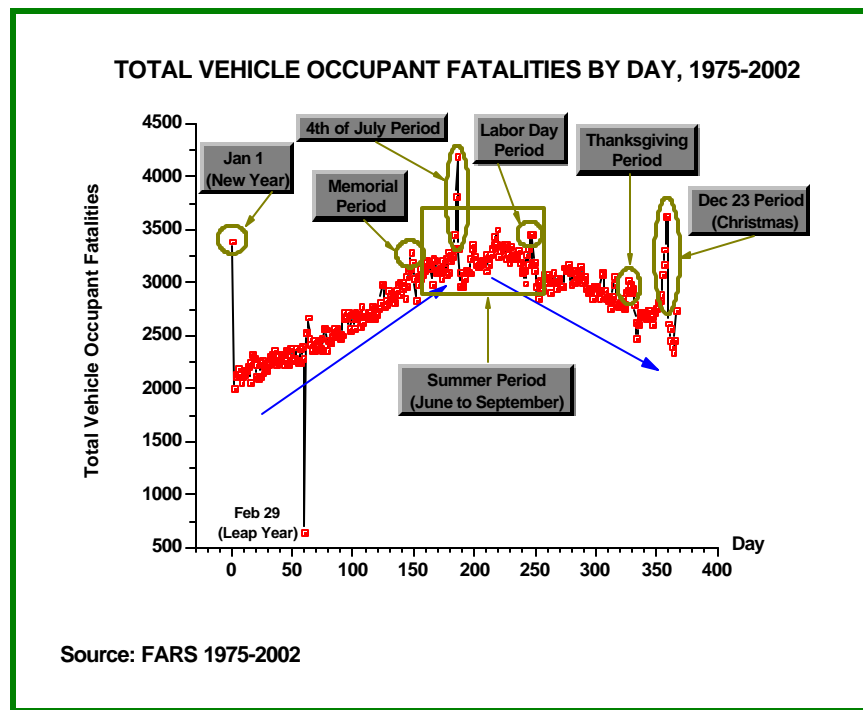




Trend and Pattern Analysis of Highway Crash Fatality By Month and Day

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Abstract The objective of this study by the National Center for Statistics and Analysis (NCSA) was to examine the trend and pattern of highway traffic crash fatality by month, day, and day of week for the period 1975-2002. Data from NCSA's Fatality Analysis Reporting System (FARS), and the Federal Highway Administration (FHWA) exposure data on Vehicle Miles Traveled (VMT) were used. The trend and pattern of monthly and daily traffic crash fatalities varies significantly, depending on the particular month, day, and day of week. Traffic safety offices will find this information useful to schedule their safety and enforcement campaigns during the high crash times of the year for drivers, passengers, and pedestrians.			
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1. Executive Summary

1.1 Abstract

Objective – This report presents an analysis on the trend and pattern of highway fatalities by month, day, and day of week in motor vehicle crashes.

Method and Data – The data for the period 1975-2002 are abstracted from the Fatality Analysis Reporting System (FARS). The Federal Highway Administration (FHWA) exposure data on Vehicle Miles Traveled (VMT) is also used for the analyses.

Conclusion – The trend and pattern of monthly and daily highway crash fatalities varies significantly, depending on the particular month, day, and day of the week. Detectable differences in historical patterns can be observed.

1.2 Summary

- Crash fatalities were higher and/or show a larger fluctuation in the early years as compared with those in recent years when the crash fatalities have remained relatively flat. The crash fatality rate per 100 million VMT shows a significantly declining pattern in the early years and a slow downward trend in recent years.
- Monthly fatalities and VMTs increase steadily from the lowest points in January and February, peak in July and August, then gradually decrease in the later months of the year. Monthly fatality rates steadily increase from the lowest points in February and March, and peak in the last quarter of the year.
- The four deadliest days on the road were July 4, July 3, December 23, and December 24, considering all years together from 1975 to 2002. Total daily fatalities over the period of 1975 to 2002 clearly illustrate an upward trend from January 1 to July 4, followed by a plateau of high fatalities during the summer period, then a downward trend after September. There are a number of outliers, which are associated with high fatality days.
- During the period of 1975 to 2002, the three deadliest days for pedestrians were December 23, January 1, and October 31, which coincide with Christmas-New Year Holidays and Halloween. During the period of 1975 to 2002, the daily pedestrian fatalities show a slowly downward trend from January 1 to July 4, then, the trend turns upward in a much higher rate.
- Between 1975 and 2002, there is small difference in the average daily fatalities among weekdays (Monday to Thursday). On the contrary, there is a relatively large reduction in average daily fatalities on weekends (Friday, Saturday, and Sunday).

2. Introduction

Studies have shown that in the United States, the numbers of motor vehicle fatalities were usually higher in six holiday periods: New Year's, Memorial Day, the 4th of July, Labor Day, Thanksgiving, and Christmas [1-3]. Recent analyses also indicate that July 4th and 3rd are the two days with the first and the second highest crash fatalities based on the data from the Fatality Analysis Reporting System (FARS), 1986-2002 [4-7]. These analyses also indicate that January 1 and October 31 (Halloween) were the two days with the most pedestrian fatalities.

In this report, not only the days with the most crash fatalities but also the overall trend and pattern of highway crash fatalities by month, day, and day of week are investigated. Traffic safety offices will find this information useful to schedule their safety and enforcement campaigns during the high crash times of the year for drivers, passengers, and pedestrians.

The outline of this report is as follows: Section 3 presents the method and the data used in this report. Section 4.1 analyzes crash fatalities by month. Section 4.2 presents the analysis of daily crash fatalities, which includes the days with the highest fatalities, the days with the highest pedestrian fatalities and the trend analysis of daily occupant fatalities. The trend of crash fatalities by day of week is presented in Section 4.3.

3. Method and Data

Descriptive statistics on highway crash fatalities by month and day are presented. Data from the Fatality Analysis Reporting System (FARS), 1975-2002 and Federal Highway Administration (FHWA) exposure data on Vehicle Miles Traveled (VMT) were used in the analyses.

4. Results

4.1 Trend of Crash Fatalities by Month

Figures 1 and 2 show how the monthly crash fatalities and fatality rates changed over the period of 1975 to 2002. For every month, crash fatalities were higher and/or show a larger fluctuation in the early years (up diagonal red shadow part) as compared with those in recent years (down diagonal green shadow part) when the crash fatalities have remained relatively flat. With regard to the crash fatality rate per 100 million VMT, it shows a significantly declining pattern in the early years (up diagonal red shadow part) and a slow downward trend in recent years (down diagonal green shadow part). Note the cutoff points between the "up diagonal red shadow part" and the "down diagonal green shadow part" in Figures 1 and 2 were determined based on the visualizations of the figures.

