Problem Set 4 **Calculus 2** **Due 3/21/18**

Pick one of the following sets of problems (α, β, or γ) and do 1-4. You are encouraged to work in groups of two to four on this assignment and make a single group submission. Each problem is worth 5 points. For full credit indicate clearly how you reached your answer.

α

1. Chester Bliss did pioneering work in probability during the 1920s and 30s dealing with agricultural research including efficacy of pesticides. He investigated the dose of a pesticide required to kill a given percentage of a treated insect population, and designated the dose required to kill, say, 80% of the treated insects as LD-80. Suppose that the probability that a dose of x mg of pesticide kills a given member of an insect population is given by $p(x) = 0.0001xe^{-0.01x}$ for positive values of x. What percentage of the population is killed by a dose of 100mg?
2. What is LD-80 for the distribution from problem 1?
3. What is LD-90 for the distribution from problem 1? What is LD-99? Is there a point?
4. Compute $\bar{x}$ for the distribution from problem 1. What does it mean?

β

1. Compute the total value of an income stream that begins at \$20,000/year and increases exponentially by 3%/year over a 15-year period.
2. Compute the total value of 20 payments, beginning at \$3000 and each increasing 3% over the previous.
3. Compute the future value (assuming 5% continuous interest) of an income stream of \$50,000/year over 20 years.
4. In class we used the fact that $\lim_{n\to\infty}(1 + \frac{r}{n})^{nt} = e^{rt}$. Show why this is true.

γ

The gamma function is defined by

$$\Gamma(x) = \int_0^\infty t^{x-1}e^{-t}\,dt$$

1. Find $\Gamma(1), \Gamma(2), \Gamma(3)$, and $\Gamma(4)$.
2. Show that $\Gamma(x + 1) = x\Gamma(x)$.
3. Show that $\Gamma(\frac{1}{2}) = \sqrt{\pi}$.
4. Find $\Gamma(\frac{3}{2})$.