

These questions were covered in details during the discussion sections.
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1. Suppose that a point  $(X, Y, Z)$  is to be chosen at random in three-dimensional space, where  $X$ ,  $Y$ , and  $Z$  are independent random variables and each has the standard normal distribution. What is the probability that the distance from the origin to the point will be less than 1 unit?
2. Chocolate chip cookies are made from batter and chocolate chips. Assume that the amount of chocolate chips per centimeter cube follows a normal distribution with mean 0.6 and variance 0.025. The goal is to then to split the chocolate chips as evenly through the box of 25 cookies. Find the probability that the average sum of squared differences between the amount of chocolate chips in each cookie and the mean is less than 0.03.
3. Assume that  $X_1, \dots, X_n$  form a random sample from the normal distribution with mean  $\mu$  and variance  $\sigma^2$ . Show that the sample variance  $\hat{\sigma}^2$  has the gamma distribution with parameters  $(n - 1)/2$  and  $n/(2\sigma^2)$ .
4. Suppose that  $X$  has a  $\chi^2$  distribution with 200 degrees of freedom. Explain why the central limit theorem can be used to determine the approximate value of  $Pr(160 < X < 240)$  and find this approximate value.