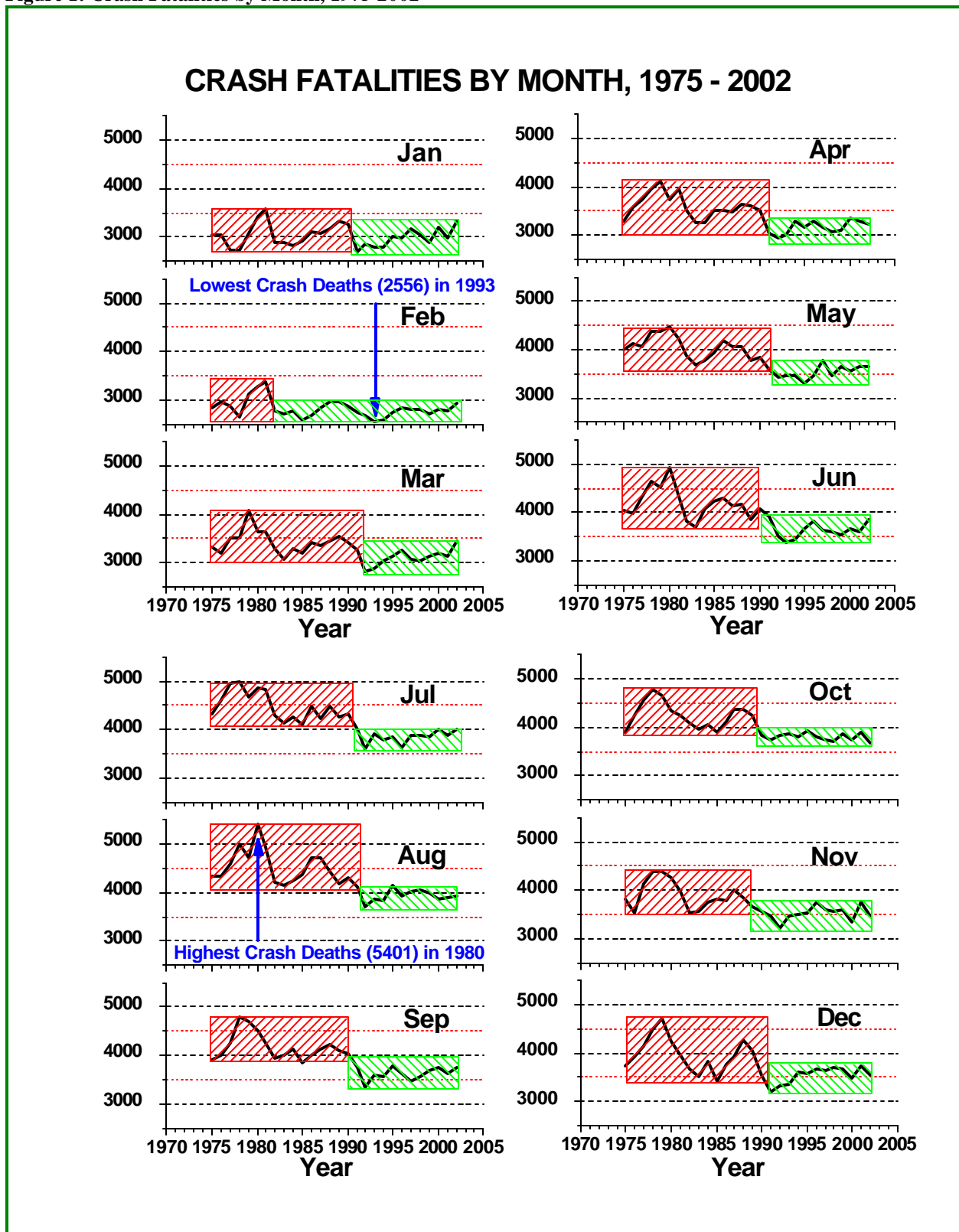
Relatively large fluctuations were seen in the yearly time series data as shown in Figures 1 and 2. To see the trend and pattern more clearly, we group the time series data in five-year increments. Table 1 contains the number of monthly fatalities and VMTs as well as fatality rates in five-year increments over the period of 1978 to 2002 (first two highest

values for each row are highlighted). For each five-year period, the monthly fatalities and VMTs increase steadily from the lowest points in January and February, peak in July and August, then gradually decrease in the later months of the year.

With respect to the fatality rate per 100 million VMT, the monthly fatality rates steadily increase from the lowest points in February and March, then peak in the last quarter of the year. In general, the differences in the rates are minuscule among later months.

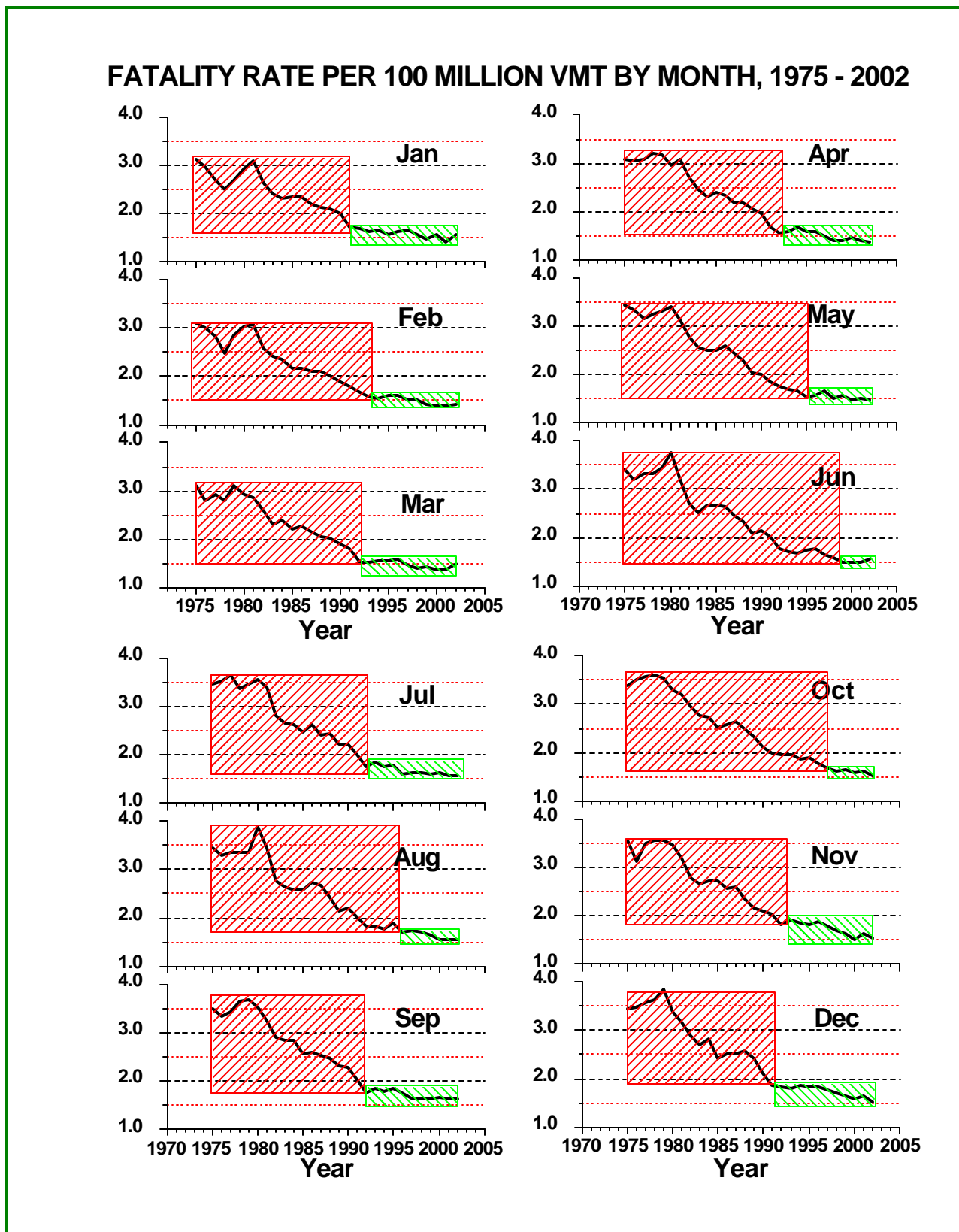
The graphical presentation of the monthly fatality rates in Figure 3 clearly shows that while all monthly fatality rates illustrate a downward trend between 1978 and 2002, the rate of decrease is larger in the later months of the year than in the early months. Also, the range of the fatality rates (i.e., the highest fatality rate minus the lowest fatality rate) has been steadily narrowing over the years, indicating the difference in fatality rates among months is smaller in recent years (this feature is graphically illustrated by the rectangular boxes in the figure).

