



Safety 2010 World Conference

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Traffic accidents in Mexico: did the frequency and severity change from 2000 to 2007?



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Friday 24th September 2010, 11:30 am, Abbey Room, J9

Global status report on road safety (1)

1. The problem

2. The model

3. Results

4. Conclusions

Approximately 1.3 million people die each year on the world's roads, and between 20 and 50 million sustain non-fatal injuries. The *Global status report on road safety* is the first broad assessment of the road safety situation in 178 countries, using data drawn from a standardized survey. The results show that road traffic injuries remain an important public health problem, particularly for low-income and middle-income countries. Pedestrians, cyclists and motorcyclists make up almost half of those killed on the roads, highlighting the need for these road users to be given more attention in road safety programmes. The results suggest that in many countries road safety laws need to be made more comprehensive while enforcement should be strengthened. The *Global status report on road safety* results clearly show that significantly more action is needed to make the world's roads safer.

Global status report on road safety (2)

1. The problem

2. The model

3. Results

4. Conclusions

There can no longer be any doubt that the burgeoning traffic accidents (TA) problem in the world has come of age. In fact, TA are currently the leading cause of death for those from 15 to 29 years old in almost all countries of America, and at least the second most important cause of death in all the rest. Not only does this create a situation of legitimate and vital concern to public health authorities, but there is also very reason to believe that this toll of economic losses, injuries, and deaths will continue to rise.

Global status report on road safety (3)

Leading causes of death, 2004 and 2030 compared

1. The problem

2. The model

3. Results

4. Conclusions

TOTAL 2004			TOTAL 2030		
RANK	LEADING CAUSE	%	RANK	LEADING CAUSE	%
1	Ischaemic heart disease	12.2	1	Ischaemic heart disease	12.2
2	Cerebrovascular disease	9.7	2	Cerebrovascular disease	9.7
3	Lower respiratory infections	7.0	3	Chronic obstructive pulmonary disease	7.0
4	Chronic obstructive pulmonary disease	5.1	4	Lower respiratory infections	5.1
5	Diarrhoeal diseases	3.6	5	Road traffic injuries	3.6
6	HIV/AIDS	3.5	6	Trachea, bronchus, lung cancers	3.5
7	Tuberculosis	2.5	7	Diabetes mellitus	2.5
8	Trachea, bronchus, lung cancers	2.3	8	Hypertensive heart disease	2.3
9	Road traffic injuries	2.2	9	Stomach cancer	2.2
10	Prematurity and low birth weight	2.0	10	HIV/AIDS	2.0
11	Neonatal infections and other	1.9	11	Nephritis and nephrosis	1.9
12	Diabetes mellitus	1.9	12	Self-inflicted injuries	1.9
13	Malaria	1.7	13	Liver cancer	1.7
14	Hypertensive heart disease	1.7	14	Colon and rectum cancer	1.7
15	Birth asphyxia and birth trauma	1.5	15	Oesophagus cancer	1.5
16	Self-inflicted injuries	1.4	16	Violence	1.4
17	Stomach cancer	1.4	17	Alzheimer and other dementias	1.4
18	Cirrhosis of the liver	1.3	18	Cirrhosis of the liver	1.3
19	Nephritis and nephrosis	1.3	19	Breast cancer	1.3
20	Colon and rectum cancers	1.1	20	Tuberculosis	1.1

Source: World health statistics 2008 (<http://www.who.int/whosis/whostat/2008/en/index.html>)



Global status report on road safety (4)

Table 1. Leading causes of death by age, world, 2004

RANK	0–4 YRS	5–14 YRS	15–29 YRS	30–44 YRS	45–69 YRS	70+ YRS	TOTAL
1	Perinatal causes	Lower respiratory infections	Road traffic injuries	HIV/AIDS	Ischaemic heart disease	Ischaemic heart disease	Ischaemic heart disease
2	Lower respiratory infections	Road traffic injuries	HIV/AIDS	Tuberculosis	Cerebrovascular disease	Cerebrovascular disease	Cerebrovascular disease
3	Diarrhoeal diseases	Malaria	Tuberculosis	Road traffic injuries	HIV/AIDS	Chronic obstructive pulmonary disease	Lower respiratory infections
4	Malaria	Drownings	Violence	Ischaemic heart disease	Tuberculosis	Lower respiratory infections	Perinatal causes
5	Measles	Meningitis	Self-inflicted injuries	Self-inflicted injuries	Chronic obstructive pulmonary disease	Trachea, bronchus, lung cancers	Chronic obstructive pulmonary disease
6	Congenital anomalies	Diarrhoeal diseases	Lower respiratory infections	Violence	Trachea, bronchus, lung cancers	Diabetes mellitus	Diarrhoeal diseases
7	HIV/AIDS	HIV/AIDS	Drownings	Lower respiratory infections	Cirrhosis of the liver	Hypertensive heart disease	HIV/AIDS
8	Whooping cough	Tuberculosis	Fires	Cerebrovascular disease	Road traffic injuries	Stomach cancer	Tuberculosis
9	Meningitis	Protein–energy malnutrition	War and conflict	Cirrhosis of the liver	Lower respiratory infections	Colon and rectum cancers	Trachea, bronchus, lung cancers
10	Tetanus	Fires	Maternal haemorrhage	Poisonings	Diabetes mellitus	Nephritis and nephrosis	Road traffic injuries
11	Protein–energy malnutrition	Measles	Ischaemic heart disease	Maternal haemorrhage	Self-inflicted injuries	Alzheimer and other dementias	Diabetes mellitus
12	Syphilis	Leukaemia	Poisonings	Fires	Stomach cancer	Tuberculosis	Malaria
13	Drownings	Congenital anomalies	Abortion	Nephritis and nephrosis	Liver cancer	Liver cancer	Hypertensive heart disease
14	Road traffic injuries	Trypanosomiasis	Leukaemia	Drownings	Breast cancer	Oesophagus cancer	Self-inflicted injuries

1. The problem

2. The model

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Mexico status on traffic accidents (1)

1. The problem

2. The model

3. Results

4. Conclusions

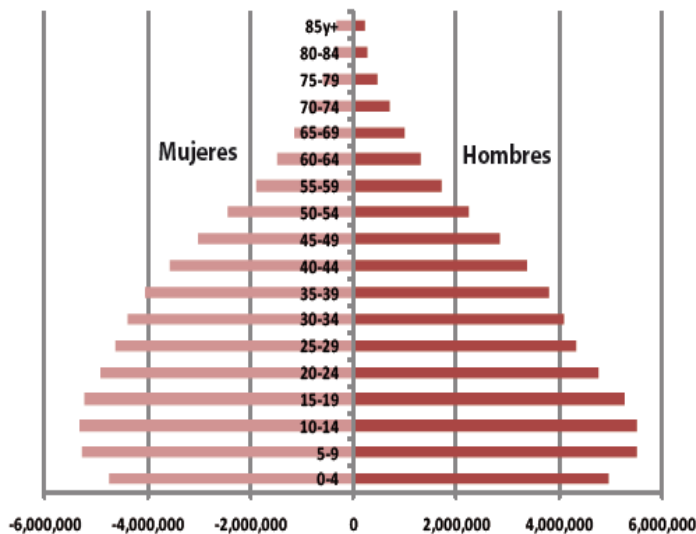
In Mexico are two sources of information: the official one which come from the National Institute of Geography, Statistics and Informatics (INEGI) and others more realistic as the National Council on Accidents Prevention (CONAPRA) or the Mexican Association of Insurance Institutions (AMIS).

Obviously, sometimes the data appear with deep differences but all are consistent in at least one way: this is **a big problem**. Each year die more than 24,000 and it doesn't look to stop increasing. A few countries have had reduced its statistics in recently years but how did they do that? Of course, the most of governments are very interested in gaining a deeper and more technical view of how to manage this kind of risks or at least, how to analyze them.

Mexico status on traffic accidents (2)

- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions

Pirámide poblacional, 2008



Fuente: Proyecciones de población CONAPO.

Jóvenes de 15 a 29 años
47.6%
50,749,103

Población total 106,682,518

Defunciones en jóvenes, 2008



Fuente: CENAPRA, 2008.

INEGI, 2008
17,046 muertos

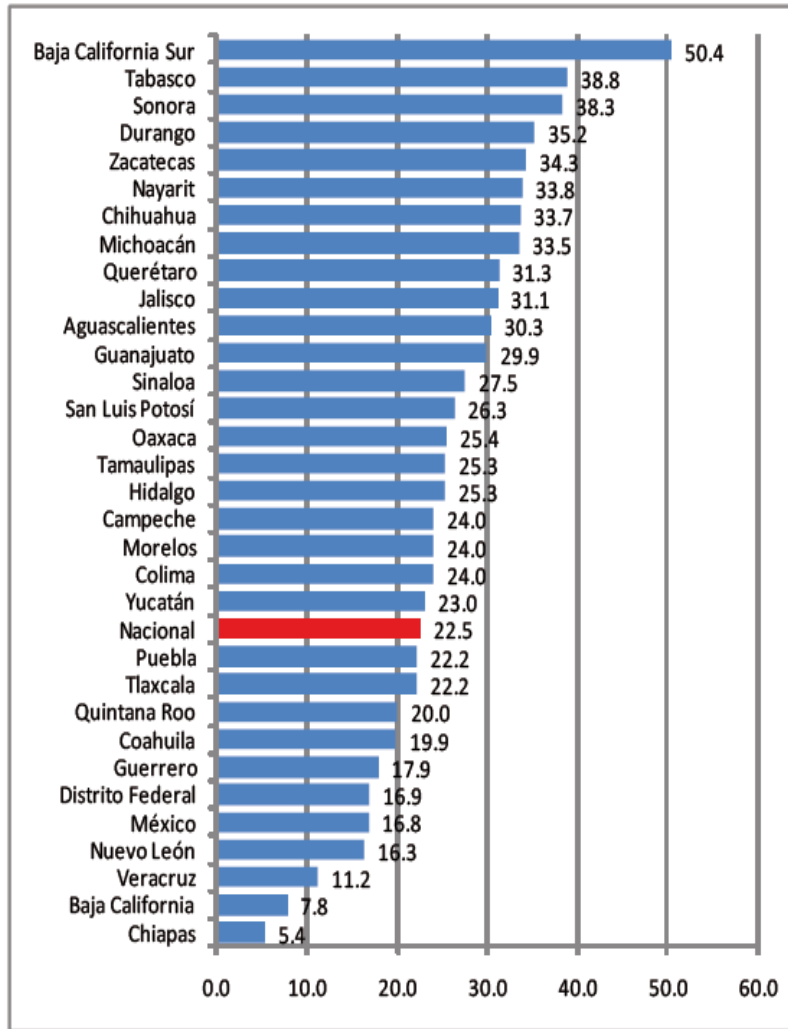
Vs.

