mnogostat_1

15 марта 2017 г.

In [1]:
```
import numpy as np
import pandas as pd
from rpy2 import robjects as ro
from pandas.rpy import common as com
import re
from matplotlib import pyplot as plt
```

```
//anaconda/envs/py3.5/lib/python3.5/site-packages/ipykernel/__main__.py:4: FutureWarning: The pandas.rpy
See here for a guide on how to port your code to rpy2: http://pandas.pydata.org/pandas-docs/stable/r_interface.
```

In [2]:
```
ro.r('''library("ppcor")''');
```

```
//anaconda/envs/py3.5/lib/python3.5/site-packages/rpy2/rinterface/__init__.py:186: RRuntimeWarning: Load

  warnings.warn(x, RRuntimeWarning)
```

In [3]:
```
data = pd.read_excel("../Downloads/airlines.(1).xlsx")
```

In [4]:
```
list(enumerate(data.columns))
```

Out[4]:
```
[(0, 'Авиакомпания'),
 (1, 'Год основания авиакомпании'),
 (2, 'Время существования авиакомпании (лет)'),
 (3, 'Страна          (развитая - 1, развивающаяся - 0)'),
 (4, 'Unnamed: 4'),
 (5, 'Кол-во воздушных судов, шт. '),
 (6, 'Количество направлений (регулярных рейсов)'),
 (7, 'Пассажиро-оборот, млн. пасс-км'),
 (8, 'Кол-во пассажиров, млн. чел. '),
 (9, 'Грузоперевозки, млн.т-км'),
 (10, 'Альянс                (да - 1, нет - 0)'),
 (11, 'Unnamed: 11'),
 (12, 'Лет без катастроф (с 1973 г.)'),
 (13, 'Жертвы авиакатастроф (с 1973 г.)'),
 (14, 'Работники (тыс. чел)'),
 (15, 'Выручка (млрд. долл)'),
 (16, 'Издержки (млрд. долл)')]
```

In [5]:
```
col = list(data.columns)
col[10] = 'Альянс'
col[3] = 'Страна'
col[4] = 'Развитая'
data.columns = col
```

In [6]:
```
airlines = data.Авиакомпания
data.drop(['Авиакомпания', 'Unnamed: 11'], axis=1, inplace=True)
```

In [7]:
```
data = pd.get_dummies(dummy_na = True, data = data,
                      columns=['Страна',
                               'Альянс'])
```

In [8]:
```
data.head()
```

Out[8]:

	Год основания авиакомпании	Время существования авиакомпании (лет)	Развитая	\
0	Y	Year	Co	
1	1928	82	1	
2	1933	77	1	
3	1934	76	1	
4	1931	79	1	

	Кол-во воздушных судов, шт.	Количество направлений (регулярных рейсов)	\
0	B	Dir	
1	729	355	
2	367	238	
3	614	250	
4	360	230	

	Пассажиро-оборот, млн. пасс-км	Кол-во пассажиров, млн. чел.	\
0	RPK	Pass	
1	304009	161	
2	202455	71.4	
3	196904	85.7	
4	161663	56.1	

	Грузоперевозки, млн.т-км	Лет без катастроф (с 1973 г.)	\
0	FTK	YC	
1	3.2	20	
2	4.9	3	
3	2.4	7	
4	2.34	7	

	Жертвы авиакатастроф (с 1973 г.)	...	Страна_ЮАР	Страна_Южная Корея	\
0	Victim	...	0	0	
1	236	...	0	0	
2	116	...	0	0	
3	895	...	0	0	
4	257	...	0	0	

	Страна_Япония	Страна_nan	Альянс_Alliance	Альянс_Oneworld	Альянс_SkyTeam	\
0	0	0	1	0	0	
1	0	0	0	0	1	
2	0	0	0	0	1	
3	0	0	0	1	0	
4	0	0	0	0	0	

	Альянс_Star Alliance	Альянс_Альянс	Альянс_nan
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	1	0	0

[5 rows x 49 columns]

In [9]: data = data.ix[1:52,:]

In [10]: data.head()

Out[10]:

	Год основания авиакомпании	Время существования авиакомпании (лет)	Развитая	\
1	1928	82	1	
2	1933	77	1	
3	1934	76	1	
4	1931	79	1	
5	1934	76	1	

	Кол-во воздушных судов, шт.	Количество направлений (регулярных рейсов)	\
1	729	355	
2	367	238	
3	614	250	
4	360	230	
5	327	287	

	Пассажиро-оборот, млн. пасс-км	Кол-во пассажиров, млн. чел.	\
1	304009	161	
2	202455	71.4	
3	196904	85.7	
4	161663	56.1	
5	128437	45.6	

	Грузоперевозки, млн.т-км	Лет без катастроф (с 1973 г.)	\
1	3.2	20	
2	4.9	3	
3	2.4	7	
4	2.34	7	
5	1.3	10	

	Жертвы авиакатастроф (с 1973 г.)	...	Страна_ЮАР	Страна_Южная Корея	\
1	236	...	0	0	
2	116	...	0	0	
3	895	...	0	0	
4	257	...	0	0	
5	25	...	0	0	

	Страна_Япония	Страна_nan	Альянс_Alliance	Альянс_Oneworld	Альянс_SkyTeam	\
1	0	0	0	1		
2	0	0	0	1		
3	0	0	1	0		
4	0	0	0	0		
5	0	0	0	0		

	Альянс_Star Alliance	Альянс_Альянс	Альянс_nan
1	0	0	0
2	0	0	0
3	0	0	0
4	1	0	0
5	1	0	0

[5 rows x 49 columns]

In [11]:
```
cols = list(data.columns)
data.columns = ['a' + str(x) for x in range(len(data.columns))]
```

In [12]:
```
list(enumerate(zip(cols,data.columns)))
```

Out[12]:
```
[(0, ('Год основания авиакомпании', 'a0')),
 (1, ('Время существования авиакомпании (лет)', 'a1')),
 (2, ('Развитая', 'a2')),
 (3, ('Кол-во воздушных судов, шт. ', 'a3')),
 (4, ('Количество направлений (регулярных рейсов)', 'a4')),
 (5, ('Пассажиро-оборот, млн. пасс-км', 'a5')),
 (6, ('Кол-во пассажиров, млн. чел. ', 'a6')),
 (7, ('Грузоперевозки, млн.т-км', 'a7')),
 (8, ('Лет без катастроф (с 1973 г.)', 'a8')),
 (9, ('Жертвы авиакатастроф (с 1973 г.)', 'a9')),
 (10, ('Работники (тыс. чел)', 'a10')),
 (11, ('Выручка (млрд. долл)', 'a11')),
 (12, ('Издержки (млрд. долл)', 'a12')),
 (13, ('Страна_Country', 'a13')),
 (14, ('Страна_Австралия', 'a14')),
 (15, ('Страна_Бразилия', 'a15')),
 (16, ('Страна_Великобритания', 'a16')),
 (17, ('Страна_Германия', 'a17')),
 (18, ('Страна_Ирландия', 'a18')),
```

```
 (19, ('Страна_Испания', 'a19')),
 (20, ('Страна_Италия', 'a20')),
 (21, ('Страна_Канада', 'a21')),
 (22, ('Страна_Катар', 'a22')),
 (23, ('Страна_Китай', 'a23')),
 (24, ('Страна_Малайзия', 'a24')),
 (25, ('Страна_Новая Зеландия ', 'a25')),
 (26, ('Страна_Португалия', 'a26')),
 (27, ('Страна_Россия', 'a27')),
 (28, ('Страна_США', 'a28')),
 (29, ('Страна_Сауд. Аравия', 'a29')),
 (30, ('Страна_Сингапур', 'a30')),
 (31, ('Страна_Страна', 'a31')),
 (32, ('Страна_Таиланд', 'a32')),
 (33, ('Страна_Тайвань', 'a33')),
 (34, ('Страна_Турция', 'a34')),
 (35, ('Страна_Франция', 'a35')),
 (36, ('Страна_Чили', 'a36')),
 (37, ('Страна_Швейцария', 'a37')),
 (38, ('Страна_Швеция', 'a38')),
 (39, ('Страна_ЮАР', 'a39')),
 (40, ('Страна_Южная Корея ', 'a40')),
 (41, ('Страна_Япония', 'a41')),
 (42, ('Страна_nan', 'a42')),
 (43, ('Альянс_Alliance', 'a43')),
 (44, ('Альянс_Oneworld', 'a44')),
 (45, ('Альянс_SkyTeam', 'a45')),
 (46, ('Альянс_Star Alliance ', 'a46')),
 (47, ('Альянс_Альянс', 'a47')),
 (48, ('Альянс_nan', 'a48'))]
```

In [13]:
```
rdf = com.convert_to_r_dataframe(data.astype('float32'))
ro.globalenv['data'] = rdf
```

