



HELLENIC REPUBLIC
National and Kapodistrian
University of Athens

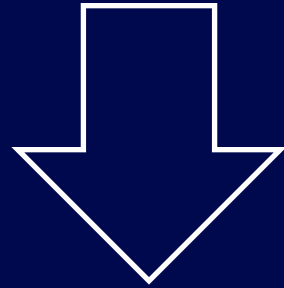
EST. 1837

Predicting Crime in Athens: A Machine Learning Approach

Speaker :
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Associate Professor: PhD Constantinos Mourlas,
PhD Catherine Sotirakou

- Big Data & Artificial Intelligence (AI)



A model to predict crime



Presentation modules

- Crime in Media
- Data Mining & Big Data
- Data Journalism



Presentation modules

- Machine Learning
- Algorithms
- Our model from $A \rightarrow Z$



Crime in Media

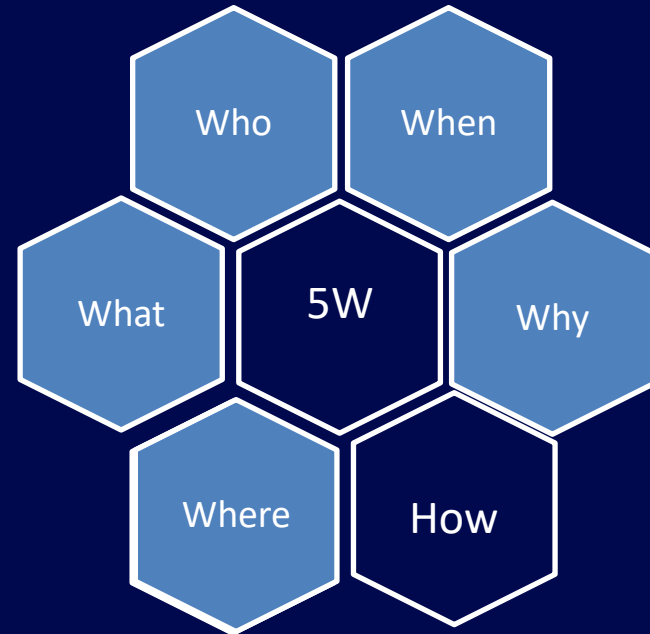
Crime: Offence punishable by law

- Place
- Time
- Social-economic solutions



Crime in Media

“News”: Things
that happen during
the day



Crime in Media

Social Media



Source: [Crowdynews](#)



Crime in Media

Framing theory:

- Journalists make decisions
- Manipulate audiences and feelings
- Visual & Verbal framing are highly important

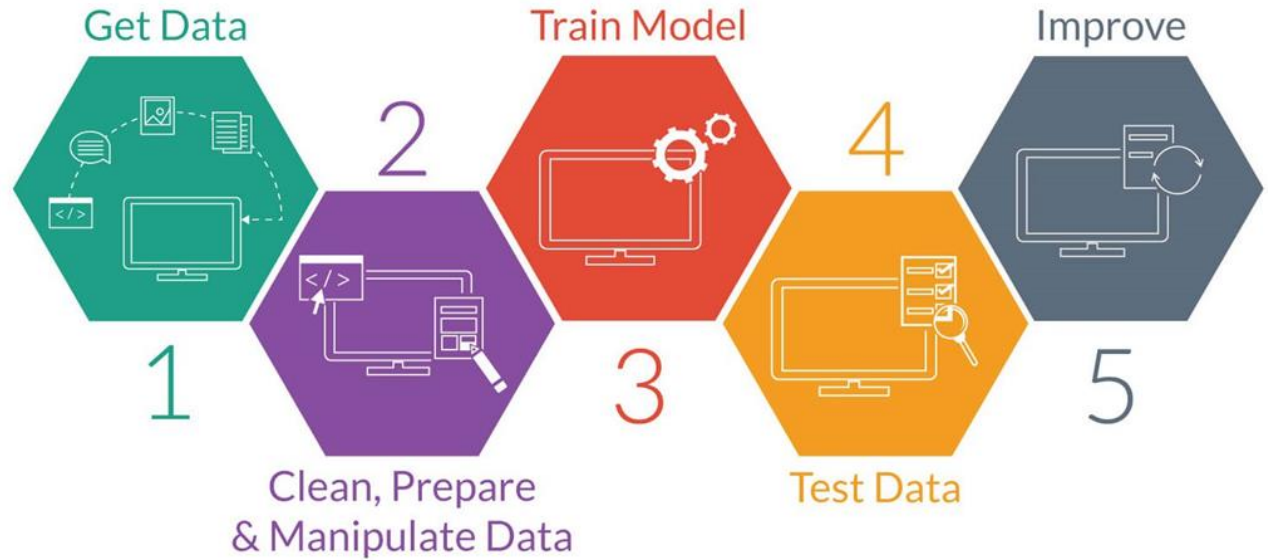


Crime in Media

Greek journalists:

