STATE OF ISRAEL

PRIME MINISTERS OFFICE - CENTRAL BUREAU OF STATISTICS

Transportation Data in Maps

Special Analysis for Influencing Decision Making

Mr. Oren Raz

Israeli Central Bureau of Statistics - GIS Sector

Abstract

The Israeli Central Bureau of Statistics (ICBS) collects and publishes data on traffic volume and road accidents with casualties on non-urban roads**.** Through the course of 2012, the ICBS GIS sector initiated new ways to present transportation data on non-urban roads – maps on a national scale, showing specific related topics. Throughout the process the databases were reviewed and adapted to enable mapping, resulting in a series of maps describing the geospatial aspects of transportation information. New methods for analyzing data for mapping purposes were introduced and implemented, setting primacy for other possible projects.

Key Categories

National Mapping, State and Local Government, Transportation.

1. Introduction

The Israeli Central Bureau of Statistics (ICBS) collects and publishes data on traffic volume and road accidents with casualties on a monthly basis. This data is produced for the use of traffic engineers in the planning and maintenance of roads, in accordance with traffic volume, as well as for the use of the police in law enforcement. In addition, the data is used for economic and traffic research and for the investigation of road accidents.

Until recently, the ICBS published traffic volume data in tables in hard copy publications and on the Internet (Table 1). Road accident data were also published on paper and in an interactive map on the Internet, showing specific detail of singular events, but not on a national scale and with no special analysis of the data (Table 2).

2. New Data Analysis

2.1. Converting Transportation Data into Maps

As of 2012, the ICBS GIS Sector has initiated new ways to present transportation data – maps on a national scale, showing specific related topics. For the first time, a national map of traffic volume counts was produced and published by the ICBS. This map shows road data on a line vector layer with a division into data categories (Fig. 1).

In addition, a new analysis of the road accidents database produced heat maps of fatal road accidents on non-urban highways. These maps will be published over the course of 2013.

2.2. Traffic Counts in Maps

2.2.1 Traffic Counts Methodology

When displaying data on maps, there are directives to follow when presenting data as polygons or points. Polygons should display data normalized or standardized into ratios, relating to the area or to the total figure of the extent of the map (Dent, Torguson & Holder 2009, Peterson 2009). In the case that absolute values have to be shown, a proportional symbol point design should be selected. However, there are practically no suggestions of which rules to follow when it comes to presenting data on a line layer. The search for ideas led to the following directive: Absolute values may be shown on a line layer, but when showing a database ranging over a few years, a short term range should be selected.

2.2.2. Building the GIS Infrastructure for Traffic Counts

ICBS publications provide transportation data on non-urban roads by road segments (ICBS Publication No. 1485, 2012). Every section has a known data collection point where the measuring equipment is deployed, or where there is a known traffic-counting camera (e.g. on toll ways). All counts on a measurement point are aggregated to the entire section. The GIS Sector transformed this tabular data onto a national road GIS layer, and edited it accordingly, thus creating a platform for geographical data collection, in addition to the plain tabular form.

Moreover, traffic surveyors were equipped with GPS devices to mark data collection spots in order to improve the measurement report accuracy. Once the connection between the raw data and a geographical GIS platform was made, a map could be produced.

2.2.3. Producing the Map

The data was categorized and symbolized according to the categories using a standard ESRI 5 color shade. A separate symbology was applied to road segments with no data and this is noted in the legend. Since the map was on a national scale, an inset map was added for the dense central area of Israel. Background information on the map includes major localities for general orientation (Fig. 1).

2.3. Traffic Accidents in Maps

2.3.1 Initial Traffic Accident Methodology

Traffic accident data are collected and updated by the Israel Police and sent to the ICBS on a monthly basis. The publication of traffic accidents in tabular form is very similar to the way traffic counts are published (ICBS Publication No. 1493, 2012). The data is presented on the same road segments (Table 2). Once traffic counts were mapped, a similar attempt was made with road accidents on non-urban roads, specifically fatal road accidents. Because there are too few cases to show each year in Israel, data was taken for the last 5 years, thus following the suggested rule to keep the map within a short term time range. A general map containing all accidents on non-urban roads was produced and then a series of maps showing different time frames, such as weekdays only, weekends only, fatal and non-fatal accidents, etc.

