Step-by-step guide

for measuring social inequalities in health

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Step by step guide for measuring social inequalities in health

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Preface

In the last 10 to 15 years, the countries of Latin America and the Caribbean (LAC) have made significant achievements in reproductive, maternal, neonatal, child and adolescent health. Even with these advances, inequalities in access and coverage between and within the countries of the region have persisted and in some cases increased. These inequalities are systematically related to social factors including gender, socioeconomic status, ethnicity, income, and education, to name a few.

One of the main challenges to address social inequalities in health is the lack of strategic information and available evidence on the magnitude of the inequalities, either between or within countries. Currently, most LAC countries are not measuring or monitoring social inequalities in health at the national or local levels. Most national programs and interventions do not include indicators in their monitoring and evaluation frameworks (which fosters the reduction of inequalities).

EWEC-LAC has developed a toolkit that includes methodological orientations and tools for the measurement and monitoring of health inequities. It also provides technical support to institutionalize the measurement and monitoring of inequalities in national health information systems.

We are sure that technical staff from Ministries of Health, researchers, students and other global health actors interested in quantitative analysis of social inequalities will find this guide useful. The purpose of this material is to facilitate the measurement and monitoring of social inequalities in health, using a widespread program (Microsoft Excel ®). Assisted by examples, the reader will be able to calculate the simple measures (absolute and relative inequality gaps) and the complex ones (slope index of inequality and concentration index of health), if data disaggregated at the sub-national level is available.

A) Preliminary data preparation

The quality of the outcome analysis will result from data quality at the beginning. It is important to create a sound database including the three dimensions required for inequality analyses:

1. Health and morbimortality indicators: outcome variables
2. Equity stratifiers: socio-economic variables used to rank the population and define the groups whose health status is to be compared
3. Demographic variables: (usually the denominators of the health indicators) needed to calculate the weighting terms according to the population relative size

Some examples:

1. Health / morbimortality indicator: Maternal mortality ratio
2. Equity stratifier: mean years of schooling
3. Demographic variable: live births

1. Health / morbimortality indicator: Coverage of family planning modern methods
2. Equity stratifier: % of poor households
3. Demographic variable: women in reproductive age

The database should have separate spreadsheets for each dimension, and if needed, paired columns for data on two periods of time. A template of database for Excel is available at:
https://www.everywomaneverychild-lac.org/plantilla_de_datos/

Once the database is configured, descriptive statistics should be of help to "clean" it from potential mistakes and outliers, and to become acquainted with the data as well. For example, using the interquartile range, the standard deviation or a whiskers and box plot, it is possible to discover which health indicators hold low variability and will, therefore, be of little help to describe social inequalities. The variation coefficient (=standard deviation/ mean x 100) may be used to compare the variability of indicators, even if their units of measure are different.

It is important to identify which equity stratifiers are of nominal (those that do not follow an inherently ordered scale: sex, urban/rural location, ethnicity) or ordinal nature (those that follow a logically ordered scale: income, levels of education achieved, access to water and sanitation). The simple inequality measures allow both types of stratifiers, not the complex ones, restricted to ordinal equity stratifiers.

Type of stratifier	Example	Measures allowed
NOMINAL	**Urban vs. rural population**	• Absolute gap • Relative gap
ORDINAL	% of analphabet population	• Absolute gap • Relative gap • Slope index of inequality • Health concentration index

Before starting to practice, it is recommended to extract from the database like the one shown below, to follow the next steps easily.

	A	B	C	D
1		Health indicator	Health stratifier	Demographic weigthing
2	Demographic units (departments, provinces, minicipalities)	Year 1	Year 2	Year 3
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Once the data is arranged in the excel sheet, the procedure can be followed more easily.

B) Absolute and relative gaps of inequality with grouped data

a. Absolute and relative gaps of inequality with grouped data

Step 1

Sort the data panel according to the equity stratifier (for ordinal stratifiers)

Whenever an ordinal equity stratifier is used, data should be ordered according to the stratifier's values. It is recommended to start top-bottom from the worst-off social situation to the best-off social situation. In some cases, like GDP per capita, the geographical units (also called observation units) with the highest values of the stratifier will lay on the bottom; on the opposite, geographical units with the highest value of the stratifier, like percentage of poor households, will be on top. The examples of the rest of the guide use ordinal stratifiers.

For nominal stratifiers, it is recommended that the selected reference group be placed at the bottom for convenience. Comparisons among the different subgroups formed by a nominal stratifier (i.e. ethnic groups) may be made as necessary.

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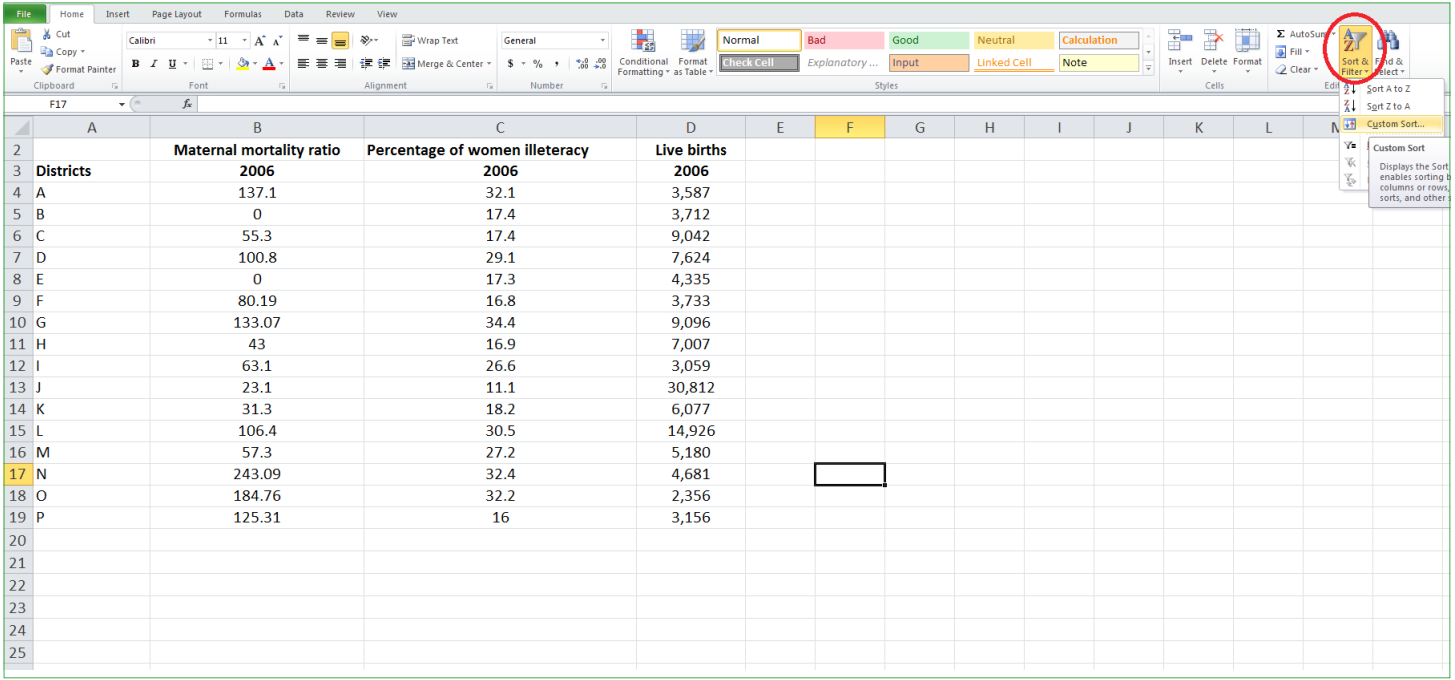
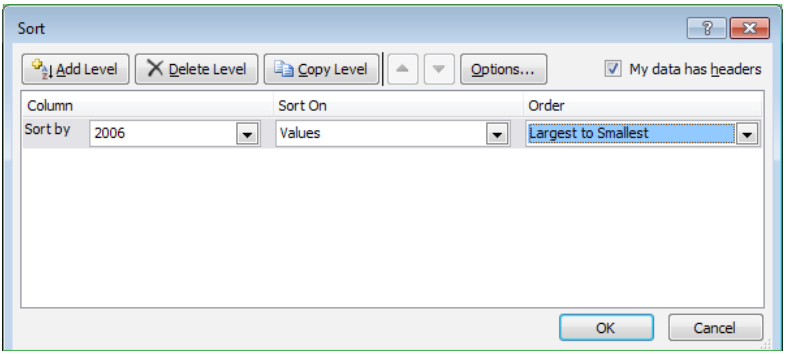
Step 1



	A	B	C	D	E	F	G	H	I	J	K	L
2		Maternal mortality ratio	Percentage of women illeteracy	Live births								
3	**Districts**	**2006**	**2006**	**2006**								
4	A	137.1	32.1	3,587								
5	B	0	17.4	3,712								
6	C	55.3	17.4	9,042								
7	D	100.8	29.1	7,624								
8	E	0	17.3	4,335								
9	F	80.19	16.8	3,733								
10	G	133.07	34.4	9,096								
11	H	43	16.9	7,007								
12	I	63.1	26.6	3,059								
13	J	23.1	11.1	30,812								
14	K	31.3	18.2	6,077								
15	L	106.4	30.5	14,926								
16	M	57.3	27.2	5,180								
17	N	243.09	32.4	4,681								
18	O	184.76	32.2	2,356								
19	P	125.31	16	3,156								
20												
21												
22												
23												
24												
25												

Step 1



	A	B	C	D
1				
2		**Maternal mortality ratio**	**Percentage of women illeteracy**	**Live births**
3	**Districts**	**2006**	**2006**	**2006**
4	G	133.07	34.4	9,096
5	N	243.09	32.4	4,681
6	O	184.76	32.2	2,356
7	A	137.1	32.1	3,587
8	L	106.4	30.5	14,926
9	D	100.8	29.1	7,624
10	M	57.3	27.2	5,180
11	I	63.1	26.6	3,059
12	K	31.3	18.2	6,077
13	B	0	17.4	3,712
14	C	55.3	17.4	9,042
15	E	0	17.3	4,335
16	H	43	16.9	7,007
17	F	80.19	16.8	3,733
18	P	125.31	16	3,156

Step 2

Group data using quantiles of the social stratifier

Depending on the number of geographical units and the heterogeneity of the equity stratifier, population groups generically named quantiles can be formed. Three groups would be "terciles," four, "quartiles"; five, "quintiles"; ten, "deciles" and so on.

This example uses quintiles, which means that the distribution of the stratifier finds cut points at percentiles 20, 40, 60 and 80, denoted by P.20, P.40, P.60, P.80.

Groups (quintiles in this example) are formed as follows:

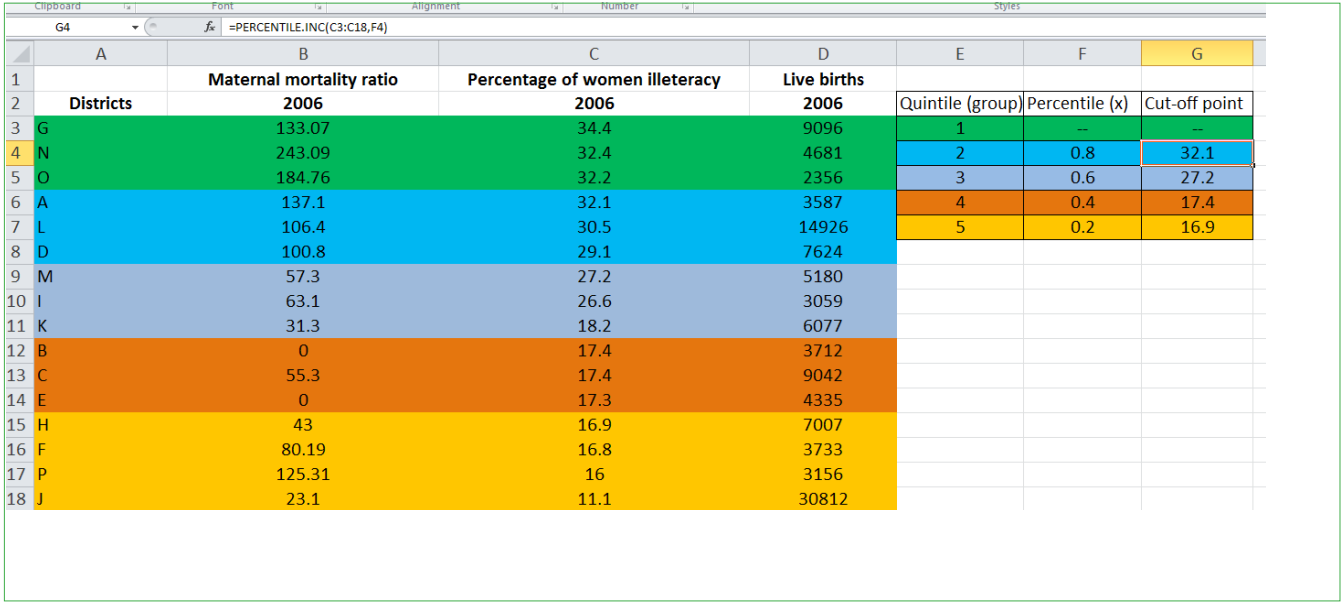
- If the stratifier is bottom-top sorted
  - Group 1 (socially worst-off): units with values of the stratifier less or equal to P.20
  - Group 2: units with values of the stratifier higher than P.20, but less or equal to P.40
  - Group 3: units with values of the stratifier higher than P.40, but less or equal to P.60
  - Group 4: units with values of the stratifier higher than P.60, but less or equal to P.80
  - Group 5 (socially best-off): units with values of the stratifier higher than P.80

- If the stratifier is top-bottom sorted:
  - Group 1 (socially worst-off): units with values of the stratifier higher than P.80
  - Group 2: units with values of the stratifier higher than P.60, but less or equal to P.80
  - Group 3: units with values of the stratifier higher than P.40, but less or equal to P.60
  - Group 4: units with values of the stratifier higher than P.20, but less or equal to P.40
  - Group 5 (socially best-off): units with values of the stratifier less or equal to P.20

(Next page)

Step 2

Example:



	A	B	C	D	E	F	G
1		Maternal mortality ratio	Percentage of women illeteracy	Live births			
2	Districts	2006	2006	2006	Quintile (group)	Percentile (x)	Cut-off point
3	G	133.07	34.4	9096	1	--	--
4	N	243.09	32.4	4681	2	0.8	32.1
5	O	184.76	32.2	2356	3	0.6	27.2
6	A	137.1	32.1	3587	4	0.4	17.4
7	L	106.4	30.5	14926	5	0.2	16.9
8	D	100.8	29.1	7624			
9	M	57.3	27.2	5180			
10	I	63.1	26.6	3059			
11	K	31.3	18.2	6077			
12	B	0	17.4	3712			
13	C	55.3	17.4	9042			
14	E	0	17.3	4335			
15	H	43	16.9	7007			
16	F	80.19	16.8	3733			
17	P	125.31	16	3156			
18	J	23.1	11.1	30812			

Excel syntax

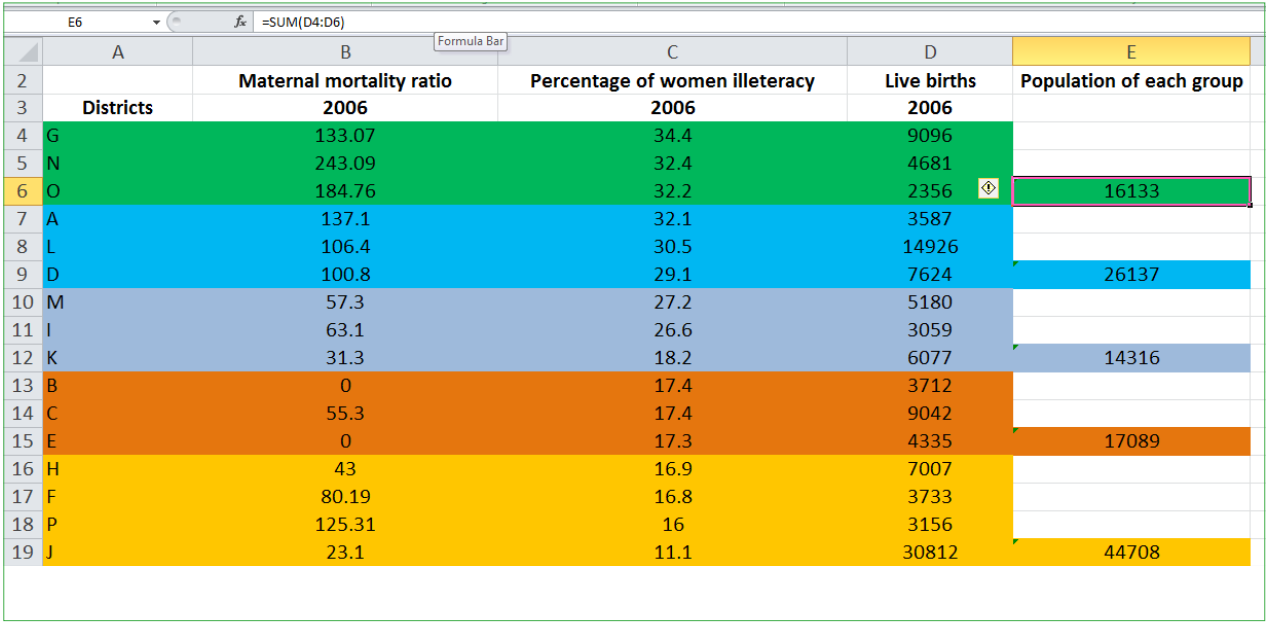
PERCENTILE.INC (range of the stratifier data, x) Where "x" takes value according to the number of groups desired.

Note:
in the case of counting with less than ten geographical units, it is advisable not to group data and effect pairwise comparisons among the socially worst and best-off units

Step 3

Calculate the population of each group

Example:



	A	B	C	D	E
2		Maternal mortality ratio	Percentage of women illeteracy	Live births	Population of each group
3	Districts	2006	2006	2006	
4	G	133.07	34.4	9096	
5	N	243.09	32.4	4681	
6	O	184.76	32.2	2356	16133
7	A	137.1	32.1	3587	
8	L	106.4	30.5	14926	
9	D	100.8	29.1	7624	26137
10	M	57.3	27.2	5180	
11	I	63.1	26.6	3059	
12	K	31.3	18.2	6077	14316
13	B	0	17.4	3712	
14	C	55.3	17.4	9042	
15	E	0	17.3	4335	17089
16	H	43	16.9	7007	
17	F	80.19	16.8	3733	
18	P	125.31	16	3156	
19	J	23.1	11.1	30812	44708

Excel syntax

=SUM(range of the population data)

Step 4

Calculate the population weight of each geographical unit within each group

Example:

F4 =D4/E6

	A	B	C	D	E	F
2		Maternal mortality ratio	Percentage of women illeteracy	Live births	Population of each group	Weight of each district within its group
3	Districts	2006	2006	2006		
4	G	133.07	34.4	9096		0.563813302
5	N	243.09	32.4	4681		0.290150623
6	O	184.76	32.2	2356	16133	0.146036075
7	A	137.1	32.1	3587		0.137238398
8	L	106.4	30.5	14926		0.571067835
9	D	100.8	29.1	7624	26137	0.291693767
10	M	57.3	27.2	5180		0.361832914
11	I	63.1	26.6	3059		0.213677005
12	K	31.3	18.2	6077	14316	0.424490081
13	B	0	17.4	3712		0.217215753
14	C	55.3	17.4	9042		0.529112294
15	E	0	17.3	4335	17089	0.253671953
16	H	43	16.9	7007		0.156728102
17	F	80.19	16.8	3733		0.083497361
18	P	125.31	16	3156		0.070591393
19	J	23.1	11.1	30812	44708	0.689183144
20						

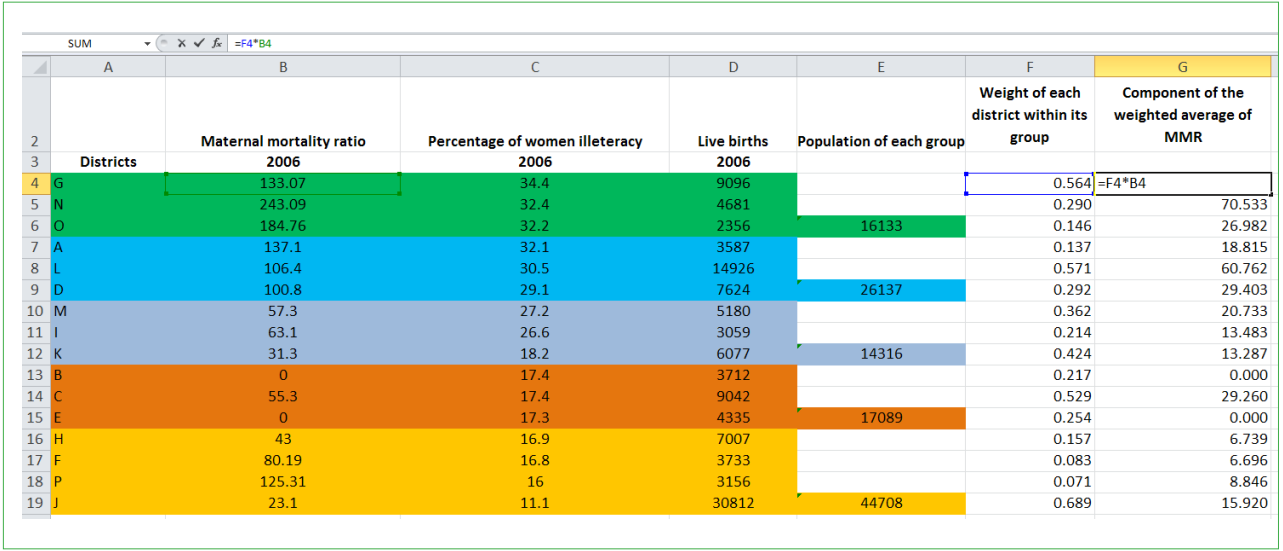
Excel syntax

=Population of each unit / population of the whole group

Step 5

Calculate the component of the weighted average of the health indicator for each geographical unit (observation unit)

Example:



SUM =F4*B4

	A	B	C	D	E	F	G
2		Maternal mortality ratio	Percentage of women illeteracy	Live births	Population of each group	Weight of each district within its group	Component of the weighted average of MMR
3	Districts	2006	2006	2006			
4	G	133.07	34.4	9096		0.564	=F4*B4
5	N	243.09	32.4	4681		0.290	70.533
6	O	184.76	32.2	2356	16133	0.146	26.982
7	A	137.1	32.1	3587		0.137	18.815
8	L	106.4	30.5	14926		0.571	60.762
9	D	100.8	29.1	7624	26137	0.292	29.403
10	M	57.3	27.2	5180		0.362	20.733
11	I	63.1	26.6	3059		0.214	13.483
12	K	31.3	18.2	6077	14316	0.424	13.287
13	B	0	17.4	3712		0.217	0.000
14	C	55.3	17.4	9042		0.529	29.260
15	E	0	17.3	4335	17089	0.254	0.000
16	H	43	16.9	7007		0.157	6.739
17	F	80.19	16.8	3733		0.083	6.696
18	P	125.31	16	3156		0.071	8.846
19	J	23.1	11.1	30812	44708	0.689	15.920

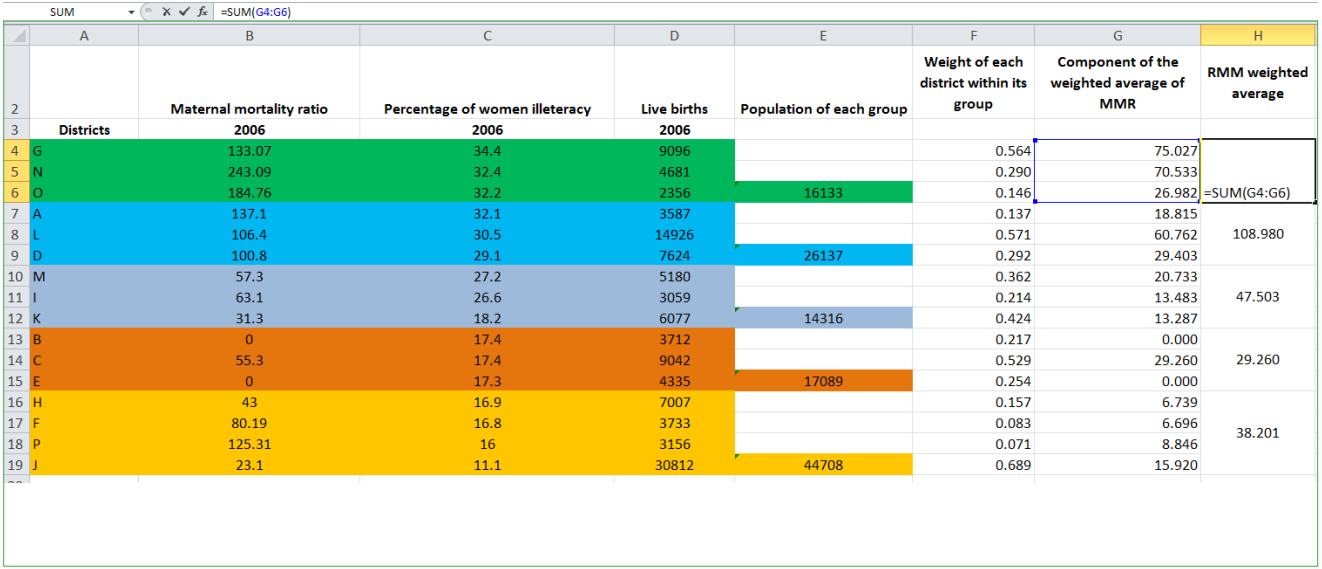
Excel syntax

= Weight of each district within its group * its own health indicator

Step 6

Calculate the weighted average of the health indicator for each group

Example:



SUM =SUM(G4:G6)

	A	B	C	D	E	F	G	H
2		Maternal mortality ratio	Percentage of women illeteracy	Live births	Population of each group	Weight of each district within its group	Component of the weighted average of MMR	RMM weighted average
3	Districts	2006	2006	2006				
4	G	133.07	34.4	9096		0.564	75.027	
5	N	243.09	32.4	4681		0.290	70.533	
6	O	184.76	32.2	2356	16133	0.146	26.982	=SUM(G4:G6)
7	A	137.1	32.1	3587		0.137	18.815	
8	L	106.4	30.5	14926		0.571	60.762	108.980
9	D	100.8	29.1	7624	26137	0.292	29.403	
10	M	57.3	27.2	5180		0.362	20.733	
11	I	63.1	26.6	3059		0.214	13.483	47.503
12	K	31.3	18.2	6077	14316	0.424	13.287	
13	B	0	17.4	3712		0.217	0.000	
14	C	55.3	17.4	9042		0.529	29.260	29.260
15	E	0	17.3	4335	17089	0.254	0.000	
16	H	43	16.9	7007		0.157	6.739	
17	F	80.19	16.8	3733		0.083	6.696	38.201
18	P	125.31	16	3156		0.071	8.846	
19	J	23.1	11.1	30812	44708	0.689	15.920	

Excel syntax

=SUM(range of data with the components of the whole group)

Step 7

Calculate and interpret the absolute gap comparing group 1 and group 5

Example:

Groups	Weighted average of each group	Absolute gap (G1-G5)
G1	172.5	172.5-38.2 = 134.3
G2	109.0	
G3	47.5	
G4	29.3	
G5	38.2	

Interpretation: For the data in the example, for that country in that year, there were 134.3 more maternal deaths per 100,000 live births in the group with the lowest educational status, compared to the group with the highest educational status. In other words, the absolute gap expresses the magnitude difference of mortality experience between the worst-off and best-off educational status.

Step 8

Calculate and interpret the relative gap comparing group 1 and group 5

Example:

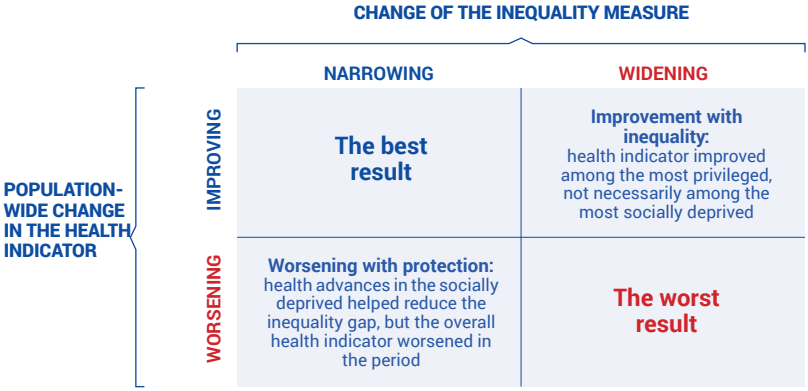
Groups	Weighted average of each group	Absolute gap (G1/G5)
G1	172.5	172.5/38.2 = 4.5
G2	109.0	
G3	47.5	
G4	29.3	
G5	38.2	

Interpretation: For the data in the example, for that country in that year, maternal mortality ratio in the group with the lowest educational status was 4.5 times that of the group with the highest educational group. In other words, the mortality experience of the socially most disadvantaged group was more than four times that of the least socially disadvantaged group.

