

# Homework #1

**Q1:(10pts)** Create your own expressions that calculate *variance* and *standart deviation* of an arbitrary  $\mathbf{x}$  vector. Compare your results by  $R$ 's `var` and `sd` functions.

**Q2:(10pts)**  $f(x) = 2x^6 - 13x^5 + 26x^4 - 7x^3 - 28x^2 + 20x$  and  $\mathbf{x}$  is a numeric vector from -1 to 3 by interval of 0.05. Calculate *variance* and *standart deviation* of  $\mathbf{f}(\mathbf{x})$  and plot  $\mathbf{f}(\mathbf{x})$ .

**Q3:(10pts)** A dependent function chain is defined as  $h(x) = \frac{\log(x)-1}{\sqrt{x}}$ ,  $g(x) = e^{\sqrt{h(x)}}$  and  $f(x) = \sin g(x)^{\cos g(x)}$ . If  $\mathbf{x}$  is an integer array in the interval of [20, 200],

- Calculate *standart deviation* and *variance* of  $f(x)$ .
- Calculate *minimum*, *1st quartile*, *median*, *mean*, *3th quartile* and *maximum* of  $\mathbf{f}(\mathbf{x})$ .

**Q4:(20pts)** You have a two air quality stations which first is located in the city center of Bursa and the latter one is at Uludağ. Their heights from mean sea level are 325m and 1743m; and  $PM_{10}$  concentrations are  $87\mu g/m^3$  and  $23\mu g/m^3$ , respectively. Assuming  $PM_{10}$  concentration change by height is linear, what is the  $PM_{10}$  concentration at a village that height is 640m?

**Q5:(20pts)** You are an English cryptology expert in World War II and MI6 agents captured a cryptred German telegraph communication. You figured out that each letter is shifted by 3 to right in cryptred text. So, write the decryption algorithm in R language and help to end the war. You can test your algorithm by the piece of text below. (*Use only English alphabet to decrypt*)

```
cryptred_text <- c("z", "l", "o", "o", "n", "r", "p", "p", "h", "q")
```

**Q6:(20pts)** In numerical integration,

$$\int_a^b f(x)dx \approx \frac{b-a}{n} \sum_{i=1}^{n+1} f(x_i)$$

is known as mid-point rule. According to the definition, calculate the  $\int_0^2 \sin(x)dx$  integral.

**Hint:** Divide the interval [a, b] into  $n$  subintervals of equal width. Theoretical solution is,

$$\int_a^b \sin(x)dx = \cos(a) - \cos(b)$$

**Q7:(10pts)** Write your own R question and the answer. What kind of a question would be useful for someone that just begins?