

Who's snitching my milk?

Nonlinear dynamics/analysis of vanishing bovine products
in an office environment.

André Franz¹ Robert Flassig¹ Mirjam Malorny²

¹Max Planck Institute for Dynamics of Complex Technical Systems, Magdeburg

²Freie Universität Berlin

Chaos Communication Camp, Day 2 - 2011-08-11

About this talk

What you need:

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

- ▶ Boring slides with bullet lists.

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

- ▶ Boring slides with bullet lists.
- ▶ Dozens of equations.

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

- ▶ Boring slides with bullet lists.
- ▶ Dozens of equations.
- ▶ No images, but maybe some graphs.

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

- ▶ Boring slides with bullet lists.
- ▶ Dozens of equations.
- ▶ No images, but maybe some graphs.
- ▶ Almost no color.

About this talk

What you need:

- ▶ You should know, how an ODE looks like.

What you can expect:

- ▶ Boring slides with bullet lists.
- ▶ Dozens of equations.
- ▶ No images, but maybe some graphs.
- ▶ Almost no color.

Let's start. Have fun.

Table of contents

Motivation/Introduction

Modeling the milk consumption

Experimental setup

First results

We need your help

Conclusion

Future work

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²
→ Adding milk to coffee can compensate this.

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²
→ Adding milk to coffee can compensate this.
- ▶ pH of coffee ≈ 5

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²
 - Adding milk to coffee can compensate this.
- ▶ pH of coffee ≈ 5
 - Adding milk to coffee increases pH → better taste.

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²
 - Adding milk to coffee can compensate this.
- ▶ pH of coffee ≈ 5
 - Adding milk to coffee increases pH → better taste.

Milk is very important!

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ A mathematician (scientist/engineer/hacker) is a machine for converting coffee into theorems (new ideas/cool software & projects)¹.
- ▶ Coffee consumption can increase calcium excretion.²
 - Adding milk to coffee can compensate this.
- ▶ pH of coffee ≈ 5
 - Adding milk to coffee increases pH → better taste.

Milk is very important!

No milk → less coffee → less productivity → economic crisis
→ apocalypse

¹Hoffman, P. The Man Who Loved Only Numbers: The Story of Paul Erdős and the Search for Mathematical Truth. New York: Hyperion, 1998.

²Massey and Whiting: Caffeine, urinary calcium, calcium metabolism and bone J. Nutr. 123: 1611-1614 (1993), PMID:8360789

Motivation/Introduction

- ▶ Nowadays many office environments offer small tea kitchens for their employees, where coffee can be cooked and the milk is stored in a refrigerator.

Motivation/Introduction

- ▶ Nowadays many office environments offer small tea kitchens for their employees, where coffee can be cooked and the milk is stored in a refrigerator.
→ Usually the milk is accessible for everybody.

Motivation/Introduction

- ▶ Nowadays many office environments offer small tea kitchens for their employees, where coffee can be cooked and the milk is stored in a refrigerator.
→ Usually the milk is accessible for everybody.
- ▶ From subjective experiences there seems to be a milk drain in these environments.
→ Who steals the milk? And why? And how?

Motivation/Introduction

- ▶ Nowadays many office environments offer small tea kitchens for their employees, where coffee can be cooked and the milk is stored in a refrigerator.
→ Usually the milk is accessible for everybody.
- ▶ From subjective experiences there seems to be a milk drain in these environments.
→ Who steals the milk? And why? And how?
- ▶ Fundamental research is still missing.

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen
 - ▶ quality of the milk q , e.g. fresh milk, UHT milk, Bio milk, expensive looking, cheap looking, ...

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen
 - ▶ quality of the milk q , e.g. fresh milk, UHT milk, Bio milk, expensive looking, cheap looking, ...
 - ▶ time since opening (age) t_a

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen
 - ▶ quality of the milk q , e.g. fresh milk, UHT milk, Bio milk, expensive looking, cheap looking, ...
 - ▶ time since opening (age) t_a
 - ▶ with/without name label l

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen
 - ▶ quality of the milk q , e.g. fresh milk, UHT milk, Bio milk, expensive looking, cheap looking, ...
 - ▶ time since opening (age) t_a
 - ▶ with/without name label l
 - ▶ social system s (e.g. communism, socialism, capitalism)

Modeling the milk consumption

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}} \quad (1)$$

Assumptions:

