

Same-day visitors crossing borders: a Big Data approach using traffic control cameras

M. Izquierdo Valverde J. Prado Mascuñano M. Velasco Gimeno
National Statistics Institute (Spain)

14th Global Forum on Tourism Statistics
Venice, November 2016



Index

1. Objectives
2. Definitions and sources
3. Statistic of Tourist Movements on Borders (FRONTUR)
4. First results
5. Theoretical approach



Index

1. Objectives
2. Definitions and sources
3. Statistic of Tourist Movements on Borders (FRONTUR)
4. First results
5. Theoretical approach



Objectives

- To take advantage of machine-generated data (automated systems) to get a better framework to estimate same-day visitors crossing borders by road.
- Two different approaches:
 - Inbound tourism
 - Outbound tourism



Index

1. Objectives
2. **Definitions and sources**
3. Statistic of Tourist Movements on Borders (FRONTUR)
4. First results
5. Theoretical approach



Definitions

IRTS 2008

- A **traveller** is someone who moves between different geographic location, for any purpose and any duration.
- A **visitor** is traveller taking a trip to a main destination outside his/her usual environment, for less than a year, for any purpose (business, leisure or other personal purpose) other than to be employed by a resident entity in the country or placed visited. These trips taken by visitors are classified as tourism trips.
- A visitor is classified as **tourist** (or overnight visitor), if his/her trip includes an overnight stay, or as a **same-day visitor** (or excursionist) otherwise.



Definitions

IRTS 2008

In relation to the country of reference, it is recommended that the following three basic forms of tourism be distinguished:

- a) **Domestic tourism**, which comprises the activities of a resident visitor within the country of reference either part of a domestic trip or part of an outbound trip.
- b) **Inbound tourism**, which comprises the activities of a non-resident visitor within the country of reference on an inbound trip.
- c) **Outbound tourism**, which comprises the activities of a resident visitor outside the country of reference, either as part of an outbound trip or as part of a domestic trip.



Traffic loops



Traffic loops:

- N^o vehicles crossing the border:
 - Intervals of 15 min
 - By length
 - And for both directions



Traffic loops

	ETD	DIA	HORA	MINUTO	PEQ_ENT	MED_ENT	LAR_ENT	TOT_ENT	PEQ_SAL	MED_SAL	LAR_SAL	TOT_SAL
1	E001	1	22	15	0	3	0	3	0	0	0	0
2	E001	1	22	30	0	0	0	0	0	0	0	0
3	E001	1	22	45	0	3	0	3	0	0	0	0
4	E001	1	23	0	0	3	0	3	0	0	0	0
5	E001	1	23	15	6	0	0	6	0	3	0	3
6	E001	1	23	30	6	3	0	9	6	3	0	9
7	E001	1	23	45	0	1	0	1	0	0	0	0
8	E001	2	0	0	21	9	0	30	6	15	0	21
9	E001	2	0	15	6	0	0	6	3	0	0	3
10	E001	2	0	30	0	9	0	9	0	0	0	0
11	E001	2	0	45	12	0	0	12	6	3	0	9
12	E001	2	1	0	3	0	0	3	0	0	0	0
13	E001	2	1	15	0	0	0	0	0	0	0	0
14	E001	2	1	30	0	3	0	3	3	0	0	3
15	E001	2	1	45	0	3	0	3	3	0	0	3
16	E001	2	2	0	0	0	0	0	0	0	0	0
17	E001	2	2	15	9	0	0	9	6	0	0	6
18	E001	2	2	30	0	0	0	0	0	0	0	0
19	E001	2	2	45	15	0	0	15	6	3	0	9
20	E001	2	3	0	6	0	0	6	0	0	0	0
21	E001	2	3	15	12	0	0	12	9	0	0	9
22	E001	2	3	30	12	0	0	12	6	9	0	15
23	E001	2	3	45	6	0	0	6	0	6	0	6
24	E001	2	4	0	0	0	0	0	0	0	0	0
25	E001	2	4	15	6	0	0	6	0	0	0	0