Step 9

Using data available on two periods of time: four scenarios of performance

When data two periods of time are available, once the calculation of inequality gaps for each period is done as well as having the national-level figure of the health indicator, it is recommended to compare those findings with the following four scenarios. The four scenarios analysis elaborates on the performance of the country regarding not only the health indicator by itself but in parallel to the inequality gaps.



C) Gradient measures of social inequality in health

a. Slope index of inequality for non-grouped data

For this regression-based measure, it is recommended to leave the data non-grouped to gain statistical power, especially when the geospatial units are a few.

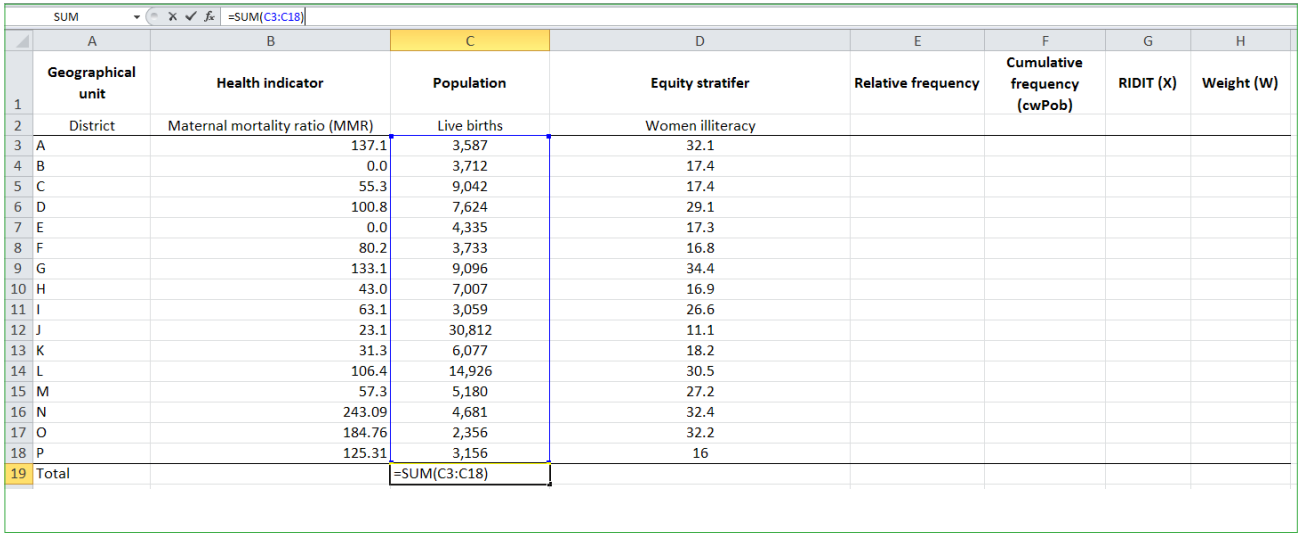
Step 1 **Construction of a table with the following columns:**

A. Geographical unit
B. Health indicator (Y)
C. Population (denominator in the health indicator)
D. Equity stratifier
E. Relative frequency of population
F. Cumulative frequency (cwpob)
G. RIDIT (X)
H. Weight (W)

(Next page)

Step 1

Example:



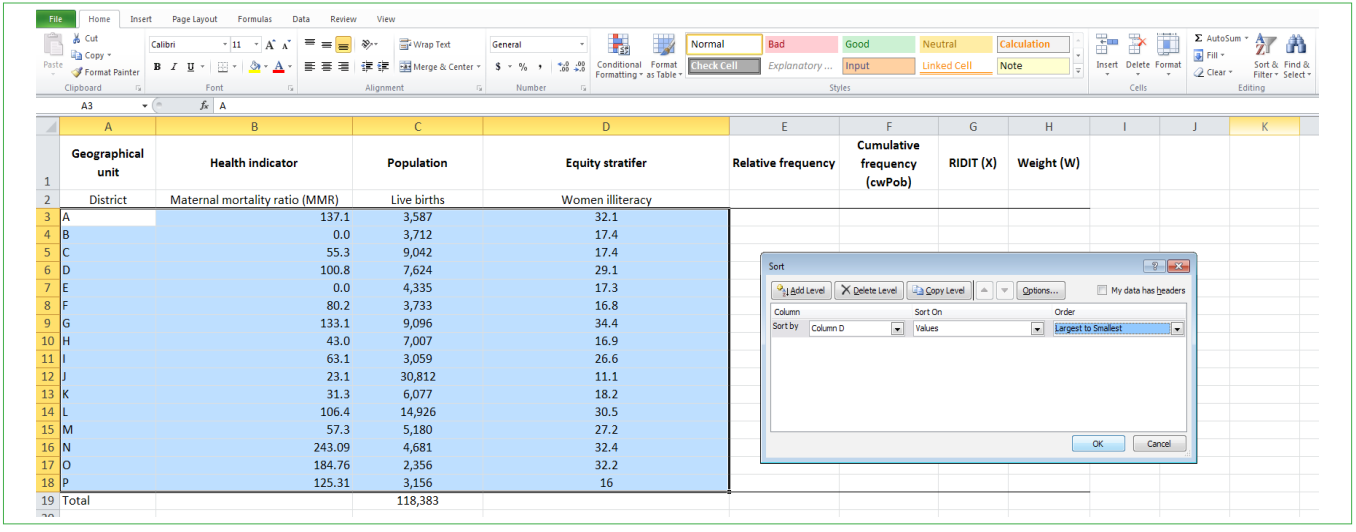
SUM =SUM(C3:C18)

	A	B	C	D	E	F	G	H
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**	**RIDIT (X)**	**Weight (W)**
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy				
3	A	137.1	3,587	32.1				
4	B	0.0	3,712	17.4				
5	C	55.3	9,042	17.4				
6	D	100.8	7,624	29.1				
7	E	0.0	4,335	17.3				
8	F	80.2	3,733	16.8				
9	G	133.1	9,096	34.4				
10	H	43.0	7,007	16.9				
11	I	63.1	3,059	26.6				
12	J	23.1	30,812	11.1				
13	K	31.3	6,077	18.2				
14	L	106.4	14,926	30.5				
15	M	57.3	5,180	27.2				
16	N	243.09	4,681	32.4				
17	O	184.76	2,356	32.2				
18	P	125.31	3,156	16				
19	Total		=SUM(C3:C18)					

Step 2

Sorting based on the equity stratifier

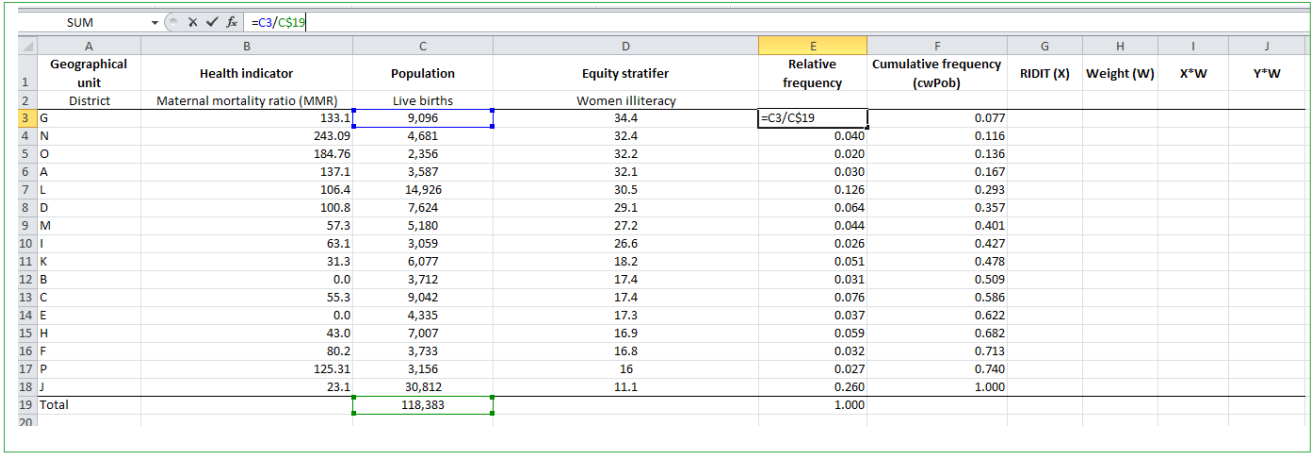
Select the range of data to be sorted. Go to Data menu Sort, and select to sort by the stratifier column. Choose the sorting criterion to have the geographical units with the socioeconomically worst-off on top of the list.



	A	B	C	D	E	F	G	H	I	J	K
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**	**RIDIT (X)**	**Weight (W)**			
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy							
3	A	137.1	3,587	32.1							
4	B	0.0	3,712	17.4							
5	C	55.3	9,042	17.4							
6	D	100.8	7,624	29.1							
7	E	0.0	4,335	17.3							
8	F	80.2	3,733	16.8							
9	G	133.1	9,096	34.4							
10	H	43.0	7,007	16.9							
11	I	63.1	3,059	26.6							
12	J	23.1	30,812	11.1							
13	K	31.3	6,077	18.2							
14	L	106.4	14,926	30.5							
15	M	57.3	5,180	27.2							
16	N	243.09	4,681	32.4							
17	O	184.76	2,356	32.2							
18	P	125.31	3,156	16							
19	Total		118,383								

Calculation of relative and cumulative frequency

Relative frequency: add up the population of all the geographical units (store in a cell at the bottom) and then divide this by the population of each unit (in the relative frequency cell). You may "fix" the cell of the population total using the "$" sign as in the example.



	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	RIDIT (X)	Weight (W)	X*W	Y*W
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	=C3/C$19	0.077				
4	N	243.09	4,681	32.4	0.040	0.116				
5	O	184.76	2,356	32.2	0.020	0.136				
6	A	137.1	3,587	32.1	0.030	0.167				
7	L	106.4	14,926	30.5	0.126	0.293				
8	D	100.8	7,624	29.1	0.064	0.357				
9	M	57.3	5,180	27.2	0.044	0.401				
10	I	63.1	3,059	26.6	0.026	0.427				
11	K	31.3	6,077	18.2	0.051	0.478				
12	B	0.0	3,712	17.4	0.031	0.509				
13	C	55.3	9,042	17.4	0.076	0.586				
14	E	0.0	4,335	17.3	0.037	0.622				
15	H	43.0	7,007	16.9	0.059	0.682				
16	F	80.2	3,733	16.8	0.032	0.713				
17	P	125.31	3,156	16	0.027	0.740				
18	J	23.1	30,812	11.1	0.260	1.000				
19	Total		118,383		1.000					
20										

Step 3

Calculation of relative and cumulative frequency

Cumulative frequency = cwpob (short name for relative cumulative frequency): make a consecutive sum of the relative frequencies of each unit. The cumulative frequency of the first unit will be its relative frequency. For the second unit, it will be cumulative of the first plus the relative of the second. For the third, the cumulative frequency will be cumulative of the second plus the relative of the third, and so on. Once entering the syntax in the second row (as in the example), you may copy top down to the rest. As a way of testing, the value of the last unit will always have to equal one (1.0).

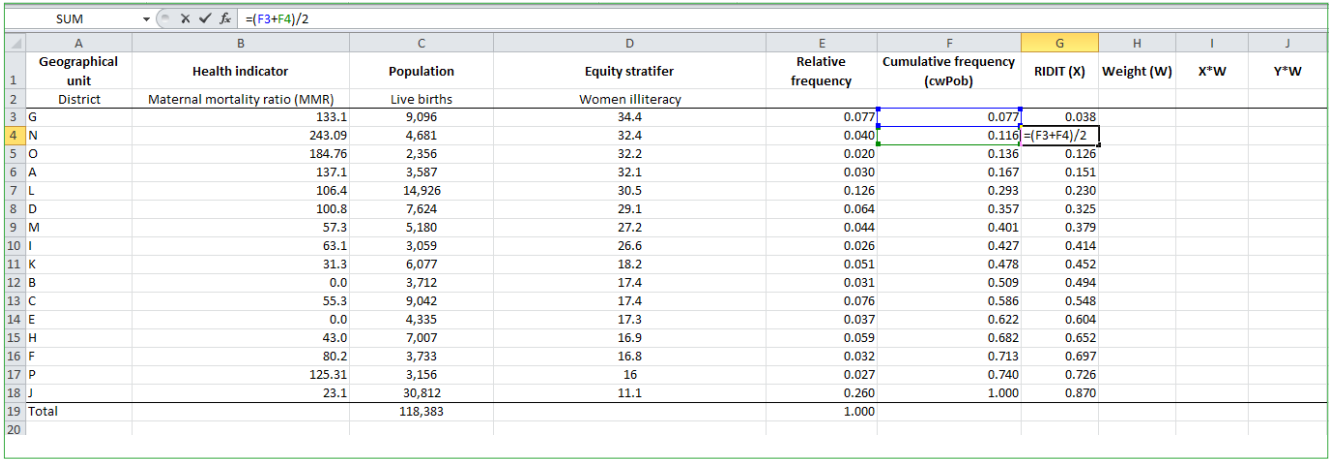
SUM =E4+F3

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	RIDIT (X)	Weight (W)	X*W	Y*W
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077				
4	N	243.09	4,681	32.4	0.040	=E4+F3				
5	O	184.76	2,356	32.2	0.020	0.136				
6	A	137.1	3,587	32.1	0.030	0.167				
7	L	106.4	14,926	30.5	0.126	0.293				
8	D	100.8	7,624	29.1	0.064	0.357				
9	M	57.3	5,180	27.2	0.044	0.401				
10	I	63.1	3,059	26.6	0.026	0.427				
11	K	31.3	6,077	18.2	0.051	0.478				
12	B	0.0	3,712	17.4	0.031	0.509				
13	C	55.3	9,042	17.4	0.076	0.586				
14	E	0.0	4,335	17.3	0.037	0.622				
15	H	43.0	7,007	16.9	0.059	0.682				
16	F	80.2	3,733	16.8	0.032	0.713				
17	P	125.31	3,156	16	0.027	0.740				
18	J	23.1	30,812	11.1	0.260	1.000				
19	Total		118,383		1.000					
20										
21										
22										

Step 4

Calculation of the RIDIT (cumulative frequency in the center of the distribution corresponding to each geographical unit)

RIDIT is half of the sum of two consecutive cumulative frequencies. For the first unit, the RIDIT will be half of its cumulative frequency, considering that there is no previous frequency to sum. For the second unit, the RIDIT will be the sum of the cumulative frequency of the first plus the cumulative frequency of the second, divided by two.