Figure 1: Crash Fatalities by Month, 1975-2002



Source: FARS 1975-2002

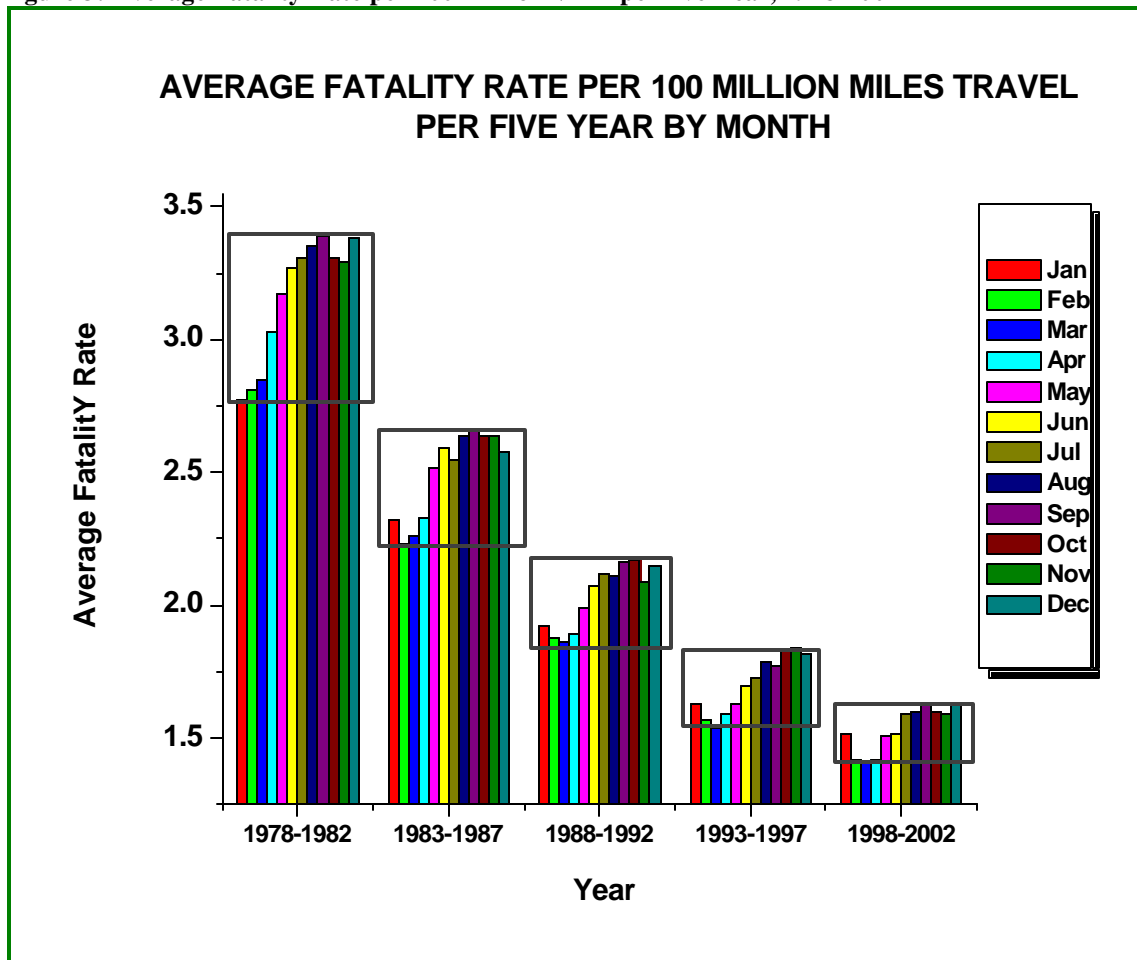
Figure 2: Crash Fatality Rate per 100 Million VMT by Month, 1975-2002



Source: FARS 1975-2002

Table 1 Fatalities, VMT and Fatality Rate per 100 Million VMT by Month and Year, Source: FARS 1978-2002													
Period	Variable	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1978-1982	Fatality	15707	15195	18187	19286	21338	22242	23618	24249	22177	22162	20501	21099
	VMT	566460	541283	637600	636288	672678	679410	712765	724833	653939	669160	622356	624179
	Fatality Rate	2.77	2.81	2.85	3.03	3.17	3.27	3.31	3.35	3.39	3.31	3.29	3.38
1983-1987	Fatality	14808	13573	16376	17026	19612	20447	21243	22224	20106	20405	18909	18419
	VMT	639003	608200	723301	731781	779626	789040	832303	843361	756082	772511	715333	712663
	Fatality Rate	2.32	2.23	2.26	2.33	2.52	2.59	2.55	2.64	2.66	2.64	2.64	2.58
1988-1992	Fatality	15307	14228	16454	16748	18682	19510	20665	20766	19431	20038	17788	18409
	VMT	797770	755594	884451	885764	940766	943012	976237	984548	901315	923976	851330	854730
	Fatality Rate	1.92	1.88	1.86	1.89	1.99	2.07	2.12	2.11	2.16	2.17	2.09	2.15
1993-1997	Fatality	14779	13503	15412	15905	17472	17977	19063	19782	18027	19141	17848	17852
	VMT	908423	860853	1001410	998900	1069919	1055869	1103626	1106441	1019555	1044275	968592	982040
	Fatality Rate	1.63	1.57	1.54	1.59	1.63	1.70	1.73	1.79	1.77	1.83	1.84	1.82
1998-2002	Fatality	15413	13995	15998	16061	18020	18230	19635	19742	18360	18878	17702	18140
	VMT	1016402	983898	1131722	1132542	1194233	1196620	1231715	1234547	1125458	1182105	1113758	1115789
	Fatality Rate	1.52	1.42	1.41	1.42	1.51	1.52	1.59	1.60	1.63	1.60	1.59	1.63
Total	Fatality	76,014	70,494	82,427	85,026	95,124	98,406	104,224	106,763	98,101	100,624	92,748	93,919
	VMT	3928058	3749828	4378484	4385275	4657222	4663951	4856646	4893730	4456349	4592027	4271369	4289401
	Fatality Rate	1.94	1.88	1.88	1.94	2.04	2.11	2.15	2.18	2.20	2.19	2.17	2.19

Figure 3: Average Fatality Rate per 100 Million VMT per five Year, 1978-2002



4.2 Trend Analysis of Daily Crash Fatalities

4.2.1 The Days with the Highest Crash Fatalities

Table 2 shows that the four deadliest days on the road were July 4, July 3, December 23, and December 24, considering all years together from 1978 to 2002. Comparing the separate rankings in 5-year increments over the same period indicates that the overall patterns are similar, but there are some variations of the top ten deadliest days.

