

Clases - Semana 3

December 4, 2020

1 Merging Dataframes

```
[1]: import pandas as pd

[14]: staff_df = pd.DataFrame([{'Name': 'Kelly', 'Role': 'Director of HR'},
                               {'Name': 'Sally', 'Role': 'Course liasion'},
                               {'Name': 'James', 'Role': 'Grader'}])
staff_df = staff_df.set_index('Name')

student_df = pd.DataFrame([{'Name': 'James', 'School': 'Business'},
                             {'Name': 'Mike', 'School': 'Law'},
                             {'Name': 'Sally', 'School': 'Engineering'}])
student_df = student_df.set_index('Name')

print(staff_df)
print(student_df)
```

	Role
Name	
Kelly	Director of HR
Sally	Course liasion
James	Grader

	School
Name	
James	Business
Mike	Law
Sally	Engineering

- Si quiero la union de estos dos grupos tengo que usar merge() e indicar 'outer'. Ademas indico que quiero los dos indices, tanto del df de la izquierda como del de la derecha.

```
[7]: pd.merge(staff_df, student_df, how = 'outer', left_index = True, right_index = True )
```

```
[7]:
```

	Role	School
Name		
James	Grader	Business
Kelly	Director of HR	NaN

Mike	NaN	Law
Sally	Course liasion	Engineering

- Si quiero la interseccion de estos dos grupos tengo que usar merge() e indicar 'inner'.

```
[8]: pd.merge(staff_df, student_df, how = 'inner', left_index = True, right_index = True)
```

```
[8]:
```

	Role	School
Name		
Sally	Course liasion	Engineering
James	Grader	Business

- Si quiero todos los de staff tengo que usar merge() e indicar 'left'. Es muy importante la posicion en que se ponen en el merge, el primero es left y el segundo es right.

```
[9]: pd.merge(staff_df, student_df, how = 'left', left_index = True, right_index = True)
```

```
[9]:
```

	Role	School
Name		
Kelly	Director of HR	NaN
Sally	Course liasion	Engineering
James	Grader	Business

- Si quiero todos los estudiantes tengo que usar merge() e indicar 'right'. Es muy importante la posicion en que se ponen en el merge, el primero es left y el segundo es right.

```
[10]: pd.merge(staff_df, student_df, how = 'right', left_index = True, right_index = True)
```

```
[10]:
```

	Role	School
Name		
James	Grader	Business
Mike	NaN	Law
Sally	Course liasion	Engineering

```
[15]: #con merge tambien se puede indicar el indice. Vamos a borrar los indices
      →actuales para mostrar un ejemplo de esto:

staff_df = staff_df.reset_index()
student_df = student_df.reset_index()

pd.merge(staff_df, student_df, how='right', on='Name') #con el 'on' indico el
      →indice. 'Name' tiene que existir en ambos df
```

```
[15]:
```

	Name	Role	School
0	Sally	Course liasion	Engineering
1	James	Grader	Business

2 Mike NaN Law

```
[17]: #agregamos una ubicacion a los df. En este caso vamos a tener dos ubicaciones
      ↪ para los que son estudiantes y del staff, por eso
      #va a aparecer _x y _y. _x significa el df de la izquierda y _y el df de la
      ↪ derecha.
      staff_df = pd.DataFrame([{'Name': 'Kelly', 'Role': 'Director of HR', 'Location':
      ↪ 'State Street'},
                               {'Name': 'Sally', 'Role': 'Course liasion', 'Location':
      ↪ 'Washinnton Avenue'},
                               {'Name': 'James', 'Role': 'Grader', 'Location':
      ↪ 'Washinnton Avenue'}])

      student_df = pd.DataFrame([{'Name': 'James', 'School': 'Business', 'Location':
      ↪ '1024 Billiard Avenue'},
                                   {'Name': 'Mike', 'School': 'Law', 'Location':
      ↪ 'Fraternity House #22'},
                                   {'Name': 'Sally', 'School': 'Engineering',
      ↪ 'Location': '512 Wilson Crescent'}])

      pd.merge(staff_df, student_df, how='left', on='Name') #obtengo todos los de
      ↪ staff
```

```
[17]:      Name      Role      Location_x      School      Location_y
0  Kelly  Director of HR      State Street      NaN      NaN
1  Sally  Course liasion  Washinnton Avenue  Engineering  512 Wilson Crescent
2  James      Grader  Washinnton Avenue      Business  1024 Billiard Avenue
```

```
[2]: #ahora vamos a agregar un apellido a los df para luego indexar con una lista:

      staff_df = pd.DataFrame([{'First Name': 'Kelly', 'Last Name': 'Desjardins',
      ↪ 'Role': 'Director of HR'},
                               {'First Name': 'Sally', 'Last Name': 'Brooks', 'Role':
      ↪ 'Course liasion'},
                               {'First Name': 'James', 'Last Name': 'Wilde', 'Role':
      ↪ 'Grader'}])

      student_df = pd.DataFrame([{'First Name': 'James', 'Last Name': 'Hammond',
      ↪ 'School': 'Business'},
                                   {'First Name': 'Mike', 'Last Name': 'Smith',
      ↪ 'School': 'Law'},
                                   {'First Name': 'Sally', 'Last Name': 'Brooks',
      ↪ 'School': 'Engineering'}])

      #en este caso la unica que es estudiante y de staff es Sally, para ver eso hago
      ↪ un inner:
```

```
pd.merge(staff_df, student_df, how='inner', on=['First Name', 'Last Name'])
```

```
[2]: First Name Last Name          Role          School
0      Sally    Brooks  Course liasion  Engineering
```

```
[19]: #merge es agregar horizontalmente y concat es agregar verticalmente. Vamos a
      → juntar 3 archivos que tienen las mismas columnas
      #pero son de años distintos con concat.
```

```
[9]: %%capture
df_2011 = pd.read_csv('MERGED2011_12_PP.csv', error_bad_lines=False) #el
      → capture es para que no tire un error raro
df_2012 = pd.read_csv('MERGED2012_13_PP.csv', error_bad_lines=False) #el head
      → lo tengo que poner en otra celda, no se por que
df_2013 = pd.read_csv('MERGED2013_14_PP.csv', error_bad_lines=False)
```

```
[11]: df_2011.head(3)
```

```
[11]: UNITID      OPEID OPEID6          INSTNM \
0  100654.0  100200.0  1002      Alabama A & M University
1  100663.0  105200.0  1052  University of Alabama at Birmingham
2  100690.0  2503400.0  25034      Amridge University
```

```
      CITY STABBR      ZIP  ACCREDITAGENCY INSTURL NPCURL  ... \
0      Normal    AL      35762          NaN    NaN    NaN  ...
1  Birmingham    AL  35294-0110          NaN    NaN    NaN  ...
2  Montgomery    AL  36117-3553          NaN    NaN    NaN  ...
```

```
      OMAWDP8_NOTFIRSTTIME_POOLED_SUPP OMENRUP_NOTFIRSTTIME_POOLED_SUPP \
0          NaN          NaN
1          NaN          NaN
2          NaN          NaN
```

```
      OMENRYP_FULLTIME_POOLED_SUPP OMENRAP_FULLTIME_POOLED_SUPP \
0          NaN          NaN
1          NaN          NaN
2          NaN          NaN
```

```
      OMAWDP8_FULLTIME_POOLED_SUPP OMENRUP_FULLTIME_POOLED_SUPP \
0          NaN          NaN
1          NaN          NaN
2          NaN          NaN
```

```
      OMENRYP_PARTTIME_POOLED_SUPP OMENRAP_PARTTIME_POOLED_SUPP \
0          NaN          NaN
1          NaN          NaN
2          NaN          NaN
```

```
      OMAWDP8_PARTTIME_POOLED_SUPP OMENRUP_PARTTIME_POOLED_SUPP
```

0	NaN	NaN
1	NaN	NaN
2	NaN	NaN

[3 rows x 1977 columns]

```
[12]: print(len(df_2011))
print(len(df_2012))
print(len(df_2013))
```

15235
7793
7804

```
[13]: #creo una lista con los df y despues uso la funcion concat:
frames = [df_2011, df_2012, df_2013]
pd.concat(frames)
```

```
[13]:
```

	UNITID	OPEID	OPEID6	\
0	100654.0	100200.0	1002	
1	100663.0	105200.0	1052	
2	100690.0	2503400.0	25034	
3	100706.0	105500.0	1055	
4	100724.0	100500.0	1005	
...	
7799	48285703.0	157107.0	1571	
7800	48285704.0	157101.0	1571	
7801	48285705.0	157105.0	1571	
7802	48285706.0	157100.0	1571	
7803	48285707.0	157103.0	1571	

	INSTNM	CITY	STABBR	\
0	Alabama A & M University	Normal	AL	
1	University of Alabama at Birmingham	Birmingham	AL	
2	Amridge University	Montgomery	AL	
3	University of Alabama in Huntsville	Huntsville	AL	
4	Alabama State University	Montgomery	AL	
...	
7799	Georgia Military College-Columbus Campus	Columbus	GA	
7800	Georgia Military College-Valdosta Campus	Valdosta	GA	
7801	Georgia Military College-Warner Robins Campus	Warner Robins	GA	
7802	Georgia Military College-Online	Milledgeville	GA	
7803	Georgia Military College-Stone Mountain	Stone Mountain	GA	

	ZIP	ACCREDITED AGENCY	INSTURL	NPCCURL	...	\
0	35762	NaN	NaN	NaN	...	
1	35294-0110	NaN	NaN	NaN	...	
2	36117-3553	NaN	NaN	NaN	...	

3	35899	NaN	NaN	NaN	...
4	36104-0271	NaN	NaN	NaN	...
...
7799	31909	NaN	NaN	NaN	...
7800	31605	NaN	NaN	NaN	...
7801	31093	NaN	NaN	NaN	...
7802	31061	NaN	NaN	NaN	...
7803	30083	NaN	NaN	NaN	...