CONAPRA, 2008
24,129 muertos

16,852 accidentes de vehículo
7,269 atropellados



Mexico status on traffic accidents (3)



Entidad	Accidentes de vehículo	Atropellados	ATVM	Tasa
Chiapas	221	18	240	5.4
Baja California	197	44	241	7.8
Veracruz	581	235	816	11.2
Nuevo León	499	219	718	16.3
México	1416	1046	2462	16.8
Distrito Federal	589	904	1493	16.9
Guerrero	494	69	563	17.9
Coahuila	357	161	517	19.9
Quintana Roo	224	30	254	20.0
Tlaxcala	186	62	248	22.2
Puebla	830	410	1241	22.2
Nacional	17053	6975	24028	22.5
Yucatán	336	102	437	23.0
Colima	102	41	142	24.0
Morelos	313	86	399	24.0
Campeche	162	27	189	24.0
Hidalgo	436	173	609	25.3
Tamaulipas	599	200	799	25.3
Oaxaca	760	144	904	25.4
San Luis Potosí	460	192	651	26.3
Sinaloa	551	178	729	27.5
Guanajuato	987	516	1503	29.9
Aguascalientes	223	118	341	30.3
Jalisco	1497	666	2163	31.1
Querétaro	388	141	529	31.3
Michoacán	1112	220	1332	33.5
Chihuahua	914	217	1131	33.7
Nayarit	247	80	327	33.8
Zacatecas	396	78	474	34.3
Durango	426	118	544	35.2
Sonora	756	197	953	38.3
Tabasco	558	234	792	38.8
Baja California Sur	231	47	278	50.4

Tasa por 100.000 habitantes

Elaborated by the *Observatorio Nacional de lesiones, CENAPRA 2010.*

Iniciativa Mexicana de Seguridad Vial



The model (1)

Mexico, before 2000



1. The problem

2. **The model**

3. Results

4. Conclusions

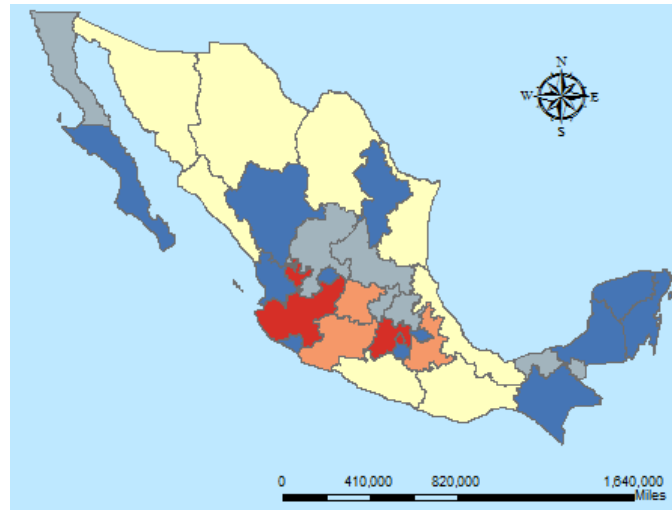
Aspects considered: Frequency, Severity and Age.

A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

Well, as we will see, in Mexico the things are ugly but there is strong evidence that if we do nothing it can be worse in the future.

The model (1)

Mexico, 2000



1. The problem

2. The model

3. Results

4. Conclusions

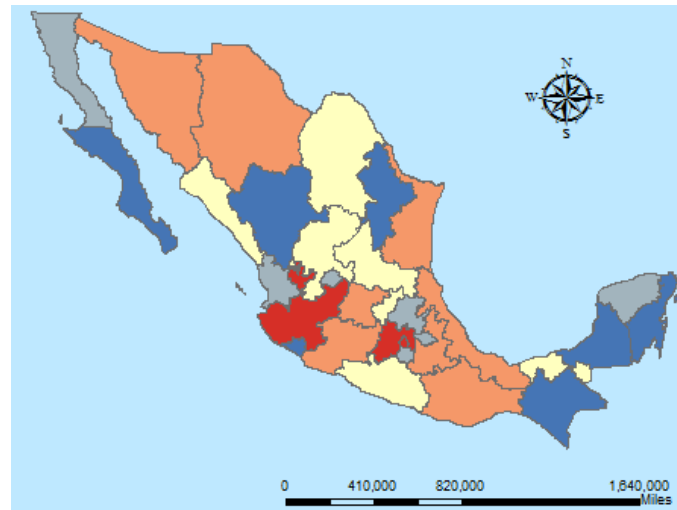
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The model (1)

Mexico, 2001



- 1. The problem
- 2. **The model**
- 3. Results
- 4. Conclusions

Aspects considered: Frequency, Severity and Age.

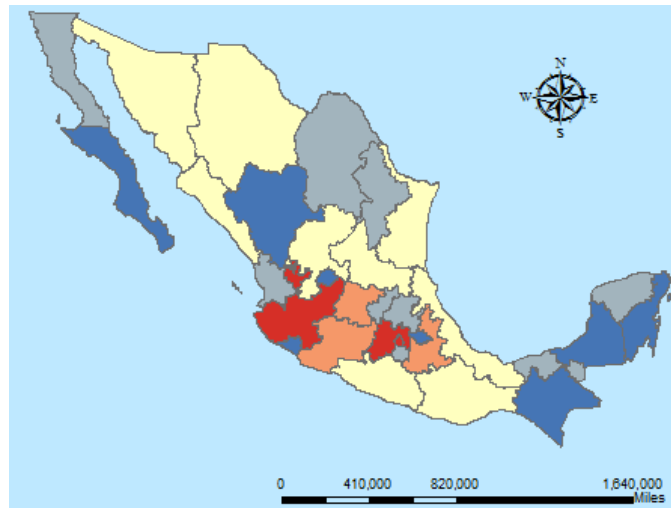
A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

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The model (1)

Mexico, 2002

1. The problem
2. The model
3. Results
4. Conclusions



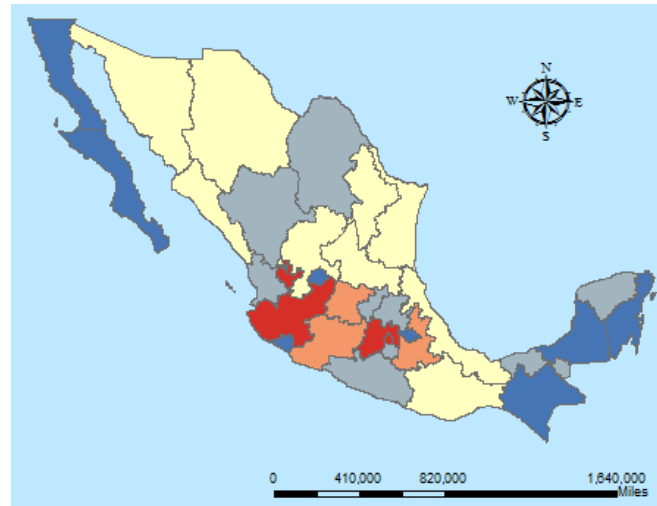
Aspects considered: Frequency, Severity and Age.

A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

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The model (1)

Mexico, 2003



1. The problem

2. The model

3. Results

4. Conclusions

Aspects considered: Frequency, Severity and Age.

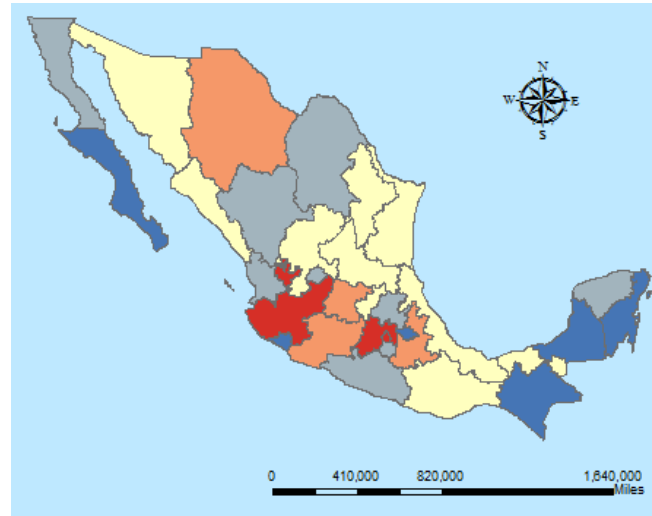
A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

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The model (1)

Mexico, 2004

1. The problem
2. The model
3. Results
4. Conclusions



Aspects considered: Frequency, Severity and Age.

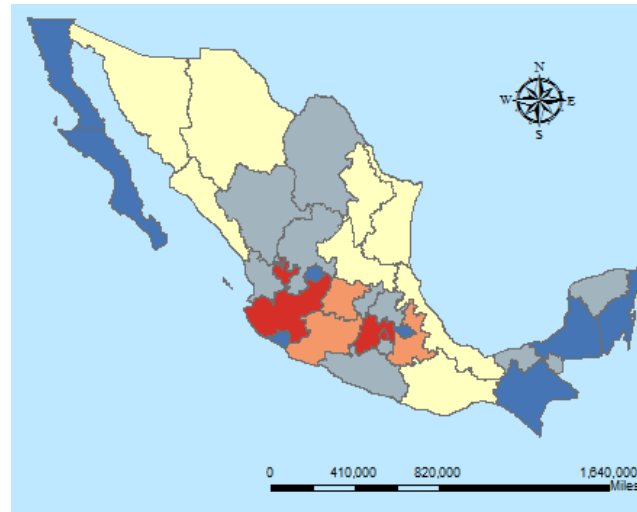
A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

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The model (1)

Mexico, 2005

1. The problem
2. The model
3. Results
4. Conclusions



Aspects considered: Frequency, Severity and Age.

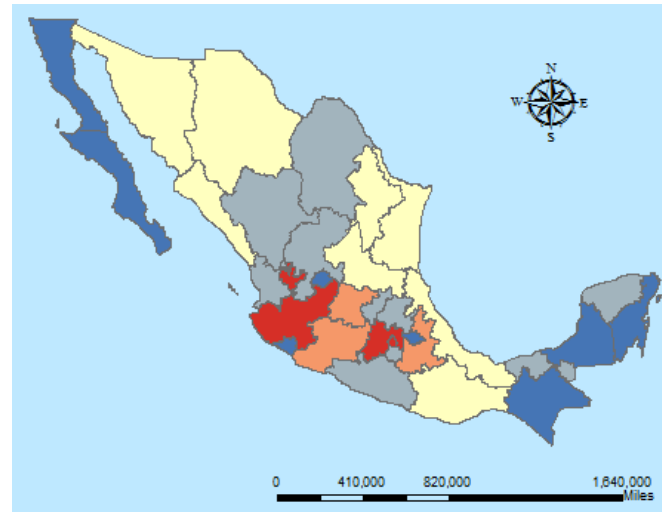
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The model (1)

Mexico, 2006

1. The problem
2. The model
3. Results
4. Conclusions



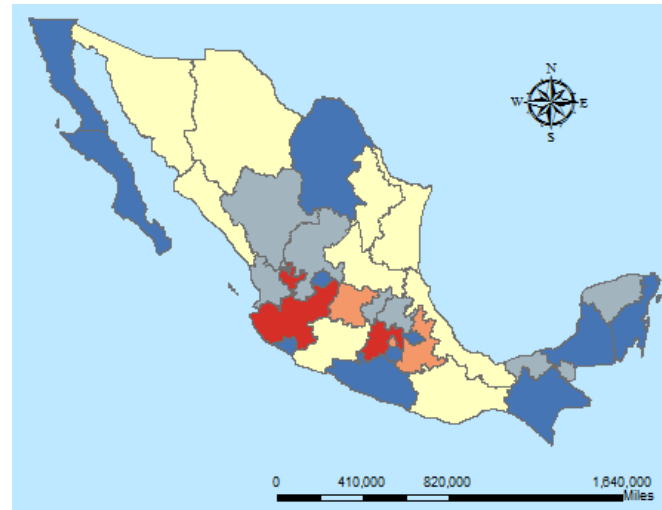
Aspects considered: Frequency, Severity and Age.