- Create & cultivate stereotypical perceptions
- Intensify xenophobia

Data mining



Source: [Noteworthy — The Journal Blog](#)

Big Data

- High volume of structured or unstructured data

- 3Vs:

- ✓ *Volume*

- ✓ *Velocity*

- ✓ *Variety*

unstructured



structured

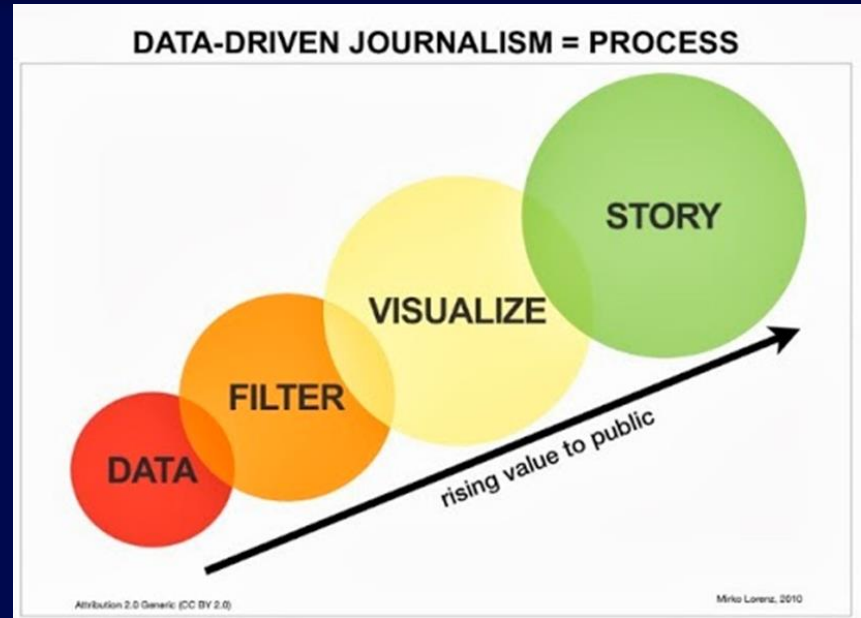


Semi-structured



Data Journalism

“Drawing conclusions through the management of digital data with the aim of their final capture through an Infographic type chart” Veglis & Bratsas



Source: [Wikimedia](#)

