

Select Flag TIPO\_DATO5 **FERTILIZZANTI** Type of fertilizer TIME Value Flags ITTER107 Territory Data type Codes time containing fertilizers distributed -2019 0 ITD59 Rimini FERT\_DISTRIB\_T CON\_MIN\_MICRO 2019 11 NaN NaN micronutrients tonnes containing fertilizers distributed -ITD59 FERT\_DISTRIB\_T 2020 2020 1 Rimini CON\_MIN\_MICRO 11 NaN NaN tonnes micronutrients fertilizers distributed containing CON\_MIN\_MICRO 2021 2 FERT\_DISTRIB\_T 2021 3 ITD59 Rimini NaN NaN tonnes micronutrients fertilizers distributed -FERT\_DISTRIB\_T ITD44 AMM\_TORB\_COMP 2019 Trieste peaty soil amendment 2019 8 NaN NaN tonnes fertilizers distributed -4 FERT\_DISTRIB\_T AMM\_TORB\_COMP peaty soil amendment 2020 2020 105 ITD44 Trieste NaN NaN tonnes **Territory** Data type Type of fertilizer Select time Value fertilizers distributed - tonnes Rimini containing micronutrients 2019 1 Rimini fertilizers distributed - tonnes containing micronutrients 2020 11 Rimini fertilizers distributed - tonnes containing micronutrients 2021 3 8 3 2019 Trieste fertilizers distributed - tonnes peaty soil amendment 4 Trieste fertilizers distributed - tonnes peaty soil amendment 2020 105 ... Sud Sardegna fertilizers distributed - tonnes specific action products -2020 422 Sud Sardegna fertilizers distributed - tonnes specific action products -2021 543 17671 17672 Sud Sardegna fertilizers distributed - tonnes specific action products -2019 164 specific action products -135 17673 Sud Sardegna fertilizers distributed - tonnes 2020 Sud Sardegna fertilizers distributed - tonnes specific action products -2021 193 17675 rows × 5 columns City Data\_type Type\_fertilizer Year Fertilizers\_tonnes containing micronutrients 2019 0 Rimini fertilizers distributed - tonnes 11 Rimini fertilizers distributed - tonnes containing micronutrients 11 2 3 Rimini fertilizers distributed - tonnes containing micronutrients 2021 Trieste fertilizers distributed - tonnes peaty soil amendment 8 4 fertilizers distributed - tonnes peaty soil amendment 2020 105 Trieste specific action products - 2020 17670 Sud Sardegna fertilizers distributed - tonnes 422 Sud Sardegna fertilizers distributed - tonnes specific action products -543 Sud Sardegna fertilizers distributed - tonnes specific action products -2019 164 17672 17673 Sud Sardegna fertilizers distributed - tonnes specific action products -135 193 Sud Sardegna fertilizers distributed - tonnes specific action products - 2021 17675 rows × 5 columns City Type\_fertilizer Year Fertilizers\_tonnes 0 containing micronutrients 2019 11 Rimini containing micronutrients Rimini 11 2 3 containing micronutrients 2021 Rimini peaty soil amendment 3 Trieste 8 4 Trieste peaty soil amendment 2020 105 ... 422 17670 Sud Sardegna specific action products -2020 Sud Sardegna specific action products -543 specific action products - 2019 17672 Sud Sardegna 164 Sud Sardegna specific action products -135 17674 Sud Sardegna specific action products - 2021 193 17675 rows × 4 columns Select fertilizer for 2020 City Type\_fertilizer Year Fertilizers\_tonnes Rimini containing micronutrients Trieste peaty soil amendment 2020 105 7 Pisa specific action products 27 10 three components - nitrogen-phosphorous-phosph... 