population

In this section we consider the scenario here gang, drug and police populations increase by 25%.

{d=0.,g=0.,n=0.,p=0.},
{d=-1.182244576,g=-0.9387185580,n=1.173398197,p=-1.255155665},
{d=-0.9652861504,g=-1.309346530,n=1.636683162,p=0.9126584540},

{d=0.5507339906,g=-1.453826407,n=1.817283008,p=0.5033646606},
{d=-3.620353770,g=-3.539307933,n=4.424134916,p=-3.642844085},

{d=-12.48417394,g=0.3278338770,n=-0.4097923462,p=-11.16679808},
{d=-1.164469680,g=0.3445205691,n=-0.4306507114,p=-0.5031044732},
{d=1.139743907,g=0.3509605124,n=-0.4387006405,p=-0.5120801960},
{d=6.382544398,g=0.3864355505,n=-0.4830444381,p=-5.709705196},
{d=-1.425645357,g=1.989036011,n=-2.486295013,p=-1.376961824},

{d=-2.067720275,g=2.284005777,n=-2.855007222,p=-2.025852956},
{d=-12.33265346,g=-0.3285860991,n=-0.4107326239,p=-11.03128073},
{d=-1.160298000,g=-0.3455332221,n=-0.4319165277,p=-0.5045115905},
{d=1.109970626,g=-0.3604829429,n=-0.4506036786,p=-0.5254710127},
{d=5.909048027,g=-0.3960534128,n=-0.4950667660,p=-5.286217967},

{d=1.024377451,g=-0.4323769696,n=-0.5404712120,p=-0.6315736455},
{d=0.1066128098,g=-0.6173032200,n=-0.7716290250,p=0.5090617362},
{d=1.690281431,g=-0.6642355514,n=-0.8302944392,p=-1.489216810},
{d=-2.301646194,g=-2.285313372,n=-2.856641715,p=2.344306899},
{d=2.388935740,g=-2.549467189,n=-3.186833986,p=-2.351847196},

{d=-5.644723098,g=-5.689448447,n=-7.111810559,p=-5.629008951},

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points

8.1 Analyzing Equilibrium Points for Stability

Table 6: Results for 25% Increase in Gang, Drug and Police Population

Equilibrium Points	Eigen values	Stability
{d=0. g=0. n=0. p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-1.182244576, g=-0.9387185580, n=1.173398197, p=-1.255155665},	-4.22465081360816, 5.60655339509931, 1.54265066756151, 1.11000476614735	Unstable
{d=-0.9652861504, g=-1.309346530, n=1.636683162, p=0.9126584540},	-.835881144232394+1.92915614832914*I, -.835881144232394-1.92915614832914*I, 1.59764096210959, .980800358955198	Unstable
{d=0.5507339906, g=-1.453826407, n=1.817283008, p=0.5033646606},	-1.14326566709315+1.21670406923911*I, -1.14326566709315-1.21670406923911*I, 1.76274301578785, -.347112203701543	Unstable
{d=-3.620353770, g=-3.539307933, n=4.424134916,	-6.69455115120800, 7.79986876972711, 4.11556676204996,	Unstable

p=-3.642844085},	3.58730135743095	
{d=-12.48417394, g=0.3278338770, n=-0.4097923462, p=-11.16679808},	-946.838531523315, 80.7275790866059, 19.8780797439796, -5.50532185227152	Unstable
{d=-1.164469680, g=0.3445205691, n=-0.4306507114, p=-0.5031044732},	-417.103207576609, 21.7513908455780+165.229886475153*I, 21.7513908455780-165.229886475153*I, 1.16581304635345	Unstable
{d=1.139743907, g=0.3509605124, n=-0.4387006405, p=-0.5120801960},	47.3342715373101, 10.3506305588544+5.60893202074726*I, 10.3506305588544-5.60893202074726*I, -.857242352418843	Unstable
{d=6.382544398, g=0.3864355505, n=-0.4830444381, p=-5.709705196},	1794.03258498022, 96.6220367765631, 4.79705132769333, -1.08626343447354	Unstable
{d=-1.425645357, g=1.989036011, n=-2.486295013, p=-1.376961824},	-5.09977891421298, 2.64576232253646, 1.31901250746337, -1.06655055088685	Unstable
{d=-2.067720275, g=2.284005777, n=-2.855007222, p=-2.025852956},	-5.93282398782442, 3.33221473529333, .273474899593611, 1.42239789393747	Unstable
{d=-12.33265346, g=-0.3285860991, n=-0.4107326239, p=-11.03128073},	-913.897959246233, 80.6830718397074, 19.7189729044976, -4.39814440097198	Unstable
{d=-1.160298000, g=-0.3455332221, n=-0.4319165277, p=-0.5045115905},	-334.549164391829, 25.8893812174952+88.7560752208621*I, 25.8893812174952-88.7560752208621*I, 1.16193533293879	Unstable
{d=1.109970626, g=-0.3604829429, n=-0.4506036786, p=-0.5254710127},	86.9071490210125, 15.0717378172363, -3.06283334762444+2.32980944288903*I, -3.06283334762444-2.32980944288903*I	Unstable
{d=5.909048027, g=-0.3960534128, n=-0.4950667660, p=-5.286217967},	4885.23945866730, 306.849899968822, .158214618698154, 3.83613870518023	Unstable
{d=1.024377451, g=-0.4323769696, n=-0.5404712120, p=-0.6315736455},	-63.1632957242831, 8.35038482515571, -27.1078327906208, -.146294726251769	Unstable
{d=0.1066128098, g=-0.6173032200, n=-0.7716290250, p=0.5090617362},	6.51215070293483, -12.2523322177396, -.773457005896991, .0305046407017799	Unstable
{d=1.690281431, g=-0.6642355514, n=-0.8302944392, p=-1.489216810},	6.51215070293483, -12.2523322177396, -.773457005896991, .0305046407017799	Unstable
{d=-2.301646194, g=-2.285313372,	-4.16578210270720, 1.24132801735284+1.35418236202551*I,	Unstable

