

# Statistical Models and Data Analysis

Summer term 2018 — Prof. Dr. Christian Leibold

## Problem Set 1

11.4.2018

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The solutions to this exercise should be ready by 2 pm on 16.4.2018. If you have any questions, please send me an email at [stemmler@bio.lmu.de](mailto:stemmler@bio.lmu.de). You may submit your exercises by email, but please be legible!

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### 1. (Integration)

(a) Compute the following integrals

$$\int_0^t (x+2) dx \quad \int_0^t x^2 \cdot t \cdot s ds \quad \int_0^t x^4 \cdot t \cdot s dx \quad \int_0^t e^{2x} dx$$
$$\int \cos(2\pi yx) dy \quad \int_1^t \frac{\ln(x)}{x} dx$$

Please show all steps (variable substitutions, etc.) in your work!

### 2. (Moving averages)

(a) The function  $t \rightarrow x(t)$  is given as  $x(t) = t^3$  for  $t \geq 0$ .

Calculate the moving average of this function in a window of unit length, i.e., calculate

$$y(t) = \int_{t-1}^t x(s) ds . \quad (1)$$

Note that  $\int_a^b z^n dz = \frac{1}{n+1}(b^{n+1} - a^{n+1})$ .

(b) Calculate a modified average over the same window using the kernel  $k(\tau) = 2\tau \Theta(\tau) \Theta(1-\tau)$ , i.e., calculate

$$y(t) = \int_0^1 2\tau \cdot x(t-\tau) d\tau . \quad (2)$$

Sketch the kernel operation graphically and show that the above formula is equivalent to

$$y(t) = \int_{t-1}^t 2 \cdot (t-s) \cdot x(s) ds . \quad (3)$$