1. Explain the difference between population parameters and sample statistics. What symbols do we use for the mean and standard deviation for each of these?

Parameters are fixed values that are determined by the population. $(\mu, \sigma)$
Statistics are calculated from the sample and can change when different samples are taken (X-bar, s)

2. Consider the following probability distribution function of the random variable $X$ which represents the number of bedrooms in a neighborhood's homes:

<table>
<thead>
<tr>
<th>$X$</th>
<th>$P(X)$</th>
<th>$xp(x)$</th>
<th>$(x-\mu)$</th>
<th>$(x-\mu)^2$</th>
<th>$(x-\mu)^2p(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.05</td>
<td>0.0</td>
<td>-2.8</td>
<td>7.84</td>
<td>0.392</td>
</tr>
<tr>
<td>1</td>
<td>0.1</td>
<td>0.1</td>
<td>-1.8</td>
<td>3.24</td>
<td>0.324</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0.4</td>
<td>-0.8</td>
<td>0.64</td>
<td>0.128</td>
</tr>
<tr>
<td>3</td>
<td>0.4</td>
<td>1.2</td>
<td>0.2</td>
<td>0.04</td>
<td>0.016</td>
</tr>
<tr>
<td>4</td>
<td>0.15</td>
<td>0.6</td>
<td>1.2</td>
<td>1.44</td>
<td>0.216</td>
</tr>
<tr>
<td>5</td>
<td>0.1</td>
<td>0.5</td>
<td>2.2</td>
<td>4.84</td>
<td>0.484</td>
</tr>
</tbody>
</table>

|     |        | 2.8     |           | 1.56        |                 |

a. Fill in the missing $P(X)$
   0.1

b. Find the population mean of $X$.
   $\mu = 2.8 \text{ bedrooms}$

c. Find the population variance and standard deviation of $X$.
   $\sigma^2 = 1.56 \quad \sigma = 1.249$
3. 10% of all children at large urban elementary school district have been diagnosed with learning disabilities. 10 children are randomly and independently selected from this school district.

   a. Let $X$ = the number of children with learning disabilities in the sample. What type of random variable is this?
      Binomial $n=10, \ p=.10$

   b. Find the mean and standard deviation of $X$.
      $\mu = (10)(.1) = 1 \quad \sigma^2 = (10)(.1)(.9) = .9 \quad \sigma = \sqrt{.9} = .949$

   c. Find the probability that exactly 2 of these selected children have a learning disability.
      from table: $P(X=2) = .194$

   d. Find the probability that at least 1 of these children has a learning disability.
      from table: $P(X\geq 1) = 1 - P(X=0) = 1 - .349 = .651$

   e. Find the probability that less than 3 of these children have a learning disability.
      from table: $P(X<3) = .349 + .387 + .194 = .93$

4. A general statement is made that an error occurs in 10% of all retail transactions. We wish to evaluate the truthfulness of this figure for a particular retail store, say store A. Twenty transactions of this store are randomly obtained. Assuming that the 10% figure also applies to store A and let $X$ be the number of retail transactions with errors in the sample

   a. The probability distribution function (pdf) of $X$ is binomial. Identify the parameters $n$ and $p$.
      $n=20, \ p=.10$

   b. Calculate the expected value of $X$.
      $\mu = np = (20)(.1) = 2$

   c. Calculate the variance of $X$
      $\sigma^2 = npq = (20)(.1)(.9) = 1.8$

   d. Find the probability exactly 2 transactions sampled are in error.
      from table: $P(X=2) = .285$

   e. Find the probability at least 2 transactions sampled are in error.
      from table: $P(X\geq 2) = 1 - P(X\leq 1) = 1 - .122 - .270 = .608$

   f. Find the probability that no more than one transaction is in error.
      from table: $P(X\leq 1) = .122 + .270 = .392$

   g. Would it be unusual if 5 or more transactions were in error?
      from table: $P(X\geq 5) = .032 + .009 + .002 = .043 \ – \ somewhat \ unusual$
5. A newspaper finds a mean of 4 typographical errors per page. Assume the errors follow a Poisson distribution.

   a. Let \( X \) equal the number of errors on one page. Find the mean and standard deviation of this random variable.
      \( \mu = \text{rate} = 4 \quad \sigma = \sqrt{\text{rate}} = 2 \)

   b. Find the probability that exactly three errors are found on one page.
      \[
P(X=3) = \frac{(e^{-4})(4^3)}{3!} = .195
      \]

   c. Find the probability that no more than 2 errors are found on one page.
      \[
P(X\leq2) = \frac{(e^{-4})(4^0)}{0!} + \frac{(e^{-4})(4^1)}{1!} + \frac{(e^{-4})(4^2)}{2!} = .238
      \]

   d. Find the probability that no more than 2 errors are found on two pages.
      Use rate = \( \mu = 8 \), from formula:
      \[
P(X\leq2) = \frac{(e^{-8})(8^0)}{0!} + \frac{(e^{-8})(8^1)}{1!} + \frac{(e^{-8})(8^2)}{2!} = .0138
      \]

6. Major accidents at a regional refinery occur on the average once every five years. Assume the accidents follow a Poisson distribution.

   a. How many accidents would you expect over 10 years?
      \( \mu = \frac{10}{5} = 2 \)

   b. Find the probability of no accidents in the next 10 years.
      \[
P(X=0) = \frac{(e^{-2})(2^0)}{0!} = .135
      \]

   c. Find the probability of no accidents in the next 20 years.
      \( \mu = \frac{20}{5} = 4 \), from formula:
      \[
P(X=0) = \frac{(e^{-4})(4^0)}{0!} = .0183
      \]