SUM =(F3+F4)/2

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	RIDIT (X)	Weight (W)	X*W	Y*W
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	0.038			
4	N	243.09	4,681	32.4	0.040	0.116	=(F3+F4)/2			
5	O	184.76	2,356	32.2	0.020	0.136	0.126			
6	A	137.1	3,587	32.1	0.030	0.167	0.151			
7	L	106.4	14,926	30.5	0.126	0.293	0.230			
8	D	100.8	7,624	29.1	0.064	0.357	0.325			
9	M	57.3	5,180	27.2	0.044	0.401	0.379			
10	I	63.1	3,059	26.6	0.026	0.427	0.414			
11	K	31.3	6,077	18.2	0.051	0.478	0.452			
12	B	0.0	3,712	17.4	0.031	0.509	0.494			
13	C	55.3	9,042	17.4	0.076	0.586	0.548			
14	E	0.0	4,335	17.3	0.037	0.622	0.604			
15	H	43.0	7,007	16.9	0.059	0.682	0.652			
16	F	80.2	3,733	16.8	0.032	0.713	0.697			
17	P	125.31	3,156	16	0.027	0.740	0.726			
18	J	23.1	30,812	11.1	0.260	1.000	0.870			
19	Total		118,383		1.000					
20										

Step 5

Calculation of the population weight and apply it to both, health indicator and RIDIT

The weight of each unit equals the square-root of its population. In Excel, you may use the syntax "SQRT," as seen in the example.

SUM =H3*B3

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	RIDIT (X)	Weight (W)	X*W	Y*W
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.1	0.1	0.0	95.4	0.0	=H3*B3
4	N	243.09	4,681	32.4	0.0	0.1	0.1	68.4	6.6	16631.7
5	O	184.76	2,356	32.2	0.0	0.1	0.1	48.5	6.1	8968.0
6	A	137.1	3,587	32.1	0.0	0.2	0.2	59.9	9.1	8211.1
7	L	106.4	14,926	30.5	0.1	0.3	0.2	122.2	28.1	12999.1
8	D	100.8	7,624	29.1	0.1	0.4	0.3	87.3	28.4	8801.4
9	M	57.3	5,180	27.2	0.0	0.4	0.4	72.0	27.3	4124.0
10	I	63.1	3,059	26.6	0.0	0.4	0.4	55.3	22.9	3489.9
11	K	31.3	6,077	18.2	0.1	0.5	0.5	78.0	35.3	2440.0
12	B	0.0	3,712	17.4	0.0	0.5	0.5	60.9	30.1	0.0
13	C	55.3	9,042	17.4	0.1	0.6	0.5	95.1	52.1	5258.4
14	E	0.0	4,335	17.3	0.0	0.6	0.6	65.8	39.8	0.0
15	H	43.0	7,007	16.9	0.1	0.7	0.7	83.7	54.6	3599.4
16	F	80.2	3,733	16.8	0.0	0.7	0.7	61.1	42.6	4899.5
17	P	125.31	3,156	16	0.0	0.7	0.7	56.2	40.8	7039.7
18	J	23.1	30,812	11.1	0.3	1.0	0.9	175.5	152.7	4054.8
19	Total		118,383		1.000					
20										

Afterward, two columns should be added:

- X*W: will store the product of the population weight and the RIDIT, namely the weighted values of the RIDIT (X). For the regression model in Excel, this is X2, the independent variable of interest.
- Y*W: will store the product of the population weight and the health indicator, namely the weighted values of the health indicator (Y). For the regression model in Excel, this is Y, the dependent variable of interest.

Note: weights must be inputted this way because Excel lacks weighted minimum square estimation for regression analyses. The model adjusted is:

$$YW = \beta_o\,(0) + \beta_1\,(W) + \beta_2\,(WX)$$

Regarding Excel: "W" of the model is X1, and "WX" of the model is X2. That is why the slope coefficient of interest in the next step will be that of X2

Step 5

SUM =H3*G3

	A	B	C	D	E	F	G	H	I	J
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**	**RIDIT (X)**	**Weight (W)**	**X*W**	**Y*W**
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.1	0.1	0.0	95.4	=H3*G3	12691.3
4	N	243.09	4,681	32.4	0.0	0.1	0.1	68.4	6.6	16631.7
5	O	184.76	2,356	32.2	0.0	0.1	0.1	48.5	6.1	8968.0
6	A	137.1	3,587	32.1	0.0	0.2	0.2	59.9	9.1	8211.1
7	L	106.4	14,926	30.5	0.1	0.3	0.2	122.2	28.1	12999.1
8	D	100.8	7,624	29.1	0.1	0.4	0.3	87.3	28.4	8801.4
9	M	57.3	5,180	27.2	0.0	0.4	0.4	72.0	27.3	4124.0
10	I	63.1	3,059	26.6	0.0	0.4	0.4	55.3	22.9	3489.9
11	K	31.3	6,077	18.2	0.1	0.5	0.5	78.0	35.3	2440.0
12	B	0.0	3,712	17.4	0.0	0.5	0.5	60.9	30.1	0.0
13	C	55.3	9,042	17.4	0.1	0.6	0.5	95.1	52.1	5258.4
14	E	0.0	4,335	17.3	0.0	0.6	0.6	65.8	39.8	0.0
15	H	43.0	7,007	16.9	0.1	0.7	0.7	83.7	54.6	3599.4
16	F	80.2	3,733	16.8	0.0	0.7	0.7	61.1	42.6	4899.5
17	P	125.31	3,156	16	0.0	0.7	0.7	56.2	40.8	7039.7
18	J	23.1	30,812	11.1	0.3	1.0	0.9	175.5	152.7	4054.8
19	Total		118.383		1.000					

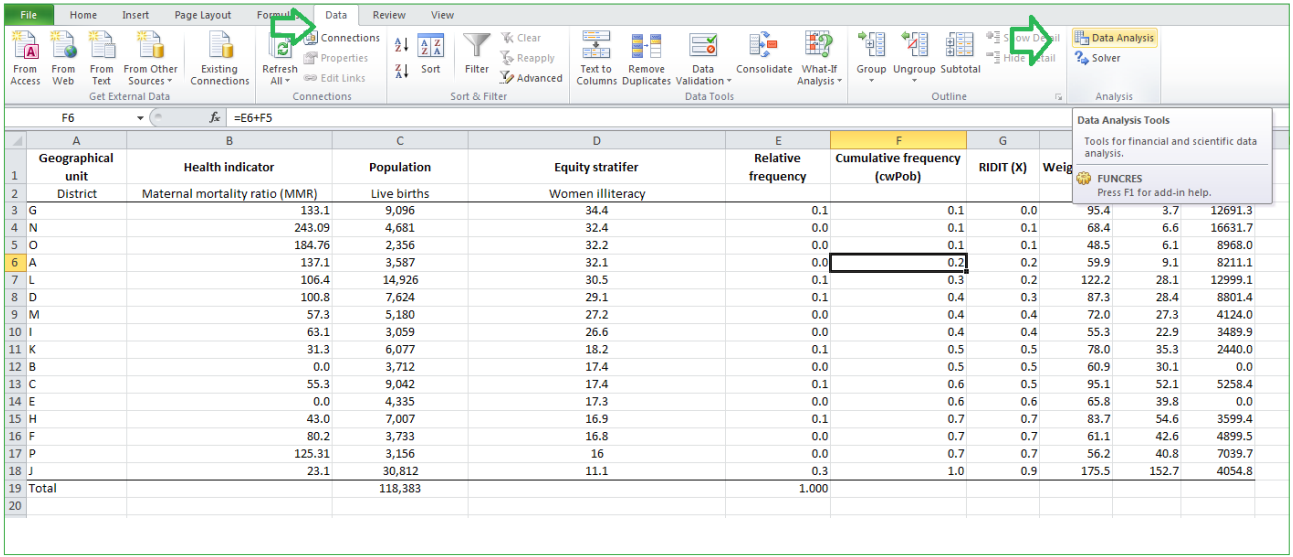
Step 6

Estimation of the regression coefficients

In the Data menu, go to Data Analyses. In case this does not appear on the user's computer, consult Annex 1 for the installation of the required complement.

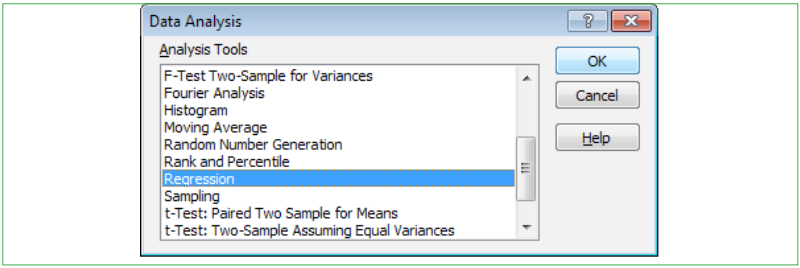
Next, select Regression. In the "Regression" window input the range of data of the column W*Y in "Y range of input." Then click on and select the range of both columns: Weight (W) and Weighted RIDIT (X*W). Check the option "Constant equals zero" and select the output preferences as wanted.

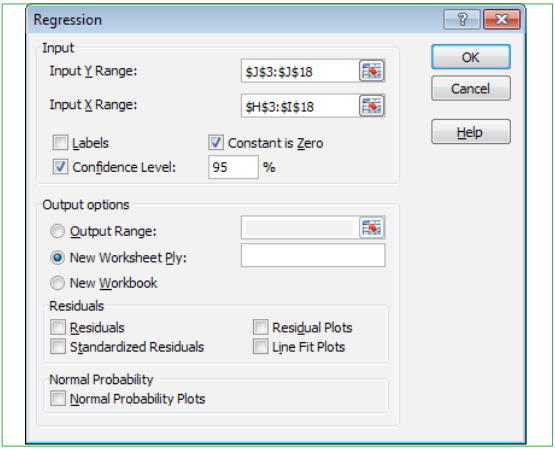
In the Excel output, the X2 slope coefficient corresponds to the slope index of inequality.



	A	B	C	D	E	F	G			
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	RIDIT (X)	Weig		
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.1	0.1	0.0	95.4	3.7	12691.3
4	N	243.09	4,681	32.4	0.0	0.1	0.1	68.4	6.6	16631.7
5	O	184.76	2,356	32.2	0.0	0.1	0.1	48.5	6.1	8968.0
6	A	137.1	3,587	32.1	0.0	0.2	0.2	59.9	9.1	8211.1
7	L	106.4	14,926	30.5	0.1	0.3	0.2	122.2	28.1	12999.1
8	D	100.8	7,624	29.1	0.1	0.4	0.3	87.3	28.4	8801.4
9	M	57.3	5,180	27.2	0.0	0.4	0.4	72.0	27.3	4124.0
10	I	63.1	3,059	26.6	0.0	0.4	0.4	55.3	22.9	3489.9
11	K	31.3	6,077	18.2	0.1	0.5	0.5	78.0	35.3	2440.0
12	B	0.0	3,712	17.4	0.0	0.5	0.5	60.9	30.1	0.0
13	C	55.3	9,042	17.4	0.1	0.6	0.5	95.1	52.1	5258.4
14	E	0.0	4,335	17.3	0.0	0.6	0.6	65.8	39.8	0.0
15	H	43.0	7,007	16.9	0.1	0.7	0.7	83.7	54.6	3599.4
16	F	80.2	3,733	16.8	0.0	0.7	0.7	61.1	42.6	4899.5
17	P	125.31	3,156	16	0.0	0.7	0.7	56.2	40.8	7039.7
18	J	23.1	30,812	11.1	0.3	1.0	0.9	175.5	152.7	4054.8
19	Total		118,383		1.000					
20										

Step 6





	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.920303424							
5	R Square	0.846958392							
6	Adjusted R Square	0.764598277							
7	Standard Error	3302.521423							
8	Observations	16							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regression	2	845029514	4.23E+08	38.7392	3.33496E-06			
13	Residual	14	152693068.5	10906648					
14	Total	16	997722582.5						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18	X Variable 1	149.4576424	19.35422664	7.722222	2.06E-06	107.9469548	190.9683301	107.9469548	190.9683301
19	X Variable 2	-154.9763358	33.61284893	-4.61063	0.000404	-227.0687268	-82.88394491	-227.0687268	-82.88394491

Step 7

Interpretation of the index slope of inequality

For the data in the example, for that country in that year, there were 154 more maternal deaths per 100,000 live births among the most illiterate populations compared to the least illiterate populations considering the information of all the geographical units, and their population weights.

The sign in the slope index of inequality is frequently negative with impact health indicators, indicating that the left section of the distribution (socially worst-off units) shows higher levels of the indicator (i.e. maternal mortality) than the right section (socially best-off units). Thus the regression line displays a negative slope. The inverse usually happens with coverage health indicators. So, the slope index compares the socially best-off population with the socially worst-off; the inverse happens with the absolute gap of inequality, which is the reason why multiplying the slope index of inequality times (-1) allows the comparison in the same terms of the absolute gap and the interpretation is as described in Step 7 of the absolute gap.

In the statistical sense, the index will be negative (<0) whenever there is an inverse relationship between the health outcome and the RIDIT.

