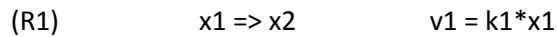# Dugga 2016-02-16, TBMT19 and TBMT37

Write Dugga-id on all pages. If you are doing this as an omdugga from previous years, Dugga 1 corresponds to questions 1-3, Dugga 2, to questions 3-5. If you take the course 2016, do all questions.

1) Consider the following model, in reaction form

       (R1)   x1 => x2   v1 = k1*x1

       (R2)   x2 =>   v2 = Vmax*x2/(Km + x2)

       (x1(0) , x2(0)) = (2 , 3)
       k1 = 1
       yhat = ky*x2
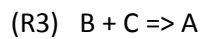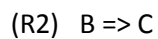   ky = 1
       Vmax = 2
       Km = 1

   a) What are the states?
   b) What are the parameters?
   c) What can be measured? (describe it in words)

2) Consider the following set of reactions:

       (R1) A => B

       (R2) B => C

       (R3) B + C => A

   a) What are the differential equations? Assume mass action kinetics for R1 and R3, and Michaelis-Menten kinetics for R2. Don't forget to specify the initial conditions. Specify some values for any parameters you might introduce.
   b) Add a measurement equation saying that you can measure something that is proportional to the sum of A and B.

3) Fitting the model to data
   a) What is the input and output of a cost function?
   b) What are the residuals, and how do they relate to the cost function?
   c) What is the principle behind numerical simulations of ordinary differential equations?

4) Statistical tests
   a) Name one benefit of using independent validation data
   b) What is the null hypothesis of a whiteness test?
   c) What happens if you do not reject a chi-square test?

5) Closing the loop
   a) A core prediction has been tested experimentally, and the experiment shows that a value outside the predicted interval has been obtained. What can we then conclude? How would that be different if the prediction was not known to be a core prediction?
   b) You have two models that are acceptable given the current data. How can you use predictions to design an experiment that ensures that a new experiment will be able to distinguish between the models?
   c) Is it better to have a well-determined or an undetermined prediction when trying to convince a biologist to collect experimental measurements of that prediction? Motivate your answer.

Good luck!

Gunnar