

Omdena - Milan Chapter Agrifoods

AI for Sustainable agri-food systems: use of Satellite Imagery

Exploratory analysis of cereals production in Italy 2020-2022

Author: Mario Fisher

Here we have analysed the major areas and crop produced in Italy. Crop dataset used in this study was downloaded from the Italian National Institute of Statistics (Istat). The objective is to get some insights about crop production and its respective areas in Italy and how climate change have affected crop production in the last 3 years.

Pre-processing dataset							
	Territory	Data type	Type of crop	Select time	Value		
0	Torino	total area - hectares	common wheat	2020	15362		
1	Torino	total area - hectares	common wheat	2021	16831		
2	Torino	total area - hectares	common wheat	2022	16735		
3	Torino	total production - quintals	common wheat	2020	844910		
4	Torino	total production - quintals	common wheat	2021	925705		
...
12125	Pesaro e Urbino	total area - hectares	rye and winter cereal mixtures (maslin)	2022	3		
12126	Roma	total area - hectares	rye and winter cereal mixtures (maslin)	2022	1		
12127	Valle d'Aosta / Vallée d'Aoste	total area - hectares	winter barley	2022	1		

Pre-processing dataset

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0	Torino	total area - hectares		2020	15362
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12125	Pesaro e Urbino	total area - hectares	rye and winter cereal mixtures (maslin)	2022	3
12126	Roma	total area - hectares	rye and winter cereal mixtures (maslin)	2022	20
12127	Valle d'Aosta / Vallée d'Aoste	total area - hectares	winter barley	2022	1
12128	Torino	total area - hectares	spring barley	2022	220
12129	Valle d'Aosta / Vallée d'Aoste	total area - hectares	oats and spring cereal mixtures (mixed grain o...	2022	3

12130 rows × 5 columns

DATASET SHAPE: (12130, 5)

FEATURE DATA TYPES:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 12130 entries, 0 to 12129
Data columns (total 5 columns):
0 Column Non-Null Count Dtype
...
0 City 12130 non-null object
1 Data_type 12130 non-null object
2 Type_crop 12130 non-null object
3 Year 12130 non-null int64
4 Value 12130 non-null int64
dtypes: int64(2), object(3)
memory usage: 474.0+ KB
None
NUMBER OF UNIQUE VALUES PER FEATURE:
City 107
Data_type 3
Type_crop 24
Year 3
Value 3183
dtype: int64

NULL VALUES PER FEATURE
City 0
Data_type 0
Type_crop 0
Year 0
Value 0
dtype: int64

Cities in Italy producing cereals

```
array(['Torino', 'Vercelli', 'Biella', 'Verbanio-Cusio-Ossola', 'Novara', 'Cuneo', 'Asti', 'Alessandria', 'Valle d'Aosta / Vallée d'Aoste', 'Savona', 'Genova', 'La Spezia', 'Varese', 'Como', 'Lecco', 'Sondrio', 'Milano', 'Bergamo', 'Brescia', 'Pavia', 'Lodi', 'Cremona', 'Mantova', 'Trentino Alto Adige / Südtirol', 'Verona', 'Vicenza', 'Belluno', 'Treviso', 'Venezia', 'Padova', 'Rovigo', 'Pordenone', 'Udine', 'GORIZIA', 'Piacenza', 'Parma', 'Reggio nell'Emilia', 'Modena', 'Bologna', 'Ferrara', 'Ravenna', 'Macerata', 'Ascoli Piceno', 'Viterbo', 'Rieti', 'Roma', 'Latina', 'Firenze', 'Prato', 'Livorno', 'Pisa', 'Arezzo', 'Siena', 'Grosseto', 'Perugia', 'Terni', 'Pesaro e Urbino', 'Ancona', 'Matera', 'Cosenza', 'Crotone', 'Catanzaro', 'Vibo Valentia', 'Frosinone', 'Abruzzo', 'L'Aquila', 'Teramo', 'Molise', 'Nuoro', 'Caltanissetta', 'Siracusa', 'Ragusa', 'Napoli', 'Palermo', 'Agrigento', 'Monza e della Brianza', 'Fermo', 'Barietta-Andria-Trani', 'Enna', 'Sud Sardegna', 'Bolzano / Bozen', 'Imperia'], dtype=object)
```

Select only Values for total production - quintals

In general crop production is reported in tonnes per hectare, however Istat (<http://dati.istat.it>) does not give variables definition, so we have assumed that the column 'Value' for rows containing data for 'harvested production - quintals', are values for total production of cereals.

