Instructions: Show all work. You may use your calculator rather than compute formulas by hand, but if you do, 'show work' by saying which program you used to obtain the result and what information you entered. Round measures of center to one decimal place more than the data, and variance/standard deviation to two decimal places more than the original data. Round probabilities to three decimal places (or percent plus one decimal place).

1. Define what is meant by the term 'unbiased estimator'.

The expectation $E(\hat{\theta})$ is equal to $E(\theta)$.
if it is not equal, then the predictor is said to be biased.

2. What is the general formula for the standard error for $\bar{X}$? [Hint: Not for a specific distribution, just in general.]

$$\frac{\sigma}{\sqrt{n}} \quad \text{for most situations}$$

3. Suppose that during a manufacturing process a certain proportion of the products are flawed and have to be rejected by quality control. To determine how serious the problem is, the company tests 50 samples coming off the line and finds that 5 of them have to be rejected. Use this information, and the fact that this is a Bernoulli random variable to find the maximum likelihood function for the process, and use that to calculate the most likely proportion of all parts that are flawed during manufacture.

$$f(p) = p^5 (1-p)^{45}$$

$$5p^4 (1-p)^{45} + p^5 \cdot 45 (1-p)^{44} (-1) = 0$$

$$5p^4 (1-p)^{44} [1-p + 9p(-1)] = 0$$

$$1 - 10p = 0 \implies 10p = 1 \implies \hat{p} = \frac{1}{10}$$