- ▶ legal consumption r_{legal} is constant over time
- ▶ illegal consumption rate r_{illegal} depends on
 - ▶ number of available milk packages in the fridge n_{milk}
 - ▶ amount of milk $x_{\text{milk}}(t)$ in the package (psychological effect)
 - ▶ number of people n_{people} using the tea kitchen
 - ▶ quality of the milk q , e.g. fresh milk, UHT milk, Bio milk, expensive looking, cheap looking, ...
 - ▶ time since opening (age) t_a
 - ▶ with/without name label l
 - ▶ social system s (e.g. communism, socialism, capitalism)

$$r_{\text{illegal}} = r_{\text{illegal}}(n_{\text{milk}}, x_{\text{milk}}, n_{\text{people}}, q, t_a, l, s) \quad (2)$$

Modeling the milk consumption

Determining the variables:

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing
- ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing
- ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)
- ▶ t_a : known (we will neglect this too)

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing
- ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)
- ▶ t_a : known (we will neglect this too)
- ▶ n_{people} : counting the people every day is stupid, but number of people will probably change

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing
- ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)
- ▶ t_a : known (we will neglect this too)
- ▶ n_{people} : counting the people every day is stupid, but number of people will probably change
 - ▶ on short time scale due to: holidays, weekend, etc.

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
- ▶ x_{milk} : weighing
- ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)
- ▶ t_a : known (we will neglect this too)
- ▶ n_{people} : counting the people every day is stupid, but number of people will probably change
 - ▶ on short time scale due to: holidays, weekend, etc.
 - ▶ on long time scale due to: end of contracts, new hiring, etc.

Modeling the milk consumption

Determining the variables:

- ▶ n_{milk} : counting
 - ▶ x_{milk} : weighing
 - ▶ q, l, s : factors which have to be determined from experimental data (we will neglect these in a first step)
 - ▶ t_a : known (we will neglect this too)
 - ▶ n_{people} : counting the people every day is stupid, but number of people will probably change
 - ▶ on short time scale due to: holidays, weekend, etc.
 - ▶ on long time scale due to: end of contracts, new hiring, etc.
- kind of *observer* is needed to determine amount of people

Modeling the milk consumption

Possible *observer*:

- ▶ consumed electrical energy x_{energy} (coffee machine, water boiler) in the tea kitchen is proportional to the number of people

$$\frac{dx_{\text{energy}}}{dt} = k_{\text{energy}} n_{\text{people}} \quad (3)$$

Modeling the milk consumption

Possible *observer*:

- ▶ consumed electrical energy x_{energy} (coffee machine, water boiler) in the tea kitchen is proportional to the number of people

$$\frac{dx_{\text{energy}}}{dt} = k_{\text{energy}} n_{\text{people}} \quad (3)$$

- ▶ consumed sugar x_{sugar} is proportional to the number of people

$$\frac{dx_{\text{sugar}}}{dt} = k_{\text{sugar}} n_{\text{people}} \quad (4)$$

Modeling the milk consumption

Possible *observer*:

- ▶ consumed electrical energy x_{energy} (coffee machine, water boiler) in the tea kitchen is proportional to the number of people

$$\frac{dx_{\text{energy}}}{dt} = k_{\text{energy}} n_{\text{people}} \quad (3)$$

- ▶ consumed sugar x_{sugar} is proportional to the number of people

$$\frac{dx_{\text{sugar}}}{dt} = k_{\text{sugar}} n_{\text{people}} \quad (4)$$

- ▶ fridge door openings n_{fdo} are proportional to the number of people

$$n_{\text{people}} = k_{\text{fdo}} n_{\text{fdo}} \quad (5)$$

Modeling the milk consumption

Possible *observer*:

- ▶ consumed electrical energy x_{energy} (coffee machine, water boiler) in the tea kitchen is proportional to the number of people

$$\frac{dx_{\text{energy}}}{dt} = k_{\text{energy}} n_{\text{people}} \quad (3)$$

