



# Real-Life Tasks

## More reality, please!

Results of an international co-operation project

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# What to expect from this talk

1. Why a project about this topic?
2. Survey: What students find (not) interesting
3. Examples from (Austrian) text books: May it be somewhat less interesting/realistic?
4. (Hopefully) more realistic tasks (includes activities for you)
5. Realistic tasks/data?



# What not to expect from this talk

1. „That’s how it works!“  
(your experience) > (my experience)
2. „These tasks are interesting for everyone!“  
Education: (Almost) all theorems with the word  
„everyone“ in them are wrong
3. „Throw away your textbooks!“  
Of course not, as a) there are lots of realistic tasks  
in them, and b) a textbook is more than a  
collection of tasks
4. „All tasks have to have realistic context“



# Why a project about this topic?

- Studies: Little motivation to do mathematics.
- Reasons (stated by students):
  - Uninteresting
  - I do not need it in my life
  - Too complicated
  - No real applications
- Numerous studies also show (not surprisingly) that realistic and interesting context increases motivation to learn.



## Who are the project partners?

- Project name: Bringing Mathematics to Earth
- Partners in Education:
  - University of Vienna, Austria
  - University of Pisa, Italy
  - Teachers' College Århus, Denmark
  - University of Nitra, Slovakia
  - Academy of Science, Bulgaria



# Whom do we work with?

- „Real-life“ partners
  - Austrian Airlines
  - NASA/JPL
  - EVN (Austrian Energy Corporation)
  - Marine-Academy Livorno, Italy
  - Employees in the following areas:
    - Gardening
    - Decoration
    - Archaeology
    - Finance
    - Chemistry



# Survey: What students find (not) interesting (part 1)

- Interesting topics (small extract)
  - Music
  - Environment
  - Job
  - Sports
  - Clothes
  - Engineering
  - Solving riddles/mysteries



# Survey: What students find (not) interesting (part 2)

- Less interesting topics
  - School (we are going to need this in grade x)
  - Shopping for food
  - Geometric objects without context
  - Collecting stamps, coins, etc.
  - Lottery and other „gambling-related“ combinatorics



## How about something less interesting/realistic? (Example 1)

- A tinsmith constructs an open can with height 22 cm, length 10 cm, and width 10 cm. What's the amount of sheet metal (in  $\text{dm}^2$ ) needed if the discard is  $6 \text{ dm}^2 20 \text{ cm}^2$ .
- a) What for?
- b) Sheet metal in  $\text{dm}^2$
- c) Discard ca. 40 %



## How about something less interesting/realistic? (Example 2)

- An advertising agency advises a politician, that he would need at least 30 one-minute and 20 three-minute TV-spots to win the next elections. Austrian TV sells one-minute broadcasting slots for 1.000 €, and three-minute slots for 2.500 €. How many one-minute and three-minute slots does he have to choose to win the elections with minimum costs?
- a) Very unusual advice
- b) Real costs (and efficiency) for ads are extremely dependent on time of broadcast – and much more expensive than stated
- c) Marginally interesting for students



## How about something less interesting/realistic? (Example 3)

- An airplane flies from Frankfurt to Vienna (660 km) and arrives in Vienna 6 minutes earlier if there is a tailwind of 60 km/h (compared with arrival with no tailwind). How fast does the plane go?
- a) Usually miles and knots are used
- b) Real distance FRA-VIE is 715 km
- c) Usually one knows the speed of the plane and wants to know the time saving



## How about something less interesting/realistic? (Example 4)

- The minute hand of a wrist watch is 2.5 cm long. What distance does the tip of the hand travel in one year?
- a) The watch would be rather big
- b) Why would you want to know that? Is there a mileage program for minute hands?



## Example: Realistic Task 1 (1)



- Flight from Vienna to Dubai (2.450 miles = 4.537 km) with a Boeing 737-800
- Average air speed: 400 knots (miles per hour)
- First guess: How much fuel (in kg) is required?



## Example: Realistic Task 1 (2)

- The minimum amount of fuel consists of:
  1. Fuel for taxiing from the parking position to the runway (200 kg)
  2. Fuel for the flight from Vienna to Dubai (2,400 kg/h)
  3. 5% of 2. as spare (e.g. to compensate for wind etc.)
  4. Fuel for the flight from the destination airport to the alternative airport (distance in this case: 160 miles)
  5. Minimum remaining fuel (after the landing there has to be fuel left for 30 minutes of flying)
- Result: ca. 18.000 kg



## Example: Realistic Task 1 (3)

- Possible extensions
  - How long does it take to refuel the plane (fuel pumps are able to fill with about 14 l/s, density of fuel is about 0.79 kg/l)
  - Saving fuel by flying slower (1% less speed requires 1% less fuel) – flight plan?
  - Saving fuel by a different flight level?
  - Students may find other airplane types and other flight routes and make similar calculations

## Example: Realistic Task 2 (1)



- Making a map of the surface of the moon with the LRO (Lunar Reconnaissance Orbiter)
- Camera angles:  $2.85^\circ$  (detail) and  $60^\circ$  (wide angle). Distance to surface: 50 km
- First guess: Minimum distance that the LRO has to fly so as to cover the whole moon surface



## Example: Realistic Task 2 (2)

- Possible extensions
  - How long does the process take?
  - One photo of the wide-angle camera uses about 10 kb of memory. How much data has to be broadcast, if the whole surface of the moon shall be covered?



## Example: Realistic Task 3 (1)



- Covering the electric power consumption by using solar cells?
- Study: About 1/3 of the current Austrian electric power consumption could be covered by using solar cells.
- First guess: Size of area (in  $\text{m}^2$  and in % of total area of the country) covered by solar cells?



## Example: Realistic Task 3 (2)

- A (typical) solar cell (module) is rectangular, 160 cm x 90 cm, and has an average power output of 200 W
- Electric power consumption 2008: 58,884 GWh
- Hours of sunlight: annual average 4.5 h/day
- Result: ca. 60 million solar cells, 85 million m<sup>2</sup> = 85 km<sup>2</sup> (~0.1 % of total area) – BUT ...



## Example: Realistic Task 3 (3)

- Possible extensions
  - How much would the cells cost?
  - What may be criticized in the study?
  - How many windmills would have to be constructed to get the same amount of energy (one windmill has a power output, under ideal conditions, of 3,600 kW).



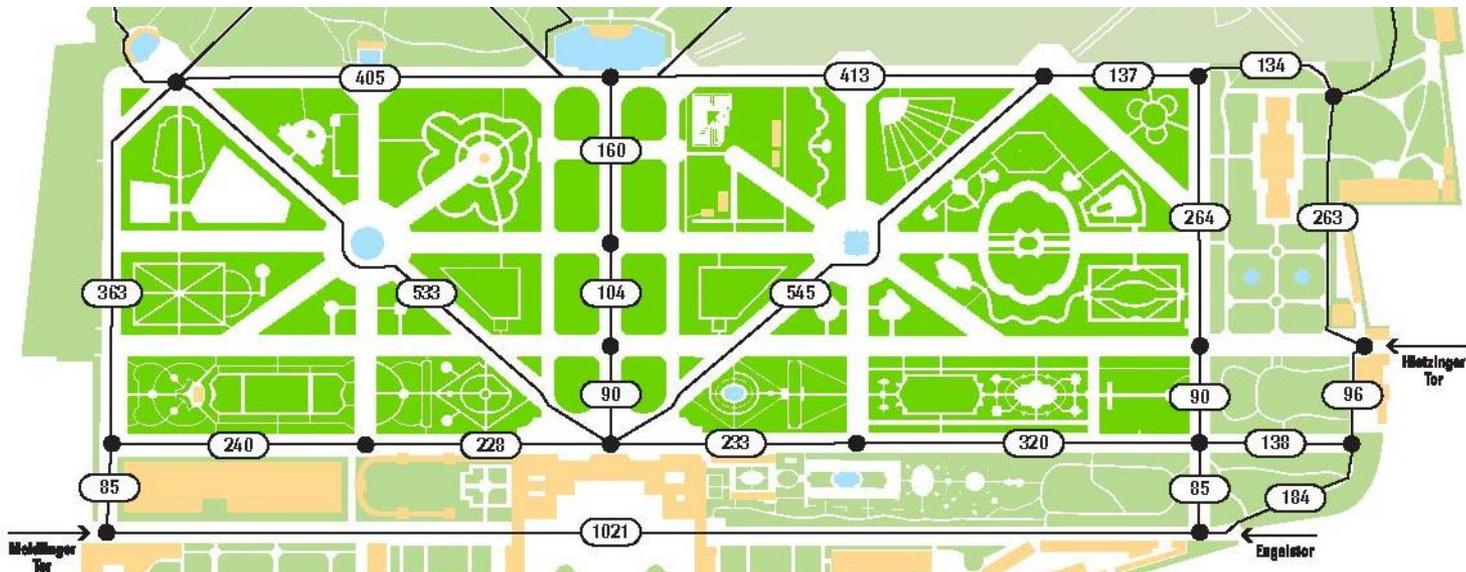
## Example: Realistic Task 4 (1)



- In the gardens of castle Schönbrunn in Vienna the lawn has to be replanted regularly.
- Newspaper: Several tons of seed are required.
- First guess: How much seed is really needed?

## Example: Realistic Task 4 (2)

- The producer of the seed recommends 1 kg of seed per 15 m<sup>2</sup> of area.
- Attached: Map of park
- Result: ca. 13 tons





## Example: Realistic Task 4 (3)

- Possible extensions
  - Cost of seed?
  - How exact can one do this calculation – and how exact does it have to be?
  - This map is actually for runners. This can be used for several more tasks.



## Sources

- <http://www.math2earth.eu>
- <http://www.whenwilliusemath.com>
- School books (sometimes it does not hurt to check the data ...)