- July 4 was either the most deadly day or the second most deadly day for all (5-year time) periods (from 1978 to 2002).
- July 3 was the second highest overall for the entire 25 year period, but was first highest in only one of the 5-year periods. This may be because July 3 was not always part of the July 4 holiday period, i.e., when July 4 was on a Tuesday, Wednesday, or Thursday.
- December 23 was the third highest overall, but varied in ranking in each 5-year increment.

Table 2 also shows that for the top 10 deadliest days, the total number of fatalities in each 5-year period declined continuously, from 9,199 between 1978 and 1982 to 7,168 from 1998 to 2002. Comparing the fatalities between the highest to the lowest days shows that the range (the most deadliest minus the 10th deadliest) has been steadily narrowing (i.e., smaller variances), from 235 during the period of 1978 – 1982, to 46 from 1998 to 2002.

Rank	Five Years Period										Total	
	1978-1982		1983-1987		1988-1992		1993-1997		1998-2002		Day	Deaths
	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths
1	Jul 4	1085	Jul 4	908	Jul 4	841	Jul 3	776	Jan 1	739	Jul 4	4320
2	Dec 24	975	Aug 3	816	Sep 2	790	Jul 4	750	Jul 4	736	Jul 3	3898
3	Dec 23	946	Aug 9	814	Dec 23	786	Aug 12	719	Sep 4	730	Dec 23	3814
4	Dec 22	926	Sep 1	796	Aug 18	784	Aug 13	704	Jul 3	729	Dec 24	3709
5	Aug 1	901	Aug 10	787	Aug 11	781	Dec 23	702	Aug 4	714	Dec 22	3676
6	Jul 3	898	Aug 2	787	Jun 23	777	Oct 9	700	Jun 30	713	Aug 3	3660
7	Aug 15	895	Jun 12	784	Aug 19	775	Aug 6	699	Aug 3	708	Jan 1	3653
8	Dec 21	871	Aug 16	782	Jul 1	767	Jul 2	690	Aug 6	707	Sep 1	3643
9	Oct 31	852	Jul 3	782	Oct 7	766	Aug 20	687	Aug 12	699	Sep 2	3638
10	Aug 30	850	Aug 23	775	May 27	763	Aug 24	685	Dec 23	693	Aug 4	3618

Source: FARS 1978-2002

Examining the total daily fatalities from 1975 to 2002 (Figure 4) illustrates an upward trend from January 1 to July 4, followed by a plateau of high fatalities during the summer period, then a downward trend after September. Also, clearly shown on the plot are a number of outliers, which are associated with high fatality days around the holidays (e.g. Independence Day and Christmas Holiday periods). The concave pattern of the daily fatalities is similar as the data were plotted separately in 5-year increments for the period of 1983 to 2002. However, further comparison of these four charts reveals some interesting results: First, the trend band has become flatter in most recent years,

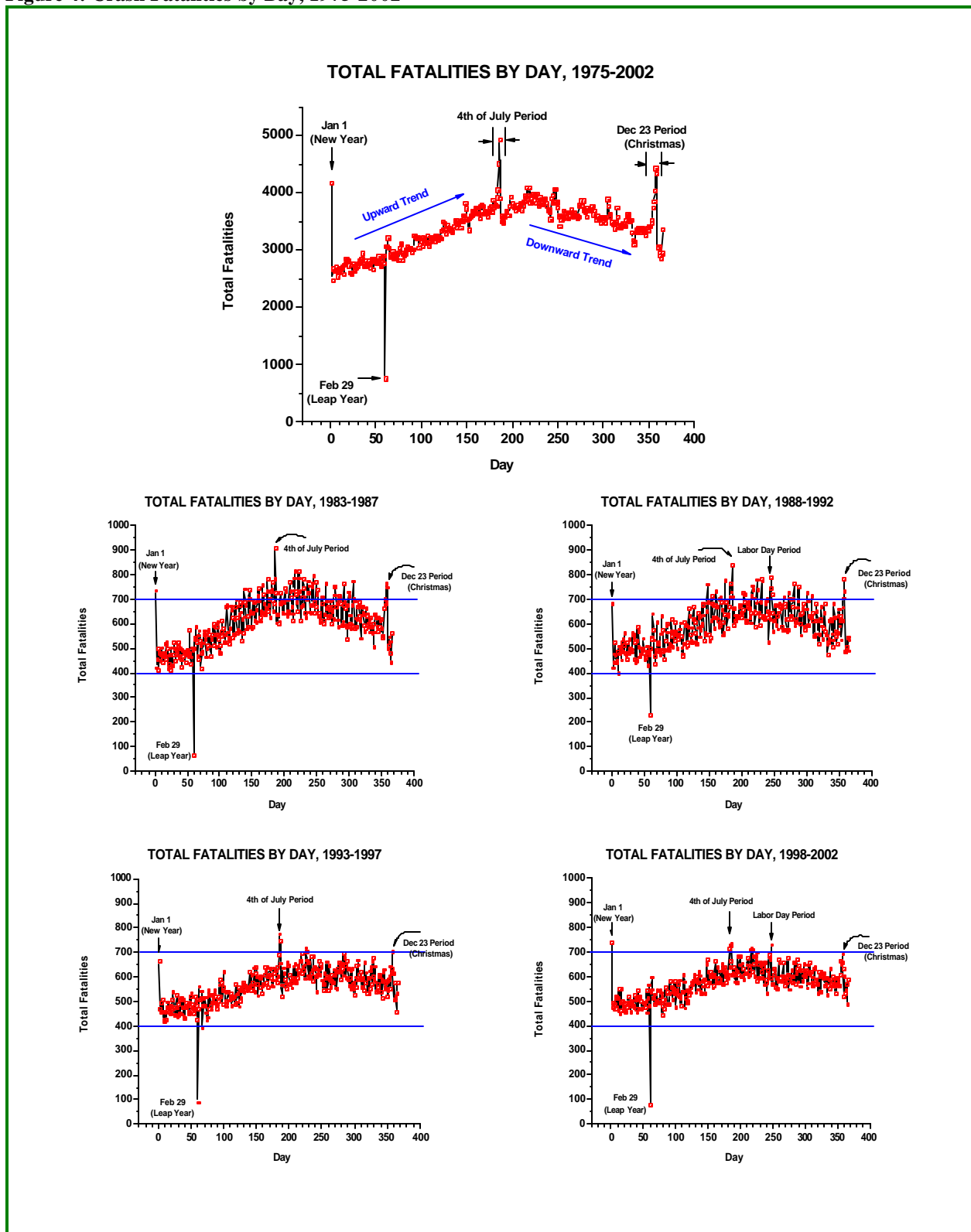
suggesting that the seasonal difference has become smaller. Secondly, the width of the band has become narrower, indicating the daily fluctuation has become smaller in recent years. Finally, these plots show that the fatalities during the first three months were of little changes over the years, however, there were large reductions in the daily fatalities during the summer period (the warmer months).

The four deadliest days on the road were also July 4, July 3, December 23, and December 24, considering all years together from 1975 to 2002.

Figure 5 presents the highest and lowest single day fatalities between 1975 and 2003. It shows that there is no significant change in the lowest single day fatalities over the years. Most of those days occurred in first three months of the year and in weekdays (Monday to Tuesday). There is a downward trend in the highest number of fatalities that occurred in a single day. Most of those days fell in Saturday.

