```
import pandas as pd

import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.impute import SimpleImputer
sns.set(rc = {'figure.figsize':(11,4)})

ds = pd.read_csv('agricultural_raw_material.csv')

ds.shape

(361, 25)

ds
```

	Month	Coarse wool Price	Coarse wool price % Change	Copra Price
0	Apr-90	482.34	-	236
1	May-90	447.26	-7.27%	234
2	Jun-90	440.99	-1.40%	216
3	Jul-90	418.44	-5.11%	205
4	Aug-90	418.44	0.00%	198
..	...	...	...	...
356	Dec-19	NaN	NaN	NaN
357	Jan-20	NaN	NaN	NaN
358	Feb-20	NaN	NaN	NaN
359	Mar-20	NaN	NaN	NaN
360	Apr-20	NaN	NaN	NaN

	Copra price % Change	Cotton Price	Cotton price % Change	Fine wool Price
0	-	1.83	-	1,071.63
1	-0.85%	1.89	3.28%	1,057.18
2	-7.69%	1.99	5.29%	898.24
3	-5.09%	2.01	1.01%	895.83
4	-3.41%	1.79	-10.95%	

951.22

		...	...	...
..	...	...		...
...				
356	NaN	1.67	1.21%	NaN
357	NaN	1.74	4.19%	NaN
358	NaN	1.69	-2.87%	NaN
359	NaN	1.49	-11.83%	NaN
360	NaN	1.40	-6.04%	NaN

	Fine wool price % Change	Hard log Price	...	Plywood Price	\
0	-	161.20	...	312.36	
1	-1.35%	172.86	...	350.12	
2	-15.03%	181.67	...	373.94	
3	-0.27%	187.96	...	378.48	
4	6.18%	186.13	...	364.60	
..	...	...	...	...	
356	NaN	272.80	...	500.37	
357	NaN	272.40	...	499.64	
358	NaN	270.56	...	496.28	
359	NaN	276.93	...	507.96	
360	NaN	276.24	...	506.68	

	Plywood price % Change	Rubber Price	Rubber price % Change	Softlog Price	\
0	-	0.84	-	120.66	
1	12.09%	0.85	1.19%	124.28	
2	6.80%	0.85	0.00%	129.45	
3	1.21%	0.86	1.18%	124.23	
4	-3.67%	0.88	2.33%	129.70	
..	...	...	...	...	
356	-0.22%	1.66	7.79%	NaN	
357	-0.15%	1.68	1.20%	NaN	
358	-0.67%	1.61	-4.17%	NaN	
359	2.35%	1.50	-6.83%	NaN	

```
360                          -0.25%          1.33                    -11.33%
NaN

     Softlog price % Change Soft sawnwood Price  Soft sawnwood price %
Change  \
0                           -               218.76
-
1                        3.00%              213.00
-2.63%
2                        4.16%              200.00
-6.10%
3                       -4.03%              210.05
5.03%
4                        4.40%              208.30
-0.83%
..                         ...                 ...
...
356                        NaN                 NaN
NaN
357                        NaN                 NaN
NaN
358                        NaN                 NaN
NaN
359                        NaN                 NaN
NaN
360                        NaN                 NaN
NaN

     Wood pulp Price  Wood pulp price % Change
0            829.29                          -
1            842.51                      1.59%
2            831.35                     -1.32%
3            798.83                     -3.91%
4            818.74                      2.49%
..              ...                        ...
356          875.00                      0.00%
357          875.00                      0.00%
358          875.00                      0.00%
359          875.00                      0.00%
360             NaN                        NaN

[361 rows x 25 columns]

ds.columns

Index(['Month', 'Coarse wool Price', 'Coarse wool price % Change',
       'Copra Price', 'Copra price % Change', 'Cotton Price',
       'Cotton price % Change', 'Fine wool Price', 'Fine wool price %
Change',
       'Hard log Price', 'Hard log price % Change', 'Hard sawnwood
```

```
Price',
       'Hard sawnwood price % Change', 'Hide Price', 'Hide price %
change',
       'Plywood Price', 'Plywood price % Change', 'Rubber Price',
       'Rubber price % Change', 'Softlog Price', 'Softlog price %
Change',
       'Soft sawnwood Price', 'Soft sawnwood price % Change',
       'Wood pulp Price', 'Wood pulp price % Change'],
      dtype='object')
```

```
ds.info
```

```
<bound method DataFrame.info of         Month Coarse wool Price Coarse
wool price % Change Copra Price  \
0     Apr-90              482.34                       -          236

1     May-90              447.26                  -7.27%          234

2     Jun-90              440.99                  -1.40%          216

3     Jul-90              418.44                  -5.11%          205

4     Aug-90              418.44                   0.00%          198

..       ...                 ...                     ...          ...

356   Dec-19                 NaN                     NaN          NaN

357   Jan-20                 NaN                     NaN          NaN

358   Feb-20                 NaN                     NaN          NaN

359   Mar-20                 NaN                     NaN          NaN

360   Apr-20                 NaN                     NaN          NaN


     Copra price % Change  Cotton Price Cotton price % Change Fine wool
Price  \
0                       -          1.83                     -
1,071.63
1                  -0.85%          1.89                  3.28%
1,057.18
2                  -7.69%          1.99                  5.29%
898.24
3                  -5.09%          2.01                  1.01%
895.83
4                  -3.41%          1.79                 -10.95%
951.22
..                    ...           ...                     ...
...
```

