Population and houses growth in Switzerland

Contents

Switzerland is known for its high standard of living and picturesque landscapes, making it a popular destination for expats, students, and travelers. However, it is also known for its high cost of living, including housing prices. Renting a flat in Switzerland can be expensive, especially in larger cities such as Zurich, Geneva, and Basel.

The scope of this article is a study to correlate the prices of the house in francs/m2 and correlating them with population. The data used is provided by opendata.swiss and the information of this paper is free of charge.

Data Mining & Preprocessing

All data used in this study was retrieved from opendata.swiss which is the Swiss public administration's central portal for open government data.

Several files with CSV and XLS extensions were used and adapted to provide a full dataset of information regarding population growth, buildings construction and price variation through the years.

Population data set cover 1950-2020, classified by sex, provenience & canton

Building construction dataset on the other side starts in 2003 to 2020 classified by flat or building & canton

Last set is about price per m2 in swiss francs. This set starts in 2012 until 2020 classified by canton & year of construction, from older than 1919 up to 2021. For our purpose, average through canton value was used in order to homogenize data accross years and building age.

Population data was truncated to start in 2003 to match building construction data set.

Analysis

For the analysis few statistical indicatore were used:

- Arithmetic mean, also known as the average, is a measure of central tendency that represents the typical value of a set of numbers. It is calculated by adding up all the values in a set and then dividing the sum by the number of values in the set. The arithmetic mean is commonly used in statistics to summarize the data and to compare different sets of data. It is a useful measure of central tendency when the data is evenly distributed and does not have any extreme outliers. However, it can be influenced by outliers, and in such cases, other measures of central tendency such as the median or mode may be more appropriate. Defined as:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

- Standard deviation, The standard deviation is a measure of the amount of variation or dispersion in a set of data. It is calculated as the square root of the variance, which is the average of the squared differences of each value from the mean. The standard deviation is commonly used in statistics to describe the spread of a distribution, with a higher standard deviation indicating a wider spread of values and a lower standard deviation indicating a narrower spread of values. It is also used in inferential statistics to calculate confidence intervals and to test hypotheses about the population from which the sample was drawn. Defined as:

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

After calculations, graphs were constructed to visualize data and get information.

Results

Population Data

Data recall population from year 1950 until 2020.

```
 opts = delimitedTextImportOptions("NumVariables", 4, "Encoding", "UTF-8");

 % Specify range and delimiter
 opts.DataLines = [2, Inf];
 opts.Delimiter = ";";

 % Specify column names and types
 opts.VariableNames = ["YEAR", "SEX", "CITIZENSHIP_CATEGORY", "VALUE"];
 opts.VariableTypes = ["double", "categorical", "categorical", "double"];

 % Specify file level properties
 opts.ExtraColumnsRule = "ignore";
 opts.EmptyLineRule = "read";

 % Specify variable properties
 opts = setvaropts(opts, ["SEX", "CITIZENSHIP_CATEGORY"], "EmptyFieldRule",
"auto");

 % Import the data
 data = readtable("C:\Users\Ale\Documents\MATLAB\Datasets\Swiss Population
Statistics
Inhabitants\Permanentresidentpopulationbycategoryofcitizenshipandsex1950_2021.cs
v", opts);
 data.Properties.VariableNames(1) = "year";
 data.Properties.VariableNames(2) = "sex";
 data.Properties.VariableNames(3) = "citizenship";
 data.Properties.VariableNames(4) = "value"
```

data = 648×4 table

	year	sex	citizenship	value
1	1950	T	T	4717200
2	1951	T	T	4778900
3	1952	T	T	4844100
4	1953	T	T	4907000
5	1954	T	T	4970300
6	1955	T	T	5033700
7	1956	T	T	5097400
8	1957	T	T	5162800

	year	sex	citizenship	value
9	1958	T	T	5230000
10	1959	T	T	5295500
11	1960	T	T	5360153
12	1961	T	T	5508435
13	1962	T	T	5639195
14	1963	T	T	5749299
15	1964	T	T	5829156
16	1965	T	T	5883788
17	1966	T	T	5952216
18	1967	T	T	6031353
19	1968	T	T	6104074
20	1969	T	T	6168700
21	1970	T	T	6193064
22	1971	T	T	6233744
23	1972	T	T	6288168
24	1973	T	T	6326525
25	1974	T	T	6356285
26	1975	T	T	6320978
27	1976	T	T	6284029
28	1977	T	T	6278319
29	1978	T	T	6285156
30	1979	T	T	6303573
31	1980	T	T	6335243
32	1981	T	T	6372904
33	1982	T	T	6409713
34	1983	T	T	6427833
35	1984	T	T	6455896
36	1985	T	T	6484834
37	1986	T	T	6523413
38	1987	T	T	6566799
39	1988	T	T	6619973
40	1989	T	T	6673850
41	1990	T	T	6750693
42	1991	T	T	6842768