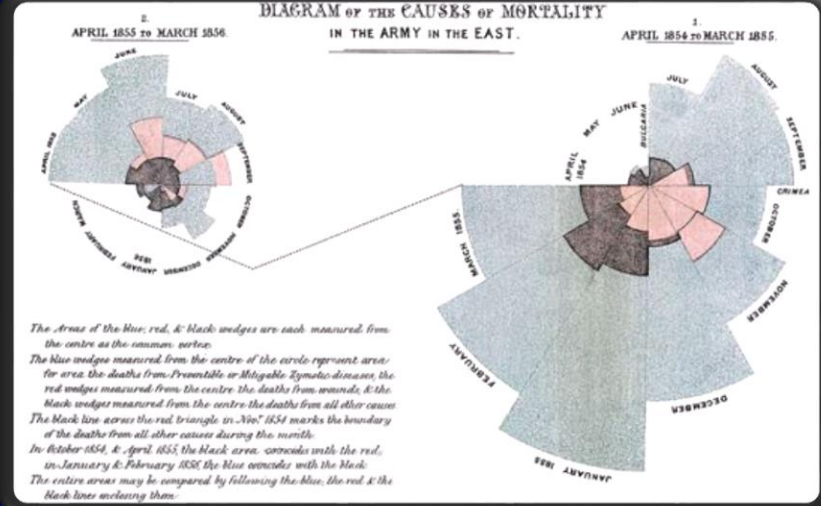
Data Journalism

Some several workmen, one of whom was so severely affected in the back of the head, that for a week he had recourse to bleeding; and a girl in a parish had her arm suddenly lacerated by its elastic end felt it becoming for some time stiff. The workmen of Mr. Tuff's were mostly struck, & a lady whilst on the loom, but was merely stunned. A lady near Blandford, who was sewing at the time, felt in the fingers in contact with the needle a sensation resembling that of a slight electric spark. The clerical staff entered the house of Mrs. Clay, in Edge Vale, where its progress was not less alarming to the inmates, than obstructive to the premises; and we have never heard of a man, woman, or child, except those that of the several individuals depicted in a house, of which almost every room bore testimony of the progress of the insupportable element. It appears probable, from an examination of the apartments which the child has made, and the directions in which the bricks, timbers, &c. have been found, that, attracted by the iron railing in front of the house, it entered the wall on one side the door, where it has shattered the bricks, run to plumb the wood and brack-work between the door-jamb and the arch-way of the doorway, lacerated the beams on the top; shook the fan-light to pieces, having part of the frame, and having a blank, now on the point-work; thence it passed up through the arch door, splitting the bricks and the stone at the bottom of the outside window, the glass of which was shattered to pieces, and the whole frame dislodged and forced into the house. Over the window it forced, in its way to the roof, a large hole, above which the roof appears exactly as if flames had issued from it. Its course appears not to have been towards the chimney; the rain was shattered to pieces; the ridge stones displaced; the rafters and much cement torn from the wall, and the lead in many places forced up. It probably reached the stone below by the chimney. In the lower room the stones, plaster and paper are in several places broken, and the hole, at opening its way out, and scattered the gilding of the chimney above, and periled the top ornaments, but did not detach the finished fire door, just below. The stones which were driven out in this room. In the room above, one corner, stood a bundle of rods, to which it is probable the way, perhaps from the chimney, between the lattice and the wall, so it forced off the plaster, and shot a quantity of it against a chest of drawers, and others.

DAY SCHOOLS.—J. J. Fishburne	Boys	Girls	Total	Exp.	Remarks.
Grammar School	155	100	255	1000	Fought, clothed and hooded.
Blue Coat do.	86	40	126	2000	Fought and clothed.
Green Coat do.	59	50	109	100	Fought and clothed.
Collegiate Church do.	30	50	80	40	Do. do.
Strangers do.	10	10	20	100	
St. Mary's do.	12	12	24	40	(Dispersed)—Fought and clothed. Funds arising from Sacramental Offerings.
St. John's do.	9	9	18	30	(Dispersed)—Expended in voluntary subscription.
St. Paul's do.	30	—	30	—	Fought, clothed and hooded. (Dispersed)—Fought and partly clothed. This school is supported by the benevolence of a single individual.
Ladies' Jubilee	30	30	60	—	Voluntary subscription, and Collections at Churches.
Back King-street	51	—	51	—	
Narcissus Terrace, Gresham-street	194	119	313	600	
Belton-street, St. John's	200	176	376	—	
	611	381	992	£5110	
Disasters.					
Leicester Square, Marshall-street	492	325	817	400	Voluntary subscription.
Leicester Square, Moley-street	25	25	50	1000	ditto
Canary-row	176	111	287	104	ditto
	693	561	1254	—	
SUNDAY SCHOOLS.					
Collegiate Church, St. John's Hill	501	505	1006	—	
St. Ann's, Back King-street	201	56	257	—	
St. Mary's, Back South Parade	120	110	230	—	
St. Paul's, Green-street	176	125	301	—	
Turkey-street	68	71	139	—	
Jersey-street	214	291	505	—	
St. George's, St. George's	111	112	223	—	
St. John's, St. John's-street	119	162	281	—	
St. James's, St. James's-street	106	100	206	—	
St. Michael's, Miller-street	224	332	556	£1023	
St. Peter's, Jackson's-row	—	139	139	—	
Alport York	97	—	97	—	
St. Clement's and St. Luke's	352	1071	1423	—	(This is, perhaps, the largest school in the Kingdom. It cost about £2,200, of which £212 or 10 1/2 per cent. is contributed in small sums by the Teachers and Scholars.)
St. Stephen's, Blom-street	181	207	388	—	
St. Paul's, St. Paul's	120	243	363	—	
Trinity, King's Head Yard	102	100	202	—	
Holme, Duke-street	142	189	331	—	
All-Saints, Oxford-road	126	121	247	—	
Artwick	60	110	170	30	

