



ICE - Functions Defined by Rates

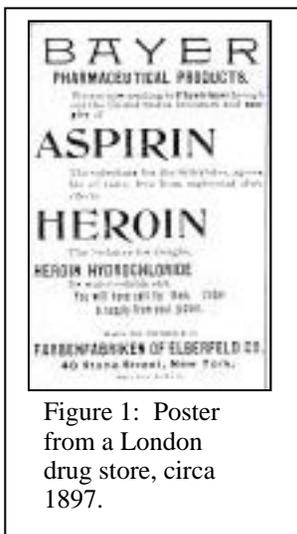


Figure 1: Poster from a London drug store, circa 1897.

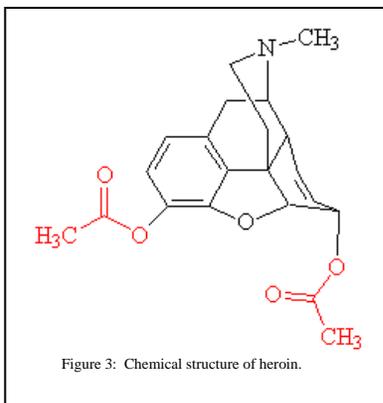
The recreational use of opium compounds has been traced back more than 5000 years to the dawn of civilization¹. In many modern countries, the recreational use of opiates is a socially stigmatized and illegal practice. This has not always been the case. Figure 1 shows a poster from 1897 that originally hung in a London drug store advertising both aspirin and heroin on the same poster!

Heroin is perhaps the most notorious opiate compound that is used for recreational purposes, being associated with criminal activity and disease (especially hepatitis and AIDS). Heroin is normally administered intravenously (see Figure 2²) which also causes feelings of revulsion in many.

Heroin (see Figure 3³) is a synthetic drug that is created from the resins secreted by the seed pod of the opium poppy (*Papaver somniferum*). Figure 4 shows the opium poppy and some of the steps in the refinement of heroin.



Figure 2: A popular method of administering heroin (among users) is intravenous injection with syringe.



Heroin was first synthesized by English chemist C. A. Wright in 1874. In 1895, German chemist Heinrich Dreser (working for the Bayer Pharmaceutical company) discovered a simpler method for synthesizing heroin by diluting morphine with acetyl compounds.

¹ Source: <http://opioids.com/timeline/> In particular, evidence has been discovered that the Sumerian civilization cultivated the opium poppy in lower Mesopotamia. The Sumerians referred to the opium poppy as *Hul Gil*, meaning “plant of joy.”

² Image source: <http://www.identa-forensics.com/>

³ Image source: <http://www.ch.ic.ac.uk/> Heroin is also known by the chemical name of *diacetylmorphine*.

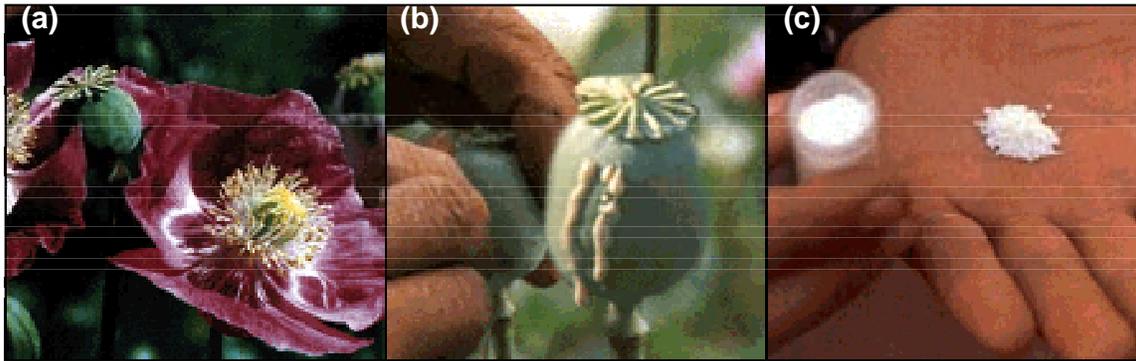


Figure 4: Some stages in the cultivation and synthesis of heroin. (a) The opium poppy, *Papaver somniferum*. (b) Growers score the unopened seed pod of the poppy with a specially designed knife. The poppy secretes resin to heal the wound. This resin is collected and refined into opium. (c) Opium is chemically purified and manipulated to create heroin, which generally has the appearance of a white or brown powder.

During the eighteenth and nineteenth centuries, possession and consumption of opium-based compounds was perfectly legal in many countries. As a result, addiction to morphine (the most popular opiate of the time) rose to alarming levels in many countries. Organizations (such as the St. James Society in the US) and many physicians believed that heroin has medical and therapeutic value as a “step-down” drug for morphine addicts who were attempting to break their habit. However, by 1905 heroin addiction had risen to alarming levels and was recognized as a serious social problem in Britain and the United States.

During World War 2 (and much of the Cold War), many of the routes for smuggling heroin into Europe and the United States were cut off. However, there was a strong resurgence in the use and smuggling of heroin during the 1960's, especially during the years of US involvement with the war in Vietnam. During the 1970's, heroin use in the United States declined. However, since 1992 heroin has a major resurgence in many developed countries, including European nations and the United States.

In this ICE, you will use information about the rate of change to estimate values of a function. The function that you will be working with here uses time (measured in years since 1992) as its independent variable and gives the number of heroin addicts (for every 100,000 people) as the output.

• Table 1⁴ (over) gives the rate of change in number of heroin addicts for several European countries. Table 2⁵ gives the number of heroin addicts (for every 100,000 people) in 1992. Select one of these countries and use the table provided below to estimate the number of heroin addicts in the year 2002.

⁴ Source: European Monitoring Center for Drugs and Drug Addiction, World Bank.

⁵ Source: European Monitoring Center for Drugs and Drug Addiction, World Bank.

	Great Britain	Switzerland	France	Germany
Rate of change in 1992 (t=0)	0.575	-0.125	0.05	-0.275
Rate of change in 1994 (t=2)	0.3	-0.625	-0.175	0.025
Rate of change in 1996 (t=4)	0.05	-0.75	-0.2	0
Rate of change in 1998 (t=6)	0.35	-0.4	-0.1	0.15
Rate of change in 2000 (t=8)	0.35	-0.15	0	0.1

Table 1: Rates of Change in Number of Heroin Addicts, 1992-2000.

Country	Great Britain	Switzerland	France	Germany
Number of heroin addicts in 1992 (t=0)	2.75	6	0.9	2.6

Table 2: Number of Heroin Addicts for every 100,000 People, 1992.

Time (years since January 1992)	Number of heroin addicts (for every 100,000 people)	Rate of change	Amount that number of addicts will change by in the next two years	New number of heroin addicts (for every 100,000 people)
0				
2				
4				
6				
8				
10				

Some points for discussion at the end of class:

- Great Britain now has the highest number of heroin addicts of any European country. A major question confronting the British government is what should they do about this situation, especially since heroin addicts engage in a lot of criminal activity. One study indicated that the average heroin user in the UK spends about £16,500 per year on drugs, and that 80% of this money comes from criminal activities.
- The one European country that has substantially reduced the number of heroin addicts is Switzerland. The Swiss policy has been to supply heroin addicts with heroin (not methadone) under controlled circumstances. Many of those addicts have given up crime and some have actually found regular and productive employment.
- In the United States, the number of heroin addicts is 308 (per 100,000 people)⁶. The city of Baltimore, MD, is regarded as America's heroin capital. In Baltimore the number of heroin addicts is about 9300 (per 100,000 people)⁷ which represents almost 10% of the population of the city. On average, a heroin addict in the United States spends at least \$22,000 per year on heroin⁸. About 60% of this total comes from prostitution, drug sales, welfare payments and work. The remaining 40% comes mainly from shoplifting and burglary.

⁶ Source: US Bureau of the Census and National Institute on Drug Abuse. "Monitoring the Future" December, 1997. Note that this figure reflects only hard-core users of heroin and does not include occasional users. Including occasional users brings the number up to about 420 (per 100,000 people).

⁷ Source: ABC News. "An Old Heroin Town." March 14, 2001.

⁸ Source: "In Heroin's Grip." *Register-Guardian*, December 4, 1999.