

This document was prepared by Hasan Basri ÖKSÜZ and Sencer BUZRUL for describing the use of ÖK-BUZ GRoFiT (Öksüz-Buzrul microbial growth modeling tool) application.

*IF YOU USE ÖK-BUZ GROFIT TOOL IN YOUR RESEARCHES, STUDIES, PROJECTS ETC., PLEASE CITE THE FOLLOWING ARTICLE (IN TURKISH WITH AN ENGLISH ABSTRACT):* “Öksüz, H.B, Buzrul, S. (2021). An Excel-based, User-friendly Freeware Tool to Describe Microbial Growth Curves: ÖK-BUZ GRoFiT. Journal of Tekirdağ Agricultural Faculty, 18(3): 521-532. DOI: 10.33462/jotaf.853435”

**IMPORTANT REMARK:** “Solver” Add-In should be installed in Excel in order to use ÖK-BUZ GRoFiT. Please click File > Options > Add-Ins > Excel Add-Ins “Go” > Select Solver and Click OK. Solver will be available under “Data” in Excel. You can also refer related websites showing how to install Solver in Excel.

ÖK-BUZ GRoFiT v2.0 is both available in Turkish and English. On the other hand, ÖK-BUZ GRoFiT v1.0 is only available in Turkish. The difference between two versions is the calculation of standard errors of the model parameters: v1.0 uses Monte Carlo analysis (100 simulations are done and it takes 10 to 40 seconds for this calculation), v2.0 uses variance-covariance matrix and calculations are almost instantaneous.

Below the use of ÖK-BUZ GRoFiT v2.0 is simply shown.

1. Download the application.
2. Open the file.
3. Sample dataset will appear (Fig. 1). You may also enter your own data.

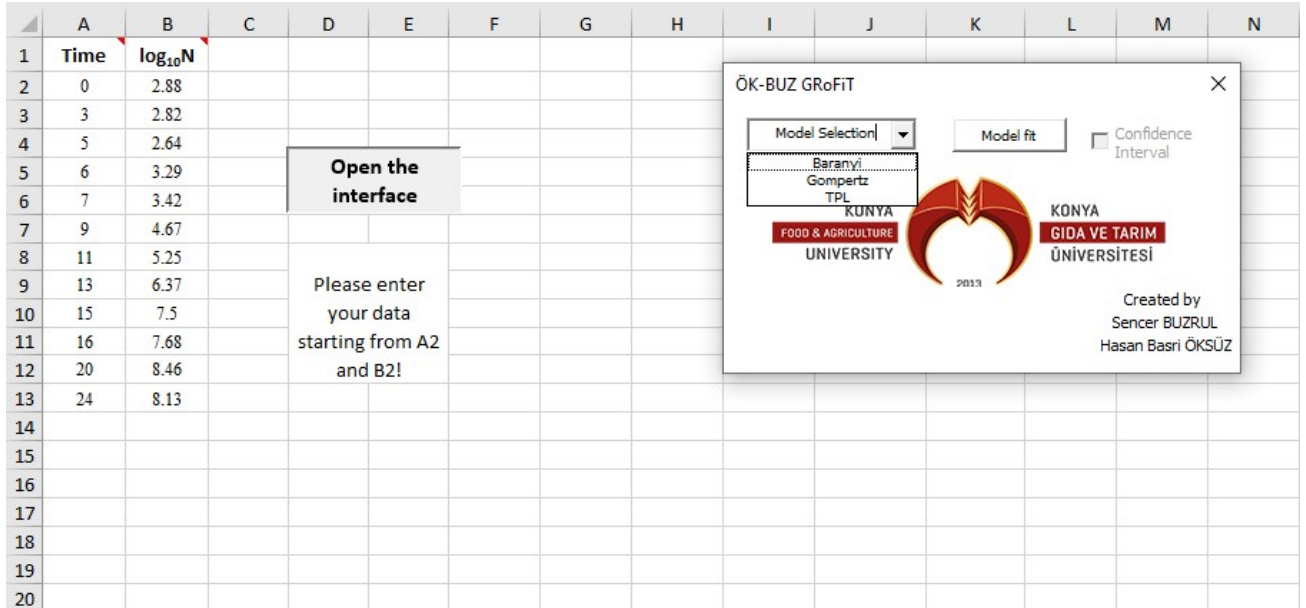
	A	B	C	D	E	F
1	Time	log <sub>10</sub> N				
2	0	2.88				
3	3	2.82				
4	5	2.64				
5	6	3.29				
6	7	3.42				
7	9	4.67				
8	11	5.25				
9	13	6.37				
10	15	7.5				
11	16	7.68				
12	20	8.46				
13	24	8.13				
14						
15						
16						
17						
18						
19						
20						

Open the interface

Please enter your data starting from A2 and B2!