In [14]:
```
cormat = {}
pearson_cormat_est = {}
for col in data.columns:
    cormat[col] = str(ro.r('cor.test(data$a3, data$' + str(col) + ')'))
    pearson_cormat_est[col] = np.array(ro.r('cor.test(data$a3, data$' + str(col) + ')$estimate'))[0]

for key in np.sort(list(cormat.keys())):
    print('-'*80)
    print(cols[int(key[1:])])
    print(cormat[key])
    print('-'*80)
```

```
--------------------------------------------------------------------------------
Год основания авиакомпании
```

Pearson's product-moment correlation

data: data$a3 and data$a0
t = -2.1512, df = 50, p-value = 0.03632
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.52245833 -0.01972283
sample estimates:
       cor
-0.2910566

Время существования авиакомпании (лет)

Pearson's product-moment correlation

data: data$a3 and data$a1
t = 2.1512, df = 50, p-value = 0.03632
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.01972283 0.52245833
sample estimates:
      cor
0.2910566

Работники (тыс. чел)

Pearson's product-moment correlation

data: data$a3 and data$a10
t = 9.4164, df = 50, p-value = 1.169e-12
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.6737737 0.8804154
sample estimates:
      cor
0.7996415

Выручка (млрд. долл)

Pearson's product-moment correlation

data: data$a3 and data$a11
t = 6.06, df = 50, p-value = 1.766e-07
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.4594177 0.7843447
sample estimates:
      cor
0.6507323

Издержки (млрд. долл)

Pearson's product-moment correlation

data: data$a3 and data$a12
t = 6.0672, df = 50, p-value = 1.721e-07
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.4600331 0.7846448
sample estimates:
     cor
0.651182

Страна_Country

Pearson's product-moment correlation

data: data$a3 and data$a13
t = NA, df = 50, p-value = NA
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 NA NA
sample estimates:
cor
 NA

Страна_Австралия

Pearson's product-moment correlation

data: data$a3 and data$a14
t = -0.67981, df = 50, p-value = 0.4998
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3592172 0.1819540
sample estimates:
       cor
-0.09569828

Страна_Бразилия

Pearson's product-moment correlation

data: data$a3 and data$a15
t = -0.22916, df = 50, p-value = 0.8197
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3026171 0.2426535
sample estimates:
       cor
-0.03239179

Страна_Великобритания

Pearson's product-moment correlation

data: data$a3 and data$a16
t = -1.0418, df = 50, p-value = 0.3025
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.4026488 0.1324016
sample estimates:
       cor
-0.1457656

Страна_Германия

Pearson's product-moment correlation

data: data$a3 and data$a17
t = 0.10981, df = 50, p-value = 0.913
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.2584683 0.2872105
sample estimates:
      cor
0.0155272

Страна_Ирландия

Pearson's product-moment correlation

data: data$a3 and data$a18
t = 0.52701, df = 50, p-value = 0.6005
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.2026878 0.3403212
sample estimates:
      cor
0.07432363

Страна_Испания

Pearson's product-moment correlation

data: data$a3 and data$a19
t = -0.4133, df = 50, p-value = 0.6812
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3260579 0.2180224
sample estimates:
      cor
-0.0583496

Развитая

Pearson's product-moment correlation

data: data$a3 and data$a2
t = 2.3069, df = 50, p-value = 0.02524
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.04070609 0.53756050
sample estimates:
      cor
0.3101609

Страна_Италия

Pearson's product-moment correlation

data: data$a3 and data$a20
t = -0.22236, df = 50, p-value = 0.8249
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3017426 0.2435590
sample estimates:
       cor
-0.03143039

Страна_Канада

Pearson's product-moment correlation

data: data$a3 and data$a21
t = -0.29828, df = 50, p-value = 0.7667
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3114633 0.2334399
sample estimates:
       cor
-0.04214527

Страна_Катар

Pearson's product-moment correlation

data: data$a3 and data$a22
t = -0.63265, df = 50, p-value = 0.5298
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3534198 0.1883669
sample estimates:
       cor
-0.0891144

Страна_Китай

Pearson's product-moment correlation

data: data$a3 and data$a23
t = 0.90866, df = 50, p-value = 0.3679
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1506852 0.3868992
sample estimates:
      cor
0.1274564

Страна_Малайзия

Pearson's product-moment correlation

data: data$a3 and data$a24
t = -0.60515, df = 50, p-value = 0.5478
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3500241 0.1921017
sample estimates:
       cor
-0.0852688