A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

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The model (1)

Mexico, 2007



1. The problem

2. The model

3. Results

4. Conclusions

Aspects considered: Frequency, Severity and Age.

A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

Well, as we will see, in Mexico the things are ugly but there is strong evidence that if we do nothing it can be worse in the future.

The model (1)

Mexico, before 2020

1. The problem
2. **The model**
3. Results
4. Conclusions



Aspects considered: Frequency, Severity and Age.

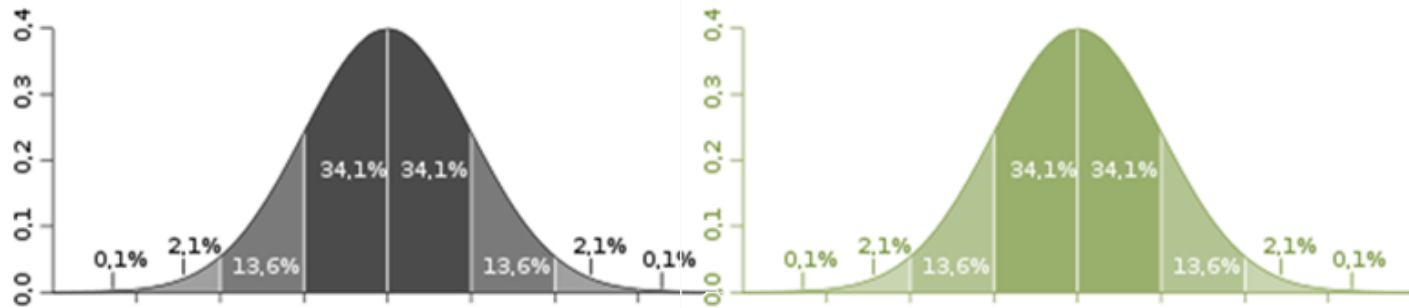
A generalized hypothesis is that the frequency and severity have changed but in what way can we state that?

The model (2)

- A Type I error is a **false POSITIVE**; and **P** has a **single** vertical line.
- A Type II error is a **false NEGATIVE**; and **N** has **two** vertical lines.

A table as follows can be useful in understanding the concept -

	Not Reject Null Hypothesis (H_0)	Reject Null Hypothesis (H_0)
Null Hypothesis (H_0) is true	GOOD	BAD - Incorrectly Reject Null Type I Error False Positive
Alternative Hypothesis (H_1) is true	BAD - Incorrectly Accept Null Type II Error False Negative	GOOD



1. The problem
2. The model
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The model (3)

1. The problem

2. The model

3. Results

4. Conclusions

In this work a semi-Markov reliability stochastic model is proposed as a useful tool for predicting the evolution of the traffic accidents (TA) and the probability of be involved in one by each group of age. This model, when compared to the most common statistical data analyses, has the following advantages:

- i) not only is the randomness in the different states in which the population can evolve into considered, but also the randomness of the age attained at the moment of the event;
- ii) all the states are interrelated, therefore any improvements are also considered;
- iii) a large number of states can be considered;
- iv) fewer and less rigid working hypotheses are needed.

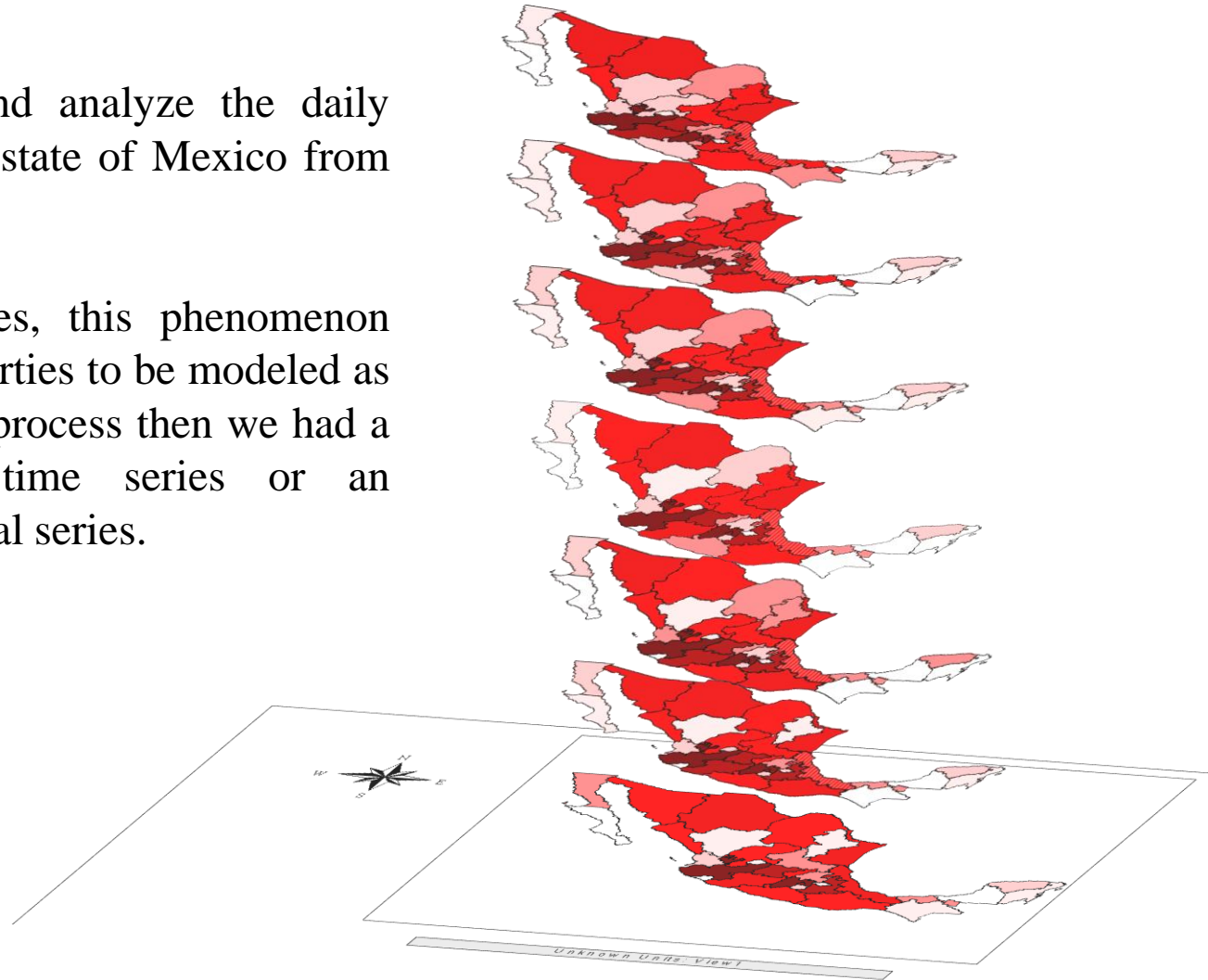
A detailed theoretical analysis of semi-Markov processes was produced in Howard [3, 4]. Since then, they have been applied in a number of scientific fields including: engineering applications (systems reliability) [3–6], finance [7], insurance, actuarial and demographic sciences [6, 8, 9]. Semi-Markov models have also been employed in the field of biomedicine, for example, in applications to prevent, screen, and design cancer prevention trials, in Davidov [10], and Davidov and Zelen [11], respectively.

The model (4)

1. The problem
2. **The model**
3. Results
4. Conclusions

We search and analyze the daily data for each state of Mexico from 2000 to 2007.

As time series, this phenomenon has rich properties to be modeled as an stochastic process then we had a multivariate time series or an spatio-temporal series.



The model (5)

Theoretical support

1. The problem

2. The model

3. Results

4. Conclusions

Theorem 1 *If a Markov process is irreducible and not lattice, then*

$$\lim_{t \rightarrow \infty} \Pr\{x(t) = j, J_{N_{t+1}} = i, S_{N_{t+1}} - t \leq z \mid J_0 = k\} = \frac{p_{ji}}{\mu_{jj}} \int_0^z [1 - F_{ji}(u)] du, \quad (1)$$

where μ_{jj} is the mean recurrence time of state j . This theorem gives the asymptotic probability that a component is found in state j , that the next state is i and that the residual life in state j is not greater than z .

Another very useful theorem gives a way for calculating the limiting probability that the process is found in a given state, starting from any initial state. This theorem is stated correctly as Theorem 5.22 in Çinlar (1975), whereas the corresponding Theorem 5.16 of Ross (1970) assumes unnecessarily that the Markov chain J_r is aperiodic. Let μ_i be the mean sojourn time in state j , given by

Theorem 2 *Suppose J_r is irreducible recurrent, π is a solution of $\pi^T P = \pi^T$ (that is, the invariant distribution for P). Then, for any initial state i*

$$p(j) = \lim_{t \rightarrow \infty} \Pr(x(t) = j \mid J_0 = i) = \frac{\pi_j \mu_j}{\sum_{k=1}^m \pi_k \mu_k}, \quad (2)$$

providing the distribution of the time between two successive occurrences of j is not lattice.

We also recall that $p(j) = \mu_j / \mu_{jj}$.

The model (6)

Theoretical support

1. The problem
2. The model
3. Results
4. Conclusions

A particular semi-Markov process is the Weibull-Markov process, introduced by Van Casteren et al. (2000). We can describe this process as follows: when the component has just entered state $x = i$, $m - 1$ independent times are generated according to $m - 1$ Weibull distributions with shape and rate parameters (β_i, λ_{ij}) , for $j = 1, \dots, m$ and $j \neq i$; the next state and the sojourn time in state i are jointly identified by the minimum of these. It can be shown, by standard probability calculations, that this method yields

$$p_{ij} = \left(\frac{\lambda_{ij}}{\lambda_i} \right)^{\beta_i}, \quad \text{with} \quad \lambda_i = \left(\sum_{j \neq i} \lambda_{ij}^{\beta_i} \right)^{1/\beta_i} \quad (3)$$

$$F_{ij}(t) = 1 - e^{-(\lambda_i t)^{\beta_i}} = F_i(t) .$$

Therefore, after choosing the next state according to the transition matrix P , the conditional duration distribution depends on the current state only. As a special case, when $\beta_i = 1$ the Markov process (with exponentially distributed sojourn times) is obtained. Using Theorem 1, we can show that the transition rate from state i to state j is given by