82	Rovigo	18998091
51	Mantova	18620664
62	Padova	18030596
100	Venezia	17475472
14	Bologna	16209589

Total cereal production in 2020-2022 by City

Cities	Production (approximate)
Torino	95000000
Ferrara	94000000
Foggia	88000000
Pavia	78000000
Cuneo	75000000
Rovigo	65000000
Mantova	62000000

4042 rows × 5 columns

Regiona	Total production
	0.0
	0.5
	1.0
	1.5
	2.0
	1e7

Italy geographic areas is organized in regions, provinces or comunes.

The regions are classified as follow:

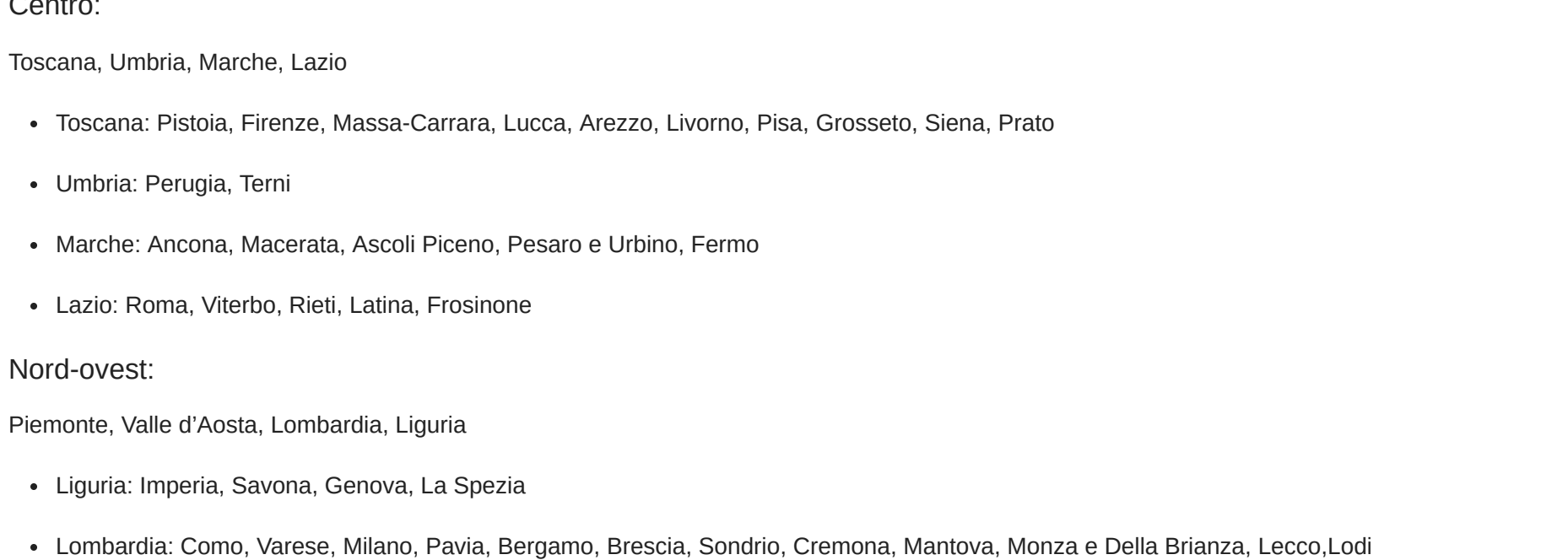
Sud/Mezzogiorno:

Abruzzo, Apulia/Puglia, Basilicata, Calabria, Campania, Molise, Sicily

- Abruzzo: L'Aquila, Pescara, Chieti, Teramo
- Apulia/Puglia: Foggia, Bari, Taranto, Brindisi, Lecce, Barletta-Andria-Trani
- Basilicata: Matera, Potenza
- Calabria: Crotona, Vibo, Valentia, Cosenza, Catanzaro, Reggio di Calabria
- Campania: Benevento, Caserta, Napoli, Avellino, Salerno