	year	sex	citizenship	value
43	1992	T	T	6907959
44	1993	T	T	6968570
45	1994	T	T	7019019
46	1995	T	T	7062354
47	1996	T	T	7081346
48	1997	T	T	7096465
49	1998	T	T	7123537
50	1999	T	T	7164444
51	2000	T	T	7204055
52	2001	T	T	7255653
53	2002	T	T	7313853
54	2003	T	T	7364148
55	2004	T	T	7415102
56	2005	T	T	7459128
57	2006	T	T	7508739
58	2007	T	T	7593494
59	2008	T	T	7701856
60	2009	T	T	7785806
61	2010	T	T	7870134
62	2011	T	T	7954662
63	2012	T	T	8039060
64	2013	T	T	8139631
65	2014	T	T	8237666
66	2015	T	T	8327126
67	2016	T	T	8419550
68	2017	T	T	8484130
69	2018	T	T	8544527
70	2019	T	T	8606033
71	2020	T	T	8670300
72	2021	T	T	8738791
73	1950	M	T	2273200
74	1951	M	T	2304500
75	1952	M	T	2337400
76	1953	M	T	2369100

	year	sex	citizenship	value
77	1954	M	T	2401000
78	1955	M	T	2433100
79	1956	M	T	2465600
80	1957	M	T	2498400
81	1958	M	T	2532300
82	1959	M	T	2565100
83	1960	M	T	2597198
84	1961	M	T	2672561
85	1962	M	T	2740094
86	1963	M	T	2797025
87	1964	M	T	2838367
88	1965	M	T	2867046
89	1966	M	T	2902660
90	1967	M	T	2943508
91	1968	M	T	2980991
92	1969	M	T	3013995
93	1970	M	T	3025330
94	1971	M	T	3045356
95	1972	M	T	3070840
96	1973	M	T	3086951
97	1974	M	T	3099698
98	1975	M	T	3079816
99	1976	M	T	3059865
100	1977	M	T	3055365

⋮

T= total value

M= Male

F= Female

CH= Swiss citizenship

F= Foreigner citizenship

```
clear opts
```

After importing data, it is usefull to display visual information of total values both for sex and citizenship. With this filter, the data is reduced up to 72 rows.

```
tPop=data.sex=="T" & data.citizenship=="T";
totalPop=data(tPop,:)
```

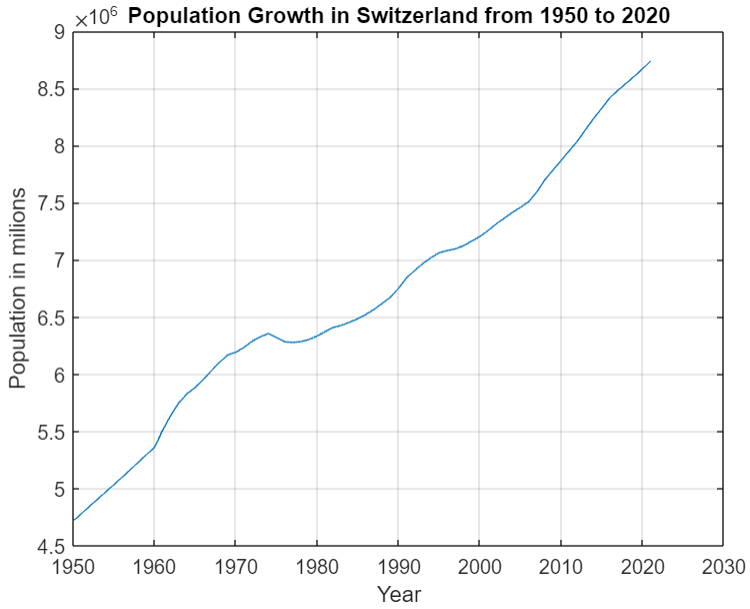
totalPop = 72×4 table

	year	sex	citizenship	value
1	1950	T	T	4717200
2	1951	T	T	4778900
3	1952	T	T	4844100
4	1953	T	T	4907000
5	1954	T	T	4970300
6	1955	T	T	5033700
7	1956	T	T	5097400
8	1957	T	T	5162800
9	1958	T	T	5230000
10	1959	T	T	5295500
11	1960	T	T	5360153
12	1961	T	T	5508435
13	1962	T	T	5639195
14	1963	T	T	5749299
15	1964	T	T	5829156
16	1965	T	T	5883788
17	1966	T	T	5952216
18	1967	T	T	6031353
19	1968	T	T	6104074
20	1969	T	T	6168700
21	1970	T	T	6193064
22	1971	T	T	6233744
23	1972	T	T	6288168
24	1973	T	T	6326525
25	1974	T	T	6356285
26	1975	T	T	6320978
27	1976	T	T	6284029
28	1977	T	T	6278319
29	1978	T	T	6285156

	year	sex	citizenship	value
30	1979	T	T	6303573
31	1980	T	T	6335243
32	1981	T	T	6372904
33	1982	T	T	6409713
34	1983	T	T	6427833
35	1984	T	T	6455896
36	1985	T	T	6484834
37	1986	T	T	6523413
38	1987	T	T	6566799
39	1988	T	T	6619973
40	1989	T	T	6673850
41	1990	T	T	6750693
42	1991	T	T	6842768
43	1992	T	T	6907959
44	1993	T	T	6968570
45	1994	T	T	7019019
46	1995	T	T	7062354
47	1996	T	T	7081346
48	1997	T	T	7096465
49	1998	T	T	7123537
50	1999	T	T	7164444
51	2000	T	T	7204055
52	2001	T	T	7255653
53	2002	T	T	7313853
54	2003	T	T	7364148
55	2004	T	T	7415102
56	2005	T	T	7459128
57	2006	T	T	7508739
58	2007	T	T	7593494
59	2008	T	T	7701856
60	2009	T	T	7785806
61	2010	T	T	7870134
62	2011	T	T	7954662
63	2012	T	T	8039060

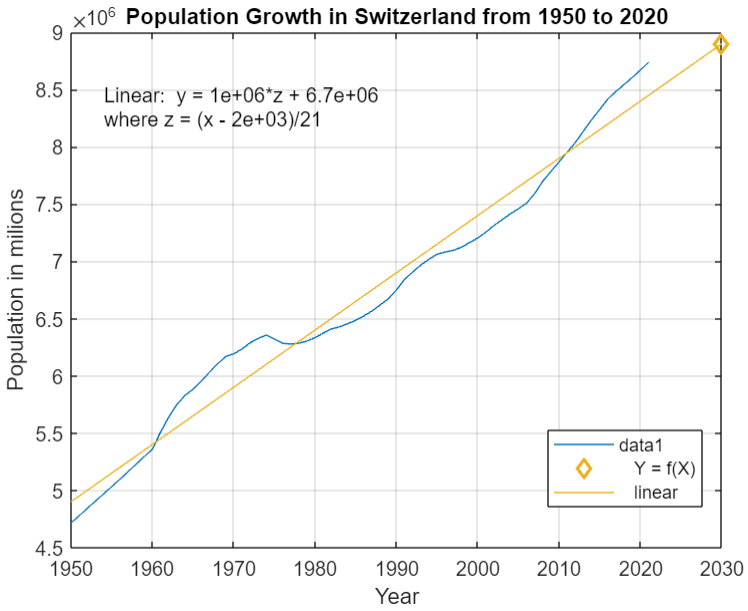
	year	sex	citizenship	value
64	2013	T	T	8139631
65	2014	T	T	8237666
66	2015	T	T	8327126
67	2016	T	T	8419550
68	2017	T	T	8484130
69	2018	T	T	8544527
70	2019	T	T	8606033
71	2020	T	T	8670300
72	2021	T	T	8738791

```
plot(totalPop.year,totalPop.value);
grid on
xlabel Year
ylabel 'Population in milions'
title 'Population Growth in Switzerland from 1950 to 2020'
```



As can be seen, the trend is constantly growing. This value is already corrected with births & deads.

```
createfigure(totalPop.year,totalPop.value,2030)
```



Adding a linear trend, gives that in 2030 the population will be around 9 millions.

Since data starts from 2003, we have to truncate data accordingly to avoid un balance in the analysis.

```
adjPopidx=data.sex=="T" & data.citizenship=="T" & data.year>=2003;
adjPop=data(adjPopidx,:)
```

adjPop = 19×4 table

	year	sex	citizenship	value
1	2003	T	T	7364148
2	2004	T	T	7415102
3	2005	T	T	7459128
4	2006	T	T	7508739
5	2007	T	T	7593494
6	2008	T	T	7701856
7	2009	T	T	7785806
8	2010	T	T	7870134
9	2011	T	T	7954662
10	2012	T	T	8039060
11	2013	T	T	8139631
12	2014	T	T	8237666
13	2015	T	T	8327126

	year	sex	citizenship	value
14	2016	T	T	8419550
15	2017	T	T	8484130
16	2018	T	T	8544527
17	2019	T	T	8606033
18	2020	T	T	8670300
19	2021	T	T	8738791

To have further detail on population, it is possible to use population change by canton. The last column refers to standar deviation, a usefull indicator to see data variation through the years

```
opts = delimitedTextImportOptions("NumVariables", 22);

% Specify range and delimiter
opts.DataLines = [2, Inf];
opts.Delimiter = ";";

% Specify column names and types
opts.VariableNames = ["canton", "y2000", "y2001", "y2002", "y2003", "y2004",
"y2005", "y2006", "y2007", "y2008", "y2009", "y2010", "y2011", "y2012", "y2013",
"y2014", "y2015", "y2016", "y2017", "y2018", "y2019", "y2020"];
opts.VariableTypes = ["categorical", "double", "double", "double", "double",
"double", "double", "double", "double", "double", "double", "double", "double",
"double", "double", "double", "double", "double", "double", "double", "double",
"double"];

% Specify file level properties
opts.ExtraColumnsRule = "ignore";
opts.EmptyLineRule = "read";

% Specify variable properties
opts = setvaropts(opts, "canton", "EmptyFieldRule", "auto");

% Import the data
popCanton = readtable("C:\Users\Ale\Documents\MATLAB\Datasets\Swiss Population
Statistics Inhabitants\swiss population 2000-2020 by canton.csv", opts);
cantonStd=rowfun(@std,popCanton(:,(2:end)),"SeparateInputs",false);
cantonStd.Properties.VariableNames(1) = "std";
popCanton = [popCanton, cantonStd]
```

popCanton = 26×23 table

	canton	y2000	y2001	y2002	y2003	y2004	y2005	…
1	VD	620294	624980	631039	639105	647382	654093	

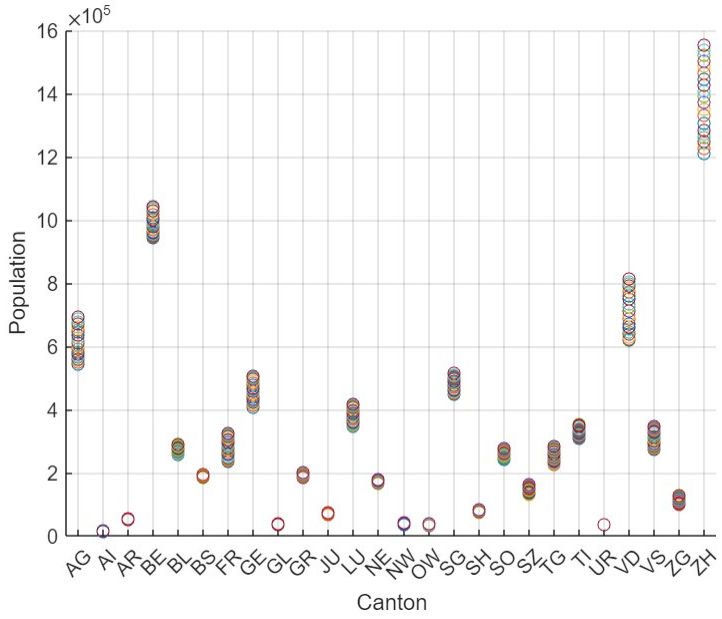
	canton	y2000	y2001	y2002	y2003	y2004	y2005	...
2	VS	276170	278419	281345	285008	287976	291575	
3	GE	408820	413618	418747	423993	427396	430638	
4	BE	943696	946310	949590	951957	955378	957064	
5	FR	236339	240339	243400	246656	250377	253954	
6	SO	244015	245264	246280	246807	247379	247937	
7	NE	165731	166227	166767	167047	167910	168444	
8	JU	68794	68930	69074	69064	69091	69110	
9	BS	187667	186469	186719	186653	186753	185601	
10	BL	260036	261083	262949	264402	265305	266089	
11	AG	544306	550298	555782	560674	565122	569344	
12	ZH	1211647	1226931	1241312	1249893	1261810	1272590	
13	GL	38546	38216	38322	38502	38317	38173	
14	SH	73305	73229	73834	73968	73788	73764	
15	AR	53515	53138	53097	52976	52841	52561	
16	AI	15021	14977	14985	15010	15029	15220	
17	SG	449399	452904	455251	457289	458821	459999	
18	GR	186744	185225	185771	186943	187812	187803	
19	TG	227306	228206	229904	231836	232978	234332	
20	LU	347209	350017	351889	353175	354731	356384	
21	UR	35246	34992	35209	35118	35083	35087	
22	SZ	130232	131264	133227	134903	135989	137522	
23	OW	32414	32678	32961	33142	33162	33269	
24	NW	38000	38389	38736	39070	39497	39803	
25	ZG	99388	101022	102407	103642	105244	106496	
26	TI	310215	312528	315256	317315	319931	322276	

```
clear opts
```

After loading population by canton, visualization can help to see if there are some changes during the years

```
scatter(popCanton.canton,popCanton.y2000)
hold on
scatter(popCanton.canton,popCanton.y2001);
scatter(popCanton.canton,popCanton.y2002)
scatter(popCanton.canton,popCanton.y2003)
```

```
scatter(popCanton.canton,popCanton.y2004)
scatter(popCanton.canton,popCanton.y2005)
scatter(popCanton.canton,popCanton.y2006)
scatter(popCanton.canton,popCanton.y2007)
scatter(popCanton.canton,popCanton.y2008)
scatter(popCanton.canton,popCanton.y2009)
scatter(popCanton.canton,popCanton.y2010)
scatter(popCanton.canton,popCanton.y2011)
scatter(popCanton.canton,popCanton.y2012)
scatter(popCanton.canton,popCanton.y2013)
scatter(popCanton.canton,popCanton.y2014)
scatter(popCanton.canton,popCanton.y2015)
scatter(popCanton.canton,popCanton.y2016)
scatter(popCanton.canton,popCanton.y2017)
scatter(popCanton.canton,popCanton.y2018)
scatter(popCanton.canton,popCanton.y2019)
scatter(popCanton.canton,popCanton.y2020)
hold off
grid on
xlabel("Canton")
ylabel ("Population")
```



It is easy to see that the cantons with most variation in 20 years are as follows:

```
stdCanton = popCanton(:,[1,23])
```

```
stdCanton = 26×2 table
```

	canton	std

	canton	std
1	VD	6.5977e+04
2	VS	2.4518e+04
3	GE	3.1423e+04
4	BE	3.4157e+04
5	FR	2.9784e+04
6	SO	1.0932e+04
7	NE	4.4527e+03
8	JU	1.8320e+03
9	BS	3.8168e+03
10	BL	9.9508e+03
11	AG	4.8707e+04
12	ZH	1.1128e+05
13	GL	941.1761
14	SH	3.3936e+03
15	AR	997.6485
16	AI	435.1522
17	SG	2.1347e+04
18	GR	4.8576e+03
19	TG	1.8646e+04
20	LU	2.3237e+04
21	UR	596.3343
22	SZ	1.0087e+04
23	OW	1.9716e+03
24	NW	1.6780e+03
25	ZG	9.4276e+03
26	TI	1.5251e+04

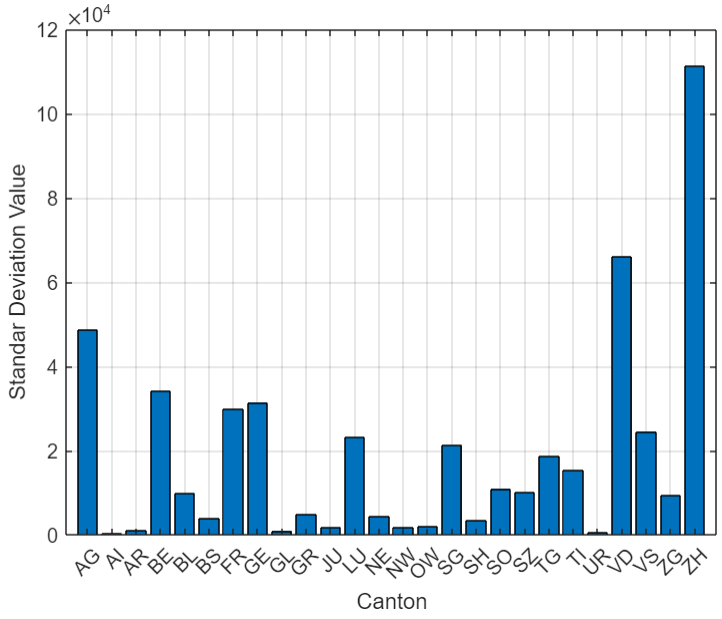
```
stdCanton = sortrows(stdCanton, "std", "descend")
```

stdCanton = 26×2 table

	canton	std
1	ZH	1.1128e+05
2	VD	6.5977e+04
3	AG	4.8707e+04
4	BE	3.4157e+04

	canton	std
5	GE	3.1423e+04
6	FR	2.9784e+04
7	VS	2.4518e+04
8	LU	2.3237e+04
9	SG	2.1347e+04
10	TG	1.8646e+04
11	TI	1.5251e+04
12	SO	1.0932e+04
13	SZ	1.0087e+04
14	BL	9.9508e+03
15	ZG	9.4276e+03
16	GR	4.8576e+03
17	NE	4.4527e+03
18	BS	3.8168e+03
19	SH	3.3936e+03
20	OW	1.9716e+03
21	JU	1.8320e+03
22	NW	1.6780e+03
23	AR	997.6485
24	GL	941.1761
25	UR	596.3343
26	AI	435.1522

```
bar(stdCanton.canton,stdCanton.std)
grid on
xlabel Canton
ylabel 'Standar Deviation Value'
```



Higher values means high variation in positive(growing) direction

Houses Data

Data about constructions in switzerland is imported. This data covers from 2003 to 2020.

```
opts = delimitedTextImportOptions("NumVariables", 15);

% Specify range and delimiter
opts.DataLines = [2, Inf];
opts.Delimiter = ";";

% Specify column names and types
opts.VariableNames = ["year", "total", "buildings", "flats", "Rbuilding",
"Rflats", "VarName7", "VarName8", "VarName9", "VarName10", "VarName11",
"VarName12", "VarName13", "VarName14", "VarName15"];
opts.VariableTypes = ["double", "double", "double", "double", "double",
"double", "double", "double", "double", "double", "double", "string", "string",
"string", "string"];

% Specify file level properties
opts.ExtraColumnsRule = "ignore";
opts.EmptyLineRule = "read";

% Specify variable properties
opts = setvaropts(opts, ["VarName12", "VarName13", "VarName14", "VarName15"],
"WhitespaceRule", "preserve");
```

```
 opts = setvaropts(opts, ["VarName12", "VarName13", "VarName14", "VarName15"],
"EmptyFieldRule", "auto");

 % Import the data
 housesswiss = readtable("C:\Users\Ale\Documents\MATLAB\Datasets\Swiss
Population Statistics Inhabitants\houses swiss 2003 2020.csv", opts);
 housesswiss = removevars(housesswiss,
["VarName7","VarName8","VarName9","VarName10","VarName11","VarName12","VarName13
","VarName14","VarName15"])
```

housesswiss = 18×6 table

	year	total	buildings	flats	Rbuilding	Rflats
1	2003	47298	15202	32096	15019	31653
2	2004	54241	17306	36935	17109	36511
3	2005	54948	16990	37958	16831	37603
4	2006	59181	17192	41989	17029	41483
5	2007	59966	17051	42915	16892	42578
6	2008	60869	16678	44191	16512	43524
7	2009	53899	14166	39733	14007	39258
8	2010	58368	14736	43632	14580	43287
9	2011	62167	14993	47174	14844	46646
10	2012	56913	13779	43134	13600	42501
11	2013	64342	14176	50166	13959	49052
12	2014	62400	13238	49162	13026	47897
13	2015	66559	13433	53126	13198	52321
14	2016	64735	12701	52034	12459	50488
15	2017	62524	12315	50209	12074	49216
16	2018	65389	12190	53199	11968	51699
17	2019	59455	11160	48295	10973	47229
18	2020	59949	10635	49314	10450	48381

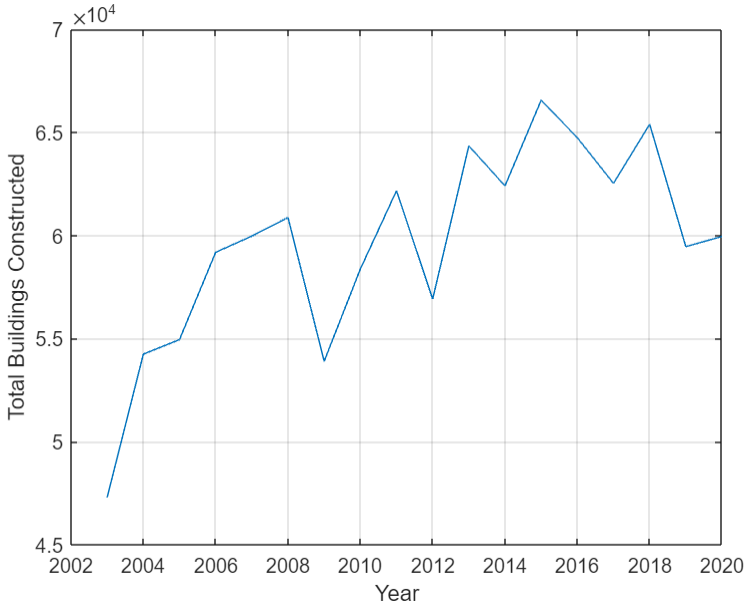
For our study we will use only the total and year columns, so data will be filtered.

```
clear opts
```

Plotting the data above, gives a better description of the situation.

```
plot(housesswiss.year,housesswiss.total)
grid on
```

```
xlabel Year
ylabel 'Total Buildings Constructed'
```



It is clearly visible that the number of new construction reaches its peak in 2015 and then change its direction to the lower values.

Rent average price m2/chf

Data is categorized by canton and year, from 2012 to 2020 and the value is expressed as average through 26 cantons. Due to lowering number of new construction, one can say that prices will growth. For this reason, this dataset can be usefull to study if there are some variation in the prices. Note that this values includes existing buildings and new constructed. Original dataset considers building older that 1919 up to 2021. For practical purposes, data was filtered.

```
opts = spreadsheetImportOptions("NumVariables", 10);

% Specify sheet and range
opts.Sheet = "Sheet1";
opts.DataRange = "A2:J27";

% Specify column names and types
opts.VariableNames = ["canton", "y2020", "y2019", "y2018", "y2017", "y2016",
"y2015", "y2014", "y2013", "y2012"];
opts.VariableTypes = ["categorical", "double", "double", "double", "double",
"double", "double", "double", "double", "double"];

% Specify variable properties
opts = setvaropts(opts, "canton", "EmptyFieldRule", "auto");
```

```
% Import the data
avgpricem2swiss = readtable("C:\Users\Ale\Documents\MATLAB\Datasets\Swiss Population Statistics Inhabitants\avgpricem2swiss.xlsx", opts, "UseExcel", false)
```

avgpricem2swiss = 26×10 table

	canton	y2020	y2019	y2018	y2017	y2016	y2015	…
1	ZH	19.3000	19.2000	19.1000	18.6000	18.6000	18.2000	
2	BE	15.1000	15	14.7000	14.4000	14.3000	14.1000	
3	LU	15.4000	15.5000	15.1000	15	15	14.9000	
4	UR	13	13.1000	13.1000	12.9000	13	13.1000	
5	SZ	16.7000	16.6000	16.8000	16.3000	16.5000	16.5000	
6	OW	14.5000	14.2000	13.7000	13.8000	13.8000	13.2000	
7	NW	16.1000	15.7000	15.8000	15.7000	15	15.3000	
8	GL	13.3000	12.7000	12.8000	12.6000	12.3000	11.6000	
9	ZG	19.4000	19.5000	19.4000	19.5000	19.5000	19.3000	
10	FR	14.7000	14.6000	14.6000	14.4000	14.1000	14.1000	
11	SO	14	13.9000	13.5000	13.3000	13.5000	13.2000	
12	BS	18.2000	18.2000	18	17.2000	17.2000	16.9000	
13	BL	17	16.8000	16.8000	16.6000	16.1000	16	
14	SH	13.7000	13.6000	13.4000	13.3000	13.1000	13.1000	
15	AR	13.1000	12.9000	13	12.7000	13	12.6000	
16	AI	14.6000	14.8000	13.7000	13.3000	12.6000	13.3000	
17	SG	14.2000	14.2000	14.1000	13.8000	13.7000	13.6000	
18	GR	15.2000	15.2000	15	14.9000	14.7000	14.9000	
19	AR	15.4000	15.2000	15.1000	14.8000	14.8000	14.7000	
20	TG	13.8000	13.6000	13.3000	13.2000	13	12.9000	
21	TI	14	13.8000	13.7000	13.4000	13.4000	13.3000	
22	VD	18	17.6000	17.5000	17.1000	17	16.7000	
23	VS	14.1000	13.9000	13.8000	13.7000	13.2000	13.1000	
24	NE	12.8000	12.6000	12.5000	12.1000	12	11.8000	
25	GE	19.7000	19.5000	19.1000	18.7000	18.6000	18.5000	
26	JU	11.6000	11.8000	10.9000	11	10.9000	10.7000	

As done for population, calculating standard deviation of the price can give a visual result of the variation of the price, classified by canton

```
avgPriceStd=rowfun(@std,avgpricem2swiss(:,(2:end)),"SeparateInputs",false);
avgPriceStd.Properties.VariableNames(1)="std"
```

avgPriceStd = 26×1 table

	std
1	0.3606
2	0.3193
3	0.2007
4	0.1563
5	0.1641
6	0.3905
7	0.3972
8	0.5099
9	0.1667
10	0.2635
11	0.2587
12	0.5434
13	0.3308
14	0.3032
15	0.2224
16	0.6846
17	0.2297
18	0.2522
19	0.2315
20	0.2872
21	0.2398
22	0.4256
23	0.3279
24	0.3464
25	0.4106
26	0.3801

```
avgpricem2swiss=[avgpricem2swiss,avgPriceStd]
```

avgpricem2swiss = 26×11 table

	canton	y2020	y2019	y2018	y2017	y2016	y2015	…
1	ZH	19.3000	19.2000	19.1000	18.6000	18.6000	18.2000	

	canton	y2020	y2019	y2018	y2017	y2016	y2015	...
2	BE	15.1000	15	14.7000	14.4000	14.3000	14.1000	
3	LU	15.4000	15.5000	15.1000	15	15	14.9000	
4	UR	13	13.1000	13.1000	12.9000	13	13.1000	
5	SZ	16.7000	16.6000	16.8000	16.3000	16.5000	16.5000	
6	OW	14.5000	14.2000	13.7000	13.8000	13.8000	13.2000	
7	NW	16.1000	15.7000	15.8000	15.7000	15	15.3000	
8	GL	13.3000	12.7000	12.8000	12.6000	12.3000	11.6000	
9	ZG	19.4000	19.5000	19.4000	19.5000	19.5000	19.3000	
10	FR	14.7000	14.6000	14.6000	14.4000	14.1000	14.1000	
11	SO	14	13.9000	13.5000	13.3000	13.5000	13.2000	
12	BS	18.2000	18.2000	18	17.2000	17.2000	16.9000	
13	BL	17	16.8000	16.8000	16.6000	16.1000	16	
14	SH	13.7000	13.6000	13.4000	13.3000	13.1000	13.1000	
15	AR	13.1000	12.9000	13	12.7000	13	12.6000	
16	AI	14.6000	14.8000	13.7000	13.3000	12.6000	13.3000	
17	SG	14.2000	14.2000	14.1000	13.8000	13.7000	13.6000	
18	GR	15.2000	15.2000	15	14.9000	14.7000	14.9000	
19	AR	15.4000	15.2000	15.1000	14.8000	14.8000	14.7000	
20	TG	13.8000	13.6000	13.3000	13.2000	13	12.9000	
21	TI	14	13.8000	13.7000	13.4000	13.4000	13.3000	
22	VD	18	17.6000	17.5000	17.1000	17	16.7000	
23	VS	14.1000	13.9000	13.8000	13.7000	13.2000	13.1000	
24	NE	12.8000	12.6000	12.5000	12.1000	12	11.8000	
25	GE	19.7000	19.5000	19.1000	18.7000	18.6000	18.5000	
26	JU	11.6000	11.8000	10.9000	11	10.9000	10.7000	

Extracting standard deviation and canton is necessary to show prices variation during the years

```
stdCantonAvgprice=avgpricem2swiss(:,[1,11]);
stdCantonAvgprice=sortrows(stdCantonAvgprice,"std","descend")
```

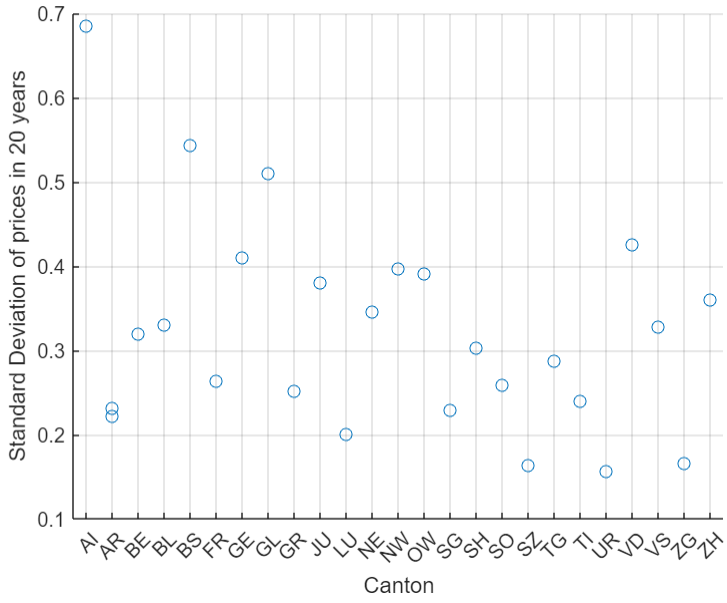
stdCantonAvgprice = 26×2 table

	canton	std
1	AI	0.6846

	canton	std
2	BS	0.5434
3	GL	0.5099
4	VD	0.4256
5	GE	0.4106
6	NW	0.3972
7	OW	0.3905
8	JU	0.3801
9	ZH	0.3606
10	NE	0.3464
11	BL	0.3308
12	VS	0.3279
13	BE	0.3193
14	SH	0.3032
15	TG	0.2872
16	FR	0.2635
17	SO	0.2587
18	GR	0.2522
19	TI	0.2398
20	AR	0.2315
21	SG	0.2297
22	AR	0.2224
23	LU	0.2007
24	ZG	0.1667
25	SZ	0.1641
26	UR	0.1563

And finally plotting

```
scatter(avgpricem2swiss.canton,avgpricem2swiss.std)
grid on
xlabel Canton
ylabel 'Standard Deviation of prices in 20 years'
```



As can be seen from graph above, the highest increase in the renting price of a house is as follow, including difference between 2012 and 2020 prices and calculate the difference.

```
stdCantonTopAvgprice=avgpricem2swiss(:,[1,2,10]);
```

```
difference=stdCantonTopAvgprice.y2020-stdCantonTopAvgprice.y2012;
difference=table(difference);
stdCantonTopAvgprice=[stdCantonTopAvgprice,difference]
```

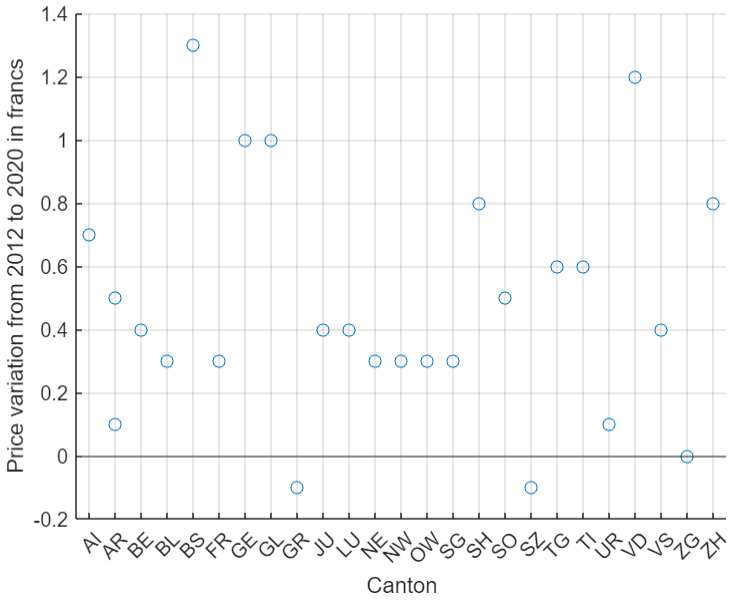
stdCantonTopAvgprice = 26×4 table

	canton	y2020	y2012	difference
1	ZH	19.3000	18.5000	0.8000
2	BE	15.1000	14.7000	0.4000
3	LU	15.4000	15	0.4000
4	UR	13	12.9000	0.1000
5	SZ	16.7000	16.8000	-0.1000
6	OW	14.5000	14.2000	0.3000
7	NW	16.1000	15.8000	0.3000
8	GL	13.3000	12.3000	1
9	ZG	19.4000	19.4000	0
10	FR	14.7000	14.4000	0.3000
11	SO	14	13.5000	0.5000

	canton	y2020	y2012	difference
12	BS	18.2000	16.9000	1.3000
13	BL	17	16.7000	0.3000
14	SH	13.7000	12.9000	0.8000
15	AR	13.1000	13	0.1000
16	AI	14.6000	13.9000	0.7000
17	SG	14.2000	13.9000	0.3000
18	GR	15.2000	15.3000	-0.1000
19	AR	15.4000	14.9000	0.5000
20	TG	13.8000	13.2000	0.6000
21	TI	14	13.4000	0.6000
22	VD	18	16.8000	1.2000
23	VS	14.1000	13.7000	0.4000
24	NE	12.8000	12.5000	0.3000
25	GE	19.7000	18.7000	1
26	JU	11.6000	11.2000	0.4000

Plotting the data above, can easy the study to get insights.

```
scatter(stdCantonTopAvgprice.canton,stdCantonTopAvgprice.difference)
yline(0);
grid on
xlabel Canton
ylabel 'Price variation from 2012 to 2020 in francs'
```



Conclusion

The highest price deviation are the AI, Appenzeller Inner, second places is for BS, Basel City and third place is GL, Glarus cantons. . On the other hand, Basel Stadt has the higher variation in the prices, passing from 16.90 chf/m2 to 18.2 chf/m2.

Zurich city which has the highest population increase during the last 20 years, don't show a proporcional increase in the price, passing 18.5 to 19.3 chf/m2.

A note from last graph is about zug that the price does not changes over 8 years, while Grisons and Schwyz the prices are lower the befor

It is worth to recall that prices are on average basis for all houses present in the canton and the price is referred only to rent, other expenses are not included like common heating, waste, cleaning, parking and so on

Average rent in Swiss francs according to the number of rooms and the canton | opendata.swiss

Demographic evolution, 1950-2021 | opendata.swiss

Average rent per m2 in Swiss francs according to the age of construction and the canton | opendata.swiss