Nutrition_Analysis_Regression

November 30, 2019

In [1]:
```
# import geopandas as gpd
import numpy as np
import pandas as pd
import copy
```

In [2]:
```
data = pd.read_csv("./data/nndb_flat.csv")
```

In [3]:
```
data.head()
```

Out[3]:

	ID	FoodGroup	ShortDescrip	Descrip	CommonName	MfgName	ScientificName	Energy_kcal	Protein_g	Fat_g	...	Folate_USRDA	Niacin_USRDA	Riboflavin_USRDA	Thiamin_USRDA	Calcium_USRDA	Copper_USRDA	Magnesium_USRDA	Phosphorus_USRDA	Selenium_USRDA	Zinc_USRDA
0	1001	Dairy and Egg Products	BUTTER,WITH SALT	Butter, salted	NaN	NaN	NaN	717.0	0.85	81.11	...	0.0075	0.002625	0.026154	0.004167	0.020000	0.000000	0.004762			
1	1002	Dairy and Egg Products	BUTTER,WHIPPED,WITH SALT	Butter, whipped, with salt	NaN	NaN	NaN	717.0	0.85	81.11	...	0.0075	0.002625	0.026154	0.004167	0.020000	0.000018	0.004762			
2	1003	Dairy and Egg Products	BUTTER OIL,ANHYDROUS	Butter oil, anhydrous	NaN	NaN	NaN	876.0	0.28	99.48	...	0.0000	0.000188	0.003846	0.000833	0.003333	0.000001	0.000000			
3	1004	Dairy and Egg Products	CHEESE,BLUE	Cheese, blue	NaN	NaN	NaN	353.0	21.40	28.74	...	0.0900	0.063500	0.293846	0.024167	0.440000	0.000044	0.054762			
4	1005	Dairy and Egg Products	CHEESE,BRICK	Cheese, brick	NaN	NaN	NaN	371.0	23.24	29.68	...	0.0500	0.007375	0.270000	0.011667	0.561667	0.000027	0.057143			

```
0          0.034286        0.018182    0.008182
1          0.032857        0.018182    0.004545
2          0.004286        0.000000    0.000909
3          0.552857        0.263636    0.241818
4          0.644286        0.263636    0.236364

[5 rows x 45 columns]
```

1 Data Preprocessing

```
In [4]: data.notnull()
        data = data.drop(columns=['CommonName','MfgName','ScientificName'])

In [5]: data.head()
```

Out[5]:

	ID	FoodGroup	ShortDescrip	Descrip	Energy_kcal	Protein_g	Fat_g	Carb_g	Sugar_g	Fiber_g	...	Folate_USRDA	Niacin_USRDA	Riboflavin_USRDA	Thiamin_USRDA	Calcium_USRDA	Copper_USRDA	Magnesium_USRDA	Phosphorus_USRDA	Selenium_USRDA	Zinc_USRDA
0	1001	Dairy and Egg Products	BUTTER,WITH SALT	Butter, salted	717.0	0.85	81.11	0.06	0.06	0.0	...	0.0075	0.002625	0.026154	0.004167	0.020000	0.000000	0.004762	0.034286	0.018182	0.008182
1	1002	Dairy and Egg Products	BUTTER,WHIPPED,WITH SALT	Butter, whipped, with salt	717.0	0.85	81.11	0.06	0.06	0.0	...	0.0075	0.002625	0.026154	0.004167	0.020000	0.000018	0.004762	0.032857	0.018182	0.004545
2	1003	Dairy and Egg Products	BUTTER OIL,ANHYDROUS	Butter oil, anhydrous	876.0	0.28	99.48	0.00	0.00	0.0	...	0.0000	0.000188	0.003846	0.000833	0.003333	0.000001	0.000000	0.004286	0.000000	0.000909
3	1004	Dairy and Egg Products	CHEESE,BLUE	Cheese, blue	353.0	21.40	28.74	2.34	0.50	0.0	...	0.0900	0.063500	0.293846	0.024167	0.440000	0.000044	0.054762	0.552857	0.263636	0.241818
4	1005	Dairy and Egg Products	CHEESE,BRICK	Cheese, brick	371.0	23.24	29.68	2.79	0.51	0.0	...	0.0500	0.007375	0.270000	0.011667	0.561667	0.000027	0.057143	0.644286	0.263636	0.241818

```
4         0.263636    0.236364

[5 rows x 42 columns]
```

```
In [6]: descrip = np.array(data['Descrip'])
        words = ""
        for i in descrip:
            words += i.lower()+','
        differentwords = (words.split(','))
```

```
In [7]: count = 0
        for i in differentwords:
            if('pizza' in i):
                count+=1
```

```
In [8]: count
```

```
Out[8]: 97
```

```
In [9]: len(set(differentwords))
```

```
Out[9]: 5952
```

```
In [10]: groups = np.array(data['FoodGroup'])
         len(set(groups))
```

```
Out[10]: 25
```

```
In [11]: set(differentwords)
```

```
Out[11]: {'',
          ' instant breakfast powder',
          ' 100 grand bar',
          'mustard spinach',
          ' apple and raspberry',
          ' dark',
          ' flavored with meat italian sauce',
          ' with broth',
          ' 80 proof',
          'juice smoothie',
          ' rolo caramels in milk chocolate',
          'p rego pasta',
          'fish sticks',
          'cattail',
          ' swordfish',
          ' royal red',
          ' mocha-flavor',
          ' perrier',
          ' mouvedre',
```

```
'next step prosobee',
' cornbread',
' bagel chips',
' berry burst cheerios',
' 3.25% milkfat',
' under blade pot roast or steak',
' grilled chicken & sausage gumbo soup',
" reese's pieces candy",
' hulled',
' link',
' bacon ranch salad without chicken',
' snack sticks',
' turkey breast (oven roasted',
' original recipe',
' crunchy almond/brown sugar',
' common (danish',
' pork)',
'chives',
' fruit flavored',
' commercially prepared with chocolate frosting',
' silken tofu',
' atlantic',
' peanut butter on cheese crackers',
' pinto bean and hominy',
' dehydrated flakes',
' flap',
' uses similar to high quality cocoa butter',
' skipjack',
' carnation breakfast essentials ',
' without caffeine',
' green variety',
' beefalo',
" sweet 'n sour sauce",
'keebler',
'rice',
' sweetened with low-calorie sweetener',
' with green chilies',
" hershey's golden almond solitaires",
' herring eggs',
' rotisserie',
' nutritional shake mix',
' fast roasted',
'eggnog-flavor mix',
' shoulder',
' non fat',
' ready-to-bake',
' waffle cones',
'house foods premium firm tofu',
```

```
' (sweetsop)',
' pudding',
' frosted wild grape toaster pastries',
' made with enriched masa flour',
' chow mein',
'vitasoy usa azumaya',
' baby ruth bar',
' (lox)',
' french or vienna',
' corn-based',
"carrabba's italian grill",
' sweet potatoes strained',
' cocktail',
'milk shakes',
' baked without fat',
'pasta mix',
' loin saddle',
' tri-tip steak',
' mature',
' cheddar cheese soup',
"morningstar farms chik'n grill veggie patties",
' with pulp',
' mayonnaise type',
' roast',
' ham (chopped with natural juice)',
" kellogg's all-bran bran buds",
' mango with tapioca',
' next step',
'kraft velveeta pasteurized process cheese spread',
' pork and beef',
' carrots and beef',
' granola bar',
' filled cream-type',
' tofu',
' vitamin d fortified',
' terra chips',
' water and margarine added',
' cinnamon brown sugar baked bites',
'worthington smoked turkey roll',
'new zealand spinach',
' low calorie',
' turkey franks',
'pomegranate juice',
' broad',
' without cheese',
' kidney',
' red leaf',
' blue or roquefort cheese',
```

```
" kellogg's crispix",
' fat free)',
'dill weed',
' denver cut',
' cranberry energy juice drink',
' all purpose',
' beef with country vegetables soup',
'loganberries',
'kellogg',
' 1/2 dipped',
' classic beef',
' sundae',
'vinegar',
' flakes without milk',
' shoulder steak',
'roast beef',
'silk very vanilla',
' back meat and skin',
' snickers cruncher',
' diluted with 3 volume water without added ascorbic acid',
' surimi',
' prepared with tap water',
' grape',
' propel zero',
' boiled (northern plains indians)',
' sausage mcmuffin with egg',
' salami (for beer)',
'brussels sprouts',
' with added oil',
' eas soy protein powder',
' 85% lean',
' without added sodium or vitamin a',
' wieners (cheese hot dogs with turkey)',
' salami (genoa)',
' good start soy',
' and cheese',
' tilapia',
' chunky chicken noodle',
' starburst sour fruit chews',
' sunchips',
'pineapple and grapefruit juice drink',
' farley fruit snacks',
' club & cheddar sandwich crackers',
' lasagna classico',
' pinot noir',
' cream of asparagus',
' cheerios',
' sugar syrup/caramel',
```

```
' nutz over chocolate',
' composite of separable fat',
' pop',
' soy oil (partially hydrogenated )',
" baker's treasures",
' 95% lean meat / 5% fat',
' made from reduced fat packaged mix',
' tomato bisque',
' salada brewed from bags',
' pizza',
' bite-size',
'watercress',
' dinner',
' cream of onion soup',
' rib roast',
' chicken mushroom chowder',
' just bunches',
' vegetable soup',
' confectioners coating',
' lil crunchies',
' raisin vineyard',
' classic double',
' blended with cookie pieces',
' dark chocolate coated coffee beans',
' pregestimil',
'cowpeas (blackeyes)',
' 100 calorie right bites',
' peanut bar',
' reduced-calorie or diet',
' pm 60/40',
'whale',
' arm pot roast',
' slim-a-bear',
' sponge',
'beans',
'braunschweiger (a liver sausage)',
' toasteds',
' quaker',
' extra firm',
' mountain dew original',
'chili',
' curd cheese',
' peanut butter on toasty crackers',
' manhattan style',
' golden crisp',
'pizza hut 12" pepperoni pizza',
'frybread',
' smoked sliced beef',
```

```
' wheat and honey',
' pasta with cheese filling',
' special dietary',
' chicken and chipotle bbq sauce with mango',
' solids and liquid',
' popcorn',
'beverages',
' prime',
' cinnamon nut)',
' boiled with salt',
"campbell's healthy request",
' frijoles with cheese',
'vitasoy usa organic nasoya sprouted',
' 96% lean / 4% fat',
' cracker chips',
' (alaska native)',
'  trimmed to 1/8" fat',
' eel',
' great grains crunchy pecan cereal',
' bun length)',
' club crackers',
' egg yolks and bacon',
' breast',
' banana and strawberry',
' high-fat',
' yane (alaska native)',
' farmed',
' italian style wedding soup',
' betty crocker supermoist yellow cake mix',
' potato ham chowder',
' corn based',
"morningstar farms chik'n nuggets",
' restaurant-prepared',
' herb and laborador combination (alaska native)',
' mature seeds',
' top loin filet',
'chokecherries',
' walleye',
' classic chicken noodle soup',
' garden',
'breakfast tart',
' quaker crunchy bran',
' neufchatel',
' sesame seed kernels',
' vitamins a and d',
' without ice',
' with cream style corn',
' chicken',
```

```
' quick',
' merry mint patties',
' soft taco with ground beef',
' and olive',
' principal use flaky pastries',
' inside skirt',
' plum',
' plums',
' milk chocolate peanut',
'sea cucumber',
" kellogg's rice krispies",
' mexican rice',
' ringed',
' sesame chicken',
'chicken tenders',
' calcium-fortified',
' baked apple pie',
'garlic',
' liquid',
'swanson broth',
' sucker',
' lightly frosted',
' mace',
" kellogg's cinnamon jacks",
'alfalfa seeds',
"campbell's homestyle new england clam chowder",
'lasagna with meat & sauce',
' pink',
' caramel filled cookies',
' pollock',
' special dietary (includes lemon-flavored)',
' high oleic (70% and over)',
'endive',
' with wheat flour added',
' cinnamon with crumb topping',
' eastern',
'chicken breast',
' with fruit and granola',
' country-style ribs',
' 85% lean meat / 15% fat',
' with corn syrup and/or sugar and low calorie sweetener',
" kellogg's product 19",
' potherb',
'v8 v. fusion juices',
' fore-shank',
' very low sodium',
' crispbread',
' medallion',
```

```
' beef and mushroom',
' oven-roasted',
'vinespinach',
'pie',
' side salad',
' apple yogurt dessert',
' oregano',
' cheddar or american',
'lamb',
' japanese',
' from raw and stone ground kernels',
' salted and fermented (fuyu)',
' 98% fat free vanilla',
' carp',
' sprite',
"kraft breakstone's reduced fat sour cream",
' organic promise autumn wheat',
' nutty clusters & almonds',
'acerola juice',
' prepared from granules',
' whiskey) 80 proof',
' vitasoy organic creamy original soymilk',
' 3 musketeers bar',
' with beef and cheese',
' mamey',
' vanilla with nuts',
' fudge stripes',
'silk nog',
'lotus root',
' meat and skin and breading',
' shortbread bites',
' thin',
' slimfast',
' chicken broth or bouillon',
' horse',
' less than 3% juice',
' quaker oatmeal to go',
' french toaster sticks',
' soybean oil and butter',
' custard pudding',
'frozen novelties',
' milk chocolate covered',
' original seasoning',
' with apples',
' top round cap-off steak/roast',
'interstate brands corp',
' whole (arm and blade)',
' beef with white and wild rice soup',
```

```
'popeyes',
' fenugreek seed',
' fiber 7 flakes',
' 14" pizza',
' flavored',
' chicken broth cubes',
'corn with red and green peppers',
' thick-cut',
' regular (10 minute)',
' unfortified',
' healthy request mexican style tortilla',
' ice cream shoppe frosted rainbow chip toaster pastries',
' brined (alaska native)',
' potatoes',
' apple - cherry',
' chicken fajita strips',
'bockwurst',
' latino bakery item',
"wend'ys",
' microwavable',
' with bananas',
" kellogg's frosted mini-wheats touch of fruit in the middle mixed berry",
' frosted pumpkin pie toaster pastries',
' jacks vanilla wafers',
' green pea soup',
'fruit butters',
' assorted',
'prego pasta',
'ostrich',
' butter or sugar',
' coffee',
' 98% fat free cream of chicken soup',
' chicken fingers',
' butter (includes fresh and frozen)',
'tomato products',
' hot fudge sundae',
' chocolatey chip thins cookies',
' chicken fettuccine',
' chump off',
' fresh pork',
' drained solids',
' hazelnut',
' hot mustard sauce',
' made with palm oil',
' unenriched',
' kashi golean crunch!',
' simmered',
' ice cream shoppe frosted hot fudge sundae toaster pastries',
```

```
' 1% fat',
' junior',
' savory chicken with white & wild rice soup',
' with iron and fiber (formerly ross)',
' coconut cream',
' with chicory',
'salsify',
" kellogg's special k chocolatey strawberry",
' ling',
' supreme topping',
" kellogg's honey smacks",
' peach melba',
'meat drippings (lard',
' hain celestial group',
' mcchicken sandwich',
' coconut dreams cookies',
' and sugar',
' monterey',
' cream of shrimp soup',
' pre-basted',
'cereals ready-to-eat',
' savory herb crackers',
' cherry',
' fruit pudding',
' not breaded',
' potato',
' almonds',
' beef sticks',
'worthington multigrain cutlets',
' batter',
' fully hydrogenated',
' somen',
'peaches',
'radish seeds',
' and grape popsicle pops',
' v8 60% vegetable juice',
' ready-to-drink',
'elk',
' breadnut tree seeds',
'orange breakfast drink',
' chopped or leaf',
' lentil soup',
' cooked (southwest)',
' with hydrogenated vegetable oil and soy protein',
'frog legs',
' grass-fed',
'shake',
' nutramigen aa',
```

```
' packed in tomato juice',
' multi-grain (includes whole-grain)',
' cereal',
' sun country',
' regular',
'peach nectar',
' quesadilla',
' mustard',
' cottage-cut',
' cookie-like',
' frosted mini-wheats bite size strawberry delight',
' without calcium propionate(includes sourdough)',
' vegetables and chicken',
' prune and orange',
' kc masterpiece',
' edible-podded',
' boneless separable lean only',
' chocolate caramel',
' made from dried potatoes',
' organic mushroom italian sauce',
' black bean soup',
' whelk',
' roasted almond',
' oatmeal',
' pepper-type',
' vegetables and beef',
' farina',
"mcdonald's bacon ranch salad with crispy chicken",
' chicken gumbo soup',
' bread',
' pumpernickel',
'morningstar farms entree chili',
' soda',
' bologna (fat free)',
' (tendergreen)',
' fudgesicle pops',
' pasta with vegetables',
' creme-filled',
' smooth',
' trimmed to 1/8" fat',
' apple and cherry',
' vegetable oil spread',
' puffs or twists',
' water',
' homestyle chicken fillet sandwich',
' peanut flavor',
" pop'ables milky way brand bite size candies",
'cranberry-apple juice drink',
```

```
' cultured',
' naturally sparkling',
' white-winged',
' frosted raspberry',
' corn on the cob with butter',
' from dark meat',
' chex mix',
' chuck',
' rabbit',
'margarine-like spread with yogurt',
' jellied',
'morningstar farms roasted garlic & quinoa burger',
' cucumber',
' skittles original bite size candies',
' green peppers',
'chicken spread',
' grape juice',
' quick (1-3 minutes)',
' hash brown rounds',
' baked and topped with sour cream and chives',
'papayas',
' franks (turkey and chicken cheese)',
' commercially prepared',
' onion-flavor',
' fresh water',
' grape-nuts cereal',
' eggo seasons',
' cod',
' shark',
' dry heat',
' ranch-flavor',
" cap'n crunch with crunchberries",
' apples',
' chicken)',
' broiled (northern plains indians)',
' dark meat (drumstick or thigh)',
' mini brownies',
' frozen concentrate',
'peppers',
' deluxe grahams cookies',
'lemonade-flavor drink',
' snickers marathon protein performance bar',
' eggs (alaska native)',
" hershey's genuine chocolate flavored lite syrup",
' golden seedless',
' berry berry kix',
' and shoulder)',
' vegetable and brown rice',
```

```
' (vegetable oyster)',
' healthy request vegetable soup',
'apples',
'edamame',
' mini mints grasshopper cookies',
'carob-flavor beverage mix',
' italian dressing',
' cake-type',
' butternut',
' niacin',
' little bites',
'bread sticks',
' usda commodity corn and rice (includes all commodity brands)',
' (pineapple and papaya and banana and guava)',
"morningstar farms mushroom lover's burger",
' original chicken sandwich',
' flavored and sweetened',
' late harvest',
"mcdonald's",
'quinoa',
' vegetables chicken',
" general tso's chicken",
' chicken and stars soup',
' outside round',
' minis original crackers',
' oriental',
' center cut chops',
' french fries',
' golden puffs',
'morningstar farms grillers quarter pound veggie burger',
"campbell's homestyle mexican style chicken tortilla soup",
'quail',
' tap',
' premium',
' la moderna rikis cream crackers',
'kashi pizza',
' regular flavor',
" newman's own low fat balsamic vinaigrette",
' with franks',
' with low calorie sweetener',
' chicken a la king',
'fiddlehead ferns',
' southwestern-style chicken w/rice (chicken not included)',
' steak cut',
'  85% lean / 15% fat',
' teaseed',
' not canned',
' pound cake type',
```

```
' tonic water',
'egg substitute',
' mechanically deboned',
'worthington saucettes',
'dessert topping',
' lemon-lime flavored',
"campbell's chicken gravy",
' caffeine free',
' almond milk',
'citrus fruit juice drink',
' familia',
' stuffed crust',
' arm picnic',
'horseradish',
' vegetable and fruit juice blend',
' (granadilla)',
' banana (navajo)',
' milk chocolate peanut butter and soft nougats',
'pork and turkey sausage',
' canned in tomato sauce',
' dumpling with mutton (navajo)',
'fruit flavored drink containing less than 3% fruit juice',
' pearled',
" split pea 'n' ham soup",
' carving board)',
' onion',
' french lentil',
'orange peel',
" m&m's semisweet chocolate mini baking bits",
"campbell's red and white",
'chili con carne with beans',
'little caesars 14" cheese pizza',
' hard type',
'pimento',
'oopah (tunicate)',
' peanut butter gauchos cookies',
' cheese)',
' with corn flour coating (corndog)',
' double chocolate cookies',
" pop'ables snickers brand bite size candies",
' strawberry',
' soft taco',
'morningstar farms grillers burger style recipe crumbles',
' top round',
' sun-dried',
' wheat germ',
' home prepared',
' cottonseed flour',
```

```
'mixed vegetable and fruit juice drink',
' wafers with peanut butter',
' cooked with water',
' harvard',
' egg drop',
' oat blenders with honey',
' prepared with butter',
' in-store bakery',
' tilefish',
' salted',
' nut and raisin',
' meat and skin',
' enriched',
' monster',
' milk',
' sazon',
' traditional flavor',
'morningstar farms grillers prime',
'cranberry-grape juice drink',
'okara',
' precooked or instant',
'silk coffee',
'baby food',
' or banana powder',
' high vitamin c and added thiamin',
' whole grain',
' stick',
' potato wedges',
' unspecified oils',
' prepared with water or ready-to-serve',
' reduced-calorie',
' and beans',
' cookie crumb topping',
" kellogg's all-bran original",
' croaker',
' summer sausage thuringer cervalat',
'celeriac',
' klondike',
' total can contents',
' canola',
' ultimate deep dish crust',
' veal',
"kellogg's eggo lowfat blueberry nutri-grain waffles",
' gumdrops',
' duoz smoked cheddar monterey jack crackers',
' blueberry muffin tops cereal',
' spaghetti in tomato & cheese sauce',
' eggo minis',
```

```
' vegetables and mayonnaise',
' dha and ara',
' high oleic (70%)',
' whiskey) 94 proof',
' twix chocolate fudge cookie bars',
' without meat',
" pop'ables 3 musketeers brand bite size candies",
' unsweetened',
' organic nasoya silken tofu',
'hush puppies',
' grouper',
' peaches',
'pace',
' turkey vegetable',
' unenriched flour',
' magic middles fudge filled cookies',
' quick oats',
' chicken vegetable soup',
' shank',
' pourable liquid fry shortening',
'little caesars 14" original round pepperoni pizza',
' triple patty',
' cookie crisp',
' chardonnay',
"morningstar farms italian herb chik'n pattie",
' cooked (includes squab)',
' heated (microwave)',
' tootie fruities',
' banana yogurt',
' flowers',
' subcutaneous fat (blubber) (alaska native)',
'prairie turnips',
' raisin nut bran',
' classic tomato soup',
' apricot',
' fish',
'ice cream sandwich',
' oats',
' neck',
'pumpkin leaves',
' soy (partially hydrogenated ) and corn for frying',
' (pigeon)',
'cauliflower',
' toppers',
' zucchini',
' cream',
' thompson seedless',
'sweet potato leaves',
```

```
' with chicken',
' beef tallow',
' pediasure',
' cheese-filled',
' chocolate with frosting',
' romano',
' round pieces or patty',
' naked juice',
' frosted wild strawberry toaster pastries',
' peanut butter sandwich',
' fudge shoppe',
' granulated',
' freeze-dried',
' rainbow chocolate chip cookies',
' blueberry hazelnut',
'yogurt',
' taro chips',
' smoked link sausage',
' salami (hard)',
' with juice and pulp',
' cola',
' oven-heated',
' with vitamin e added',
' chervil',
' chunky garden combination italian sauce',
' swanson chicken broth 99% fat free',
' choco zucaritas',
' hamburger or hotdog',
' holiday circus animal cookies',
'wocas',
' cake',
' dry form',
' packets',
' salpora de arroz con azucar',
'potato pancakes',
' carignane',
' puffed',
' pasta',
' glazed',
' smokies sausage little cheese (pork',
' fan fillet',
' kashi tlc bar',
' healthy request chicken with mini noodles soup',
' made with egg',
' lima',
' roasting',
' coconut water',
' tofu plus extra firm',
```

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'butter replacement',
' dices',
' honey nut cheerios',
' shoulder)',
'salmon',
' poppy',
' vanilla wafers',
' candy bits',
' bbq',
' peanut butter cups cookies',
' brownberry sage and onion stuffing mix',
' compressed',
' self-rising',
' tip side',
' from whole',
'silk hazelnut creamer',
' pilaf',
'rice flour',
' cool nestea ice tea lemon flavor',
' white popcorn',
' nutritional shake',
' extra crispy',
' vegetables and turkey',
' regular patty; with condiments and vegetables',
'croutons',
' french fried in vegetable oil',
'french toast',
' mashed',
' ricotta',
' rusk toast',
' mixed',
' tenderloin steak/roast',
'beet greens',
' coho (silver)',
' unenriched (includes honey buns)',
' unbaked',
' wing meat and skin',
' rice bran',
' without added salt',
'fast foods',
' microwave',
' sugar-coated almonds',
' animal',
' ready-to-feed',
'silk key lime soy yogurt',
' starburst fruit chews',
' coconut custard',
' fried chicken',
```

```
' yumberry',
' sweet yeast bread',
'abiyuch',
' powder',
' in oil (alaska native)',
' boston (steaks)',
' bimbo bakeries usa',
' with cheese filling',
' frozen (liquid expressed from grated meat and water)',
' g performance o 2',
' patty; plain',
' fortified cereal bar',
' wieners (light pork',
'cloudberries',
' dannon',
' semi solid',
' traditional varieties',
'ham and cheese spread',
" tony's smartpizza whole grain 4x6 cheese pizza 50/50 cheese- frozen",
' ripe',
' grilled sirloin steak with hearty vegetables soup',
' canola harvest soft spread (canola',
' ribeye  petite roast/filet',
' vegetables and ham',
' prepared with water and ice',
' oh henry! bar',
' with dha and ara (formerly ross)',
' contains wheat flour and rice flour',
' after eight mints',
' extra lean and regular',
'v8 splash smoothies',
' ham -- water added',
'breadfruit',
' cinnamon crunch',
' bottom sirloin butt',
'mouse nuts',
' with coconut',
' aust. marble score 9',
' includes plain and from mutton sandwich (navajo)',
' oat cluster cheerios crunch',
' claret',
'kellogg mini-wheats frosted bite size touch of fruit raisin',
' soybean oil',
' (skunk cabbage)',
' top loin petite roast',
' not from concentrate',
" o'brien",
' extra firm tofu',
```

