Excercise 7

1. You have a small sample of radioactive material. You measure how many decays occurs in one minute, totally 30 minutes. Measurements (t, A) are stored `data_07.txt`. Activity obeys

$$A(t) = A_0 e^{-\lambda t}$$

where

$$\lambda = \frac{\ln 2}{T_{(1/2)}}.$$

Fit function of that form to the data points (use `FindFit[]`), plot fit-function and data points in same graph and determine the half life $T_{1/2}$ of that radioactive material.

2. You have spent nice morning in physics lab. You have rolled down a cylinder on an inclined plane thousand times and measured the time it takes to travel over some certain distance (with quite accurate stop watch). Measurements you have typed in `data2_h07.txt`. You have also heard that physical measurements somehow obeys normal distribution

$$\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

where σ is variance ja μ is mean or expectation value of the distribution.

   a) Illustrate your measurements with histogram (you need `Histograms‘` –package and `Histogram[]` –command).

   b) Find the expectation value (mean) and variance of your measurements. With them construct a normaldistribution propability density function (`NormalDistribution[]` and `PDF[]`) and plot PDF.

   c) From your PDF, find the probability to measure $4 < t < 6$.

3. Then back to the basics of Mathematica. Read helps and go through examples of functions `Limit[]`, `Series[]` and `Normal[]`.

   a) Calculate limit of function $f(x) = \frac{\sqrt{4-x}-2}{x}$, when $x \to 0$

   b) Expand $\sin(x)$ to the series orders of 3, 5, 7 and 9 at $x = 0$. Plot functions and compare with the original function. (Taylor series)

   c) Expand $f(x) = \frac{e^x}{x-1}$ at x=1 and plot it. (Laurent series)