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Contemporary development of processing of raw materials of animal origin (meat quality evaluation) Practical example

Modul no. 4: Precision Livestock Farming

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Evaluation of fat/muscle content

FOM

AUTOFOM

HENNESSY GRADING PROBE

COMPUTED TOMOGRAPHY

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Data obtained from FOM measurements

- Back fat thickness (mm) – BF
- Muscle thickness (mm) – MD
  (*Musculus longissimus dorsi)*

Values of lean meat content obtained from dissection

- Lean meat content (%) – LMP

LMP	BF	MD
60.01	16	58
55.37	20	50
72.04	13	57
61.13	14	60
65.15	18	67
64.13	13	67
57.83	16	56
53.67	22	60
66.47	13	65
59.96	12	58
68.06	11	65
67.10	10	60
69.36	11	67
66.34	11	61
69.28	9	62
63.37	13	65
66.52	11	58
69.61	9	74
66.13	12	63
59.71	13	59

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Example 1:

Find out if the back fat thickness (BF) and the muscle thickness (MD) correlate with the lean meat content and therefore whether it is possible to use these measured values for the prediction of the lean meat content.

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We can solve the problem using **multivariate correlation and regression analysis**

Dependent variable (y):

- Lean meat content (LMP)

Independent variables (x_1, x_2):

- Back fat thickness (BF)
- Muscle thickness (MD)

1) Assessment of a relation between variables **correlation coefficient (r)** /coefficient of determination (r^2)

2) Constructing of regression equation with one dependent and two independent variables

$$\boldsymbol{y = a + b_1 x_1 + b_2 x_2}$$

where y – dependent variable; x_1 a x_2 – independent variables;
a – intercept; b_1 and b_2 – regression coefficients

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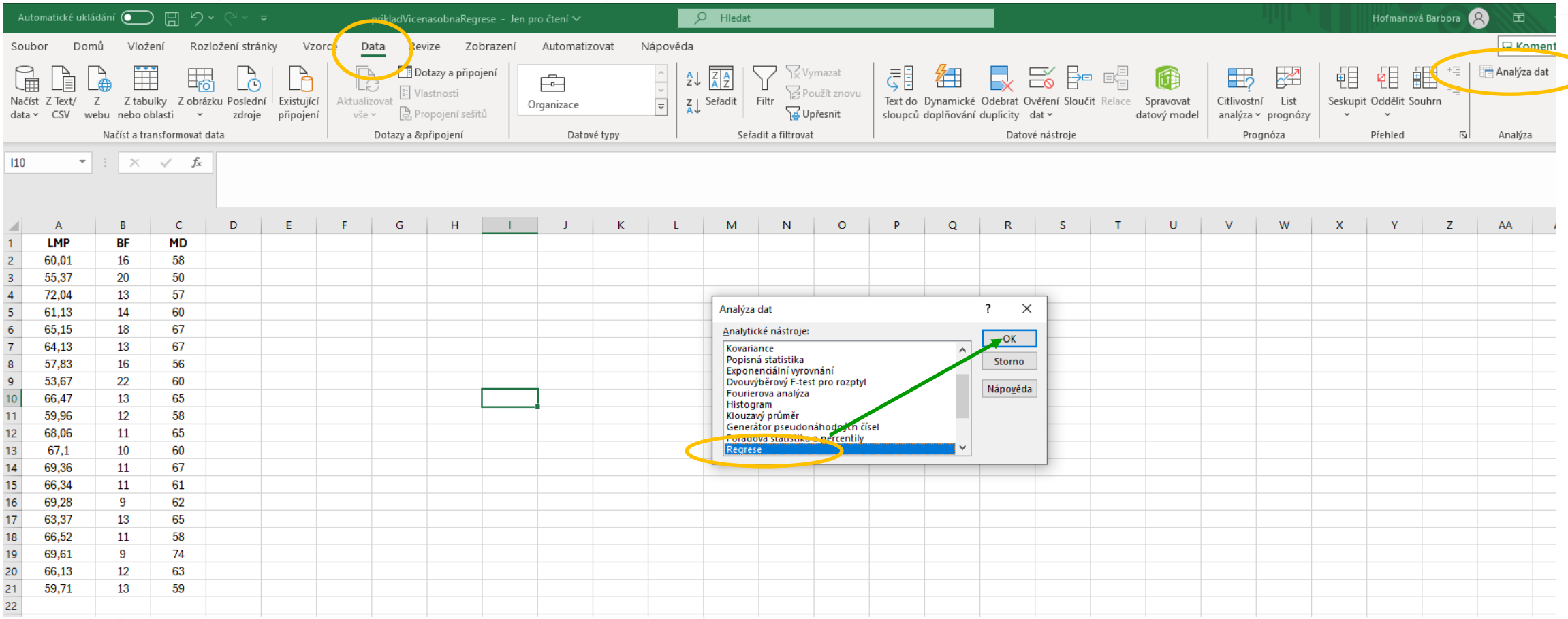
We can use, for example, MS Excel.