Страна_Новая Зеландия

Pearson's product-moment correlation

data: data$a3 and data$a25
t = -0.86773, df = 50, p-value = 0.3897
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3820046 0.1562935
sample estimates:
      cor
-0.121802

Страна_Португалия

Pearson's product-moment correlation

data: data$a3 and data$a26
t = -0.80526, df = 50, p-value = 0.4245
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3744862 0.1648410
sample estimates:
      cor
-0.1131494

Страна_Россия

Pearson's product-moment correlation

data: data$a3 and data$a27
t = -1.3285, df = 50, p-value = 0.19
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.43560047 0.09293272
sample estimates:
      cor
-0.1846506

Страна_США

Pearson's product-moment correlation

data: data$a3 and data$a28
t = 5.364, df = 50, p-value = 2.091e-06
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.3969318 0.7530621
sample estimates:
      cor
0.6043655

Страна_Сауд. Аравия

Pearson's product-moment correlation

data: data$a3 and data$a29
t = -0.35867, df = 50, p-value = 0.7214
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3191466 0.2253574
sample estimates:
       cor
-0.05065839

Кол-во воздушных судов, шт.

Pearson's product-moment correlation

data: data$a3 and data$a3
t = Inf, df = 50, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 1 1
sample estimates:
cor
  1

Страна_Сингапур

Pearson's product-moment correlation

data: data$a3 and data$a30
t = -0.42697, df = 50, p-value = 0.6712
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3277813 0.2161838
sample estimates:
       cor
-0.0602724

Страна_Страна

Pearson's product-moment correlation

data: data$a3 and data$a31
t = NA, df = 50, p-value = NA
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 NA NA
sample estimates:
cor
 NA

Страна_Таиланд

Pearson's product-moment correlation

data: data$a3 and data$a32
t = -0.56394, df = 50, p-value = 0.5753
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3449175 0.1976889
sample estimates:
       cor
-0.0795004

Страна_Тайвань

Pearson's product-moment correlation

data: data$a3 and data$a33
t = -1.1227, df = 50, p-value = 0.2669
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.4120707 0.1212868
sample estimates:
       cor
-0.1568036

Страна_Турция

Pearson's product-moment correlation

data: data$a3 and data$a34
t = -0.31092, df = 50, p-value = 0.7572
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3130757 0.2317500
sample estimates:
        cor
-0.04392859

Страна_Франция

Pearson's product-moment correlation

data: data$a3 and data$a35
t = 1.3446, df = 50, p-value = 0.1848
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.09071763 0.43740875
sample estimates:
      cor
0.1868075

Страна_Чили

Pearson's product-moment correlation

data: data$a3 and data$a36
t = -0.79833, df = 50, p-value = 0.4285
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3736486 0.1657881
sample estimates:
      cor
-0.112188

Страна_Швейцария

Pearson's product-moment correlation

data: data$a3 and data$a37
t = -0.77063, df = 50, p-value = 0.4446
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3702944 0.1695716
sample estimates:
      cor
-0.1083424

Страна_Швеция

Pearson's product-moment correlation

data: data$a3 and data$a38
t = -0.16791, df = 50, p-value = 0.8673
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.2947301 0.2507858
sample estimates:
       cor
-0.02373919

Страна_ЮАР

Pearson's product-moment correlation

data: data$a3 and data$a39
t = -0.83994, df = 50, p-value = 0.4049
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3786673 0.1600975
sample estimates:
       cor
-0.1179564

Количество направлений (регулярных рейсов)

Pearson's product-moment correlation

data: data$a3 and data$a4
t = 8.0102, df = 50, p-value = 1.604e-10
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.5994245 0.8489101
sample estimates:
      cor
0.7496884

Страна_Южная Корея

Pearson's product-moment correlation

data: data$a3 and data$a40
t = -0.71922, df = 50, p-value = 0.4754
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3640383 0.1765858
sample estimates:
       cor
-0.1011909

Страна_Япония

Pearson's product-moment correlation

data: data$a3 and data$a41
t = -0.094117, df = 50, p-value = 0.9254
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.2851736 0.2605376
sample estimates:
       cor
-0.01330903

Страна_nan

Pearson's product-moment correlation

data: data$a3 and data$a42
t = NA, df = 50, p-value = NA
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 NA NA
sample estimates:
cor
 NA