	Fine wool price % Change	Hard log Price	...	Plywood Price
356	NaN	1.67		1.21%
	NaN			
357	NaN	1.74		4.19%
	NaN			
358	NaN	1.69		-2.87%
	NaN			
359	NaN	1.49		-11.83%
	NaN			
360	NaN	1.40		-6.04%
	NaN			

	Fine wool price % Change	Hard log Price	...	Plywood Price
0	-	161.20	...	312.36
1	-1.35%	172.86	...	350.12
2	-15.03%	181.67	...	373.94
3	-0.27%	187.96	...	378.48
4	6.18%	186.13	...	364.60
..	...	...	...	...
356	NaN	272.80	...	500.37
357	NaN	272.40	...	499.64
358	NaN	270.56	...	496.28
359	NaN	276.93	...	507.96
360	NaN	276.24	...	506.68

	Plywood price % Change	Rubber Price	Rubber price % Change	Softlog Price
0	-	0.84	-	120.66
1	12.09%	0.85	1.19%	124.28
2	6.80%	0.85	0.00%	129.45
3	1.21%	0.86	1.18%	124.23
4	-3.67%	0.88	2.33%	129.70
..	...	...	...	...
356	-0.22%	1.66	7.79%	NaN
357	-0.15%	1.68	1.20%	NaN
358	-0.67%	1.61	-4.17%	NaN
359	2.35%	1.50	-6.83%	NaN
360	-0.25%	1.33	-11.33%	NaN

