# Statistical Models and Data Analysis

Summer term 2017 — Prof. Dr. Christian Leibold

**Problem Set 1** **26.4.2017**

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The solutions to this exercise should be ready by 11 am on 2.5.2015. If you have any questions, please send me an email at 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

$$\int_0^t (x+2)\ dx \qquad \int_0^t x^2 \cdot t \cdot s\ ds \qquad \int_0^t x^4 \cdot t \cdot s\ dx \qquad \int_0^t e^{2\,x} dx$$

$$\int \cos(2\pi y x)\ dy \qquad \int_1^t \frac{\ln(x)}{x}\ dx$$

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

**2.** (Moving averages)

(a) The function $t \to x(t)$ 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

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

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

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

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

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