```
' meat-filled',
'pokeberry shoots',
' contains caffeine',
' soymilk',
' orange-flavor drink',
' store brand',
' young green',
' reduced sugar frosted flakes cereal',
'soy flour',
' soy',
'cranberries',
'asparagus',
'barley',
' wagyu',
' pasteurized',
' monkfish',
'yardlong bean',
' peppers',
' kashi go lean hot cereal',
" kellogg's special k",
' honey bunches of oats with vanilla bunches',
' sea salt',
' ribeye petite roast',
' plain (alaska native)',
' with added vitamin d',
' all natural light vanilla chocolate strawberry',
' boneless separable lean and fat',
' chunky garden mushroom and green pepper italian sauce',
'balsam-pear (bitter gourd)',
' infant',
' soybean without cholesterol',
' evaporated',
' cream cheese-flavor',
' glaze',
'pectin',
' wieners (beef franks',
' chocolate creme sandwich cookies',
'butcher boy meats',
'melon balls',
' sausage biscuit with egg',
'silk blueberry soy yogurt',
' chicken alphabet soup',
'whipped cream substitute',
' burbot',
' iced cookies',
' spoon-size',
' chocolate mousse',
'radishes',
```

```
' scotch',
' milk chocolate coated raisins',
'soy sauce made from hydrolyzed vegetable protein',
' watermelon seed kernels',
' non-alcoholic',
'baking chocolate',
" hearty bean 'n' ham soup",
'fluid replacement',
' cheese enchilada',
' degermed',
' muller thurgau',
'buffalo',
'strawberries',
' lentil with ham',
' ground bulk/coarse ground',
' frosted wild berry',
'cheesefurter',
' whiskey) 86 proof',
' thomas english muffins',
' chicken and dumplings',
' shortbread pie crust',
' peanuts (for sundaes)',
' seedlings (alaska native)',
' extra light syrup',
' thank u berry munch cookies',
'broccoli',
' brownies',
'bread',
' blade (chops or roasts)',
' cinnamon rolls with icing',
' cinnamon crisp',
' chocolate almond snack bar',
' with cauliflower onion mustard',
' energy drink',
' plate',
' heart',
' zinfandel',
'sapote',
'sapodilla',
' truffles',
' mixed fruit',
' steam meal',
' soup)',
' diluted with 3 volume water',
' back ribs',
'shortening',
' red taco sauce',
' good start 2 essentials',
```

```
 'winged bean tuber',
 ' oatmeal dark chocolate cookies',
 ' egg and onion',
 ' tuna',
 ' and red chili peppers',
 ' honey buzzers',
 ' cheese on wheat sandwich crackers',
 ' dried (prunes)',
 'worthington vegetarian burger',
 ' turkey and rice',
 ' chocolate malt powder',
 'duck',
 ' creamy chicken noodle soup',
 ' enriched (n x 5.70)',
 ' and giblets and neck',
 ' stock',
 ' nutmeg butter',
 'silk plus omega-3 dha',
 ' sweet',
 'gardenburger sun-dried tomato basil burger',
 'beef sausage',
 ...}
```

```
In [12]: set(groups)
```

```
Out[12]: {'American Indian/Alaska Native Foods',
          'Baby Foods',
          'Baked Products',
          'Beef Products',
          'Beverages',
          'Breakfast Cereals',
          'Cereal Grains and Pasta',
          'Dairy and Egg Products',
          'Fast Foods',
          'Fats and Oils',
          'Finfish and Shellfish Products',
          'Fruits and Fruit Juices',
          'Lamb, Veal, and Game Products',
          'Legumes and Legume Products',
          'Meals, Entrees, and Side Dishes',
          'Nut and Seed Products',
          'Pork Products',
          'Poultry Products',
          'Restaurant Foods',
          'Sausages and Luncheon Meats',
          'Snacks',
          'Soups, Sauces, and Gravies',
          'Spices and Herbs',
```

```
          'Sweets',
          'Vegetables and Vegetable Products'}
```

```
In [13]: nonveg = [
          'American Indian/Alaska Native Foods',
          'Beef Products',
          'Dairy and Egg Products',
          'Finfish and Shellfish Products',
          'Lamb, Veal, and Game Products',
          'Pork Products',
          'Poultry Products',
          'Sausages and Luncheon Meats',]
         remove = ['Restaurant Foods','Meals, Entrees, and Side Dishes', 'Fast Foods', 'Baked
```

```
In [14]: len(remove)
```

```
Out[14]: 4
```

```
In [15]: newlabels = []
         index = []
         j = 0
         for i in groups:
             if(i in nonveg):
                 newlabels.append('Non-Veg')
             elif(i in remove):
                 newlabels.append('Remove')
                 index.append(j)
             else:
                 newlabels.append('Veg')
             j+=1
```

```
In [16]: newlabels
```

```
Out[16]: ['Non-Veg',
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          ...]
```

```
In [17]: len(index)
```

```
Out[17]: 1389
```

```
In [18]: from collections import Counter
```

```
In [19]: Counter(newlabels)
```

```
Out[19]: Counter({'Non-Veg': 3057, 'Veg': 4172, 'Remove': 1389})
```

```
In [20]: data['FoodGroup'] = newlabels
```

```
In [21]: data.head()
```

```
Out[21]:      ID FoodGroup              ShortDescrip                     Descrip  \
         0  1001   Non-Veg          BUTTER,WITH SALT              Butter, salted
         1  1002   Non-Veg  BUTTER,WHIPPED,WITH SALT  Butter, whipped, with salt
         2  1003   Non-Veg      BUTTER OIL,ANHYDROUS       Butter oil, anhydrous
         3  1004   Non-Veg               CHEESE,BLUE                Cheese, blue
         4  1005   Non-Veg              CHEESE,BRICK               Cheese, brick

            Energy_kcal  Protein_g  Fat_g  Carb_g  Sugar_g  Fiber_g  ...  Folate_USRDA  \
         0        717.0       0.85  81.11    0.06     0.06      0.0  ...        0.0075
```

```
1        717.0       0.85  81.11    0.06     0.06      0.0  ...         0.0075
2        876.0       0.28  99.48    0.00     0.00      0.0  ...         0.0000
3        353.0      21.40  28.74    2.34     0.50      0.0  ...         0.0900
4        371.0      23.24  29.68    2.79     0.51      0.0  ...         0.0500

   Niacin_USRDA  Riboflavin_USRDA  Thiamin_USRDA  Calcium_USRDA  Copper_USRDA  \
0      0.002625          0.026154       0.004167       0.020000      0.000000
1      0.002625          0.026154       0.004167       0.020000      0.000018
2      0.000188          0.003846       0.000833       0.003333      0.000001
3      0.063500          0.293846       0.024167       0.440000      0.000044
4      0.007375          0.270000       0.011667       0.561667      0.000027

   Magnesium_USRDA  Phosphorus_USRDA  Selenium_USRDA  Zinc_USRDA
0         0.004762          0.034286        0.018182    0.008182
1         0.004762          0.032857        0.018182    0.004545
2         0.000000          0.004286        0.000000    0.000909
3         0.054762          0.552857        0.263636    0.241818
4         0.057143          0.644286        0.263636    0.236364

[5 rows x 42 columns]
```

```
In [22]: datacopy = copy.deepcopy(data)

In [23]: data = data.loc[data['FoodGroup'] != 'Remove']

In [24]: len(data)

Out[24]: 7229

In [25]: data = data.drop(columns=['ShortDescrip','Descrip','ID'])

In [26]: energy = data['Energy_kcal']
         label = data['FoodGroup']

In [27]: data = data.drop(columns=['Energy_kcal','FoodGroup'])

In [28]: data.head()

Out[28]:    Protein_g  Fat_g  Carb_g  Sugar_g  Fiber_g  VitA_mcg  VitB6_mg  VitB12_mcg  \
         0       0.85  81.11    0.06     0.06      0.0     684.0     0.003        0.17
         1       0.85  81.11    0.06     0.06      0.0     684.0     0.003        0.13
         2       0.28  99.48    0.00     0.00      0.0     840.0     0.001        0.01
         3      21.40  28.74    2.34     0.50      0.0     198.0     0.166        1.22
         4      23.24  29.68    2.79     0.51      0.0     292.0     0.065        1.26

            VitC_mg  VitE_mg  ...  Folate_USRDA  Niacin_USRDA  Riboflavin_USRDA  \
         0      0.0     2.32  ...        0.0075      0.002625          0.026154
         1      0.0     2.32  ...        0.0075      0.002625          0.026154
         2      0.0     2.80  ...        0.0000      0.000188          0.003846
```

```
3      0.0     0.25  ...         0.0900      0.063500           0.293846
4      0.0     0.26  ...         0.0500      0.007375           0.270000

   Thiamin_USRDA  Calcium_USRDA  Copper_USRDA  Magnesium_USRDA  \
0       0.004167       0.020000      0.000000         0.004762
1       0.004167       0.020000      0.000018         0.004762
2       0.000833       0.003333      0.000001         0.000000
3       0.024167       0.440000      0.000044         0.054762
4       0.011667       0.561667      0.000027         0.057143

   Phosphorus_USRDA  Selenium_USRDA  Zinc_USRDA
0          0.034286        0.018182    0.008182
1          0.032857        0.018182    0.004545
2          0.004286        0.000000    0.000909
3          0.552857        0.263636    0.241818
4          0.644286        0.263636    0.236364

[5 rows x 37 columns]
```

2 Splitting in 70:30

```
In [29]: from sklearn.model_selection import train_test_split
         x_train, x_test, y_train, y_test = train_test_split(data,energy, test_size = 0.3, ran
```

```
In [30]: from sklearn.preprocessing import StandardScaler
         sc = StandardScaler()
         x_train = sc.fit_transform(x_train)
         x_test = sc.transform(x_test)
```

```
In [42]: import  matplotlib.pyplot as plt
         from sklearn.metrics import mean_squared_error,mean_absolute_error,r2_score
         from sklearn.linear_model import LinearRegression, RidgeCV, LassoCV
```

3 Linear Regression

```
In [36]: reg = LinearRegression().fit(x_train, y_train)
         y_pred_test = reg.predict(x_test)
```

```
In [33]: len(y_test),len(y_pred_test)
```

```
Out[33]: (2169, 2169)
```

4 Regression Metrics

```
In [38]: def reg_metrics(y_test,y_pred):
             print("MSE: " + str(mean_squared_error(y_test, y_pred)) +"\n" )
             rmse = np.sqrt(mean_squared_error(y_test, y_pred))
```

```
            print("RMSE: "+str(rmse)+"\n")
            mae=mean_absolute_error(y_test, y_pred)
            print("MAE: "+str(mae)+"\n")
            r2score=r2_score(y_test,y_pred)
            print("r2score: "+str(r2score)+"\n")
```

```
In [39]: reg_metrics(y_test,y_pred_test)
```

```
MSE: 286.0931502955001

RMSE: 16.914288347296793

MAE: 6.678435049967229

r2score: 0.989927967989939
```

5 Lasso Regression

```
In [43]: lasso = LassoCV(max_iter = 40000, cv = 20)
         lasso = lasso.fit(x_train, y_train)
         y_pred_test = lasso.predict(x_test)
```

```
In [44]: reg_metrics(y_test,y_pred_test)
```

```
MSE: 282.0348041566524

RMSE: 16.79389187045851

MAE: 6.763150189569077

r2score: 0.990070843805652
```

6 Neural Network

```
In [46]: from keras.callbacks import ModelCheckpoint
         from keras.models import Sequential
         from keras.layers import Dense, Activation, Flatten
         from sklearn.model_selection import train_test_split
         from sklearn.ensemble import RandomForestRegressor
         from sklearn.metrics import mean_absolute_error
         from matplotlib import pyplot as plt
         import seaborn as sb
         import matplotlib.pyplot as plt
```

```
          import pandas as pd
          import numpy as np
          import warnings
          warnings.filterwarnings('ignore')
          warnings.filterwarnings('ignore', category=DeprecationWarning)
          #from xgboost import XGBRegressor

In [99]: # Reference - https://towardsdatascience.com/deep-neural-networks-for-regression-prob
          NN_model = Sequential()

In [107]: # The Input Layer :
           NN_model.add(Dense(128,input_dim = data.shape[1], activation='relu'))

In [108]: # The Hidden Layers :
           NN_model.add(Dense(256,activation='relu'))
           NN_model.add(Dense(256,activation='relu'))
           NN_model.add(Dense(256,activation='relu'))