	Softlog price % Change	Soft sawnwood Price	Soft sawnwood price %

```
Change  \
0                               -         218.76
-
1                    3.00%         213.00
-2.63%
2                    4.16%         200.00
-6.10%
3                   -4.03%         210.05
5.03%
4                    4.40%         208.30
-0.83%
..                    ...            ...
...
356                   NaN            NaN
NaN
357                   NaN            NaN
NaN
358                   NaN            NaN
NaN
359                   NaN            NaN
NaN
360                   NaN            NaN
NaN

     Wood pulp Price  Wood pulp price % Change
0            829.29                          -
1            842.51                      1.59%
2            831.35                     -1.32%
3            798.83                     -3.91%
4            818.74                      2.49%
..              ...                        ...
356          875.00                      0.00%
357          875.00                      0.00%
358          875.00                      0.00%
359          875.00                      0.00%
360             NaN                        NaN

[361 rows x 25 columns]>

ds_copy = ds.copy()

ds = ds.replace('%','',regex=True)
ds = ds.replace(',','',regex=True)
ds = ds.replace('-','',regex=True)
ds = ds.replace('',np.nan)
ds = ds.replace('MAY90',np.nan)


ds = ds.dropna()
```

```
ds.isnull().sum()
```

```
Month                          0
Coarse wool Price              0
Coarse wool price % Change     0
Copra Price                    0
Copra price % Change           0
Cotton Price                   0
Cotton price % Change          0
Fine wool Price                0
Fine wool price % Change       0
Hard log Price                 0
Hard log price % Change        0
Hard sawnwood Price            0
Hard sawnwood price % Change   0
Hide Price                     0
Hide price % change            0
Plywood Price                  0
Plywood price % Change         0
Rubber Price                   0
Rubber price % Change          0
Softlog Price                  0
Softlog price % Change         0
Soft sawnwood Price            0
Soft sawnwood price % Change   0
Wood pulp Price                0
Wood pulp price % Change       0
dtype: int64
```

```python
# Converting data type to float
agri = ["Coarse wool Price", "Coarse wool price % Change", "Copra
Price", "Copra price % Change", "Cotton price % Change","Fine wool
Price", "Fine wool price % Change", "Hard log price % Change", "Hard
sawnwood price % Change", "Hide price % change", "Plywood price %
Change", "Rubber price % Change", "Softlog price % Change", "Soft
sawnwood price % Change", "Wood pulp price % Change"]

ds[agri] = ds[agri].astype("float")

ds[agri] = ds[agri].astype("float")

summary_stats = ds.describe()
print(summary_stats)
```

```
            index  Coarse wool Price  Coarse wool price % Change
Copra Price  \
count  326.000000         326.000000                  326.000000
326.000000
mean   163.500000         626.775429                    3.845307
530.047761
std     94.252321         299.992828                    3.628820
```

```
264.001641
min        1.000000          247.090000                        0.000000
182.000000
25%       82.250000          368.490000                        1.300000
371.000000
50%      163.500000          526.890000                        2.910000
449.500000
75%      244.750000          848.795000                        5.157500
657.125000
max      326.000000         1391.470000                       22.250000
1503.000000
```

```
       Copra price % Change  Cotton Price  Cotton price % Change  \
count            326.000000    326.000000             326.000000
mean               5.562362      1.620736               3.999663
std                5.091321      0.533457               3.930971
min                0.000000      0.820000               0.000000
25%                1.895000      1.272500               1.377500
50%                4.350000      1.540000               2.840000
75%                7.775000      1.830000               5.407500
max               31.820000      5.060000              23.640000
```

```
       Fine wool Price  Fine wool price % Change  Hard log Price  ...
\
count       326.000000                326.000000      326.000000  ...

mean        849.440092                  4.803497      249.253620  ...

std         285.248110                  4.698225       68.553994  ...

min         417.470000                  0.000000      133.280000  ...

25%         646.257500                  1.557500      195.275000  ...

50%         747.555000                  3.470000      247.550000  ...

75%        1016.352500                  6.362500      287.025000  ...

max        1865.440000                 32.840000      520.810000  ...
```

```
       Plywood Price  Plywood price % Change  Rubber Price  \
count     326.000000              326.000000    326.000000
mean      510.027178                2.268466      1.663282
std        93.188458                2.659446      1.068344
min       335.250000                0.000000      0.490000
25%       434.727500                0.402500      0.842500
50%       512.495000                1.470000      1.335000
75%       582.035000                3.147500      2.157500
max       751.810000               19.500000      6.260000
```

```
        Rubber price % Change   Softlog Price   Softlog price % Change  \
count             326.000000      326.000000               326.000000
mean                5.499755      164.662025                 5.442454
std                 5.185055       25.519555                 4.768734
min                 0.000000      119.350000                 0.000000
25%                 1.617500      146.117500                 2.152500
50%                 3.910000      160.430000                 4.230000
75%                 7.397500      180.345000                 7.457500
max                32.160000      259.970000                33.210000

        Soft sawnwood Price   Soft sawnwood price % Change   Wood pulp
Price  \
count            326.000000                     326.000000
326.000000
mean             291.283497                       4.979663
678.212362
std               33.929470                       5.773700
158.315029
min              183.610000                       0.000000
384.000000
25%              277.717500                       1.905000
544.632500
50%              294.975000                       3.695000
662.160000
75%              310.887500                       6.122500
832.245000
max              372.600000                      65.240000
966.490000

        Wood pulp price % Change
count              326.000000
mean                 2.800000
std                  2.890238
min                  0.000000
25%                  0.662500
50%                  2.000000
75%                  4.107500
max                 21.570000

[8 rows x 25 columns]