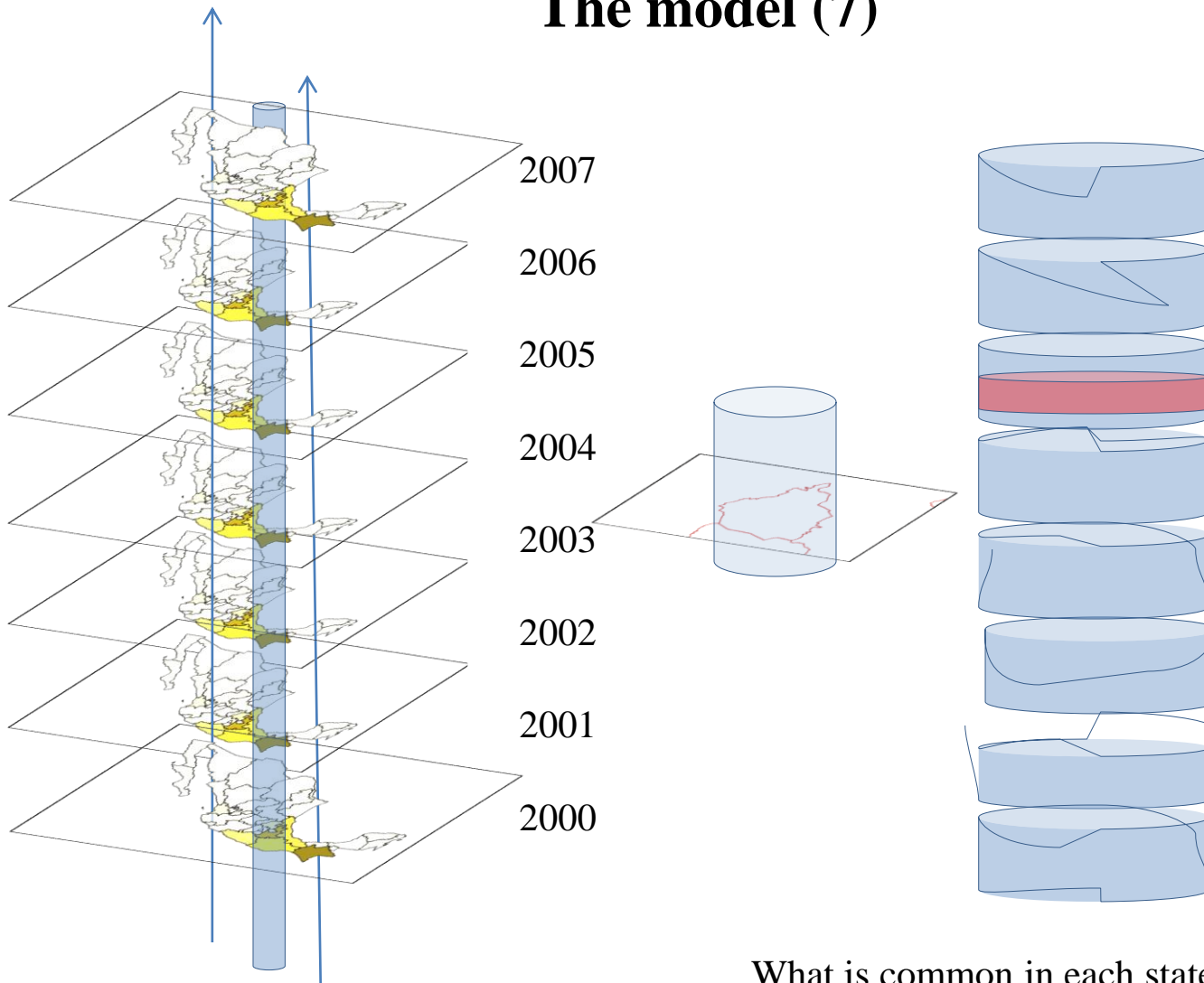
$$\left(\frac{\lambda_{ij}}{\lambda_i} \right)^{\beta_i} \frac{\lambda_i}{\Gamma \left(1 + \frac{1}{\beta_i} \right)},$$

which reduces to λ_{ij} when $\beta_i = 1$.

A system of components which evolve independently as Weibull-Markov processes is called a Weibull-Markov system. We will consider this particular process in our examples.

- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions

The model (7)



What is common in each state?

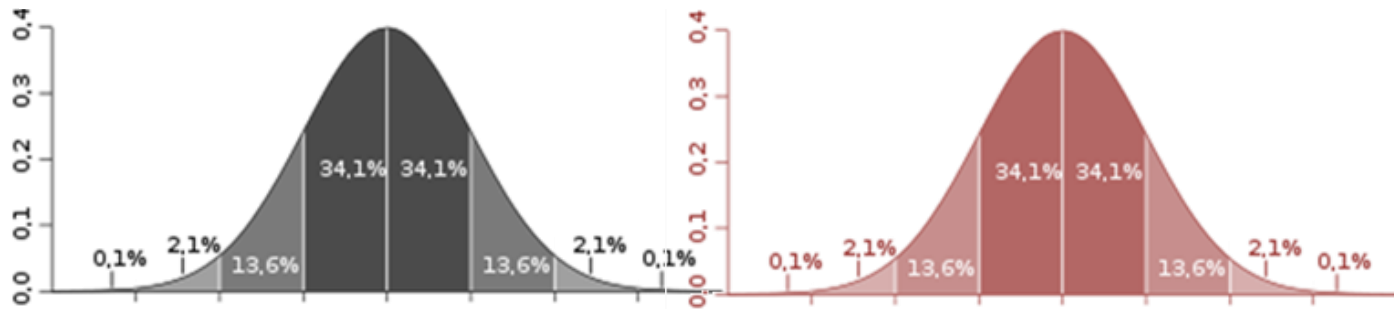
What is the difference among years?

First result (1)

If for any state or region we say something like:

we are controlling this problem, at national level, our state (region) is ranking in the same place...

	Not Reject Null Hypothesis (H0)	Reject Null Hypothesis (H0)
H0: Both, frequency and severity have not changed		Both have increased!
H1: Both, frequency and severity, have changed	BAD - Incorrectly Accept Null Type II Error False Negative	

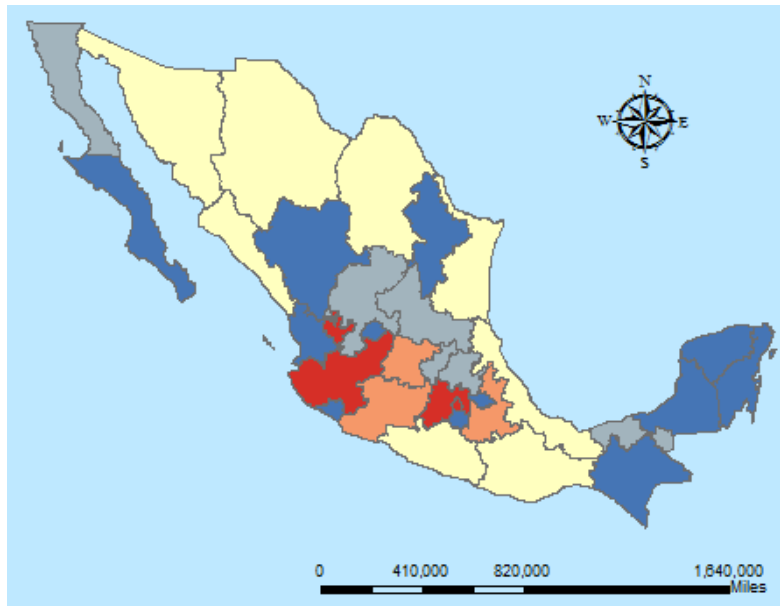


- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions

First result (2)

1. The problem
2. The model
3. Results
4. Conclusions

Did the traffic accidents have changed in Mexico?



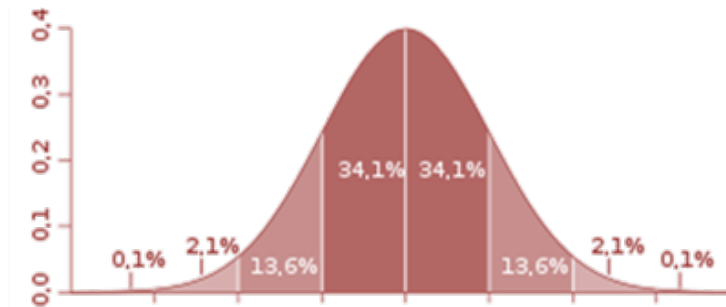
not really...at least not the spatial distribution...

Second result (1)

If we say something like:

The things are going better, the rate of fatal TA are decreasing...

	Not Reject Null Hypothesis (H ₀)	Reject Null Hypothesis (H ₀)
H ₀ : The severity is equal or decreasing		In fact, there are more deaths every year!
H ₁ : The severity is increasing	BAD - Incorrectly Accept Null Type II Error False Negative	



1. The problem

2. The model

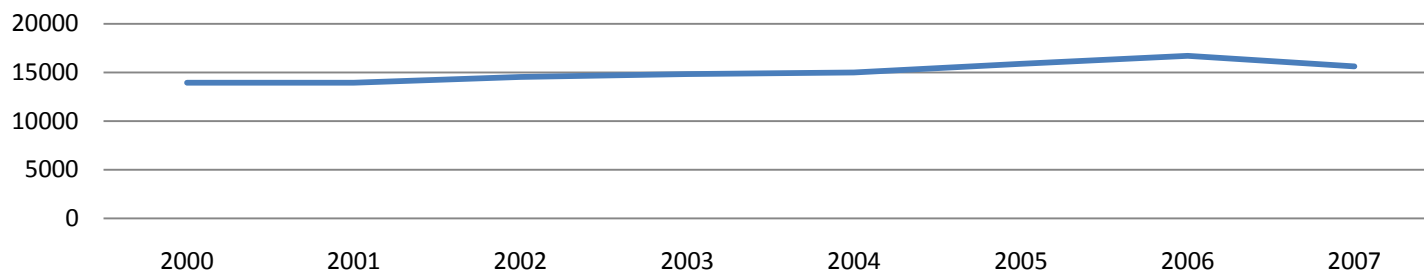
3. Results

4. Conclusions

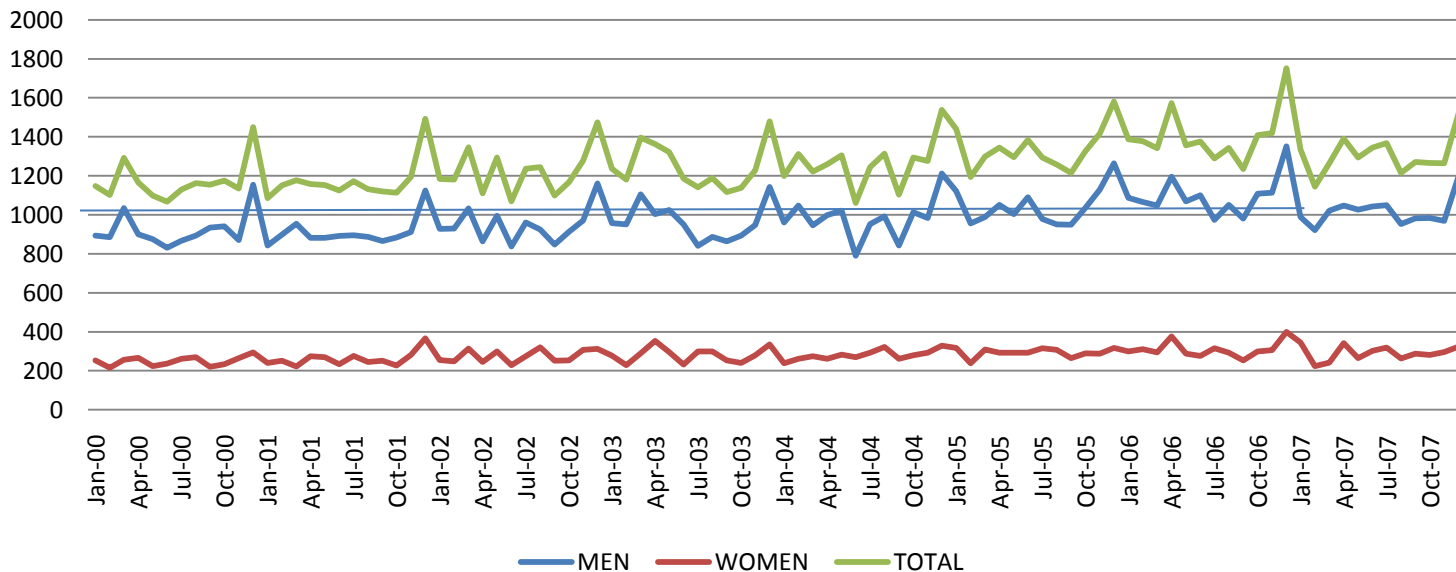
- 1. The problem
- 2. The model
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- 4. Conclusions