2020 8547 Pordenone 13 Venezia soil correctives - sulphur for agricultural use 5 17661 Sud Sardegna soil correctives - other soil correctives 2020 2 Sud Sardegna 2020 112 17664 crop substrates 17667 Sud Sardegna specific action products 557 Sud Sardegna specific action products -422 17670 17673 Sud Sardegna specific action products - 2020 135 5892 rows × 4 columns Selecting only 6 type of fertilizers for future analysis City Type\_fertilizer Year Fertilizers\_tonnes 76 ammonium sulphate 2020 747 Pavia 154 Benevento calcium cyanamide 0 166 1423 ammonium sulphate 2020 Treviso Provincia Autonoma Bolzano / Bozen nitrogen fertilizers 2020 31 organic fertilizers 2020 2251 235 Alessandria Create new dataframe with the selected type of fertilizers as columns Fertilizers\_tonnes ammonium calcium nitrogen Type\_fertilizer organic fertilizers phosphorus fertilizers potassium fertilizers fertilizers sulphate cyanamide City Year 1715 Agrigento 2020 155 12 4006 142 16 105 20968 2251 782 Alessandria 2020 135 743 567 17 22511 2695 1258 33 Ancona 2020 2053 72 Arezzo 2020 68 26 3675 209 **Ascoli** 2020 1284 8 1065 267 158 22 Piceno Vercelli 2020 2570 7604 6585 0 1013 14 Verona 2020 3919 258 66460 9529 9363 6141 Vibo Valentia 2020 1433 0 2487 92 157 0 1350 225 10182 1252 220 351 Vicenza 2020 0 603 10 Viterbo 2020 176 14138 2673 108 rows × 6 columns calcium ammonium nitrogen organic fertilizers phosphorus fertilizers potassium fertilizers Type\_fertilizer sulphate cyanamide fertilizers City Year Agrigento 2020 155 12 1715 4006 142 16 Alessandria 2020 135 105 20968 2251 782 743 Ancona 2020 567 17 22511 2695 1258 33 2053 72 Arezzo 2020 68 26 3675 209 Ascoli 2020 8 158 1065 1284 22 267 Piceno 2570 7604 6585 0 1013 Vercelli 2020 14 3919 258 9363 Verona 2020 66460 9529 6141 Vibo Valentia 1433 0 157 0 2020 2487 92 1252 351 Vicenza 2020 1350 225 10182 220 0 10 2020 14138 2673 603 Viterbo 176 108 rows × 6 columns ammonium sulphate calcium cyanamide nitrogen fertilizers organic fertilizers phosphorus fertilizers potassium fertilizers City Year Agrigento 2020 155 12 1715 4006 142 16 105 20968 2251 782 Alessandria 2020 135 743 Ancona 2020 17 22511 2695 1258 33 567 2053 72 209 Arezzo 2020 68 26 3675 Ascoli Piceno 2020 1284 22 267 8 158 1065 Vercelli 2020 14 2570 7604 6585 0 1013 2020 3919 258 9529 9363 6141 Verona 66460 Vibo Valentia 2020 1433 0 92 157 0 2487 1350 225 10182 1252 220 351 Vicenza 2020 Viterbo 2020 0 2673 603 10 176 14138 108 rows × 6 columns Year ammonium sulphate calcium cyanamide nitrogen fertilizers organic fertilizers phosphorus fertilizers potassium fertilizers City 0 Agrigento 2020 155 12 1715 4006 142 16 1 Alessandria 2020 135 105 20968 2251 782 743 2 1258 2020 567 17 22511 2695 33 Ancona 3 2020 26 3675 2053 72 209 Arezzo 68 4 Ascoli Piceno 2020 8 158 1065 1284 22 