#Find the high-range and low-range raw materials according to their
prices
price_column = ds.columns[ds.columns.str.contains('price',
case=False)].tolist()[0]  # assuming price is in column name
high_range_materials = ds[ds[price_column] > summary_stats.loc['75%',
price_column]]
low_range_materials = ds[ds[price_column] < summary_stats.loc['25%',
price_column]]
```

```python
print("High-range materials:")
print(high_range_materials)
print("\nLow-range materials:")
print(low_range_materials)
```

```
High-range materials:
     index  Month  Coarse wool Price  Coarse wool price % Change
Copra Price  \
238    239  Mar10             850.47                        3.97
608.00
245    246  Oct10             853.99                        8.05
947.00
246    247  Nov10             889.49                        4.16
1013.30
247    248  Dec10             883.84                        0.64
1154.00
248    249  Jan11            1011.45                       14.44
1354.00
..     ...    ...                ...                         ...
...
321    322  Feb17            1029.58                        0.18
1146.25
322    323  Mar17            1059.60                        2.92
1016.00
323    324  Apr17             991.12                        6.46
1044.00
324    325  May17            1019.95                        2.91
1112.50
325    326  Jun17            1065.81                        4.50
1119.00

     Copra price % Change  Cotton Price  Cotton price % Change  \
238                 13.01          1.89                   7.39
245                 11.81          2.79                  20.78
246                  7.00          3.41                  22.22
247                 13.89          3.70                   8.50
248                 17.33          3.94                   6.49
..                    ...           ...                    ...
321                  6.43          1.88                   3.30
322                 11.36          1.91                   1.60
323                  2.76          1.92                   0.52
324                  6.56          1.95                   1.56
325                  0.58          1.87                   4.10

     Fine wool Price  Fine wool price % Change  ...  Plywood Price  \
238          1004.69                      3.27  ...         557.22
245          1084.72                      9.76  ...         578.23
246          1274.93                     17.54  ...         581.00
247          1266.17                      0.69  ...         582.38
```

```
248           1549.40                       22.37   ...          584.49
..              ...                          ...    ...             ...
321           1368.14                        6.06   ...          483.23
322           1454.83                        6.34   ...          483.27
323           1404.98                        3.43   ...          495.87
324           1433.47                        2.03   ...          486.59
325           1403.83                        2.07   ...          492.29

      Plywood price % Change  Rubber Price  Rubber price % Change  \
238                    0.00          3.34                   6.71
245                    0.50          3.92                  11.05
246                    0.48          4.31                   9.95
247                    0.24          4.75                  10.21
248                    0.36          5.52                  16.21
..                      ...           ...                    ...
321                    1.88          2.71                   5.86
322                    0.01          2.35                  13.28
323                    2.61          2.21                   5.96
324                    1.87          2.10                   4.98
325                    1.17          1.72                  18.10

      Softlog Price  Softlog price % Change  Soft sawnwood Price  \
238          143.08                    2.52               277.01
245          145.89                    6.55               281.78
246          141.02                    3.34               271.34
247          149.49                    6.01               287.84
248          152.47                    1.99               291.81
..              ...                     ...                  ...
321          157.58                    7.39               287.43
322          160.05                    1.57               300.42
323          159.84                    0.13               306.60
324          159.84                    0.00               306.60
325          159.84                    0.00               306.60

      Soft sawnwood price % Change  Wood pulp Price  Wood pulp price %
Change
238                           2.10           813.74
4.79
245                           0.06           915.26
0.96
246                           3.71           897.20
1.97
247                           6.08           880.79
1.83
248                           1.38           879.09
0.19
..                             ...              ...
...
321                           7.73           875.00
0.00
```

```
322                          4.52          875.00
0.00
323                          2.06          875.00
0.00
324                          0.00          875.00
0.00
325                          0.00          875.00
0.00

[82 rows x 26 columns]

Low-range materials:
     index  Month  Coarse wool Price  Coarse wool price % Change
Copra Price  \
6        7  Nov90             334.50                       15.24
236.0
7        8  Dec90             328.24                        1.87
237.0
8        9  Jan91             319.47                        2.67
233.0
9       10  Feb91             323.23                        1.18
226.0
10      11  Mar91             328.24                        1.55
236.0
..     ...    ...                ...                         ...
...
134    135  Jul01             328.26                        0.41
223.0
135    136  Aug01             348.94                        6.30
235.0
136    137  Sep01             340.53                        2.41
210.0
137    138  Oct01             330.29                        3.01
195.0
138    139  Nov01             335.91                        1.70
202.0

     Copra price % Change  Cotton Price  Cotton price % Change  \
6                   19.19          1.82                   1.68
7                    0.42          1.85                   1.65
8                    1.69          1.85                   0.00
9                    3.00          1.87                   1.08
10                   4.42          1.86                   0.53
..                    ...           ...                    ...
134                 13.78          1.00                   4.76
135                  5.38          0.96                   4.00
136                 10.64          0.91                   5.21
137                  7.14          0.82                   9.89
138                  3.59          0.84                   2.44
```