The magnitude of the index equals the absolute inequality (in this case, the difference) of maternal mortality ratio between the population with the highest and lowest analphabetism levels.

b. Slope index of inequality for grouped data

Step 1

Construction of a table with the following columns, using the results obtained from the gap measures of inequality:

1) Group number
2) Group population
3) Relative frequency
4) Cumulative frequency
5) RIDIT

Example:

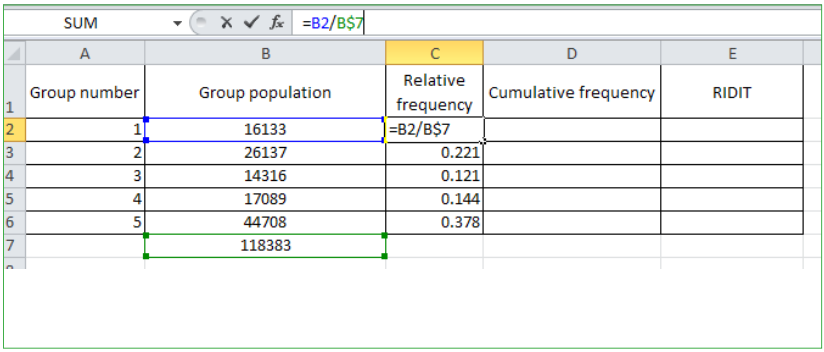
Group number	Group population	Relative frequency	Cumulative frequency	RIDIT
1	2833			
2	2547			
3	6764			
4	5934			
5	908			

Step 2

Calculation of the relative frequency for each group

Add up the population of all the groups, which will give the total population. Each group's population divided by the total population will give each group's relative frequency.

Example:



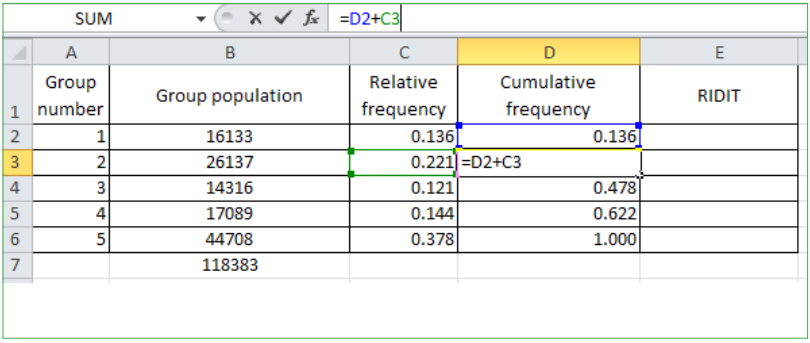
	A	B	C	D	E
1	Group number	Group population	Relative frequency	Cumulative frequency	RIDIT
2	1	16133	=B2/B$7		
3	2	26137	0.221		
4	3	14316	0.121		
5	4	17089	0.144		
6	5	44708	0.378		
7		118383			

Excel syntax = GROUP POPULATION/ TOTAL POPULATION

Step 3

Calculation of the cumulative frequency for each group

Example:



	A	B	C	D	E
1	Group number	Group population	Relative frequency	Cumulative frequency	RIDIT
2	1	16133	0.136	0.136	
3	2	26137	0.221	=D2+C3	
4	3	14316	0.121	0.478	
5	4	17089	0.144	0.622	
6	5	44708	0.378	1.000	
7		118383			

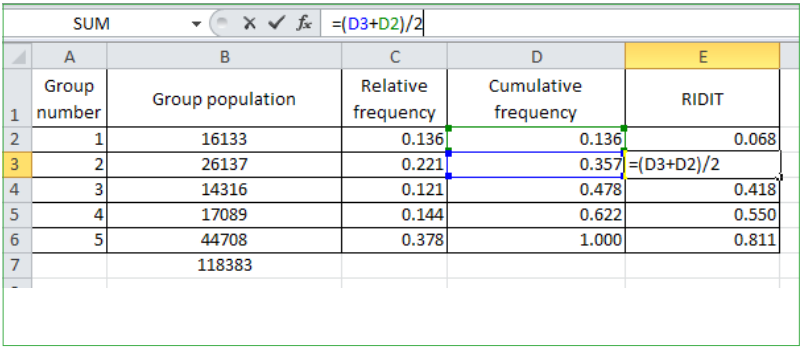
Excel syntax = relative frequency of each group + cumulative frequency of the previous group

Note: The cumulative for the first group will be its relative frequency. For the second and next groups, add the cumulative frequency of its previous one plus its relative frequency.

Step 4

Calculation of the RIDIT for each group

Example:



	A	B	C	D	E
1	Group number	Group population	Relative frequency	Cumulative frequency	RIDIT
2	1	16133	0.136	0.136	0.068
3	2	26137	0.221	0.357	=(D3+D2)/2
4	3	14316	0.121	0.478	0.418
5	4	17089	0.144	0.622	0.550
6	5	44708	0.378	1.000	0.811
7		118383			

Excel syntax

= (cumulative frequency of each group + cumulative frequency of the previous group) / 2

Note: The RIDIT for the first group will be the cumulative frequency of the first group divided by half. For the second and following groups, sum up the cumulative frequency of the previous one plus the cumulative frequency of itself and divide the result by two

Step 5

Construction of a 7-column table

Example:

	A	B	C	D	E	F	G
1	Group number	Y	X	Group population	W	W*X	W*Y
2	1	172.5	0.07	16133	127.0	8.7	21915.4
3	2	109.0	0.25	26137	161.7	39.9	17618.7
4	3	47.5	0.42	14316	119.6	50.0	5683.7
5	4	29.3	0.55	17089	130.7	71.9	3825.0
6	5	38.2	0.81	44708	211.4	171.5	8077.3
7				118383			

Excel syntax

To calculate the square root:
=RSQRT(each group population)

Note:

Group: number of each group (depends on the number of quantiles used)

Y: health indicator for each group (obtained as in step 6 of the gaps measures)

X: RIDIT of each group

Group population

W: the population weight (Square root of the population of each group)

W*X: weighted RIDIT (the product of weight times the RIDIT of each group)

W*Y: weighted health indicator (the product of weight times the health indicator of each group)

Step 6

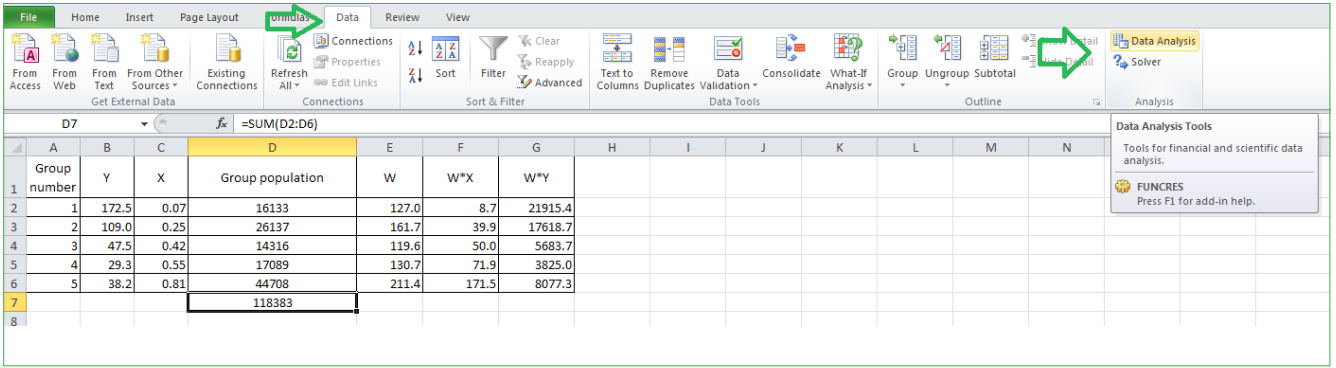
Calculation of the slope index of inequality using Excel

Follow: DATA ➔ Data analyses ➔ Regression

DIn the "Regression" window input the range of data of the column W*Y in "Y range of input." Then click on and select the range of both columns: Weight (W) and Weighted RIDIT (X*W). Check the option "Constant equals zero" and select the output preferences as wanted.
On the Excel output, the X2 slope coefficient corresponds to the slope index of inequality.

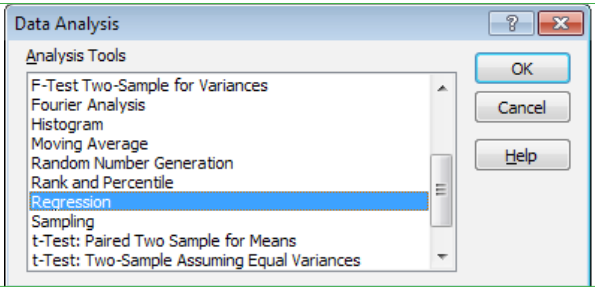
Note 1: In case "Data Analyses" does not appear in your computer's menu, consult Annex 1 for the installation of the required complement.

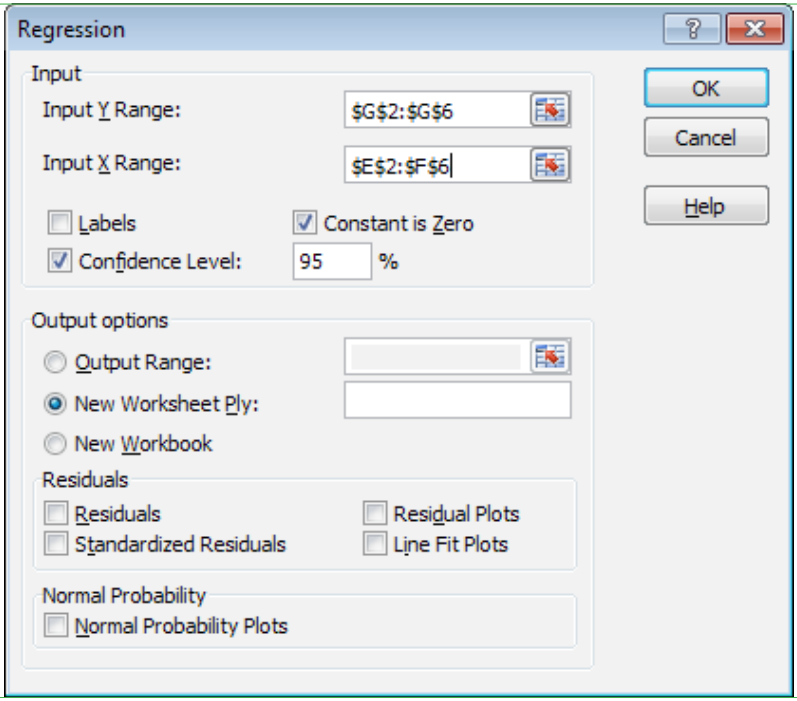
Example:



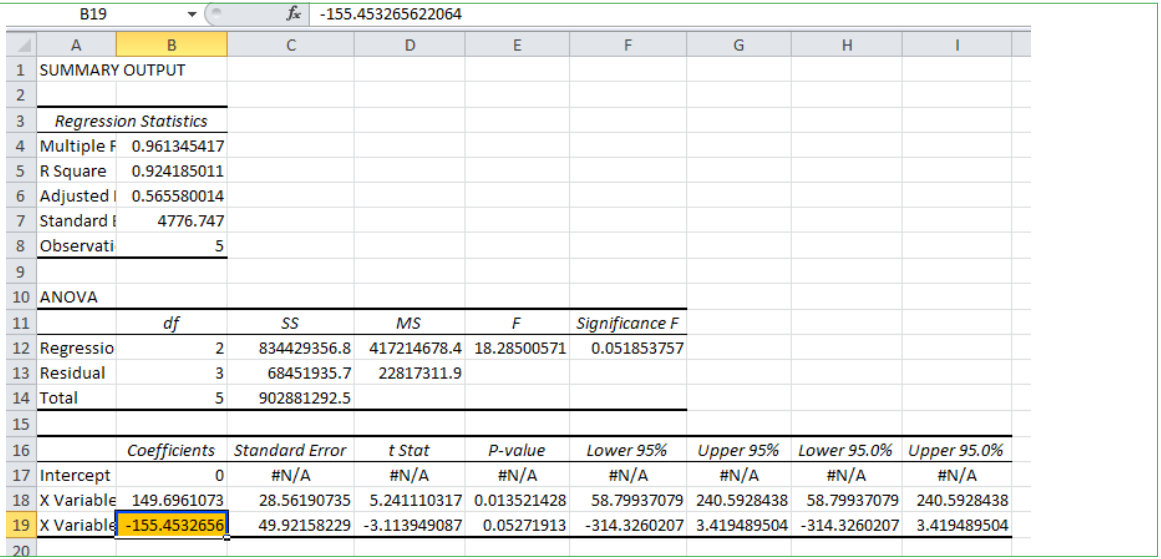
	A	B	C	D	E	F	G
1	Group number	Y	X	Group population	W	W*X	W*Y
2	1	172.5	0.07	16133	127.0	8.7	21915.4
3	2	109.0	0.25	26137	161.7	39.9	17618.7
4	3	47.5	0.42	14316	119.6	50.0	5683.7
5	4	29.3	0.55	17089	130.7	71.9	3825.0
6	5	38.2	0.81	44708	211.4	171.5	8077.3
7				118383			
8							

Step 6


Data Analysis
Analysis Tools
F-Test Two-Sample for Variances
Fourier Analysis
Histogram
Moving Average
Random Number Generation
Rank and Percentile
Regression
Sampling
t-Test: Paired Two Sample for Means
t-Test: Two-Sample Assuming Equal Variances
OK
Cancel
Help


Regression
Input
Input Y Range:
$G$2:$G$6
Input X Range:
$E$2:$F$6
Labels
Constant is Zero
Confidence Level:
95
%
OK
Cancel
Help
Output options
Output Range:
New Worksheet Ply:
New Workbook
Residuals
Residuals
Residual Plots
Standardized Residuals
Line Fit Plots
Normal Probability
Normal Probability Plots

Step 6



B19 | -155.453265622064

	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple F	0.961345417							
5	R Square	0.924185011							
6	Adjusted I	0.565580014							
7	Standard E	4776.747							
8	Observati	5							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*Significance F*			
12	Regressio	2	834429356.8	417214678.4	18.28500571	0.051853757			
13	Residual	3	68451935.7	22817311.9					
14	Total	5	902881292.5						
15									
16		*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
17	Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18	X Variable	149.6961073	28.56190735	5.241110317	0.013521428	58.79937079	240.5928438	58.79937079	240.5928438
19	X Variable	-155.4532656	49.92158229	-3.113949087	0.05271913	-314.3260207	3.419489504	-314.3260207	3.419489504
20									

Nota2:

El índice de la pendiente se debe calcular utilizando el Método de Mínimos Cuadrado Ponderados. Como EXCEL no tiene incorporado este método y solo el Método de Mínimos Cuadrados Ordinarios, se hace necesario calcular las nuevas variables: W, X*W & Y*W y usar estas con EXCEL para obtener los resultados deseados

Columna Y*W es el nuevo “Y”
Columnas W más X*W es el nuevo “X”

Nota 3:

El valor del “X VARIABLE 2” es el índice de la pendiente.