Альянс_Alliance

Pearson's product-moment correlation

data: data$a3 and data$a43
t = NA, df = 50, p-value = NA
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 NA NA
sample estimates:
cor
 NA

Альянс_Oneworld

Pearson's product-moment correlation

data: data$a3 and data$a44
t = 0.24458, df = 50, p-value = 0.8078
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.2406022 0.3045948
sample estimates:
      cor
0.0345679

Альянс_SkyTeam

Pearson's product-moment correlation

data: data$a3 and data$a45
t = 2.3013, df = 50, p-value = 0.02558
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.03994997 0.53702179
sample estimates:
      cor
0.3094763

Альянс_Star Alliance

Pearson's product-moment correlation

data: data$a3 and data$a46
t = -0.28239, df = 50, p-value = 0.7788
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3094343 0.2355619
sample estimates:
       cor
-0.03990367

Альянс_Альянс

Pearson's product-moment correlation

data: data$a3 and data$a47
t = NA, df = 50, p-value = NA
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 NA NA
sample estimates:
cor
 NA

Альянс_nan

Pearson's product-moment correlation

data: data$a3 and data$a48
t = -1.3593, df = 50, p-value = 0.1802
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.43905866 0.08869198
sample estimates:
       cor
-0.1887775

Пассажиро-оборот, млн. пасс-км

Pearson's product-moment correlation

data: data$a3 and data$a5
t = 12.343, df = 50, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.7793487 0.9222235
sample estimates:
      cor
0.8677022

Кол-во пассажиров, млн. чел.

Pearson's product-moment correlation

data: data$a3 and data$a6
t = 20.33, df = 50, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.9048224 0.9679162
sample estimates:
      cor
0.9445007

Грузоперевозки, млн.т-км

Pearson's product-moment correlation

data: data$a3 and data$a7
t = -0.85295, df = 50, p-value = 0.3978
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.3802310 0.1583171
sample estimates:
       cor
-0.1197573

Лет без катастроф (с 1973 г.)

Pearson's product-moment correlation

data: data$a3 and data$a8
t = -1.307, df = 50, p-value = 0.1972
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.43317483 0.09589586
sample estimates:
       cor
-0.1817611

Жертвы авиакатастроф (с 1973 г.)

```
        Pearson's product-moment correlation

data:  data$a3 and data$a9
t = 1.1882, df = 50, p-value = 0.2403
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.1122570  0.4196421
sample estimates:
      cor
0.1657202
```

```
In [15]: cormat = {}
         for col in data.columns:
             cormat[col] = str(ro.r('cor.test(data$a3, data$' + str(col) + ', method="spearman")'))

         for key in np.sort(list(cormat.keys())):
             print('-'*80)
             print(cols[int(key[1:])])
             print(cormat[key])
             print('-'*80)
```

```
Год основания авиакомпании

        Spearman's rank correlation rho

data:  data$a3 and data$a0
S = 29296, p-value = 0.07316
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.2505926
```

```
Время существования авиакомпании (лет)

        Spearman's rank correlation rho

data:  data$a3 and data$a1
S = 17556, p-value = 0.07316
alternative hypothesis: true rho is not equal to 0
```

sample estimates:
rho
0.2505926

Работники (тыс. чел)

Spearman's rank correlation rho

data: data$a3 and data$a10
S = 6897.2, p-value = 5.185e-09
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.705576

Выручка (млрд. долл)

Spearman's rank correlation rho

data: data$a3 and data$a11
S = 7269.9, p-value = 1.562e-08
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.689664

Издержки (млрд. долл)

Spearman's rank correlation rho

data: data$a3 and data$a12
S = 7610.3, p-value = 4.029e-08
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.6751345

Страна_Country

	Spearman's rank correlation rho

data: data$a3 and data$a13
S = NA, p-value = NA
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
 NA

Страна_Австралия

	Spearman's rank correlation rho

data: data$a3 and data$a14
S = 25143, p-value = 0.6056
alternative hypothesis: true rho is not equal to 0
sample estimates:
	rho
-0.07329263

Страна_Бразилия

	Spearman's rank correlation rho

data: data$a3 and data$a15
S = 22661, p-value = 0.8182
alternative hypothesis: true rho is not equal to 0
sample estimates:
	rho
0.03265507

Страна_Великобритания

	Spearman's rank correlation rho

data: data$a3 and data$a16

S = 27652, p-value = 0.2007
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.1803773

Страна_Германия

        Spearman's rank correlation rho

data: data$a3 and data$a17
S = 21865, p-value = 0.6388
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.06662966