Second result (2)

TA in Mexico, series 2000.1:2007.12

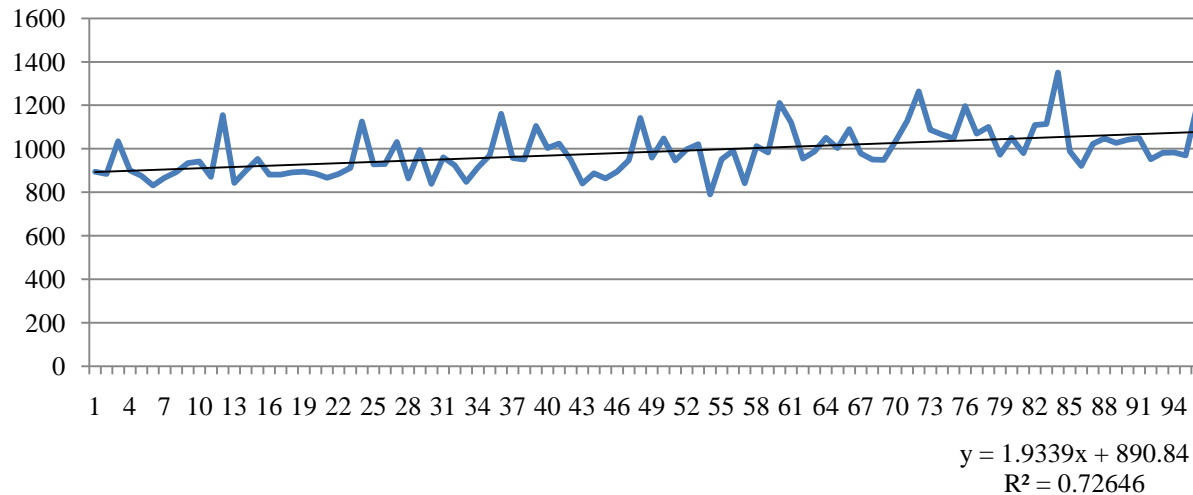


TA in Mexico, series 2000.1:2007.12

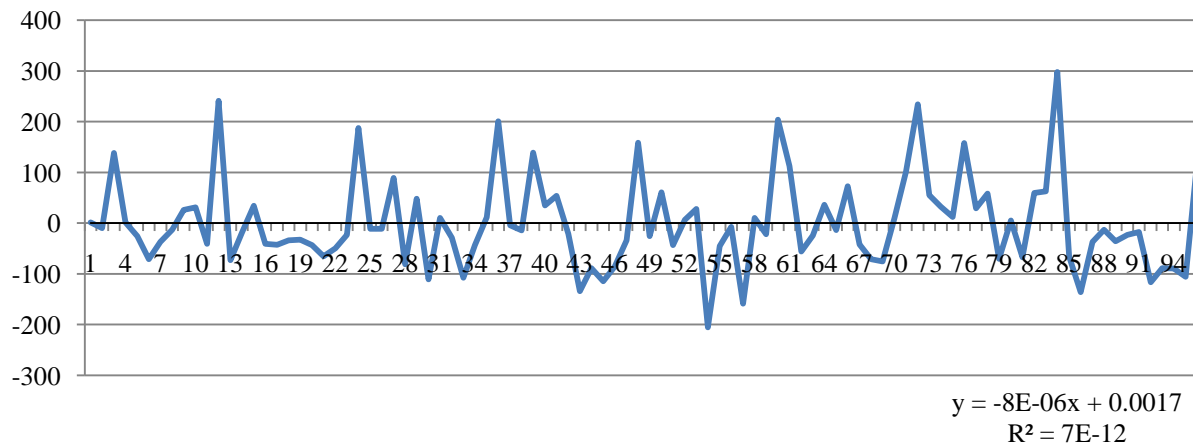


Second result (3)

- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions



We use the transformation to $X_t = Y_t - E(Y_t)$ under trend of linear model.

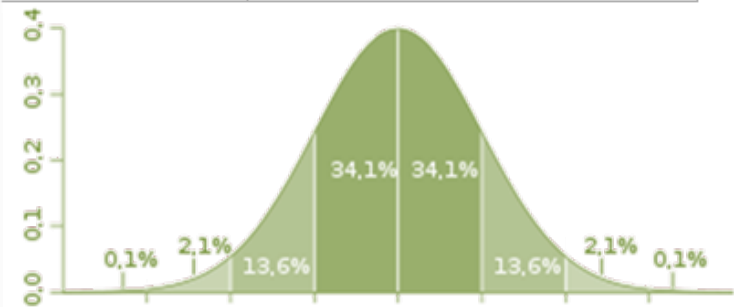


Third result (1)

If we say something like:

Is a national problem and the magnitude is the same in all the states...

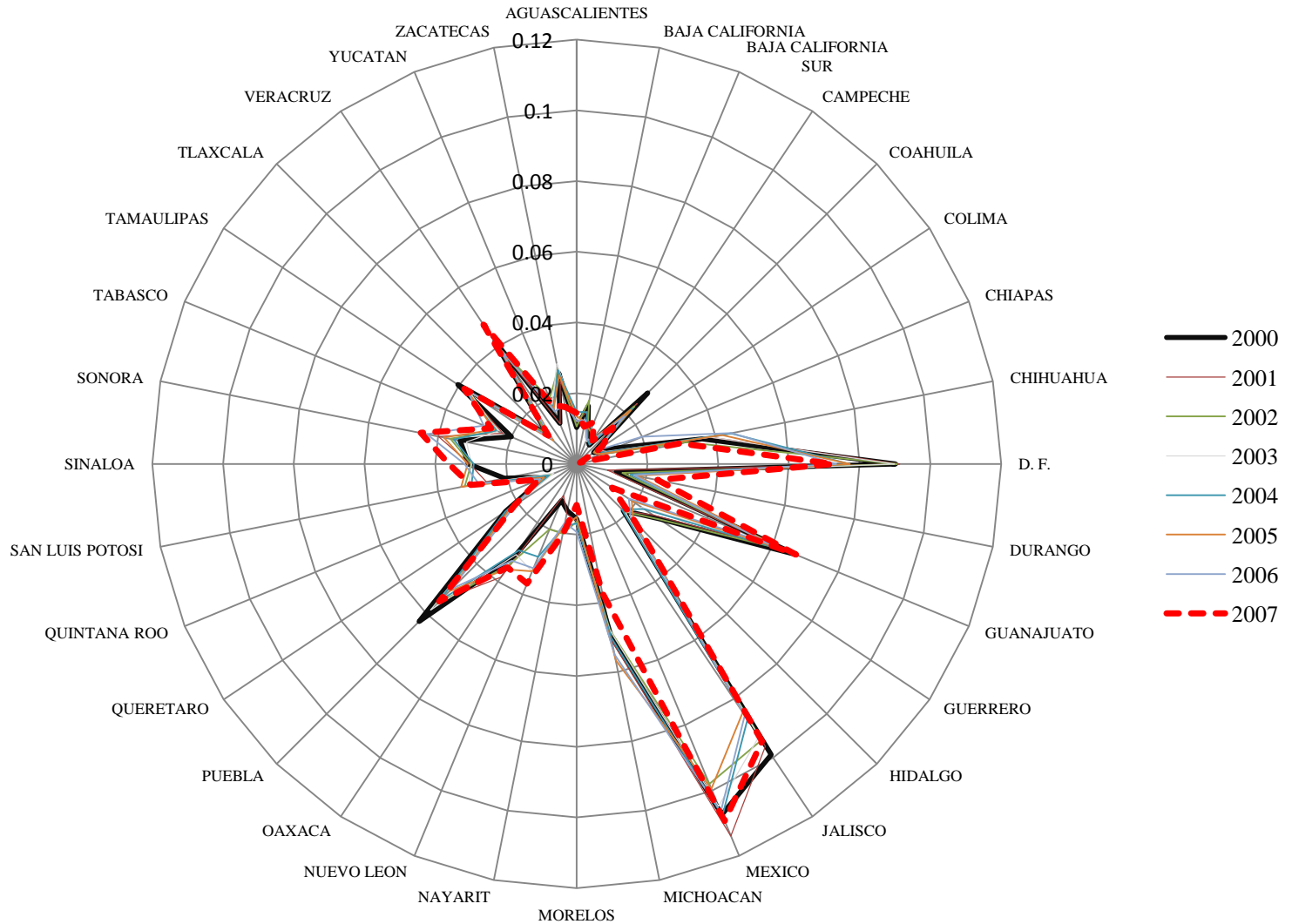
	Not Reject Null Hypothesis (H ₀)	Reject Null Hypothesis (H ₀)
H ₀ : All the states have the same magnitude		There are a few states doing better!
H ₁ : All the states have the same problem	BAD - Incorrectly Accept Null Type II Error False Negative	