Step 7

Interpretation of the slope index of inequality

Interpretation: For the data in the example, for that country in that year, there were 155 more maternal deaths per 100,000 live births among the provinces of the most illiterate group than in the less illiterate group, taking into consideration the information on the whole gradient and their population weights.

Note:

See steps 5, 6 and 7 of the slope index for non-grouped data for further explanation about the weighting and estimations using regression with Excel.

Step 1

Preparation of the data table

Repeat steps 1-3 of the slope index for non-grouped data, or copy the table including the first six columns through "cumulative frequency." In the case of retaining the same dataset, the user will be using the same values as initial inputs.

	A	B	C	D	E	F
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy		
3	G	133.1	9,096	34.4	0.077	0.077
4	N	243.09	4,681	32.4	0.040	0.116
5	O	184.76	2,356	32.2	0.020	0.136
6	A	137.1	3,587	32.1	0.030	0.167
7	L	106.4	14,926	30.5	0.126	0.293
8	D	100.8	7,624	29.1	0.064	0.357
9	M	57.3	5,180	27.2	0.044	0.401
10	I	63.1	3,059	26.6	0.026	0.427
11	K	31.3	6,077	18.2	0.051	0.478
12	B	0.0	3,712	17.4	0.031	0.509
13	C	55.3	9,042	17.4	0.076	0.586
14	E	0.0	4,335	17.3	0.037	0.622
15	H	43.0	7,007	16.9	0.059	0.682
16	F	80.2	3,733	16.8	0.032	0.713
17	P	125.31	3,156	16	0.027	0.740
18	J	23.1	30,812	11.1	0.260	1.000
19	Total		118,383		1.000	
20						

Step 1

To the table, add the following columns to the right:

a) Health share (fHealth)
b) Relative frequency of the health share (wHealth)
c) Cumulative relative frequency of the health share (cwHealth)
d) Health concentration index (HCI)

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth	HCI
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077				
4	N	243.09	4,681	32.4	0.040	0.116				
5	O	184.76	2,356	32.2	0.020	0.136				
6	A	137.1	3,587	32.1	0.030	0.167				
7	L	106.4	14,926	30.5	0.126	0.293				
8	D	100.8	7,624	29.1	0.064	0.357				
9	M	57.3	5,180	27.2	0.044	0.401				
10	I	63.1	3,059	26.6	0.026	0.427				
11	K	31.3	6,077	18.2	0.051	0.478				
12	B	0.0	3,712	17.4	0.031	0.509				
13	C	55.3	9,042	17.4	0.076	0.586				
14	E	0.0	4,335	17.3	0.037	0.622				
15	H	43.0	7,007	16.9	0.059	0.682				
16	F	80.2	3,733	16.8	0.032	0.713				
17	P	125.31	3,156	16	0.027	0.740				
18	J	23.1	30,812	11.1	0.260	1.000				
19	Total		118,383		1.000					

Step 2

Calculation of the health share for each geographical unit

Note:
it is necessary to extract the numerator of the health indicator for each geographical unit to graph the concentration curve with the cumulative share of health in the abscissa and the correspondent cumulative population share in the ordinate.

The numerator is obtained by solving for it in the equation defining the health indicator. Please note that different health indicators use different multiplying factors, i.e., the maternal mortality ratio uses 100,000 live births, but infant mortality uses 1,000 live births.

$$MMR = \frac{(maternal\ deaths)}{(Live\ births)} \times 100{,}000$$

Thus:

$$maternal\ deaths = \frac{RMM}{100{,}000} \times live\ births$$

(Next page)

Step 2

That is how the health share column (fHealth) is filled out. Under last unit's row, obtain the arithmetic sum of the health share.

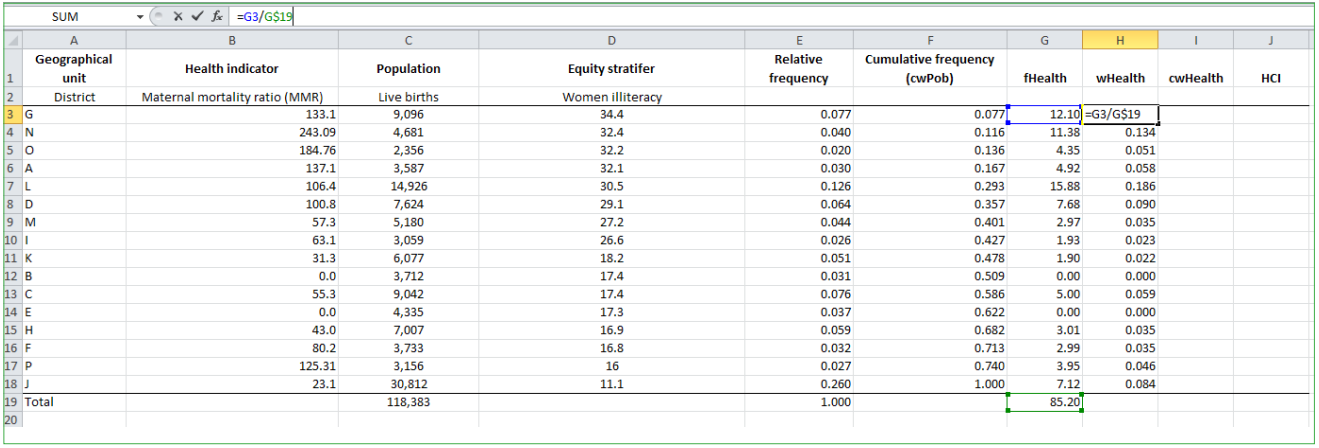
SUM =B3/100000*C3

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth	HCI
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	00000*C3			
4	N	243.09	4,681	32.4	0.040	0.116	11.38			
5	O	184.76	2,356	32.2	0.020	0.136	4.35			
6	A	137.1	3,587	32.1	0.030	0.167	4.92			
7	L	106.4	14,926	30.5	0.126	0.293	15.88			
8	D	100.8	7,624	29.1	0.064	0.357	7.68			
9	M	57.3	5,180	27.2	0.044	0.401	2.97			
10	I	63.1	3,059	26.6	0.026	0.427	1.93			
11	K	31.3	6,077	18.2	0.051	0.478	1.90			
12	B	0.0	3,712	17.4	0.031	0.509	0.00			
13	C	55.3	9,042	17.4	0.076	0.586	5.00			
14	E	0.0	4,335	17.3	0.037	0.622	0.00			
15	H	43.0	7,007	16.9	0.059	0.682	3.01			
16	F	80.2	3,733	16.8	0.032	0.713	2.99			
17	P	125.31	3,156	16	0.027	0.740	3.95			
18	J	23.1	30,812	11.1	0.260	1.000	7.12			
19	Total		118,383		1.000		85.20			

Step 3

Calculation of the simple relative and cumulative relative health share

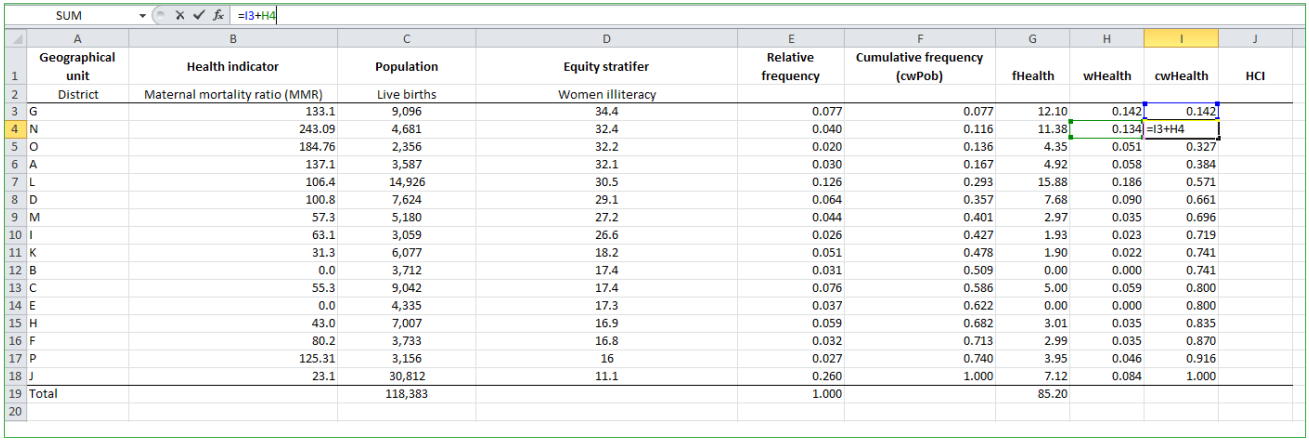
The simple relative (relative, for easy) frequency of health share (wHealth) equals the quotient between the health share of each unit divided by the total health share (arithmetic sum). As shown, using the "$" sign, the value of the total share can be locked, and the syntax may be copied down to the rest of the units.



	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth	HCI
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	12.10	=G3/G$19		
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134		
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051		
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058		
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186		
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090		
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035		
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023		
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022		
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000		
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059		
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000		
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035		
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035		
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046		
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084		
19	Total		118,383		1.000		85.20			
20										

Step 3

The cumulative relative frequency of health share (cwHealth) equals the sum of two consecutive relative frequencies. A "zero" must be filled in the immediate row before the first geographical unit. That way the cumulative relative frequency of the first unit will equal zero plus its relative frequency. For the second, it will equal the relative frequency of the first plus its own. The user can pull down the syntax to the lower rows, as in the last column. By way of verification, the column cwHealth must add-up one (1.0).



	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth	HCI
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142	
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	=I3+H4	
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384	
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571	
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696	
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719	
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741	
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800	
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835	
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870	
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916	
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	
19	Total		118,383		1.000		85.20			
20										

Step 4

Estimation of the health concentration index (HCI)

Both cumulative relative frequencies of the population and health share columns will be the inputs to estimate the health concentration index using the Fuller formula of cross-product difference.

The HCI for the first unit will be the product of the cumulative relative frequency of population of the first unit times the cumulative relative frequency of health share of the second unit. The result is subtracted from the product of the cumulative relative frequency of population of the second unit times the cumulative relative frequency of health share of the first unit.

$$HCI_1=(cwpob_1 \times cwHealth_2)-(cwpob_2 \times cwHealth_1)$$

SUM =(F3*I4)-(I3*F4)

	A	B	C	D	E	F	G	H	I	J
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth	HCI
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142	4)-(I3*F4)
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276	0.00046047
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	-0.00203341
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384	-0.01742035
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571	-0.01036463
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	-0.01648539
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696	-0.00890061
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719	-0.02735932
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	-0.02323013
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741	-0.02669317
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800	-0.02927801
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	-0.02531568
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835	-0.00238161
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870	0.00990438
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916	-0.17673391
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	0
19	Total		118,383		1.000		85.20			-0.35118694
20										

Step 4

The fractional areas thus calculated are to be added to get the final HCI. In the example shown, the result is -0.35

SUM =SUM(J3:J18)

	A	B	C	D	E	F	G	H	I	J
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**	**fHealth**	**wHealth**	**cwHealth**	**HCI**
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy						
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142	0.00464444
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276	0.00046047
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	-0.00203341
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384	-0.01742035
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571	-0.01036463
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	-0.01648539
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696	-0.00890061
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719	-0.02735932
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	-0.02323013
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741	-0.02669317
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800	-0.02927801
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	-0.02531568
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835	-0.00238161
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870	0.00990438
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916	-0.17673391
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	0
19	Total		118,383		1.000		85.20			M(J3:J18)
20										

Step 5

Interpretation of the HCI

This complex measure makes a comparison in relative terms, between the share of population and the share of health (or disease) in a certain time and place. Thus it is a dimensionless measure. Theoretical values fluctuate among -1 (in the case a single person would concentrate the whole burden of disease) and +1 (in the case a single person would concentrate the whole health coverage). In practice, as referred by a bibliography(1), the HCI rarely exceeds |0.5|. Conventionally, values around |0.2| and |0.3| are interpreted as a reasonably high inequality.

In the presented example, an HCI=-0.35 indicates a considerably high inequality (>|0.3|) with a higher concentration of maternal deaths among the more illiterate population.

Another way of looking at it is finding approximately half of the cumulative population share and what is its corresponding (in this case) mortality share. In the example, 50.9% of the population is accumulated through Province "B" in cell F12. Its corresponding share of mortality is shown in cell I12, 74.1%. In other words, the most socially deprived half of the population shares more than half of the maternal deaths.

Step 6

Finally, there is an alternative interpretation available(2). Multiplying the HCI times 75 equals the percentage of health (in this case maternal deaths) that would have to be redistributed among the less-burdened half of the population to achieve equality. Nevertheless, this translation might arise ethical concerns about the redistribution of disease burden /health coverage; as the aspirational goal is getting the entire population to experience the good health status of the most socially advantaged.

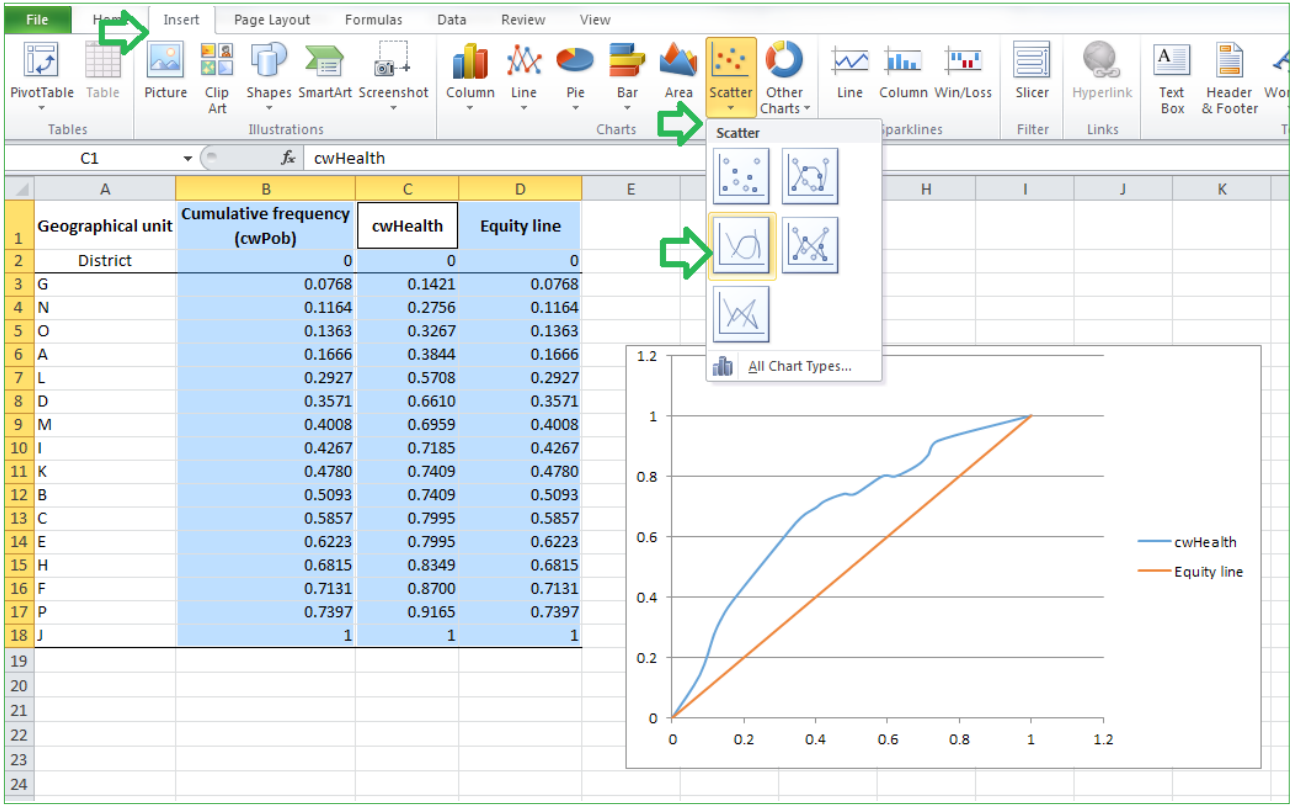
Plotting of the concentration curve

Copy the following columns in a separate spreadsheet with the following titles: Name of the geographic unit, the cumulative relative frequency of population (cwpob) and cumulative relative frequency of health (cwHealth). Add a column to the right named "Equity line." The three columns on the right should start with a zero and end with a one, as in the image. Note that the zero is written in the immediate row before the first geographical unit.

	A	B	C	D
1	Geographical unit	Cumulative frequency (cwPob)	cwHealth	Equity line
2	District	0	0	0
3	G	0.0768	0.1421	0.0768
4	N	0.1164	0.2756	0.1164
5	O	0.1363	0.3267	0.1363
6	A	0.1666	0.3844	0.1666
7	L	0.2927	0.5708	0.2927
8	D	0.3571	0.6610	0.3571
9	M	0.4008	0.6959	0.4008
10	I	0.4267	0.7185	0.4267
11	K	0.4780	0.7409	0.4780
12	B	0.5093	0.7409	0.5093
13	C	0.5857	0.7995	0.5857
14	E	0.6223	0.7995	0.6223
15	H	0.6815	0.8349	0.6815
16	F	0.7131	0.8700	0.7131
17	P	0.7397	0.9165	0.7397
18	J	1	1	1

Step 6

Select the cwpob column. Press the Ctrl key and hold it. Select the cwHealth column and continue holding the Ctrl key as the user selects the Equity line column.



	Geographical unit	Cumulative frequency (cwPob)	cwHealth	Equity line
2	District	0	0	0
3	G	0.0768	0.1421	0.0768
4	N	0.1164	0.2756	0.1164
5	O	0.1363	0.3267	0.1363
6	A	0.1666	0.3844	0.1666
7	L	0.2927	0.5708	0.2927
8	D	0.3571	0.6610	0.3571
9	M	0.4008	0.6959	0.4008
10	I	0.4267	0.7185	0.4267
11	K	0.4780	0.7409	0.4780
12	B	0.5093	0.7409	0.5093
13	C	0.5857	0.7995	0.5857
14	E	0.6223	0.7995	0.6223
15	H	0.6815	0.8349	0.6815
16	F	0.7131	0.8700	0.7131
17	P	0.7397	0.9165	0.7397
18	J	1	1	1

Step 6

Go to the Insert menu➔Graph. Select scatterplot with smooth lines. Personalize the labels accordingly, considering:

a) The relative cumulative frequency of population should be plotted on the abscissa axis (x) and the relative cumulative frequency of health on the ordinate axis (y)

b) The range goes from 0 to 1

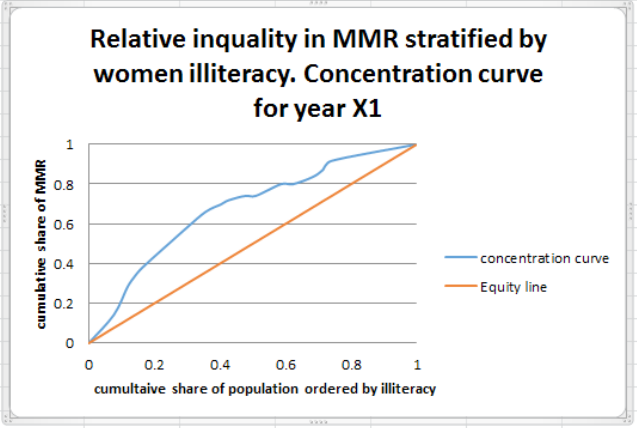
c) One curve should be plotted for each analyzed year

d) HCI < 0 correspond to a curve above the theoretical equity line, and HCI > 0 to a curve plotted below the theoretical equity line

e) The absolute value of the HCI equals twice the area between the curve and the equity line

Chart 1

	A	B	C	D
1	Geographical unit	Cumulative frequency (cwPob)	cwHealth	Equity line
2	District	0	0	0
3	G	0.0768	0.1421	0.0768
4	N	0.1164	0.2756	0.1164
5	O	0.1363	0.3267	0.1363
6	A	0.1666	0.3844	0.1666
7	L	0.2927	0.5708	0.2927
8	D	0.3571	0.6610	0.3571
9	M	0.4008	0.6959	0.4008
10	I	0.4267	0.7185	0.4267
11	K	0.4780	0.7409	0.4780
12	B	0.5093	0.7409	0.5093
13	C	0.5857	0.7995	0.5857
14	E	0.6223	0.7995	0.6223
15	H	0.6815	0.8349	0.6815
16	F	0.7131	0.8700	0.7131
17	P	0.7397	0.9165	0.7397
18	J	1	1	1
19				
20				



d. Health concentration index for grouped data

In case there were outliers affecting the estimation of the HCI, one option is to group data using quantiles.

Step 1

Construction of a table as the one used in step 3 for HCI for non-grouped data

Follow steps 1-3 in HCI for non-grouped data or copy the table in case the user has already built it.

SUM =I3+H4

	A	B	C	D	E	F	G	H	I
1	**Geographical unit**	**Health indicator**	**Population**	**Equity stratifer**	**Relative frequency**	**Cumulative frequency (cwPob)**	**fHealth**	**wHealth**	**cwHealth**
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy					
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	=I3+H4
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000
19	Total		118,383		1.000		85.20		
20									
21	k value	cut-off point							
22	0.2	16.9							
23	0.4	17.4							
24	0.6	27.2							
25	0.8	32.1							

Step 2

Grouping data

Data are grouped according to the distribution quantiles of the equity stratifier. To get the cut-off points of the distribution, use the syntax =PERCENTILE.INC (range of the data on the equity stratifier, k). When using quintiles, k takes values 0.2, 0.4, 0.6 and 0.8. The image shows data grouped in quintiles, as well as the following steps. For details on grouping data, see step 2 of the absolute gap of inequality.

SUM =PERCENTILE.INC(D$3:D$18,A22)

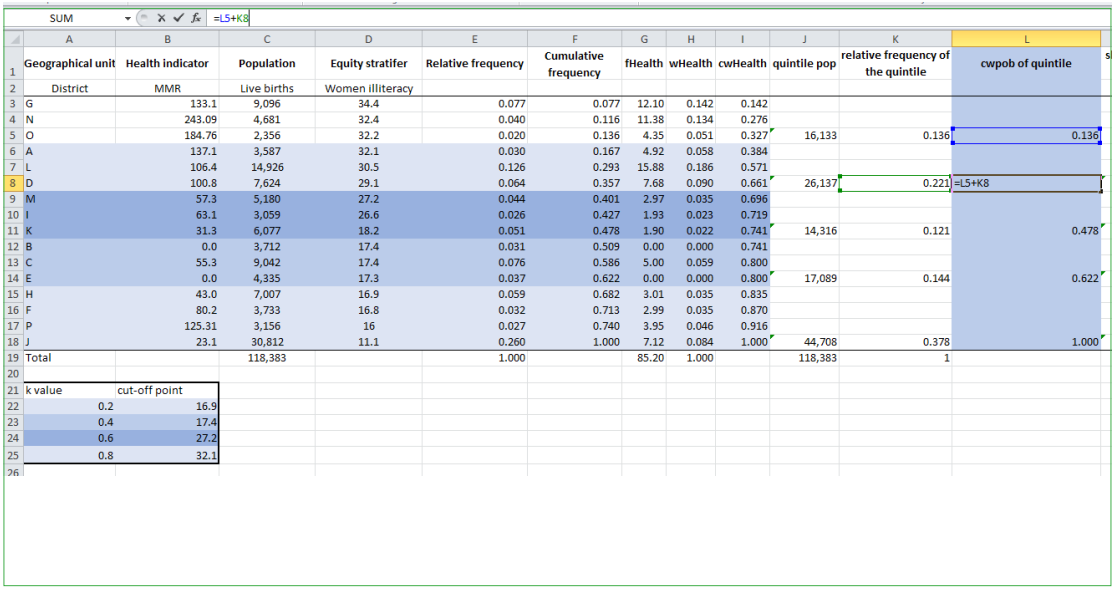
	A	B	C	D	E	F	G	H	I
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency (cwPob)	fHealth	wHealth	cwHealth
2	District	Maternal mortality ratio (MMR)	Live births	Women illiteracy					
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000
19	Total		118,383		1.000		85.20		
20									
21	k value	cut-off point							
22	0.2	=PERCENTILE.INC(D$3:D$18,A22)							
23	0.4	17.4							
24	0.6	27.2							
25	0.8	32.1							

Step 3

Obtaining the population share of each quintile

The columns for the equity stratifier and the population shares may be hidden, to improve visualization. Add three additional columns to the right:

- Population of the quintile: sum of the population of each of the geographical units included in the quintile
- Relative frequency (population) for the quintile: the population of each quintile divided by the total of the population
- The cumulative relative frequency (population) for the quintile: for quintile 1, this will equal zero plus the relative frequency of quintile 1. For quintile 2, this will equal the cumulative frequency of quintile 1 plus the relative frequency of quintile 2, and consecutively until quintile 5 which will add-up 1, as shown in the image.



SUM =L5+K8

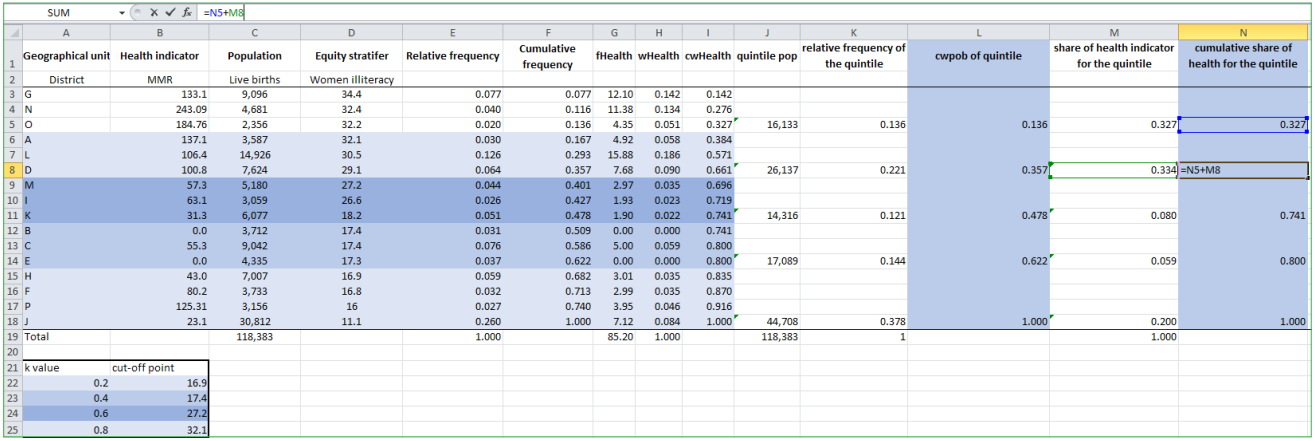
	A	B	C	D	E	F	G	H	I	J	K	L
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency	fHealth	wHealth	cwHealth	quintile pop	relative frequency of the quintile	cwpob of quintile
2	District	MMR	Live births	Women illiteracy								
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142			
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276			
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	16,133	0.136	0.136
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384			
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571			
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	26,137	0.221	=L5+K8
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696			
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719			
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	14,316	0.121	0.478
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741			
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800			
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	17,089	0.144	0.622
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835			
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870			
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916			
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	44,708	0.378	1.000
19	Total		118,383		1.000		85.20	1.000		118,383	1	
20												
21	k value	cut-off point										
22	0.2	16.9										
23	0.4	17.4										
24	0.6	27.2										
25	0.8	32.1										
26												

Step 4

Obtaining the health share of each quintile

Add two columns to the right:

- Relative frequency of health: equals the sum of the relative frequencies of the health of the units included in the quintile.
- The cumulative relative frequency of health: for quintile 1, this will equal zero plus the relative frequency of quintile 1. For quintile 2, this will equal the cumulative frequency of quintile 1 plus the relative frequency of quintile 2, and consecutively until quintile 5 which will add-up 1, as shown in the image.



SUM =N5+M8

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency	fHealth	wHealth	cwHealth	quintile pop	relative frequency of the quintile	cwpob of quintile	share of health indicator for the quintile	cumulative share of health for the quintile
2	District	MMR	Live births	Women illiteracy										
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142					
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276					
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	16,133	0.136	0.136	0.327	0.327
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384					
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571					
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	26,137	0.221	0.357	0.334	=N5+M8
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696					
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719					
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	14,316	0.121	0.478	0.080	0.741
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741					
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800					
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	17,089	0.144	0.622	0.059	0.800
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835					
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870					
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916					
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	44,708	0.378	1.000	0.200	1.000
19	Total		118,383		1.000		85.20	1.000		118,383	1		1.000	
20														
21	k value	cut-off point												
22	0.2	16.9												
23	0.4	17.4												
24	0.6	27.2												
25	0.8	32.1												

Step 5

Estimation of the Health Concentration Index (HCI)

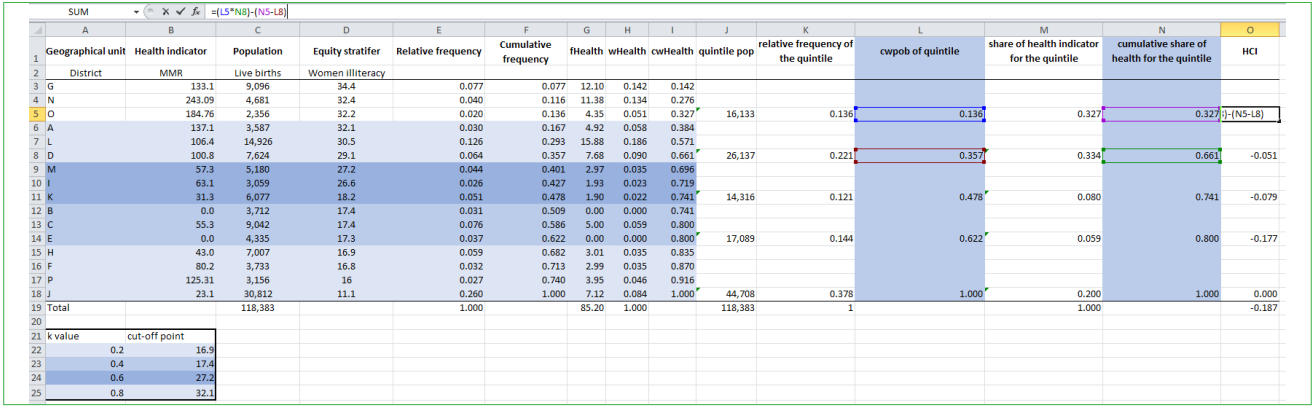
Two columns are needed: relative cumulative frequency of population, and relative cumulative frequency of health (columns L and N in the example).

The Fuller formula is applied here as in step 4 of HCI for non-grouped data.

The HCI for the first quintile will be the product of the cumulative relative frequency of population of the first quintile times the cumulative relative frequency of health share of the second quintile. The result is subtracted from the product of the cumulative relative frequency of population of the second quintile times the cumulative relative frequency of health share of the first quintile. Brackets should be used in the syntax to indicate the subtraction of products.

$$HCI_1=(cwpob_1 \times cwHealth_2)-(cwpob_2 \times cwHealth_1)$$

The total HCI will equal the sum of the HCI of the quintiles.



SUM =(L5*N8)-(N5-L8)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Geographical unit	Health indicator	Population	Equity stratifer	Relative frequency	Cumulative frequency	fHealth	wHealth	cwHealth	quintile pop	relative frequency of the quintile	cwpob of quintile	share of health indicator for the quintile	cumulative share of health for the quintile	HCI
2	District	MMR	Live births	Women illiteracy											
3	G	133.1	9,096	34.4	0.077	0.077	12.10	0.142	0.142						
4	N	243.09	4,681	32.4	0.040	0.116	11.38	0.134	0.276						
5	O	184.76	2,356	32.2	0.020	0.136	4.35	0.051	0.327	16,133	0.136	0.136	0.327	0.327	i)-(N5-L8)
6	A	137.1	3,587	32.1	0.030	0.167	4.92	0.058	0.384						
7	L	106.4	14,926	30.5	0.126	0.293	15.88	0.186	0.571						
8	D	100.8	7,624	29.1	0.064	0.357	7.68	0.090	0.661	26,137	0.221	0.357	0.334	0.661	-0.051
9	M	57.3	5,180	27.2	0.044	0.401	2.97	0.035	0.696						
10	I	63.1	3,059	26.6	0.026	0.427	1.93	0.023	0.719						
11	K	31.3	6,077	18.2	0.051	0.478	1.90	0.022	0.741	14,316	0.121	0.478	0.080	0.741	-0.079
12	B	0.0	3,712	17.4	0.031	0.509	0.00	0.000	0.741						
13	C	55.3	9,042	17.4	0.076	0.586	5.00	0.059	0.800						
14	E	0.0	4,335	17.3	0.037	0.622	0.00	0.000	0.800	17,089	0.144	0.622	0.059	0.800	-0.177
15	H	43.0	7,007	16.9	0.059	0.682	3.01	0.035	0.835						
16	F	80.2	3,733	16.8	0.032	0.713	2.99	0.035	0.870						
17	P	125.31	3,156	16	0.027	0.740	3.95	0.046	0.916						
18	J	23.1	30,812	11.1	0.260	1.000	7.12	0.084	1.000	44,708	0.378	1.000	0.200	1.000	0.000
19	Total		118,383		1.000		85.20	1.000		118,383	1		1.000		-0.187
20															

	k value	cut-off point
21		
22	0.2	16.9
23	0.4	17.4
24	0.6	27.2
25	0.8	32.1

Bibliography

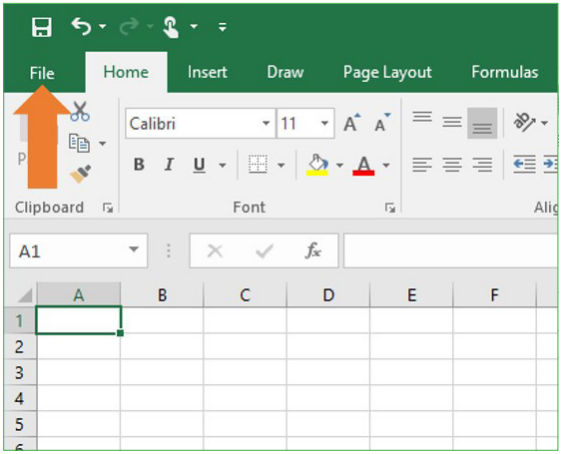
1. Donnell O, Wagstaff A, Lindelow M. Analyzing Health Equity Using Household Survey Data. Washington: World Bank; 2008. 95-96 p.
2. World Health Organization. Handbook on Health Inequality Monitoring. Hosseinpoor AR, editor. Luxembourg: World Health Organization; 2013. 105 p.

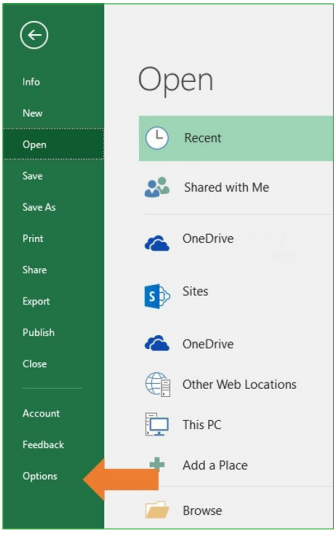
ANNEX 1

Instalation of the Analysis ToolPak Add-inn on Excel 2013.

Step 1

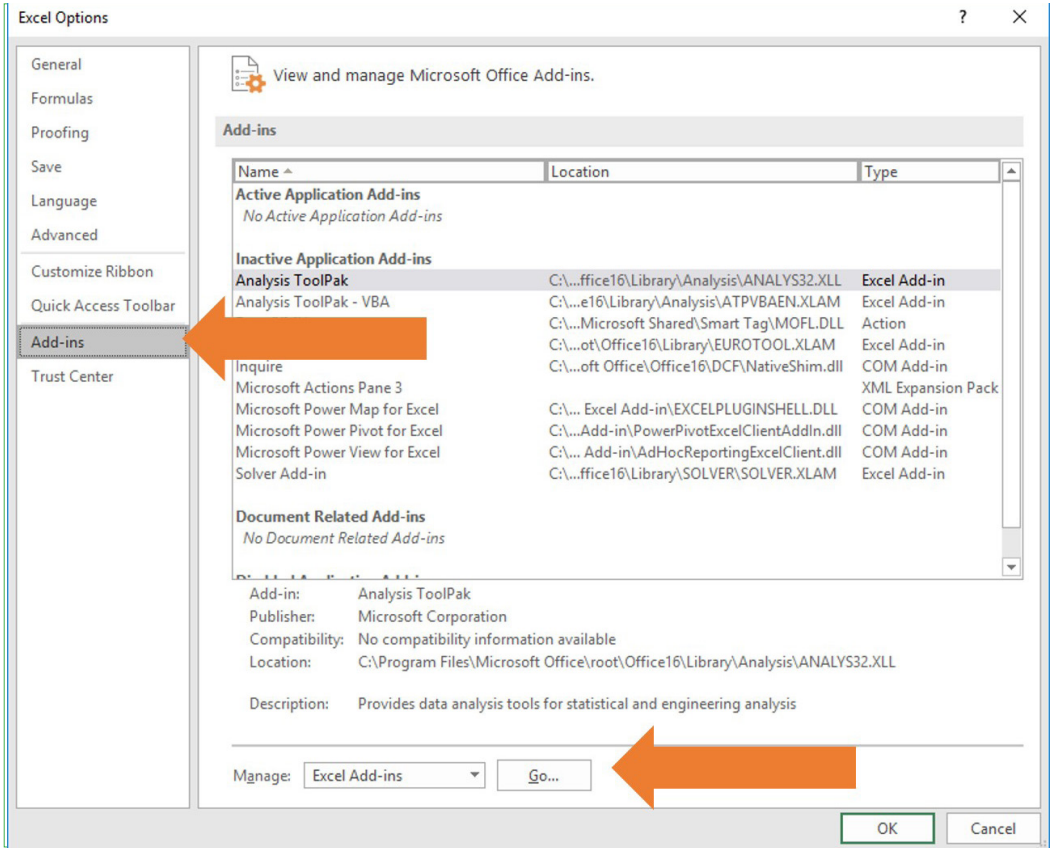
In the Excel file, click on the File menu, tag Options.





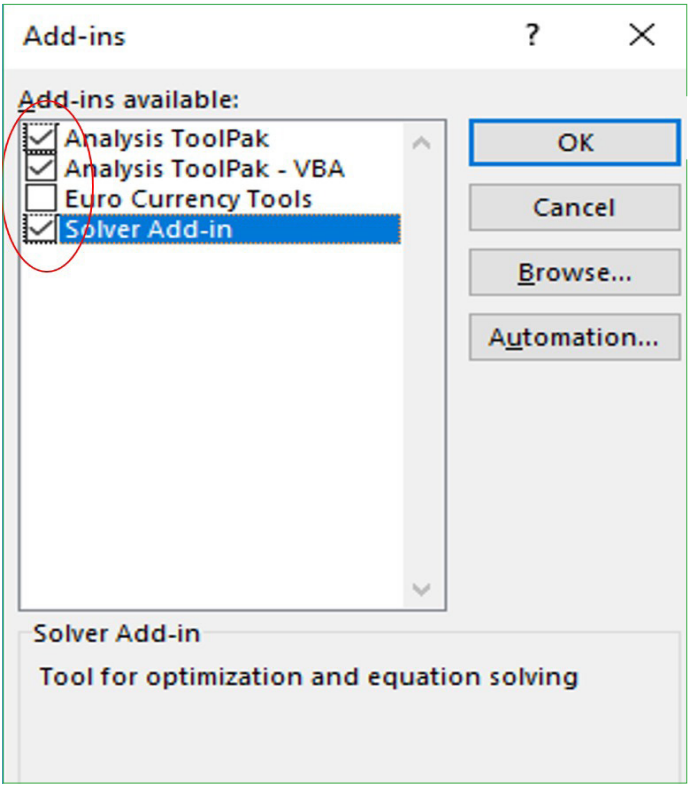
Step 2

On the Options window, select Add-ins. In the dropdown menu at the bottom section of the window, select Manage Excel Add-ins, and the press Go.



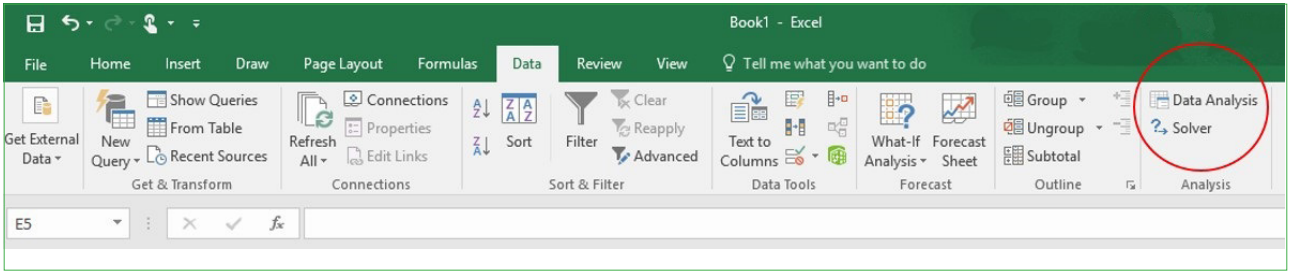
Step 3

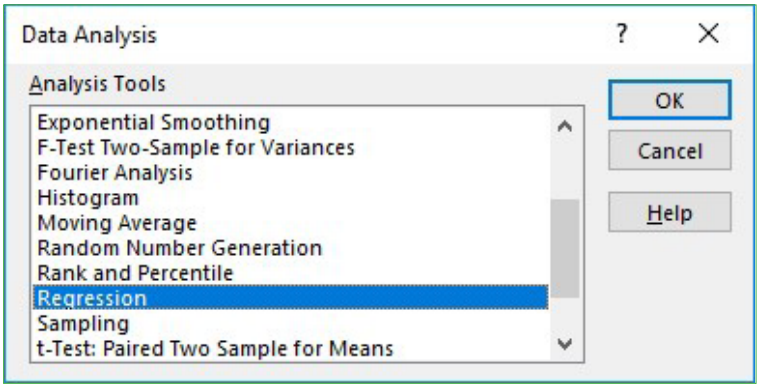
It will appear the Add-ins window. Click on the options "Analysis ToolPak", "Analysis ToolPak-VBA" and "Solver add-inn". And then, click on "Ok".



Step 4

You could check on the Data menu that now a new option appears: data Anlysis, where you can find the Regression tool needed to perform the step 6 for the Gradient measures of social inequality in health.





Every Woman Every Child Latin America and Caribbean (EWEC LAC) is the regional coordination mechanism for the Global Strategy for Women's, Children's and Adolescents' Health in the context of Latin America and the Caribbean. EWEC-LAC catalyzes and supports countries in their efforts to meet the goals and targets set out in the Global Strategy and align with the Sustainable Development Goals, with a focus on reducing social inequalities in health.

EWEC-LAC collaborates with key stakeholders in the region including governments, international development agencies, civil society representatives, academic institutions, professional institutions and non-governmental organizations to catalyze and support country-led efforts with the objective to reduce disparities in access to quality health services.

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