267 2020 2570 7604 6585 0 1013 103 Vercelli 14 2020 3919 258 9529 9363 104 Verona 66460 6141 0 92 157 0 105 Vibo Valentia 2020 1433 2487 106 Vicenza 2020 1350 225 10182 1252 220 351 107 Viterbo 2020 176 0 14138 2673 603 10 108 rows × 8 columns Join crop and fertilizers datasets phosphorus potassium durum ammonium calcium common nitrogen organic grain City Year barley oats wheat wheat maize sulphate cyanamide fertilizers fertilizers fertilizers fertilizers 0 Abruzzo 2020 701200.0 915055.0 1272250.0 640900.0 0.0 68600.0 0.0 0.0 0.0 0.0 0.0 1 Agrigento 2020 21600.0 0.0 575100.0 0.0 18500.0 155.0 12.0 1715.0 4006.0 142.0 16.0 2 2020 277530.0 997605.0 75560.0 2336125.0 13475.0 135.0 105.0 20968.0 2251.0 782.0 743.0 Alessandria 2020 115611.0 9008.0 2036568.0 196603.0 567.0 17.0 22511.0 2695.0 1258.0 33.0 Ancona 209.0 117000.0 247000.0 129000.0 147000.0 14300.0 68.0 26.0 3675.0 2053.0 72.0 4 2020 Arezzo 2020 64250.0 2650.0 7604.0 0.0 101 Vercelli 44110.0 583.0 1114320.0 14.0 2570.0 6585.0 1013.0 102 Verona 2020 214925.0 914350.0 87980.0 3010230.0 900.0 3919.0 258.0 66460.0 9529.0 9363.0 6141.0 Vibo 2020 13500.0 33000.0 27900.0 44200.0 1433.0 2487.0 103 34800.0 0.0 92.0 157.0 0.0 Valentia 1688515.0 1240.0 1350.0 225.0 10182.0 220.0 104 Vicenza 2020 158750.0 459370.0 32240.0 1252.0 351.0 Viterbo 178000.0 14138.0 2673.0 105 2020 555000.0 136000.0 749000.0 176.0 0.0 603.0 10.0 106 rows × 13 columns Select fertilizer for 2021 City Type\_fertilizer Year Fertilizers\_tonnes 2 Rimini 2021 3 containing micronutrients Trieste peaty soil amendment 0 Pisa 8 2021 33 specific action products Pordenone 11 three components - nitrogen-phosphorous-phosph... 8286 14 Venezia soil correctives - sulphur for agricultural use 2021 95 ... soil correctives - other soil correctives Sud Sardegna 2021 4 17662 17665 Sud Sardegna 40 crop substrates Sud Sardegna 17668 specific action products 2021 736 17671 Sud Sardegna specific action products -543 specific action products - 2021 Sud Sardegna 193 17674 5892 rows × 4 columns Selecting only 6 type of fertilizers for future analysis City Type\_fertilizer Year Fertilizers\_tonnes ammonium sulphate 2021 77 2504 Pavia 0 155 calcium cyanamide 2021 Benevento 167 Treviso ammonium sulphate 1541 Provincia Autonoma Bolzano / Bozen nitrogen fertilizers 2021 28 173 236 Alessandria organic fertilizers 2021 3930 Create new dataframe with the selected type of fertilizers as columns Fertilizers tonnes ammonium calcium nitrogen organic fertilizers phosphorus fertilizers potassium fertilizers Type\_fertilizer cyanamide fertilizers sulphate City Year Agrigento 2021 738 12 4592 3668 1075 36 21951 3930 900 Alessandria 2021 151 105 713 2021 954 14630 2500 1809 Ancona 17 43 71 Arezzo 2021 32 27 2414 2174 8 2021 Ascoli 3 158 1610 1211 8 46 Piceno 2021 5 2571 8929 8312 225 1014 Vercelli 10023 12968 Verona 2021 7632 258 59389 10878 Vibo Valentia 0 61 185 0 2021 518 1498 226 1100 382 Vicenza 2021 1784 6690 1634 0 Viterbo 2021 152 11245 2199 587 11 108 rows × 6 columns ammonium