4042 rows × 4 columns

Total cereal production in 2020-2022



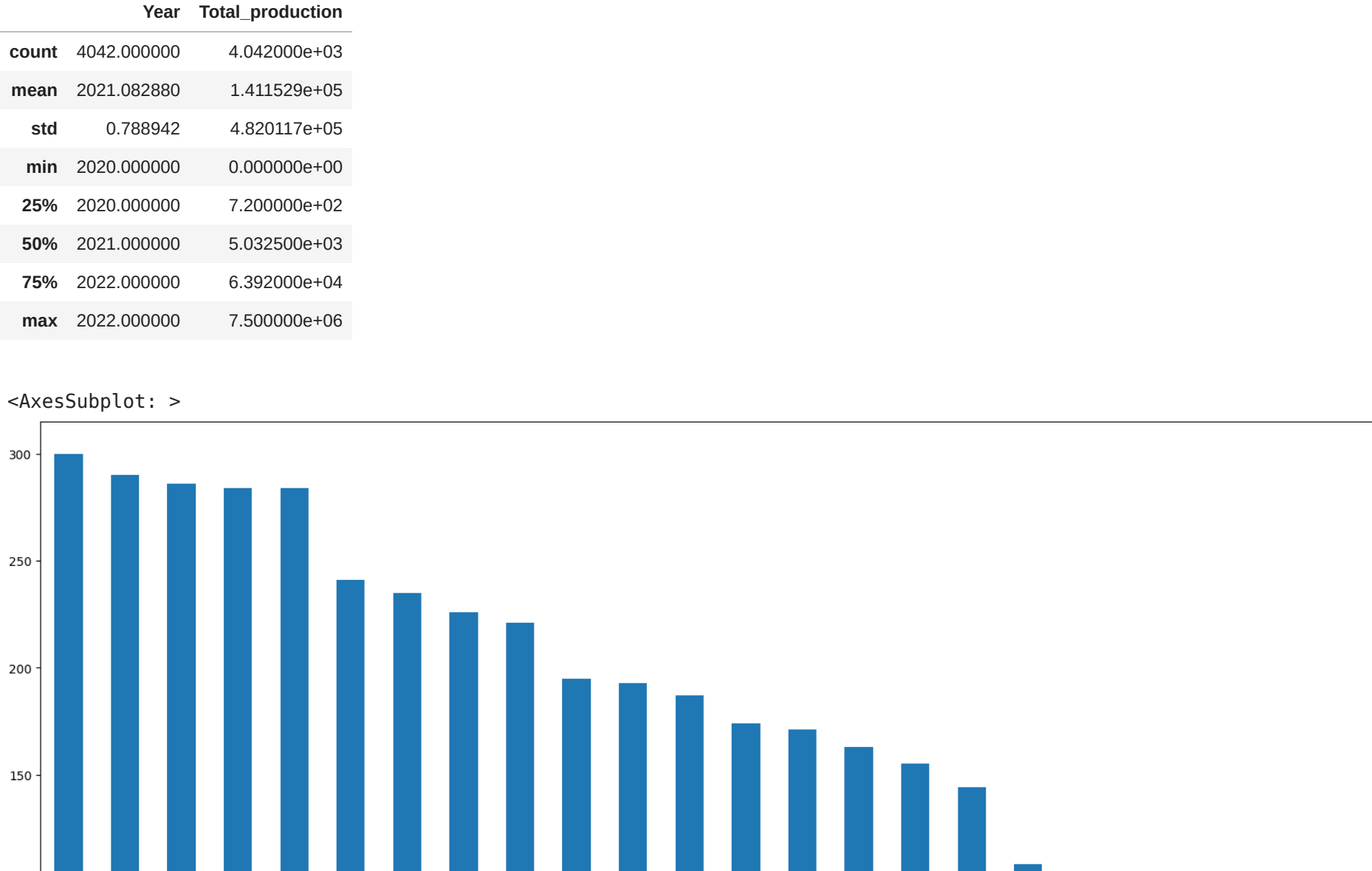
Cereal production by Cities

Nord-est:

Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna
<ul style="list-style-type: none">Trentino: Bolzano/Bozen, TrentoVeneto: Belluno, Verona, Vicenza, Rovigo, Treviso, Venezia, PadovaFriuli: Udine, Gorizia, Trieste, PordenoneEmilia-Romagna: Parma, Reggio Nell'Emilia, Piacenza, Forlì-Cesena, Modena, Bologna, Ferrara, Ravenna, Rimini

Cereals highest production 2020-2022

Dataset shows there are 24 different types of cereals cultivated in Italy. The top five most produced crops are Wheat, Barley, Maize, Beans and Oats.



Italy geographic areas is organized in regions, provinces or communes.

