

Advanced Mathematics – WS2021 – Lab 10

Submission is for next Wednesday, February the 3rd! Do your best! 😊 Good luck!

Exercise 1 – Exploring Data (in Matlab)

The Earth's magnetic field is known to have reversed direction over geologic time. The file *GK2007.txt* contains data from the Gee and Kent (2007) magnetic time scale. It lists all normal and reversely magnetized chrons and gives the duration of each interval (in Myr).

Make box-and-whisker plots for the entire data set as well as for normal and reverse polarities separately. Note that the last letter in the chron, “n”, means normalized, and “r” stands for reversed polarized. Make a histogram of all intervals using a bin width of 0.1 Myr. Comment.

Exercise 2 – Error Analysis

The subsidence of young (< 80 Myr) oceanic crust due to lithospheric cooling has been shown to follow approximately a linear $\sqrt{\text{age}}$ relationship, given by

$$z = z_r + \frac{2\rho_m\alpha_v T_m}{(\rho_m - \rho_w)} \sqrt{\frac{\kappa t}{\pi}}.$$

Given estimates of thermal diffusivity $\kappa = 1.00 \pm 0.04 \text{ mm}^2 \text{ s}^{-1}$, water density $\rho_w = 1.027 \pm 0.001 \text{ g cm}^{-3}$, mantle density $\rho_m = 3.30 \pm 0.01 \text{ g cm}^{-3}$, volumetric thermal expansion coefficient $\alpha_v = (3.00 \pm 0.02) \cdot 10^{-5} \text{ }^\circ\text{K}^{-1}$, average ridge depth $z_r = 2500 \pm 200 \text{ m}$, and mantle temperature $T_m = 1300 \pm 25 \text{ }^\circ\text{K}$, determine the predicted depth and its uncertainty for a location where rocks of age $t = 29.7 \pm 0.5 \text{ Myr}$ were recovered. Which term dominates the final uncertainty?

Exercise 3 – Least square method (in Matlab)

Apply the generalized least square method on the Ice Sheet data set to study the ice change. There are no other instructions on purpose, to let you think and research. You must send me a commented code in Matlab with a physical analysis of the result.