Statistics B – Winter term 2023

Excercise 2

1. A housing agent sells last April 26 flats with the following data regarding size G in [m^2] and rental M in [Euro]. We know Cov(G, M) = 5760 σ_M = 223, 61 σ_G = 21, 9 μ_M = 1100 μ_G = 80
    a. Calculate and draw the regression line.
    b. Calculate the average and marginal price per m^2.
    c. Estimate the rental of flat of size 100 m^2.

2. In 2021 a brewery has the following output and costs:

	Output [Hektoliter]	Costs [Euro]
Jan	600	6500
Feb	680	8200
Mrz	720	7300
Apr	1010	8900
Mai	900	9900
Jun	990	10000
Jul	1270	10300
Aug	1440	12500
Sep	1380	11500
Okt	1010	9200
Nov	830	8200
Dez	1070	930

    a. Calculate the Cost function via a linear regression.
    b. Interprete economically the parameters.
    c. Calculate the correlation between Output and costs?
    d. Estimate the total costs and average variable costs of an output of 1100 Hektoliter.

3. An enterprise for PC-Hardware und -Software has a central storage. The management wants to analyze the dependences within the logistic processes and the cost development, since currently they charge a flat rate shipping independent from the volume of the order premium. During the last 23 month, the following data was collected: Logistic costs (y in 1.000 e), revenue (x1 in 1.000 e), number of orders (x2). From a linear regression, we obtained the following equation:
    i. $y = -2,77 + 0,047x1 + 0,012x2$

   and the following data

No.	x1	x2	y	yhat	(y−yhat)^2	(y−ybar)^2	x1^2	x2^2
1.–23.	...	...	...	...	...	...	...	...
Sum	10.541	101.271	1.643	1.643	477	3.824	4.982.081	458.344.481

    a. Interprete the coefficiants.
    b. Which costs, do we expect by a revenue of 400.000 e and 4.500 orders?
    c. Calculate the coefficiant of determination and interprete!
    d. Is the assumed linear dependence signifikant to a level of $\alpha = 5\%$?
    e. Is the coefficiant of the variable revenue significant for $\alpha = 1\%$ if $se\beta1 = 0,0126$

4. A company has 7 stores in cities with a different number of inhabitants and different size:

	Inhabitants [10.000]	Size [100m^2]	Revenue [100.000 Euro]				
No.	x1	x2	y	yhat	(y-yhat)^2	(y-ybar)^2	(yhat-ybar)^2
1	1	1,2	2				
2	3	2,3	3				
3	4	2,5	5				
4	6	4	7				
5	7	7	8				
6	8	6,5	9				
7	9	8,3	11				

a. Calculate the linear linear regression parameters β_0, β_1 and β_2 via $[\mathrm{X}^{\mathrm{T}}\mathrm{X}]^{-1}\mathrm{X}^{\mathrm{T}}\vec{\mathrm{y}}$
b. Calculate the coefficient of determination R^2 and the standard error sey of y
c. Calculate the standard errors $se\beta_{\mathrm{i}}$ of the regression parameters β_{i}.
d. Test β_0, β_1 and β_2 for significant deviation from zero ($\alpha = 5\%$).
e. Test the model of linear dependence for ($\alpha = 10\%$).
f. Calculate the correlation coefficients $\mathrm{R}_{\mathrm{x_1y}}$, $\mathrm{R}_{\mathrm{x_2y}}$ and interprete these values with your former results.