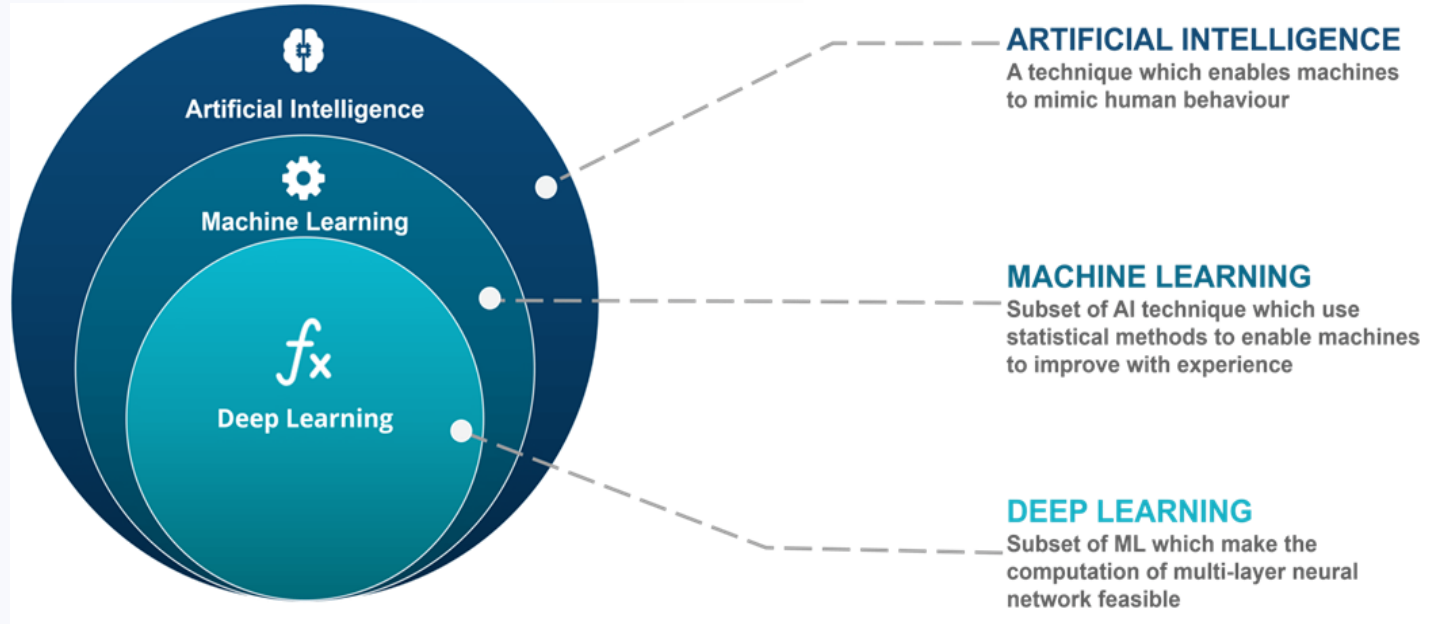
Misses, Youlstone and Jenson, Throgmorton-street.
 LEE Jonathan, of Blandford, in the county of Dorset, street, &c. v. May 19, 19, June 12, at Guildhall, London. Atts. Messrs. G. Becket and Tenny, Temple-street.
 PAYN Thomas, and John Daniel Paps, of Croydon, in the county of York, street, &c. v. May 5, 12, June 5, at 1, at Gold-st. Mr. Hildson, Baringhall-street.
 SMITH John, son of late of Stratford, in the county of York, street, &c. v. May 11, 12, June 9, at 11, at Dea and Back Tavern, King's-square-Bath. Mr. Walsley, Hall.
 TATE John, of Liverpool, in the county of Lancashire, street, &c. v. May 11, June 11, June 5, at 1, at the George Inn, Liverpool. Mr. Toulson, Liverpool.
 WARD Joseph, late of Barbary, in the county of Oxford, (but now a prisoner in the King's Bench), street, &c. v. May 5, 12, June 12, at Guildhall, London. Atts. Messrs. F. and Mansley, Belford.
 WHARTON Robert and Henry Wharton, of Croydon, in the county of Lancashire, street, &c. v. May 5, 12, June 12, at Guildhall, London. Atts. Messrs. G. Becket and Tenny, Temple-street.
 J. HILGOTT Daniel, of Farnborough, in the county of Surrey, master-mason, street, &c. v. May 5, at 11, at the George Inn, Liverpool. Atts. Mr. Hildson, Liverpool.
 MUMES, PATTERSON and PAUL, Old Broad-street, v. 1854.
 May 22. NARWELL & ALKINSON, London, street, &c. v. 1854.
 23. J. HINDS, Shoreditch, sea-purveyor.
 24. W. BUCKLEY, Manchester, writer.
 25. W. BURN, Epsom, draper.
 26. J. DODD, St. Giles's, Kent, draper & taylor.
 27. J. LEE, London, warehouseman.
 28. T. CAULY, Liverpool, feather-merchant.
 29. J. W. HILLMAN, London, draper.
 30. J. B. SCHLESINGER, London, indigo-merchant.
 June 5. HYDE & SMYTH, London, sugar-merchant, street, &c. v. 1854.
 JOHN HARRISON and BROTHERS, Manchester, v. 1854.
 WILSON WILSON and SONS, Manchester, v. 1854.