However, the process of quality control revealed that something was wrong. Comparisons between the tabular data and what appeared on the maps showed discrepancies. Eventually, the cause for this was found: When an accident occurred within the boundaries of a road section, the data was aggregated to that section. However, when an accident occurred at the junction of two or more road sections, it was recorded in the tabular form in each road section separately. This standard is satisfactory when each road section is noted separately, but when the data was transformed into the GIS system, these accidents were in fact duplicated to the various road sections, thus distorting the general picture.

In addition, it was found that some of the data did not have exact geospatial information, because the Israel Police has not yet fully implemented procedures that call for GPS generated coordinates for each accident investigated. Thus, some of the accidents were affiliated with a road number, not the correct road section, and they found their way to the road's middle section. This caused another distortion in the map.

The lack of congruence between the tabular database and the GIS platform could not be modified satisfactorily, and these maps were at a deadlock.

2.3.2 Changing Direction to Heat Maps

The failure of the GIS platform to correctly show accidents on the road section layer led to a different direction. The accident database was reviewed again, and was modified to meet GIS standards. Each accident was presented as an independent entity along with its XY coordinates, which were collected by the Israel Police at the scene of the accident. If the geospatial information was not precise, that accident was not taken into account. Although meaning a loss of a very small percentage of the data, the remaining data were 100% accurate.

2.3.3 Preparing Heat Maps with Road Accident Data

The ICBS Transportation Sector prepared the final database as requested by the GIS Sector. The Excel sheets were modified to meet GIS standards (translation of field names from Hebrew to English, redefining text fields to numeric fields, etc.) and were double checked for missing data in comparison with the original database.

Next, this data was exported into a GIS vector point layer and uploaded into ESRI's Spatial Analyst extension. A kernel density type was selected, with a 1,000 meter search radius and a 100 square meter output cell size, resulting in an IDW raster layer that shows the density for the accidents (Fig. 2).

3. Comparing and Publishing the Data

3.1. Putting the Maps Together

In the final stage we produced a map showing the national non-urban road grid, which combined a vector layer of traffic volume counts with a raster layer of fatal road accident hot spots (Fig. 3). This map demonstrates the GIS capability of providing a different perspective to a national analysis, and shows how one map can represent a database with thousands of entities.

The raster layer was symbolized in a way that values lower than two (=2 accidents) were not visible (hollow), thus emphasizing the actual hot spots. The vector point layer was symbolized as one accident and placed under the raster layer, showing all individual accidents without obscuring the map background as the IDW layer did. The map was presented for the first time in a national map contest.

The ICBS leaves it to the public to work together to consider the implications. However, even a brief analysis of the map highlights a different perspective on the basic thesis that there is a direct relation between traffic volume levels and fatal road accident density levels.

3.2. Planned Map Publications

Individual maps for each of the separate subjects will be available for free public download on an annual basis on the ICBS website, under the transportation section, as well as in the map section of the Statistical Abstract of Israel.

4. Future Benefit

The traffic volume map serves as a visual aid for future planning and for a fast and easy analysis of the data with a national perspective.

This method of displaying annually renewed traffic volume counts is new in Israel. In addition, there is no other public example of density analysis of road accidents in the country. The combination itself is new in ICBS maps. The introduction of new mapping technics may have an effect and help persuade other ICBS units to map their data in the same way.

The maps put an emphasis on road accident hot spots and also act as a visual work plan for the future. Once these hot spots are identified and analyzed, it will be easier to prioritize resources to neutralize dangers on the roads. A widespread dissemination of these maps will help in effective decision making and could lead to deeper study, using maps as a visual aid for understanding and analyzing our databases.

Fig.1: Map of daily traffic volume. (Source: ICBS, Statistical Abstract of Israel, No. 63, 2012)

Fig.2: Map of traffic accidents. (Source: ICBS, Statistical Abstract of Israel, No. 63, 2012)

