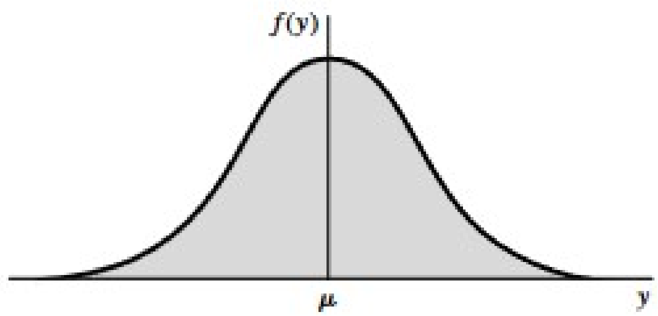
Piece 4

Normal, Beta, and Gamma Distributions Report

The first section in chapter 4 that is covered would be section 4.5. These sections go over the normal, beta, and gamma distributions. Prior to this chapter, I was not the best at double integrals. However, after I read about this chapter, I was able to understand more regarding integration as well as the several distributions. This section goes over the Normal Probability Distribution. This most widely used continuous probability distribution has a bell-shaped curve or an upside-down parabola. The normal probability distribution is a random variable Y and is said to have to a *normal probability distribution* if and only if, a > 0 and -∞, the density function of Y is:

$$f(y) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(y-\mu)^2/(2\sigma^2)}, \qquad -\infty < y < \infty.$$



Normal Distribution is one of the most used distributions within the entire textbook. On the top of the curve is where the mean, the median, and the mode are located. Since we are looking at the normal probability distribution, all three of them are in the same spot. To find the normal distribution, you would need to solve the areas under the function using integration. For the areas that are under the distribution that correspond to P(a <= Y <=b) would require the evaluation for the following integral:

$$\int_a^b \frac{1}{\sigma\sqrt{2\pi}} e^{-(y-\mu)^2/(2\sigma^2)}\, dy.$$

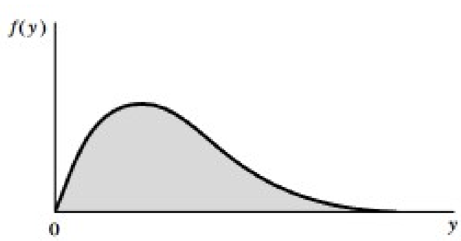
The next distribution is the Gamma Distribution which is when random variables are always nonnegative. Therefore, the yield distributions of the data are skewed to the right so most of the density of the function would be near the origin on the graph. The Gamma Probability Distribution and the Normal Probability Distribution are very different due to the graphs. The Gamma Distribution contains two parameters. The first parameter is the alpha parameter which can also be named the scale parameter.

A random variable Y is said to have a *gamma distribution with parameters* $\alpha > 0$ and $\beta > 0$ if and only if the density function of Y is

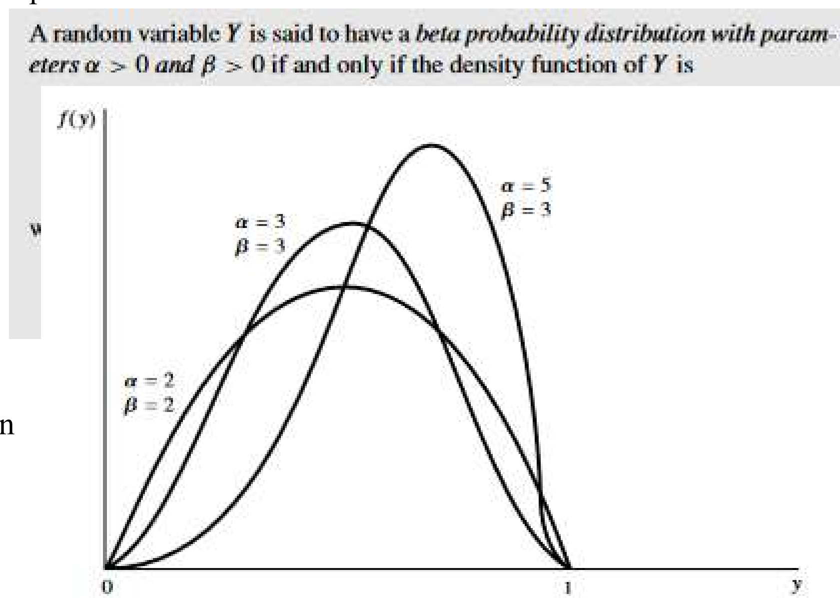
$$f(y) = \begin{cases} \dfrac{y^{\alpha-1}e^{-y/\beta}}{\beta^{\alpha}\Gamma(\alpha)}, & 0 \le y < \infty, \\ 0, & \text{elsewhere,} \end{cases}$$

where

$$\Gamma(\alpha) = \int_0^{\infty} y^{\alpha-1}e^{-y}\, dy.$$



The last distribution in the chapter in the Beta Probability Distribution. This distribution is a density function that has two parameters over the closed interval of zero and one. Beta Probability Distribution unlike the Gamma Probability Distribution and the Normal Probability Distribution, has different shapes of how the Beta Probability Distribution graph looks due to the two parameters. The highest point of the graph could be like the Gamma Probability Distribution where it is in the middle of the distribution, or it could be like the Normal Probability Distribution. The apex can also be all the way to the right unlike any of the other distributions that we have gone through. Similarly, to the Gamma Probability Distribution, the names of the parameters are also alpha and beta.



Overall, I found that double integrals are difficult to do and figure out the correct bounds for. At times I found that double integrals would make me sit there and ponder about what the bounds could be if it wasn't obvious in the question. However, chapter 4 allowed me to practice my integrals a lot more and I feel pretty confident with solving them. This is one of the five chapters that we covered that I struggled with the most in my opinion. I tried my hardest to understand that proofs and the solutions to the examples in the class however, I would sometimes get lost and not understand why we would get a certain bound in the integrals.