- 1. The problem
- 2. The model
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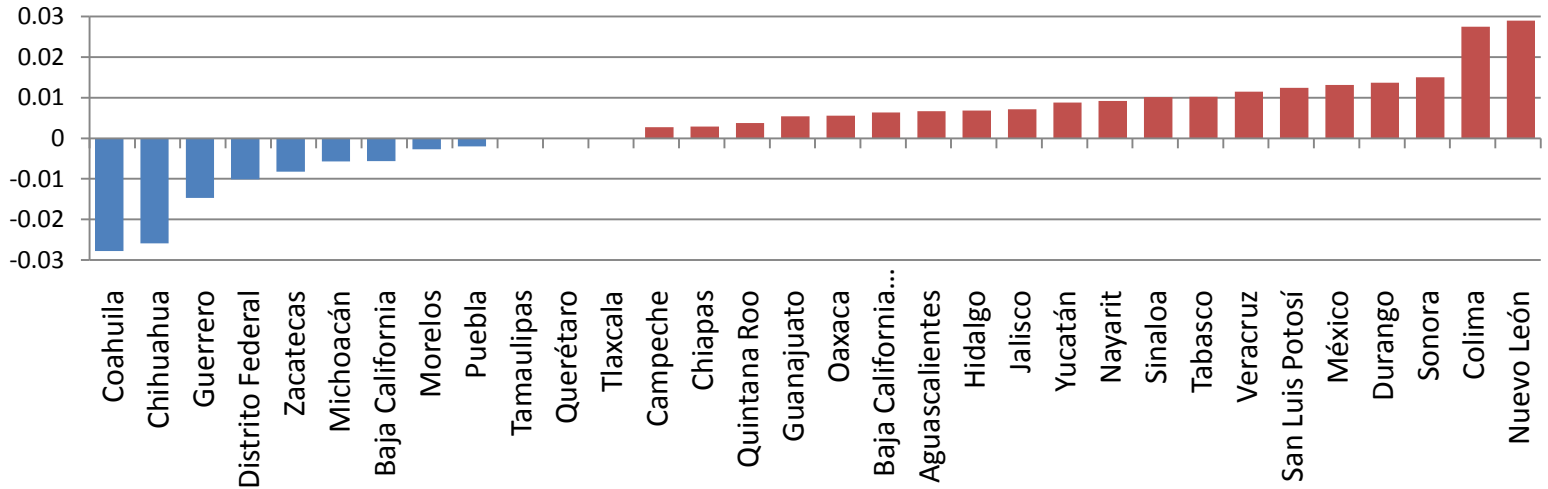
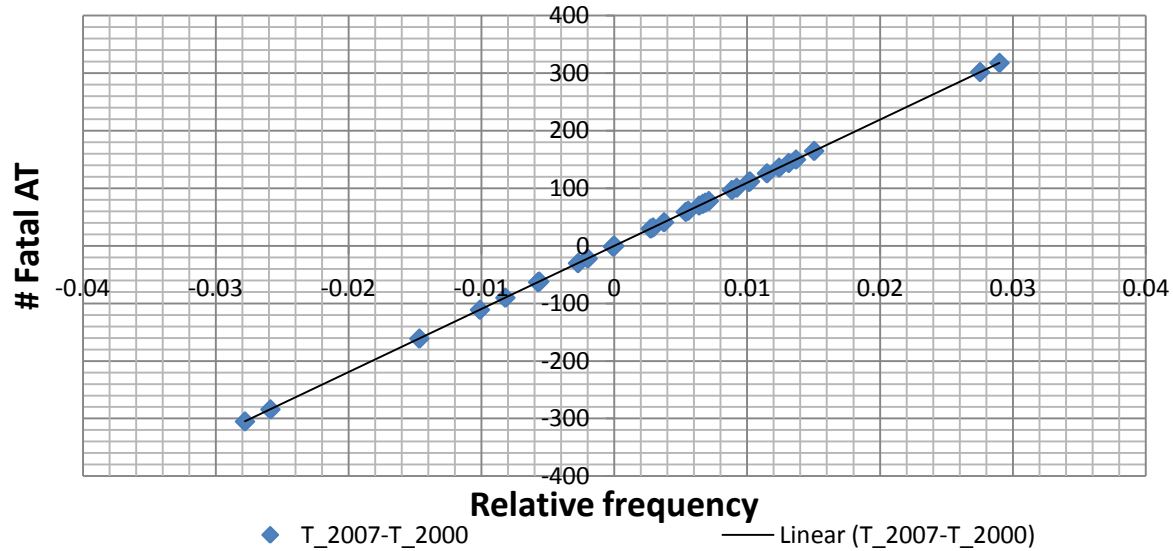
Third result (2)

- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions



Third result (3)

- 1. The problem
- 2. The model
- 3. Results
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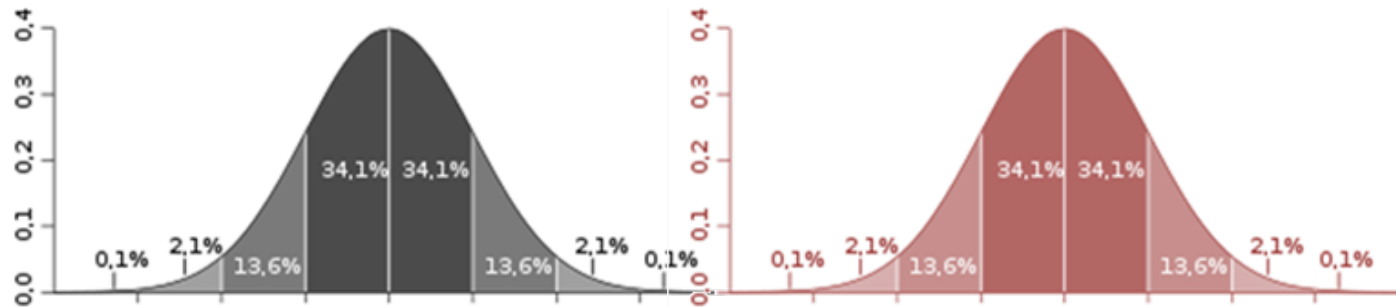


Fourth result (1)

If we say something like:

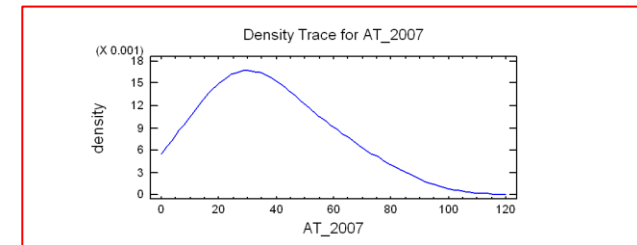
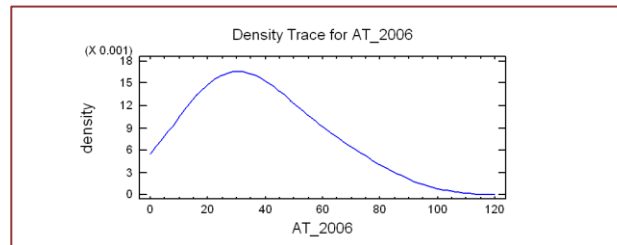
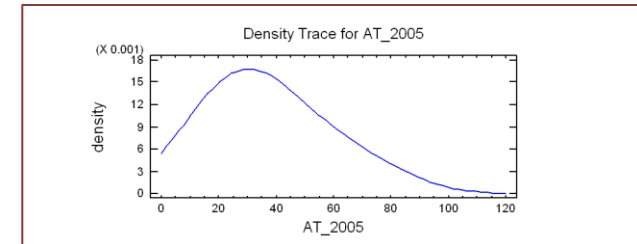
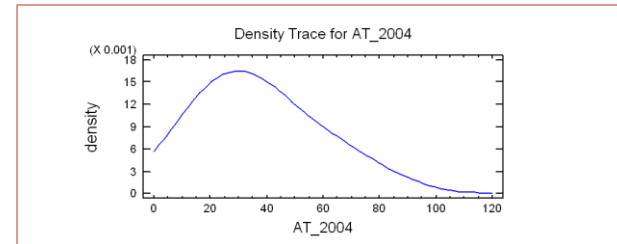
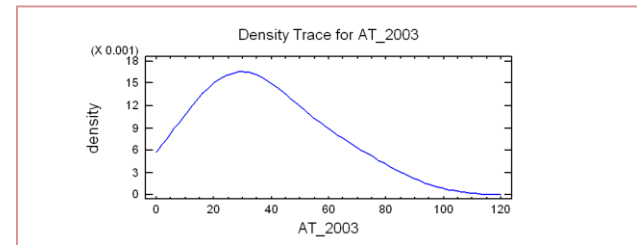
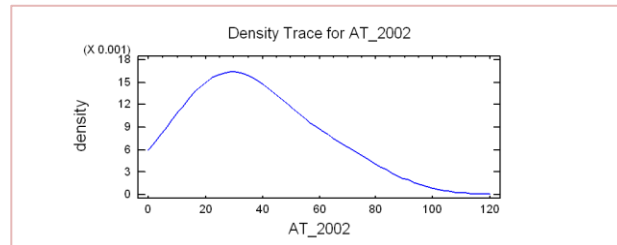
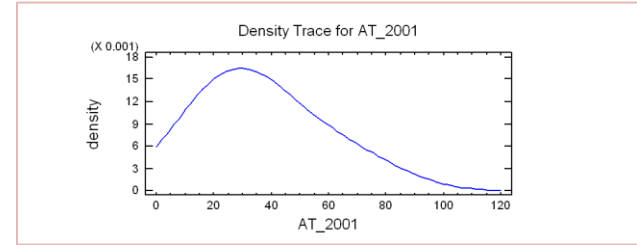
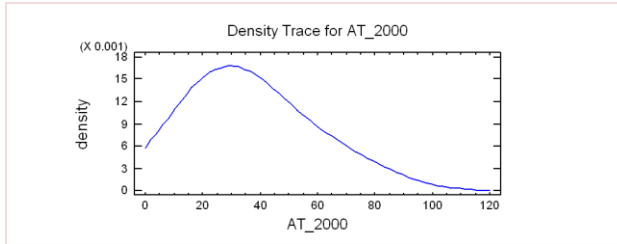
This problem is the same for young and old people...

	Not Reject Null Hypothesis (H ₀)	Reject Null Hypothesis (H ₀)
H ₀ : The severity is the same for all ages		The most of involved people is between 15 and 29 years old!
H ₁ : The severity is not the same for all ages	BAD - Incorrectly Accept Null Type II Error False Negative	



Fourth result (2)

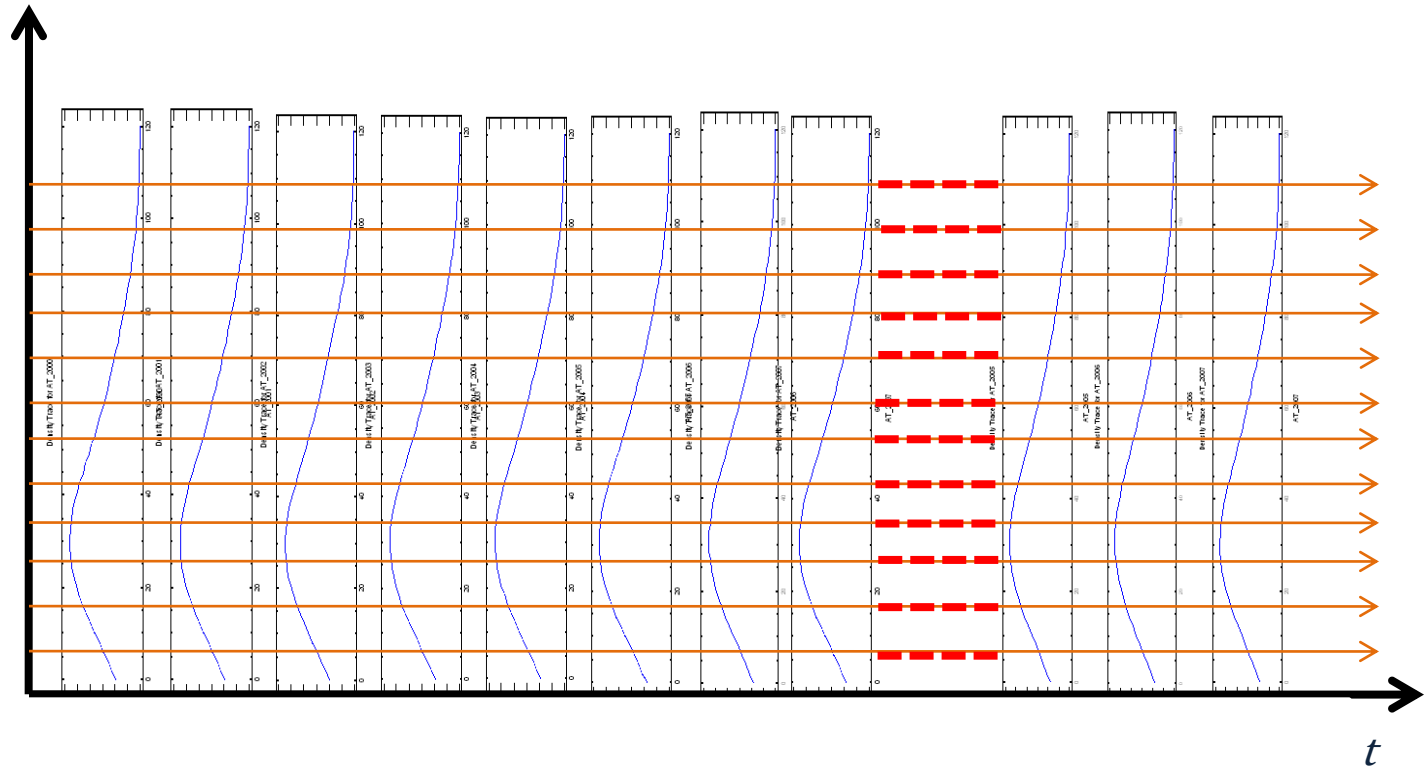
- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions



Fourth result (3)

The time elapsed from new born until the TA occurrence is estimated by the age at death. Then we can establish a “vulnerable cohort” according with the estimations of vulnerability and crude rates (Harvey Sánchez and Luis Chias, 2008). This is not an extrapolation is a reconstruction.

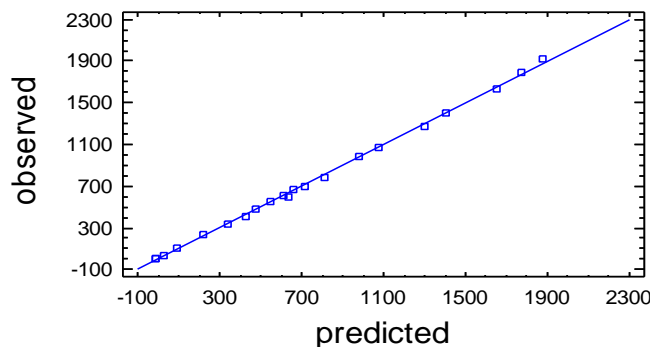
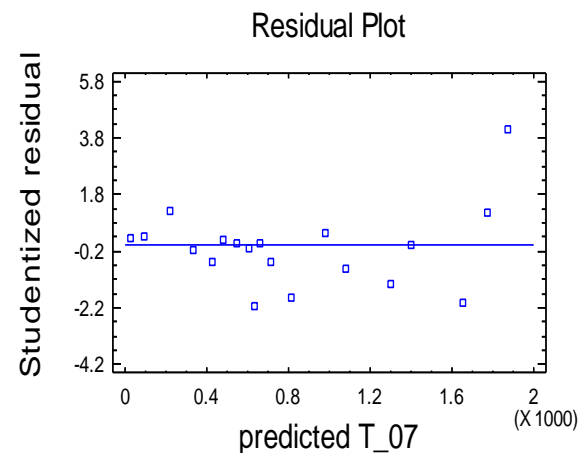
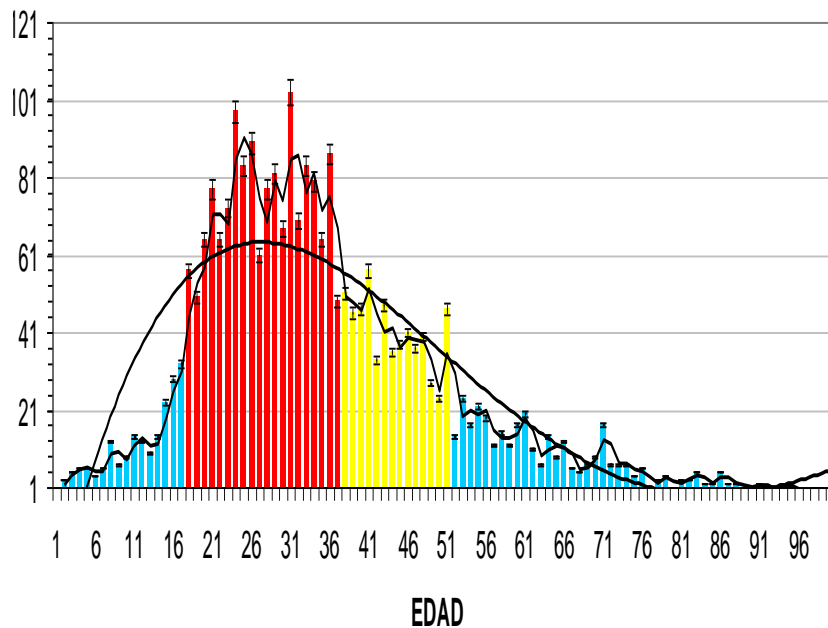
1. The problem
2. The model
3. Results
4. Conclusions



Fourth result (4)

And it looks like reality?...it does...

- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions



Statistics of regression

Correlation coefficient	0.99938924
Determination coefficient R ²	0.99877886
R ² adjusted	0.99843694
Typical error	104.589456
Observations	33

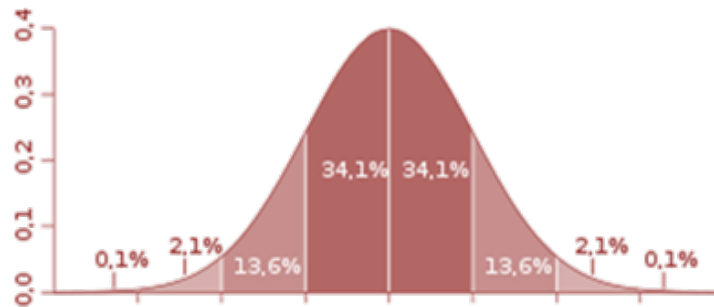


Fifth result (1)

If we say something like:

The things could not be worse...

	Not Reject Null Hypothesis (H ₀)	Reject Null Hypothesis (H ₀)
H ₀ : We are in the worst situation		The TA are increasing all the time, the groups most affected are 15-29, specially the women!
H ₁ : We are not in the worst situation	BAD - Incorrectly Accept Null Type II Error False Negative	



Fifth result (2)

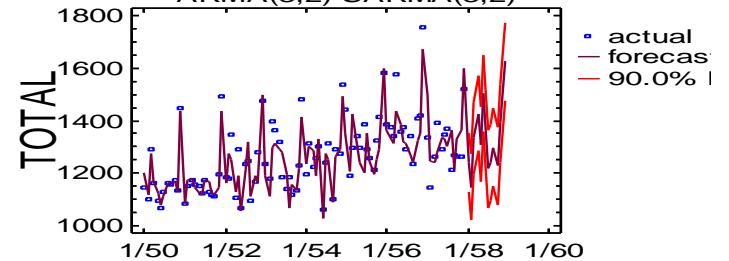
SnapStat: Automatic Forecasting

Data variable: TOTAL

RMSE=65.8378 MAE=47.27 MAPE=3.64%
ME=10.07 MPE=0.63%

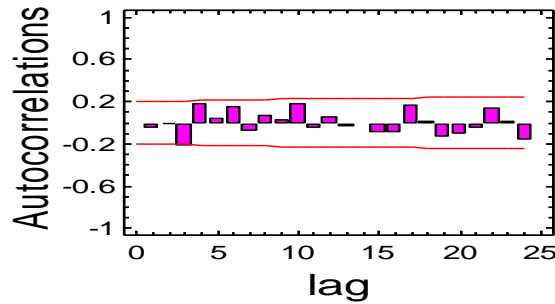
Period	Forecast	Lower 90% Limit	Upper 90% Limit
1/58	1241.71	1128.59	1354.84
2/58	1148.97	1023.2	1274.75
3/58	1333.85	1195.36	1472.33
4/58	1427.65	1284.73	1570.58
5/58	1309.39	1166.32	1452.47
6/58	1501.41	1355.96	1646.86

Time Series Plot
ARMA(3,2) SARMA(3,2)

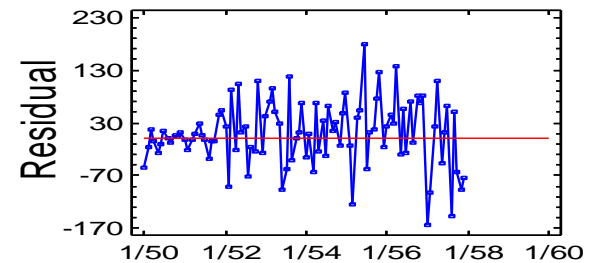


- 1. The problem
- 2. The model
- 3. Results
- 4. Conclusions

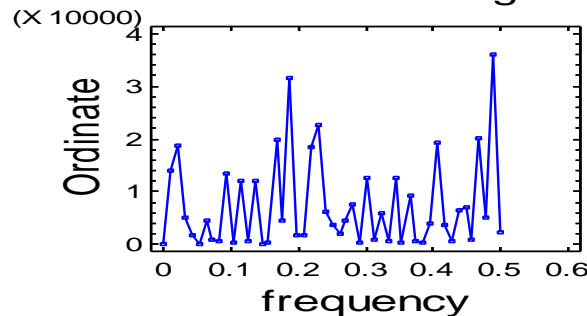
Residual Autocorrelations



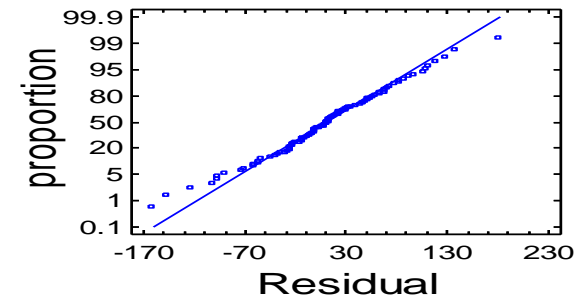
Residual Plot



Residual Periodogram



Normal Probability Plot

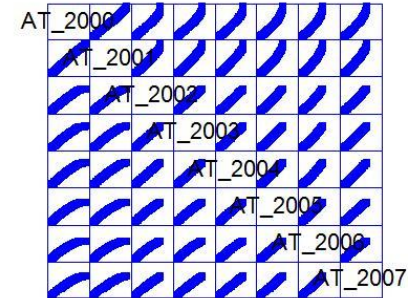
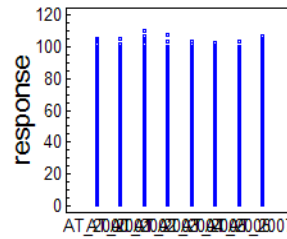


Fifth result (3)

SnapStat: Multiple Sample Comparison

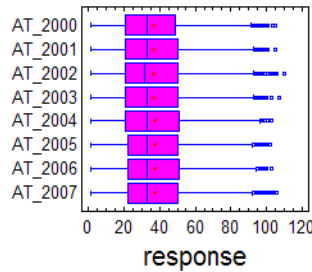
Sample	Count	Mean	Sigma
AT_2000	13927	36.4045	20.4186
AT_2001	13935	36.6995	20.7567
AT_2002	14519	36.471	20.6747
AT_2003	14836	36.7487	20.5529
AT_2004	15010	37.0648	20.5133
AT_2005	15879	37.144	20.2478
AT_2006	16722	37.102	20.251
AT_2007	15628	37.0316	20.2387
	120456	36.847	20.4499

Scatterplot



1. The problem
2. The model
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4. Conclusions

Box-and-Whisker Plot



ANOVA Table

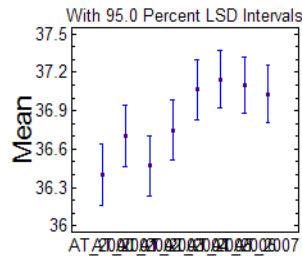
Source	Sum of Squares	Df	Mean Square	F-Ratio
Between	8959.08	7	1279.87	3.06
Within	5.0365E7	120448	418.147	
Total	5.0374E7	120455		

P-Value = 0.0032

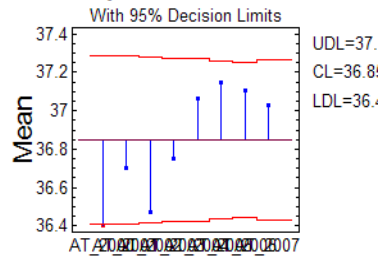
Variance Check

Cochran's C test: 0.128682
P-Value = 0.0267

Means Plot



Analysis of Means Plot



Probabilities estimation

There is a positive correlation between annual series and age distribution.

