MATH 495: Mathematics of Cancer
Quiz 3

NAME: ——————————————————— Date: April 4, 2019

Answer the following question on this sheet of paper. No calculators or other electronic devices are permitted.

Consider a tumor that is **growing exponentially**. Answer the following questions related to growth and treatment of such a tumor.

(a) In the absence of treatment, suppose that is takes $\tau = 2\ln 2$ days for the tumor mass to double in size. Find the growth rate λ of the population.

(b) Now assume that treatment is applied to the **same tumor**. We experimentally observe **log-kill** dynamics in response to therapy. If the treatment is represented with efficacy $u(t)$ at time t (i.e. its per-capita induced-death rate), write down a differential equation describing the dynamics of the tumor population during treatment.

(c) Similarly to (b), write down a differential equation describing tumor growth **post-treatment**. How would you connect the dynamics of pre- and post-treatment? That is, how do the ODEs from (b) and (c) related to one another?

(d) Suppose we apply the following treatment strategy:

$$u(t) = \begin{cases} 1, & \text{for} \quad 0 \le t \le 2 \\ 0, & \text{for} \quad t > 2, \end{cases}$$

where t is measured in days. If (in some units, say 10^7 cells) the initial tumor had size $N_0 = 10$, find its size **four days after treatment has ended**.