A Look at Consecutive Days with Below Normal Average Temperatures

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Amarillo recently experienced 11 days in a row of daily average temperatures that were below normal. The question is, "How unusual is this streak?"

Using Amarillo's daily temperature data back to January 1, 1991, I looked at the occurrences of consecutive days with below normal daily averages. The winner is 24 consecutive days, which occurred from January 12, 2007 to February 4, 2007. We will probably not challenge that record any time soon.

The data (1991 through 2016) are summarized in the following table. The relative frequencies are the individual frequencies divided by the total of all the frequencies (1250).

Consecutive Days Below Normal	Frequency	Relative Frequency
1	399	0.3192
2	289	0.2312
3	191	0.1528
4	113	0.0904
5	81	0.0648
6	58	0.0464
7	47	0.0376
8	26	0.0208
9	17	0.0136
10	7	0.0056
11	3	0.0024
12	4	0.0032
13	5	0.0040
14	3	0.0024
15	3	0.0024
16	1	0.0008
17	0	0
18	1	0.0008
19	0	0
20	0	0
21	0	0
22	1	0.0008
23	0	0
24	1	0.0008

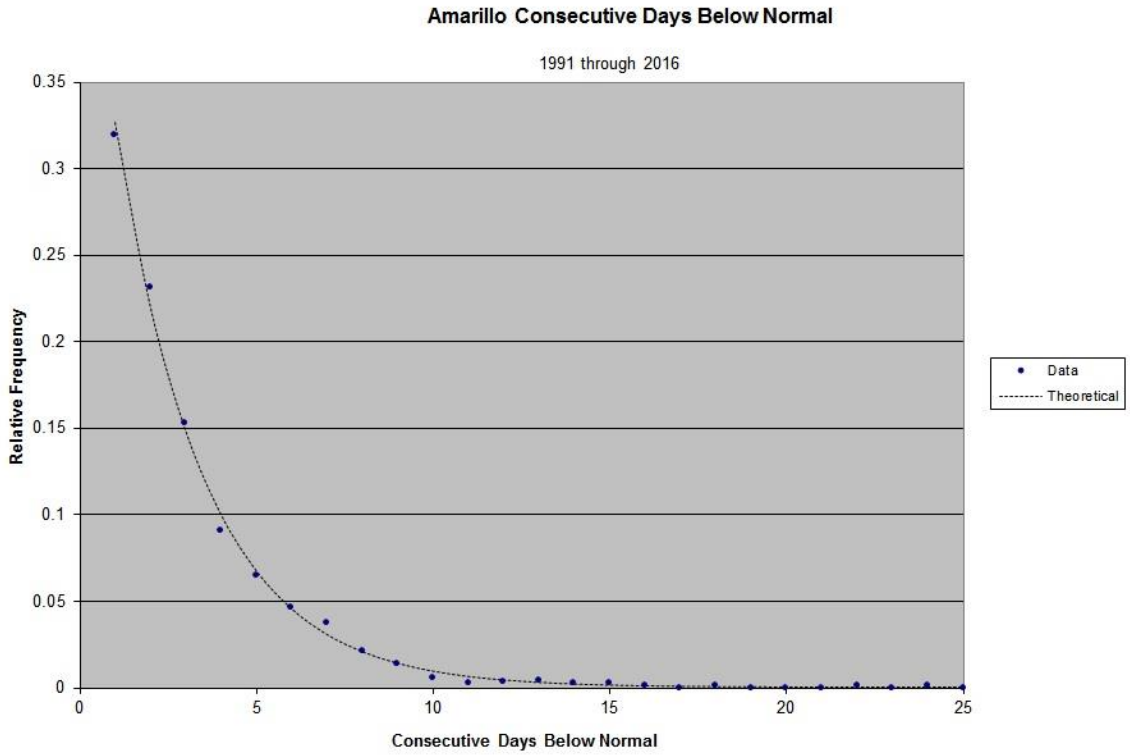
As seen in the table, a streak of 11 consecutive days is rather unusual, since it occurred only three times in 26 years.

Statistical theory suggests that data of this type should follow a geometric distribution. The probability density function is given by

$$p(n) = \left(1 - \frac{1}{\mu}\right)^{n-1} \left(\frac{1}{\mu}\right)$$

where *n* is the number of consecutive days with below normal average temperatures, and μ is the mean or average number of consecutive days below normal. The mean of this data set is 3.0624 days.

As seen in the following graph of relative frequency versus consecutive days, the theoretical curve is a good fit to the data.



As more data are gathered, the model will probably fit even better.

Note: I used Amarillo's climate normal data for the 30-year window from 1961 through 1990 as my standard. The current climate normal data have been updated twice since then, with the current window being 1981 through 2010. I wanted my analysis to be based on a fixed standard.