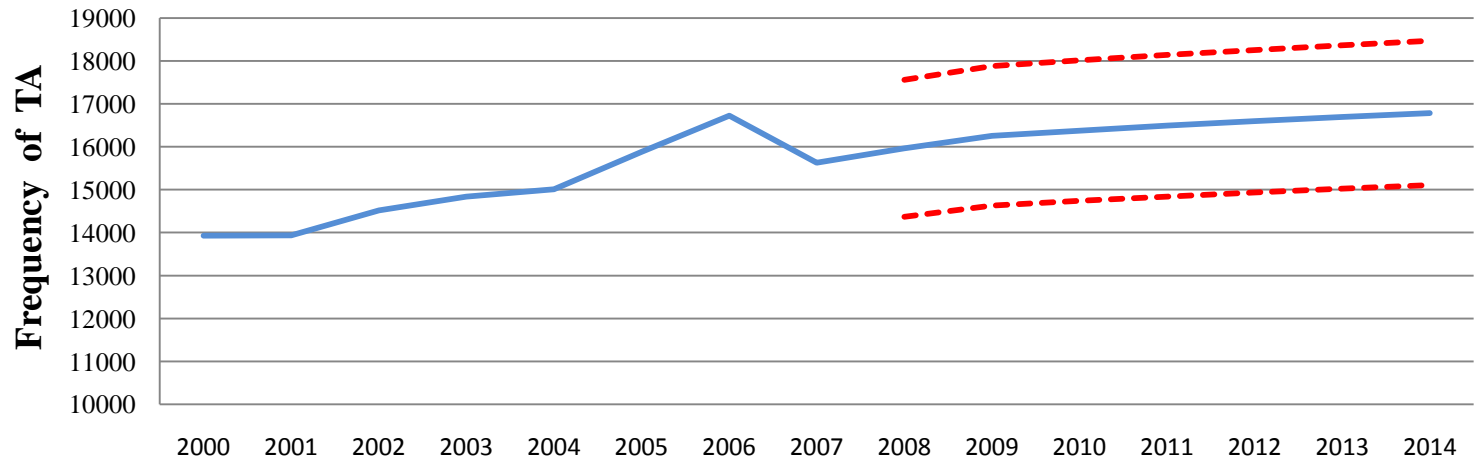
There is a statistically significant relationship between the variables at the 99% confidence level.

(Harvey Sánchez and Luis Chias, 2008).



Final results

Total TA, Mexico, series 2000-2007. Forecast until 2014



The forecast model to the time series is

$$TA(t) = -14.16 + 0.62 * TA(t-1) - 0.49 * TA(t-2) + 1.32 * TA(t-3) - 0.23 * TA(t-4) - 0.18 * TA(t-5)$$

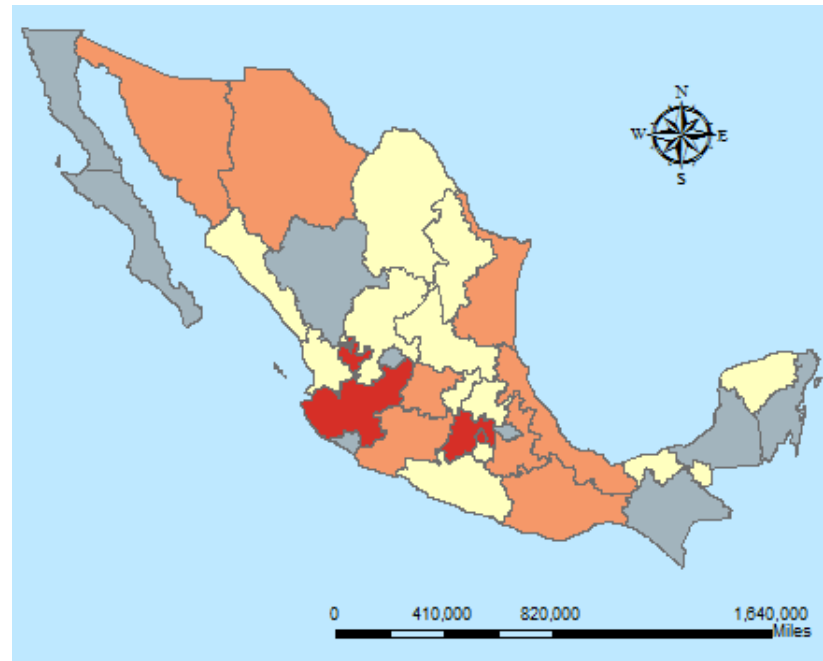
Among others bad things, we will experience more frequency of TA and, if we do nothing, the severity will increase until uncontrollable levels. In this sense, the WHO's expectations are going to be optimistic.

- 1. The problem
- 2. The model
- 3. Results
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Final results

Well, as we will see, in Mexico the things are ugly but there is strong evidence that if we do nothing it can be worse in the future.

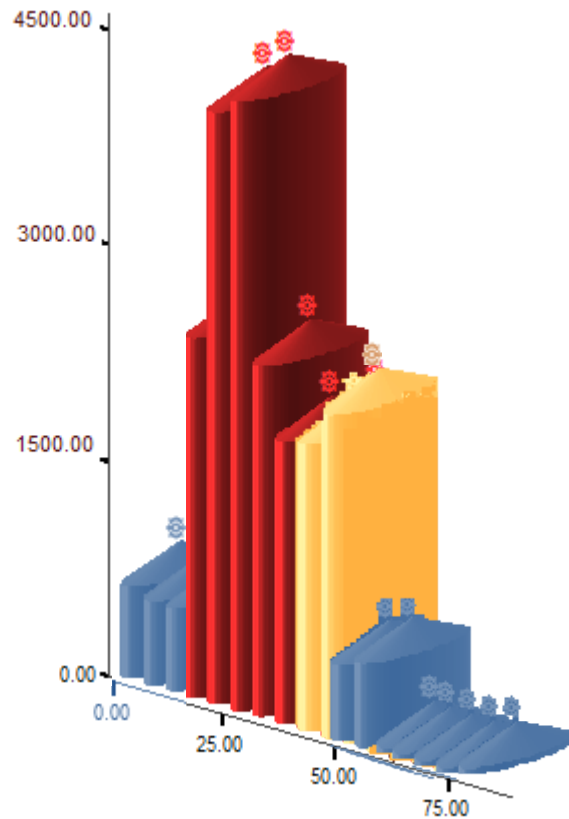
1. The problem
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Among others bad things, we will experience more frequency of TA and, if we do nothing, the severity will increase until uncontrollable levels. In this sense, the WHO's expectative are going to be optimistic.

Conclusions (1)

1. The problem
2. The model
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4. Conclusions



*Forecast of deaths by a TA to 2020
per age groups.*

With this kind of models we can compare actions and politics in the frame of WHO's directions with theoretical basis.

The stochastic framework allows us to try with the accuracy of data, a big deal at this moment.

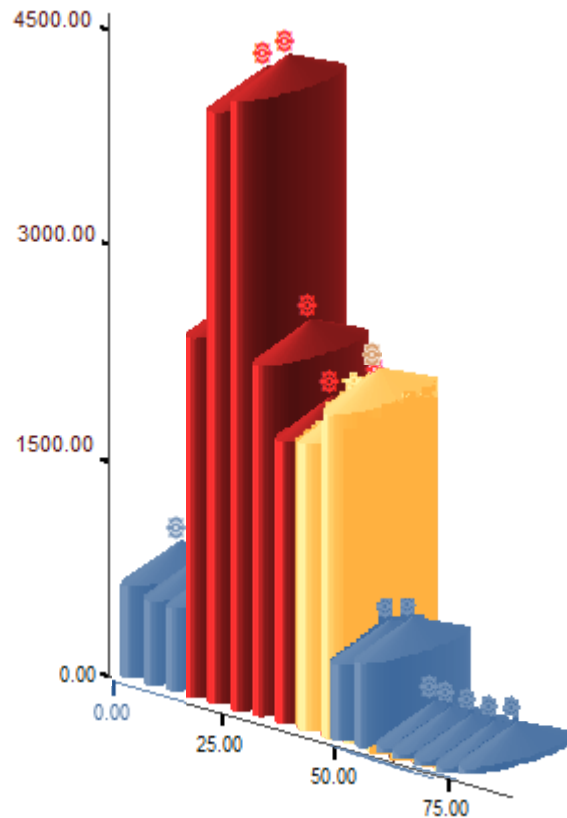
By this way, we can catch up the dynamic aspects of the phenomenon and propose several sceneries and simulate the evolution of the frequency and severity.

It seems to work because we can obtain the real data through the model with high level of significance.

If it can tell us something about future, this is not a beautiful one. The groups of people between 15 and 29 years old are going to be the most impacted with this problem.

Conclusions (2)

1. The problem
2. The model
3. Results
4. Conclusions



*Forecast of deaths by a TA to 2020
per age groups.*

In Mexico, the next decade:

- More than 2 million people will be involved in an TA.
- At least 250,000 are going to die by a TA, more than 70,000 will be pedestrians.
- The young people will expect to have a TA with the highest rates. Around 100,000 fatal TA will be in people less than 30 years old.
- The government (or someone else) is going to expend a lot of money as consequence of this problem (some people have calculated from 2 to 4% of GNP). If we are optimistic, could think in something between 150'000,000,000 and 300'000,000,000 dlls (1 to 2% of GNP).

Conclusions (3)

1. The problem
2. The model
3. Results
4. Conclusions

As group, we have three kind of goals:

1. Learn how the best researchers raise useful tools for understanding the dynamic of traffic accidents,
2. develop our own tools and show to apply them for solve this and other associated problems as well as questions from different perspectives and approaches, and
3. train people with a multidisciplinary background so needed to meet safety and public health problems.

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Thank you!

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