Traffic cameras



Traffic cameras:

- Who is coming?
 - Vehicle nationality (residents/non residents)
 - In both directions



Traffic cameras

Sesion	ID	Dia	Mes	Año	Hora	Matricula	Nacionalidad	Punto	Sentido	Camil
PF17(09/03/2014)	0000472	09	03	2014	12:42:27	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000473	09	03	2014	12:44:06	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000474	09	03	2014	12:44:12	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000475	09	03	2014	12:44:22	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000476	09	03	2014	12:44:44	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000477	09	03	2014	12:45:53	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000478	09	03	2014	12:47:14	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000479	09	03	2014	12:49:02	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000480	09	03	2014	12:49:20	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000481	09	03	2014	12:49:32	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000482	09	03	2014	12:49:37	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000483	09	03	2014	12:51:00	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000484	09	03	2014	12:51:08	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000485	09	03	2014	12:51:39	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000486	09	03	2014	12:51:51	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000487	09	03	2014	12:51:56	.....	FRA	PF17	S	C1
PF17(09/03/2014)	0000488	09	03	2014	12:52:48	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000489	09	03	2014	12:53:46	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000490	09	03	2014	12:53:50	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000491	09	03	2014	12:53:55	.....	ITA	PF17	S	C1
PF17(09/03/2014)	0000492	09	03	2014	12:56:02	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000493	09	03	2014	12:56:17	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000494	09	03	2014	12:57:07	.....	ESP	PF17	S	C1
PF17(09/03/2014)	0000495	09	03	2014	12:57:22	.....	PRT	PF17	S	C1
PF17(09/03/2014)	0000496	09	03	2014	12:58:32	.....	ESP	PF17	S	C1

Around 5 millions of data each month → % vehicles per nationality
 Next step: tracking the ID associated to the number plate



Traffic cameras

Nº	NUEVOS EMPLAZAMIENTOS	PROVINCIA	Nº LECTORES
PUNTOS FRONTERA PORTUGUESA			
19	TUY PUENTE INTERNACIONAL, A-55, P.K. 31+000	PONTEVEDRA	4
20	TUY PUENTE VIEJO, N-550, P.K. 172+500	PONTEVEDRA	2
21	VERIN, A-75, P.K. 15+300	ORENSE	4
22	VERIN FECES DE ABAIXO, N-532, P.K. 15+000	ORENSE	2
23	TRABAZOS, N-122, P.K. 531+500	ZAMORA	2
24	FUENTES DE OÑORO, N-620, P.K. 350+900	SALAMANCA	4
25	VALENCIA DE ALCANTARA, N-521, P.K. 151+000	CACERES	2
26	BADAJOS, A-5, P.K. 405+000	BADAJOS	4
27	AYAMONTE, A-49, P.K. 131+500	HUELVA	6
28	EL ROSAL DE LA FRONTERA, N-493, P.K. 155+000	HUELVA	2

Nº	EMPLAZAMIENTO	PROVINCIA	Nº LECTORES
PUNTOS FRONTERA FRANCESA			
1	PORTBOU, N-260, P.K. 1+900	GERONA	2
2	LA JUNQUERA, N-8, P.K. 7 79+500	GERONA	3
3	LA JUNQUERA, AP-7, P.K. 0+000	GERONA	4
4	LA SEU D'URGELL, N-145, P.K. 4+500	LERIDA	2
5	PUIGCERDA-BOURGMADAME, N-152, P.K. 169+000	GERONA	2
6	PUIGCERDA-LLIVIA, N-154, P.K. 0+300	GERONA	2
7	LES, N-230, P.K. 186+650	LERIDA	2
8	CANFRANC, N-330, P.K. 675+150	HUESCA	2
9	TUNEL DE SOMPORT, BOCA SUR	HUESCA	3
10	PUENTE DE SANTIAGO, GI-636-H, P.K. 0+495	GUIPUZCOA	4
11	LANDIBAR, N-121, P.K. 80+000	NAVARRA	2
12	PEROTXETA, N-135, P.K. 66+500	NAVARRA	2
13	BEHOBIA, N-121-A, P.K. 87+000	GUIPUZCOA	4
14	IRUN, AP-8 P.K. 0+000	GUIPUZCOA	4
15	ETXALAR, NA-4400, P.K. 0+100	NAVARRA	2
16	EUGI, NA-138, P.K. 33+125	NAVARRA	2
17	ISABA, NA-137, P.K. 20+900	NAVARRA	2
18	BIELSA, A-138, P.K. 86+900	HUESCA	2