Source: [Data Journalism Handbook](#)



Source: [Data Journalism Handbook](#)

Machine Learning



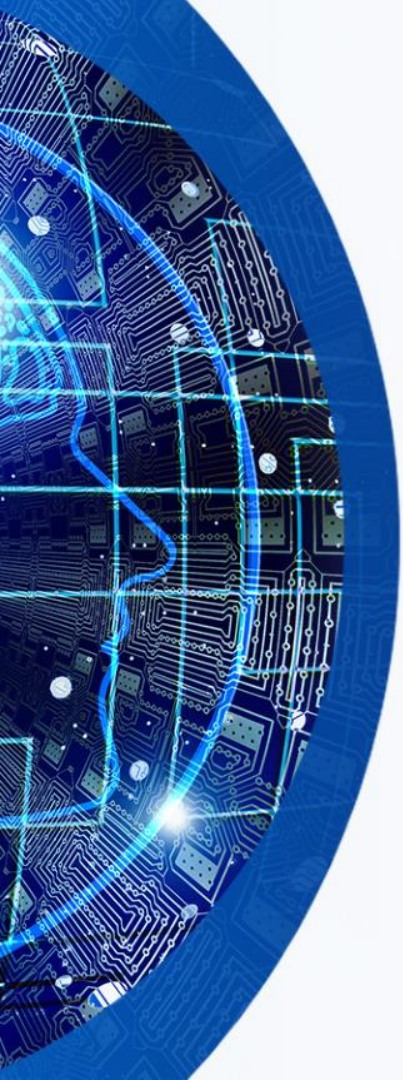
Source : [i Stack](#)

Algorithms

- Algorithms- Black box
- Access by experts
- Demand expertise



Limit in participation





Analysis

- Based on unstructured data
- Press releases: 2015- 2020 (October)

Analysis

Αθήνα, 27 Ιουνίου 2015

ΔΕΛΤΙΟ ΤΥΠΟΥ

Συνελήφθησαν πέντε (5) άτομα για διακίνηση ναρκωτικών

***Κατασχέθηκαν ποσότητες κατεργασμένης και ακατέργαστης
κάνναβης, κοκαΐνης, ηρωΐνης και ναρκωτικών δισκίων***

Συνελήφθησαν, στις 23-6-2015 στον Άγιο Δημήτριο και στην Κορινθία, από την Υποδιεύθυνση Δίωξης Ναρκωτικών της Διεύθυνσης Ασφάλειας Αττικής, τέσσερις (4) ημεδαποί ηλικίας 43,48,51 και 58 ετών και μία 53χρονη αλλοδαπή υπήκοος Αλβανίας, για διακίνηση ναρκωτικών ουσιών σε περιοχές της Αττικής και της περιφέρειας.

Σε βάρος των συλληφθέντων σχηματίστηκε ποινική δικογραφία, για τις κατά περίπτωση παραβάσεις των νόμων περί ναρκωτικών, περί όπλων και περί αλλοδαπών.

Analysis

Date	Date_2	Day	Day_2	Team	Native	N_Arrested	Foreign	F_Arrested	Nationality	Nationality_2	Age	Min	Max	Sex	Location	T
12/9/2015	12/9/2015	Σάββατο	6	0			1		Σερβία	1	34			1	Διεθνής Αερολιμένα	1
25/9/2013	25/9/2013	Τετάρτη	3	0	0				Ελληνική	0	19			1		
25/9/2013	25/9/2013	Τετάρτη	3	0	0				Ελληνική	0	20			1		
25/9/2013	25/9/2013	Τετάρτη	3	0	0				Ελληνική	0	24			1		
25/9/2013	25/9/2013	Τετάρτη	3	0	0				Ελληνική	0	30			1		
25/9/2013	25/9/2013	Κυριακή	7	0	0				Ελληνική	0	26			1		
25/9/2013	25/9/2013	Κυριακή	7	0	0				Ελληνική	0	36			1		
25/9/2013	25/9/2013	Τετάρτη	3	0			1		Αλγερία	1	32			1		
22/2/2015	22/2/2015	Παρασκευή-Σάββατο	5	2			1	4	Γεωργία	1	0			2		
22/2/2015	22/2/2015	Παρασκευή-Σάββατο	5	0			1		Βουλγαρία	1	0			2		
30/9/2015	30/9/2015	Παρασκευή-Σάββατο	5	0			1		Βουλγαρία	1	0			2		
30-31/1/2015	30/1/2015	Σάββατο	6	0			1		Αφγανιστάν	1	34			1	Πλατεία Βικτωρίας	1
30-31/1/2015	30/1/2015	Σάββατο	6	1			1		Νέα Γουινέα	1	0			1	Περιοχή Κυψέλης	1
30-31/1/2015	30/1/2015	Σάββατο	6	1			1		Σιέρα Λεόνε	1	0			1	Περιοχή Κυψέλης	1
3/10/2015	3/10/2015	Σάββατο-Κυριακή	6	2			1	2	Γεωργία	1	0			2	Νοσοκομείο	
5/2/2015	5/2/2015	Πέμπτη	4	0			1		Βουλγαρία	1	0			2	Νοσοκομείο	
5/2/2015	5/2/2015	Πέμπτη	4	0			1		Ρωσία	1	0			2	Νοσοκομείο	
7-8/2/2015	7/2/2015	Σάββατο-Κυριακή	6	0			1		Αλβανία	1	0			2	Νοσοκομείο	

