# Mathematical Portfolio

Task II:

# Body Mass Index

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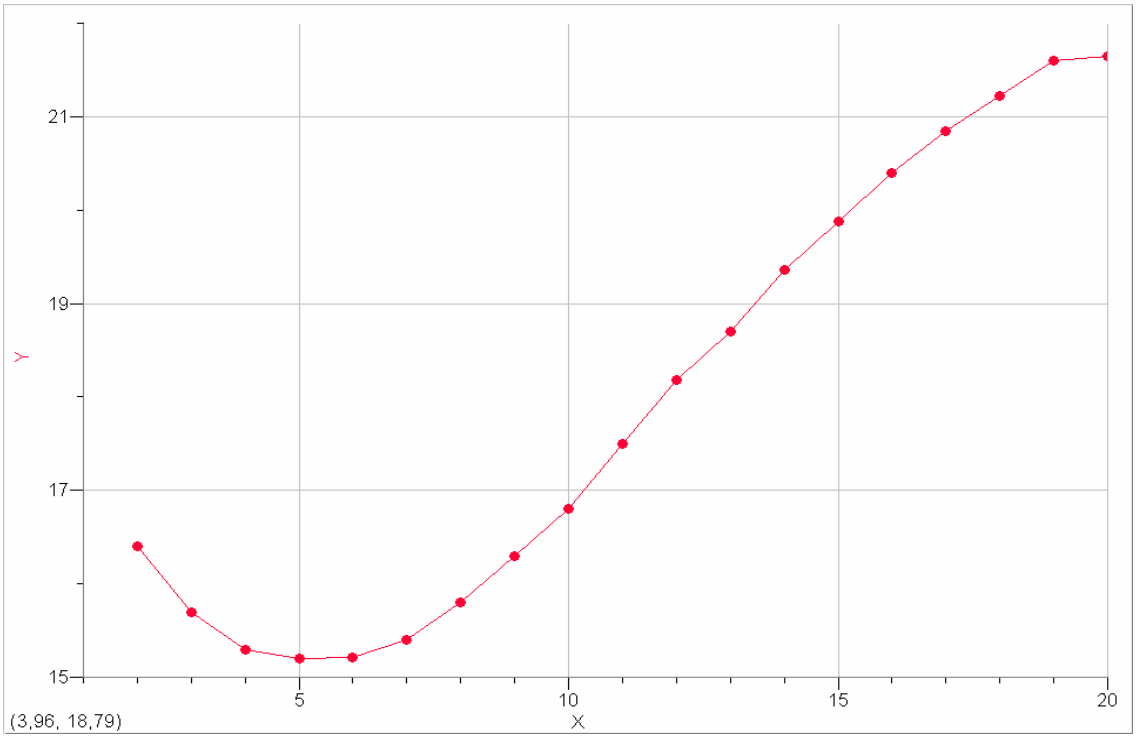
The data given in the task is plotted in the following graph:



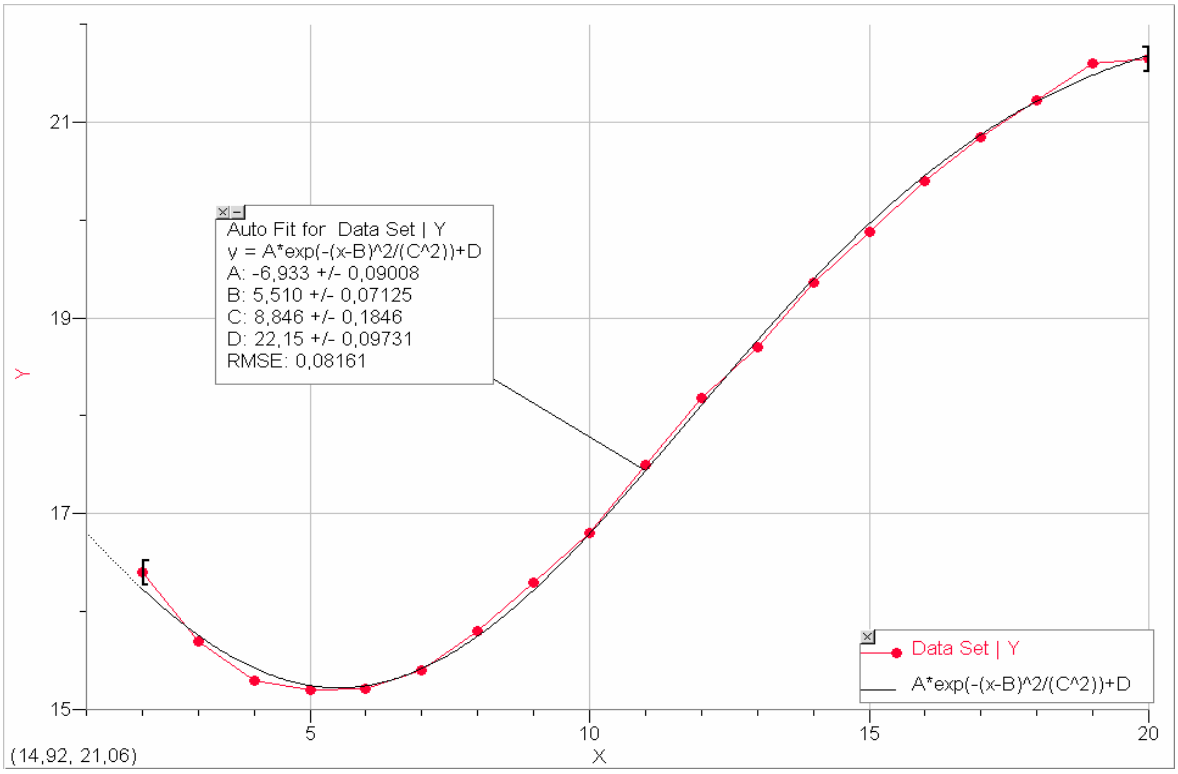

The values on the x-axis express the age and the values of the y-axis – the Body Mass Index. As far the age of a person must be always a positive number, than the BMI must also be a number bigger than 0.

The graph of the function behaves like a Gaussian function. The Gaussian function has a general expression of this look:

$$f(x) = ae^{-\frac{(x-b)^2}{2c^2}},$$

where a, b, c are bigger than 0,
and e ≈ 2.718281828 (Euler's number).

I chose this function, because the curve line, that the Gaussian function forms fits the best to the graph I got from the data for the age of females and their BMI. To be more sure, I drew a simple Gaussian function over the graph, which I already have had. The new graph looks as follows (the red line is the function that the given data form and the black line is the Gaussian function):