Страна_Ирландия

        Spearman's rank correlation rho

data: data$a3 and data$a18
S = 20257, p-value = 0.3389
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.1352853

Страна_Испания

        Spearman's rank correlation rho

data: data$a3 and data$a19
S = 24410, p-value = 0.7676
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.04198508

Развитая

	Spearman's rank correlation rho

data: data$a3 and data$a2
S = 15590, p-value = 0.01536
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.3344886

Страна_Италия

	Spearman's rank correlation rho

data: data$a3 and data$a20
S = 22442, p-value = 0.7676
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.04198508

Страна_Канада

	Spearman's rank correlation rho

data: data$a3 and data$a21
S = 23114, p-value = 0.9253
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.01332593

Страна_Катар

	Spearman's rank correlation rho

data: data$a3 and data$a22
S = 25939, p-value = 0.449
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.1072952

Страна_Китай

        Spearman's rank correlation rho

data: data$a3 and data$a23
S = 18244, p-value = 0.1151
alternative hypothesis: true rho is not equal to 0
sample estimates:
     rho
0.2211948

Страна_Малайзия

        Spearman's rank correlation rho

data: data$a3 and data$a24
S = 25721, p-value = 0.4896
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.0979652

Страна_Новая Зеландия

        Spearman's rank correlation rho

data: data$a3 and data$a25
S = 28344, p-value = 0.1353
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho

-0.2099254

Страна_Португалия

Spearman's rank correlation rho

data: data$a3 and data$a26
S = 27688, p-value = 0.1967
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
-0.1819354

Страна_Россия

Spearman's rank correlation rho

data: data$a3 and data$a27
S = 29799, p-value = 0.05107
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
-0.2720283

Страна_США

Spearman's rank correlation rho

data: data$a3 and data$a28
S = 11189, p-value = 7.117e-05
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.5223885

Страна_Сауд. Аравия

Spearman's rank correlation rho

data: data$a3 and data$a29
S = 23972, p-value = 0.8696
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.02332505

Кол-во воздушных судов, шт.

Spearman's rank correlation rho

data: data$a3 and data$a3
S = 2.6008e-12, p-value < 2.2e-16
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
  1

Страна_Сингапур

Spearman's rank correlation rho

data: data$a3 and data$a30
S = 24628, p-value = 0.7179
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
-0.0513151

Страна_Страна

Spearman's rank correlation rho

data: data$a3 and data$a31
S = NA, p-value = NA
alternative hypothesis: true rho is not equal to 0

sample estimates:
rho
 NA

Страна_Таиланд

	Spearman's rank correlation rho

data: data$a3 and data$a32
S = 25284, p-value = 0.5763
alternative hypothesis: true rho is not equal to 0
sample estimates:
	rho
-0.07930516

Страна_Тайвань

	Spearman's rank correlation rho

data: data$a3 and data$a33
S = 28889, p-value = 0.09615
alternative hypothesis: true rho is not equal to 0
sample estimates:
	rho
-0.2332038

Страна_Турция

	Spearman's rank correlation rho

data: data$a3 and data$a34
S = 23535, p-value = 0.9738
alternative hypothesis: true rho is not equal to 0
sample estimates:
	 rho
-0.004665009

Страна_Франция

	Spearman's rank correlation rho

data: data$a3 and data$a35
S = 18508, p-value = 0.1353
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.2099254

Страна_Чили

	Spearman's rank correlation rho

data: data$a3 and data$a36
S = 27469, p-value = 0.2211
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.1726053

Страна_Швейцария

	Spearman's rank correlation rho

data: data$a3 and data$a37
S = 27032, p-value = 0.2759
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.1539453

Страна_Швеция

	Spearman's rank correlation rho

data: data$a3 and data$a38

S = 22224, p-value = 0.7179
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.0513151

Страна_ЮАР

        Spearman's rank correlation rho

data: data$a3 and data$a39
S = 28125, p-value = 0.1539
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.2005954

Количество направлений (регулярных рейсов)

        Spearman's rank correlation rho

data: data$a3 and data$a4
S = 7082.2, p-value = 9.044e-09
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.6976774

Страна_Южная Корея

        Spearman's rank correlation rho

data: data$a3 and data$a40
S = 25455, p-value = 0.5415
alternative hypothesis: true rho is not equal to 0
sample estimates:
        rho
-0.08661856