	OMAWDP8_NOTFIRSTTIME_POOLED_SUPP	OMENRUP_NOTFIRSTTIME_POOLED_SUPP	\
0		NaN	NaN
1		NaN	NaN
2		NaN	NaN
3		NaN	NaN
4		NaN	NaN
...	
7799		NaN	NaN
7800		NaN	NaN
7801		NaN	NaN
7802		NaN	NaN
7803		NaN	NaN

	OMENRYP_FULLTIME_POOLED_SUPP	OMENRAP_FULLTIME_POOLED_SUPP	\
0		NaN	NaN
1		NaN	NaN
2		NaN	NaN
3		NaN	NaN
4		NaN	NaN
...	
7799		NaN	NaN
7800		NaN	NaN
7801		NaN	NaN
7802		NaN	NaN
7803		NaN	NaN

	OMAWDP8_FULLTIME_POOLED_SUPP	OMENRUP_FULLTIME_POOLED_SUPP	\
0		NaN	NaN
1		NaN	NaN
2		NaN	NaN
3		NaN	NaN
4		NaN	NaN
...	
7799		NaN	NaN
7800		NaN	NaN
7801		NaN	NaN
7802		NaN	NaN
7803		NaN	NaN

	OMENRYP_PARTTIME_POOLED_SUPP	OMENRAP_PARTTIME_POOLED_SUPP	\
0	NaN	NaN	
1	NaN	NaN	
2	NaN	NaN	
3	NaN	NaN	
4	NaN	NaN	
...	
7799	NaN	NaN	
7800	NaN	NaN	
7801	NaN	NaN	
7802	NaN	NaN	
7803	NaN	NaN	

	OMAWDP8_PARTTIME_POOLED_SUPP	OMENRUP_PARTTIME_POOLED_SUPP
0	NaN	NaN
1	NaN	NaN
2	NaN	NaN
3	NaN	NaN
4	NaN	NaN
...
7799	NaN	NaN
7800	NaN	NaN
7801	NaN	NaN
7802	NaN	NaN
7803	NaN	NaN

[30832 rows x 1977 columns]

```
[15]: #vamos a comprobar la cantidad de filas:
len(df_2011) + len(df_2012) + len(df_2013) #coincide con el concat hecho en la
→celda anterior
```

[15]: 30832

```
[16]: #en el concat puedo agregar keys para poder ver facilmente de que años es cada
→dato
pd.concat(frames, keys=['2011', '2012', '2013'])
```

```
[16]:
```

		UNITID	OPEID	OPEID6	\
2011	0	100654.0	100200.0	1002	
	1	100663.0	105200.0	1052	
	2	100690.0	2503400.0	25034	
	3	100706.0	105500.0	1055	
	4	100724.0	100500.0	1005	
...	
2013	7799	48285703.0	157107.0	1571	
	7800	48285704.0	157101.0	1571	
	7801	48285705.0	157105.0	1571	

7802	48285706.0	157100.0	1571
7803	48285707.0	157103.0	1571

		INSTNM	CITY \
2011	0	Alabama A & M University	Normal
	1	University of Alabama at Birmingham	Birmingham
	2	Amridge University	Montgomery
	3	University of Alabama in Huntsville	Huntsville
	4	Alabama State University	Montgomery
...	
2013	7799	Georgia Military College-Columbus Campus	Columbus
	7800	Georgia Military College-Valdosta Campus	Valdosta
	7801	Georgia Military College-Warner Robins Campus	Warner Robins
	7802	Georgia Military College-Online	Milledgeville
	7803	Georgia Military College-Stone Mountain	Stone Mountain

		STABBR	ZIP	ACCREDITAGENCY	INSTURL	NPCURL	... \
2011	0	AL	35762	NaN	NaN	NaN	...
	1	AL	35294-0110	NaN	NaN	NaN	...
	2	AL	36117-3553	NaN	NaN	NaN	...
	3	AL	35899	NaN	NaN	NaN	...
	4	AL	36104-0271	NaN	NaN	NaN	...
...	
2013	7799	GA	31909	NaN	NaN	NaN	...
	7800	GA	31605	NaN	NaN	NaN	...
	7801	GA	31093	NaN	NaN	NaN	...
	7802	GA	31061	NaN	NaN	NaN	...
	7803	GA	30083	NaN	NaN	NaN	...

		OMAWDP8_NOTFIRSTTIME_POOLED_SUPP	OMENRUP_NOTFIRSTTIME_POOLED_SUPP \
2011	0	NaN	NaN
	1	NaN	NaN
	2	NaN	NaN
	3	NaN	NaN
	4	NaN	NaN
...	
2013	7799	NaN	NaN
	7800	NaN	NaN
	7801	NaN	NaN
	7802	NaN	NaN
	7803	NaN	NaN

		OMENRYP_FULLTIME_POOLED_SUPP	OMENRAP_FULLTIME_POOLED_SUPP \
2011	0	NaN	NaN
	1	NaN	NaN
	2	NaN	NaN
	3	NaN	NaN

	4	NaN	NaN
...	
2013	7799	NaN	NaN
	7800	NaN	NaN
	7801	NaN	NaN
	7802	NaN	NaN
	7803	NaN	NaN
		OMAWDP8_FULLTIME_POOLED_SUPP	OMENRUP_FULLTIME_POOLED_SUPP \
2011	0	NaN	NaN
	1	NaN	NaN
	2	NaN	NaN
	3	NaN	NaN
	4	NaN	NaN
...	
2013	7799	NaN	NaN
	7800	NaN	NaN
	7801	NaN	NaN
	7802	NaN	NaN
	7803	NaN	NaN
		OMENRYP_PARTTIME_POOLED_SUPP	OMENRAP_PARTTIME_POOLED_SUPP \
2011	0	NaN	NaN
	1	NaN	NaN
	2	NaN	NaN
	3	NaN	NaN
	4	NaN	NaN
...	
2013	7799	NaN	NaN
	7800	NaN	NaN
	7801	NaN	NaN
	7802	NaN	NaN
	7803	NaN	NaN
		OMAWDP8_PARTTIME_POOLED_SUPP	OMENRUP_PARTTIME_POOLED_SUPP
2011	0	NaN	NaN
	1	NaN	NaN
	2	NaN	NaN
	3	NaN	NaN
	4	NaN	NaN
...	
2013	7799	NaN	NaN
	7800	NaN	NaN
	7801	NaN	NaN
	7802	NaN	NaN
	7803	NaN	NaN

[30832 rows x 1977 columns]

```
[17]: #concat tambien tiene los metodos 'outer' e 'inner'. Si los df no tienen las
      ↪ mismas columnas y se elije outer, algunas celdas
      #seran NaN. Si en el mismo caso elegimos inner, se tiraran algunos valores por
      ↪ no coincidir.
```

2 Pandas Idioms

```
[1]: import pandas as pd
import numpy as np
import timeit

df = pd.read_csv('census.csv')
df.head()
```

```
[1]: SUMLEV REGION DIVISION STATE COUNTY STNAME CTYNAME \
0 40 3 6 1 0 Alabama Alabama
1 50 3 6 1 1 Alabama Autauga County
2 50 3 6 1 3 Alabama Baldwin County
3 50 3 6 1 5 Alabama Barbour County
4 50 3 6 1 7 Alabama Bibb County

CENSUS2010POP ESTIMATESBASE2010 POPESTIMATE2010 ... RDOMESTICMIG2011 \
0 4779736 4780127 4785161 ... 0.002295
1 54571 54571 54660 ... 7.242091
2 182265 182265 183193 ... 14.832960
3 27457 27457 27341 ... -4.728132
4 22915 22919 22861 ... -5.527043

RDOMESTICMIG2012 RDOMESTICMIG2013 RDOMESTICMIG2014 RDOMESTICMIG2015 \
0 -0.193196 0.381066 0.582002 -0.467369
1 -2.915927 -3.012349 2.265971 -2.530799
2 17.647293 21.845705 19.243287 17.197872
3 -2.500690 -7.056824 -3.904217 -10.543299
4 -5.068871 -6.201001 -0.177537 0.177258

RNETMIG2011 RNETMIG2012 RNETMIG2013 RNETMIG2014 RNETMIG2015
0 1.030015 0.826644 1.383282 1.724718 0.712594
1 7.606016 -2.626146 -2.722002 2.592270 -2.187333
2 15.844176 18.559627 22.727626 20.317142 18.293499
3 -4.874741 -2.758113 -7.167664 -3.978583 -10.543299
4 -5.088389 -4.363636 -5.403729 0.754533 1.107861
```

[5 rows x 100 columns]

```
[2]: #vamos a escribir funciones mas al estilo pandas:
(df.where(df['SUMLEV']==50) #le paso mascara con valores de sumlev igual a 50
  .dropna()                #elimino los valores que no correspondan segun la
  →mascara
  .set_index(['STNAME', 'CTYNAME']) #seteo los indices
  .rename(columns={'ESTIMATESBASE2010': 'Estimates Base 2010'})) #renombró
  →una columna

#para escribir codigo en multiples lineas hay que empezar con parentesis. De
→esta manera es mas legible
```

```
[2]:
```

		SUMLEV	REGION	DIVISION	STATE	COUNTY	\
STNAME	CTYNAME						
Alabama	Autauga County	50.0	3.0	6.0	1.0	1.0	
	Baldwin County	50.0	3.0	6.0	1.0	3.0	
	Barbour County	50.0	3.0	6.0	1.0	5.0	
	Bibb County	50.0	3.0	6.0	1.0	7.0	
	Blount County	50.0	3.0	6.0	1.0	9.0	
...		
Wyoming	Sweetwater County	50.0	4.0	8.0	56.0	37.0	
	Teton County	50.0	4.0	8.0	56.0	39.0	
	Uinta County	50.0	4.0	8.0	56.0	41.0	
	Washakie County	50.0	4.0	8.0	56.0	43.0	
	Weston County	50.0	4.0	8.0	56.0	45.0	

		CENSUS2010POP	Estimates Base 2010	\
STNAME	CTYNAME			
Alabama	Autauga County	54571.0	54571.0	
	Baldwin County	182265.0	182265.0	
	Barbour County	27457.0	27457.0	
	Bibb County	22915.0	22919.0	
	Blount County	57322.0	57322.0	
...		
Wyoming	Sweetwater County	43806.0	43806.0	
	Teton County	21294.0	21294.0	
	Uinta County	21118.0	21118.0	
	Washakie County	8533.0	8533.0	
	Weston County	7208.0	7208.0	

		POPESTIMATE2010	POPESTIMATE2011	POPESTIMATE2012	\
STNAME	CTYNAME				
Alabama	Autauga County	54660.0	55253.0	55175.0	
	Baldwin County	183193.0	186659.0	190396.0	
	Barbour County	27341.0	27226.0	27159.0	
	Bibb County	22861.0	22733.0	22642.0	
	Blount County	57373.0	57711.0	57776.0	
...		

Wyoming	Sweetwater County	43593.0	44041.0	45104.0
	Teton County	21297.0	21482.0	21697.0
	Uinta County	21102.0	20912.0	20989.0
	Washakie County	8545.0	8469.0	8443.0
	Weston County	7181.0	7114.0	7065.0

STNAME	CTYNAME	...	RDOMESTICMIG2011	RDOMESTICMIG2012	\
Alabama	Autauga County	...	7.242091	-2.915927	
	Baldwin County	...	14.832960	17.647293	
	Barbour County	...	-4.728132	-2.500690	
	Bibb County	...	-5.527043	-5.068871	
	Blount County	...	1.807375	-1.177622	
...		
Wyoming	Sweetwater County	...	1.072643	16.243199	
	Teton County	...	-1.589565	0.972695	
	Uinta County	...	-17.755986	-4.916350	
	Washakie County	...	-11.637475	-0.827815	
	Weston County	...	-11.752361	-8.040059	

STNAME	CTYNAME	...	RDOMESTICMIG2013	RDOMESTICMIG2014	\
Alabama	Autauga County		-3.012349	2.265971	
	Baldwin County		21.845705	19.243287	
	Barbour County		-7.056824	-3.904217	
	Bibb County		-6.201001	-0.177537	
	Blount County		-1.748766	-2.062535	
...		
Wyoming	Sweetwater County		-5.339774	-14.252889	
	Teton County		19.525929	14.143021	
	Uinta County		-6.902954	-14.215862	
	Washakie County		-2.013502	-17.781491	
	Weston County		12.372583	1.533635	

STNAME	CTYNAME	...	RDOMESTICMIG2015	RNETMIG2011	RNETMIG2012	\
Alabama	Autauga County		-2.530799	7.606016	-2.626146	
	Baldwin County		17.197872	15.844176	18.559627	
	Barbour County		-10.543299	-4.874741	-2.758113	
	Bibb County		0.177258	-5.088389	-4.363636	
	Blount County		-1.369970	1.859511	-0.848580	
...		
Wyoming	Sweetwater County		-14.248864	1.255221	16.243199	
	Teton County		-0.564849	0.654527	2.408578	
	Uinta County		-12.127022	-18.136812	-5.536861	
	Washakie County		1.682288	-11.990126	-1.182592	
	Weston County		6.935294	-12.032179	-8.040059	

STNAME	CTYNAME	RNETMIG2013	RNETMIG2014	RNETMIG2015
Alabama	Autauga County	-2.722002	2.592270	-2.187333
	Baldwin County	22.727626	20.317142	18.293499
	Barbour County	-7.167664	-3.978583	-10.543299
	Bibb County	-5.403729	0.754533	1.107861
	Blount County	-1.402476	-1.577232	-0.884411
...
Wyoming	Sweetwater County	-5.295460	-14.075283	-14.070195
	Teton County	21.160658	16.308671	1.520747
	Uinta County	-7.521840	-14.740608	-12.606351
	Washakie County	-2.250385	-18.020168	1.441961
	Weston County	12.372583	1.533635	6.935294

[3142 rows x 98 columns]

[3]: *#a continuacion hay otra manera de hacer lo mismo, pero de una forma menos*
→pandorable:

```
df = df[df['SUMLEV'] == 50]
df.set_index(['STNAME', 'CTYNAME'], inplace=True)
df.rename(columns={'ESTIMATESBASE2010': 'Estimates Base 2010'})
```

[3]:

		SUMLEV	REGION	DIVISION	STATE	COUNTY	\
STNAME	CTYNAME						
Alabama	Autauga County	50	3	6	1	1	
	Baldwin County	50	3	6	1	3	
	Barbour County	50	3	6	1	5	
	Bibb County	50	3	6	1	7	
	Blount County	50	3	6	1	9	
...	
Wyoming	Sweetwater County	50	4	8	56	37	
	Teton County	50	4	8	56	39	
	Uinta County	50	4	8	56	41	
	Washakie County	50	4	8	56	43	
	Weston County	50	4	8	56	45	

		CENSUS2010POP	Estimates Base 2010	\
STNAME	CTYNAME			
Alabama	Autauga County	54571	54571	
	Baldwin County	182265	182265	
	Barbour County	27457	27457	
	Bibb County	22915	22919	
	Blount County	57322	57322	
...	
Wyoming	Sweetwater County	43806	43806	
	Teton County	21294	21294	

Uinta County	21118	21118
Washakie County	8533	8533
Weston County	7208	7208

STNAME	CTYNAME	POPESTIMATE2010	POPESTIMATE2011	POPESTIMATE2012	\
Alabama	Autauga County	54660	55253	55175	
	Baldwin County	183193	186659	190396	
	Barbour County	27341	27226	27159	
	Bibb County	22861	22733	22642	
	Blount County	57373	57711	57776	
...	
Wyoming	Sweetwater County	43593	44041	45104	
	Teton County	21297	21482	21697	
	Uinta County	21102	20912	20989	
	Washakie County	8545	8469	8443	
	Weston County	7181	7114	7065	

STNAME	CTYNAME	...	RDOMESTICMIG2011	RDOMESTICMIG2012	\
Alabama	Autauga County	...	7.242091	-2.915927	
	Baldwin County	...	14.832960	17.647293	
	Barbour County	...	-4.728132	-2.500690	
	Bibb County	...	-5.527043	-5.068871	
	Blount County	...	1.807375	-1.177622	
...	
Wyoming	Sweetwater County	...	1.072643	16.243199	
	Teton County	...	-1.589565	0.972695	
	Uinta County	...	-17.755986	-4.916350	
	Washakie County	...	-11.637475	-0.827815	
	Weston County	...	-11.752361	-8.040059	

STNAME	CTYNAME	RDOMESTICMIG2013	RDOMESTICMIG2014	\
Alabama	Autauga County	-3.012349	2.265971	
	Baldwin County	21.845705	19.243287	
	Barbour County	-7.056824	-3.904217	
	Bibb County	-6.201001	-0.177537	
	Blount County	-1.748766	-2.062535	
...	
Wyoming	Sweetwater County	-5.339774	-14.252889	
	Teton County	19.525929	14.143021	
	Uinta County	-6.902954	-14.215862	
	Washakie County	-2.013502	-17.781491	
	Weston County	12.372583	1.533635	

RDOMESTICMIG2015	RNETMIG2011	RNETMIG2012	\
------------------	-------------	-------------	---

STNAME	CTYNAME			
Alabama	Autauga County	-2.530799	7.606016	-2.626146
	Baldwin County	17.197872	15.844176	18.559627
	Barbour County	-10.543299	-4.874741	-2.758113
	Bibb County	0.177258	-5.088389	-4.363636
	Blount County	-1.369970	1.859511	-0.848580
...	
Wyoming	Sweetwater County	-14.248864	1.255221	16.243199
	Teton County	-0.564849	0.654527	2.408578
	Uinta County	-12.127022	-18.136812	-5.536861
	Washakie County	1.682288	-11.990126	-1.182592
	Weston County	6.935294	-12.032179	-8.040059

		RNETMIG2013	RNETMIG2014	RNETMIG2015
STNAME	CTYNAME			
Alabama	Autauga County	-2.722002	2.592270	-2.187333
	Baldwin County	22.727626	20.317142	18.293499
	Barbour County	-7.167664	-3.978583	-10.543299
	Bibb County	-5.403729	0.754533	1.107861
	Blount County	-1.402476	-1.577232	-0.884411
...	
Wyoming	Sweetwater County	-5.295460	-14.075283	-14.070195
	Teton County	21.160658	16.308671	1.520747
	Uinta County	-7.521840	-14.740608	-12.606351
	Washakie County	-2.250385	-18.020168	1.441961
	Weston County	12.372583	1.533635	6.935294

[3142 rows x 98 columns]

[5]: *#ahora vamos a usar una funcion para colocar los dos codigos anteriores y luego*
→medir el tiempo de ejecucion para ver que manera
#es mas rapida:

```
def first_approach():
    global df
    return (df.where(df['SUMLEV']==50)
            .dropna()
            .set_index(['STNAME', 'CTYNAME'])
            .rename(columns={'ESTIMATESBASE2010': 'Estimates Base 2010'}))

df = pd.read_csv('census.csv')
timeit.timeit(first_approach, number=10) #lo uso para medir el tiempo
```

[5]: 0.512591764330864

[6]:

```
def second_approach():
    global df
    new_df = df[df['SUMLEV'] == 50]
```

```

new_df.set_index(['STNAME', 'CTYNAME'], inplace=True)
return new_df.rename(columns={'ESTIMATESBASE2010': 'Estimates Base 2010'})

df = pd.read_csv('census.csv')
timeit.timeit(second_approach, number=10)

```

[6]: 0.051063138991594315

[7]: *#es importante conocer el metodo de encadenamiento (el primer ejemplo) porque
→ se usa mucho, pero tambien hay que tener en cuenta
#que puedo tener problemas de performance o que hay otras maneras mas rapidas.*

[8]: *#ahora vamos a crear una funcion que obtenga el minimo y maximo de unas
→ columnas particulares, para luego usar apply:*

```

def min_max(row):
    data = row[['POPESTIMATE2010',
                'POPESTIMATE2011',
                'POPESTIMATE2012',
                'POPESTIMATE2013',
                'POPESTIMATE2014',
                'POPESTIMATE2015']]
    return pd.Series({'min': np.min(data), 'max': np.max(data)})

```

[9]: df.apply(min_max, axis='columns').head()

```

[9]:      min      max
0  4785161  4858979
1    54660   55347
2   183193  203709
3    26489   27341
4    22512   22861

```

[10]: *#hago lo mismo para los valores min y max los agrego al df como columnas nuevas:*

```

def min_max(row):
    data = row[['POPESTIMATE2010',
                'POPESTIMATE2011',
                'POPESTIMATE2012',
                'POPESTIMATE2013',
                'POPESTIMATE2014',
                'POPESTIMATE2015']]
    row['max'] = np.max(data)
    row['min'] = np.min(data)
    return row
df.apply(min_max, axis='columns').head()

```

```

[10]:  SUMLEV  REGION  DIVISION  STATE  COUNTY  STNAME  CTYNAME  \
0      40      3      6      1      0  Alabama  Alabama
1      50      3      6      1      1  Alabama  Autauga County
2      50      3      6      1      3  Alabama  Baldwin County

```


3	50	3	6	1	5	Alabama	Barbour County
4	50	3	6	1	7	Alabama	Bibb County

	CENSUS2010POP	ESTIMATESBASE2010	POPESTIMATE2010	...	RDOMESTICMIG2013	\
0	4779736	4780127	4785161	...	0.381066	
1	54571	54571	54660	...	-3.012349	
2	182265	182265	183193	...	21.845705	
3	27457	27457	27341	...	-7.056824	
4	22915	22919	22861	...	-6.201001	

	RDOMESTICMIG2014	RDOMESTICMIG2015	RNETMIG2011	RNETMIG2012	RNETMIG2013	\
0	0.582002	-0.467369	1.030015	0.826644	1.383282	
1	2.265971	-2.530799	7.606016	-2.626146	-2.722002	
2	19.243287	17.197872	15.844176	18.559627	22.727626	
3	-3.904217	-10.543299	-4.874741	-2.758113	-7.167664	
4	-0.177537	0.177258	-5.088389	-4.363636	-5.403729	

	RNETMIG2014	RNETMIG2015	max	min
0	1.724718	0.712594	4858979	4785161
1	2.592270	-2.187333	55347	54660
2	20.317142	18.293499	203709	183193
3	-3.978583	-10.543299	27341	26489
4	0.754533	1.107861	22861	22512

[5 rows x 102 columns]

[11]: *#ahora vamos a usar apply junto con lambda:*

```
rows = ['POPESTIMATE2010', 'POPESTIMATE2011', 'POPESTIMATE2012',
        'POPESTIMATE2013', 'POPESTIMATE2014', 'POPESTIMATE2015']
df.apply(lambda x: np.max(x[rows]), axis=1).head()

#lambda es una funcion sin nombre, en este caso toma un parametro (x) y retorna
#un solo valor (el maximo) con todas las
#columnas asociadas con rows.
```

[11]: 0 4858979
 1 55347
 2 203709
 3 27341
 4 22861
 dtype: int64

[12]: *#ahora definimos una funcion para obtener la region del estado y luego*
→agregarlo como una nueva columna al df:

```
def get_state_region(x):
    northeast = ['Connecticut', 'Maine', 'Massachusetts', 'New Hampshire',
```

```

        'Rhode Island', 'Vermont', 'New York', 'New Jersey', 'Pennsylvania']
    midwest = ['Illinois', 'Indiana', 'Michigan', 'Ohio', 'Wisconsin', 'Iowa',
               'Kansas', 'Minnesota', 'Missouri', 'Nebraska', 'North Dakota',
               'South Dakota']
    south = ['Delaware', 'Florida', 'Georgia', 'Maryland', 'North Carolina',
             'South Carolina', 'Virginia', 'District of Columbia', 'West Virginia',
             'Alabama', 'Kentucky', 'Mississippi', 'Tennessee', 'Arkansas',
             'Louisiana', 'Oklahoma', 'Texas']
    west = ['Arizona', 'Colorado', 'Idaho', 'Montana', 'Nevada', 'New Mexico', 'Utah',
            'Wyoming', 'Alaska', 'California', 'Hawaii', 'Oregon', 'Washington']

    if x in northeast:
        return "Northeast"
    elif x in midwest:
        return "Midwest"
    elif x in south:
        return "South"
    else:
        return "West"

```

```

[13]: #creo columna nueva y aplico la funcion a la columna de los estados
df['state_region'] = df['STNAME'].apply(lambda x: get_state_region(x))

```

```

[15]: df[['STNAME', 'state_region']].head()

```

```

[15]:  STNAME state_region
0  Alabama      South
1  Alabama      South
2  Alabama      South
3  Alabama      South
4  Alabama      South

```

3 Group By

```

[1]: import pandas as pd
import numpy as np

```

```

[12]: df = pd.read_csv('census.csv')
df = df[df['SUMLEV'] == 50]
df.head()

```

```

[12]:  SUMLEV  REGION  DIVISION  STATE  COUNTY  STNAME  CTYNAME \
1      50      3         6      1      1  Alabama  Autauga County
2      50      3         6      1      3  Alabama  Baldwin County
3      50      3         6      1      5  Alabama  Barbour County
4      50      3         6      1      7  Alabama  Bibb County
5      50      3         6      1      9  Alabama  Blount County

```

	CENSUS2010POP	ESTIMATESBASE2010	POPESTIMATE2010	...	RDOMESTICMIG2011 \
1	54571	54571	54660	...	7.242091
2	182265	182265	183193	...	14.832960
3	27457	27457	27341	...	-4.728132
4	22915	22919	22861	...	-5.527043
5	57322	57322	57373	...	1.807375

	RDOMESTICMIG2012	RDOMESTICMIG2013	RDOMESTICMIG2014	RDOMESTICMIG2015 \
1	-2.915927	-3.012349	2.265971	-2.530799
2	17.647293	21.845705	19.243287	17.197872
3	-2.500690	-7.056824	-3.904217	-10.543299
4	-5.068871	-6.201001	-0.177537	0.177258
5	-1.177622	-1.748766	-2.062535	-1.369970

	RNETMIG2011	RNETMIG2012	RNETMIG2013	RNETMIG2014	RNETMIG2015
1	7.606016	-2.626146	-2.722002	2.592270	-2.187333
2	15.844176	18.559627	22.727626	20.317142	18.293499
3	-4.874741	-2.758113	-7.167664	-3.978583	-10.543299
4	-5.088389	-4.363636	-5.403729	0.754533	1.107861
5	1.859511	-0.848580	-1.402476	-1.577232	-0.884411

[5 rows x 100 columns]

[3]: *#Vamos a calcular el promedio de poblacion de los condados por estado:*

```
[6]: %%timeit -n 3

for state in df['STNAME'].unique():
    avg = np.average(df.where(df['STNAME'] == state).dropna()['CENSUS2010POP'])
    ➔#calculo el promedio usando numpy
    print('Counties in state ' + state + ' have an average population of ' +
    ➔str(avg))
```

Counties in state Alabama have an average population of 71339.34328358209
 Counties in state Alaska have an average population of 24490.724137931036
 Counties in state Arizona have an average population of 426134.4666666667
 Counties in state Arkansas have an average population of 38878.906666666667
 Counties in state California have an average population of 642309.5862068966
 Counties in state Colorado have an average population of 78581.1875
 Counties in state Connecticut have an average population of 446762.125
 Counties in state Delaware have an average population of 299311.3333333333
 Counties in state District of Columbia have an average population of 601723.0
 Counties in state Florida have an average population of 280616.5671641791
 Counties in state Georgia have an average population of 60928.63522012578
 Counties in state Hawaii have an average population of 272060.2
 Counties in state Idaho have an average population of 35626.86363636364
 Counties in state Illinois have an average population of 125790.50980392157

Counties in state Indiana have an average population of 70476.10869565218
 Counties in state Iowa have an average population of 30771.262626262625
 Counties in state Kansas have an average population of 27172.55238095238
 Counties in state Kentucky have an average population of 36161.391666666667
 Counties in state Louisiana have an average population of 70833.9375
 Counties in state Maine have an average population of 83022.5625
 Counties in state Maryland have an average population of 240564.666666666666
 Counties in state Massachusetts have an average population of 467687.78571428574
 Counties in state Michigan have an average population of 119080.0
 Counties in state Minnesota have an average population of 60964.65517241379
 Counties in state Mississippi have an average population of 36186.54878048781
 Counties in state Missouri have an average population of 52077.62608695652
 Counties in state Montana have an average population of 17668.125
 Counties in state Nebraska have an average population of 19638.075268817203
 Counties in state Nevada have an average population of 158855.9411764706
 Counties in state New Hampshire have an average population of 131647.0
 Counties in state New Jersey have an average population of 418661.61904761905
 Counties in state New Mexico have an average population of 62399.36363636364
 Counties in state New York have an average population of 312550.03225806454
 Counties in state North Carolina have an average population of 95354.83
 Counties in state North Dakota have an average population of 12690.396226415094
 Counties in state Ohio have an average population of 131096.63636363635
 Counties in state Oklahoma have an average population of 48718.844155844155
 Counties in state Oregon have an average population of 106418.72222222222
 Counties in state Pennsylvania have an average population of 189587.74626865672
 Counties in state Rhode Island have an average population of 210513.4
 Counties in state South Carolina have an average population of
 100551.39130434782
 Counties in state South Dakota have an average population of 12336.060606060606
 Counties in state Tennessee have an average population of 66801.1052631579
 Counties in state Texas have an average population of 98998.27165354331
 Counties in state Utah have an average population of 95306.37931034483
 Counties in state Vermont have an average population of 44695.78571428572
 Counties in state Virginia have an average population of 60111.29323308271
 Counties in state Washington have an average population of 172424.10256410256
 Counties in state West Virginia have an average population of 33690.8
 Counties in state Wisconsin have an average population of 78985.91666666667
 Counties in state Wyoming have an average population of 24505.478260869564
 Counties in state Alabama have an average population of 71339.34328358209
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 Counties in state New Jersey have an average population of 418661.61904761905
 Counties in state New Mexico have an average population of 62399.36363636364
 Counties in state New York have an average population of 312550.03225806454
 Counties in state North Carolina have an average population of 95354.83
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 1.97 s ± 8.06 ms per loop (mean ± std. dev. of 7 runs, 3 loops each)

[7]: *#ahora vamos a hacerlo con group by:*

[8]: `%%timeit -n 3`

```
for group, frame in df.groupby('STNAME'):
    #group by devuelve una tupla, el primer valor es la clave que estamos tratando
    →de agrupar (en este caso los estados) y el
    #segundo valor es el dato que fue encontrado para esa clave.
    avg = np.average(frame['CENSUS2010POP'])
    print('Counties in state ' + group + ' have an average population of ' +
    →str(avg))
```

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 Counties in state Nebraska have an average population of 19638.075268817203
 Counties in state Nevada have an average population of 158855.9411764706
 Counties in state New Hampshire have an average population of 131647.0
 Counties in state New Jersey have an average population of 418661.61904761905
 Counties in state New Mexico have an average population of 62399.36363636364
 Counties in state New York have an average population of 312550.03225806454
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 20.3 ms ± 241 µs per loop (mean ± std. dev. of 7 runs, 3 loops each)

[13]: *#al group by tambien se le puede poner una funcion. Es importante para este*
→ejemplo poner el nombre de estado como indice, para
#que la funcion group by sepa que agrupar

```
df = df.set_index('STNAME') #seteo el estado como indice

def set_batch_number(item): #defino una funcion para dividir en 3 grupos,
    →dependiendo de la letra inicial del estado
    if item[0] < 'M':
        return 0
    if item[0] < 'Q':
        return 1
    return 2

for group, frame in df.groupby(set_batch_number):
    print('There are ' + str(len(frame)) + ' records in group ' + str(group) +
    →' for processing.')
```

There are 1177 records in group 0 for processing.
 There are 1134 records in group 1 for processing.
 There are 831 records in group 2 for processing.

```
[14]: #como no se le paso ningun nombre de columna en especifico, group by toma
      ↳directamente el index (en este caso STNAME)
```

```
[13]: import pandas as pd
import numpy as np
```

```
[6]: #vamos a importar un nuevo df, en este caso uno de Airbnb:
df = pd.read_csv('listings.csv')
df.head()
```

```
[6]:      id      listing_url      scrape_id \
0  12147973  https://www.airbnb.com/rooms/12147973  20160906204935
1   3075044  https://www.airbnb.com/rooms/3075044  20160906204935
2    6976    https://www.airbnb.com/rooms/6976  20160906204935
3  1436513  https://www.airbnb.com/rooms/1436513  20160906204935
4   7651065  https://www.airbnb.com/rooms/7651065  20160906204935

      last_scraped      name \
0   2016-09-07      Sunny Bungalow in the City
1   2016-09-07  Charming room in pet friendly apt
2   2016-09-07  Mexican Folk Art Haven in Boston
3   2016-09-07  Spacious Sunny Bedroom Suite in Historic Home
4   2016-09-07      Come Home to Boston

      summary \
0  Cozy, sunny, family home. Master bedroom high...
1  Charming and quiet room in a second floor 1910...
2  Come stay with a friendly, middle-aged guy in ...
3  Come experience the comforts of home away from...
4  My comfy, clean and relaxing home is one block...

      space \
0  The house has an open and cozy feel at the sam...
1  Small but cozy and quite room with a full size...
2  Come stay with a friendly, middle-aged guy in ...
3  Most places you find in Boston are small howev...
4  Clean, attractive, private room, one block fro...

      description experiences_offered \
0  Cozy, sunny, family home. Master bedroom high...      none
1  Charming and quiet room in a second floor 1910...      none
2  Come stay with a friendly, middle-aged guy in ...      none
3  Come experience the comforts of home away from...      none
4  My comfy, clean and relaxing home is one block...      none

      neighborhood_overview  ... review_scores_value \
0  Roslindale is quiet, convenient and friendly. ...      NaN
1  The room is in Roslindale, a diverse and prima...      9.0
```

2	The LOCATION: Roslindale is a safe and diverse...	...	10.0
3	Roslindale is a lovely little neighborhood loc...	...	10.0
4	I love the proximity to downtown, the neighbor...	...	10.0

	requires_license	license	jurisdiction_names	instant_bookable	\
0	f	NaN	NaN	f	
1	f	NaN	NaN	t	
2	f	NaN	NaN	f	
3	f	NaN	NaN	f	
4	f	NaN	NaN	f	

	cancellation_policy	require_guest_profile_picture	\
0	moderate	f	
1	moderate	f	
2	moderate	t	
3	moderate	f	
4	flexible	f	

	require_guest_phone_verification	calculated_host_listings_count	\
0	f	1	
1	f	1	
2	f	1	
3	f	1	
4	f	1	

	reviews_per_month
0	NaN
1	1.30
2	0.47
3	1.00
4	2.25

[5 rows x 95 columns]

[7]: *#nos interesa observar la politica de cancelacion y el puntaje de valoración:*

```
df = df.set_index(['cancellation_policy', 'review_scores_value'])
for group, frame in df.groupby(level=(0,1)):
    print(group)
```

```
('flexible', 2.0)
('flexible', 4.0)
('flexible', 5.0)
('flexible', 6.0)
('flexible', 7.0)
('flexible', 8.0)
('flexible', 9.0)
('flexible', 10.0)
```

```

('moderate', 2.0)
('moderate', 4.0)
('moderate', 6.0)
('moderate', 7.0)
('moderate', 8.0)
('moderate', 9.0)
('moderate', 10.0)
('strict', 2.0)
('strict', 3.0)
('strict', 4.0)
('strict', 5.0)
('strict', 6.0)
('strict', 7.0)
('strict', 8.0)
('strict', 9.0)
('strict', 10.0)
('super_strict_30', 6.0)
('super_strict_30', 7.0)
('super_strict_30', 8.0)
('super_strict_30', 9.0)
('super_strict_30', 10.0)

```

[10]: *#ahora vamos a crear una funcion para agrupar en dos categorias, los que tienen*
→puntaje 10 y los que no tienen puntaje 10:

```

def grouping_fun(item):
    if item[1] == 10.0:          #item[1] es el valor del puntaje de reseña
    →(ver orden de index en celda anterior)
        return (item[0], '10.0') #item[0] es en valor de politica de
    →cancelacion
    else:
        return (item[0], 'not 10.0')

for group, frame in df.groupby(by=grouping_fun):
    print(group)

```

```

('flexible', '10.0')
('flexible', 'not 10.0')
('moderate', '10.0')
('moderate', 'not 10.0')
('strict', '10.0')
('strict', 'not 10.0')
('super_strict_30', '10.0')
('super_strict_30', 'not 10.0')

```

[11]: `df.head()`

[11]:

		id \	
cancellation_policy	review_scores_value		
moderate	NaN	12147973	
	9.0	3075044	
	10.0	6976	
	10.0	1436513	
flexible	10.0	7651065	

		listing_url
cancellation_policy	review_scores_value	
moderate	NaN	https://www.airbnb.com/rooms/12147973
	9.0	https://www.airbnb.com/rooms/3075044
	10.0	https://www.airbnb.com/rooms/6976
	10.0	https://www.airbnb.com/rooms/1436513
flexible	10.0	https://www.airbnb.com/rooms/7651065

		scrape_id	last_scraped \
cancellation_policy	review_scores_value		
moderate	NaN	20160906204935	2016-09-07
	9.0	20160906204935	2016-09-07
	10.0	20160906204935	2016-09-07
	10.0	20160906204935	2016-09-07
flexible	10.0	20160906204935	2016-09-07

name \		
cancellation_policy	review_scores_value	
moderate	NaN	Sunny Bungalow in
the City		
	9.0	Charming room in pet
friendly apt		
	10.0	Mexican Folk Art Haven in
Boston		
	10.0	Spacious Sunny Bedroom Suite in
Historic Home		
flexible	10.0	Come Home to
Boston		

summary \		
cancellation_policy	review_scores_value	
moderate	NaN	Cozy, sunny, family home. Master
bedroom high...		
	9.0	Charming and quiet room in a second
floor 1910...		
	10.0	Come stay with a friendly, middle-aged
guy in ...		
	10.0	Come experience the comforts of home

away from...			
flexible	10.0		My comfy, clean and relaxing home is
one block...			
space \			
cancellation_policy	review_scores_value		
moderate	NaN		The house has an open and cozy feel at
the sam...			
	9.0		Small but cozy and quite room with a
full size...			
	10.0		Come stay with a friendly, middle-aged
guy in ...			
	10.0		Most places you find in Boston are
small howev...			
flexible	10.0		Clean, attractive, private room, one
block fro...			
description \			
cancellation_policy	review_scores_value		
moderate	NaN		Cozy, sunny, family home. Master
bedroom high...			
	9.0		Charming and quiet room in a second
floor 1910...			
	10.0		Come stay with a friendly, middle-aged
guy in ...			
	10.0		Come experience the comforts of home
away from...			
flexible	10.0		My comfy, clean and relaxing home is
one block...			
experiences_offered \			
cancellation_policy	review_scores_value		
moderate	NaN	none	
	9.0	none	
	10.0	none	
	10.0	none	
flexible	10.0	none	
neighborhood_overview \			
cancellation_policy	review_scores_value		
moderate	NaN		Roslindale is quiet, convenient and
friendly. ...			
	9.0		The room is in Roslindale, a diverse
and prima...			
	10.0		The LOCATION: Roslindale is a safe and
diverse...			
	10.0		Roslindale is a lovely little

neighborhood loc...		
flexible	10.0	I love the proximity to downtown, the
neighbor...		

		... review_scores_communication \
cancellation_policy	review_scores_value	...
moderate	NaN	NaN
	9.0	10.0
	10.0	10.0
	10.0	10.0
flexible	10.0	10.0

		review_scores_location \
cancellation_policy	review_scores_value	
moderate	NaN	NaN
	9.0	9.0
	10.0	9.0
	10.0	10.0
flexible	10.0	9.0

		requires_license	license \
cancellation_policy	review_scores_value		
moderate	NaN	f	NaN
	9.0	f	NaN
	10.0	f	NaN
	10.0	f	NaN
flexible	10.0	f	NaN

		jurisdiction_names	instant_bookable \
cancellation_policy	review_scores_value		
moderate	NaN	NaN	f
	9.0	NaN	t
	10.0	NaN	f
	10.0	NaN	f
flexible	10.0	NaN	f

		require_guest_profile_picture \
cancellation_policy	review_scores_value	
moderate	NaN	f
	9.0	f
	10.0	t
	10.0	f
flexible	10.0	f

		require_guest_phone_verification \
cancellation_policy	review_scores_value	
moderate	NaN	f

	9.0	f
	10.0	f
	10.0	f
flexible	10.0	f

		calculated_host_listings_count	\
cancellation_policy	review_scores_value		
moderate	NaN		1
	9.0		1
	10.0		1
	10.0		1
flexible	10.0		1

		reviews_per_month
cancellation_policy	review_scores_value	
moderate	NaN	NaN
	9.0	1.30
	10.0	0.47
	10.0	1.00
flexible	10.0	2.25

[5 rows x 93 columns]

```
[ ]: #hay tres categorias de procesamiento de datos, aggregation, transformation y
      ↳filtration
```

4 Aggregation

```
[14]: #ahora quiero agrupar por politcas de cancelacion y calcular el promedio de
      ↳valoracion de reseñas:
df = df.reset_index() #reseteo index

df.groupby('cancellation_policy').agg({'review_scores_value': np.average})
      ↳#esto no funciona porque np.average no ignora nans
```

```
[14]:
      review_scores_value
cancellation_policy
flexible              NaN
moderate              NaN
strict               NaN
super_strict_30      NaN
```

```
[15]: df.groupby('cancellation_policy').agg({'review_scores_value': np.nanmean})
      ↳#nanmean si ignora los nans
```

```
[15]:
      review_scores_value
cancellation_policy
flexible          9.237421
```



```
moderate          9.307398
strict            9.081441
super_strict_30   8.537313
```

[16]: *#con agg se pueden agregar varias columnas y varias funciones:*

```
df.groupby('cancellation_policy').agg({'review_scores_value': (np.nanmean, np.
    ↳nanstd),
                                     'reviews_per_month': np.nanmean})
```

[16]:

	review_scores_value		reviews_per_month
	nanmean	nanstd	nanmean
cancellation_policy			
flexible	9.237421	1.096271	1.829210
moderate	9.307398	0.859859	2.391922
strict	9.081441	1.040531	1.873467
super_strict_30	8.537313	0.840785	0.340143

[17]: *#group by crea un objeto a partir de los valores de politica de cancelacion.↳*
↳Con la funcion agg() voy dando nombres de columnas
#e indico las funciones a aplicar en cada una de ellas

5 Transformation

[18]: *#la diferencia con aggregation es que no devuelve un valor por cada grupo, sino↳*
↳que devuelve una cantidad de valores del mismo
#shape del df, por lo que hace mas facil incorporar esos datos al df original.↳
↳Vamos a hacer lo mismo que antes pero con
#transformation:

```
cols = ['cancellation_policy', 'review_scores_value']
transform_df = df[cols].groupby('cancellation_policy').transform(np.nanmean)
transform_df.head()
```

[18]:

	review_scores_value
0	9.307398
1	9.307398
2	9.307398
3	9.307398
4	9.237421

[19]: *#ahora voy a renombrar la columna de transform_df para luego agregarla al df↳*
↳original

```
transform_df.rename({'review_scores_value': 'mean_review_scores'},↳
    ↳axis='columns', inplace=True) #con esto renombro
df = df.merge(transform_df, left_index=True, right_index=True)
df.head()
```

```

[19]: index cancellation_policy review_scores_value id \
0      0      moderate      NaN 12147973
1      1      moderate      9.0 3075044
2      2      moderate     10.0  6976
3      3      moderate     10.0 1436513
4      4      flexible     10.0 7651065

      listing_url      scrape_id last_scraped \
0 https://www.airbnb.com/rooms/12147973 20160906204935 2016-09-07
1 https://www.airbnb.com/rooms/3075044 20160906204935 2016-09-07
2 https://www.airbnb.com/rooms/6976 20160906204935 2016-09-07
3 https://www.airbnb.com/rooms/1436513 20160906204935 2016-09-07
4 https://www.airbnb.com/rooms/7651065 20160906204935 2016-09-07

      name \
0      Sunny Bungalow in the City
1      Charming room in pet friendly apt
2      Mexican Folk Art Haven in Boston
3 Spacious Sunny Bedroom Suite in Historic Home
4      Come Home to Boston

      summary \
0 Cozy, sunny, family home. Master bedroom high...
1 Charming and quiet room in a second floor 1910...
2 Come stay with a friendly, middle-aged guy in ...
3 Come experience the comforts of home away from...
4 My comfy, clean and relaxing home is one block...

      space ... \
0 The house has an open and cozy feel at the sam... ...
1 Small but cozy and quite room with a full size... ...
2 Come stay with a friendly, middle-aged guy in ... ...
3 Most places you find in Boston are small howev... ...
4 Clean, attractive, private room, one block fro... ...

review_scores_location requires_license license jurisdiction_names \
0      NaN      f      NaN      NaN
1      9.0      f      NaN      NaN
2      9.0      f      NaN      NaN
3     10.0      f      NaN      NaN
4      9.0      f      NaN      NaN

instant_bookable require_guest_profile_picture \
0      f      f
1      t      f
2      f      t
3      f      f

```

```

4           f           f

require_guest_phone_verification  calculated_host_listings_count  \
0           f           1
1           f           1
2           f           1
3           f           1
4           f           1

reviews_per_month  mean_review_scores
0           NaN           9.307398
1           1.30           9.307398
2           0.47           9.307398
3           1.00           9.307398
4           2.25           9.237421

```

[5 rows x 97 columns]

[20]: *#ahora puedo, por ejemplo, calcular la diferencia entre cada valor de reseña
→ con la media de su grupo:*

```

df['mean_dif'] = np.absolute(df['review_scores_value'] -
    → df['mean_review_scores'])
df['mean_dif'].head()

```

[20]:

```

0           NaN
1           0.307398
2           0.692602
3           0.692602
4           0.762579
Name: mean_dif, dtype: float64

```

6 Filtering

[21]: *#la funcion filter() aplica una funcion a cada grupo del df y retorna los
→ valores que cumplen con la condicion (True)*

[24]:

```

df.groupby('cancellation_policy').filter(lambda x: np.nanmean(
    → (x['review_scores_value']) > 9.2)

```

[24]:

```

index  cancellation_policy  review_scores_value  id  \
0           0           moderate           NaN  12147973
1           1           moderate           9.0   3075044
2           2           moderate          10.0     6976
3           3           moderate          10.0  1436513
4           4           flexible          10.0  7651065
...         ...           ...           ...         ...

```

3576	3576	flexible	NaN	14689681
3577	3577	flexible	NaN	13750763
3579	3579	flexible	NaN	14852179
3582	3582	flexible	NaN	14585486
3584	3584	flexible	NaN	14504422

	listing_url	scrape_id	last_scraped	\
0	https://www.airbnb.com/rooms/12147973	20160906204935	2016-09-07	
1	https://www.airbnb.com/rooms/3075044	20160906204935	2016-09-07	
2	https://www.airbnb.com/rooms/6976	20160906204935	2016-09-07	
3	https://www.airbnb.com/rooms/1436513	20160906204935	2016-09-07	
4	https://www.airbnb.com/rooms/7651065	20160906204935	2016-09-07	
...	
3576	https://www.airbnb.com/rooms/14689681	20160906204935	2016-09-07	
3577	https://www.airbnb.com/rooms/13750763	20160906204935	2016-09-07	
3579	https://www.airbnb.com/rooms/14852179	20160906204935	2016-09-07	
3582	https://www.airbnb.com/rooms/14585486	20160906204935	2016-09-07	
3584	https://www.airbnb.com/rooms/14504422	20160906204935	2016-09-07	

	name	\
0	Sunny Bungalow in the City	
1	Charming room in pet friendly apt	
2	Mexican Folk Art Haven in Boston	
3	Spacious Sunny Bedroom Suite in Historic Home	
4	Come Home to Boston	
...	...	
3576	Beautiful loft style bedroom with large bathroom	
3577	Comfortable Space in the Heart of Brookline	
3579	Spacious Queen Bed Room Close to Boston Univer...	
3582	Gorgeous funky apartment	
3584	(K1) Private Room near Harvard/MIT	

	summary	\
0	Cozy, sunny, family home. Master bedroom high...	
1	Charming and quiet room in a second floor 1910...	
2	Come stay with a friendly, middle-aged guy in ...	
3	Come experience the comforts of home away from...	
4	My comfy, clean and relaxing home is one block...	
...	...	
3576	You'd be living on the top floor of a four sto...	
3577	Our place is close to Coolidge Corner, Allston...	
3579	- Grocery: A full-size Star market is 2 minute...	
3582	Funky little apartment close to public transpo...	
3584	My place is close to My home is a warm and fri...	

	space	... requires_license	\
0	The house has an open and cozy feel at the sam...	...	f

1	Small but cozy and quite room with a full size...	...	f
2	Come stay with a friendly, middle-aged guy in	f
3	Most places you find in Boston are small howev...	...	f
4	Clean, attractive, private room, one block fro...	...	f
...	
3576		NaN	f
3577	This space consists of 2 Rooms and a private b...	...	f
3579		NaN	f
3582	Modern and relaxed space with many facilities	...	f
3584	To ensure a smooth check in: 1. You MUST have	...	f

	license	jurisdiction_names	instant_bookable	\
0	NaN	NaN	f	
1	NaN	NaN	t	
2	NaN	NaN	f	
3	NaN	NaN	f	
4	NaN	NaN	f	
...	
3576	NaN	NaN	f	
3577	NaN	NaN	f	
3579	NaN	NaN	f	
3582	NaN	NaN	f	
3584	NaN	NaN	t	

	require_guest_profile_picture	require_guest_phone_verification	\
0	f	f	
1	f	f	
2	t	f	
3	f	f	
4	f	f	
...	
3576	f	f	
3577	f	f	
3579	f	f	
3582	f	f	
3584	f	f	

	calculated_host_listings_count	reviews_per_month	mean_review_scores	\
0	1	NaN	9.307398	
1	1	1.30	9.307398	
2	1	0.47	9.307398	
3	1	1.00	9.307398	
4	1	2.25	9.237421	
...	
3576	1	NaN	9.237421	
3577	1	NaN	9.237421	
3579	1	NaN	9.237421	

3582	1	NaN	9.237421
3584	3	NaN	9.237421

	mean_dif
0	NaN
1	0.307398
2	0.692602
3	0.692602
4	0.762579
...	...
3576	NaN
3577	NaN
3579	NaN
3582	NaN
3584	NaN

[1918 rows x 98 columns]

7 Applying

[28]: *#la funcion apply() permite aplicar a cada grupo una funcion determinada, y
→ tener todos los resultados en un solo df:*

```
df = pd.read_csv('listings.csv')
df = df[['cancellation_policy', 'review_scores_value']]
df.head()
```

```
[28]:  cancellation_policy  review_scores_value
0          moderate          NaN
1          moderate          9.0
2          moderate         10.0
3          moderate         10.0
4          flexible         10.0
```

[29]: *#voy a definir una funcion para invocar con apply(), y que automaticamente
→ calcule el desvio de la reseña con respecto a la
#reseña promedio del grupo*

```
def calc_mean_review_scores(group):
    avg = np.nanmean(group['review_scores_value'])
    group['review_scores_mean'] = np.abs(avg - group['review_scores_value'])
    return group

df.groupby('cancellation_policy').apply(calc_mean_review_scores).head()
```

```
[29]:  cancellation_policy  review_scores_value  review_scores_mean
0          moderate          NaN          NaN
```

1	moderate	9.0	0.307398
2	moderate	10.0	0.692602
3	moderate	10.0	0.692602
4	flexible	10.0	0.762579

8 Scales

```
[1]: import pandas as pd

#creo un df de notas de pruebas en orden
df = pd.DataFrame(['A+', 'A', 'A-', 'B+', 'B', 'B-', 'C+', 'C', 'C-', 'D+', 'D'],
                  index = ['excellent', 'excellent', 'excellent', 'good', '
→'good', 'good',
                           'ok', 'ok', 'ok', 'poor', 'poor'],
                  columns = ['Grades'])

df
```

```
[1]:          Grades
excellent    A+
excellent    A
excellent    A-
good         B+
good         B
good         B-
ok           C+
ok           C
ok           C-
poor         D+
poor         D
```

```
[3]: df.dtypes #vemos que es un objeto
```

```
[3]: Grades    object
dtype: object
```

```
[4]: df['Grades'].astype('category').head() #cambio a una variable categorica usando
→astype
```

```
[4]: excellent    A+
excellent    A
excellent    A-
good         B+
good         B
Name: Grades, dtype: category
Categories (11, object): [A, A+, A-, B, ..., C+, C-, D, D+]
```

```
[5]: my_categories = pd.CategoricalDtype(categories=['D', 'D+', 'C-', 'C', 'C+', '
→'B-', 'B', 'B+', 'A-', 'A', 'A+'],
```

```

                                ordered=True) #creo una variable categorica
→y le digo que la ordene
grades = df['Grades'].astype(my_categories)
grades.head()

```

```

[5]: excellent    A+
      excellent    A
      excellent    A-
      good         B+
      good         B
      Name: Grades, dtype: category
      Categories (11, object): [D < D+ < C- < C ... B+ < A- < A < A+]

```

```

[6]: #esto nos va a servir para crear mascaras booleanas, aca hay un ejemplo:
      df[df['Grades'] > 'C'] #el resultado no es correcto usando el df original

```

```

[6]:      Grades
      ok      C+
      ok      C-
      poor    D+
      poor    D

```

```

[8]: grades[grades > 'C'] #ahora si nos devuelve las notas mayores a C

```

```

[8]: excellent    A+
      excellent    A
      excellent    A-
      good         B+
      good         B
      good         B-
      ok           C+
      Name: Grades, dtype: category
      Categories (11, object): [D < D+ < C- < C ... B+ < A- < A < A+]

```

```

[16]: import numpy as np

      df = pd.read_csv('census.csv') #leo df de censo
      df = df[df['SUMLEV']==50] #quiero solos los que tienen SUMLEV igual a 50
      df = df.set_index('STNAME').groupby(level=0)['CENSUS2010POP'].agg(np.average)
      →#seteo como indice el nombre de estado
      df.head()

```

```

[16]: STNAME
      Alabama      71339.343284
      Alaska      24490.724138
      Arizona      426134.466667
      Arkansas      38878.906667
      California    642309.586207
      Name: CENSUS2010POP, dtype: float64

```



```
[21]: pd.cut(df, 10) #con esta funcion puedo hacer "bins", o sea hago 10 categorias_
      →segun la poblacion
```

```
[21]: STNAME
Alabama      (11706.087, 75333.413]
Alaska       (11706.087, 75333.413]
Arizona      (390320.176, 453317.529]
Arkansas     (11706.087, 75333.413]
California   (579312.234, 642309.586]
Colorado     (75333.413, 138330.766]
Connecticut  (390320.176, 453317.529]
Delaware     (264325.471, 327322.823]
District of Columbia (579312.234, 642309.586]
Florida      (264325.471, 327322.823]
Georgia      (11706.087, 75333.413]
Hawaii       (264325.471, 327322.823]
Idaho        (11706.087, 75333.413]
Illinois     (75333.413, 138330.766]
Indiana      (11706.087, 75333.413]
Iowa         (11706.087, 75333.413]
Kansas       (11706.087, 75333.413]
Kentucky     (11706.087, 75333.413]
Louisiana    (11706.087, 75333.413]
Maine        (75333.413, 138330.766]
Maryland     (201328.118, 264325.471]
Massachusetts (453317.529, 516314.881]
Michigan     (75333.413, 138330.766]
Minnesota    (11706.087, 75333.413]
Mississippi  (11706.087, 75333.413]
Missouri     (11706.087, 75333.413]
Montana      (11706.087, 75333.413]
Nebraska     (11706.087, 75333.413]
Nevada       (138330.766, 201328.118]
New Hampshire (75333.413, 138330.766]
New Jersey   (390320.176, 453317.529]
New Mexico   (11706.087, 75333.413]
New York     (264325.471, 327322.823]
North Carolina (75333.413, 138330.766]
North Dakota (11706.087, 75333.413]
Ohio         (75333.413, 138330.766]
Oklahoma     (11706.087, 75333.413]
Oregon       (75333.413, 138330.766]
Pennsylvania (138330.766, 201328.118]
Rhode Island (201328.118, 264325.471]
South Carolina (75333.413, 138330.766]
South Dakota (11706.087, 75333.413]
Tennessee    (11706.087, 75333.413]
```

```

Texas                (75333.413, 138330.766]
Utah                 (75333.413, 138330.766]
Vermont              (11706.087, 75333.413]
Virginia             (11706.087, 75333.413]
Washington           (138330.766, 201328.118]
West Virginia        (11706.087, 75333.413]
Wisconsin            (75333.413, 138330.766]
Wyoming              (11706.087, 75333.413]
Name: CENSUS2010POP, dtype: category
Categories (10, interval[float64]): [(11706.087, 75333.413] < (75333.413,
138330.766] < (138330.766, 201328.118] < (201328.118, 264325.471] ...
(390320.176, 453317.529] < (453317.529, 516314.881] < (516314.881, 579312.234] <
(579312.234, 642309.586]]

```

9 Pivot Table

```
[21]: import pandas as pd
import numpy as np
```

```
[22]: df = pd.read_csv('cwurData.csv')
df.head()
```

```
[22]:
```

	world_rank	institution	country	\
0	1	Harvard University	USA	
1	2	Massachusetts Institute of Technology	USA	
2	3	Stanford University	USA	
3	4	University of Cambridge	United Kingdom	
4	5	California Institute of Technology	USA	

	national_rank	quality_of_education	alumni_employment	quality_of_faculty	\
0	1	7	9	1	
1	2	9	17	3	
2	3	17	11	5	
3	1	10	24	4	
4	4	2	29	7	

	publications	influence	citations	broad_impact	patents	score	year
0	1	1	1	NaN	5	100.00	2012
1	12	4	4	NaN	1	91.67	2012
2	4	2	2	NaN	15	89.50	2012
3	16	16	11	NaN	50	86.17	2012
4	37	22	22	NaN	18	85.21	2012

```
[23]: #creo una funcion para agregar una columna segun el ranking de la universidad:

def create_category(ranking):
    if (ranking >= 1) & (ranking <= 100): #primeras 100
```

```

        return "First Tier Top University"
    elif (ranking >= 101) & (ranking <= 200): #de la 101 a la 200
        return "Second Tier Top University"
    elif (ranking >= 201) & (ranking <= 300): #de la 201 hasta la 300
        return "Third Tier Top University"
    return "Other Top University" #de la 300 en adelante

df['rank_level'] = df['world_rank'].apply(lambda x: create_category(x))
df.head()

```

```

[23]: world_rank      institution      country \
0      1      Harvard University      USA
1      2  Massachusetts Institute of Technology      USA
2      3      Stanford University      USA
3      4      University of Cambridge  United Kingdom
4      5  California Institute of Technology      USA

      national_rank  quality_of_education  alumni_employment  quality_of_faculty \
0      1      7      9      1
1      2      9      17      3
2      3      17      11      5
3      1      10      24      4
4      4      2      29      7

      publications  influence  citations  broad_impact  patents  score  year \
0      1      1      1      NaN      5  100.00  2012
1      12      4      4      NaN      1  91.67  2012
2      4      2      2      NaN      15  89.50  2012
3      16      16      11      NaN      50  86.17  2012
4      37      22      22      NaN      18  85.21  2012

      rank_level
0  First Tier Top University
1  First Tier Top University
2  First Tier Top University
3  First Tier Top University
4  First Tier Top University

```

```

[24]: #vamos a comparar los promedios de los distintos rank_level de las
      ↪ universidades del mundo
      #a la tabla pivot le digo cuales son los valores a tomar (score), cual es el
      ↪ indice (country), cuales son las columnas
      #(rank_level) y que hacer con los valores (aggregation function):

df.pivot_table(values='score', index='country', columns='rank_level',
      ↪aggfunc=[np.mean]).head()

```

```
[24]:
```

	mean	
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	44.672857
Australia	47.9425	44.645750
Austria	NaN	44.864286
Belgium	51.8750	45.081000
Brazil	NaN	44.499706

rank_level	Second Tier Top University	Third Tier Top University
country		
Argentina	NaN	NaN
Australia	49.2425	47.285000
Austria	NaN	47.066667
Belgium	49.0840	46.746667
Brazil	49.5650	NaN

```
[25]: #tambien se pueden pasar mas de una funcion con aggfunc:

df.pivot_table(values='score', index='country', columns='rank_level',
                aggfunc=[np.mean, np.max]).head()
```

```
[25]:
```

	mean	
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	44.672857
Australia	47.9425	44.645750
Austria	NaN	44.864286
Belgium	51.8750	45.081000
Brazil	NaN	44.499706

rank_level	Second Tier Top University	Third Tier Top University
country		
Argentina	NaN	NaN
Australia	49.2425	47.285000
Austria	NaN	47.066667
Belgium	49.0840	46.746667
Brazil	49.5650	NaN

	amax	
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	45.66
Australia	51.61	45.97
Austria	NaN	46.29
Belgium	52.03	46.21

Brazil	NaN	46.08
--------	-----	-------

rank_level	Second Tier Top University	Third Tier Top University
country		
Argentina	NaN	NaN
Australia	50.40	47.47
Austria	NaN	47.78
Belgium	49.73	47.14
Brazil	49.82	NaN

```
[26]: #tambien puedo agregar una columna al final de cada funcion que calculara el
      → promedio de los promedios y el maximo de los
      #maximos:

      df.pivot_table(values='score', index='country', columns='rank_level',
      →aggfunc=[np.mean, np.max],
      margins=True).head()
```

```
[26]:
```

	mean	\
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	44.672857
Australia	47.9425	44.645750
Austria	NaN	44.864286
Belgium	51.8750	45.081000
Brazil	NaN	44.499706

rank_level	Second Tier Top University	Third Tier Top University	All
country			
Argentina	NaN	NaN	44.672857
Australia	49.2425	47.285000	45.825517
Austria	NaN	47.066667	45.139583
Belgium	49.0840	46.746667	47.011000
Brazil	49.5650	NaN	44.781111

```
amax
```

rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	45.66
Australia	51.61	45.97
Austria	NaN	46.29
Belgium	52.03	46.21
Brazil	NaN	46.08

rank_level	Second Tier Top University	Third Tier Top University	All
------------	----------------------------	---------------------------	-----

country			
Argentina	NaN	NaN	45.66
Australia	50.40	47.47	51.61
Austria	NaN	47.78	47.78
Belgium	49.73	47.14	52.03
Brazil	49.82	NaN	49.82

- Una tabla pivot es un data frame multi nivel

[27]: *#Vamos a crear un nuevo df con el ejemplo anterior:*

```
new_df = df.pivot_table(values='score', index='country', columns='rank_level',
    →aggfunc=[np.mean, np.max], margins=True)
print(new_df.index) #imprimo los indices
print(new_df.columns) #imprimo las columnas
```

```
Index(['Argentina', 'Australia', 'Austria', 'Belgium', 'Brazil', 'Bulgaria',
      'Canada', 'Chile', 'China', 'Colombia', 'Croatia', 'Cyprus',
      'Czech Republic', 'Denmark', 'Egypt', 'Estonia', 'Finland', 'France',
      'Germany', 'Greece', 'Hong Kong', 'Hungary', 'Iceland', 'India', 'Iran',
      'Ireland', 'Israel', 'Italy', 'Japan', 'Lebanon', 'Lithuania',
      'Malaysia', 'Mexico', 'Netherlands', 'New Zealand', 'Norway', 'Poland',
      'Portugal', 'Puerto Rico', 'Romania', 'Russia', 'Saudi Arabia',
      'Serbia', 'Singapore', 'Slovak Republic', 'Slovenia', 'South Africa',
      'South Korea', 'Spain', 'Sweden', 'Switzerland', 'Taiwan', 'Thailand',
      'Turkey', 'USA', 'Uganda', 'United Arab Emirates', 'United Kingdom',
      'Uruguay', 'All'],
      dtype='object', name='country')
MultiIndex([('mean', 'First Tier Top University'),
            ('mean', 'Other Top University'),
            ('mean', 'Second Tier Top University'),
            ('mean', 'Third Tier Top University'),
            ('mean', 'All'),
            ('amax', 'First Tier Top University'),
            ('amax', 'Other Top University'),
            ('amax', 'Second Tier Top University'),
            ('amax', 'Third Tier Top University'),
            ('amax', 'All')],
            names=[None, 'rank_level'])
```

[28]: *#podemos ver que las columnas son jerarquicas, primero tenemos los mean y*
→despues los amax. Como podemos hacer para obtener
#el promedio de score del First Tier Top University para cada país? Aca va la
→solucion:

```
new_df['mean']['First Tier Top University'].head() #primero vamos a observar
    →los valores que nos interesan
```

```
[28]: country
      Argentina      NaN
      Australia    47.9425
      Austria      NaN
      Belgium      51.8750
      Brazil       NaN
      Name: First Tier Top University, dtype: float64
```

```
[29]: type(new_df['mean']['First Tier Top University']) #observamos el tipo y vemos
      →que es una serie
```

```
[29]: pandas.core.series.Series
```

```
[30]: #si quiero encontrar el pais que tiene el mayor promedio para el First level
      →puedo usar idxmax:

      new_df['mean']['First Tier Top University'].idxmax()
```

```
[30]: 'United Kingdom'
```

```
[31]: new_df.head()
```

```
[31]:
```

	mean		
rank_level	First Tier Top University	Other Top University	
country			
Argentina	NaN	44.672857	
Australia	47.9425	44.645750	
Austria	NaN	44.864286	
Belgium	51.8750	45.081000	
Brazil	NaN	44.499706	

rank_level	Second Tier Top University	Third Tier Top University	All
country			
Argentina	NaN	NaN	44.672857
Australia	49.2425	47.285000	45.825517
Austria	NaN	47.066667	45.139583
Belgium	49.0840	46.746667	47.011000
Brazil	49.5650	NaN	44.781111


```

      amax
rank_level First Tier Top University Other Top University
country
Argentina      NaN      45.66
Australia      51.61      45.97
Austria        NaN      46.29
Belgium        52.03      46.21
Brazil         NaN      46.08

```

rank_level	Second Tier Top University	Third Tier Top University	All
country			
Argentina	NaN	NaN	45.66
Australia	50.40	47.47	51.61
Austria	NaN	47.78	47.78
Belgium	49.73	47.14	52.03
Brazil	49.82	NaN	49.82

[32]: *#vamos a usar stack (stack es transformar las columnas de menor categoria y*
→convertirlas en indices de las filas)

```
new_df = new_df.stack()
new_df.head()
```

[32]:

		mean	amax
country	rank_level		
Argentina	Other Top University	44.672857	45.66
	All	44.672857	45.66
Australia	First Tier Top University	47.942500	51.61
	Other Top University	44.645750	45.97
	Second Tier Top University	49.242500	50.40

[33]: *#ahora vamos a usar unstack (que es exactamente lo contrario que stack):*

```
new_df.unstack().head()
```

[33]:

	mean	\
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	44.672857
Australia	47.9425	44.645750
Austria	NaN	44.864286
Belgium	51.8750	45.081000
Brazil	NaN	44.499706

rank_level	Second Tier Top University	Third Tier Top University	All
country			
Argentina	NaN	NaN	44.672857
Australia	49.2425	47.285000	45.825517
Austria	NaN	47.066667	45.139583
Belgium	49.0840	46.746667	47.011000
Brazil	49.5650	NaN	44.781111

	amax	\
rank_level	First Tier Top University	Other Top University
country		
Argentina	NaN	45.66
Australia	51.61	45.97

Austria	NaN	46.29
Belgium	52.03	46.21
Brazil	NaN	46.08

rank_level	Second Tier	Top University	Third Tier	Top University	All
country					
Argentina		NaN		NaN	45.66
Australia	50.40			47.47	51.61
Austria		NaN		47.78	47.78
Belgium	49.73			47.14	52.03
Brazil	49.82			NaN	49.82

[34]: *#que paso si hago unstack dos veces?:*

```
new_df.unstack().unstack().head() #obtengo 3 indices distintos (mean/amax, ↵
→rank_level y country) y una serie de datos
```

```
[34]:      rank_level      country
mean First Tier Top University Argentina      NaN
      Australia      47.9425
      Austria      NaN
      Belgium      51.8750
      Brazil      NaN

dtype: float64
```

10 Date/Time Functionality

```
[2]: import pandas as pd
import numpy as np
```

- Pandas tiene 4 clases referidas al tiempo: Timestamp, DatetimeIndex, Period y PeriodIndex.

11 Timestamp

```
[36]: pd.Timestamp('9/1/2019 10:05AM') #puedo crear timestamp con un string
```

```
[36]: Timestamp('2019-09-01 10:05:00')
```

```
[38]: pd.Timestamp(2019, 12, 20, 0, 0, 30) #tambien le puedo pasar año, mes, día, ↵
→hora, minutos y segundos.
```

```
[38]: Timestamp('2019-12-20 00:00:30')
```

```
[39]: #tambien puedo ver que día cayó una fecha determinada, siendo 1 lunes y 7 ↵
→domingo:
```

```
pd.Timestamp(2019, 12, 20, 0, 0, 30).isoweekday() #cayó viernes el 20/12/2019
```

[39]: 5

```
[40]: #tambien puedo encontrar el valor del año, mes, día, hora, minutos y segundos
pd.Timestamp(2019, 12, 20, 0, 0, 30).second
```

[40]: 30

```
[42]: pd.Timestamp(2019, 12, 20, 0, 0, 30).year
```

[42]: 2019

12 Period

```
[43]: #Period se usa para un lapso de tiempo determinado, por ejemplo enero de 2016:
pd.Period('1/2016') #el M de la salida es la unidad mas chica de tiempo que se
→encuentra, en esta caso el mes (month)
```

[43]: Period('2016-01', 'M')

```
[46]: pd.Period('3/5/2016') #ahora la salida nos marca D, es decir el día (day). La
→anotacion es mes/día/año. La salida es año/mes/día
```

[46]: Period('2016-03-05', 'D')

```
[3]: #se pueden hacer cuantas con el tiempo:
```

```
pd.Period('1/2016') + 5
```

[3]: Period('2016-06', 'M')

```
[4]: pd.Period('3/5/2016') - 2 #siempre usa la unidad mas chica para hacer la
→cuenta, en este caso los días
```

[4]: Period('2016-03-03', 'D')

13 DatetimeIndex and PeriodIndex

- DatetimeIndex es un timestamp pero usado como indice. Analogamente para Period y PeriodIndex

```
[13]: #ejemplo de DatetimeIndex:
```

```
t1 = pd.Series(list('abc'), [pd.Timestamp('2016-9-01'), pd.
→Timestamp('2016-9-02'), pd.Timestamp('2016-9-03')])
t1
```

```
[13]: 2016-09-01    a
      2016-09-02    b
      2016-09-03    c
      dtype: object
```

```
[14]: type(t1.index) #veo el tipo del indice
```

```
[14]: pandas.core.indexes.datetimes.DatetimeIndex
```

```
[17]: t2 = pd.Series(list('def'), [pd.Period('2016-09'), pd.Period('2016-10'), pd.
      ↪Period('2016-11')])
      t2
```

```
[17]: 2016-09    d
      2016-10    e
      2016-11    f
      Freq: M, dtype: object
```

```
[18]: type(t2.index)
```

```
[18]: pandas.core.indexes.period.PeriodIndex
```

14 Converting to Datetime

```
[21]: #esto sirve para convertir muchos tipos de anotacion de tiempo en una standar
```

```
d1 = ['2 June 2013', 'Aug 29, 2014', '2015-06-26', '7/12/16']
ts3 = pd.DataFrame(np.random.randint(10, 100, (4,2)), index=d1,
      ↪columns=list('ab'))
ts3
```

```
[21]:
```

	a	b
2 June 2013	50	28
Aug 29, 2014	34	49
2015-06-26	39	22
7/12/16	94	48

```
[23]: ts3.index = pd.to_datetime(ts3.index)
      ts3
```

```
[23]:
```

	a	b
2013-06-02	50	28
2014-08-29	34	49
2015-06-26	39	22
2016-07-12	94	48

```
[24]: #tambien se puede poner dayfirst para indicar tipo de fecha europea:
```

```
pd.to_datetime('4.7.12', dayfirst=True) #en este caso el 4 es el dia
```

```
[24]: Timestamp('2012-07-04 00:00:00')
```

15 Timedelta

- Es la diferencia entre dos tiempos

```
[26]: pd.Timestamp('9/3/2016') - pd.Timestamp('9/1/2016')
[26]: Timedelta('2 days 00:00:00')
[27]: pd.Timestamp('9/2/2016 8:10AM') + pd.Timedelta('12D 3H')  #a una fecha
      ↪determinada le agrego 12 dias y 3 horas
[27]: Timestamp('2016-09-14 11:10:00')
```

16 Offset

- Es similar timedelta, pero sigue mas las reglas del calendario

```
[28]: pd.Timestamp('9/4/2016') + pd.offsets.Week()  #le agrego una semana
[28]: Timestamp('2016-09-11 00:00:00')
[29]: pd.Timestamp('9/1/2016') + pd.offsets.MonthEnd()  #voy hasta el ultimo dia del
      ↪mes
[29]: Timestamp('2016-09-30 00:00:00')
```

17 Working with Dates in a DataFrame

```
[31]: #tambien se pueden armar rangos de fechas:

dates = pd.date_range('10-01-2016', periods=9, freq='2W-SUN') #le digo que es a
      ↪partir del 1/10/2016, que quiero 9 periodos y
      #que la frecuencia es domingo por medio
dates

[31]: DatetimeIndex(['2016-10-02', '2016-10-16', '2016-10-30', '2016-11-13',
                    '2016-11-27', '2016-12-11', '2016-12-25', '2017-01-08',
                    '2017-01-22'],
                    dtype='datetime64[ns]', freq='2W-SUN')

[32]: #hay muchas frecuencias comunes, una de ellas es el dia laburable (business
      ↪day):

pd.date_range('10-01-2016', periods=9, freq='B')

[32]: DatetimeIndex(['2016-10-03', '2016-10-04', '2016-10-05', '2016-10-06',
                    '2016-10-07', '2016-10-10', '2016-10-11', '2016-10-12',
                    '2016-10-13'],
                    dtype='datetime64[ns]', freq='B')

[33]: #otro es trimestral (quarterly) en este caso arrancando en junio:

pd.date_range('04-01-2016', periods=12, freq='QS-JUN')
```

```
[33]: DatetimeIndex(['2016-06-01', '2016-09-01', '2016-12-01', '2017-03-01',
                    '2017-06-01', '2017-09-01', '2017-12-01', '2018-03-01',
                    '2018-06-01', '2018-09-01', '2018-12-01', '2019-03-01'],
                    dtype='datetime64[ns]', freq='QS-JUN')
```

```
[34]: #vamos a volver al ejemplo anterior y crear un dataframe:
```

```
dates = pd.date_range('10-01-2016', periods=9, freq='2W-SUN')
df = pd.DataFrame({'Count 1': 100 + np.random.randint(-5, 10, 9).cumsum(),
                  'Count 2': 120 + np.random.randint(-5, 10, 9)}, index=dates)
df
```

```
[34]:
```

	Count 1	Count 2
2016-10-02	106	118
2016-10-16	103	126
2016-10-30	100	126
2016-11-13	95	125
2016-11-27	91	125
2016-12-11	90	121
2016-12-25	96	120
2017-01-08	92	116
2017-01-22	100	119

```
[35]: df.index.weekday_name #con esto obtengo el nombre del dia, obviamente son todos
      ↪ domingos porque asi lo seteamos
```

```
[35]: Index(['Sunday', 'Sunday', 'Sunday', 'Sunday', 'Sunday', 'Sunday', 'Sunday',
            'Sunday', 'Sunday'],
            dtype='object')
```

```
[36]: df.diff() #obtengo la diferencia de valores con respecto al anterior
```

```
[36]:
```

	Count 1	Count 2
2016-10-02	NaN	NaN
2016-10-16	-3.0	8.0
2016-10-30	-3.0	0.0
2016-11-13	-5.0	-1.0
2016-11-27	-4.0	0.0
2016-12-11	-1.0	-4.0
2016-12-25	6.0	-1.0
2017-01-08	-4.0	-4.0
2017-01-22	8.0	3.0

```
[37]: df.resample('M').mean() #calculo es promedio para cada mes
```

```
[37]:
```

	Count 1	Count 2
2016-10-31	103.0	123.333333
2016-11-30	93.0	125.000000
2016-12-31	93.0	120.500000
2017-01-31	96.0	117.500000

[38]: *#para hacer slice puedo simplemente poner el año que quiero:*

```
df['2017']
```

[38]:

	Count 1	Count 2
2017-01-08	92	116
2017-01-22	100	119

[39]: *df['2016-12'] #puedo hacer lo mismo poniendo año y mes*

[39]:

	Count 1	Count 2
2016-12-11	90	121
2016-12-25	96	120

[40]: *#para obtener los datos de diciembre de 2016 en adelante:*

```
df['2016-12':]
```

[40]:

	Count 1	Count 2
2016-12-11	90	121
2016-12-25	96	120
2017-01-08	92	116
2017-01-22	100	119

[]: