MATH 314: Applied Probability and Statistics

Project 4: Due April 10th, 2020

1. For each of the following functions, write Python code to determine if it possible for the function to be the probability density function for a continuous random variable (remember, this means that the area under the curve equals 1). **For full points, make sure you include the Python function you wrote as well as your conclusion on whether or not we have a probability density function for a continuous random variable.**

   (a) $f(t) = \begin{cases} 10e^{-10t} & t > 0, \\ 0 & t \leq 0. \end{cases}$

   (b) $f(t) = \begin{cases} 10e^{-0.1t} & t > 0, \\ 0 & t \leq 0. \end{cases}$

   (c) $f(t) = \begin{cases} 0.3e^{-0.3t} & t > 0, \\ 0 & t \leq 0. \end{cases}$

   (d) $f(x) = \begin{cases} \frac{1}{5} & 0 \leq x < 5, \\ 0 & \text{otherwise.} \end{cases}$

   (e) $f(x) = \begin{cases} x & 0 \leq x < \sqrt{2}, \\ 0 & \text{otherwise.} \end{cases}$

2. Based on the previous problem, what can you say about functions of the form

$$f(t) = \begin{cases} ae^{-at} & t > 0, \\ 0 & t \leq 0. \end{cases}$$

   for some $a \in \mathbb{R}$?

3. For the functions (c), (d), and (e) from Problem 1, do the following:

   (a) Graph the function.

   (b) Shade the area under the curve between 0.5 and 1.25.

   (c) Use Python to find the area under the curve between 0.5 and 1.25

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4. For the standard normal curve ($\mu = 0, \sigma = 1$), do the following:

   (a) Graph the curve

   (b) Shade the area under the curve between $z = -1.5$ and $z = 2.25$.

   (c) Use Python to find the area under the curve between $z = -1.5$ and $z = 2.25$.

5. In a recent study, the Centers for Disease Control and Prevention reported that diastolic blood pressures of adult women in the United States are approximately normally distributed with mean 80.5 and standard deviation 9.9.

   (a) Graph this normal distribution.

   (b) What proportion of women have blood pressures lower than 70? Provide the Python code you used to determine this information, and provide a picture of a properly shaded graph depicting this area.

   (c) A diastolic blood pressure greater than 90 is classified as hypertension (high blood pres- sure). What proportion of women have hypertension? Provide the Python code you used to determine this information, and provide a picture of a properly shaded graph depicting this area.