Index

1. Objectives
2. Definitions and sources
3. **Statistic of Tourist Movements on Borders (FRONTUR)**
4. First results
5. Theoretical approach



FRONTUR (by road)

- **Objective:** to measure the number of non-resident visitors coming into Spain each month, and describe the main characteristics of the trips.
- **Framework:** there is no a population framework (in the traditional sense). It must be built combining the following data:
 - Traffic loops
 - *Aforo*: sample operation that counts number of persons in vehicles, by type of vehicle and nationality.
 - Traffic cameras



Index

1. Objectives
2. Definitions and sources
3. Statistic of Tourist Movements on Borders (FRONTUR)
4. **First results**
5. Theoretical approach



First results

VEHICLES AS SAME-DAY VISITORS:

For vehicles with foreign-number plate:

- vehicles registered as *entrance* during day D, their number plates are tracked to find them as *exit* during the same day

For vehicles with Spanish number plate:

- vehicles registered as *exit* during day D, their number plates are tracked to find them as *entrance* during the same day



First results

For each border crossing, i , the number of vehicles coming into Spain, counted by cameras is:

$$VC_i = ECNR_i + TCNR_i + ECR_i + TCR_i + NOIDEF_i$$



First results

may-16	Type of visitor				Non identified number plate		All		
	Non same-day visitor		Same-day visitor		Non identified number plate				
	N	%	N	%	N	%	N	%	
PF01	SEO DE URGELL, N-145 P.K. 8900	103.334	64,63%	54.002	33,77%	2.535	1,58%	159.871	100,00%
PF02	PUIGCERDA-BOURMADAME, N-152 P.K.	45.057	43,77%	50.554	49,11%	7.316	7,10%	102.927	100,00%
PF03	PUIGCERDA-LLIVIA, N-154 P.K. 300	32.279	38,31%	36.842	43,73%	15.119	17,94%	84.240	100,00%
PF04	LA JUNQUERA, NII P.K. 779500	7.495	60,20%	3.838	30,82%	1.116	8,96%	12.449	100,00%
PF05	PORTBOU, N-620 P.K. 1900	16.447	68,01%	7.218	29,84%	518	2,14%	24.183	100,00%
PF06	LA JUNQUERA AP-7 P.K. 0	345.397	80,92%	35.993	8,43%	45.416	10,64%	426.806	100,00%
PF07	LES, N-230 P.K. 186650	22.981	43,39%	27.262	51,47%	2.715	5,12%	52.958	100,00%
PF08	CANFRANC, N-330 P.K. 675150	1.753	70,03%	348	13,90%	402	16,06%	2.503	100,00%
PF09	TUNEL DE SOMPORT (BOCA SUR) P.K. 0	11.739	70,12%	4.803	28,69%	197	1,17%	16.739	100,00%
PF10	BEHOVIA, NI P.K. 468000	79.175	37,66%	110.133	52,38%	20.925	9,95%	210.233	100,00%
PF11	IRUN, AP-8 P.K. 0	138.938	83,13%	27.253	16,30%	931	0,55%	167.122	100,00%
PF12	PUENTE DE SANTIAGO, N-121 P.K. 8700	75.762	28,98%	184.911	70,74%	710	0,27%	261.383	100,00%
PF13	PEKOTXETA, N-135 P.K. 166500	6.876	50,98%	6.073	45,03%	536	3,97%	13.485	100,00%
PF14	LANDIBAR, N-121 P.K. 80000	38.703	40,72%	55.296	58,18%	1.036	1,09%	95.035	100,00%
PF15	TUY PUENTE INTERNACIONAL, A-55 P.K.	73.154	51,93%	52.741	37,44%	14.949	10,61%	140.844	100,00%
PF16	TUY PUENTE VIEJO, N-550 P.K. 172500	27.605	51,21%	25.988	48,21%	312	0,57%	53.905	100,00%
PF17	VERIN FECES DE ABAIXO, N-532 P.K. 15	2.483	36,80%	3.265	48,39%	998	14,79%	6.746	100,00%
PF18	TRABAZOS, N-122 P.K. 538000	7.697	55,40%	4.453	32,05%	1.743	12,54%	13.893	100,00%
PF19	FUENTES DE OÑORO, N-620 P.K. 35090	60.877	60,28%	36.061	35,70%	4.045	4,00%	100.983	100,00%
PF20	VALENCIA DE ALCANTARA, N-521 P.K.	6.063	34,01%	11.464	64,31%	299	1,67%	17.826	100,00%
PF21	BADAJOS, A-5 P.K. 405000	64.834	54,53%	51.127	43,00%	2.931	2,46%	118.892	100,00%
PF22	AYAMONTE, A-49 P.K. 131500	33.478	58,70%	21.360	37,45%	2.193	3,84%	57.031	100,00%
PF23	EL ROSAL DE LA FRONTERA, N-433 P.K.	7.461	45,99%	8.621	53,14%	140	0,86%	16.222	100,00%
PF31	BIELSA, A138 P.K. 86900	4.416	69,10%	1.560	24,41%	414	6,47%	6.390	100,00%
PF32	ETXALAR, N-121A P.K. 0	7.338	38,35%	11.643	60,85%	150	0,78%	19.131	100,00%
PF33	ISABA, NA140 P.K. 0	4.937	43,58%	5.550	48,99%	841	7,42%	11.328	100,00%
PF35	GOIAN,	14.217	32,43%	28.159	64,23%	1.461	3,33%	43.837	100,00%
PF36	SALVATIERRA DE MIÑO,	19.005	35,45%	33.226	61,97%	1.379	2,57%	53.610	100,00%
Todo		1.456.783	54,29%	1.049.946	39,13%	176.246	6,56%	2.682.975	100,00%