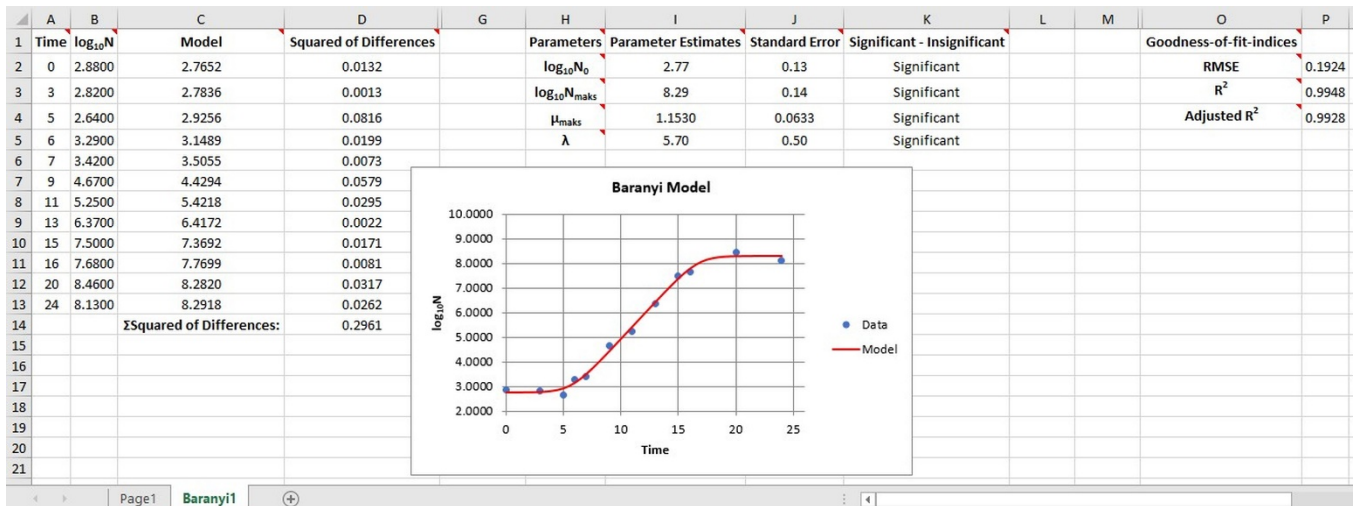
**Fig 1.** Splash screen of ÖK-BUZ GRoFiT v2.0

4. Click “Open the interface”.
5. Select a model (Fig. 2).



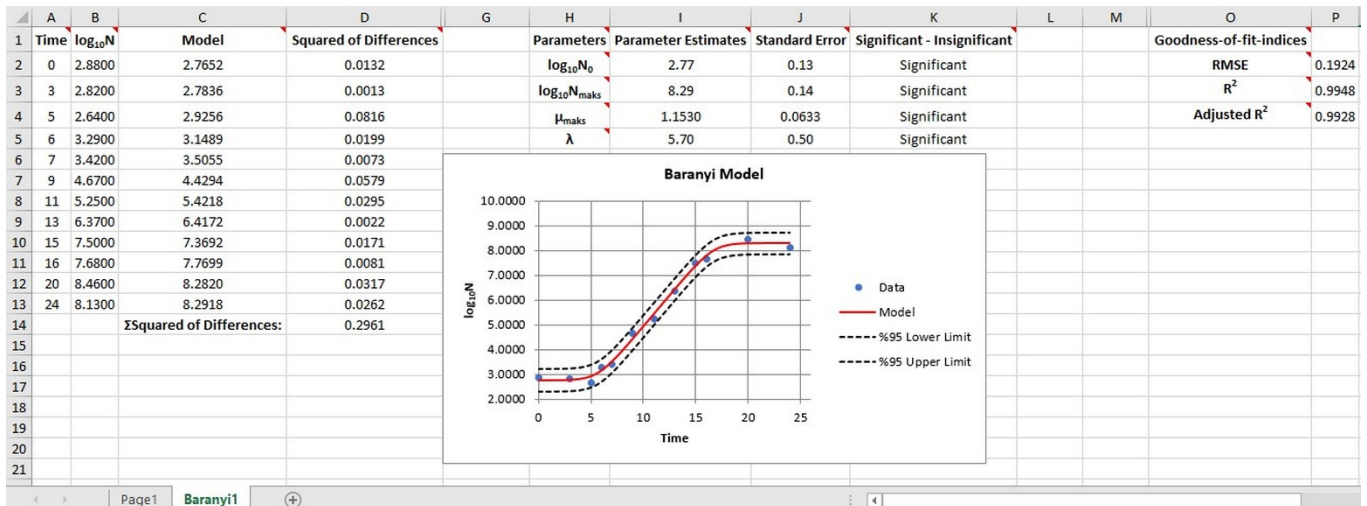
**Fig 2.** Microbial growth models in the interface of ÖK-BUZ GRoFiT v2.0

6. Click “Model fit”.
7. Results appear as in Fig. 3. Parameter estimates, standard errors of the parameters and goodness-of-fit indices ( $R^2$ ,  $R^2_{adj}$ , RMSE) are given. Besides, if parameters are statistically significant ( $p \leq 0.05$ ) they are marked as “significant” if not ( $p > 0.05$ ) marked as “insignificant”. Model’s fit and experimental data are shown in a graph. Each model’s results will be shown in a separate workbook.



**Fig. 3.** Results of the selected model for ÖK-BUZ GRoFiT v2.0

8. If the user wants to see the model's fit 95% confidence intervals on the same graph, he/she should click on the box "Confidence Interval" before closing the interface. Then approximate confidence intervals will appear on the graph together with the model fit (Fig. 4).



**Fig 4.** Confidence intervals of the model fit

## References

- Baranyi, J., Roberts, T.A. (1994). A dynamic approach to predicting bacterial growth in food. *International Journal of Food Microbiology*, 23: 277-294.
- Buchanan, R.L., Whiting, R.C., Damert, W.C. (1997). When is simple good enough: a comparison of the Gompertz, Baranyi, and three-phase linear models for fitting bacterial growth curves. *Food Microbiology*, 14: 313-326.
- Öksüz, H.B, Buzrul, S. (2021). An Excel-based, User-friendly Freeware Tool to Describe Microbial Growth Curves: ÖK-BUZ GRoFiT. *Journal of Tekirdağ Agricultural Faculty*, 18(3): 521-532
- Zwietering, M.H., Jongenburger, I., Rombouts, F.M., Van't Riet, K. (1990). Modelling of the bacterial growth curve. *Applied and Environmental Microbiology*, 56: 1875–1881.