In [109]: # The Output Layer :
           NN_model.add(Dense(1,activation='linear'))

In [110]: # Compile the network :
           NN_model.compile(loss='mean_absolute_error', optimizer='adam', metrics=['mean_absolu
           NN_model.summary()

Model: "sequential_6"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_35 (Dense)             (None, 128)               4864
_________________________________________________________________
dense_36 (Dense)             (None, 256)               33024
_________________________________________________________________
dense_37 (Dense)             (None, 256)               65792
_________________________________________________________________
dense_38 (Dense)             (None, 256)               65792
_________________________________________________________________
dense_39 (Dense)             (None, 1)                 257
_________________________________________________________________
dense_40 (Dense)             (None, 128)               256
_________________________________________________________________
dense_41 (Dense)             (None, 256)               33024
_________________________________________________________________
dense_42 (Dense)             (None, 256)               65792
_________________________________________________________________
dense_43 (Dense)             (None, 256)               65792
_________________________________________________________________
dense_44 (Dense)             (None, 1)                 257
=================================================================
```

```
Total params: 334,850
Trainable params: 334,850
Non-trainable params: 0
_________________________________________________________________
```

```
In [111]: NN_model.fit(x_train, y_train, epochs=500, batch_size=32, validation_split = 0.3)
```

```
Train on 3542 samples, validate on 1518 samples
Epoch 1/500
3542/3542 [==============================] - 1s 296us/step - loss: 17.8622 - mean_absolute_erro
Epoch 2/500
3542/3542 [==============================] - 1s 174us/step - loss: 6.2703 - mean_absolute_error
Epoch 3/500
3542/3542 [==============================] - 1s 179us/step - loss: 5.4750 - mean_absolute_error
Epoch 4/500
3542/3542 [==============================] - 1s 181us/step - loss: 5.8710 - mean_absolute_error
Epoch 5/500
3542/3542 [==============================] - 1s 181us/step - loss: 6.0260 - mean_absolute_error
Epoch 6/500
3542/3542 [==============================] - 1s 178us/step - loss: 6.1798 - mean_absolute_error
Epoch 7/500
3542/3542 [==============================] - 1s 195us/step - loss: 5.9673 - mean_absolute_error
Epoch 8/500
3542/3542 [==============================] - 1s 174us/step - loss: 5.5548 - mean_absolute_error
Epoch 9/500
3542/3542 [==============================] - 1s 177us/step - loss: 5.5606 - mean_absolute_error
Epoch 10/500
3542/3542 [==============================] - 1s 184us/step - loss: 5.1387 - mean_absolute_error
Epoch 11/500
3542/3542 [==============================] - 1s 175us/step - loss: 5.4698 - mean_absolute_error
Epoch 12/500
3542/3542 [==============================] - 1s 173us/step - loss: 5.6300 - mean_absolute_error
Epoch 13/500
3542/3542 [==============================] - 1s 183us/step - loss: 5.7219 - mean_absolute_error
Epoch 14/500
3542/3542 [==============================] - 1s 179us/step - loss: 5.3739 - mean_absolute_error
Epoch 15/500
3542/3542 [==============================] - 1s 203us/step - loss: 5.4960 - mean_absolute_error
Epoch 16/500
3542/3542 [==============================] - 1s 244us/step - loss: 5.6508 - mean_absolute_error
Epoch 17/500
3542/3542 [==============================] - 1s 229us/step - loss: 5.4321 - mean_absolute_error
Epoch 18/500
3542/3542 [==============================] - 1s 205us/step - loss: 5.2246 - mean_absolute_error
Epoch 19/500
3542/3542 [==============================] - 1s 195us/step - loss: 5.5482 - mean_absolute_error
Epoch 20/500
```

```
3542/3542 [==============================] - 1s 259us/step - loss: 5.9605 - mean_absolute_erro
Epoch 21/500
3542/3542 [==============================] - 1s 182us/step - loss: 5.6068 - mean_absolute_erro
Epoch 22/500
3542/3542 [==============================] - 1s 178us/step - loss: 5.2672 - mean_absolute_erro
Epoch 23/500
3542/3542 [==============================] - 1s 193us/step - loss: 5.8686 - mean_absolute_erro
Epoch 24/500
3542/3542 [==============================] - 1s 182us/step - loss: 5.0503 - mean_absolute_erro
Epoch 25/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.9810 - mean_absolute_erro
Epoch 26/500
3542/3542 [==============================] - 1s 273us/step - loss: 6.0964 - mean_absolute_erro
Epoch 27/500
3542/3542 [==============================] - 1s 181us/step - loss: 5.4862 - mean_absolute_erro
Epoch 28/500
3542/3542 [==============================] - 1s 229us/step - loss: 5.1072 - mean_absolute_erro
Epoch 29/500
3542/3542 [==============================] - 1s 207us/step - loss: 5.1844 - mean_absolute_erro
Epoch 30/500
3542/3542 [==============================] - 1s 211us/step - loss: 5.3804 - mean_absolute_erro
Epoch 31/500
3542/3542 [==============================] - 1s 255us/step - loss: 5.8208 - mean_absolute_erro
Epoch 32/500
3542/3542 [==============================] - 1s 278us/step - loss: 5.4701 - mean_absolute_erro
Epoch 33/500
3542/3542 [==============================] - 1s 227us/step - loss: 5.1646 - mean_absolute_erro
Epoch 34/500
3542/3542 [==============================] - 1s 210us/step - loss: 5.4571 - mean_absolute_erro
Epoch 35/500
3542/3542 [==============================] - 1s 165us/step - loss: 6.2520 - mean_absolute_erro
Epoch 36/500
3542/3542 [==============================] - 1s 172us/step - loss: 5.2758 - mean_absolute_erro
Epoch 37/500
3542/3542 [==============================] - 1s 172us/step - loss: 5.5456 - mean_absolute_erro
Epoch 38/500
3542/3542 [==============================] - 1s 173us/step - loss: 5.0955 - mean_absolute_erro
Epoch 39/500
3542/3542 [==============================] - 1s 176us/step - loss: 5.0032 - mean_absolute_erro
Epoch 40/500
3542/3542 [==============================] - 1s 182us/step - loss: 5.3445 - mean_absolute_erro
Epoch 41/500
3542/3542 [==============================] - 1s 190us/step - loss: 5.7248 - mean_absolute_erro
Epoch 42/500
3542/3542 [==============================] - 1s 170us/step - loss: 4.9826 - mean_absolute_erro
Epoch 43/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.5917 - mean_absolute_erro
Epoch 44/500
```

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3542/3542 [==============================] - 1s 174us/step - loss: 5.9543 - mean_absolute_erro
Epoch 45/500
3542/3542 [==============================] - 1s 192us/step - loss: 6.3159 - mean_absolute_erro
Epoch 46/500
3542/3542 [==============================] - 1s 205us/step - loss: 5.6780 - mean_absolute_erro
Epoch 47/500
3542/3542 [==============================] - 1s 181us/step - loss: 5.2443 - mean_absolute_erro
Epoch 48/500
3542/3542 [==============================] - 1s 181us/step - loss: 5.6853 - mean_absolute_erro
Epoch 49/500
3542/3542 [==============================] - 1s 193us/step - loss: 5.4109 - mean_absolute_erro
Epoch 50/500
3542/3542 [==============================] - 1s 181us/step - loss: 5.2627 - mean_absolute_erro
Epoch 51/500
3542/3542 [==============================] - 1s 210us/step - loss: 5.1550 - mean_absolute_erro
Epoch 52/500
3542/3542 [==============================] - 1s 219us/step - loss: 4.6065 - mean_absolute_erro
Epoch 53/500
3542/3542 [==============================] - 1s 223us/step - loss: 5.4869 - mean_absolute_erro
Epoch 54/500
3542/3542 [==============================] - 1s 205us/step - loss: 6.1572 - mean_absolute_erro
Epoch 55/500
3542/3542 [==============================] - 1s 183us/step - loss: 5.2079 - mean_absolute_erro
Epoch 56/500
3542/3542 [==============================] - 1s 172us/step - loss: 5.4795 - mean_absolute_erro
Epoch 57/500
3542/3542 [==============================] - 1s 170us/step - loss: 5.8091 - mean_absolute_erro
Epoch 58/500
3542/3542 [==============================] - 1s 166us/step - loss: 4.8422 - mean_absolute_erro
Epoch 59/500
3542/3542 [==============================] - 1s 167us/step - loss: 5.4505 - mean_absolute_erro
Epoch 60/500
3542/3542 [==============================] - 1s 165us/step - loss: 4.9722 - mean_absolute_erro
Epoch 61/500
3542/3542 [==============================] - 1s 168us/step - loss: 5.4389 - mean_absolute_erro
Epoch 62/500
3542/3542 [==============================] - 1s 171us/step - loss: 5.2441 - mean_absolute_erro
Epoch 63/500
3542/3542 [==============================] - 1s 170us/step - loss: 5.5003 - mean_absolute_erro
Epoch 64/500
3542/3542 [==============================] - 1s 164us/step - loss: 5.8591 - mean_absolute_erro
Epoch 65/500
3542/3542 [==============================] - 1s 165us/step - loss: 5.5489 - mean_absolute_erro
Epoch 66/500
3542/3542 [==============================] - 1s 163us/step - loss: 4.8040 - mean_absolute_erro
Epoch 67/500
3542/3542 [==============================] - 1s 172us/step - loss: 4.8078 - mean_absolute_erro
Epoch 68/500
```

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3542/3542 [==============================] - 1s 199us/step - loss: 4.8546 - mean_absolute_erro
Epoch 69/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.9120 - mean_absolute_erro
Epoch 70/500
3542/3542 [==============================] - 1s 167us/step - loss: 6.5330 - mean_absolute_erro
Epoch 71/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.9744 - mean_absolute_erro
Epoch 72/500
3542/3542 [==============================] - 1s 194us/step - loss: 4.7113 - mean_absolute_erro
Epoch 73/500
3542/3542 [==============================] - 1s 186us/step - loss: 5.2663 - mean_absolute_erro
Epoch 74/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.7265 - mean_absolute_erro
Epoch 75/500
3542/3542 [==============================] - 1s 232us/step - loss: 4.7684 - mean_absolute_erro
Epoch 76/500
3542/3542 [==============================] - 1s 191us/step - loss: 4.9163 - mean_absolute_erro
Epoch 77/500
3542/3542 [==============================] - 1s 222us/step - loss: 5.2146 - mean_absolute_erro
Epoch 78/500
3542/3542 [==============================] - 1s 209us/step - loss: 5.5814 - mean_absolute_erro
Epoch 79/500
3542/3542 [==============================] - 1s 190us/step - loss: 5.0480 - mean_absolute_erro
Epoch 80/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.4886 - mean_absolute_erro
Epoch 81/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.8525 - mean_absolute_erro
Epoch 82/500
3542/3542 [==============================] - 1s 183us/step - loss: 6.0853 - mean_absolute_erro
Epoch 83/500
3542/3542 [==============================] - 1s 227us/step - loss: 5.0395 - mean_absolute_erro
Epoch 84/500
3542/3542 [==============================] - 1s 208us/step - loss: 4.9000 - mean_absolute_erro
Epoch 85/500
3542/3542 [==============================] - 1s 252us/step - loss: 4.9694 - mean_absolute_erro
Epoch 86/500
3542/3542 [==============================] - 1s 286us/step - loss: 4.3900 - mean_absolute_erro
Epoch 87/500
3542/3542 [==============================] - 1s 238us/step - loss: 4.8918 - mean_absolute_erro
Epoch 88/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.8619 - mean_absolute_erro
Epoch 89/500
3542/3542 [==============================] - 1s 207us/step - loss: 5.5389 - mean_absolute_erro
Epoch 90/500
3542/3542 [==============================] - 1s 206us/step - loss: 5.4611 - mean_absolute_erro
Epoch 91/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.8020 - mean_absolute_erro
Epoch 92/500
```

