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I pledge my honor that I have abided by the Stevens Honor System - Kush, Jo-Anne, Simerjeet

Problem 1.

a. The population random variable is represented by m, which contains both defective and qualified goods.
b. The population probability distribution in this case would determine the frequency at which defective goods are drawn (r) vs qualified ones (m-r) being drawn from (m) goods at (n) random times. Since we are performing a quality inspection, we are trying to find all the defective products (r).

c. Assuming 0 for every defect and 1 for every qualified

For the Mean: $T_1(X_1, \ldots X_2)$ $\quad \bar{x} = \frac{1}{m}\sum_{i=1}^{m} x_i \ = \ E[X] \quad -> \ E[X] \ = \ (\frac{m-r}{m})$

For the Variance Using the idea that $\sum_{i=1}^{n}(x_i - \bar{x})^2 \ = \ \sum_{i=1}^{n} x_i^2 - n\bar{x}^2$ we can simplify

$$T_1(X_1, \ldots X_2) \quad S^2 = \frac{1}{m-1}\sum_{i=1}^{m}(x_i - \bar{x})^2 = \ Var[x] \ -> \ Var[X] \ = \frac{1}{m-1}\sum_{i=1}^{n} x_i^2 - \frac{(m-r)^2}{m}$$

Problem 2.

a. Yes, the sample observation is a simple and random sample as each element in the sample is randomly selected and are mutually independent of each other.

b. $T(N_1, \ldots, N_r)$ This would be Binary Distribution, specifically a binomial distribution. We

know this because there are only 2 possible options, either the item is a defect or it is not, and we also know that each good is independent.

This is a binomial distribution hence $P(N = N_1) = \binom{m}{N_1} (\frac{r}{m})^{N_1} * (1 - \frac{r}{m})^{m-N_1}$

c. For the Mean: $E[X] \ = \ E[n_1] \ = n_1 * (\frac{r}{m})$

For the Variance: $Var[X] \ = \ Var[n_1] \ = n_1(\frac{r}{m})(1 - (\frac{r}{m}))$

Problem 3.

a. No, the sample is not a simple and random sample since the selection of each element in the sample depends on the other selections since it occurs without replacement.
b. $T(N_1, \ldots, N_r)$ This would be a normal distribution or hypergeometric distribution; we know

this because all the variables depend on one another, as they are drawn without replacement.

$\mu = n(\frac{m-r}{m})$

$\sigma = \frac{1}{m-1}\sum_{i=1}^{n} x_i^2 - \frac{(m-r)^2}{m}$

Normal distribution $f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{(\frac{-x-\mu}{2\sigma^2})}$

c. For the Mean: $E[N_2] = N_2 * (\frac{m-r}{m})$