For this exam, please do all of your work on the bottom of the page or on the back side. To pass, you must exhibit mastery of the concepts examined. You may use a calculator and the provided normal table. **Please return the normal table with your exam and please do not write on it so we may use them again.** You may also use the fact that the binomial probability formula is

$$\Pr\{Y = j\} = {}_nC_j p^j (1-p)^{n-j} \qquad \text{for } j = 0, 1, 2, \ldots, n, \text{ where } {}_nC_j = \frac{n!}{j!(n-j)!}.$$

In a population of women with family histories of breast cancer, 16% have the *BRCA1* gene, a gene linked to breast cancer. The weights of the women in this population are normally distributed with a mean of 143 pounds and a standard deviation of 22 pounds.

(a) In a random sample of eight women from the population, what is the probability that exactly two have the *BRCA1* gene?

Solution: $28(0.16)^2(0.84)^6 = 0.2518$

(b) In a random sample of eight women from the population, what is the probability that two or more have the *BRCA1* gene?

Solution: $1 - (0.16)^0(0.84)^8 - 8(0.16)^1(0.84)^7 = 0.3744.$

(c) In a random sample of eight women from the population, what is the probability that their mean weight is greater than 150 pounds?

Solution: $\Pr\{\bar{Y} > 150\} = \Pr\{Z > 0.9\} = 0.1841.$

(d) What proportion of the population of women weigh more than 150 pounds?

Solution: $\Pr\{Y > 150\} = \Pr\{Z > 0.32\} = 0.3745.$

(e) What is the 20th percentile of the weight distribution of this population of women?

Solution: $143 - 0.84(22) = 124.5.$