If we examine the ratio of the highest single day fatalities to lowest single day fatalities (HLSR), that is, $(HLSR)_{year} = (\text{Highest single day fatalities}) / (\text{Lowest single day fatalities})$, we can see that the smallest value of HLSR was around three and the highest HLSR was around six over the last 25 years (Figure 6). This quantity can be used as an indication of the variance of the daily crash fatalities for the year.

Figure 4: Crash Fatalities by Day, 1975-2002



Source: FARS 1975-2002

Figure 5: Highest and Lowest Single Day Fatalities, 1975-2003

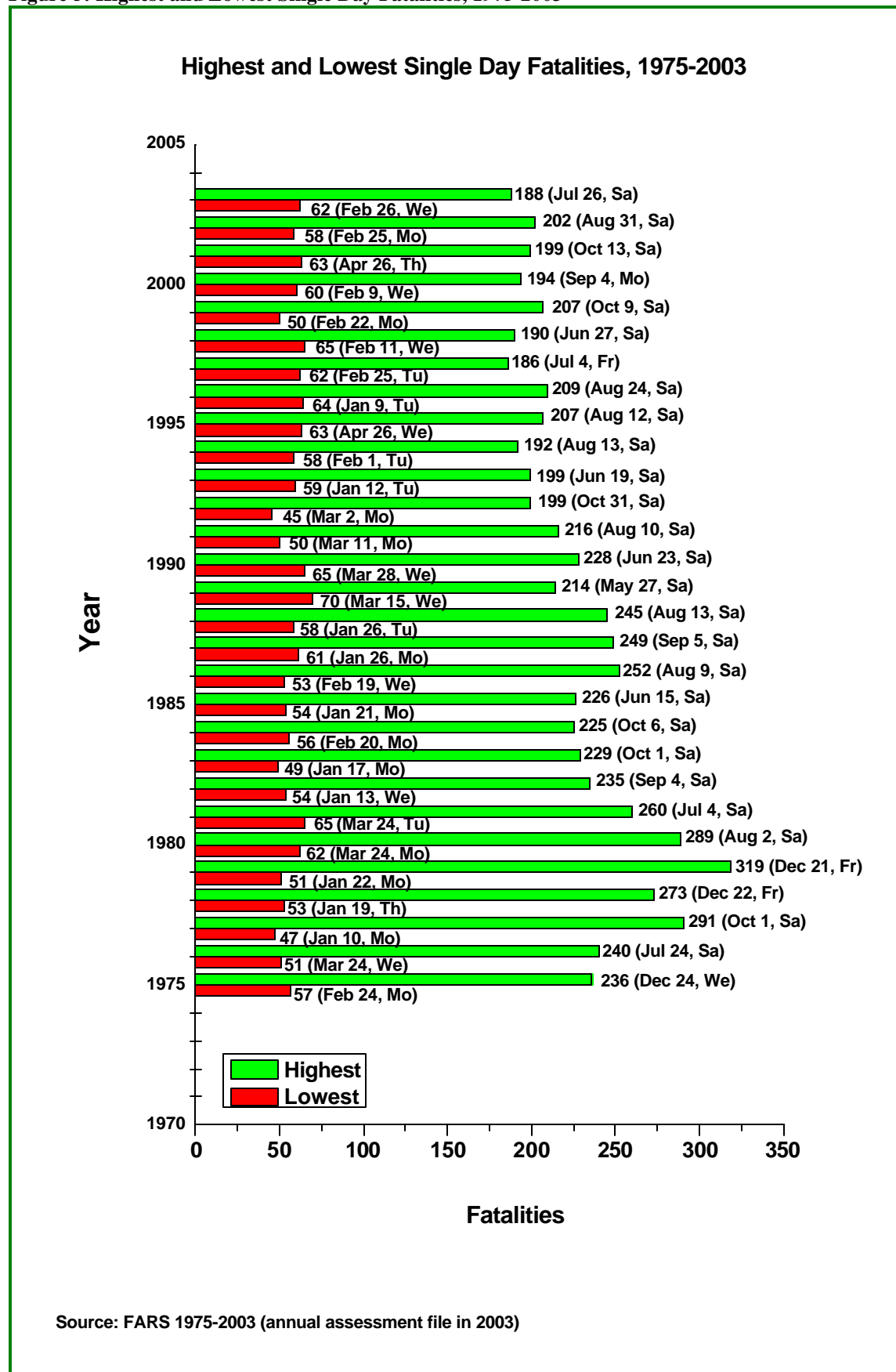
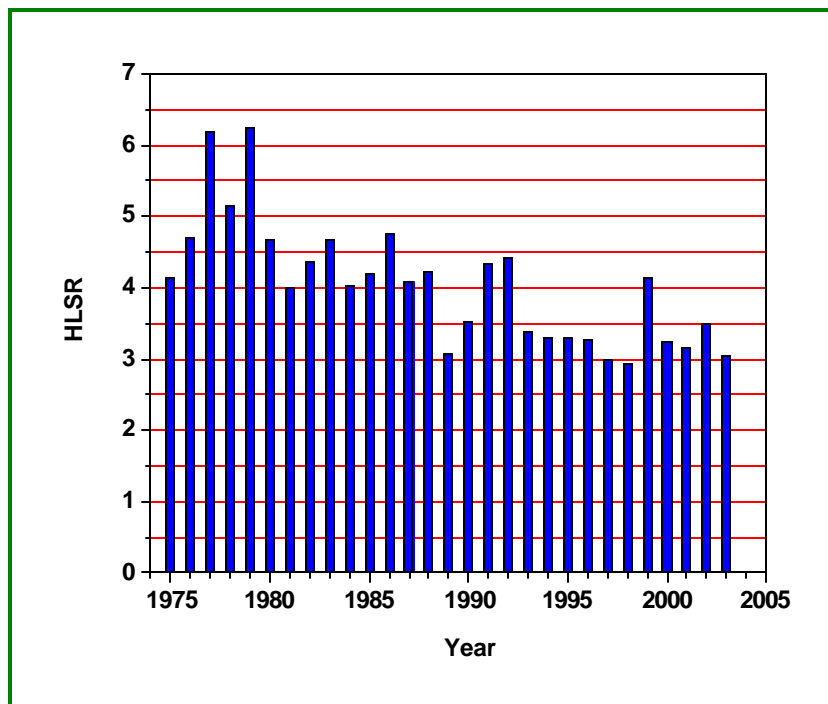


Figure 6: Ratio of Highest to Lowest Single Day Fatalities (HLSR), 1975-2003



Source: FARS 1975-2002

4.2.2 The Days with the Highest Pedestrian Fatalities

Between 1978 and 2002, the three deadliest days for pedestrians were January 1, December 23, and October 31 (Halloween). While these three days (see Table 3) were not always on the top-ten lists as the data were displayed in 5-year increments, January 1 and October 31 had been the top two deadliest days for the recent 10-year period (1993-2002). All the top-ten deadliest days except January 1 were in the last three months of the year, and more than half of them were in November and December.

The top-ten fatality rankings for pedestrians are different from the rankings for all fatalities. For example, while pedestrian fatalities were relatively high during the July 4 holiday period compared with other summer days, July 4 is not among the top ten most lethal days for pedestrians. This is because the average daily pedestrian fatalities were much higher during the cooler months, as shown in Figure 7. Examining the daily pedestrian fatality plots in Figure 7 reveals an interesting contrast against the plots in Figure 4 - during the period of 1975 to 2002, the daily pedestrian fatalities show a slowly downward trend from January 1 to July 4, then, the trend turns upward. As was the same for the overall fatalities, there are some differences in patterns as the daily pedestrian fatalities were plotted separately in 5-year increments. The width of the band (i.e., the difference between the highest pedestrian fatalities and the lowest pedestrian fatalities) has become narrower in later years, indicating a smaller fluctuation in daily pedestrian fatalities. The plots also show that the trend band shifts down continuously. This means that the total daily pedestrian fatalities decreased from approximately 100 during 1983-1987 to around 60 during 1998 - 2002.

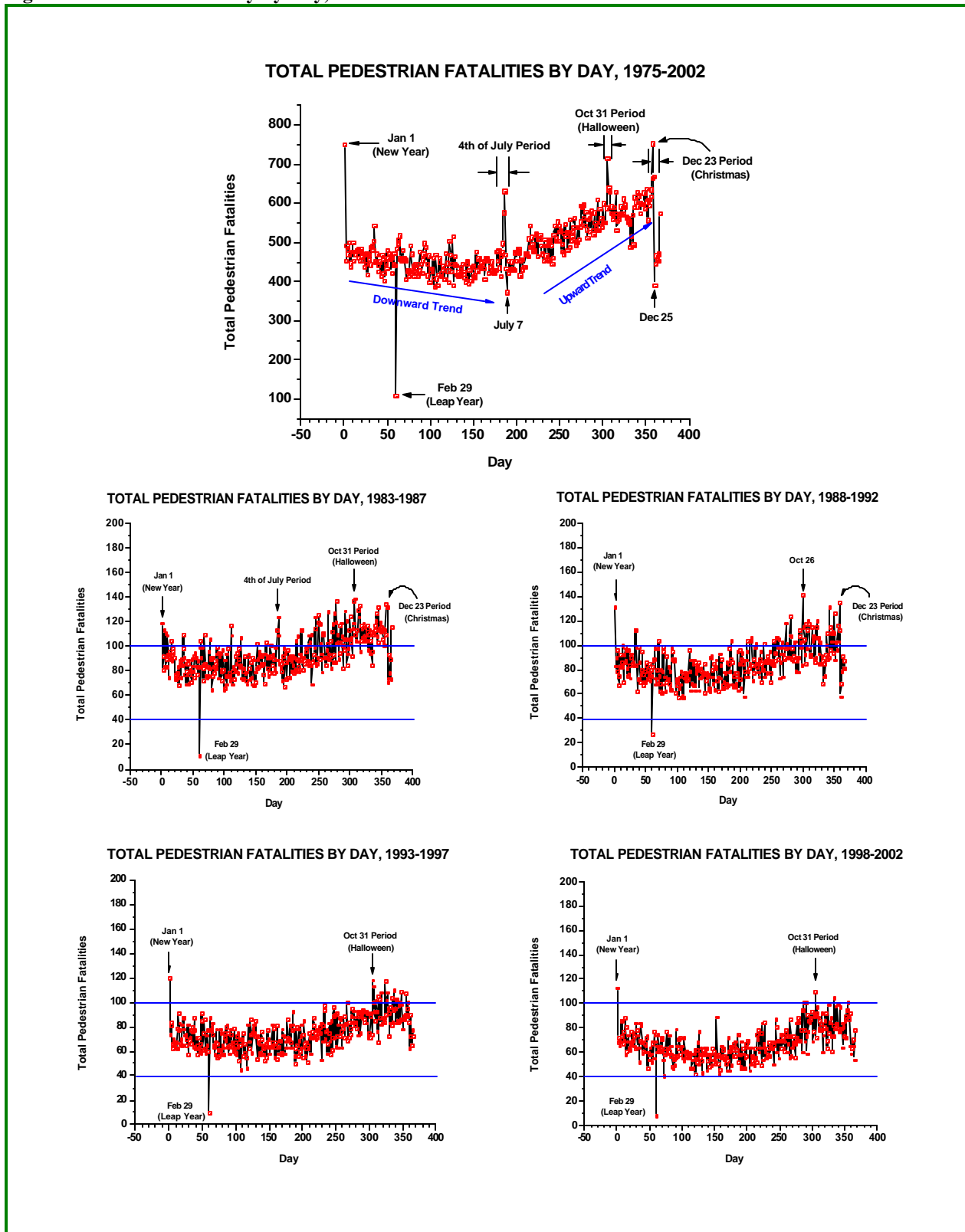
Note that the three deadliest days for pedestrians were December 23 (753), January 1 (751), and October 31 (715. Halloween), considering all years together from 1975 to 2002.

Table 3
Days with the Highest Pedestrian Fatalities, 1978-2002

Rank	Five Years Period										Total	
	1978-1982		1983-1987		1988-1992		1993-1997		1998-2002		Day	Deaths
	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths	Day	Deaths
1	Dec 22	150	Nov 2	139	Oct 26	141	Jan 1	120	Jan 1	113	Jan 1	539
2	Oct 31	146	Oct 4	137	Dec 23	135	Oct 31	118	Oct 31	110	Dec 23	498
3	Dec 23	144	Nov 1	137	Dec 7	131	Nov 19	117	Nov 29	105	Oct 31	489
4	Dec 15	144	Dec 22	135	Jan 1	131	Nov 1	113	Dec 20	101	Nov 2	462
5	Dec 21	137	Nov 10	133	Dec 15	126	Dec 2	110	Oct 16	101	Nov 10	455
6	Dec 24	136	Dec 24	132	Oct 6	124	Dec 13	109	Oct 13	101	Oct 26	451
7	Oct 20	127	Dec 23	132	Nov 18	120	Nov 22	108	Nov 20	99	Dec 20	451
8	Dec 12	123	Dec 10	132	Nov 3	120	Nov 13	108	Dec 4	99	Dec 10	451
9	Nov 17	122	Nov 8	130	Sep 29	118	Dec 20	107	Dec 1	98	Dec 22	447
10	Dec 6	122	Oct 18	129	Oct 31	117	Nov 8	105	Dec 8	97	Dec 7	440

Source: FARS 1978-2002

Figure 7: Pedestrian Fatality by Day, 1975-2002

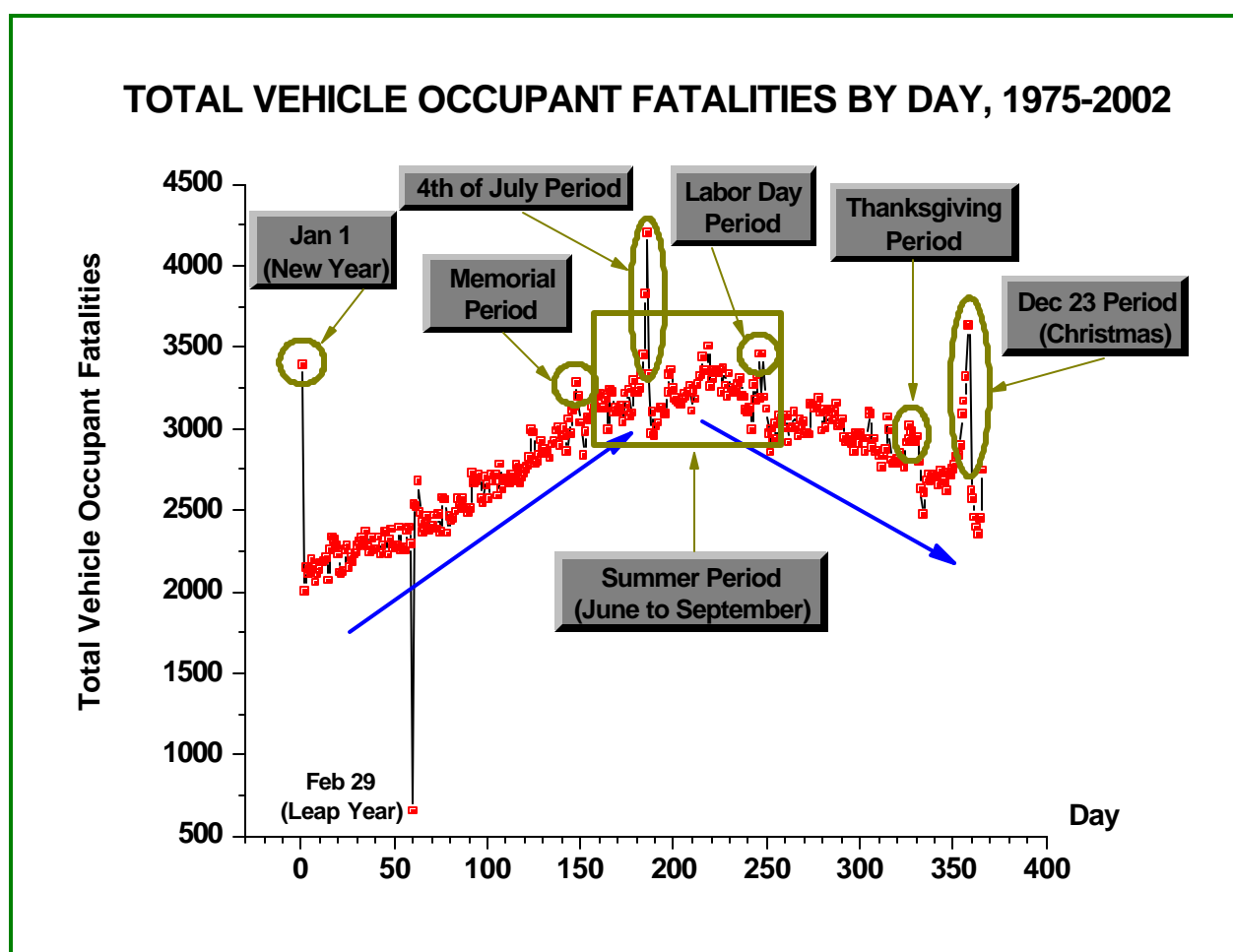


Source: FARS 1975-2002

4.2.3 Occupant Fatalities by Day

The pedestrian fatality pattern is opposite of the overall fatality pattern. This raises a question about what the daily vehicle occupant fatality pattern looks like. Not surprisingly, since vehicle occupant fatalities comprise eighty percent of all fatalities, the general trend is similar to that for the overall fatalities, where occupant fatalities increased from the beginning of the year, peaked in the summer then came down toward the end of the year (Figure 8). However, the slopes of the upward and downward trends are steeper as would be expected when compared to the overall fatality pattern in Figure 4. The days with the highest vehicle occupant fatalities are highlighted: New Year's, Memorial Day, 4th of July, Labor Day, Thanksgiving, and Christmas.

Figure 8: Vehicle Occupant Fatalities by Day, 1975-2002

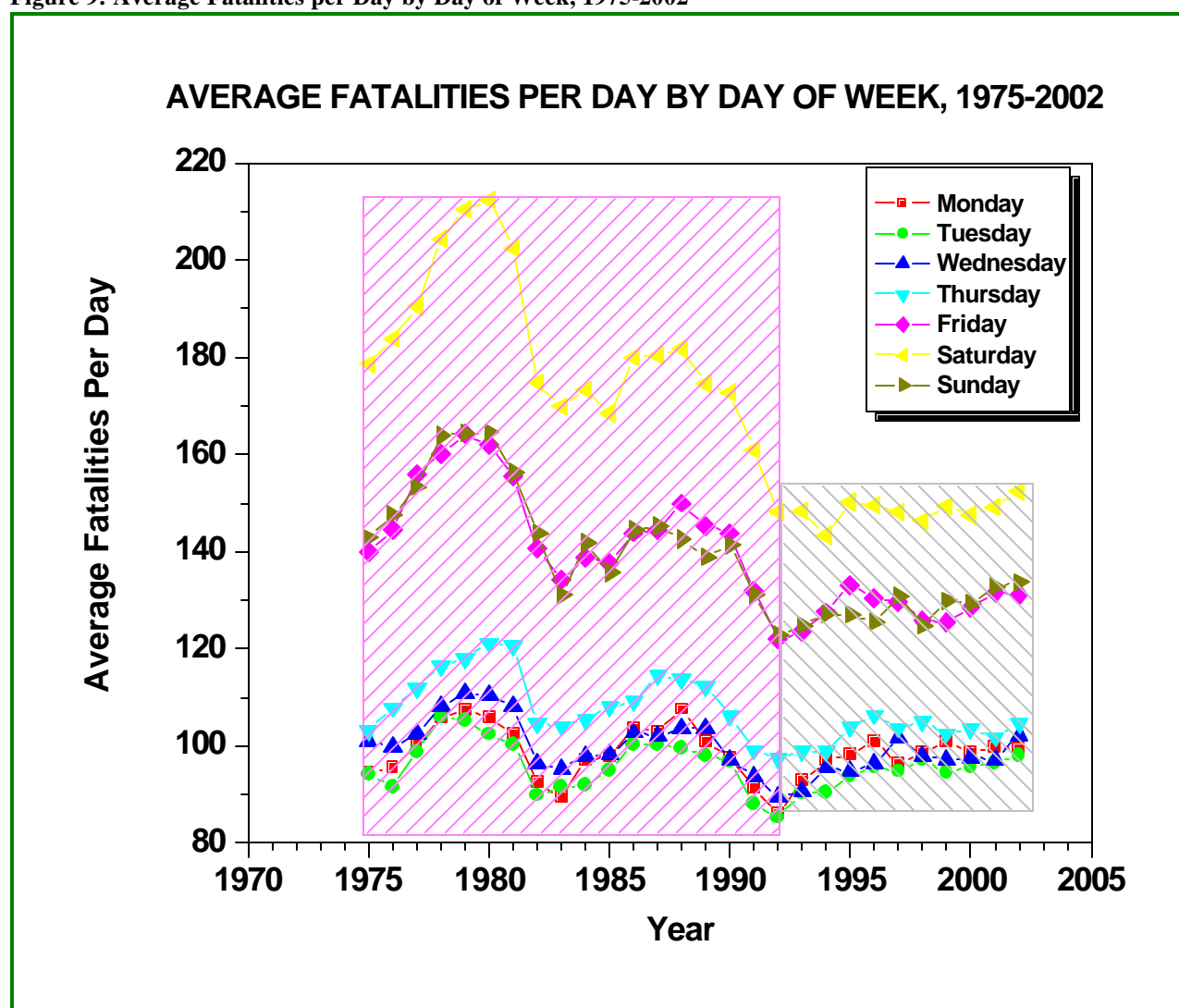


Source: FARS 1975-2002

4.3 Trend of Crash Fatalities by Day of Week

Far more fatalities occur on weekends (particularly on Saturdays) than on weekdays ([5] and [8]). Figure 9 presents the average fatalities per day by day of week for the period of 1975 to 2002. There is no large difference in the average daily fatalities among weekdays (Monday to Thursday). On the contrary, there is a relatively large reduction in average daily fatalities on weekends (Friday, Saturday, and Sunday) between 1975 and 1992. These results indicate that the fatality reduction over the last 25 years has mostly occurred on weekends. This phenomenon is even better illustrated by examining the average fatalities per day per five years by day of week, as shown in Table 4 and Figure 10. The five-year average fatalities on weekdays are relatively unchanged since 1978, while the five-year average for fatalities on weekends have decreased steadily since 1978 until the five-year period (1993-1997), at which point the average fatalities plateaued.

Figure 9: Average Fatalities per Day by Day of Week, 1975-2002

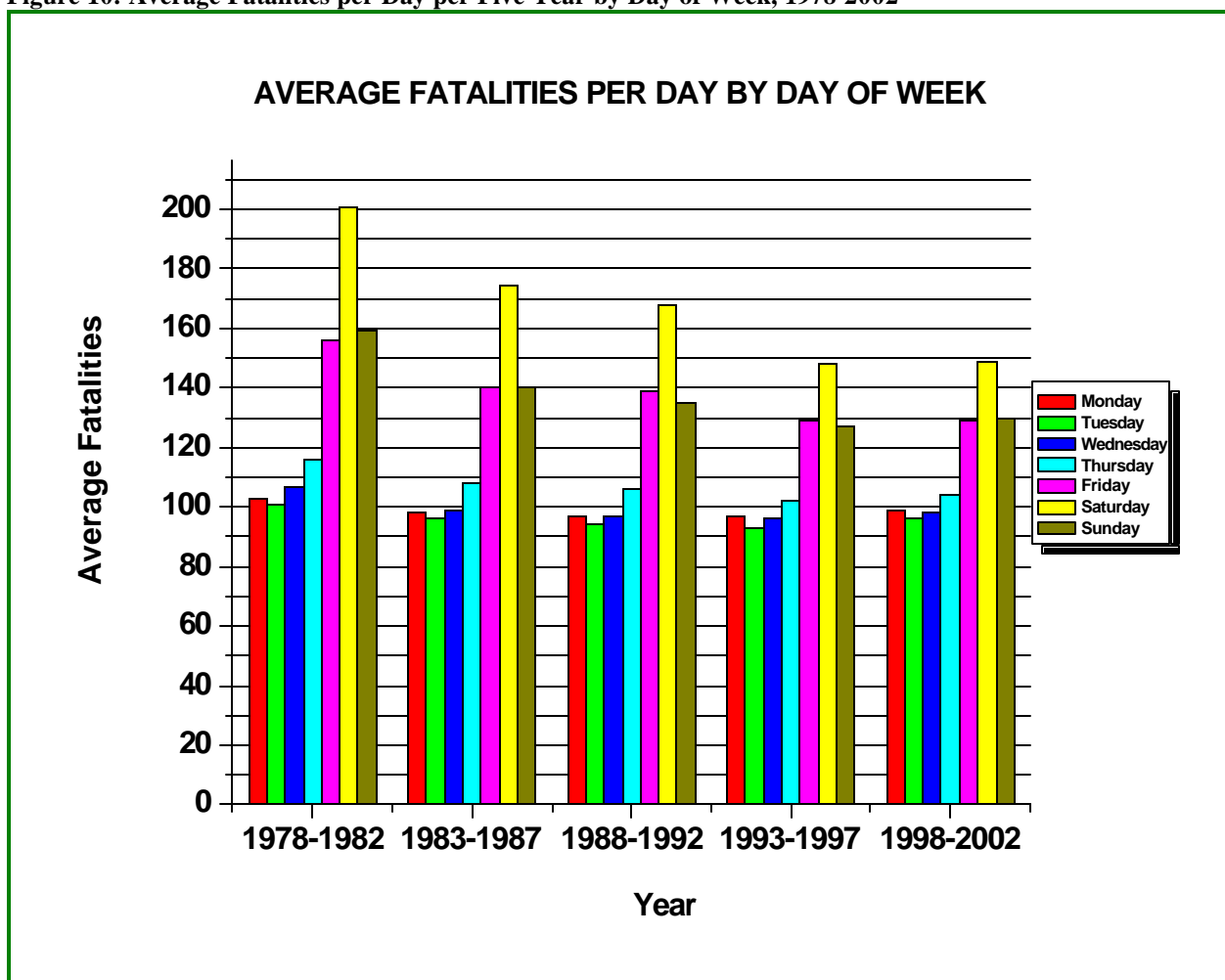


Source: FARS 1975-2002

Table 4 Average Fatalities per Day by Day of Week							
Period	Day of Week						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1978 -1982	103	101	107	116	156	201	159
1983 -1987	98	96	99	108	140	174	140
1988 -1992	97	94	97	106	139	168	135
1993 -1997	97	93	96	102	129	148	127
1998 -2002	99	96	98	104	129	149	130
Total	99	96	100	107	138	168	138

Source: FARS 1978-2002

Figure 10: Average Fatalities per Day per Five Year by Day of Week, 1978-2002



Source: FARS 1978-2002

5. Summary and Conclusions

The trends and patterns of highway traffic crash fatalities by month, day, and day of week between 1975 and 2002 were examined in this report. The trends and patterns in monthly and daily traffic crash fatalities vary significantly, depending on the particular month, day, and day of week.

Monthly fatalities and VMTs increase steadily from the lowest points in January and February, peak in July and August, then gradually decrease in the later months of the year. Monthly fatality rates per 100 million VMT steadily increase from the lowest points in February and March, and peak in the last quarter of the year.

The four deadliest days on the road were July 4, July 3, December 23, and December 24, considering all years together from 1975 to 2002. Total daily fatalities over the period of 1975 to 2002 clearly illustrates an upward trend from January 1 to July 4, followed by a plateau of high fatalities during the summer period, then a downward trend after September. There are a number of outliers, which are associated with high fatality days. Studies also show that there is no significant change in the lowest number of fatalities in a single day over the years. However, there is a downward trend in the highest number of fatalities in a single day.

During the period of 1975 to 2002, the three deadliest days for pedestrians were December 23, January 1, and October 31 (there were higher childhood pedestrian deaths during Halloween [9]). During the period of 1975 to 2002, the daily pedestrian fatalities show a slow downward trend from January 1 to July 4, then, the trend turns upward.

There is no large difference in the average daily fatalities among weekdays (Monday to Thursday). However, there is a relatively large reduction in average daily fatalities on weekends (Friday, Saturday, and Sunday) between 1975 and 1992. Results indicate that the fatality reduction over the last 25 years has mostly occurred on weekends.

Finally, we should point out that this report intended to present an analysis on the overall trend and pattern of highway fatalities by month, day, and day of week in motor vehicle crashes for the period 1975-2002. We did not examine factors, such as the changes in economic activity, traffic volume, weather, alcohol use, restraint use, vehicle design and safety equipment, roadway design, laws and rules, seasonality, policy, public informing and education, emergency medical services (EMS), etc., which have definitely affected the crash outcomes and hence the trend and pattern of crash fatalities over the past years. For instance, fatalities in crashes that involve one or more impaired drivers appear to increase significantly during holiday periods [10, 11, 7]. Additional analyses might also investigate why there are more pedestrian fatalities during the colder months of the year or whether there are variations by geographic region of the country by season.

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