	Fine wool Price	Fine wool price % Change	...	Plywood Price \
6	888.61	1.47	...	375.74
7	870.55	2.03	...	363.16
8	887.41	1.94	...	362.26
9	596.02	32.84	...	371.70
10	586.39	1.62	...	364.43
..	...	...	...	...
134	630.79	7.75	...	393.10
135	617.91	2.04	...	402.94
136	524.19	15.17	...	411.85
137	441.98	15.68	...	404.02
138	466.09	5.45	...	400.63

	Plywood price % Change	Rubber Price	Rubber price % Change \
6	8.20	0.90	0.00
7	3.35	0.88	2.22
8	0.25	0.87	1.14
9	2.61	0.85	2.30
10	1.96	0.83	2.35
..	...	...	...
134	3.96	0.60	3.23
135	2.50	0.59	1.67
136	2.21	0.58	1.69
137	1.90	0.54	6.90
138	0.84	0.51	5.56

	Softlog Price	Softlog price % Change	Soft sawnwood Price \
6	130.50	7.58	206.64
7	119.35	8.54	198.22
8	126.14	5.69	186.94
9	126.77	0.50	220.67
10	122.87	3.08	211.42
..	...	...	...
134	154.69	1.24	289.42
135	157.23	1.64	292.20
136	160.37	2.00	282.92
137	144.92	9.63	274.31
138	152.06	4.93	289.10

	Soft sawnwood price % Change	Wood pulp Price	Wood pulp price % Change
6	0.16	773.37	4.22
7	4.07	741.29	4.15
8	5.69	721.85	2.62
9	18.04	706.81	2.08
10	4.19	655.35	

```
7.28
..                                              ...                  ...
...
134                              5.18               464.67
7.81
135                              0.96               413.28
11.06
136                              3.18               420.80
1.82
137                              3.04               440.56
4.70
138                              5.39               442.42
0.42

[82 rows x 26 columns]
```

```python
# high and low %Change materials
price_column = ds.columns[ds.columns.str.contains('price',
case=False)].tolist()[0]

# Calculate percentage change for each row
ds['%Change'] = ds[price_column].pct_change()

# Identify high and low %Change materials
high_change_materials = ds['%Change'].nlargest(5)
low_change_materials = ds['%Change'].nsmallest(5)

print("High %Change materials:")
print(high_change_materials)
print("\nLow %Change materials:")
print(low_change_materials)
```

```
High %Change materials:
198     0.219876
140     0.180735
141     0.162662
228     0.160105
21      0.150990
Name: %Change, dtype: float64

Low %Change materials:
221    -0.222549
6      -0.152392
66     -0.119781
222    -0.116211
98     -0.113169
Name: %Change, dtype: float64
```

```python
#Identify the range of prices changed over the years
price_column = ds.columns[ds.columns.str.contains('price',
```

```python
case=False)].tolist()[0]


year_column = 'Month'  # Adjust for actual year column name

# Calculate the range of prices changed over the years
price_range_over_years = ds.groupby(year_column)
[price_column].agg(lambda x: x.max() - x.min())

print("Range of prices changed over the years:")
print(price_range_over_years)

Range of prices changed over the years:
Month
Apr00    0.0
Apr01    0.0
Apr02    0.0
Apr03    0.0
Apr04    0.0
         ...
Sep95    0.0
Sep96    0.0
Sep97    0.0
Sep98    0.0
Sep99    0.0
Name: Coarse wool Price, Length: 326, dtype: float64

ds.reset_index(inplace=True)

data_column = ['Coarse wool Price', 'Copra Price', 'Cotton Price',
'Fine wool Price',
            'Hard log Price', 'Hard sawnwood Price', 'Plywood Price',
            'Rubber Price', 'Softlog Price', 'Soft sawnwood Price',
'Wood pulp Price','Hide Price']

#Map a correlation between them using a heatmap.
plt.figure(figsize=(8,8))
hm = sns.heatmap(ds[data_column].corr(), vmax=1, vmin=-1,
cmap="coolwarm", square=True)
```