- ▶ consumed sugar x_{sugar} is proportional to the number of people

$$\frac{dx_{\text{sugar}}}{dt} = k_{\text{sugar}} n_{\text{people}} \quad (4)$$

- ▶ fridge door openings n_{fdo} are proportional to the number of people

$$n_{\text{people}} = k_{\text{fdo}} n_{\text{fdo}} \quad (5)$$

Modeling the milk consumption

Summary:

$$\frac{dx_{\text{milk}}(t)}{dt} = r_{\text{legal}} + r_{\text{illegal}}(n_{\text{milk}}, x_{\text{milk}}, n_{\text{people}}) \quad (6)$$

$$\frac{dx_{\text{energy}}}{dt} = k_{\text{energy}} n_{\text{people}} \quad (7)$$

$$\frac{dx_{\text{sugar}}}{dt} = k_{\text{sugar}} n_{\text{people}} \quad (8)$$

with

$$r_{\text{legal}} = k_{\text{legal}} \mathcal{H}^*(x_{\text{milk}}) \quad (9)$$

$$r_{\text{illegal}} = k_{\text{illegal}} \frac{1}{n_{\text{milk}}} n_{\text{people}} f_{\text{psych}}(x_{\text{milk}}) \mathcal{H}^*(x_{\text{milk}}) \quad (10)$$

where

$$\mathcal{H}^*(x_{\text{milk}}) = \begin{cases} 0 & : x_{\text{milk}} \leq 0 \\ 1 & : x_{\text{milk}} > 0 \end{cases} \quad (11)$$

Modeling the milk consumption

Question: How does f_{psych} look like?

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Hypothesis 2:

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Hypothesis 2:

- ▶ Milk snitching is always constant.

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Hypothesis 2:

- ▶ Milk snitching is always constant.

Hypothesis 3:

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Hypothesis 2:

- ▶ Milk snitching is always constant.

Hypothesis 3:

- ▶ Something else is true.

Modeling the milk consumption

Question: How does f_{psych} look like?

Hypothesis 1:

- ▶ If milk package is full, people snitch no or very little milk, because snitching will be recognized very easily.
- ▶ If milk package is almost empty, people will also snitch no or very little milk, because it's probably old milk
- ▶ Milk snitching is highest, if package is half full (half empty).

Hypothesis 2:

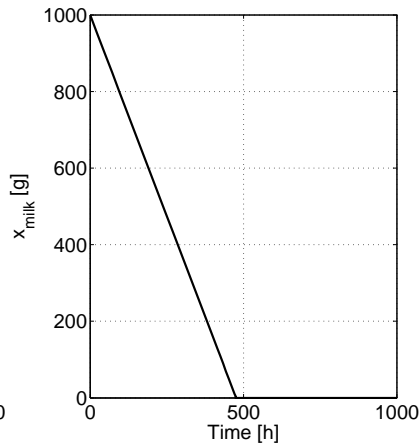
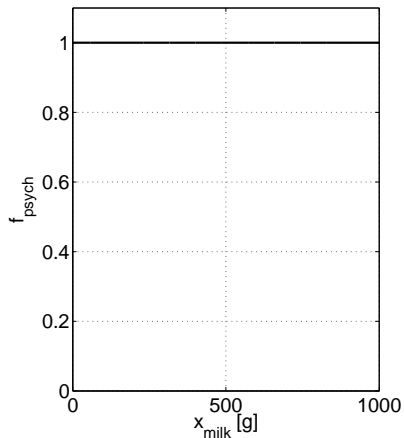
- ▶ Milk snitching is always constant.

Hypothesis 3:

- ▶ Something else is true.

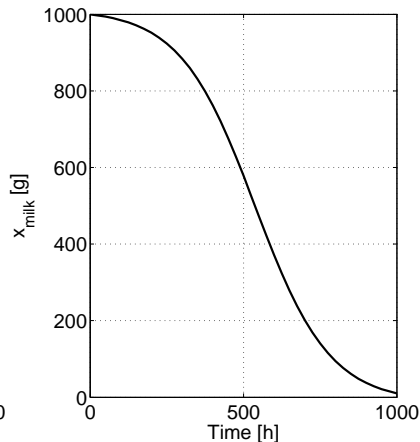
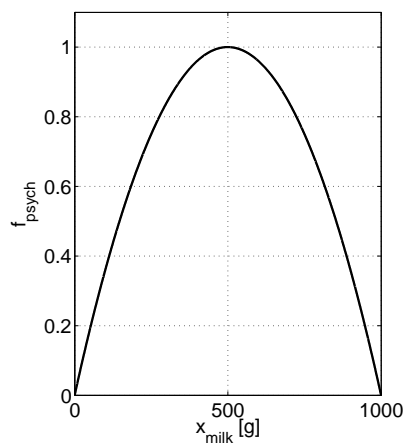
Modeling the milk consumption

Hypothesis 2: constant milk snitching



Modeling the milk consumption

Hypothesis 1: e.g. quadratic dependency



(Alternative: Gaussian distribution or something similar.)

Experimental setup

- ▶ As DDAVM (device for determining the amount of vanished milk), we use an ordinary kitchen scales.

Experimental setup

- ▶ As DDAVM (device for determining the amount of vanished milk), we use an ordinary kitchen scales.
- ▶ As DMCEE (device for measuring the consumed electrical energy), we use a digital electricity meter. Remember: consumed electrical energy is proportional to number of people using the kitchen (at least we assume this.).

Experimental setup

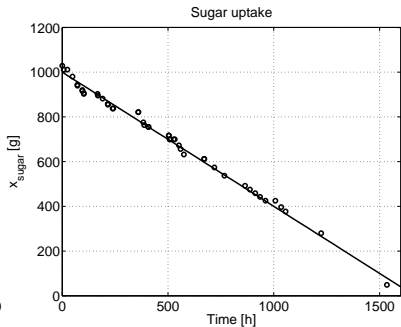
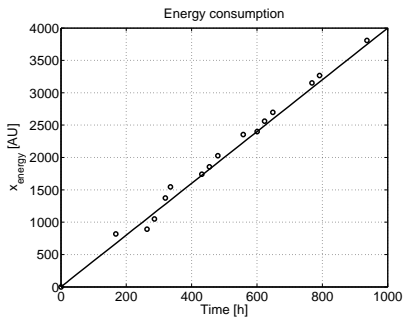
- ▶ As DDAVM (device for determining the amount of vanished milk), we use an ordinary kitchen scales.
- ▶ As DMCEE (device for measuring the consumed electrical energy), we use a digital electricity meter. Remember: consumed electrical energy is proportional to number of people using the kitchen (at least we assume this.).
- ▶ As DCFDO (device for counting fridge door openings), we use ... nothing so far. Please help us to make/solder such a device. Maybe a kind of digital counter with 2 7-segment displays triggered by a photodiode. We will hide this in a regular yoghurt cup.

Experimental setup

- ▶ As DDAVM (device for determining the amount of vanished milk), we use an ordinary kitchen scales.
- ▶ As DMCEE (device for measuring the consumed electrical energy), we use a digital electricity meter. Remember: consumed electrical energy is proportional to number of people using the kitchen (at least we assume this.).
- ▶ As DCFDO (device for counting fridge door openings), we use ... nothing so far. Please help us to make/solder such a device. Maybe a kind of digital counter with 2 7-segment displays triggered by a photodiode. We will hide this in a regular yoghurt cup.

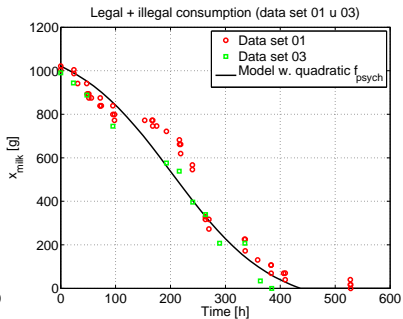
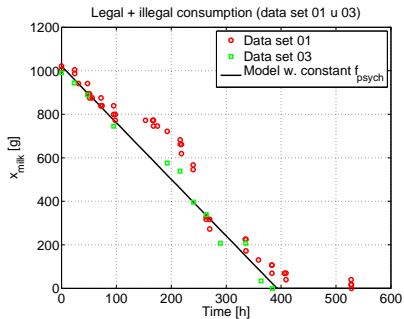
First results

Energy and sugar consumption are almost constant:



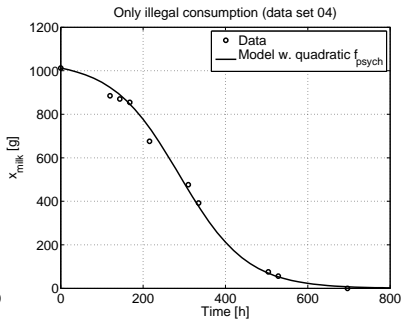
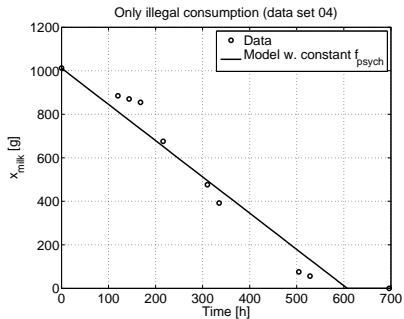
First results

Data sets with legal and illegal consumption:



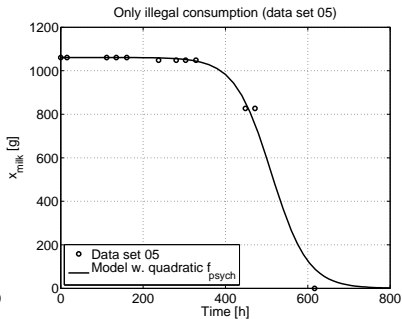
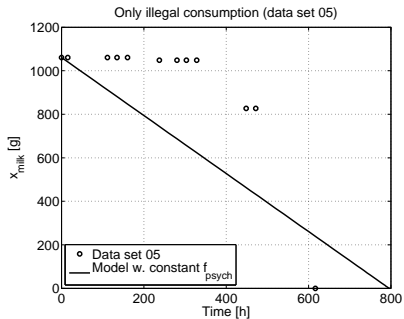
First results

Data set with only illegal consumption:



First results

Data set with only illegal consumption:



We need your help!

We need your help!

- ▶ We need more data sets! If you like to support us, please analyze your office environment.

We need your help!

- ▶ We need more data sets! If you like to support us, please analyze your office environment.
- ▶ We need a DCFDO (device for counting fridge door openings). Can you solder? Are you familiar with electronics?

We need your help!

- ▶ We need more data sets! If you like to support us, please analyze your office environment.
- ▶ We need a DCFDO (device for counting fridge door openings). Can you solder? Are you familiar with electronics?
- ▶ You disagree with our model assumption? Better ideas?

We need your help!

- ▶ We need more data sets! If you like to support us, please analyze your office environment.
- ▶ We need a DCFDO (device for counting fridge door openings). Can you solder? Are you familiar with electronics?
- ▶ You disagree with our model assumption? Better ideas?
- ▶ Anything else?

We need your help!

- ▶ We need more data sets! If you like to support us, please analyze your office environment.
- ▶ We need a DCFDO (device for counting fridge door openings). Can you solder? Are you familiar with electronics?
- ▶ You disagree with our model assumption? Better ideas?
- ▶ Anything else?

Then please contact me: email@andrefranz.de
Or find me somewhere at the camp side, probably at
LeiwandVille.

Conclusion

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers
- ▶ a coffee day without milk would be disastrous

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers
- ▶ a coffee day without milk would be disastrous
- ▶ therefore: want to construct a milk-consumption model in order to
 - ▶ predict, when to buy new milk without surveillance of the employees and their milk consumption

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers
- ▶ a coffee day without milk would be disastrous
- ▶ therefore: want to construct a milk-consumption model in order to
 - ▶ predict, when to buy new milk without surveillance of the employees and their milk consumption
 - ▶ understand the mechanisms behind the psychology of illegal consumption in general

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers
- ▶ a coffee day without milk would be disastrous
- ▶ therefore: want to construct a milk-consumption model in order to
 - ▶ predict, when to buy new milk without surveillance of the employees and their milk consumption
 - ▶ understand the mechanisms behind the psychology of illegal consumption in general
 - ▶ derive the social composition in large office environments (can be used to account for at social events or group trips, etc. without the need of time-consuming surveys)

Conclusion

- ▶ milk is important for the health of mankind, especially coffee drinkers
- ▶ a coffee day without milk would be disastrous
- ▶ therefore: want to construct a milk-consumption model in order to
 - ▶ predict, when to buy new milk without surveillance of the employees and their milk consumption
 - ▶ understand the mechanisms behind the psychology of illegal consumption in general
 - ▶ derive the social composition in large office environments (can be used to account for at social events or group trips, etc. without the need of time-consuming surveys)

Future work

Future work

- ▶ Generate more experimental data. Can you help us?

Future work

- ▶ Generate more experimental data. Can you help us?
- ▶ Implement more alternatives for f_{psych} (model candidates).

Future work

- ▶ Generate more experimental data. Can you help us?
- ▶ Implement more alternatives for f_{psych} (model candidates).
- ▶ Use model discrimination techniques to falsify/exclude model candidates.

Future work

- ▶ Generate more experimental data. Can you help us?
- ▶ Implement more alternatives for f_{psych} (model candidates).
- ▶ Use model discrimination techniques to falsify/exclude model candidates.
- ▶ Evaluate influence of remaining parameters q , l and s .
- ▶ etc.

Thanks for your attention!

For questions, feedback, ideas, help ... please contact
email@andrefranz.de