```
3542/3542 [==============================] - 1s 267us/step - loss: 4.7659 - mean_absolute_erro
Epoch 93/500
3542/3542 [==============================] - 1s 248us/step - loss: 5.2116 - mean_absolute_erro
Epoch 94/500
3542/3542 [==============================] - 1s 252us/step - loss: 4.6136 - mean_absolute_erro
Epoch 95/500
3542/3542 [==============================] - 1s 257us/step - loss: 4.3014 - mean_absolute_erro
Epoch 96/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.9643 - mean_absolute_erro
Epoch 97/500
3542/3542 [==============================] - 1s 203us/step - loss: 4.8577 - mean_absolute_erro
Epoch 98/500
3542/3542 [==============================] - 1s 248us/step - loss: 5.0723 - mean_absolute_erro
Epoch 99/500
3542/3542 [==============================] - 1s 362us/step - loss: 4.6032 - mean_absolute_erro
Epoch 100/500
3542/3542 [==============================] - 1s 282us/step - loss: 5.2956 - mean_absolute_erro
Epoch 101/500
3542/3542 [==============================] - 1s 306us/step - loss: 5.1738 - mean_absolute_erro
Epoch 102/500
3542/3542 [==============================] - 1s 208us/step - loss: 5.4600 - mean_absolute_erro
Epoch 103/500
3542/3542 [==============================] - 1s 240us/step - loss: 4.5899 - mean_absolute_erro
Epoch 104/500
3542/3542 [==============================] - 1s 199us/step - loss: 5.0397 - mean_absolute_erro
Epoch 105/500
3542/3542 [==============================] - 1s 182us/step - loss: 4.6915 - mean_absolute_erro
Epoch 106/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.6493 - mean_absolute_erro
Epoch 107/500
3542/3542 [==============================] - 1s 185us/step - loss: 4.9568 - mean_absolute_erro
Epoch 108/500
3542/3542 [==============================] - 1s 218us/step - loss: 4.4625 - mean_absolute_erro
Epoch 109/500
3542/3542 [==============================] - 1s 223us/step - loss: 4.6377 - mean_absolute_erro
Epoch 110/500
3542/3542 [==============================] - 1s 192us/step - loss: 5.1422 - mean_absolute_erro
Epoch 111/500
3542/3542 [==============================] - 1s 184us/step - loss: 5.0896 - mean_absolute_erro
Epoch 112/500
3542/3542 [==============================] - 1s 190us/step - loss: 4.9933 - mean_absolute_erro
Epoch 113/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.6592 - mean_absolute_erro
Epoch 114/500
3542/3542 [==============================] - 1s 217us/step - loss: 4.6268 - mean_absolute_erro
Epoch 115/500
3542/3542 [==============================] - 1s 291us/step - loss: 4.7905 - mean_absolute_erro
Epoch 116/500
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3542/3542 [==============================] - 1s 231us/step - loss: 4.6538 - mean_absolute_erro
Epoch 117/500
3542/3542 [==============================] - 1s 292us/step - loss: 4.5297 - mean_absolute_erro
Epoch 118/500
3542/3542 [==============================] - 1s 230us/step - loss: 5.3024 - mean_absolute_erro
Epoch 119/500
3542/3542 [==============================] - 1s 206us/step - loss: 5.0789 - mean_absolute_erro
Epoch 120/500
3542/3542 [==============================] - 1s 222us/step - loss: 4.7189 - mean_absolute_erro
Epoch 121/500
3542/3542 [==============================] - 1s 209us/step - loss: 4.7651 - mean_absolute_erro
Epoch 122/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.5713 - mean_absolute_erro
Epoch 123/500
3542/3542 [==============================] - 1s 214us/step - loss: 4.8541 - mean_absolute_erro
Epoch 124/500
3542/3542 [==============================] - 1s 251us/step - loss: 4.5007 - mean_absolute_erro
Epoch 125/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.7951 - mean_absolute_erro
Epoch 126/500
3542/3542 [==============================] - 1s 209us/step - loss: 4.5878 - mean_absolute_erro
Epoch 127/500
3542/3542 [==============================] - 1s 182us/step - loss: 5.5919 - mean_absolute_erro
Epoch 128/500
3542/3542 [==============================] - 1s 224us/step - loss: 4.8833 - mean_absolute_erro
Epoch 129/500
3542/3542 [==============================] - 1s 254us/step - loss: 4.9061 - mean_absolute_erro
Epoch 130/500
3542/3542 [==============================] - 1s 257us/step - loss: 4.9218 - mean_absolute_erro
Epoch 131/500
3542/3542 [==============================] - 1s 324us/step - loss: 4.7710 - mean_absolute_erro
Epoch 132/500
3542/3542 [==============================] - 1s 262us/step - loss: 4.1896 - mean_absolute_erro
Epoch 133/500
3542/3542 [==============================] - 1s 262us/step - loss: 4.8009 - mean_absolute_erro
Epoch 134/500
3542/3542 [==============================] - 1s 224us/step - loss: 4.6845 - mean_absolute_erro
Epoch 135/500
3542/3542 [==============================] - 1s 217us/step - loss: 5.0859 - mean_absolute_erro
Epoch 136/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.6572 - mean_absolute_erro
Epoch 137/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.5005 - mean_absolute_erro
Epoch 138/500
3542/3542 [==============================] - 1s 197us/step - loss: 5.3127 - mean_absolute_erro
Epoch 139/500
3542/3542 [==============================] - 1s 240us/step - loss: 5.0715 - mean_absolute_erro
Epoch 140/500
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3542/3542 [==============================] - 1s 211us/step - loss: 4.8785 - mean_absolute_erro
Epoch 141/500
3542/3542 [==============================] - 1s 208us/step - loss: 4.7833 - mean_absolute_erro
Epoch 142/500
3542/3542 [==============================] - 1s 224us/step - loss: 4.6709 - mean_absolute_erro
Epoch 143/500
3542/3542 [==============================] - 1s 265us/step - loss: 4.5279 - mean_absolute_erro
Epoch 144/500
3542/3542 [==============================] - 1s 234us/step - loss: 5.0497 - mean_absolute_erro
Epoch 145/500
3542/3542 [==============================] - 1s 210us/step - loss: 4.9623 - mean_absolute_erro
Epoch 146/500
3542/3542 [==============================] - 1s 197us/step - loss: 4.5332 - mean_absolute_erro
Epoch 147/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.7796 - mean_absolute_erro
Epoch 148/500
3542/3542 [==============================] - 1s 178us/step - loss: 5.0952 - mean_absolute_erro
Epoch 149/500
3542/3542 [==============================] - 1s 188us/step - loss: 4.4778 - mean_absolute_erro
Epoch 150/500
3542/3542 [==============================] - 1s 174us/step - loss: 4.4026 - mean_absolute_erro
Epoch 151/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.8965 - mean_absolute_erro
Epoch 152/500
3542/3542 [==============================] - 1s 202us/step - loss: 4.7834 - mean_absolute_erro
Epoch 153/500
3542/3542 [==============================] - 1s 244us/step - loss: 4.8508 - mean_absolute_erro
Epoch 154/500
3542/3542 [==============================] - 1s 184us/step - loss: 5.0049 - mean_absolute_erro
Epoch 155/500
3542/3542 [==============================] - 1s 183us/step - loss: 5.2641 - mean_absolute_erro
Epoch 156/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.8110 - mean_absolute_erro
Epoch 157/500
3542/3542 [==============================] - 1s 188us/step - loss: 4.7815 - mean_absolute_erro
Epoch 158/500
3542/3542 [==============================] - 1s 193us/step - loss: 4.5425 - mean_absolute_erro
Epoch 159/500
3542/3542 [==============================] - 1s 235us/step - loss: 4.9864 - mean_absolute_erro
Epoch 160/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.7655 - mean_absolute_erro
Epoch 161/500
3542/3542 [==============================] - 1s 211us/step - loss: 4.4891 - mean_absolute_erro
Epoch 162/500
3542/3542 [==============================] - 1s 188us/step - loss: 5.2430 - mean_absolute_erro
Epoch 163/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.8880 - mean_absolute_erro
Epoch 164/500
```

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3542/3542 [==============================] - 1s 193us/step - loss: 4.3481 - mean_absolute_erro
Epoch 165/500
3542/3542 [==============================] - 1s 306us/step - loss: 4.4480 - mean_absolute_erro
Epoch 166/500
3542/3542 [==============================] - 1s 232us/step - loss: 4.4604 - mean_absolute_erro
Epoch 167/500
3542/3542 [==============================] - 1s 257us/step - loss: 4.2707 - mean_absolute_erro
Epoch 168/500
3542/3542 [==============================] - 1s 245us/step - loss: 4.8023 - mean_absolute_erro
Epoch 169/500
3542/3542 [==============================] - 1s 185us/step - loss: 4.4960 - mean_absolute_erro
Epoch 170/500
3542/3542 [==============================] - 1s 216us/step - loss: 4.6994 - mean_absolute_erro
Epoch 171/500
3542/3542 [==============================] - 1s 259us/step - loss: 4.6515 - mean_absolute_erro
Epoch 172/500
3542/3542 [==============================] - 1s 220us/step - loss: 4.6991 - mean_absolute_erro
Epoch 173/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.7531 - mean_absolute_erro
Epoch 174/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.6143 - mean_absolute_erro
Epoch 175/500
3542/3542 [==============================] - 1s 203us/step - loss: 4.6785 - mean_absolute_erro
Epoch 176/500
3542/3542 [==============================] - 1s 238us/step - loss: 4.8413 - mean_absolute_erro
Epoch 177/500
3542/3542 [==============================] - 1s 182us/step - loss: 5.0708 - mean_absolute_erro
Epoch 178/500
3542/3542 [==============================] - 1s 187us/step - loss: 4.5031 - mean_absolute_erro
Epoch 179/500
3542/3542 [==============================] - 1s 186us/step - loss: 5.0810 - mean_absolute_erro
Epoch 180/500
3542/3542 [==============================] - 1s 184us/step - loss: 5.2806 - mean_absolute_erro
Epoch 181/500
3542/3542 [==============================] - 1s 199us/step - loss: 4.8945 - mean_absolute_erro
Epoch 182/500
3542/3542 [==============================] - 1s 218us/step - loss: 4.4055 - mean_absolute_erro
Epoch 183/500
3542/3542 [==============================] - 1s 247us/step - loss: 4.5595 - mean_absolute_erro
Epoch 184/500
3542/3542 [==============================] - 1s 237us/step - loss: 4.6665 - mean_absolute_erro
Epoch 185/500
3542/3542 [==============================] - 1s 195us/step - loss: 4.4677 - mean_absolute_erro
Epoch 186/500
3542/3542 [==============================] - 1s 214us/step - loss: 5.1442 - mean_absolute_erro
Epoch 187/500
3542/3542 [==============================] - 1s 295us/step - loss: 4.3958 - mean_absolute_erro
Epoch 188/500
```

