Traffic Deaths Down for the Third Straight Year…

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So read the headline in the newspaper. The story, put out by the Associated Press, using data provided by the Tennessee Department of Safety, concerned the traffic deaths in Tennessee. The article quoted the Department of Safety spokesman as saying, "We like to think that more active law enforcement has been a factor."

But is this really a banner event? Is it really newsworthy? While it is good to have fewer traffic fatalities, does the smaller number signify any real change in highway safety? And should the Department of Safety be congratulating themselves for this third straight decline in fatalities?

The way to answer these questions is to place the data on a process behavior chart, and the chart of choice for data like these will be the chart for individual values and a moving range, (the *XmR* Chart). We begin with the raw data, which consist of the counts of traffic deaths in Tennessee in each of the past 25 years. (This amount of data was chosen because it is the amount of data given in the article.) We then compute moving ranges, which are simply the differences between successive values. By convention, these moving ranges are always recorded as being positive or zero.

The central line for the running record of the traffic fatalities will be the average of the 25 counts. In this case this central line will be 1177.9. The central line for the moving range portion of the XmR chart will be the average moving range, which is 51.67.

The upper limit for the moving ranges will be found by multiplying the average moving range by the scaling factor of 3.268. This limit is 168.8. The limits for the *X* portion of the *XmR* chart are called Natural Process Limits because they define the limits of routine variation for the data stream being plotted. The upper Natural Process Limit is found by multiplying the average moving range by the scaling factor of 2.66, and then adding the product to the central line. This limit is 1315.3. The lower Natural Process Limit is found by subtracting 2.66 times the average moving range from the central line, giving a value of 1040.5. The scaling factors of 3.268 and 2.660 are constants for this type of chart which convert the summary statistics into the appropriate values for the limits.

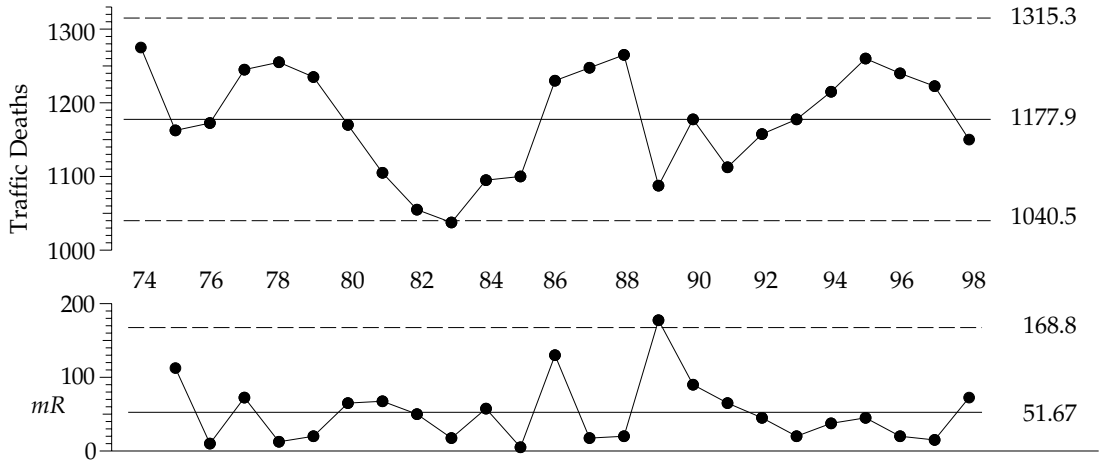
Year-by-Year Traffic Fatalities in Tennessee

year	*fatalities*	*mR*	*year*	*fatalities*	*mR*	*year*	*fatalities*	*mR*
1974	1274	—	1982	1055	49	1990	1177	89
1975	1162	112	1983	1037	18	1991	1113	64
1976	1172	10	1984	1095	58	1992	1158	45
1977	1244	72	1985	1101	6	1993	1177	19
1978	1256	12	1986	1230	129	1994	1214	37
1979	1236	20	1987	1247	17	1995	1259	45
1980	1171	65	1988	1266	19	1996	1239	20
1981	1104	67	1989	1088	17	1997	1223	16
						1998	1150	73

When we look at the chart we see several interesting things. In 1983, and possibly in 1982 as well,

something was happening to reduce the number of traffic fatalities. The limits define the routine variation about the central line, and the number of traffic deaths in 1983 was enough smaller than this average to warrant looking for an explanation.

Also, the dramatic drop in traffic deaths between 1988 and 1989 was larger than is likely to have occurred by chance. This is indicated by the moving range value that exceeds the upper limit on the moving range portion of the chart. It would be appropriate to seek an explanation of this change, because it does not appear to be routine variation.



***XmR* Chart for Number of Traffic Fatalities by Year for Tennessee**

Finally, the third straight decline in the number of traffic fatalities heralded in the headline does not appear to signify anything unusual happening. It is well within the bounds of routine variation, and does not constitute an abnormal pattern. After all, there were *four straight increases* before the last three declines!

Now when we compare counts from one year to another we are making an implicit assumption that the counts are logically comparable. That is, each count has approximately the same sized area of opportunity. Every count will have an area of opportunity, and to really know what a given count represents you will need to know the area of opportunity for that count. In this case, the area of opportunity for traffic fatalities is usually taken to be the number of vehicle miles driven. (All roads are safe if they are not used!) By comparing the counts directly, we are essentially assuming that the number of vehicle miles driven in Tennessee in each of these 25 years is approximately the same. And, or course, the trick is in what you call approximately the same. If we had information about the number of vehicle miles driven each year, then we could adjust the counts before comparing them. The number of traffic deaths would be divided by the number of vehicle miles driven, and the traffic fatality rates could then be compared on another XmR chart. The low number of deaths in 1982 and 1983, and the sudden drop between 1988 and 1989 could be due to a drop in vehicle miles. Thus, these counts are not definitive. More information is needed before we can be sure that something is really happening here. Nevertheless, we know better than to claim that the third straight decline signifies that the highways were really safer

in 1998 than they were in 1997 or 1996.

By the way, the Department of Safety spokesman did go on to say that "we should be concerned" about the fact that Tennessee's fatality rate was tenth in the nation. He seems to forget that someone will always be in tenth place. Tenth out of 50 is comfortably in the middle of the pack. Oh, well, I guess he expects every state to be below the average on this measure….

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