The regions are classified as follow:

Sud/Mezzogiorno:

- Abruzzo, Apulia/Puglia, Basilicata, Calabria, Campania, Molise, Sicily
- Abruzzo: L'Aquila, Pescara, Chieti, Teramo
- Apulia/Puglia: Foggia, Bari, Taranto, Brindisi, Lecce, Barietta-Andria-Treni
- Basilicata: Matera, Potenza
- Calabria: Crotone, Vibo, Valentia, Cosenza, Catanzaro, Reggio di Calabria
- Campania: Benevento, Salerno, Napoli, Avellino, Caserta, Salerno
- Molise: Campobasso, Isernia
- Sicilia: Messina, Siracusa, Agrigento, Caltanissetta, Trapani, Enna, Palermo, Catania, Ragusa
- Sardegna: Oristano, Carbonia-Iglesias, Olbia-Tempio, Ogliastr, Medio Campidano, Sassari, Nuoro, Cagliari

Centro:

- Toscana, Umbria, Marche, Lazio
- Toscana: Pistoia, Firenze, Massa-Carrara, Lucca, Arezzo, Livorno, Pisa, Grosseto, Siena, Prato
- Umbria: Perugia, Terni
- Marche: Ancona, Macerata, Ascoli Piceno, Pesaro e Urbino, Fermo
- Lazio: Roma, Viterbo, Rieti, Latina, Frosinone

Nord-ovest:

- Piemonte, Valle d'Aosta, Lombardia, Liguria
- Liguria: Imperia, Savona, Genova, La Spezia
- Lombardia: Como, Varese, Milano, Pavia, Bergamo, Brescia, Sondrio, Cremona, Mantova, Monza e Della Brianza, Lecco, Lodi
- Piemonte: Vercelli, Novara, Torino, Cuneo, Asti, Alessandria, Biella, Verbanio-Cusio-Ossola
- Valdaosta: Valle d'Aosta

Nord-est:

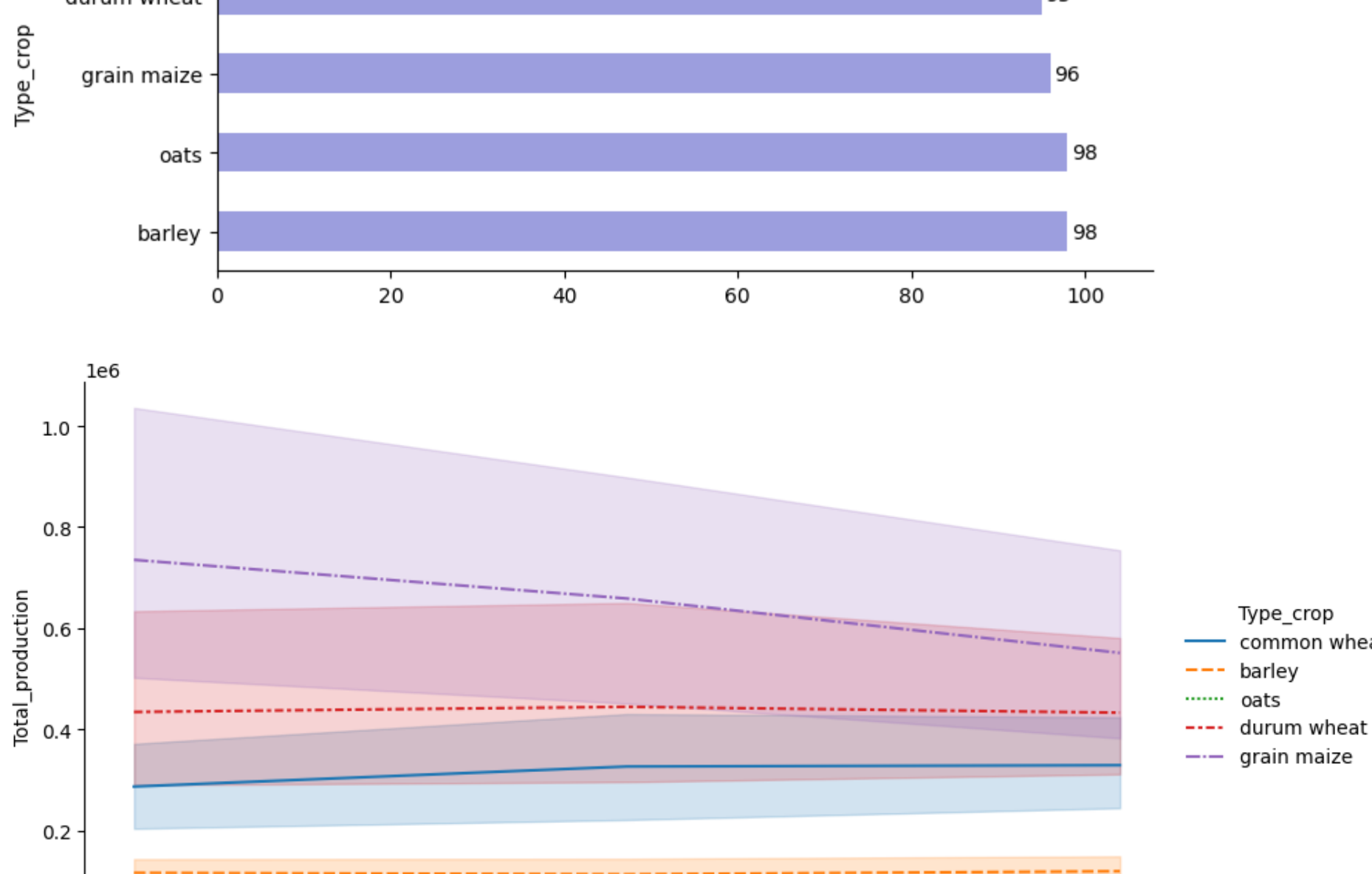
- Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna
- Trentino: Bolzano/Bozen, Trento
- Veneto: Belluno, Verona, Vicenza, Rovigo, Treviso, Venezia, Padova
- Friuli: Udine, Gorizia, Trieste, Pordenone
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Cereals highest production 2020-2022