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3542/3542 [==============================] - 1s 194us/step - loss: 4.2526 - mean_absolute_erro
Epoch 189/500
3542/3542 [==============================] - 1s 256us/step - loss: 4.8515 - mean_absolute_erro
Epoch 190/500
3542/3542 [==============================] - 1s 197us/step - loss: 4.6985 - mean_absolute_erro
Epoch 191/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.8360 - mean_absolute_erro
Epoch 192/500
3542/3542 [==============================] - 1s 186us/step - loss: 4.3224 - mean_absolute_erro
Epoch 193/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.5342 - mean_absolute_erro
Epoch 194/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.2480 - mean_absolute_erro
Epoch 195/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.5648 - mean_absolute_erro
Epoch 196/500
3542/3542 [==============================] - 1s 211us/step - loss: 4.8633 - mean_absolute_erro
Epoch 197/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.5377 - mean_absolute_erro
Epoch 198/500
3542/3542 [==============================] - 1s 256us/step - loss: 4.4499 - mean_absolute_erro
Epoch 199/500
3542/3542 [==============================] - 1s 206us/step - loss: 5.0869 - mean_absolute_erro
Epoch 200/500
3542/3542 [==============================] - 1s 172us/step - loss: 4.3656 - mean_absolute_erro
Epoch 201/500
3542/3542 [==============================] - 1s 172us/step - loss: 5.1230 - mean_absolute_erro
Epoch 202/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.3190 - mean_absolute_erro
Epoch 203/500
3542/3542 [==============================] - 1s 190us/step - loss: 5.0250 - mean_absolute_erro
Epoch 204/500
3542/3542 [==============================] - 1s 180us/step - loss: 5.1995 - mean_absolute_erro
Epoch 205/500
3542/3542 [==============================] - 1s 171us/step - loss: 4.5367 - mean_absolute_erro
Epoch 206/500
3542/3542 [==============================] - 1s 204us/step - loss: 4.2605 - mean_absolute_erro
Epoch 207/500
3542/3542 [==============================] - 1s 196us/step - loss: 4.4169 - mean_absolute_erro
Epoch 208/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.1845 - mean_absolute_erro
Epoch 209/500
3542/3542 [==============================] - 1s 182us/step - loss: 4.4952 - mean_absolute_erro
Epoch 210/500
3542/3542 [==============================] - 1s 232us/step - loss: 4.5117 - mean_absolute_erro
Epoch 211/500
3542/3542 [==============================] - 1s 242us/step - loss: 4.3782 - mean_absolute_erro
Epoch 212/500
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3542/3542 [==============================] - 1s 191us/step - loss: 4.6201 - mean_absolute_erro
Epoch 213/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.6645 - mean_absolute_erro
Epoch 214/500
3542/3542 [==============================] - 1s 259us/step - loss: 4.2420 - mean_absolute_erro
Epoch 215/500
3542/3542 [==============================] - 1s 252us/step - loss: 4.2627 - mean_absolute_erro
Epoch 216/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.8027 - mean_absolute_erro
Epoch 217/500
3542/3542 [==============================] - 1s 300us/step - loss: 4.6869 - mean_absolute_erro
Epoch 218/500
3542/3542 [==============================] - 1s 241us/step - loss: 4.4109 - mean_absolute_erro
Epoch 219/500
3542/3542 [==============================] - 1s 164us/step - loss: 4.8937 - mean_absolute_erro
Epoch 220/500
3542/3542 [==============================] - 1s 200us/step - loss: 4.3623 - mean_absolute_erro
Epoch 221/500
3542/3542 [==============================] - 1s 245us/step - loss: 4.1686 - mean_absolute_erro
Epoch 222/500
3542/3542 [==============================] - 1s 237us/step - loss: 4.3255 - mean_absolute_erro
Epoch 223/500
3542/3542 [==============================] - 1s 185us/step - loss: 4.0166 - mean_absolute_erro
Epoch 224/500
3542/3542 [==============================] - 1s 190us/step - loss: 4.1476 - mean_absolute_erro
Epoch 225/500
3542/3542 [==============================] - 1s 267us/step - loss: 4.2636 - mean_absolute_erro
Epoch 226/500
3542/3542 [==============================] - 1s 179us/step - loss: 4.4676 - mean_absolute_erro
Epoch 227/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.3336 - mean_absolute_erro
Epoch 228/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.6320 - mean_absolute_erro
Epoch 229/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.2844 - mean_absolute_erro
Epoch 230/500
3542/3542 [==============================] - 1s 178us/step - loss: 4.5782 - mean_absolute_erro
Epoch 231/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.3440 - mean_absolute_erro
Epoch 232/500
3542/3542 [==============================] - 1s 222us/step - loss: 4.1558 - mean_absolute_erro
Epoch 233/500
3542/3542 [==============================] - 1s 237us/step - loss: 4.9816 - mean_absolute_erro
Epoch 234/500
3542/3542 [==============================] - 1s 249us/step - loss: 4.2463 - mean_absolute_erro
Epoch 235/500
3542/3542 [==============================] - 1s 242us/step - loss: 4.2272 - mean_absolute_erro
Epoch 236/500
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3542/3542 [==============================] - 1s 291us/step - loss: 4.9126 - mean_absolute_erro
Epoch 237/500
3542/3542 [==============================] - 1s 214us/step - loss: 4.4202 - mean_absolute_erro
Epoch 238/500
3542/3542 [==============================] - 1s 255us/step - loss: 4.1981 - mean_absolute_erro
Epoch 239/500
3542/3542 [==============================] - 1s 206us/step - loss: 5.0093 - mean_absolute_erro
Epoch 240/500
3542/3542 [==============================] - 1s 234us/step - loss: 4.5166 - mean_absolute_erro
Epoch 241/500
3542/3542 [==============================] - 1s 196us/step - loss: 4.1175 - mean_absolute_erro
Epoch 242/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.3888 - mean_absolute_erro
Epoch 243/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.6130 - mean_absolute_erro
Epoch 244/500
3542/3542 [==============================] - 1s 195us/step - loss: 4.4741 - mean_absolute_erro
Epoch 245/500
3542/3542 [==============================] - 1s 170us/step - loss: 4.4949 - mean_absolute_erro
Epoch 246/500
3542/3542 [==============================] - 1s 188us/step - loss: 4.2417 - mean_absolute_erro
Epoch 247/500
3542/3542 [==============================] - 1s 259us/step - loss: 4.7976 - mean_absolute_erro
Epoch 248/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.7386 - mean_absolute_erro
Epoch 249/500
3542/3542 [==============================] - 1s 246us/step - loss: 4.4100 - mean_absolute_erro
Epoch 250/500
3542/3542 [==============================] - 1s 240us/step - loss: 4.4470 - mean_absolute_erro
Epoch 251/500
3542/3542 [==============================] - 1s 255us/step - loss: 4.3078 - mean_absolute_erro
Epoch 252/500
3542/3542 [==============================] - 1s 282us/step - loss: 4.1555 - mean_absolute_erro
Epoch 253/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.3430 - mean_absolute_erro
Epoch 254/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.7600 - mean_absolute_erro
Epoch 255/500
3542/3542 [==============================] - 1s 206us/step - loss: 4.2947 - mean_absolute_erro
Epoch 256/500
3542/3542 [==============================] - 1s 196us/step - loss: 4.1787 - mean_absolute_erro
Epoch 257/500
3542/3542 [==============================] - 1s 182us/step - loss: 4.4778 - mean_absolute_erro
Epoch 258/500
3542/3542 [==============================] - 1s 277us/step - loss: 4.5461 - mean_absolute_erro
Epoch 259/500
3542/3542 [==============================] - 1s 171us/step - loss: 4.2447 - mean_absolute_erro
Epoch 260/500
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3542/3542 [==============================] - 1s 192us/step - loss: 5.0662 - mean_absolute_erro
Epoch 261/500
3542/3542 [==============================] - 1s 317us/step - loss: 4.4038 - mean_absolute_erro
Epoch 262/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.7364 - mean_absolute_erro
Epoch 263/500
3542/3542 [==============================] - 1s 187us/step - loss: 4.7077 - mean_absolute_erro
Epoch 264/500
3542/3542 [==============================] - 1s 253us/step - loss: 4.2089 - mean_absolute_erro
Epoch 265/500
3542/3542 [==============================] - 1s 171us/step - loss: 3.9966 - mean_absolute_erro
Epoch 266/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.6159 - mean_absolute_erro
Epoch 267/500
3542/3542 [==============================] - 1s 206us/step - loss: 4.6850 - mean_absolute_erro
Epoch 268/500
3542/3542 [==============================] - 1s 189us/step - loss: 4.2778 - mean_absolute_erro
Epoch 269/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.3122 - mean_absolute_erro
Epoch 270/500
3542/3542 [==============================] - 1s 259us/step - loss: 4.3737 - mean_absolute_erro
Epoch 271/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.2357 - mean_absolute_erro
Epoch 272/500
3542/3542 [==============================] - 1s 168us/step - loss: 4.2463 - mean_absolute_erro
Epoch 273/500
3542/3542 [==============================] - 1s 201us/step - loss: 4.3452 - mean_absolute_erro
Epoch 274/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.2920 - mean_absolute_erro
Epoch 275/500
3542/3542 [==============================] - 1s 217us/step - loss: 5.0175 - mean_absolute_erro
Epoch 276/500
3542/3542 [==============================] - 1s 225us/step - loss: 4.3229 - mean_absolute_erro
Epoch 277/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.7145 - mean_absolute_erro
Epoch 278/500
3542/3542 [==============================] - 1s 160us/step - loss: 4.3856 - mean_absolute_erro
Epoch 279/500
3542/3542 [==============================] - 1s 160us/step - loss: 4.5282 - mean_absolute_erro
Epoch 280/500
3542/3542 [==============================] - 1s 163us/step - loss: 4.0642 - mean_absolute_erro
Epoch 281/500
3542/3542 [==============================] - 1s 212us/step - loss: 4.7111 - mean_absolute_erro
Epoch 282/500
3542/3542 [==============================] - 1s 216us/step - loss: 4.7550 - mean_absolute_erro
Epoch 283/500
3542/3542 [==============================] - 1s 215us/step - loss: 4.1161 - mean_absolute_erro
Epoch 284/500
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3542/3542 [==============================] - 1s 221us/step - loss: 4.3952 - mean_absolute_erro
Epoch 285/500
3542/3542 [==============================] - 1s 278us/step - loss: 3.9426 - mean_absolute_erro
Epoch 286/500
3542/3542 [==============================] - 1s 214us/step - loss: 4.1345 - mean_absolute_erro
Epoch 287/500
3542/3542 [==============================] - 1s 203us/step - loss: 3.9261 - mean_absolute_erro
Epoch 288/500
3542/3542 [==============================] - 1s 183us/step - loss: 4.1114 - mean_absolute_erro
Epoch 289/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.2660 - mean_absolute_erro
Epoch 290/500
3542/3542 [==============================] - 1s 242us/step - loss: 4.1331 - mean_absolute_erro
Epoch 291/500
3542/3542 [==============================] - 1s 185us/step - loss: 4.4478 - mean_absolute_erro
Epoch 292/500
3542/3542 [==============================] - 1s 250us/step - loss: 3.9642 - mean_absolute_erro
Epoch 293/500
3542/3542 [==============================] - 1s 178us/step - loss: 4.0996 - mean_absolute_erro
Epoch 294/500
3542/3542 [==============================] - 1s 172us/step - loss: 4.3117 - mean_absolute_erro
Epoch 295/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.2279 - mean_absolute_erro
Epoch 296/500
3542/3542 [==============================] - 1s 205us/step - loss: 4.6908 - mean_absolute_erro
Epoch 297/500
3542/3542 [==============================] - 1s 344us/step - loss: 4.2188 - mean_absolute_erro
Epoch 298/500
3542/3542 [==============================] - 1s 237us/step - loss: 4.4293 - mean_absolute_erro
Epoch 299/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.6719 - mean_absolute_erro
Epoch 300/500
3542/3542 [==============================] - 1s 177us/step - loss: 4.1643 - mean_absolute_erro
Epoch 301/500
3542/3542 [==============================] - 1s 170us/step - loss: 4.6270 - mean_absolute_erro
Epoch 302/500
3542/3542 [==============================] - 1s 163us/step - loss: 4.3187 - mean_absolute_erro
Epoch 303/500
3542/3542 [==============================] - 1s 172us/step - loss: 3.9916 - mean_absolute_erro
Epoch 304/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.1829 - mean_absolute_erro
Epoch 305/500
3542/3542 [==============================] - 1s 168us/step - loss: 4.3531 - mean_absolute_erro
Epoch 306/500
3542/3542 [==============================] - 1s 197us/step - loss: 4.0822 - mean_absolute_erro
Epoch 307/500
3542/3542 [==============================] - 1s 231us/step - loss: 4.0598 - mean_absolute_erro
Epoch 308/500
```

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3542/3542 [==============================] - 1s 195us/step - loss: 4.4590 - mean_absolute_erro
Epoch 309/500
3542/3542 [==============================] - 1s 172us/step - loss: 4.0254 - mean_absolute_erro
Epoch 310/500
3542/3542 [==============================] - 1s 169us/step - loss: 4.1557 - mean_absolute_erro
Epoch 311/500
3542/3542 [==============================] - 1s 165us/step - loss: 4.4012 - mean_absolute_erro
Epoch 312/500
3542/3542 [==============================] - 1s 171us/step - loss: 4.2019 - mean_absolute_erro
Epoch 313/500
3542/3542 [==============================] - 1s 170us/step - loss: 4.5316 - mean_absolute_erro
Epoch 314/500
3542/3542 [==============================] - 1s 169us/step - loss: 4.3510 - mean_absolute_erro
Epoch 315/500
3542/3542 [==============================] - 1s 166us/step - loss: 4.4780 - mean_absolute_erro
Epoch 316/500
3542/3542 [==============================] - 1s 166us/step - loss: 3.9050 - mean_absolute_erro
Epoch 317/500
3542/3542 [==============================] - 1s 166us/step - loss: 4.5198 - mean_absolute_erro
Epoch 318/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.1436 - mean_absolute_erro
Epoch 319/500
3542/3542 [==============================] - 1s 265us/step - loss: 4.4972 - mean_absolute_erro
Epoch 320/500
3542/3542 [==============================] - 1s 318us/step - loss: 3.9346 - mean_absolute_erro
Epoch 321/500
3542/3542 [==============================] - 1s 234us/step - loss: 4.2035 - mean_absolute_erro
Epoch 322/500
3542/3542 [==============================] - 1s 217us/step - loss: 4.2669 - mean_absolute_erro
Epoch 323/500
3542/3542 [==============================] - 1s 216us/step - loss: 4.1487 - mean_absolute_erro
Epoch 324/500
3542/3542 [==============================] - 1s 215us/step - loss: 4.3113 - mean_absolute_erro
Epoch 325/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.1912 - mean_absolute_erro
Epoch 326/500
3542/3542 [==============================] - 1s 200us/step - loss: 4.0595 - mean_absolute_erro
Epoch 327/500
3542/3542 [==============================] - 1s 229us/step - loss: 3.9505 - mean_absolute_erro
Epoch 328/500
3542/3542 [==============================] - 1s 192us/step - loss: 4.4553 - mean_absolute_erro
Epoch 329/500
3542/3542 [==============================] - 1s 200us/step - loss: 3.9436 - mean_absolute_erro
Epoch 330/500
3542/3542 [==============================] - 1s 195us/step - loss: 4.1343 - mean_absolute_erro
Epoch 331/500
3542/3542 [==============================] - 1s 222us/step - loss: 4.1773 - mean_absolute_erro
Epoch 332/500
```

```
3542/3542 [==============================] - 1s 221us/step - loss: 4.2461 - mean_absolute_erro
Epoch 333/500
3542/3542 [==============================] - 1s 186us/step - loss: 4.2803 - mean_absolute_erro
Epoch 334/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.0763 - mean_absolute_erro
Epoch 335/500
3542/3542 [==============================] - 1s 226us/step - loss: 4.3407 - mean_absolute_erro
Epoch 336/500
3542/3542 [==============================] - 1s 275us/step - loss: 4.0142 - mean_absolute_erro
Epoch 337/500
3542/3542 [==============================] - 1s 198us/step - loss: 4.1863 - mean_absolute_erro
Epoch 338/500
3542/3542 [==============================] - 1s 252us/step - loss: 4.0902 - mean_absolute_erro
Epoch 339/500
3542/3542 [==============================] - 1s 250us/step - loss: 4.1140 - mean_absolute_erro
Epoch 340/500
3542/3542 [==============================] - 1s 270us/step - loss: 4.5802 - mean_absolute_erro
Epoch 341/500
3542/3542 [==============================] - 1s 245us/step - loss: 4.1185 - mean_absolute_erro
Epoch 342/500
3542/3542 [==============================] - 1s 232us/step - loss: 3.9946 - mean_absolute_erro
Epoch 343/500
3542/3542 [==============================] - 1s 240us/step - loss: 4.0745 - mean_absolute_erro
Epoch 344/500
3542/3542 [==============================] - 1s 255us/step - loss: 4.0038 - mean_absolute_erro
Epoch 345/500
3542/3542 [==============================] - 1s 209us/step - loss: 4.0180 - mean_absolute_erro
Epoch 346/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.6442 - mean_absolute_erro
Epoch 347/500
3542/3542 [==============================] - 1s 239us/step - loss: 4.1359 - mean_absolute_erro
Epoch 348/500
3542/3542 [==============================] - 1s 194us/step - loss: 4.2758 - mean_absolute_erro
Epoch 349/500
3542/3542 [==============================] - 1s 208us/step - loss: 4.2081 - mean_absolute_erro
Epoch 350/500
3542/3542 [==============================] - 1s 203us/step - loss: 4.1415 - mean_absolute_erro
Epoch 351/500
3542/3542 [==============================] - 1s 220us/step - loss: 4.1477 - mean_absolute_erro
Epoch 352/500
3542/3542 [==============================] - 1s 196us/step - loss: 4.5144 - mean_absolute_erro
Epoch 353/500
3542/3542 [==============================] - 1s 186us/step - loss: 4.0808 - mean_absolute_erro
Epoch 354/500
3542/3542 [==============================] - 1s 243us/step - loss: 4.0260 - mean_absolute_erro
Epoch 355/500
3542/3542 [==============================] - 1s 204us/step - loss: 3.7935 - mean_absolute_erro
Epoch 356/500
```

```
3542/3542 [==============================] - 1s 197us/step - loss: 4.5696 - mean_absolute_erro
Epoch 357/500
3542/3542 [==============================] - 1s 174us/step - loss: 4.1222 - mean_absolute_erro
Epoch 358/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.1805 - mean_absolute_erro
Epoch 359/500
3542/3542 [==============================] - 1s 201us/step - loss: 3.9649 - mean_absolute_erro
Epoch 360/500
3542/3542 [==============================] - 1s 194us/step - loss: 4.0500 - mean_absolute_erro
Epoch 361/500
3542/3542 [==============================] - 1s 226us/step - loss: 4.5020 - mean_absolute_erro
Epoch 362/500
3542/3542 [==============================] - 1s 246us/step - loss: 4.0555 - mean_absolute_erro
Epoch 363/500
3542/3542 [==============================] - 1s 213us/step - loss: 3.8402 - mean_absolute_erro
Epoch 364/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.1697 - mean_absolute_erro
Epoch 365/500
3542/3542 [==============================] - 1s 178us/step - loss: 3.9893 - mean_absolute_erro
Epoch 366/500
3542/3542 [==============================] - 1s 178us/step - loss: 4.2480 - mean_absolute_erro
Epoch 367/500
3542/3542 [==============================] - 1s 174us/step - loss: 4.2767 - mean_absolute_erro
Epoch 368/500
3542/3542 [==============================] - 1s 182us/step - loss: 4.7010 - mean_absolute_erro
Epoch 369/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.5344 - mean_absolute_erro
Epoch 370/500
3542/3542 [==============================] - 1s 174us/step - loss: 3.9073 - mean_absolute_erro
Epoch 371/500
3542/3542 [==============================] - 1s 171us/step - loss: 3.8191 - mean_absolute_erro
Epoch 372/500
3542/3542 [==============================] - 1s 179us/step - loss: 4.3761 - mean_absolute_erro
Epoch 373/500
3542/3542 [==============================] - 1s 178us/step - loss: 3.8922 - mean_absolute_erro
Epoch 374/500
3542/3542 [==============================] - 1s 174us/step - loss: 4.4742 - mean_absolute_erro
Epoch 375/500
3542/3542 [==============================] - 1s 174us/step - loss: 4.3334 - mean_absolute_erro
Epoch 376/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.0270 - mean_absolute_erro
Epoch 377/500
3542/3542 [==============================] - 1s 183us/step - loss: 3.9848 - mean_absolute_erro
Epoch 378/500
3542/3542 [==============================] - 1s 210us/step - loss: 3.9494 - mean_absolute_erro
Epoch 379/500
3542/3542 [==============================] - 1s 241us/step - loss: 3.7710 - mean_absolute_erro
Epoch 380/500
```

```
3542/3542 [==============================] - 1s 292us/step - loss: 3.8220 - mean_absolute_erro
Epoch 381/500
3542/3542 [==============================] - 1s 211us/step - loss: 3.9247 - mean_absolute_erro
Epoch 382/500
3542/3542 [==============================] - 1s 247us/step - loss: 4.1318 - mean_absolute_erro
Epoch 383/500
3542/3542 [==============================] - 1s 281us/step - loss: 4.0514 - mean_absolute_erro
Epoch 384/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.0605 - mean_absolute_erro
Epoch 385/500
3542/3542 [==============================] - 1s 183us/step - loss: 3.9746 - mean_absolute_erro
Epoch 386/500
3542/3542 [==============================] - 1s 203us/step - loss: 4.2004 - mean_absolute_erro
Epoch 387/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.5726 - mean_absolute_erro
Epoch 388/500
3542/3542 [==============================] - 1s 188us/step - loss: 4.1304 - mean_absolute_erro
Epoch 389/500
3542/3542 [==============================] - 1s 213us/step - loss: 3.9176 - mean_absolute_erro
Epoch 390/500
3542/3542 [==============================] - 1s 228us/step - loss: 4.5327 - mean_absolute_erro
Epoch 391/500
3542/3542 [==============================] - 1s 244us/step - loss: 4.1112 - mean_absolute_erro
Epoch 392/500
3542/3542 [==============================] - 1s 248us/step - loss: 3.7737 - mean_absolute_erro
Epoch 393/500
3542/3542 [==============================] - 1s 195us/step - loss: 4.5791 - mean_absolute_erro
Epoch 394/500
3542/3542 [==============================] - 1s 208us/step - loss: 4.0040 - mean_absolute_erro
Epoch 395/500
3542/3542 [==============================] - 1s 222us/step - loss: 4.3656 - mean_absolute_erro
Epoch 396/500
3542/3542 [==============================] - 1s 207us/step - loss: 3.8671 - mean_absolute_erro
Epoch 397/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.7195 - mean_absolute_erro
Epoch 398/500
3542/3542 [==============================] - 1s 237us/step - loss: 3.9450 - mean_absolute_erro
Epoch 399/500
3542/3542 [==============================] - 1s 267us/step - loss: 4.0551 - mean_absolute_erro
Epoch 400/500
3542/3542 [==============================] - 1s 229us/step - loss: 4.0441 - mean_absolute_erro
Epoch 401/500
3542/3542 [==============================] - 1s 194us/step - loss: 4.2840 - mean_absolute_erro
Epoch 402/500
3542/3542 [==============================] - 1s 280us/step - loss: 4.0731 - mean_absolute_erro
Epoch 403/500
3542/3542 [==============================] - 1s 248us/step - loss: 3.7232 - mean_absolute_erro
Epoch 404/500
```

```
3542/3542 [==============================] - 1s 238us/step - loss: 4.1827 - mean_absolute_erro
Epoch 405/500
3542/3542 [==============================] - 1s 231us/step - loss: 3.8397 - mean_absolute_erro
Epoch 406/500
3542/3542 [==============================] - 1s 259us/step - loss: 3.8548 - mean_absolute_erro
Epoch 407/500
3542/3542 [==============================] - 1s 238us/step - loss: 4.0298 - mean_absolute_erro
Epoch 408/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.1167 - mean_absolute_erro
Epoch 409/500
3542/3542 [==============================] - 1s 175us/step - loss: 4.1680 - mean_absolute_erro
Epoch 410/500
3542/3542 [==============================] - 1s 191us/step - loss: 4.1382 - mean_absolute_erro
Epoch 411/500
3542/3542 [==============================] - 1s 226us/step - loss: 3.9275 - mean_absolute_erro
Epoch 412/500
3542/3542 [==============================] - 1s 213us/step - loss: 3.7990 - mean_absolute_erro
Epoch 413/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.0336 - mean_absolute_erro
Epoch 414/500
3542/3542 [==============================] - 1s 258us/step - loss: 3.8117 - mean_absolute_erro
Epoch 415/500
3542/3542 [==============================] - 1s 213us/step - loss: 4.1230 - mean_absolute_erro
Epoch 416/500
3542/3542 [==============================] - 1s 201us/step - loss: 3.7323 - mean_absolute_erro
Epoch 417/500
3542/3542 [==============================] - 1s 188us/step - loss: 3.6495 - mean_absolute_erro
Epoch 418/500
3542/3542 [==============================] - 1s 195us/step - loss: 4.4434 - mean_absolute_erro
Epoch 419/500
3542/3542 [==============================] - 1s 228us/step - loss: 3.7808 - mean_absolute_erro
Epoch 420/500
3542/3542 [==============================] - 1s 215us/step - loss: 4.0558 - mean_absolute_erro
Epoch 421/500
3542/3542 [==============================] - 1s 207us/step - loss: 3.8704 - mean_absolute_erro
Epoch 422/500
3542/3542 [==============================] - 1s 198us/step - loss: 3.9801 - mean_absolute_erro
Epoch 423/500
3542/3542 [==============================] - 1s 201us/step - loss: 3.7870 - mean_absolute_erro
Epoch 424/500
3542/3542 [==============================] - 1s 184us/step - loss: 3.8805 - mean_absolute_erro
Epoch 425/500
3542/3542 [==============================] - 1s 280us/step - loss: 4.0897 - mean_absolute_erro
Epoch 426/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.3886 - mean_absolute_erro
Epoch 427/500
3542/3542 [==============================] - 1s 187us/step - loss: 4.0725 - mean_absolute_erro
Epoch 428/500
```

```
3542/3542 [==============================] - 1s 218us/step - loss: 3.5784 - mean_absolute_erro
Epoch 429/500
3542/3542 [==============================] - 1s 199us/step - loss: 3.9701 - mean_absolute_erro
Epoch 430/500
3542/3542 [==============================] - 1s 214us/step - loss: 3.7917 - mean_absolute_erro
Epoch 431/500
3542/3542 [==============================] - 1s 181us/step - loss: 4.2672 - mean_absolute_erro
Epoch 432/500
3542/3542 [==============================] - 1s 191us/step - loss: 3.7344 - mean_absolute_erro
Epoch 433/500
3542/3542 [==============================] - 1s 177us/step - loss: 3.9585 - mean_absolute_erro
Epoch 434/500
3542/3542 [==============================] - 1s 184us/step - loss: 4.1197 - mean_absolute_erro
Epoch 435/500
3542/3542 [==============================] - 1s 215us/step - loss: 3.7016 - mean_absolute_erro
Epoch 436/500
3542/3542 [==============================] - 1s 201us/step - loss: 3.4678 - mean_absolute_erro
Epoch 437/500
3542/3542 [==============================] - 1s 178us/step - loss: 3.8563 - mean_absolute_erro
Epoch 438/500
3542/3542 [==============================] - 1s 173us/step - loss: 3.7891 - mean_absolute_erro
Epoch 439/500
3542/3542 [==============================] - 1s 182us/step - loss: 3.9371 - mean_absolute_erro
Epoch 440/500
3542/3542 [==============================] - 1s 248us/step - loss: 3.9448 - mean_absolute_erro
Epoch 441/500
3542/3542 [==============================] - 1s 179us/step - loss: 3.7903 - mean_absolute_erro
Epoch 442/500
3542/3542 [==============================] - 1s 201us/step - loss: 3.6372 - mean_absolute_erro
Epoch 443/500
3542/3542 [==============================] - 1s 186us/step - loss: 4.1795 - mean_absolute_erro
Epoch 444/500
3542/3542 [==============================] - 1s 180us/step - loss: 3.6714 - mean_absolute_erro
Epoch 445/500
3542/3542 [==============================] - 1s 173us/step - loss: 4.2991 - mean_absolute_erro
Epoch 446/500
3542/3542 [==============================] - 1s 192us/step - loss: 3.9583 - mean_absolute_erro
Epoch 447/500
3542/3542 [==============================] - 1s 173us/step - loss: 3.8746 - mean_absolute_erro
Epoch 448/500
3542/3542 [==============================] - 1s 175us/step - loss: 3.7753 - mean_absolute_erro
Epoch 449/500
3542/3542 [==============================] - 1s 173us/step - loss: 3.6366 - mean_absolute_erro
Epoch 450/500
3542/3542 [==============================] - 1s 224us/step - loss: 3.9113 - mean_absolute_erro
Epoch 451/500
3542/3542 [==============================] - 1s 234us/step - loss: 3.6843 - mean_absolute_erro
Epoch 452/500
```

```
3542/3542 [==============================] - 1s 211us/step - loss: 4.2655 - mean_absolute_erro
Epoch 453/500
3542/3542 [==============================] - 1s 203us/step - loss: 3.9380 - mean_absolute_erro
Epoch 454/500
3542/3542 [==============================] - 1s 196us/step - loss: 3.7690 - mean_absolute_erro
Epoch 455/500
3542/3542 [==============================] - 1s 179us/step - loss: 3.7568 - mean_absolute_erro
Epoch 456/500
3542/3542 [==============================] - 1s 184us/step - loss: 3.8169 - mean_absolute_erro
Epoch 457/500
3542/3542 [==============================] - 1s 280us/step - loss: 3.6127 - mean_absolute_erro
Epoch 458/500
3542/3542 [==============================] - 1s 273us/step - loss: 3.8443 - mean_absolute_erro
Epoch 459/500
3542/3542 [==============================] - 1s 193us/step - loss: 3.7526 - mean_absolute_erro
Epoch 460/500
3542/3542 [==============================] - 1s 175us/step - loss: 3.8287 - mean_absolute_erro
Epoch 461/500
3542/3542 [==============================] - 1s 191us/step - loss: 3.7962 - mean_absolute_erro
Epoch 462/500
3542/3542 [==============================] - 1s 255us/step - loss: 3.6718 - mean_absolute_erro
Epoch 463/500
3542/3542 [==============================] - 1s 246us/step - loss: 4.2169 - mean_absolute_erro
Epoch 464/500
3542/3542 [==============================] - 1s 259us/step - loss: 3.9036 - mean_absolute_erro
Epoch 465/500
3542/3542 [==============================] - 1s 211us/step - loss: 4.1836 - mean_absolute_erro
Epoch 466/500
3542/3542 [==============================] - 1s 205us/step - loss: 3.6183 - mean_absolute_erro
Epoch 467/500
3542/3542 [==============================] - 1s 184us/step - loss: 3.6351 - mean_absolute_erro
Epoch 468/500
3542/3542 [==============================] - 1s 180us/step - loss: 4.0398 - mean_absolute_erro
Epoch 469/500
3542/3542 [==============================] - 1s 241us/step - loss: 3.6665 - mean_absolute_erro
Epoch 470/500
3542/3542 [==============================] - 1s 204us/step - loss: 3.7464 - mean_absolute_erro
Epoch 471/500
3542/3542 [==============================] - 1s 214us/step - loss: 3.9379 - mean_absolute_erro
Epoch 472/500
3542/3542 [==============================] - 1s 223us/step - loss: 3.6357 - mean_absolute_erro
Epoch 473/500
3542/3542 [==============================] - 1s 225us/step - loss: 3.9808 - mean_absolute_erro
Epoch 474/500
3542/3542 [==============================] - 1s 185us/step - loss: 3.7595 - mean_absolute_erro
Epoch 475/500
3542/3542 [==============================] - 1s 205us/step - loss: 3.8300 - mean_absolute_erro
Epoch 476/500
```

```
3542/3542 [==============================] - 1s 228us/step - loss: 3.8865 - mean_absolute_erro
Epoch 477/500
3542/3542 [==============================] - 1s 240us/step - loss: 4.1469 - mean_absolute_erro
Epoch 478/500
3542/3542 [==============================] - 1s 223us/step - loss: 3.7543 - mean_absolute_erro
Epoch 479/500
3542/3542 [==============================] - 1s 188us/step - loss: 3.7163 - mean_absolute_erro
Epoch 480/500
3542/3542 [==============================] - 1s 257us/step - loss: 3.7742 - mean_absolute_erro
Epoch 481/500
3542/3542 [==============================] - 1s 264us/step - loss: 3.8242 - mean_absolute_erro
Epoch 482/500
3542/3542 [==============================] - 1s 208us/step - loss: 3.6294 - mean_absolute_erro
Epoch 483/500
3542/3542 [==============================] - 1s 244us/step - loss: 3.6146 - mean_absolute_erro
Epoch 484/500
3542/3542 [==============================] - 1s 258us/step - loss: 3.7589 - mean_absolute_erro
Epoch 485/500
3542/3542 [==============================] - 1s 221us/step - loss: 4.2216 - mean_absolute_erro
Epoch 486/500
3542/3542 [==============================] - 1s 180us/step - loss: 3.8109 - mean_absolute_erro
Epoch 487/500
3542/3542 [==============================] - 1s 212us/step - loss: 3.8499 - mean_absolute_erro
Epoch 488/500
3542/3542 [==============================] - 1s 213us/step - loss: 3.7081 - mean_absolute_erro
Epoch 489/500
3542/3542 [==============================] - 1s 208us/step - loss: 4.5309 - mean_absolute_erro
Epoch 490/500
3542/3542 [==============================] - 1s 172us/step - loss: 4.0059 - mean_absolute_erro
Epoch 491/500
3542/3542 [==============================] - 1s 210us/step - loss: 3.6057 - mean_absolute_erro
Epoch 492/500
3542/3542 [==============================] - 1s 269us/step - loss: 3.9017 - mean_absolute_erro
Epoch 493/500
3542/3542 [==============================] - 1s 177us/step - loss: 3.7836 - mean_absolute_erro
Epoch 494/500
3542/3542 [==============================] - 1s 185us/step - loss: 4.3180 - mean_absolute_erro
Epoch 495/500
3542/3542 [==============================] - 1s 200us/step - loss: 4.6081 - mean_absolute_erro
Epoch 496/500
3542/3542 [==============================] - 1s 207us/step - loss: 4.5242 - mean_absolute_erro
Epoch 497/500
3542/3542 [==============================] - 1s 215us/step - loss: 3.8397 - mean_absolute_erro
Epoch 498/500
3542/3542 [==============================] - 1s 229us/step - loss: 3.5953 - mean_absolute_erro
Epoch 499/500
3542/3542 [==============================] - 1s 228us/step - loss: 3.5591 - mean_absolute_erro
Epoch 500/500
```

```
3542/3542 [==============================] - 1s 223us/step - loss: 3.5951 - mean_absolute_erro
```

```
Out[111]: <keras.callbacks.callbacks.History at 0x7fb0c0b4bfd0>
```

```
In [112]: y_pred_test = NN_model.predict(x_test)
```

```
In [113]: reg_metrics(y_test,y_pred_test)
```

```
MSE: 413.08601574260456

RMSE: 20.32451760171947

MAE: 6.515900369446747

r2score: 0.985457129717469
```

7 Visualisation by SVD for Veg and Non-Veg

```
In [114]: data.head()
```

```
Out[114]:    Protein_g  Fat_g  Carb_g  Sugar_g  Fiber_g  VitA_mcg  VitB6_mg  VitB12_mcg  \
          0       0.85  81.11    0.06     0.06      0.0     684.0     0.003        0.17
          1       0.85  81.11    0.06     0.06      0.0     684.0     0.003        0.13
          2       0.28  99.48    0.00     0.00      0.0     840.0     0.001        0.01
          3      21.40  28.74    2.34     0.50      0.0     198.0     0.166        1.22
          4      23.24  29.68    2.79     0.51      0.0     292.0     0.065        1.26

             VitC_mg  VitE_mg  ...  Folate_USRDA  Niacin_USRDA  Riboflavin_USRDA  \
          0      0.0     2.32  ...        0.0075      0.002625          0.026154
          1      0.0     2.32  ...        0.0075      0.002625          0.026154
          2      0.0     2.80  ...        0.0000      0.000188          0.003846
          3      0.0     0.25  ...        0.0900      0.063500          0.293846
          4      0.0     0.26  ...        0.0500      0.007375          0.270000

             Thiamin_USRDA  Calcium_USRDA  Copper_USRDA  Magnesium_USRDA  \
          0       0.004167       0.020000      0.000000         0.004762
          1       0.004167       0.020000      0.000018         0.004762
          2       0.000833       0.003333      0.000001         0.000000
          3       0.024167       0.440000      0.000044         0.054762
          4       0.011667       0.561667      0.000027         0.057143

             Phosphorus_USRDA  Selenium_USRDA  Zinc_USRDA
          0          0.034286        0.018182    0.008182
          1          0.032857        0.018182    0.004545
          2          0.004286        0.000000    0.000909
```

```
3          0.552857        0.263636    0.241818
4          0.644286        0.263636    0.236364

[5 rows x 37 columns]
```

