dynamics of alcohol

alcohol is contributing factor in:
* 40-55% of all traffic fatalities
* 50% of homicides
* 30% of suicides
* 30-79% of sexual assaults involves an intoxicated person (usually both perpetrator and victim drink)

plus:
personal cost (emotional pain, destroyed relationships, death of loved ones …)
definition

one drink = 14 grams of alcohol

* 5 ounces of wine, or
* 12 ounces of beer, or
* 1.5 ounces of 80 proof (vodka, rum, gin, etc.)

effects

depend on many factors (body mass, constitution, gender, age, etc.)

10 g … slight impairment
40 g … driving while intoxicated (DWI) limit; blunted feelings, disinhibition; impaired reasoning
60 g … emotional swings; staggering, slurred speech, reaction time slows down
100 g … loss of understanding, impaired sensations, memory blackout
150 g … serious breathing problems, irregular heart rate, unconsciousness
200 g … possible coma, death
elimination of chemicals

*** filtration by kidneys (kidneys break down constant amount per hour … caffeine: 13% per hour)

*** breaking down the chemicals using enzymes from the liver (amount of chemical broken down depends on the amount present … alcohol)

alcohol elimination rate

experimental data:

\[ f(x) = \frac{10.1}{4.2 + x} \]

i.e, increasing amount of alcohol causes elimination rate to slow down
model for dynamics of alcohol

\[ a_{t+1} = a_t - \frac{10.1}{4.2 + a_t} a_t + d \]

we consider cases \( d = 0, 7, \) or 14 grams

[most calculations are done in your textbook]

1/2 drink every hour (Example 2.3.6)

\[ a_{t+1} = a_t - \frac{10.1 a_t}{4.2 + a_t} + 7 \]

equilibrium = 9.5 grams
1/2 drink every hour (Example 2.3.6)

\[ a_{t+1} = a_t - \frac{10.1a_t}{4.2 + a_t} + 7 \]

Do the calculations to check the following:

If \( a_0 = 0 \) then \( a_t \) increases, and approaches 9.5 grams

If \( a_0 = 28 \) then \( a_t \) decreases, and approaches 9.5 grams

one drink every hour (Example 2.3.7)

\[ a_{t+1} = a_t - \frac{10.1a_t}{4.2 + a_t} + 14 \]

no equilibrium
one drink every hour (Example 2.3.7)

\[ a_{t+1} = a_t - \frac{10.1 a_t}{4.2 + a_t} + 14 \]

Do the calculations to check the following:

If \( a_0 = 14 \) then \( a_t \) increases (for instance, reaches 41 grams (basically three drinks) after 5 hours and there is no limit to its increase.

no drinking - pure elimination (Example 2.3.8)

\[ a_{t+1} = a_t - \frac{10.1 a_t}{4.2 + a_t} + 0 \]

no equilibrium

stop drinking when the amount of alcohol is 60 grams; takes 7 hours to eliminate
so … how much alcohol is in the body

** 1/2 drink every hour, starting from no alcohol ... increases, stabilizes at 9.5 grams

** 2 rapid drinks, then 1/2 drink every hour ... decreases, stabilizes at 9.5 grams

** one drink every hour ... increases, after 5 hours reaches 41 grams. keeps increasing, no limit

** stop drinking after consuming 60 grams of alcohol ... takes about 7 hours for alcohol to reach 0 grams