n=-2.856641715, p=2.344306899},	1.24132801735284-1.35418236202551*I, 2.29422581500153	
{d=2.388935740, g=-2.549467189, n=-3.186833986, p=-2.351847196},	-4.16578210270720, 1.24132801735284+1.35418236202551*I, 1.24132801735284-1.35418236202551*I, 2.29422581500153	Unstable
{d=-5.644723098, g=-5.689448447, n=-7.111810559, p=-5.629008951},	2.13439936663873+7.45328046591818*I, 2.13439936663873-7.45328046591818*I, 5.67143752517011, 6.34659718155243	Unstable

9.0 Decline in the Gang Population

In this section we return the drug and police populations back to original levels. We then reduce the gang population by 25%.

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points

{d=0.,g=0.,n=0.,p=0.},
{d=-1.097004551,g=-2.033848406,n=1.525386305,p=1.097004551},
{d=0.4621168143,g=0.05920150901,n=-0.04440113176,p=-0.4621168143},
{d=-0.1194570727,g=0.5791322427,n=-0.4343491820,p=0.1194570727},
{d=0.6129702633,g=0.5821307530,n=-0.4365980648,p=-0.6129702633},

{d=8.344125927,g=0.6578624439,n=-0.4933968329,p=-8.344125927},
{d=1.737716148,g=-0.5162114517,n=0.3871585887,p=1.737716148},
{d=0.6859851047,g=-0.6896795060,n=0.5172596295,p=0.6859851047},
{d=-1.565311824,g=-1.630526799,n=1.222895099,p=-1.565311824},
{d=0.6457117284,g=-2.329949211,n=1.747461908,p=0.6457117284},

{d=-4.509223111,g=-5.873402697,n=4.405052022,p=-4.509223111},
{d=-0.1021722488,g=0.2736388313,n=-0.2052291235,p=-0.1021722488},
{d=-17.91166536,g=0.5437339263,n=-0.4078004447,p=-17.91166536},
{d=-0.6087147846,g=0.5772594567,n=-0.4329445925,p=-0.6087147846},
{d=0.1194166854,g=0.5790893343,n=-0.4343170008,p=0.1194166854},

{d=-1.643425253,g=3.240627740,n=-2.430470805,p=-1.643425253},
{d=-2.681650416,g=3.880975931,n=-2.910731948,p=-2.681650416},
{d=1.394526555,g=0.6709326963,n=0.5031995222,p=1.394526555},
{d=0.9406662430,g=0.7886914490,n=0.5915185868,p=0.9406662430},
{d=-17.70756911,g=-0.5448792122,n=-0.4086594092,p=-17.70756911},

{d=-0.6095185931,g=-0.5781809395,n=-0.4336357046,p=-0.6095185931},
{c=0.1190922207,g=-0.5787445750,n=-0.4340584313,p=0.1190922207},
{c=0.2759314011,g=-0.7396795196,n=-0.5547596397,p=0.2759314011},
{c=-7.061422213,g=-9.488693592,n=-7.116520194,p=-7.061422213},
{c=-0.5778401412,g=0.6104402386,n=0.4578301790,p=0.5778401412},

{d=0.6074629882,g=-0.5758231326,n=-0.4318673495,p=-0.6074629882},

{d=-0.1192298499,g=-0.5788908216,n=-0.4341681162,p=0.1192298499},
{d=7.574969617,g=-0.6796097608,n=-0.5097073206,p=-7.574969617},
{d=2.511151327,g=-1.139214290,n=-0.8544107172,p=-2.511151327},
{d=-2.912991512,g=-3.845483962,n=-2.884112971,p=2.912991512},

{d=3.010550875,g=-4.259463527,n=-3.194597645,p=-3.010550875},

9.1 Analyzing Equilibrium Points for Stability

Table 7: Results for 25% Reduced Gang Population

Equilibrium Points	Eigen Values	Stability
{d=0., g=0., n=0., p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-1.097004551, g=-2.033848406, n=1.525386305, p=1.097004551},	-.800968403902939+2.08354122097206*I, -.800968403902939-2.08354122097206*I, 2.85263333377190, 1.22371085743398	Unstable
{d=0.4621168143, g=0.05920150901, n=-0.04440113176, p=-0.4621168143},	25.6658074681001, 12.2242616293315, -6.71927718745678, -.439388101374860	Unstable
{d=-0.1194570727, g=0.5791322427, n=-0.4343491820, p=0.1194570727},	52.3840478856763, 33.1814113532780, -.405940795506759, .0887199045524461	Unstable
{d=0.6129702633, g=0.5821307530, n=-0.4365980648, p=-0.6129702633}	44.6651400377206, 37.4201473788221, -.308859626654844, -.510442278187927	Unstable
{d=8.344125927, g=0.6578624439, n=-0.4933968329, p=-8.344125927},	7556.11348718953, 233.697244548499, 4.35177105409830, -1.68323008212058	Unstable
{d=1.737716148, g=-0.5162114517, n=0.3871585887, p=1.737716148},	-8.20505358340480, 2.83543143072638, .996261410685580, -1.77010471700716	Unstable
{d=0.6859851047, g=-0.6896795060, n=0.5172596295, p=0.6859851047},	-2.15980476699526, 1.83624618226880, .716216805747210, -.652815697820749	Unstable
{d=-1.565311824, g=-1.630526799, n=1.222895099, p=-1.565311824},	-4.31673618084459, 7.69397504310559, 2.22241943666065, 1.57830678707835	Unstable
{d=0.6457117284,	-.879623418555871+1.83843391981646*I,	Unstable

g=-2.329949211, n=1.747461908, p=0.6457117284},	-.879623418555871-1.83843391981646*I, 2.63528291087112, -.466250520859380	
{d=-4.509223111, g=-5.873402697, n=4.405052022, p=-4.509223111},	-7.56252105153167, 11.6464732522461, 4.72641764048803, 5.84478171179760	Unstable
{d=-0.1021722488, g=0.2736388313, n=-0.2052291235, p=-0.1021722488},	11.4068961040687, -6.22125938466041, 2.86502817017752, -.0741635994858310	Unstable
{d=-17.91166536, g=0.5437339263, n=-0.4078004447 ,p=-17.91166536},	-1396.06016571461, 112.914110646221, 28.9167058703539, -5.74216911796297	Unstable
{d=-0.6087147846, g=0.5772594567, n=-0.4329445925, p=-0.6087147846},	-71.1939005260415, 43.7244839412011, -.106006781028622, .400289017768973	Unstable
{d=0.1194166854, g=0.5790893343, n=-0.4343170008, p=0.1194166854},	67.6348109681267, 38.2017869395114, -.0618593366143083, -.446526162723764	Unstable
{d=-1.643425253, g=3.240627740, n=-2.430470805 p=-1.643425253},	-5.72376910457491, -.434600303678353, 2.01478814712663+.200087831118145*I, 2.01478814712663-.200087831118145*I	Unstable
{d=-2.681650416, g=3.880975931, n=-2.910731948, p=-2.681650416},	-7.12197768309619, 1.37951115195451+.984743732983020*I, 1.37951115195451-.984743732983020*I, 3.59853543118716	Unstable
{d=1.394526555, g=0.6709326963, n=0.5031995222, p=1.394526555},	-9.76562299892273, 2.94310223683414, -.553517760860126, -1.36636569195129	Unstable
{d=0.9406662430, g=0.7886914490, n=0.5915185868, p=0.9406662430},	-7.61356674494737, 2.39852577254800, -.529749082970916, -.921692271029713	Unstable
{d=-17.70756911, g=-0.5448792122, n=-0.4086594092, p=-17.70756911},	-1327.47041387102, 114.343300487252, 28.7751339822909, -4.14899172252086	Unstable
{d=-0.6095185931, g=-0.5781809395, n=-0.4336357046, p=-0.6095185931},	-91.1839145549000, 44.0013425284462, .0678512754908728, .596636333562919	Unstable
{d=0.1190922207, g=-0.5787445750, n=-0.4340584313, p=0.1190922207},	41.5896750111617+6.92275855837780*I, 41.5896750111617-6.92275855837780*I, -.175832386949049, .601681392925564	Unstable
{d=0.2759314011, g=-0.7396795196, n=-0.5547596397, p=0.2759314011},	-68.8802642927284, -14.7057258375912, 8.04949381163829, .206864238681309	Unstable

{d=-7.061422213, g=-9.488693592, n=-7.116520194, p=-7.061422213},	2.35865784009152+10.9878344971825*I, 2.35865784009152-10.9878344971825*I, 8.58175261633449, 7.65694958748247	Unstable
{d=-0.5778401412, g=0.6104402386, n=0.4578301790, p=0.5778401412},	-2.45412856680730, .652330673833567+.373590974639644*I, .652330673833567-.373590974639644*I, .0613353875401700	Unstable
{d=0.6074629882, g=-0.5758231326, n=-0.4318673495, p=-0.6074629882},	43.2318548135505, 14.8394033711577, -1.80880871952385, 1.54528664541566	Unstable
{d=-0.1192298499, g=-0.5788908216, n=-0.4341681162, p=0.1192298499},	38.9614050380957, 23.5148308978911, .798514482891253, .147099080621989	Unstable
{d=7.574969617, g=-0.6796097608, n=-0.5097073206, p=-7.574969617},	-3889.48799517563, 1.05241500425987+1.61572657388263*I, 1.05241500425987-1.61572657388263*I, -143.188746012889	Unstable
{d=2.511151327, g=-1.139214290, n=-0.8544107172, p=-2.511151327},	-18.6669924904213, .437773603940089+2.70505164424840*I, .437773603940089-2.70505164424840*I, 2.75441405654109	Unstable
{d=-2.912991512, g=-3.845483962, n=-2.884112971, p=2.912991512},	-4.95263531925370, 1.26131544050906+2.96682395095750*I, 1.26131544050906-2.96682395095750*I, 3.31960054623557	Unstable
{d=3.010550875, g=-4.259463527, n=-3.194597645, p=-3.010550875},	-7.07543796505456, 2.37461814512715+2.85213182006796*I, 2.37461814512715-2.85213182006796*I, 3.42080023080025	Unstable

10. Decline in Drug Populations

In this section we look at the scenario where the drug populations are reduced by 25%.

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points.

{d=0.,g=0.,n=0.,p=0.},
{d=-1.462672735,g=-1.525386305,n=1.525386305,p=1.097004551},
{d=0.6161557524,g=0.04440113176,n=-0.04440113176,p=-0.4621168143},
{d=-0.1592760969,g=0.4343491820,n=-0.4343491820,p=0.1194570727},
{d=0.8172936843,g=0.4365980648,n=-0.4365980648,p=-0.6129702633},

{d=11.12550124,g=0.4933968329,n=-0.4933968329,p=-8.344125927},
{d=2.316954864,g=-0.3871585887,n=0.3871585887,p=1.737716148},
{d=0.9146468063,g=-0.5172596295,n=0.5172596295,p=0.6859851047},
{d=-2.087082432,g=-1.222895099,n=1.222895099,p=-1.565311824},
{d=0.8609489713,g=-1.747461908,n=1.747461908,p=0.6457117284},

{d=-6.012297481,g=-4.405052022,n=4.405052022,p=-4.509223111},
{d=-0.1362296650,g=0.2052291235,n=-0.2052291235,p=-0.1021722488},

{d=-23.88222048,g=0.4078004447,n=-0.4078004447,p=-17.91166536},
{d=-0.8116197128,g=0.4329445925,n=-0.4329445925,p=-0.6087147846},
{d=0.1592222472,g=0.4343170008,n=-0.4343170008,p=0.1194166854},

{d=-2.191233671,g=2.430470805,n=-2.430470805,p=-1.643425253},
{d=-3.575533888,g=2.910731948,n=-2.910731948,p=-2.681650416},
{d=1.859368740,g=0.5031995222,n=0.5031995222,p=1.394526555},
{d=1.254221657,g=0.5915185868,n=0.5915185868,p=0.9406662430},
{d=-23.61009215,g=-0.4086594092,n=-0.4086594092,p=-17.70756911},

{d=-0.8126914574,g=-0.4336357046,n=-0.4336357046,p=-0.6095185931},
{d=0.1587896276,g=-0.4340584313,n=-0.4340584313,p=0.1190922207},
{d=0.3679085347,g=-0.5547596397,n=-0.5547596397,p=0.2759314011},
{d=-9.415229618,g=-7.116520194,n=-7.116520194,p=-7.061422213},
{d=-0.7704535217,g=0.4578301790,n=0.4578301790,p=0.5778401412},

{d=0.8099506510,g=-0.4318673495,n=-0.4318673495,p=-0.6074629882},
{d=-0.1589731332,g=-0.4341681162,n=-0.4341681162,p=0.1192298499},
{d=10.09995949,g=-0.5097073206,n=-0.5097073206,p=-7.574969617},
{d=3.348201769,g=-0.8544107172,n=-0.8544107172,p=-2.511151327},
{d=-3.883988683,g=-2.884112971,n=-2.884112971,p=2.912991512},

{d=4.014067834,g=-3.194597645,n=-3.194597645,p=-3.010550875},

10.1 Analyzing Equilibrium Points for Stability

Table 8: 25% Decline in Drug Populations

Equilibrium Points	Eigen Values	Stability
{d=0., g=0., n=0., p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-1.462672735, g=-1.525386305, n=1.525386305, p=1.097004551},	-.840789763620315+2.06889453695710*I, -.840789763620315-2.06889453695710*I, 2.30484887106737, 1.48662865167326	Unstable
{d=0.6161557524, g=0.04440113176, n=-0.04440113176, p=-0.4621168143},	24.6156459924508, 13.1658161172205, -6.76025142346780, -.586685218603544	Unstable
{d=-0.1592760969, g=0.4343491820, n=-0.4343491820, p=0.1194570727},	48.4628797073666, 30.8286414458095, -.320285095831357, .129002365555249	Unstable
{d=0.8172936843, g=0.4365980648, n=-0.4365980648, p=-0.6129702633},	49.8940803627465, 46.5227983330350, -.326592788440719+.336615259600390*I, -.326592788440719-.336615259600390*I	Unstable
{d=11.12550124,	36773.7147293830,	Unstable

g=0.4933968329, n=-0.4933968329, p=-8.344125927},	235.682125356944, 3.52698894705836, -2.22188667700210	
{d=2.316954864, g=-0.3871585887, n=0.3871585887, p=1.737716148},	-10.1948153097689, 3.39266828300864, .733234985578548, -2.09537993091830	Unstable
{d=0.9146468063, g=-0.5172596295, n=0.5172596295, p=0.6859851047},	-3.15119921571288, 1.97695132940829, -.800743509328131, .560118890232714	Unstable
{d=-2.087082432, g=-1.222895099, n=1.222895099, p=-1.565311824},	7.92797811333878, -4.36812498675788, 1.61146244228528, 2.12184959873382	Unstable
{d=0.8609489713, g=-1.747461908, n=1.747461908, p=0.6457117284},	2.00811156940272, -1.28631621105328+.951611757603452*I, -1.28631621105328-.951611757603452*I, -.544030197096149	Unstable
{d=-6.012297481, g=-4.405052022, n=4.405052022, p=-4.509223111},	-7.58224788508787, 11.7323463485359, 4.80435379837874, 5.70526058117318	Unstable
{d=-0.1362296650, g=0.2052291235, n=-0.2052291235, p=-0.1021722488},	16.2349789925804, . 723967143658861, .0872465851154535, -6.08255868835470	Unstable
{d=-23.88222048, g=0.4078004447, n=-0.4078004447, p=-17.91166536},	-1618.92267746837, 122.385491014196, 37.5189647698257, -5.21552403065633	Unstable
{d=-0.8116197128, g=0.4329445925, n=-0.4329445925, p=-0.6087147846},	-89.5472807777849, 43.7537219583267, -.141329690375395, .548782364133685	Unstable
{d=0.1592222472, g=0.4343170008, n=-0.4343170008, p=0.1194166854},	67.5221124202668, 38.8539700272796, -.0940188079814139, -.353450669564866	Unstable
{d=-2.191233671, g=2.430470805, n=-2.430470805, p=-1.643425253},	-6.32192439482636, -.443814430695768, 2.94905168076764, 1.57959864775449	Unstable
{d=-3.575533888, g=2.910731948, n=-2.910731948, p=-2.681650416},	-7.17691493662430, 1.43514922594207+1.81603182562831*I, 1.43514922594207-1.81603182562831*I, 3.79679115974016	Unstable
{d=1.859368740, g=0.5031995222, n=0.5031995222, p=1.394526555},	-10.4682574124334, 3.21740139336005, -1.65872176264816, -.414855424078487	Unstable
{d=1.254221657, g=0.5915185868, n=0.5915185868, p=0.9406662430},	-7.82081616481236, 2.56591343937851, -.406495510677273, -1.13219534528888	Unstable

{d=-23.61009215, g=-0.4086594092, n=-0.4086594092, p=-17.70756911},	-1572.91383031998, 121.652684367265, 37.1747007350967, -3.96697466938455	Unstable
{d=-0.8126914574, g=-0.4336357046, n=-0.4336357046, p=-0.6095185931},	-105.731667119939, 44.0270878718435, .112796190124453, .664984049971203	Unstable
{d=0.1587896276, g=-0.4340584313, n=-0.4340584313, p=0.1190922207},	44.6574458670310+4.68838216338892*I, 44.6574458670310-4.68838216338892*I, -.207587654528988, .415656208167077	Unstable
{d=0.3679085347, g=-0.5547596397, n=-0.5547596397, p=0.2759314011},	25.8619725128508, -38.6405601194351, -9.10341923145467, .0450290380388341	Unstable
{d=-9.415229618, g=-7.116520194, n=-7.116520194, p=-7.061422213},	2.31374380574687+10.9843750907584*I, 2.31374380574687-10.9843750907584*I, 7.48675839080983, 8.79479656669644	Unstable
{d=-0.7704535217, g=0.4578301790, n=0.4578301790, p=0.5778401412},	-1.59114108813463, .219461704845174+.657745209042234*I, .219461704845174-.657745209042234*I, 1.10454850024428	Unstable
{d=0.8099506510, g=-0.4318673495, n=-0.4318673495, p=-0.6074629882},	32.3592845081948, .815789093978118, 43.2385295905368, -1.69101412820985	Unstable
{d=-0.1589731332, g=-0.4341681162, n=-0.4341681162, p=0.1192298499},	40.0734313968851, 21.9116459136323, .571776160577055, .193208366305465	Unstable
{d=10.09995949, g=-0.5097073206, n=-0.5097073206, p=-7.574969617},	10965.8182549953, -146.010191284599, -1.12805160037951+2.53519226615694*I, -1.12805160037951-2.53519226615694*I	Unstable
{d=3.348201769, g=-0.8544107172, n=-0.8544107172, p=-2.511151327},	-12.8104340448180, 5.94136907614854, .403723564834751+1.87297289111278*I, .403723564834751-1.87297289111278*I	Unstable
{d=-3.883988683, g=-2.884112971, n=-2.884112971, p=2.912991512}	-4.93067005457902, 1.18260927400290+2.94616007381597*I, 1.18260927400290-2.94616007381597*I, 3.35724774157321	Unstable
{d=4.014067834, g=-3.194597645, n=-3.194597645, p=-3.010550875},	-7.20431143186521, 2.25108809662648+2.03352153286976*I, 2.25108809662648-2.03352153286976*I, 3.31927825361226	Unstable

11.0 Decline in Gang and Drug Populations

In this section, we consider the scenario where both the gang and drug populations are reduced by 25%

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points.

{d=0.,g=0.,n=0.,p=0.},
{d=-1.462672735,g=-2.033848406,n=1.525386305,p=1.097004551},
{d=0.6161557524,g=0.05920150901,n=-0.04440113176,p=-0.4621168143},
{d=-0.1592760969,g=0.5791322427,n=-0.4343491820,p=0.1194570727},
{d=0.8172936843,g=0.5821307530,n=-0.4365980648,p=-0.6129702633},

{d=11.12550124,g=0.6578624439,n=-0.4933968329,p=-8.344125927},
{d=2.316954864,g=-0.5162114517,n=0.3871585887,p=1.737716148},
{d=0.9146468063,g=-0.6896795060,n=0.5172596295,p=0.6859851047},
{d=-2.087082432,g=-1.630526799,n=1.222895099,p=-1.565311824},
{d=0.8609489713,g=-2.329949211,n=1.747461908,p=0.6457117284},

{d=-6.012297481,g=-5.873402697,n=4.405052022,p=-4.509223111},
{d=-0.1362296650,g=0.2736388313,n=-0.2052291235,p=-0.1021722488},
{d=-23.88222048,g=0.5437339263,n=-0.4078004447,p=-17.91166536},
{d=-0.8116197128,g=0.5772594567,n=-0.4329445925,p=-0.6087147846},
{d=0.1592222472,g=0.5790893343,n=-0.4343170008,p=0.1194166854},

{d=-2.191233671,g=3.240627740,n=-2.430470805,p=-1.643425253},
{d=-3.575533888,g=3.880975931,n=-2.910731948,p=-2.681650416},
{d=1.859368740,g=0.6709326963,n=0.5031995222,p=1.394526555},
{d=1.254221657,g=0.7886914490,n=0.5915185868,p=0.9406662430},
{d=-23.61009215,g=-0.5448792122,n=-0.4086594092,p=-17.70756911},

{d=-0.8126914574,g=-0.5781809395,n=-0.4336357046,p=-0.6095185931},
{d=0.1587896276,g=-0.5787445750,n=-0.4340584313,p=0.1190922207},
{d=0.3679085347,g=-0.7396795196,n=-0.5547596397,p=0.2759314011},
{d=-9.415229618,g=-9.488693592,n=-7.116520194,p=-7.061422213},
{d=-0.7704535217,g=0.6104402386,n=0.4578301790,p=0.5778401412},

{d=0.8099506510,g=-0.5758231326,n=-0.4318673495,p=-0.6074629882},
{d=-0.1589731332,g=-0.5788908216,n=-0.4341681162,p=0.1192298499},
{d=10.09995949,g=-0.6796097608,n=-0.5097073206,p=-7.574969617},
{d=3.348201769,g=-1.139214290,n=-0.8544107172,p=-2.511151327},
{d=-3.883988683,g=-3.845483962,n=-2.884112971,p=2.912991512},

{d=4.014067834,g=-4.259463527,n=-3.194597645,p=-3.010550875},

11.1 Analyzing equilibrium points for stability

Table 9: 25% Decline in Both Gang and Drug Populations

Equilibrium Points	Eigen Values	Stability
{d=0. g=0. n=0, p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)- 2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-	Stable

	2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	
{d=-1.462672735, g=-2.033848406, n=1.525386305, p=1.097004551},	-.795737609604474+2.15796878225424*I, -.795737609604474-2.15796878225424*I, 3.12417553773663, 1.62389025097232	Unstable
{d=0.6161557524, g=0.05920150901, n=-0.04440113176, p=-0.4621168143},	24.3509842583080, 13.2819951104234, -6.77328237504278, -.587483943088666	Unstable
{d=-0.1592760969, g=0.5791322427, n=-0.4343491820, p=0.1194570727},	50.6419519674819, 31.5265455607109, -.398845845335048, .112116309342200	Unstable
{d=0.8172936843, g=0.5821307530, n=-0.4365980648, p=-0.6129702633},	54.4702479447526, 46.4487300808430, -.444030907447773+.276351579654158*I, -.444030907447773-.276351579654158*I	Unstable
{d=11.12550124, g=0.6578624439, n=-0.4933968329, p=-8.344125927},	38605.4707740876, 235.691784131110, 3.83419468903407, -2.55800150767650	Unstable
{d=2.316954864, g=-0.5162114517, n=0.3871585887, p=1.737716148},	-9.79397122662809, 3.27053918525517, .955778012771205, -2.09289844839829	Unstable
{d=0.9146468063, g=-0.6896795060, n=0.5172596295, p=0.6859851047},	-2.71288860290927, 1.95916729301374, .721858430092777, -.796036283597246	Unstable
{d=-2.087082432, g=-1.630526799, n=1.222895099, p=-1.565311824},	8.64125294857268, -4.59886285327490, 2.17830766496673, 1.99683996773550	Unstable
{d=0.8609489713, g=-2.329949211, n=1.747461908, p=0.6457117284}	2.61687868969088, -.999913342578174+1.66431444858338*I, -.999913342578174-1.66431444858338*I, -.592735710834536	Unstable
{d=-6.012297481, g=-5.873402697, n=4.405052022, p=-4.509223111},	-8.00969208004889, 13.0886752068510, 5.76139879583000, 5.89947529836789	Unstable
{d=-0.1362296650, g=0.2736388313, n=-0.2052291235, p=-0.1021722488},	13.2850231027771, -6.18397513611600, .888087248698028, .0565203410608661	Unstable
{d=-23.88222048, g=0.5437339263, n=-0.4078004447, p=-17.91166536},	-1629.34443992125, 121.593917284019, 37.4814256629331, -5.39592322170502	Unstable
{d=-0.8116197128, g=0.5772594567, n=-0.4329445925, p=-0.6087147846},	-87.5905944776965, 43.7452146797720, -.190632413077566, .552737991102088	Unstable

{d=0.1592222472, g=0.5790893343, n=-0.4343170008, p=0.1194166854},	70.6628831894998, 38.5654635838396, -.0854224008222583, -.453309486017104	Unstable
{d=-2.191233671, g=3.240627740, n=-2.430470805, p=-1.643425253},	-6.22271283889856, 1.65424349206667, 2.71398338571346, -.367534849081567	Unstable
{d=-3.575533888, g=3.880975931, n=-2.910731948, p=-2.681650416},	-7.61269697836422, 1.56723724591699+1.63967540219417*I, 1.56723724591699-1.63967540219417*I, 3.78919449853025	Unstable
{d=1.859368740, g=0.6709326963, n=0.5031995222, p=1.394526555},	-10.9765890065770, 3.30053004303416, -1.66971610236122, -.557249719995985	Unstable
{d=1.254221657, g=0.7886914490, n=0.5915185868, p=0.9406662430},	-8.38766217055799, 2.64756605576080, -.525004601379807, -1.15787788242300	Unstable
{d=-23.61009215, g=-0.5448792122, n=-0.4086594092, p=-17.70756911},	-1562.96401324007, 122.444582145265, 37.2121704662264, -3.78578145541713	Unstable
{d=-0.8126914574, g=-0.5781809395, n=-0.4336357046, p=-0.6095185931},	-108.109537741561, 44.0007997428978, .137545026729069, .713533398834037	Unstable
{d=0.1587896276, g=-0.5787445750, n=-0.4340584313, p=0.1190922207},	43.2763886240975+6.73266490276293*I, 43.2763886240975-6.73266490276293*I, -.217362260392806, .590783173597737	Unstable
{d=0.3679085347, g=-0.7396795196, n=-0.5547596397, p=0.2759314011},	-56.1055699913222, 12.2301080757592, -13.0002390356044, .149982321167478	Unstable
{d=-9.415229618, g=-9.488693592, n=-7.116520194, p=-7.061422213},	2.40542491477393+12.1625109013662*I, 2.40542491477393-12.1625109013662*I, 8.31236299309313, 9.44823516435903	Unstable
{d=-0.7704535217, g=0.6104402386, n=0.4578301790, p=0.5778401412},	-2.01267076219934, .283145753549206+.466107270977228*I, .283145753549206-.466107270977228*I, .848074277100931	Unstable
{d=0.8099506510, g=-0.5758231326, n=-0.4318673495, p=-0.6074629882},	43.2974130814627, 30.7286982303795, 1.14141569461744, -1.69608557885969	Unstable
{d=-0.1589731332, g=-0.5788908216, n=-0.4341681162, p=0.1192298499},	39.4411460923247, 19.5511240607847, .883903531410906, .207605958279721	Unstable
{d=10.09995949, g=-0.6796097608, n=-0.5097073206,	10033.3378082302, -146.107468945528, -1.19151316733239+2.79764372849920*I,	Unstable

p=-7.574969617},	-1.19151316733239-2.79764372849920*I	
{d=3.348201769, g=-1.139214290, n=-0.8544107172, p=-2.511151327},	-14.1099672186686, 4.94159208775213, .674967105458220+2.13013664395271*I, .674967105458220-2.13013664395271*I	Unstable
{d=-3.883988683, g=-3.845483962, n=-2.884112971, p=2.912991512},	-4.96804594922305, 1.03164179245653+3.64299277122079*I, 1.03164179245653-3.64299277122079*I, 3.86538426931000	Unstable
{d=4.014067834, g=-4.259463527, n=-3.194597645, p=-3.010550875},	-7.65663141669472, 2.57452144754136+2.72866149495211*I, 2.57452144754136-2.72866149495211*I, 3.41261092061201	Unstable

12.0 Decline in Gang, Drug and Police Populations

In this section, we consider the scenario where both the gang and drug populations are reduced by 25% and the police population is also decreased by 25%

Using the Maple CAS we executed the solve command on (1-4) and obtained the following real valued equilibrium points.

{d=0.,g=0.,n=0.,p=0.},
{d=-1.462672735,g=-2.033848406,n=1.525386305,p=1.462672735},
{d=0.6161557524,g=0.05920150901,n=-0.04440113176,p=-0.6161557524},
{d=-0.1592760969,g=0.5791322427,n=-0.4343491820,p=0.1592760969},
{d=0.8172936843,g=0.5821307530,n=-0.4365980648,p=-0.8172936843},

{d=11.12550124,g=0.6578624439,n=-0.4933968329,p=-11.12550124},
{d=2.316954864,g=-0.5162114517,n=0.3871585887,p=2.316954864},
{d=0.9146468063,g=-0.6896795060,n=0.5172596295,p=0.9146468063},
{d=-2.087082432,g=-1.630526799,n=1.222895099,p=-2.087082432},
{d=0.8609489713,g=-2.329949211,n=1.747461908,p=0.8609489713},

{d=-6.012297481,g=-5.873402697,n=4.405052022,p=-6.012297481},
{d=-0.1362296650,g=0.2736388313,n=-0.2052291235,p=-0.1362296650},
{d=-23.88222048,g=0.5437339263,n=-0.4078004447,p=-23.88222048},
{d=-0.8116197128,g=0.5772594567,n=-0.4329445925,p=-0.8116197128},
{d=0.1592222472,g=0.5790893343,n=-0.4343170008,p=0.1592222472},

{d=-2.191233671,g=3.240627740,n=-2.430470805,p=-2.191233671},
{d=-3.575533888,g=3.880975931,n=-2.910731948,p=-3.575533888},
{d=1.859368740,g=0.6709326963,n=0.5031995222,p=1.859368740},
{d=1.254221657,g=0.7886914490,n=0.5915185868,p=1.254221657},
{d=-23.61009215,g=-0.5448792122,n=-0.4086594092,p=-23.61009215},

{d=-0.8126914574,g=-0.5781809395,n=-0.4336357046,p=-0.8126914574},
{d=0.1587896276,g=-0.5787445750,n=-0.4340584313,p=0.1587896276},
{d=0.3679085347,g=-0.7396795196,n=-0.5547596397,p=0.3679085347},
{d=-9.415229618,g=-9.488693592,n=-7.116520194,p=-9.415229618},

{d=-0.7704535217,g=0.6104402386,n=0.4578301790,p=0.7704535217},

{d=0.8099506510,g=-0.5758231326,n=-0.4318673495,p=-0.8099506510},
{d=-0.1589731332,g=-0.5788908216,n=-0.4341681162,p=0.1589731332},
{d=10.09995949,g=-0.6796097608,n=-0.5097073206,p=-10.09995949},
{d=3.348201769,g=-1.139214290,n=-0.8544107172,p=-3.348201769},
{d=-3.883988683,g=-3.845483962,n=-2.884112971,p=3.883988683},

{d=4.014067834,g=-4.259463527,n=-3.194597645,p=-4.014067834},

12.1 Analyzing Equilibrium Points for Stability

Table 10: 25% Decline in Both Gang, Drug and Police Populations

Equilibrium Points	Eigen Values	Stability
{d=0, g=0. n=0, p=0.},	0, (4+(4*I)*sqrt(3))^(1/3)+4/(4+(4*I)*sqrt(3))^(1/3)+2, -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2+I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)), -(1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3)+2-I*sqrt(3)*((1/2)*(4+(4*I)*sqrt(3))^(1/3)-2/(4+(4*I)*sqrt(3))^(1/3))	Stable
{d=-1.462672735, g=-2.033848406, n=1.525386305, p=1.462672735},	-4.25346696713605, 7.79187850053826, 2.60257038621199, 1.57833754438581	Unstable
{d=0.6161557524, g=0.05920150901, n=-0.04440113176, p=-0.6161557524},	-8.08299144976161, 6.26024068365491, -1.97356746565523, -.478343447538065	Unstable
{d=-0.1592760969, g=0.5791322427, n=-0.4343491820, p=0.1592760969},	52.2337833689980, 33.1690048314044, -.360027939200596, .107976410998186	Unstable
{d=0.8172936843, g=0.5821307530, n=-0.4365980648, p=-0.8172936843},	53.1936553318058, 34.4577165702552, -.342576880680529+.238972729519314*I, -.342576880680529-.238972729519314*I	Unstable
{d=11.12550124, g=0.6578624439, n=-0.4933968329, p=-11.12550124},	7555.61569781380, 233.300780457438, 5.30886178484382, -1.7126723560850O	Unstable
{d=2.316954864, g=-0.5162114517, n=0.3871585887, p=2.316954864},	-11.4860880817099, 3.55086452265686, 1.01734971546924, -2.35165659441619	Unstable
{d=0.9146468063, g=-0.6896795060, n=0.5172596295, p=0.9146468063},	-3.37681705438570, 1.89604704676989, -.876599912516216, .825438385632032	Unstable
{d=-2.087082432, g=-1.630526799,	-3.37681705438570, 1.89604704676989,	Unstable

n=1.222895099, p=-2.087082432},	-.876599912516216, .825438385632032	
{d=0.8609489713, g=-2.329949211, n=1.747461908, p=0.8609489713},	2.59362994954255, -1.22372880972179+1.48560594770999*I, -1.22372880972179-1.48560594770999*I, -.645363792298965	Unstable
{d=-6.012297481, g=-5.873402697, n=4.405052022, p=-6.012297481},	-8.14511072017963, 14.5020691666491, 6.58800706020080, 5.94760970532977	Unstable
{d=-0.1362296650, g=0.2736388313, n=-0.2052291235}, p=-0.1362296650}	14.2555773118462, -.219980313145949, .441871145260275, -6.12732179336055	Unstable
{d=-23.88222048, g=0.5437339263, n=-0.4078004447, p=-23.88222048},	14.2555773118462, -.219980313145949, .441871145260275, -6.12732179336055	Unstable
{d=-0.8116197128, g=0.5772594567, n=-0.4329445925, p=-0.8116197128},	-97.6513764514967, 43.5269262363779, -.256657999557790, .579035434776522	Unstable
{d=0.1592222472, g=0.5790893343, n=-0.4343170008, p=0.1592222472},	73.5913207408747, 38.8793149742990, -.435538220055941, -.0815631286178125	Unstable
{d=-2.191233671, g=3.240627740, n=-2.430470805, p=-2.191233671},	-6.89405742665596, .856636113202813+.297892849665806*I, .856636113202813-.297892849665806*I, 3.14881760125033	Unstable
{d=-3.575533888, g=3.880975931, n=-2.910731948, p=-3.575533888},	-8.07343694681644, 1.62252611581247+2.53348300299809*I, 1.62252611581247-2.53348300299809*I, 4.34797046419150	Unstable
{d=1.859368740, g=0.6709326963, n=0.5031995222, p=1.859368740},	-8.07343694681644, 1.62252611581247+2.53348300299809*I, 1.62252611581247-2.53348300299809*I, 4.34797046419150	Unstable
{d=1.254221657, g=0.7886914490, n=0.5915185868, p=1.254221657},	-9.17130035076560, 2.70028442019448, -.622569833671630, -1.20995900835724	Unstable
{d=-23.61009215, g=-0.5448792122, n=-0.4086594092, p=-23.61009215},	-1799.69498057718, 140.917376034152, 36.9952322315149, -3.88789773248961	Unstable
{d=-0.8126914574, g=-0.5781809395, n=-0.4336357046, p=-0.8126914574},	-117.803764622885, 43.1469024741295, -.150237102389122, .742693648044734	Unstable
{d=0.1587896276, g=-0.5787445750, n=-0.4340584313, p=0.1587896276},	44.9063085070392+6.03924534358932*I, 44.9063085070392-6.03924534358932*I, -.213840058874305, .551087386195942	Unstable
{d=0.3679085347,	44.9063085070392+6.03924534358932*I,	Unstable

g=-0.7396795196, n=-0.5547596397, p=0.3679085347},	44.9063085070392-6.03924534358932*I, -.213840058874305, .551087386195942	
{d=-9.415229618, g=-9.488693592, n=-7.116520194, p=-9.415229618},	2.32585826867044+13.5489861535030*I, 2.32585826867044-13.5489861535030*I, 10.1209241254361, 9.45447580122301	Unstable
{d=-0.7704535217, g=0.6104402386, n=0.4578301790, p=0.7704535217},	-2.62211945453724, . 616817853528552+.508210547526980*I, 616817853528552-.508210547526980*I, . 159691039980136	Unstable
{d=0.8099506510, g=-0.5758231326, n=-0.4318673495, p=-0.8099506510},	21.9060508972832, 1.41740443151028, -2.02898105918111, 42.5924712979876	Unstable
{d=-0.1589731332, g=-0.5788908216, n=-0.4341681162, p=0.1589731332},	39.0219534327198, 23.3657304482913, .729969323259815, .206799618529007	Unstable
{d=10.09995949, g=-0.6796097608, n=-0.5097073206, p=-10.09995949},	-3890.11857058912, 1.25101310120000+1.42374000249150*I, 1.25101310120000-1.42374000249150*I, -142.918164763278	Unstable
{d=3.348201769, g=-1.139214290, n=-0.8544107172, p=-3.348201769},	-19.1773079910990, .327291307739145+3.39242818128440*I, .327291307739145-3.39242818128440*I, 3.63182303362072	Unstable
{d=-3.883988683, g=-3.845483962, n=-2.884112971, p=3.883988683},	-6.24292581425875, 1.60151246123914+3.45385498400426*I, 1.60151246123914-3.45385498400426*I, 3.86460168678046	Unstable
{d=4.014067834, g=-4.259463527, n=-3.194597645, p=-4.014067834},	-7.95356873354997, 2.31497442215167+3.57976200023445*I, 2.31497442215167-3.57976200023445*I, 4.53196691024662	Unstable

13. Conclusion

In this paper we modeled and analyzed the interaction of neutral, radical, undocumented, and welfare populations. We analyzed the system for various population sizes.

When we modeled only two populations there were a number of stable equilibrium points. Analyzing all four populations simultaneously shows that there are no stable equilibrium points in the system. This is a potentially disastrous situation.

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