In [115]:
```
from sklearn.decomposition import TruncatedSVD

svd = TruncatedSVD(n_components=2)
```

In [116]:
```
new_data = svd.fit_transform(data)
```

In [117]:
```
new_data.shape
```

Out[117]:
```
(7229, 2)
```

In [123]:
```
label
```

Out[123]:
```
0       Non-Veg
1       Non-Veg
2       Non-Veg
3       Non-Veg
4       Non-Veg
         ...
8613    Non-Veg
8614    Non-Veg
8615        Veg
8616    Non-Veg
8617    Non-Veg
Name: FoodGroup, Length: 7229, dtype: object
```

In [125]:
```
len(datan)
```

Out[125]:
```
7229
```

In [127]:
```
new_data.shape
```

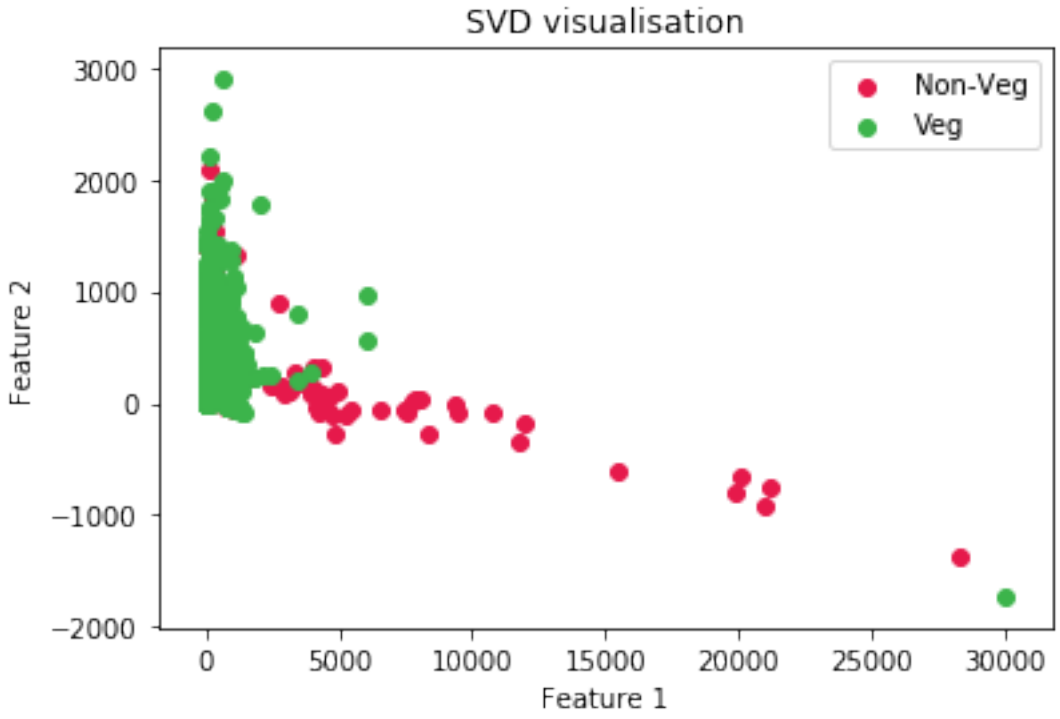
Out[127]:
```
(7229, 2)
```

In [136]:
```
import copy
data1 = copy.deepcopy(data)
datan = np.array(data1)
label = list(label)
dic={}
for i in range(0,len(datan)):
    #print( datan[i][0] , datan[i][1] , datan[i][2] )
    try:
        #print(label[i],i)
        dic[label[i]].append ([new_data[i][0],new_data[i][1]])
    except:
        #print(label[i])
        dic[label[i]] = []
        dic[label[i]].append ([new_data[i][0],new_data[i][1]])
    #print( datan[i][0] , dic[datan[i][0]] )
```

```
In [140]: len(dic['Non-Veg'])

Out[140]: 3057

In [141]: import matplotlib.pyplot as plt
          plt.title("SVD visualisation")
          plt.xlabel('Feature 1')
          plt.ylabel('Feature 2')
          colors=['#e6194b', '#3cb44b', '#ffe119', '#4363d8', '#f58231', '#911eb4', '#46f0f0',
          l=0
          for type in dic.keys():
              #plt.plot(new_data[i,0:1], new_data[i,1:2], color=colors[l],ls='None')
              plt.scatter(np.array(dic[type])[:,0],np.array(dic[type])[:,1], color=colors[l],la
              plt.legend(loc="best")
              l+=1
              #plt.xlim([-5, 6])
              #plt.ylim([-5, 5])
          #plt.savefig(name)
          #plt.show()
```




```
In [142]: data.shape

Out[142]: (7229, 38)
```