Hurricanes

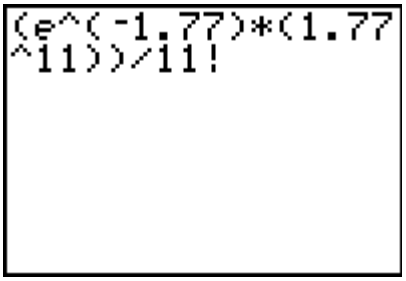
In 1995, 11 hurricanes formed in the Atlantic Ocean off the coast of the United States. Was the number of hurricanes outside the norm? That is, given the historical data (1.77 hurricanes per year), what is the probability of 11 hurricanes hitting the United States that year?

To determine this, a **Poisson distribution** can be used. The probability that an event occurs exactly x times is given by $P(m, x) = \frac{e^{-m}m^x}{x!}$, x=0,1,2,3...

For the hurricane example above, m = 1.77 and x =11

which results in: $P(1.77, 11) = \frac{e^{-1.77}(1.77)^{11}}{11!}$.

(The key entry is to the right.)

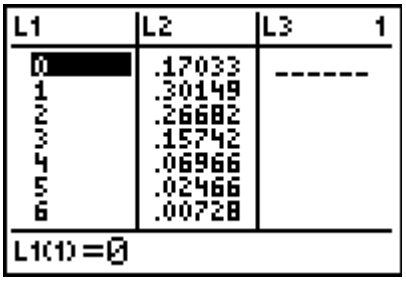


1. $P(1.77, 11)$ = _____

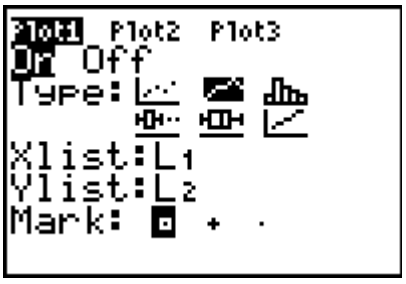
2. Using the formula, compute the probabilities of 0 to 10 hurricanes hitting the United states in one year. (To do this quickly, press 2nd [ENTRY] and change the values appropriately.)

3. Which numbers of hurricanes per year have the highest probability of occurring? Why is this answer reasonable?

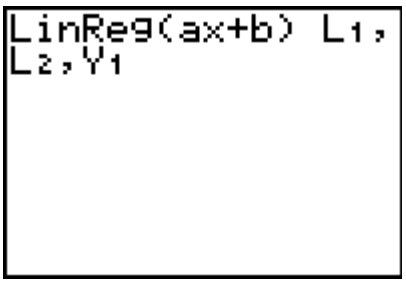
Sometimes it is easier to view a graph of the distribution in order to make judgments. To create a line graph of the calculated probability distribution, enter the data for 0 to 11 hurricanes into **L1** and **L2**.



To set-up the graph, press 2nd [STAT PLOT] and select **Plot1**. Adjust the settings as shown at the right. To display the graph, press ZOOM and select **ZoomStat**.



The points form a line, so this data is linear. Use the **LinReg** command to draw a line through these points. (Add **Y1** to the end of the command to store the equation of the line in **Y1**.)



Cumulative Probabilities

For any sample space, the sum of the probabilities of the outcomes is 1.
So, for a given value of *m*,

$$P(0) + P(1) + P(2) + \ldots = 1$$

From this, you can use the **complement** of an event to help you find a probability. For example, given *m*, to find the probability that an event will happen **more than 2 times** ($x > 2$), subtract the probability that the event will happen **2 or fewer times** ($x \leq 2$) from 1.

$P(x \leq 2) + \mathbf{P(x > 2)} = 1$
$\mathbf{P(x > 2)} = 1 - P(x \leq 2)$
$\mathbf{P(x > 2)} = 1 - P(0) - P(1) - P(2)$

4. **a.** What is the probability that 2 or fewer hurricanes will hit the United States in a year?

b. What is the probability that more than 2 hurricanes will hit the United States in a year?

c. How are the answers to part a and part b related?

Exercises:

In a Midwestern US city, there are 9 deaths per year involving car accidents with trains. Using the Poisson Distribution for rare, independent events find the probabilities.

1. Find the probability of 0 to 9 of these deaths in one year in the city.

2. Find the probability that there are 5 or fewer of these deaths occurring in one year in the city.

3. Find the probability that there are more than 5 of these deaths occurring in one year in the city.