Data exploration

Percentage of arrests by sex

Men Women Not defined

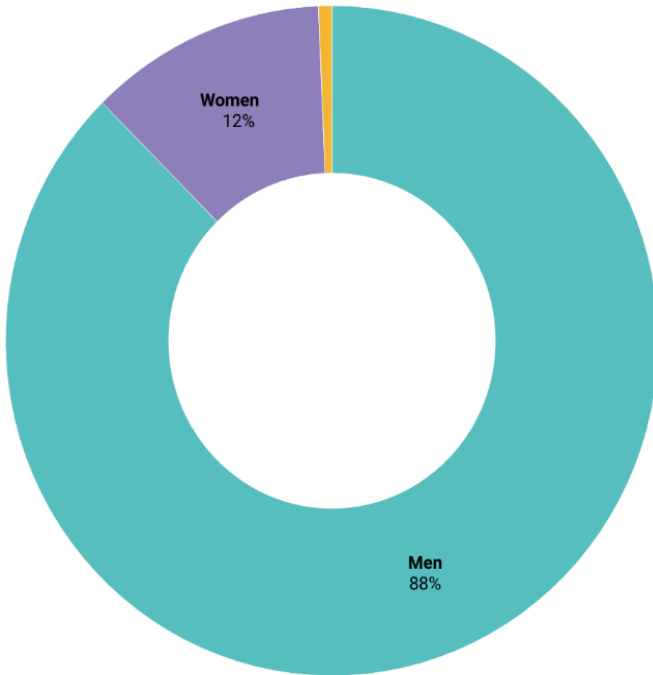


Chart: Maria-Eleni Vardaki • Source: www.astynomia.gr • Created with Datawrapper

Mean age of arrests by sex

Men Women Not defined

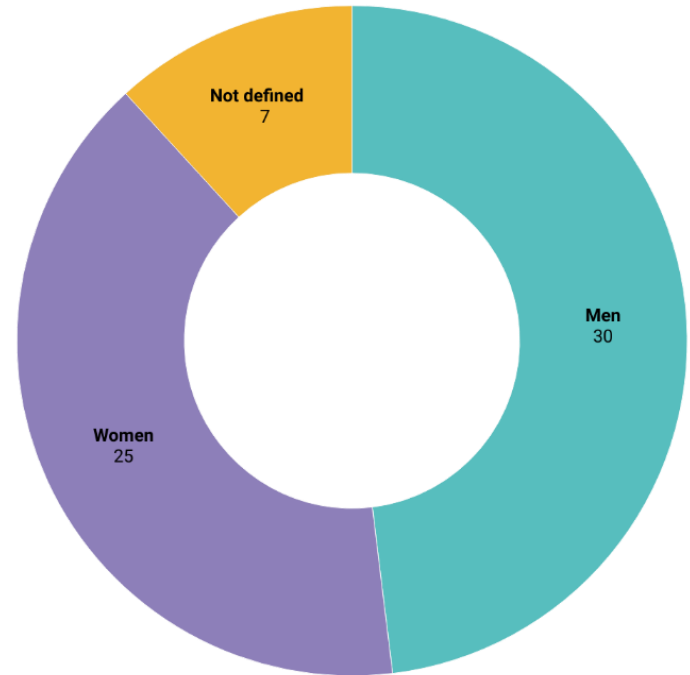
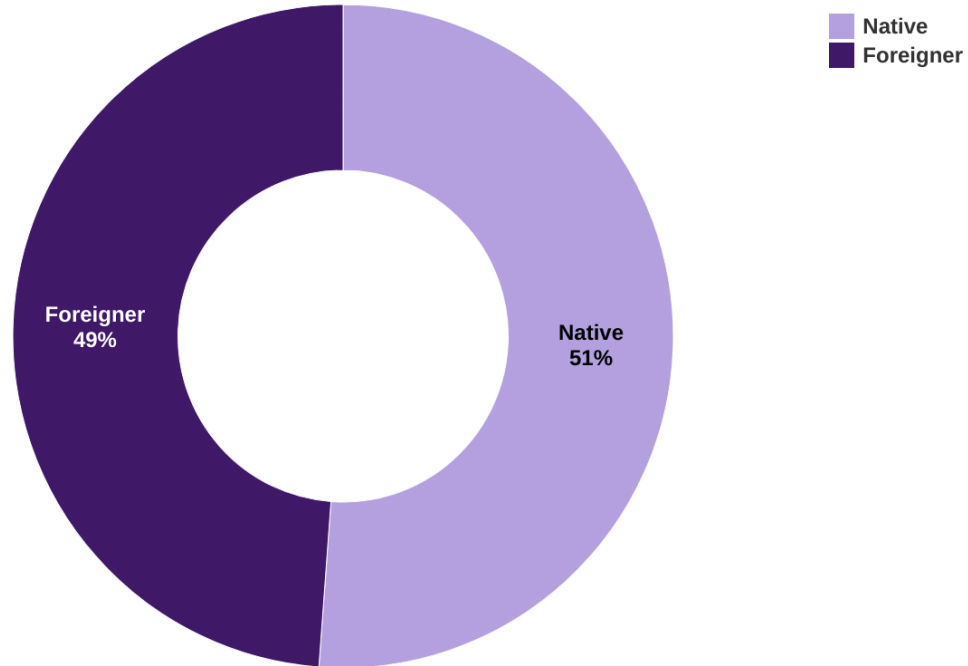


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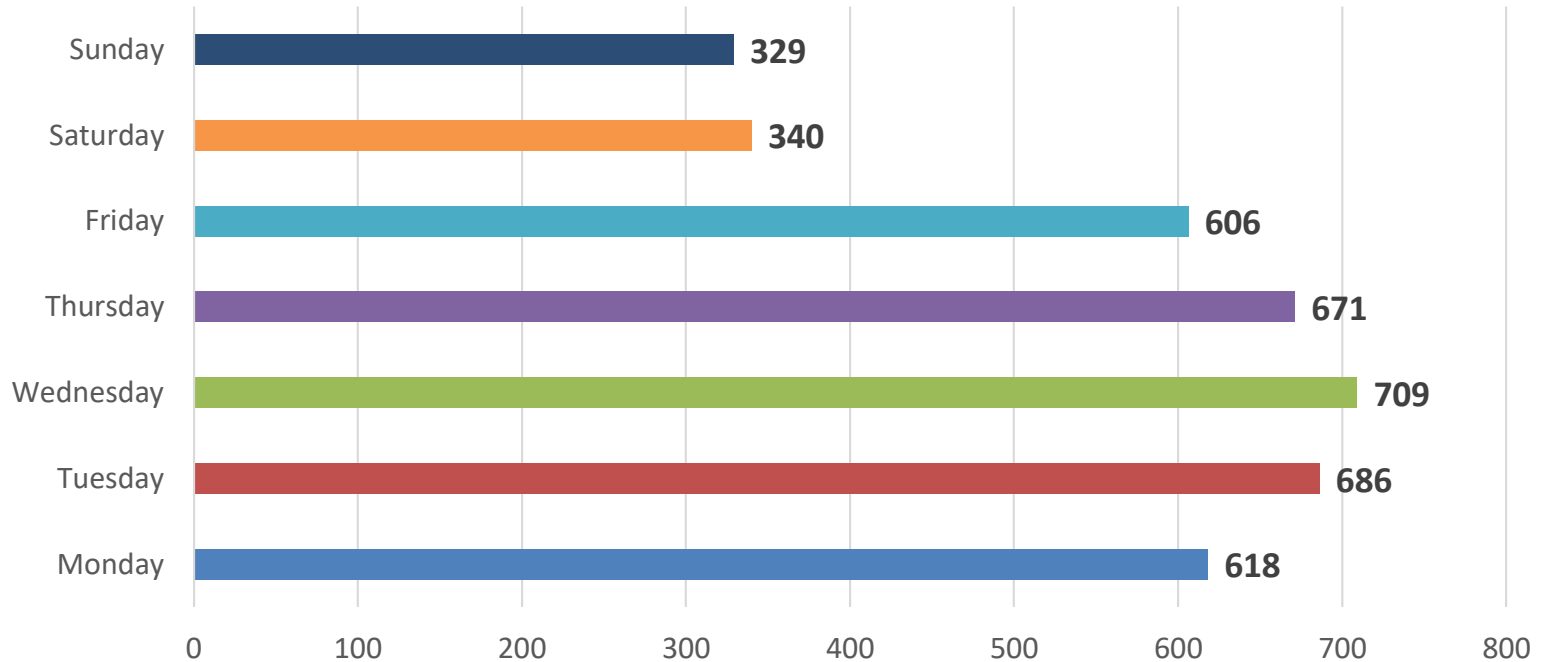
Data exploration

Frequency of arrests by Nationality



Data exploration

Total arrests per day of week



3 Classes model I:

Algorithm: Decision tree

Metrics:

- F1_score \rightarrow 0.69
- Accuracy \rightarrow 0.695

3 Classes model II:

Algorithm: Random Forest

Metrics:

- F1_score \rightarrow 0.69
- Accuracy \rightarrow 0.695

2 Classes model I:

Algorithm: Decision tree

Metrics:

- $F1_score \rightarrow 0.74$
- $Accuracy \rightarrow 0.74$

2 Classes model II:

Algorithm: Random forest

Metrics:

- $F1_score \rightarrow 0.75$
- $Accuracy \rightarrow 0.752$



Variables importance

3 Classes model I:

- Age
- Day of week
- Total Retirees
- Postal code
- Population

3 Classes model II:

- Age
- Day of week
- Postal code
- Total employees
- Nationality



Variables importance

2 Classes model I:

- Age
- Total employees
- Day of week
- Postal code
- Nationality

2 Classes model II:

- Age
- Day of week
- Postal code
- Total employees
- Nationality

Minor Importance Variables

DECISION TREE (3 CLASSES)

Native/Foreigner

Sex

DECISION TREE (2 CLASSES)

Sex

Team or not

RANDOM FOREST (3 CLASSES)

Sex

Native/Foreigner

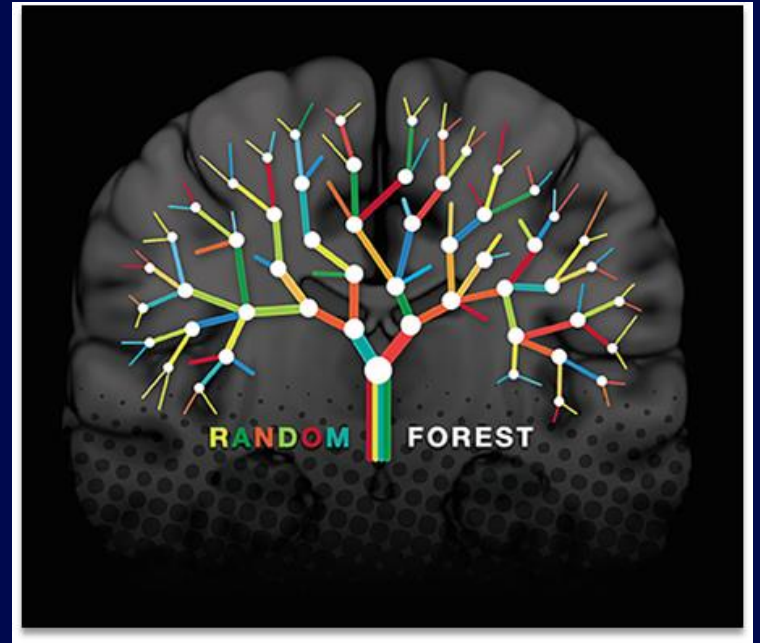
RANDOM FOREST (2 CLASSES)

Native/Foreigner

Sex

Results

- Accuracy of prediction: 0.752
- $F1 \rightarrow 0.75$
- Variable importance:
 1. Age
 2. Day of the week
 3. Postal code
 4. Total employees
 5. Nationality



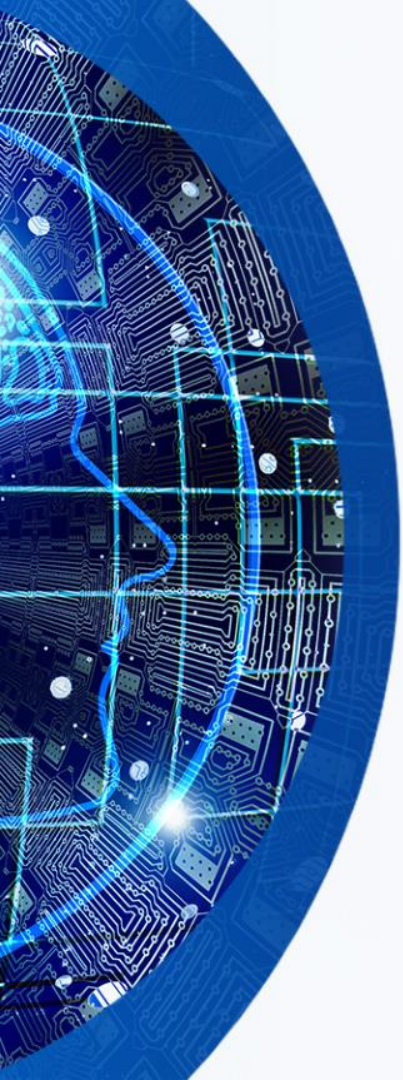
Source : [Frontiersin](#)

Minor importance variables:

1. Native / Foreigners
2. Sex

Conclusion

- Our purpose fulfilled
- Good accuracy of model
- Further investigation required





Contribution

- Advantages of unstructured data:
 1. Better policing
 2. More efficient Human Resource Management
- From experiment to action



Source: Unsplash



Thank you!



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