

# Growth of Dutch Children

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The weight-for-stature diagram is used as a screening tool to identify children that do not weigh as much as they should for their height, at this moment. This may indicate serious weight problems because of acute malnutrition, wasting, dehydration, genetic disorder, infectious disease, or a combination of such factors. Major drawback in the weight-for-stature diagram is that it does not take age into account; only weight and height are used. Especially puberty should be taken into account. Therefore you see in the weight-for-stature diagram that a distinction is made between weight-for-stature graphs before and after the age of 16 year. In this task we shall look at the graphs of average weight for Dutch boys and girls younger than 16 years in relation to their stature.

## Research Questions

- What is the mean weight for Dutch boys and girls younger than 16 years in relation to their height? What are the points in common and what are the differences?
- Does there exist a simple formula that fits well the mean weight for boys up to some height? If so, what is this formula and up to what height can it be applied? What about a formula for girls?
- Can you divide the height axis in segments such that there exists for each segment a simple formula that fits well the mean weight for boys in relation to their height? And for girls?

## Task D. Mathematical Weight-for-Height Model

1. Start Coach and select the project *Growth of Dutch Boys and Girls*.
2. Select activity D: *Mathematical Weight-for-Height Model*.
3. Carry out the subtasks in this activity and answer the questions.

## Growth Data

Growth data have been placed in a text window inside the Coach activity. We write these data down here for those who want to put the text window in the background during their work.

Height is in centimetres; weight is in kilograms (and are of course mean values).

| Height | Weight<br>boys | Weight<br>girls | Height | Weight<br>boys | Weight<br>girls | Height | Weight<br>boys | Weight<br>girls |
|--------|----------------|-----------------|--------|----------------|-----------------|--------|----------------|-----------------|
| 50     | 3.3            | 3.3             | 100    | 15.8           | 15.7            | 150    | 38.3           | 39.2            |
| 55     | 4.5            | 4.5             | 105    | 17.2           | 17.1            | 155    | 41.9           | 43.5            |
| 60     | 5.7            | 5.7             | 110    | 18.7           | 18.7            | 160    | 45.9           | 48.1            |
| 65     | 7.1            | 7.0             | 115    | 20.4           | 20.4            | 165    | 50.1           | 52.8            |
| 70     | 8.4            | 8.2             | 120    | 22.3           | 22.3            | 170    | 54.4           | 57.2            |
| 75     | 9.7            | 9.4             | 125    | 24.3           | 24.4            | 175    | 58.9           | 61.4            |
| 80     | 10.9           | 10.6            | 130    | 26.6           | 26.8            | 180    | 63.3           | 65.5            |
| 85     | 12.1           | 11.7            | 135    | 29.1           | 29.4            | 185    | 67.6           | 69.6            |
| 90     | 13.2           | 13.0            | 140    | 31.8           | 32.2            | 190    | 72.0           |                 |
| 95     | 14.5           | 14.3            | 145    | 34.9           | 35.5            | 195    | 76.3           |                 |

## Hints

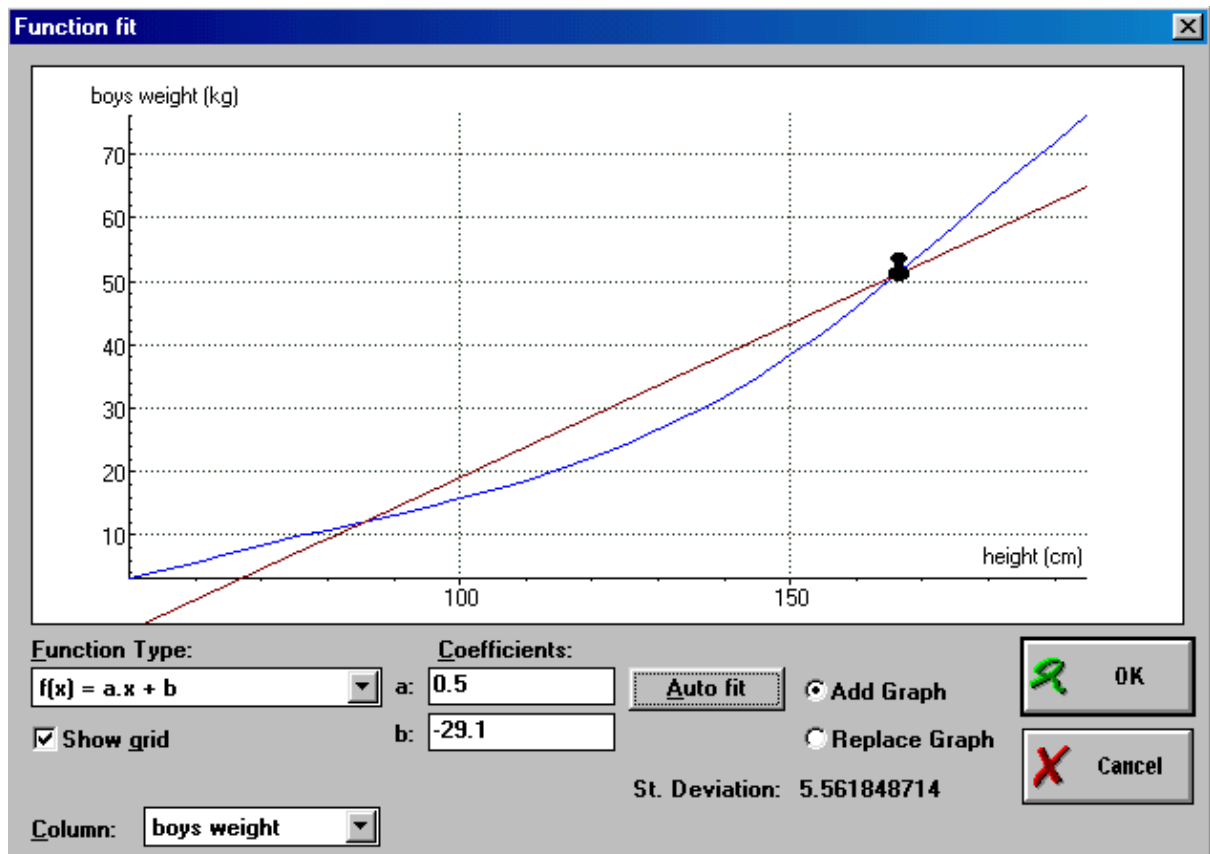
Once you have a table with the growth data you can use several tools of Coach to answers the research questions. We give some hints:

- Make use of diagrams.

- Also study the weight increase diagram.
- Select in the diagram window the menu option 'Analyse' ▶ 'Function-fit' and use it to find a nice linear fit of the weight of boys up to a height of 110 cm. A new window pops up in which you can match the graph of any desired quantity with the graph of a known mathematical function. For example, you can determine the straight line that fits best with the weight increase of boys. This can be done manually or automatically (see the online help or the text in the paragraph below).
- The shape of the increase diagram of weight for boys gives a clue to what kind of formula for weight might be suitable in the various height segments.
- Once you have an idea about the kind of formula you are looking for on a certain height segment, you can select in the diagram window the menu option 'Analyse' ▶ 'Function-fit' and try to find a simple formula as meant in the second research question.
- Also try to find simple formulas that describe well the mean weight for girls in relation to their height until puberty.

### Function-fit

The screen dump below shows manual fit in action. The formula of a straight line,  $y = a x + b$ , has been selected as function type; the selected column corresponds with the mean weight for boys. The icon of the pin on the screen dump is such that the approximation has been fixed at that location. By dragging another point of the straight line with the mouse you can rotate the line. When you release the fixed pin by double clicking, then you can translate the line. When you press 'Auto-fit', then you let the software itself find the least-squares fit of all data.



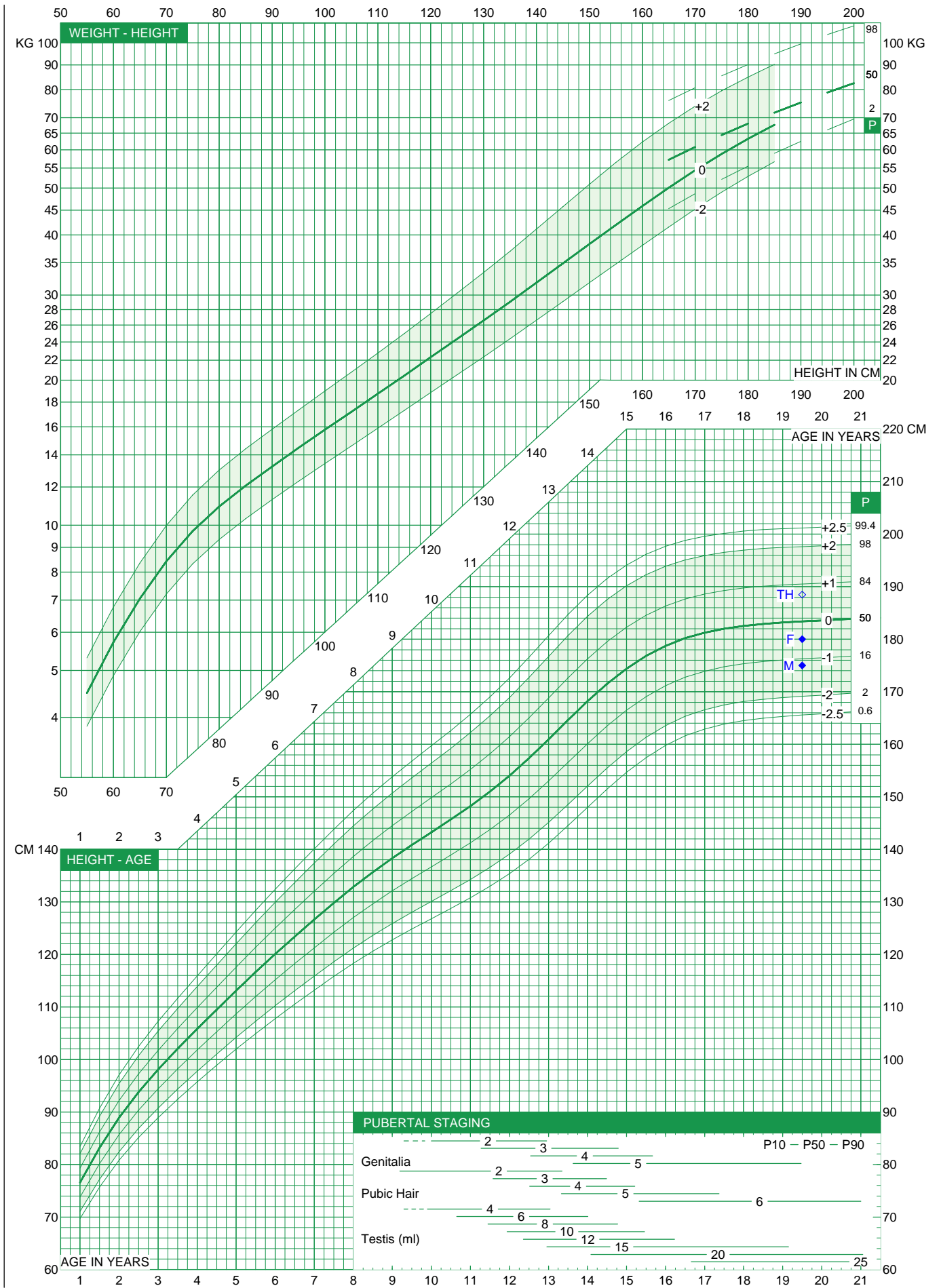
### Additional exercise:

In growth charts that are really used in health care the weight-for-stature diagram has a logarithmic vertical axis. See the attachment; herein is the middle dark graph, which is labelled both as 0 SDS curve and as percentile curve  $P_{50}$ , the curve that we investigate in this task. Check that you get a similar graph in Coach when you plot the quantity  $\ln(\text{weight})$  (instead of  $\text{weight}$ ) in relation to height.

# GROEIDIAGRAM 1-21 JAAR JONGENS

|                                |                             |                     |
|--------------------------------|-----------------------------|---------------------|
| Naam <b>MR X</b>               |                             |                     |
| Geboortedatum <b>18/5/2000</b> | Reg. nr <b>1</b>            |                     |
| Vader (g) <b>180.00 cm</b>     | Moeder (g) <b>175.00 cm</b> | TH <b>188.50 cm</b> |

< 16 jaar —————  
 > 16 jaar - - - - -



# GROEIDIAGRAM 1-21 JAAR MEISJES

|                                |                             |                     |  |
|--------------------------------|-----------------------------|---------------------|--|
| Naam <b>MRS Y</b>              |                             |                     |  |
| Geboortedatum <b>18/5/2000</b> |                             | Reg. nr <b>2</b>    |  |
| Vader (g) <b>185.00</b> cm     | Moeder (g) <b>170.00</b> cm | TH <b>175.50</b> cm |  |

< 16 jaar —————  
> 16 jaar - - - - -