First results

Problems to solve:

Lack of information: camera registers are incomplete

- For a number plate we can find the following situation:

Border crossing	Date	Number plate	Nationality	IN/OUT
PF24	07/05/16	1111AA	PTR	O
PF24	08/05/16	1111AA	PTR	I
PF24	08/05/16	1111AA	PTR	O
PF24	09/05/16	1111AA	PTR	O
PF24	10/05/16	1111AA	PTR	I
PF24	10/05/16	1111AA	PTR	O

When?

First results

Problems to solve:

Same-day vehicles are underestimated

If we transform same-day vehicles in same-day visitors (occupancy rate by vehicle), and compare the results to the ones obtained by FRONTUR, the underestimation is around 25%



First results

Problems to solve:

Definition of usual environment.

Establish patterns for frequent border crossing vehicles:

- To define a clear criteria to classify same-day vehicles as vehicles moving in its usual environment: border workers, border population,...
- Public transport crossing borders.

Solution: integrated system traffic loops-traffic cameras. For each register, more complete information.

Always combined with complementary sources as surveys.

Index

1. Objectives
2. Definitions and sources
3. Statistic of Tourist Movements on Borders (FRONTUR)
4. First results
5. Theoretical approach



Theoretical approach

Next steps of this study: Integrate the information from traffic loops in terms of the length of vehicles with the data from cameras in terms of same-day visits:

$$VF_i = LFNR_i + PFNR_i + LFR_i + PFR_i$$

$$VC_i = ECNR_i + TCNR_i + ECR_i + TCR_i + NOIDEF_i$$

Different hypothesis are being testing



**Thank you very much
for your attention**

maria.izquierdo.valverde@ine.es

jesus.prado.mascunano@ine.es

maria.velasco.gimeno@ine.es

