

Math 518 HW 2. Due Feb 7.

- 1) Wan, p. 21 problem 2. Part a was outlined in class on 1-27. Find the solution as outlined in class using linear least squares.
- 2) Assume that the world population is parabolic: $P(t) = a_0 + a_1t + a_2t^2$. Use least squares (as described on 2-11) to find the parameters a_k that best fit the data from table 2.3 starting at 1959.
- 3) Find the world population now and compare predictions from 1) the nonlinear least squares approach in (2.3.9), 2) the least squares of logarithm of population in problem 1 above, and the prediction of problem 2. How do they compare for 1927 data?
- 4) Wan, Problem 6, p. 48.

Project problems:

- P1) Use world population data from 1970, 80, 90, 2000 and apply nonlinear least squares data fit to the model $P(t) = P_0 e^{a_0 t}$. Describe how results compare to Wan's example.
- P2) Use a difference quotient to estimate the dP/dt (where P is population) based on data from Table 2.3 in Wan. (Assume the year that exact rate happens is in the middle of the years used in the difference quotient.) Then use least squares to find the best form of $f(P) = aP - bP^2$ used in $dP/dt = f(P)$. Then solve the DE and see how population predicted by this model compares with the other approaches in problem 3.
- P3) For the glucose injection model described in Wan, $dG/dt = -a_0 G + c(t)$, $G(0) = G_0$, assume that an injection of c_0 grams occurs once at the start of each time interval (say each day). Thus if e.g., $t \in [4, 5]$, $c(t)$ is the sum $c_0(\delta(t) + \delta(t-1) + \dots + \delta(t-4))$. First find expressions for $G(t)$ at time t , and also at integer times M . How does $G(M)$ compare to $\lim_{t \rightarrow (M+1)^-} G(t)$? Next find the limiting expression for $G(t)$ for $t \in [M, M+1)$ as $M \rightarrow \infty$. Based on this limiting expression, if the desired glucose level is g , what is best choice for c_0 ? Graph the solution over the first few time intervals and compare G to the limiting expressions. Discuss how the best choice of c_0 might be affected.