Страна_Япония

	Spearman's rank correlation rho

data: data$a3 and data$a41
S = 20773, p-value = 0.424
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.1132704

Страна_nan

	Spearman's rank correlation rho

data: data$a3 and data$a42
S = NA, p-value = NA
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
 NA

Альянс_Alliance

	Spearman's rank correlation rho

data: data$a3 and data$a43
S = NA, p-value = NA
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
 NA

Альянс_Oneworld

	Spearman's rank correlation rho

data: data$a3 and data$a44
S = 23509, p-value = 0.9801
alternative hypothesis: true rho is not equal to 0
sample estimates:
        rho
-0.003551373

Альянс_SkyTeam

        Spearman's rank correlation rho

data: data$a3 and data$a45
S = 17413, p-value = 0.06623
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.2566806

Альянс_Star Alliance

        Spearman's rank correlation rho

data: data$a3 and data$a46
S = 22562, p-value = 0.7952
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
0.03687592

Альянс_Альянс

        Spearman's rank correlation rho

data: data$a3 and data$a47
S = NA, p-value = NA
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho

NA

Альянс_nan

Spearman's rank correlation rho

data: data$a3 and data$a48
S = 28106, p-value = 0.1556
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
-0.1997738

Пассажиро-оборот, млн. пасс-км

Spearman's rank correlation rho

data: data$a3 and data$a5
S = 4910, p-value < 2.2e-16
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.7904038

Кол-во пассажиров, млн. чел.

Spearman's rank correlation rho

data: data$a3 and data$a6
S = 1175.1, p-value < 2.2e-16
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
0.9498399

Грузоперевозки, млн.т-км

```
        Spearman's rank correlation rho

data:  data$a3 and data$a7
S = 26889, p-value = 0.2956
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.1478255
```

Лет без катастроф (с 1973 г.)

```
        Spearman's rank correlation rho

data:  data$a3 and data$a8
S = 28457, p-value = 0.1263
alternative hypothesis: true rho is not equal to 0
sample estimates:
       rho
-0.2147474
```

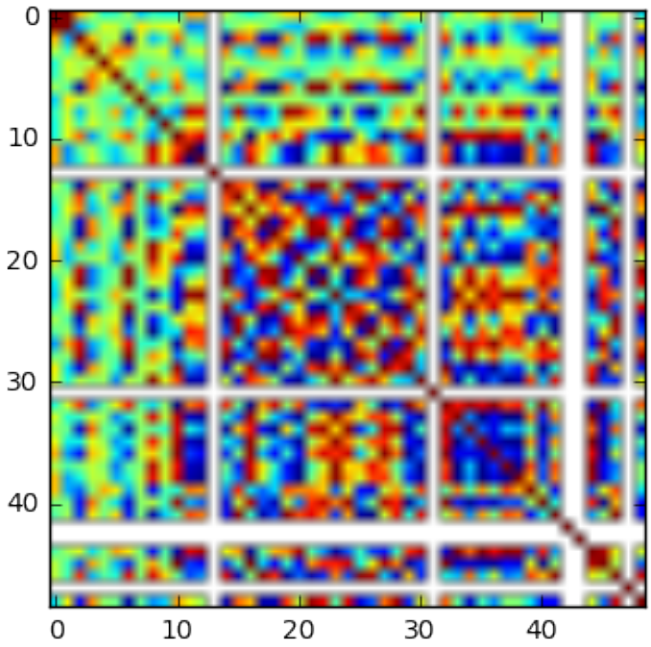
Жертвы авиакатастроф (с 1973 г.)

```
        Spearman's rank correlation rho

data:  data$a3 and data$a9
S = 20485, p-value = 0.3753
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.1255239
```

In [16]:
```
pcor = np.array((ro.r('pcor(data)$estimate')))
```

In [17]:
```
plt.imshow(pcor)
plt.show()
```




```
In [18]: cormat = {}
         for i, cor in enumerate(pcor[3]):
             cormat['a'+str(i)] = ('{}\n\nPartial: {}\n'.format(cols[i], cor))

         for key in np.sort(list(cormat.keys())):
             print('-'*80)
             print(cormat[key])
             print('Pearson: {}'.format(pearson_cormat_est[key]))
             print('-'*80)
```

Год основания авиакомпании

Partial: 0.14663183592790408

Pearson: -0.2910565791518727

Время существования авиакомпании (лет)

Partial: -0.1466318359298795

Pearson: 0.2910565791518727

Работники (тыс. чел)