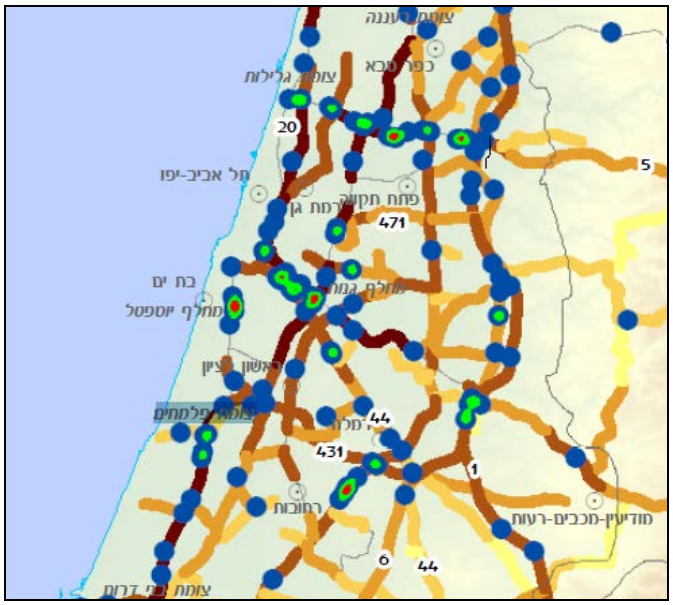

Fig.2: Fatal accident density hotspots combined with traffic counts- central area of Israel enlarged. (Source: ICBS, 2012)

Table 1: **Data Table Example: Traffic Volume Map.**

Traffic Volume by Road, Section and Day of Week (in Thousands)

Road	Section	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Daily Average Sun-Thu
431	6	67.4	68.2	69.3	68.3	71.3	63.5	49.9	68.9
431	6	34.2	35.2	35.6	35	37.2	33.9	26.4	35.5
431	6	33.2	32.9	33.7	33.3	34.1	29.6	23.5	33.4
431	10	62.2	62.6	64.1	63.3	65.8	57.2	45	63.6
431	10	29.7	30.4	31	30.6	32.3	28.2	22.2	30.8
431	10	32.5	32.2	33.1	32.7	33.4	28.9	22.9	32.8
431	20	47.8	47.9	49	48.2	50.1	40.7	32.9	48.6
431	20	22.3	22.9	23.2	22.9	24	18.2	14.5	23.1
431	20	25.5	25	25.8	25.3	26.1	22.5	18.4	25.6
431	30	97.1	97.3	99.4	98.5	101.9	82.5	63.3	98.9
431	30	54.3	55.2	56.1	55.8	58.3	47.6	36.6	55.9
431	30	42.8	42.1	43.3	42.7	43.6	34.9	26.8	42.9
431	40	85.1	85.3	84.3	86.1	88.1	66.2	51.7	85.8

(Source: ICBS Publication No.1485, 2012)

Table 2: **Data Table Example: Road Accidents with Casualties**

Description		Accidents for 2011				Total Accidents in Years			Accidents per 1 Million Drives	
Junction Name	KM	Total	Minor	Serious	Lethal	08	09	10	2010	2011
Road 1 Section 10 from Kibutz Galuyot Interchange to Ganot Interchange										
Average Daily Traffic for 2010: 148449 and in 2011 123065										
Kibutz Galuyot Interchange	0	5	5			4	1	4	0.04	0.06
	0	2	2				2	3	0.06	0.04
	1	2	2			1	1	1	0.02	0.04
	2	2	1		1	1	3	1	0.02	0.04
	3	4	2	2		6	4	3	0.06	0.09
Entrance to Electricity Co.	3.3								0	0
Junction	3.7								0	0
Junction	3.8								0	0
	4	3	1	1	1	6	6	2	0.04	0.07
Total Road 1 Section 11		18	13	3	2	8	17	14	0.06	0.09

(Source: ICBS Publication No. 1493, 2012)

References

1. Israeli Central Bureau of Statistics and the Israel National Road Safety Authority (2012): ***Road Accidents with Casualties 2011, Part II: Accidents on Non-Urban Roads***, Publication No. 1493, http://www.cbs.gov.il/reader/transport/accidents.html , Accessed 11 Nov 2012.
2. Israeli Central Bureau of Statistics (2012): ***Traffic Counting on Non-Urban Roads 2006-2011***. Publication No. 1485, http://teunot.cbs.gov.il/niturtnuaenterprise/, Accessed 11 Nov 2012.
3. Israeli Central Bureau of Statistics (2012**): *Maps Based on Data from the Statistical Abstract of Israel 2012 No. 63***, Chapter 24: Transport and Communications, map 24.1, http://www.cbs.gov.il/shnaton63/map/24_01e.pdf , Accessed 11 Nov 2012.
4. Borden D. Dent, Jeffery S. Torguson, Thomas W. Holder (2009): ***Cartography, Thematic Map Design, Sixth Edition***. Georgia State University, St. Cloud State University & University of Georgia, McGraw-Hill NY.
5. Gretchen N. Peterson (2009): **GIS Cartography, *A Guide to Effective Map Design***. CRC Press, FL.