Curve Estimation of Number of People Killed in Traffic Accidents in Turkey

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Abstract. One or more than one vehicle in motion on the highway involving death, injury and loss events which have resulted are called accidents. As a result of increasing population and traffic density, traffic accidents continue to increase and this leads to both human losses and harm to the economy. In addition, also leads to social problems. As a result of increasing population and traffic density, traffic accidents continue to increase and this leads to both human losses and harm to the economy. In addition to this, it also leads to social problems. As a result of traffic accidents, millions of people die year by year. A great majority of these accidents occur in developing countries. One of the most important tasks of transportation engineers is to reduce traffic accidents by creating a specific system. For that reason, statistical information about traffic accidents which occur in the past years should be organized by versed people. Factors affecting the traffic accidents are analyzed in various ways. In this study, modelling the number of people killed in traffic accidents in Turkey is determined. The dead people were modelled using curve fitting method with the number of people killed in traffic accidents in Turkey dataset between 1990 and 2014. It was also predicted the number of dead people by using various models for the future. It is decided that linear model is suitable for the estimates.

1. Introduction
Traffic Safety is traffic rules to convert a natural behaviour of individuals in life and is the work which has to be done to ensure the safety of life and property of individuals [1]. Results of traffic accidents are economic and social losses. Although it is possible to
compensate the economic losses, it is not possible to compensate for the social losses [2].

Each year about 1.24 million people lost their lives as a result of road traffic accidents and about 20 to 50 million people are injured as a result of the accidents according to the 2013 report of the World Health Organization [3].

The aim of this study is to estimate the number of people who died in traffic accidents in Turkey travelling by highway in the future by using the number of people who died in traffic accidents in Turkey.

In this study, the number of people who died in traffic accidents in Turkey in the period between 1990 and 2014 was taken from annually data from Turkey Statistical Institute.

In the second part of the study, the Curve Estimation technique is described. The number of people who died in traffic accidents in Turkey is predicted by using Curve Estimation technique for the period between 1990 and 2014 in the third chapter. Then the results which obtained by Curve Estimation are given. The fourth section which is the conclusion part has general comments.

2. Material and method

In many cases, the relationship between two variables may be linear or geometric. Assume that the mean of the dependent variable Y grows linearly or geometrically as X increases. Curve fitting, statistical technique used to derive coefficient values for equations that express the value of Y as a function of X.

A linear or geometric model can be appropriate if it is thought that the slope of the effect of X on E(Y) changes sign as X increases. For many such models, the relationship between X and E(Y) can be accurately reflected with a specification in which Y is viewed as a function of X and one or more powers of X. In these methods, the linear equation that will minimize the sum of squared errors is investigated and the model which has maximum R² value which is coherence measure is the best model [4, 5].

3. Results and discussions

Graphics are drawn for linear and geometrical models by using data. The graphics for the data sets are shown in Figure 1. The parameters of these curves and R² values are shown in Table 1 - 3.

X is taken as time variable and Y is taken as the number of people who died in traffic accidents in Turkey. According to Table 1 results, considering the linear model, a unit increase in time causes 120,360-unit decrease in number of killed in traffic accidents. Although, the coefficients are found statistically meaningful (p<0.05), the value of R² is found 0.834. According to Table 2 results, considering the quadratic model, the quadratic regression model of number of killed in traffic accidents and time is calculated meaningful but time² is not found statistically meaningful (p>0.05). R² value of the model is found 0.840. Another model research, cubic model results show that a unit increase in time causes 123,401 unit decrease in number of killed in traffic accidents. In addition, a unit increase in log time² causes 1,618 unit increase in the number of people who died in traffic accidents. The cubic model is not statistically meaningful (p>0,05), the value of R²
is found 0.840. Therefore, the linear model parameters will be used while making future predictions.

![Figure 1. Curve of people who died in traffic accidents](image)

**Table 1.** Model parameters for linear

| Parameters | Estimate | SE  | t    | Sig. | R²   |
|------------|----------|-----|------|------|------|
| Constant   | 4938.800 | 80.742 | 61.143 | 0.000 | 0.834 |
| x          | -120.360 | 11.197 | -10.749 | 0.000 |      |

**Table 2.** Model parameters for quadratic

| Parameters | Estimate | SE  | t    | Sig. | R²   |
|------------|----------|-----|------|------|------|
| Constant   | 4852.651 | 121.647 | 39.891 | 0.000 | 0.840 |
| x          | -120.360 | 11.231 | -10.717 | 0.000 |      |
| x²         | 1.618    | 1.746 | 0.927 | 0.364 |      |

Predictions for people who died in traffic accidents in Turkey for the period between 2015 and 2017 are made by the linear model which is defined by analysis result shown in Table 4.
### Table 3. Model parameters for cubic

| Parameters | Estimate | SE  | t     | Sig. | R²  |
|------------|----------|-----|-------|------|-----|
| Constant   | 4852.651 | 124.471 | 38.986 | 0.000 | 0.840 |
| x          | -123.401 | 8.893 | -4.271 | 0.000 |     |
| x²         | 1.618    | 1.786 | 0.906  | 0.375 |     |
| x³         | 0.033    | 0.284 | 0.115  | 0.910 |     |

### Table 4. Forecast for number of people who died in traffic accidents

| Period | Estimate Value of Number of People Who Died in Traffic Accidents |
|--------|---------------------------------------------------------------|
| 2015   | 3374                                                          |
| 2016   | 3254                                                          |
| 2017   | 3134                                                          |

### 4. Conclusions

Road traffic injuries are a huge public health and development problem, killing almost 1.24 million people a year and injuring or disabling between 20 million and 50 million more. Both WHO and World Bank data show that, without appropriate action, these injuries will rise dramatically by the year 2020, particularly in rapidly-motorizing countries. Not only is 90% of the current burden borne by low-income and middle-income countries, but the increase in casualty rates will be greatest in these countries [6].

In this study, the number of people who died in traffic accidents in Turkey in the period between 1990 and 2014 was taken from annually data from Turkey Statistical Institute. These data sets were analyzed by Curve Estimation technique.

Linear estimation model showed that number of people who died in traffic accidents in Turkey would continue to decrease.

### References

[1] Sönmez V., 1991. Okul öncesi ve temel eğitimde trafik eğitiminin önemi, The importance of pre-school and basic education, traffic education 1, Trafik Şurası Bildirileri, EGM Trafik Daire Başkanlığı, 30-31 Temmuz, Ankara.

[2] Hatipoğlu S., 2011. Okul Öncesi Çağrı Çocuklarının Trafik Bilgi ve Algıları, Pegasus Eğitim Öğretim Dergisi, Cilt:1, Sayı:3.

[3] World Health Statistics, 2013. World Health Organization.

[4] Greene W. H., 2003. Econometric Analysis, 5th ed., Prentice Hall, New Jersey.

[5] Deming W.E., 1964. Statistical adjustment of data, Dover Publications.

[6] Peden, Margie, et al., 2004. World report on road traffic injury prevention, World Health Organization.