Partial: -0.43219890804946365

Pearson: 0.7996415203640224

Выручка (млрд. долл)

Partial: 0.1232320861247087

Pearson: 0.6507322907554649

Издержки (млрд. долл)

Partial: 0.19776626223277413

Pearson: 0.6511819893630253

Страна_Country

Partial: nan

Pearson: nan

Страна_Австралия

Partial: 0.5439008324728745

Pearson: -0.09569828043415263

Страна_Бразилия

Partial: -0.2743979425518142

Pearson: -0.03239179112662253

Страна_Великобритания

Partial: -0.39631199517269305

Pearson: -0.14576559678562742

Страна_Германия

Partial: 0.5096014781776824

Pearson: 0.015527204441302908

Страна_Ирландия

Partial: 0.5619561088115644

Pearson: 0.07432363032478456

Страна_Испания

Partial: -0.2850286282649352

Pearson: -0.05834959634453236

Развитая

Partial: 0.4132392501756838

Pearson: 0.3101609207086134

Страна_Италия

Partial: 0.07792849651365573

Pearson: -0.03143039093336661

Страна_Канада

Partial: -0.5127442064203358

Pearson: -0.04214526919782218

Страна_Катар

Partial: -0.5043017092478751

Pearson: -0.08911440252872178

Страна_Китай

Partial: -0.1317789101347356

Pearson: 0.12745638460988126

Страна_Малайзия

Partial: -0.5508917655096232

Pearson: -0.0852688017556981

Страна_Новая Зеландия

Partial: 0.4067594681005189

Pearson: -0.12180200909942307

Страна_Португалия

Partial: 0.1901847933164711

Pearson: -0.11314940736011977

Страна_Россия

Partial: -0.42516759460079645

Pearson: -0.18465058590611305

Страна_США

Partial: -0.5541695370701234

Pearson: 0.6043655300637485

Страна_Сауд. Аравия

Partial: 0.4898186154667179

Pearson: -0.050658394798485

Кол-во воздушных судов, шт.

Partial: 1.0

Pearson: 1.0

Страна_Сингапур

Partial: 0.02596586189882228

Pearson: -0.0602723967310442

Страна_Страна

Partial: nan

Pearson: nan

Страна_Таиланд

Partial: -0.4965021207088145

Pearson: -0.07950040059616259

Страна_Тайвань

Partial: 0.2342000397157452

Pearson: -0.15680363940893993

Страна_Турция

Partial: 0.6128690503865318

Pearson: -0.04392859344569357

Страна_Франция

Partial: 0.25959215735963453

Pearson: 0.18680745293572715

Страна_Чили

Partial: 0.392557635803088

Pearson: -0.11218800716686386

Страна_Швейцария

Partial: 0.1761948668224104

Pearson: -0.10834240639384018

Страна_Швеция

Partial: 0.1525515118310056

Pearson: -0.02373918938731925

Страна_ЮАР

Partial: 0.018946703263343728

Pearson: -0.11795640832639938

Количество направлений (регулярных рейсов)

Partial: 0.161126501777533

Pearson: 0.7496884428488443

Страна_Южная Корея

Partial: 0.582801796837711

Pearson: -0.10119089697121215

Страна_Япония

Partial: 0.3158858877686211

Pearson: -0.013309032378259636

Страна_nan

Partial: nan

Pearson: nan

Альянс_Alliance

Partial: nan

Pearson: nan

Альянс_Oneworld

Partial: -0.31039115767317677

Pearson: 0.03456789832431767

Альянс_SkyTeam

Partial: 0.47365932862582755

Pearson: 0.30947627130216926

Альянс_Star Alliance

Partial: -0.38390855940348406

Pearson: -0.03990366567742098

Альянс_Альянс

Partial: nan

Pearson: nan

Альянс_nan

Partial: 0.5323825059349568

Pearson: -0.1887775236871775

Пассажиро-оборот, млн. пасс-км

Partial: 0.564436679916233

Pearson: 0.8677021865322986

Кол-во пассажиров, млн. чел.

Partial: 0.5343692190224151

Pearson: 0.9445006671921536

Грузоперевозки, млн.т-км

Partial: 0.11024161629471577

Pearson: -0.11975726339661222

Лет без катастроф (с 1973 г.)

Partial: 0.11116684370194113

Pearson: -0.18176114615118646

Жертвы авиакатастроф (с 1973 г.)

Partial: 0.21242376637340596

Pearson: 0.16572016125019973

In [ ]: