Homework Assignment 7: Due at the beginning of class 10/11/02

The specific learning goals of this assignment are for you to:

- Determine the independent and dependent variables in examples of function notation.
- Translate examples of function notation into statements expressed in plain English.
- Translate statements expressed in plain English into examples of function notation.

The United Kingdom now has the largest heroin problem of any country in Europe, with approximately 6 out of every 100,000 Britons addicted to the drug[1]. In the United States, by comparison, 308 out of every 100,000 people are heroin addicts[2] and in the city of Baltimore MD, approximately 9300 out of every 100,000 people are heroin addicts[3]. Representatives of the Drug Enforcement Administration (DEA) have called Baltimore "America's heroin capital."[4]

By 1993, AIDS had become a citywide epidemic in Baltimore[5]. According to the Baltimore City Health Department[6], approximately four new cases of AIDS were reported each day and 72% of all new cases were among intravenous drug users (IDUs) or their close associates[7].

Desperate, the Baltimore city officials examined every alternative that they could think of to stem the tide of what they saw as a serious public health crisis. (Subsequent analysis[8] has suggested that this was also a financial crisis, as each new case of AIDS cost the city an average of $150,000 in direct medical costs.) One of the options considered was a

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[1] Source: European Monitoring Center for Drugs and Drug Addiction, World Bank.

[2] Source: Office of Applied Statistics. 2002. *National Household Survey on Drug Abuse, 2001*. Washington DC: U.S. Bureau of the Census.
NOTE: This figure includes only hard-core addicts. When occasional users are included the figure is closer to 420 heroin users per 100,000 people.

[3] Source: Peter Bielenson, M.D. M.P.H. at the Baltimore City Health Department Annual Meeting, May 12, 2002. Dr. Bielenson is the director of the Baltimore City Health Department.

[4] Source: ABC News. *An Old Heroin Town.* March 14, 2001.

[5] Source: Office of the Mayor, Baltimore MD. 1994. Initiating needle exchange programs. A look at two communities. *The United States Conference of Mayors AIDS Information Exchange Newsletter*, 11(3): 2-7.

[6] Source: Office of the Mayor, Baltimore MD. 1994. Initiating needle exchange programs. A look at two communities. *The United States Conference of Mayors AIDS Information Exchange Newsletter*, 11(3): 2-7.

[7] 61% of cases were among the drug users themselves, 8% of new AIDS cases were among sexual partners of IDUs and 3% of new AIDS cases occurred in babies born to IDUs or their sexual partners.

[8] Drug Strategies, Inc. 2000. *Smart Steps: Treating Baltimore's Drug Problem.* Washington DC: Drug Strategies, Inc.

needle exchange program (NEP), modeled on programs that had operated in Europe since 1984.

However, Maryland state law prohibits possession, distribution or selling of needles or syringes if there is any reason to believe that they will be used with a controlled substance. For three years (1992, 1993 and 1994) Baltimore Mayor Kurt Schmoke lobbied the Maryland state legislature to grant an exception to the law and finally in May 1994, Maryland Governor William D. Schaefer signed the law allowing the City of Baltimore to operate an NEP.

In Questions 1, 2 and 3 you are given an independent variable, a dependent variable and a statement involving function notation. Rewrite each statement so that it is expressed entirely in plain English and still conveys the same information.

1.   Christine Todd Whitman was sworn in as EPA Administrator on January 31, 2001. Prior to that, she had served as the 50th Governor of the State of New Jersey. In December 2001, New Jersey advanced to fifth highest cumulative total of AIDS cases in the United States[9]. On January 10, 1996, Governor Whitman wrote to the chairman of her advisory council on AIDS (David Troast) informing him of her opposition to needle exchange programs, and stating, "I … do not view this issue solely in terms of science, but also in legal, public policy and philosophical terms." Two years later, Governor Whitman published a letter to the editor of the *Trenton Times*[10] stating: " …my opposition [to needle exchange programs] comes from two sources: I am a mother and I am a governor."

   - **Independent variable:** Number of needle exchange programs in the State of New Jersey, N.
   - **Dependent variable:** Level of confusion among New Jersey children, C.
   - **Statement:** Government cannot, on the one hand, say that drug use is bad and illegal and, on the other, provide the tools for this destructive behavior in the name of health. $C(N) > C(0) \geq 0$ when $N \geq 1$.

2.   General Barry McCaffrey was appointed to the post of Director of the Office of National Drug Control Policy in 1996 by President Clinton.

   - **Independent variable:** Time, T.
   - **Dependent variable:** Number of intravenous drug users, U.
   - **Statement:** The focus should be on bringing help to this suffering population [heroin addicts] – not giving them more effective means to continue their addiction. One doesn't want to $U(T + 1) > U(T)$.

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[9] Centers for Disease Control. 2001. *HIV-AIDS Surveillance Report. Year-end Edition.* Rockville, MD: CDC National AIDS Clearinghouse.

[10] "Needle exchange sends mixed message." *Trenton Times*, May 19, 1998. p. A10.

3.   In 1989 U.S. Senator Jesse Helms (R-NC) sponsored a bill banning the use of federal funds in needle exchange programs. In 1992, Senator Helms attempted to amend a bill on Health and Human Services spending[11].

- **Independent variable:** Time, T.
- **Dependent variable:** Health and Human Services funds for a particular state, H.
- **Statement:** Mr. Speaker, I propose that if any state use federal or state funds for the purposes of funding any kind of [needle] exchange program, then $H(T + 1) = 0$, $H(T + 2) = 0$, $H(T + 3) = 0$, …, $H(T + k) = 0$, …

There has been quite a bit of interest in the Baltimore needle exchange program (NEP), and several scientific studies have been carried out to evaluate its effects. In Questions 4 and 5, you are given two excerpts from scientific studies of Baltimore's NEP. In each case, identify the independent variable and the dependent variable, and rewrite the excerpt as an equation involving function notation.

4.   The following two excerpts speak to the effects that the Baltimore NEP has had on reducing the spread of AIDS and HIV.

- From Doherty *et al.*[12]:

   "There was a significant drop in the number of dirty needles in areas around NEPs, compared to other areas frequented by heavy drug users. The mean number of needles found in trash dropped from an average of 2.42 needles per 100 items of trash to 1.30 needles per hundred items of trash in only two years."

- From Riley *et al.*[13]:

   "Four years of follow-up studies have shown that the HIV incidence among intravenous drug users in the NEP has dropped by 35%."

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[11] Ultimately, the amendment was defeated.

[12] Doherty, M., R. Garfein, D. Vlahov, B. Junge, P. rathouz, N. Galai, J. Anthony and P. Beilenson. 1997. Discarded needles do not increase soon after the opening of a needle exchange program. *American Journal of Epidemiology*, 145(3): 730-736.

[13] Riley, E., P. Beilenson, D. Vlahov, L. Smith, M. Koenig, T. S. Jones and M. Doherty. 1998. Operation Red Box: A pilot project of needle and syringe drop boxes for injection drug users in East Baltimore. *Journal of Acquired Immune Deficiency Syndromes and Human retrovirology*, 18(Supplement 1): S120-S125.

5.   The next two excerpts comment on the effect of the Baltimore NEP on intravenous drug use and drug-related crime in the city.

- From the evaluation of the Baltimore NEP conducted by the Johns Hopkins University Bloomberg School of Public Health[14]:

  "Between 1994 and 1998 there was a 20% reduction in the frequency of intravenous drug use among drug users who participated in the NEP."

- From Bor[15]

  "During the first four years of the [needle exchange] program, break-ins and burglaries[16] fell by 11% in needle exchange areas but increased 8% elsewhere."

Epilogue

According to the Baltimore City Health Department, people under the age of eighteen (including children) were generally discouraged from using drugs by the sight of addicts at a needle exchange program.

- Percentage of Baltimore high school students who said seeing a person at an NEP would make them want to stay away from drugs: 47%.
- Percentage of Baltimore high school students who said they were more likely to want to use drugs if their friends use drugs: 47%.
- Percentage of Baltimore high school students who said that seeing their parents use drugs would encourage them to use drugs: 44%.
- Average age of Baltimore NEP participant: 41.
- State with the highest rate of HIV infection among children: New Jersey[17].

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[14] Office of the Mayor, Baltimore MD, Press Briefing. July 21, 1999.

[15] Bor, J. 1999. Needle program no spur to crime. City's exchange effort has little effect on arrests. *Baltimore Sun*, March 30, 1999. p. B1.

[16] These are the two main property crimes associated with drug addiction. Proceeds from burglaries and break-ins are thought to account for about 40% of the money spent by addicts on illicit drugs. The remaining 60% is estimated to come mainly from prostitution, drug sales, welfare payments and regular work.

[17] Mitra, K. S. 1999. Activists claim New Jersey in crisis state without exchange. *Boston Globe*, January 13, 1999.