Dataset shows there are 24 different types of cereals cultivated in Italy. The top five most produced crops are Wheat, Barley, Maize, Beans and Oats.

	Year	Total_production
count	4042.000000	4.042000e+03
mean	2021.062880	1.411529e+05
std	0.788942	4.820117e+05
min	2020.000000	0.000000e+00
25%	2020.000000	7.200000e+02
50%	2021.000000	5.032500e+03
75%	2022.000000	6.392000e+04
max	2022.000000	7.500000e+06

<AxesSubplot: >

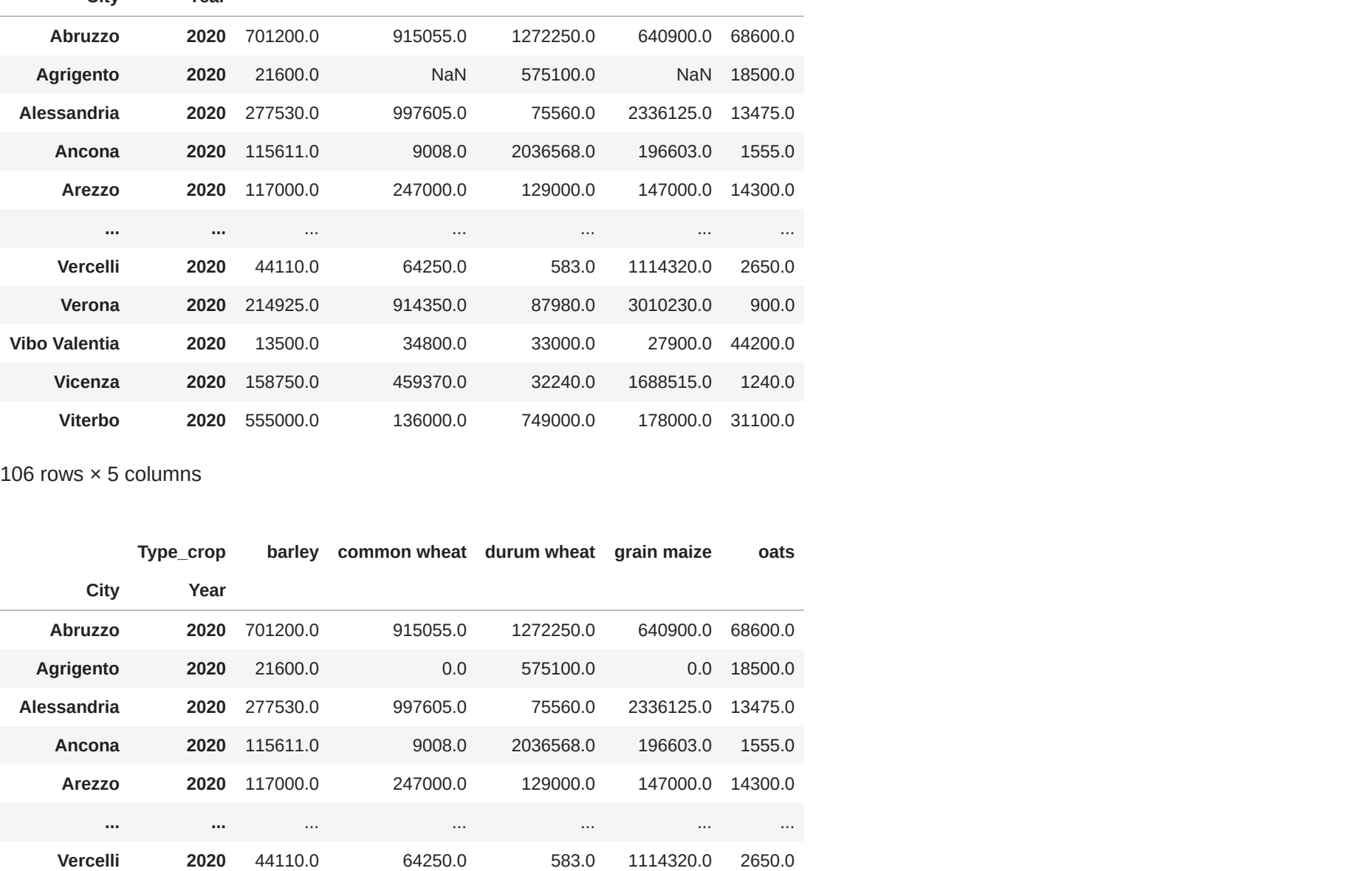


Subsetting data

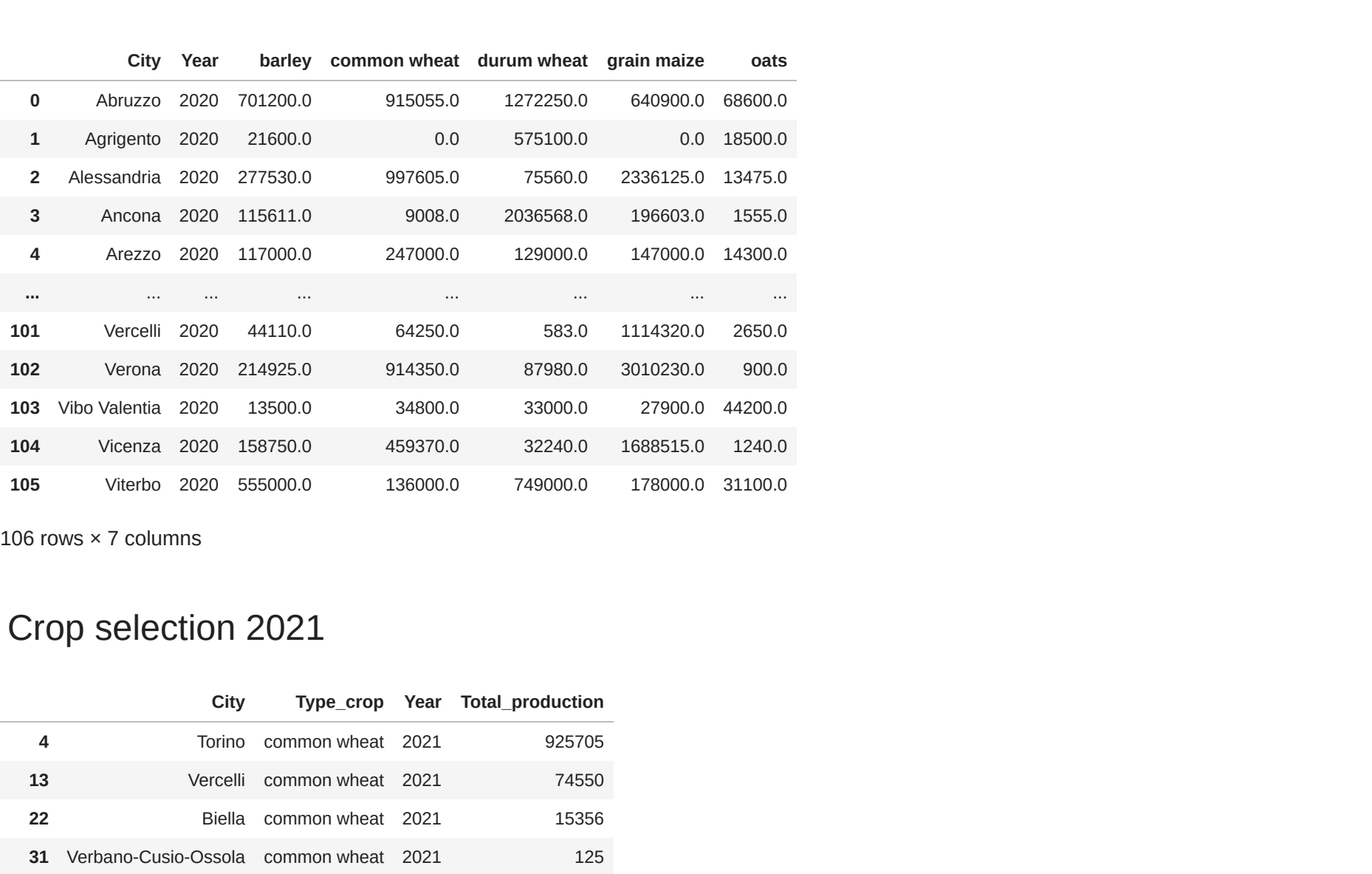
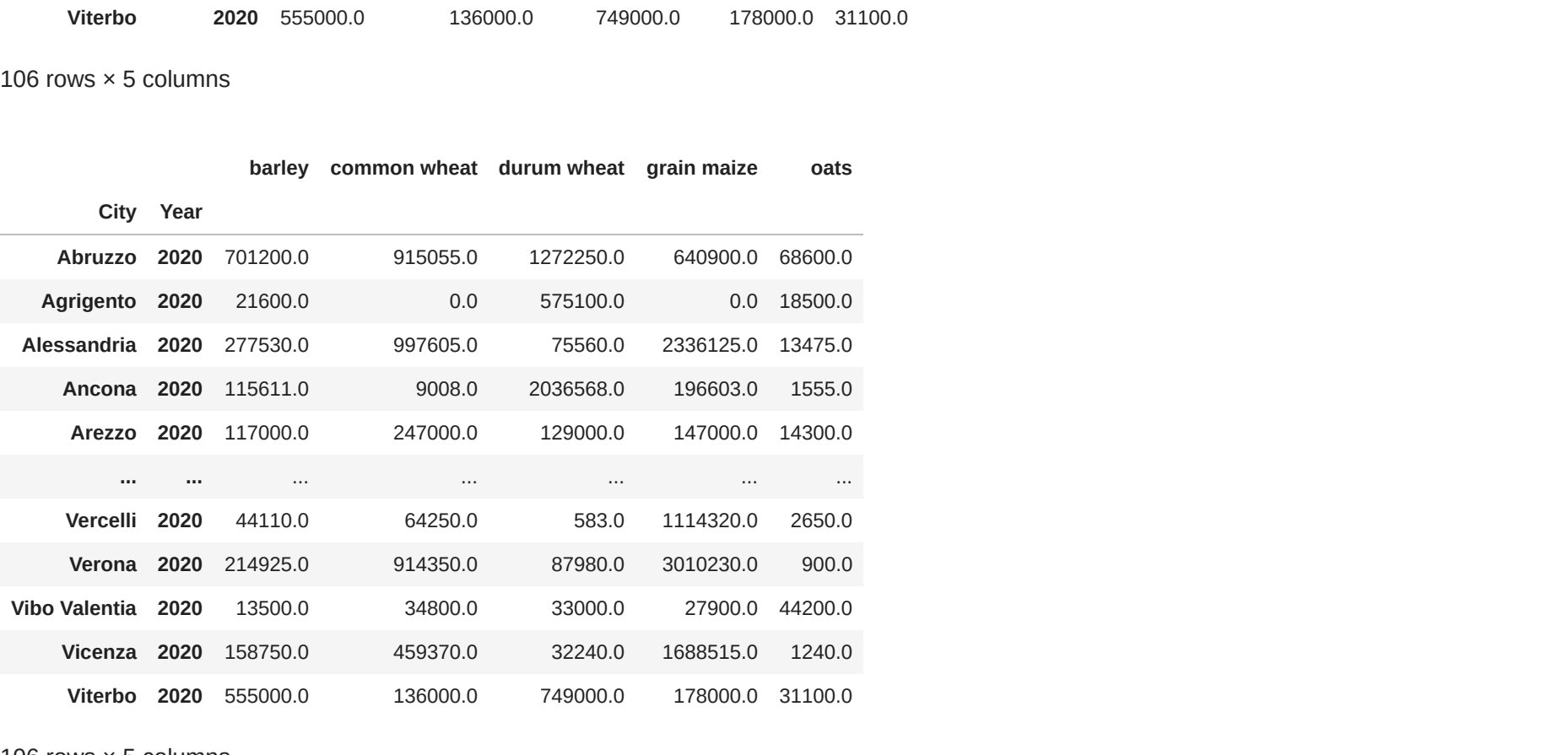
	City	Type_crop	Year	Total_production
3	Torino	common wheat	2020	844910
12	Vercelli	common wheat	2020	64250
21	Bielletta	common wheat	2020	5590
30	Verbano-Cusio-Ossola	common wheat	2020	130
39	Novara	common wheat	2020	60550
...
8605	Sud Sardegna	durum wheat	2020	396335
8614	Bolzano / Bozen	common wheat	2020	1400
8632	Bolzano / Bozen	barley	2020	2305
8641	Bolzano / Bozen	oats	2020	352
9552	Bolzano / Bozen	tritic-molise	2020	955