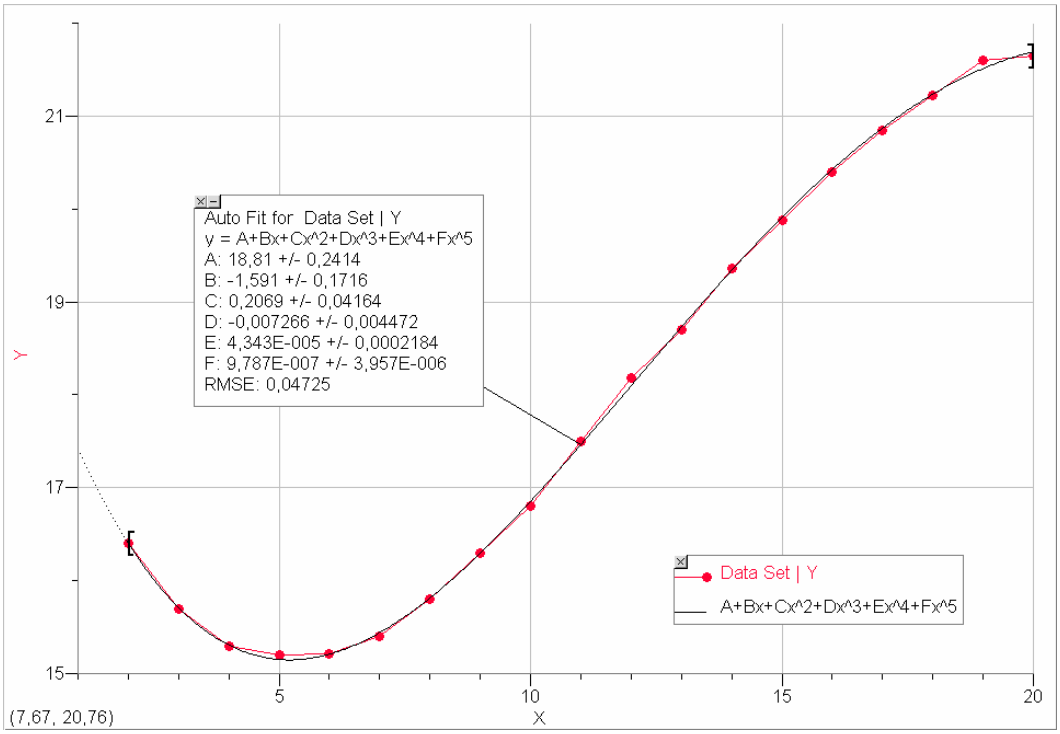

The exact equation of the Gaussian function, which fits the data graph, is:
y = A*exp(-(x-B)^2/(C^2))+D, where
A=-6,933
B= 5,510
C=8.846
D=22.15

It must be noted that it is highly possible the Gaussian function to be inappropriate if the data is for elder people. The biological development of the human body leads in most of the cases to changes in the weight, height and the mass amount, that if put in a data set and represented in graph those quantities would not look like the Gaussian graph. The Gaussian graph is symmetric and the age/BMI graph for elder people would not be symmetric. That is why, the Gaussian normal distribution is not appropriate for proceeding with the task.

The graph of an equation of highest power 5 fits well the graph, too.

$$y = ax^5 + bx^4 + cx^3 + dx^2 + ex + f$$

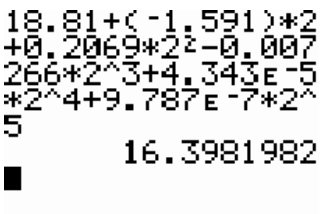
The best way to show that the equation of highest power fits well to the graph of the data that is given is to draw the two graphs on what plot. The new graph looks like this:



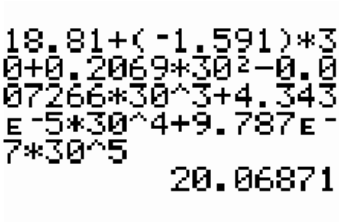

The black line represents the equation $y = A + Bx + Cx^2 + Dx^3 + Ex^4 + Dx^5$, where:

A = 18,81
B = -1,591
C = 0,2069
D = -0,007266
E = $4{,}343\ e^{-5}$
F = $9{,}787\ e^{-7}$

Before using this equation for a model, it is better first to test it. Using the graphical calculator I calculated the BMI of a 2-year-old girl. This is what I got:



The answer (16.398) is very close to real BMI of a 2-year-old girl, which is 16.40. This little testing gives me the courage to proceed with the task and to estimate the BMI of a 30-year-old woman in the USA using my model. The result is as follows:

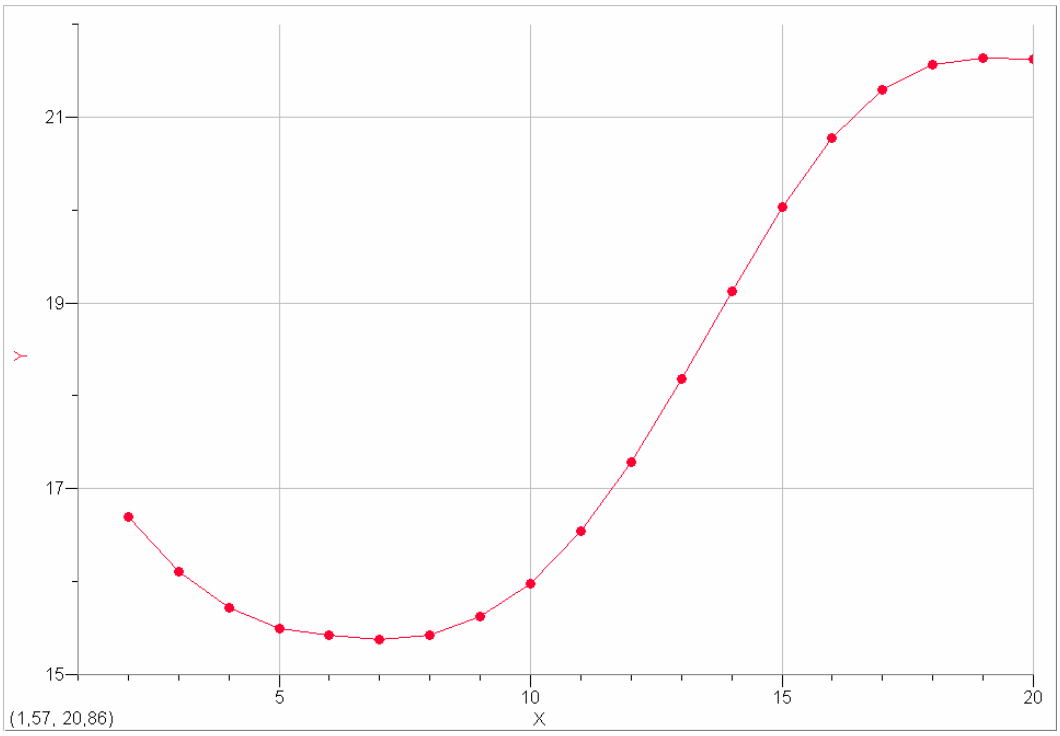



The result looks relatively fine, because it is near to the quantity of the BMI of a 20-year-old woman and during that period of time (between 20 to 30-35 years) almost no radical changes happen in the female body. In Internet I found many BMI calculators and assuming that a woman, that is 30 years old, weights 58 kg and is 167 cm high, the BMI is estimated around 20.8. That could be assumed for another proof that my model could be used for relative estimating the Body Mass Index.

Also, I used the Internet to find BMI data for females from Brazil. I found the following information:

| AGE (YRS) | BMI |
|---|---|
| 2 | 16.70 |
| 3 | 16.11 |
| 4 | 15.72 |
| 5 | 15.50 |
| 6 | 15.43 |
| 7 | 15.38 |
| 8 | 15.43 |
| 9 | 15.62 |
| 10 | 15.98 |
| 11 | 16.54 |
| 12 | 17.29 |
| 13 | 18.18 |
| 14 | 19.13 |
| 15 | 20.03 |
| 16 | 20.78 |
| 17 | 21.29 |
| 18 | 21.56 |
| 19 | 21.63 |
| 20 | 21.62 |

The graph, which represents this data, is:




My model does not perfectly fit this data, but using the same method, but with the different quantities one will develop another model, with different coefficients, which would fit this data better. Anyway, this model has limitations, because every race has different characteristics, including differences in weight, height, etc.

List of sources:

http://www.nhlbisupport.com/bmi/bmi-m.htm (March, 2009)
http://www.scielo.br/img/revistas/jped/v82n4/en_a07tab01.gif (March, 2009)

Owen, John. Haese, Robert. Haese, Sandra. Bruce, Mark. "Mathematics for the international student", Haese and Harris publications

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