	A	B	C
1	**LMP**	**BF**	**MD**
2	60,01	16	58
3	55,37	20	50
4	72,04	13	57
5	61,13	14	60
6	65,15	18	67
7	64,13	13	67
8	57,83	16	56
9	53,67	22	60
10	66,47	13	65
11	59,96	12	58
12	68,06	11	65
13	67,1	10	60
14	69,36	11	67
15	66,34	11	61
16	69,28	9	62
17	63,37	13	65
18	66,52	11	58
19	69,61	9	74
20	66,13	12	63
21	59,71	13	59
22			

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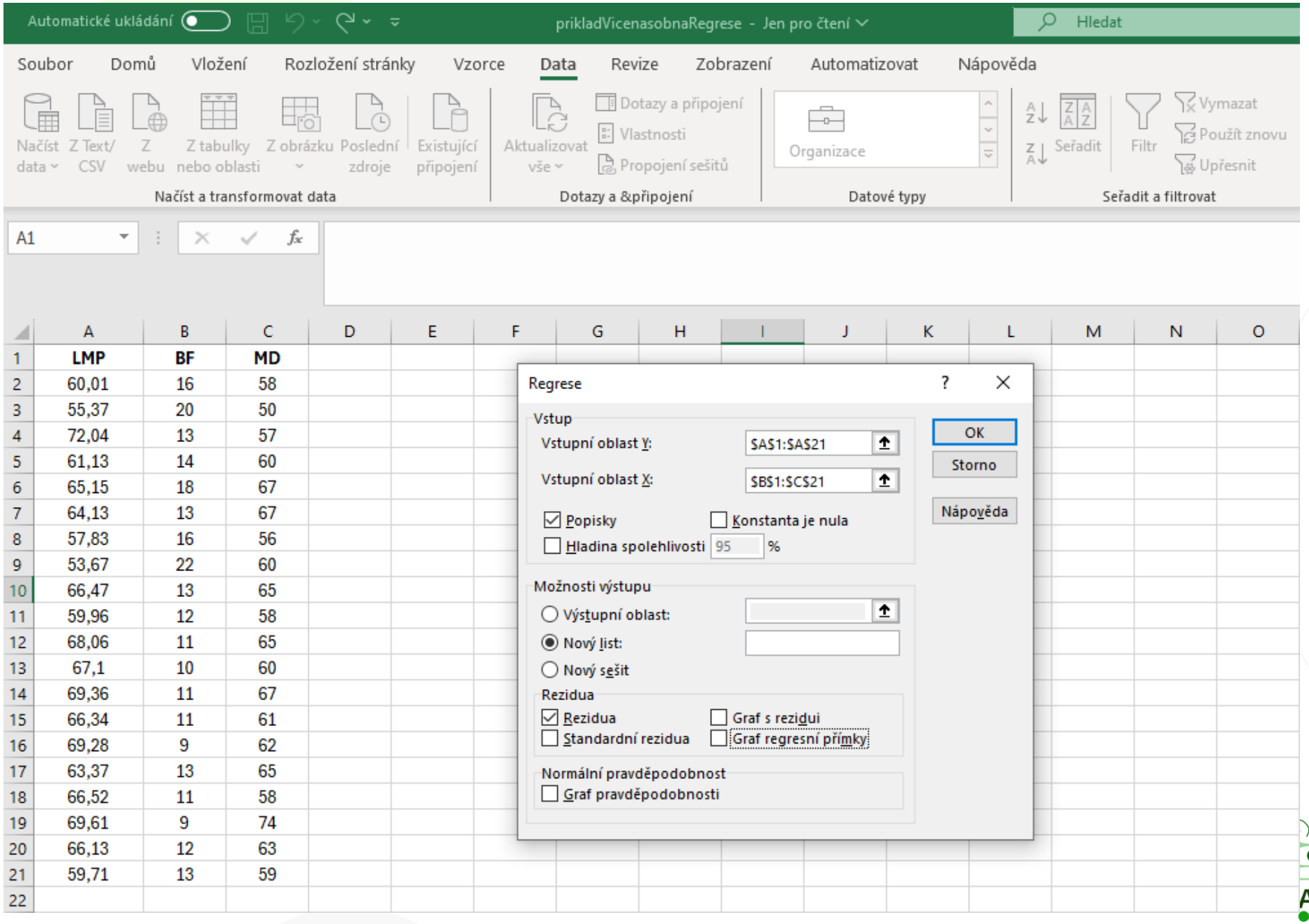