Stats

Year	Total_production
count	1444
mean	2020
std	0
min	2020
25%	2020
50%	2021
75%	2022
max	2022



Visualzation of five type of cereal produced in Italy in the period of 2020-2022



...	Verona	common wheat	2021	...	17359	...
...
8606	Sud Sardegna	durum wheat	2021	529123	...	...
8615	Bolzano / Bozen	common wheat	2021	3000	...	...
8633	Bolzano / Bozen	barley	2021	1890	...	...
8642	Bolzano / Bozen	oats	2021	352	...	...
8651	Bolzano / Bozen	grain maize	2021	240	...	...
484 rows × 4 columns						
Total_production						
	Type_crop	barley	common wheat	durum wheat	grain maize	oats
City	Year					
Abruzzo	2021	701200.0	915095.0	1275250.0	641080.0	68600.0
Agirgento	2021	20000.0	NaN	5495600.0	NaN	17700.0
Alessandria	2021	186410.0	1469966.0	69120.0	2065125.0	133335.0
	2020	115611.0	9008.0	2036568.0	196603.0	1555.0
Ancona	2021	88560.0	208000.0	150000.0	133000.0	6760.0
Arezzo	2021	88560.0	208000.0	150000.0	133000.0	6760.0
...
Vercelli	2021	39532.0	74550.0	742.0	1124280.0	114.0
Verona	2021	212610.0	1171023.0	137480.0	2515990.0	968.0
Vibo Valentia	2021	13500.0	34800.0	33000.0	27900.0	44200.0
	2020	149200.0	591750.0	49910.0	1425640.0	1395.0
Viterbo	2021	54000.0	129000.0	740000.0	172500.0	30100.0

483 rows × 4 columns

City	Type_crop	barley	common wheat	durum wheat	grain maize	oats
Abruzzo	2020	701200.0	915055.0	1272250.0	640900.0	68600.0
Agrigento	2020	21600.0	NaN	575100.0	NaN	18500.0
Alessandria	2020	277530.0	997605.0	75560.0	2336125.0	13475.0
Ancona	2020	115611.0	9008.0	2036568.0	196603.0	1555.0
Arezzo	2020	117000.0	247000.0	129000.0	147000.0	14300.0
...
Vercelli	2020	44110.0	64250.0	583.0	1114320.0	2650.0
Verona	2020	214925.0	914350.0	87980.0	3010230.0	900.0
Vibo Valentia	2020	13500.0	34800.0	33000.0	27900.0	44200.0
Vicenza	2020	158750.0	459370.0	32240.0	1688515.0	1240.0
Viterbo	2020	555000.0	136000.0	749000.0	178000.0	31100.0

106 rows × 5 columns

City	Type_crop	barley	common wheat	durum wheat	grain maize	oats
Abruzzo	2020	701200.0	915055.0	1272250.0	640900.0	68600.0
Agrigento	2020	21600.0	0.0	575100.0	0.0	17700.0
Alessandria	2020	277530.0	997605.0	75560.0	2336125.0	13335.0
Ancona	2020	115611.0	9008.0	2036568.0	196603.0	1555.0
Arezzo	2020	117000.0	247000.0	129000.0	147000.0	14300.0
...
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Alessandria	2020	277530.0	997605.0	75560.0	2336125.0	13335.0
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Viterbo	2020	540000.0	129000.0	740000.0	172500.0	30100.0

106 rows × 5 columns

City	Type_crop	barley	common wheat	durum wheat	grain maize	oats
Abruzzo	2020	701200.0	915055.0			

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