calcium nitrogen organic fertilizers phosphorus fertilizers potassium fertilizers Type\_fertilizer sulphate cyanamide fertilizers City Year Agrigento 738 12 4592 1075 36 2021 3668 Alessandria 2021 151 105 21951 3930 900 713 954 14630 2500 1809 43 Ancona 2021 17 2021 32 27 2414 2174 71 8 Arezzo Ascoli 2021 158 8 3 1211 46 1610 **Piceno** Vercelli 2021 5 2571 8929 8312 225 1014 258 10023 12968 Verona 2021 7632 59389 10878 Vibo Valentia 0 185 0 2021 518 1498 61 1784 226 1634 1100 382 Vicenza 2021 6690 2021 152 0 2199 587 11 Viterbo 11245 108 rows × 6 columns ammonium sulphate calcium cyanamide nitrogen fertilizers organic fertilizers phosphorus fertilizers potassium fertilizers City Year 1075 36 Agrigento 2021 738 12 4592 3668 Alessandria 2021 954 17 2500 1809 Ancona 2021 14630 43 Arezzo 2021 32 27 2414 2174 71 8 3 158 1211 8 46 Ascoli Piceno 2021 1610 2021 5 2571 8929 8312 225 1014 Vercelli Verona 2021 10023 12968 7632 258 59389 10878 Vibo Valentia 2021 518 0 1498 61 185 0 Vicenza 2021 1784 226 6690 1634 1100 382 152 0 2199 587 Viterbo 2021 11245 11 108 rows × 6 columns ammonium sulphate calcium cyanamide nitrogen fertilizers organic fertilizers phosphorus fertilizers potassium fertilizers City Year 0 Agrigento 2021 738 12 4592 3668 1075 36 900 1 Alessandria 2021 151 105 21951 3930 713 2 Ancona 2021 954 17 14630 2500 1809 43 3 2021 32 27 2414 2174 71 8 Arezzo Ascoli Piceno 3 158 8 46 4 2021 1610 1211 2021 5 225 103 Vercelli 2571 8929 8312 1014 59389 10023 12968 104 Verona 2021 7632 258 10878 2021 518 0 185 0 105 Vibo Valentia 1498 61 226 1100 106 2021 1784 6690 1634 382 Vicenza 107 0 11245 587 11 Viterbo 2021 152 2199 108 rows × 8 columns Join crop and fertilizers datasets common durum grain ammonium calcium nitrogen organic phosphorus potassium oats Year City barley sulphate cyanamide wheat fertilizers fertilizers fertilizers fertilizers wheat maize 0 Abruzzo 2021 701200.0 915055.0 1275250.0 641080.0 68600.0 0.0 0.0 0.0 0.0 0.0 0.0 2021 3668.0 20000.0 0.0 17700.0 738.0 12.0 4592.0 1075.0 36.0 1 Agrigento 0.0 549500.0 2 Alessandria 2021 186410.0 1469965.0 69120.0 2065125.0 13335.0 151.0 105.0 21951.0 3930.0 900.0 713.0 9008.0 954.0 14630.0 1809.0 43.0 3 Ancona 2021 115611.0 2036568.0 196603.0 1555.0 17.0 2500.0 4 Arezzo 2021 88500.0 208000.0 150000.0 133000.0 6760.0 32.0 27.0 2414.0 2174.0 71.0 8.0 101 Vercelli 2021 39532.0 74550.0 742.0 1124280.0 114.0 5.0 2571.0 8929.0 8312.0 225.0 1014.0 102 7632.0 258.0 10878.0 Verona 2021 212610.0 1171023.0 137480.0 2515950.0 968.0 59389.0 10023.0 12968.0 Vibo 103 2021 13500.0 34800.0 33000.0 27900.0 44200.0 518.0 0.0 1498.0 61.0 185.0 0.0 Valentia 104 Vicenza 149200.0 591750.0 49910.0 1425640.0 1395.0 1784.0 226.0 6690.0 1634.0 1100.0 382.0 105 Viterbo 2021 540000.0 129000.0 740000.0 172500.0 30100.0 152.0 0.0 11245.0 2199.0 587.0 11.0 106 rows × 13 columns Correlation analysis 2020 <AxesSubplot: title={'center': 'Correlation'}> Correlation 1.0 barley -0.43 0.24 0.36 0.063 0.0035 0.2 0.24 0.42 0.088 0.26 0.43 1 0.047 0.57 common wheat --0.16 0.25 0.16 0.61 0.34 0.42 0.43 - 0.8 durum wheat -0.24 0.047 1 -0.13 0.61 0.1 -0.039 0.23 0.099 0.24 -0.092 grain maize -0.36 -0.131 -0.22 0.11 0.15 0.57 0.57 0.56 0.14 0.24 - 0.6 0.24 -0.16 0.61 -0.22 1 0.12 -0.097 0.05 -0.051 0.2 -0.18 oats ammonium sulphate -0.063 0.12 1 0.2 - 0.4 0.25 0.1 0.11 0.59 0.26 0.58 0.47 calcium cyanamide - 0.0035 0.16 -0.039 0.15 -0.097 0.2 1 0.4 0.59 0.19 0.45 - 0.2 0.23 nitrogen fertilizers -0.42 0.61 0.56 0.05 0.59 0.4 1 0.53 0.7 0.78 organic fertilizers - 0.088 0.099 0.14 -0.051 0.53 1 0.34 0.26 0.59 0.43 0.5 - 0.0 0.26 1 phosphorus fertilizers -0.42 0.24 0.24 0.2 0.58 0.19 0.7 0.43 0.54 0.2 -0.18 potassium fertilizers -0.43 -0.092 0.57 0.47 0.45 0.78 0.5 0.54 -0.2nitrogen fertilizers potassium fertilizers barley grain maize oats ammonium sulphate organic fertilizers common wheat calcium cyanamide durum wheat phosphorus fertilizers Correlation analysis of cereal production in Italy 2020: • Maize has hight correlation with potassion and nitrogen fertilizers and Wheat. • Barley has correlation with nitrogen fertilizer and Wheat. • Common wheat has hight correlation with nitrogen fertilizer and Maize. • Oats has hight correlation with Durum Wheat. • There is also hight correlation between phosphorus and potassium with nitrogen fertilizer. Correlation analysis 2021 <AxesSubplot: title={'center': 'Correlation'}> Correlation 1.0 0.43 0.24 0.2 barley -0.36 0.24 0.063 0.0035 0.42 0.088 0.26 common wheat -0.43 1 0.047 -0.16 0.57 0.25 0.16 0.61 0.34 0.42 0.43 - 0.8 durum wheat -0.24 0.047 -0.130.61 0.1 -0.039 0.23 0.099 0.24 -0.092 0.36 -0.13 1 -0.22 0.11 0.15 0.24 grain maize -0.57 0.56 0.14 0.57 - 0.6 -0.097 0.24 -0.051 oats --0.160.61 -0.22 1 0.12 0.05 0.2 -0.18 - 0.4 ammonium sulphate -0.063 0.25 0.1 0.11 0.12 0.2 0.59 0.26 0.58 0.47 0.15 -0.097 calcium cyanamide - 0.0035 0.16 -0.039 0.2 0.4 0.59 0.19 0.45 1 0.2 1 nitrogen fertilizers -0.61 0.23 0.56 0.05 0.59 0.4 0.53 0.78 organic fertilizers - 0.088 0.099 0.34 0.14 -0.051 0.26 0.59 0.53 1 0.43 0.5 - 0.0 phosphorus fertilizers -0.26 0.42 0.24 0.24 0.2 0.58 0.19 0.7 0.43 1 0.54 potassium fertilizers -0.2 0.43 -0.092 0.57 -0.18 0.47 0.45 0.78 0.5 0.54 1 -0.2ammonium sulphate organic fertilizers potassium fertilizers barley grain maize oats nitrogen fertilizers durum wheat calcium cyanamide common wheat phosphorus fertilizers Correlation analysis of cereal production in Italy 2021: • Maize has hight correlation with potassion and nitrogen fertilizers, and Common Wheat. • Barley has correlation with nitrogen fertilizer, Maize and Common Wheat. • Durum Wheat has hight correlation with Oats. • There is also hight correlation between phosphorus and potassium with nitrogen fertilizer. Modelling References http://dati.istat.it https://maps.princeton.edu/catalog/stanford-mn871sp9778 https://www.crea.gov.it/documents/68457/0/ITACONTA+2020 ENG+DEF+xweb+%281%29.pdf/95c6b30a-1e18-8e94-d4ac-ce884aef76e8? t=1619527317576 https://seaborn.pydata.org/generated/seaborn.relplot.html