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22			

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Results

Regression Statistics	
Multiple R	0.816245
R Square	0.666257
Adjusted R Square	0.626993
Standard Error	3.073185
Observations	20

Correlation coefficient

Coefficient of determination

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	320.52	160.26	16.96868	8.89215E-05
Residual	17	160.5559	9.444463		
Total	19	481.0759			

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Regression

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	61.92299	10.92	5.67	0.00	38.89	84.96	38.89	84.96
BF	-0.97097	0.23	-4.31	0.00	-1.45	-0.50	-1.45	-0.50
MD	0.24515	0.15	1.63	0.12	-0.07	0.56	-0.07	0.56

$$y = a + b_1 x_1 + b_2 x_2$$

$$y = 61.92299 - 0.97097 x_1 + 0.24515 x_2$$

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Results

- Dependent variable estimation

$$y = 61.92 - 0.97x_1 + 0.25x_2$$

$$y = 61.92299 - 0.97097 * 16 + 0.24515 * 58$$

$$y = 60.60638$$

LMP	BF	MD	Estimated LMP
60.01	16	58	60.60638
55.37	20	50	.
72.04	13	57	.
61.13	14	60	.
65.15	18	67	
64.13	13	67	
57.83	16	56	
53.67	22	60	
66.47	13	65	
59.96	12	58	
68.06	11	65	
67.10	10	60	
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63.37	13	65	
66.52	11	58	
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66.13	12	63	
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Results

- Comparison of exact and estimated values of lean meat content (LMP)

exact LMP	estimated LMP	residuum
60.01	60.60638	-0.59638
55.37	54.76128	0.60872
72.04	63.27413	8.765866
61.13	63.03863	-1.90863
65.15	60.87082	4.279176
64.13	65.72567	-1.59567
57.83	60.11607	-2.28607
53.67	55.27088	-1.60088
66.47	65.23536	1.23464
59.96	64.49026	-4.53026
68.06	67.1773	0.882702
67.1	66.9225	0.1775
69.36	67.6676	1.692396
66.34	66.19668	0.143316
69.28	68.38377	0.896225
63.37	65.23536	-1.86536
66.52	65.46122	1.058776
69.61	71.32561	-1.71561
66.13	65.71602	0.413978
59.71	63.76444	-4.05444

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Example 2:

Based on previous calculations estimate lean meat content in the carcass with these measured values:

- Back fat thickness(BF) = 15 mm
- Muscle thickness (MD) = 62 mm

We find out the lean meat content by substituting these values into the regression equation

$$y = 61.92 - 0.97x_1 + 0.25x_2$$

$$y = 61.92 - 0.97 * 15 + 0.25 * 62$$

$$\boldsymbol{y = 62.87\ \%}$$

A lean meat content of aproximattely 63 % can be expected on this carcass.

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Conclusion

- The multivariate regression analysis was used to predict lean meat content.
- Back fat thickness and muscle thickness were considered as independent variables.
- The assembled regression model with two independent variables allowed a very accurate estimation of lean meat content.

  Correlation coefficient r = 0.82

  Coefficient of determination r^2 = 0.67 = 67 %

- However, since this is a statistical analysis, verifying the results on a more significant number of observations would be necessary.

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Thank you for your attention!

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Picture sources

https://www.frontmatec.com

https://www.jarvisitalia.it/en/prodotto/hennessy-probing-system

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