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ACTUARIAL PENETRATION AND ACTUARIAL DENSITY: POTENTIALLY USEFUL CONCEPTS

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- Background
- Data
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Introduction

The concepts of insurance penetration and insurance density motivated our analysis.

The usual definitions are as follows:

Insurance penetration	**the amount of insurance premium divided by the Gross Domestic Product (GDP)**
Insurance density	**the amount of insurance premium divided by the population**

Introduction

We propose the following concept names and definitions:

Actuarial economic penetration	**the number of actuaries divided by the GDP**
Actuarial density	**the number of actuaries divided by the population**
Actuarial insurance penetration	**the number of actuaries divided by the amount of insurance premium**

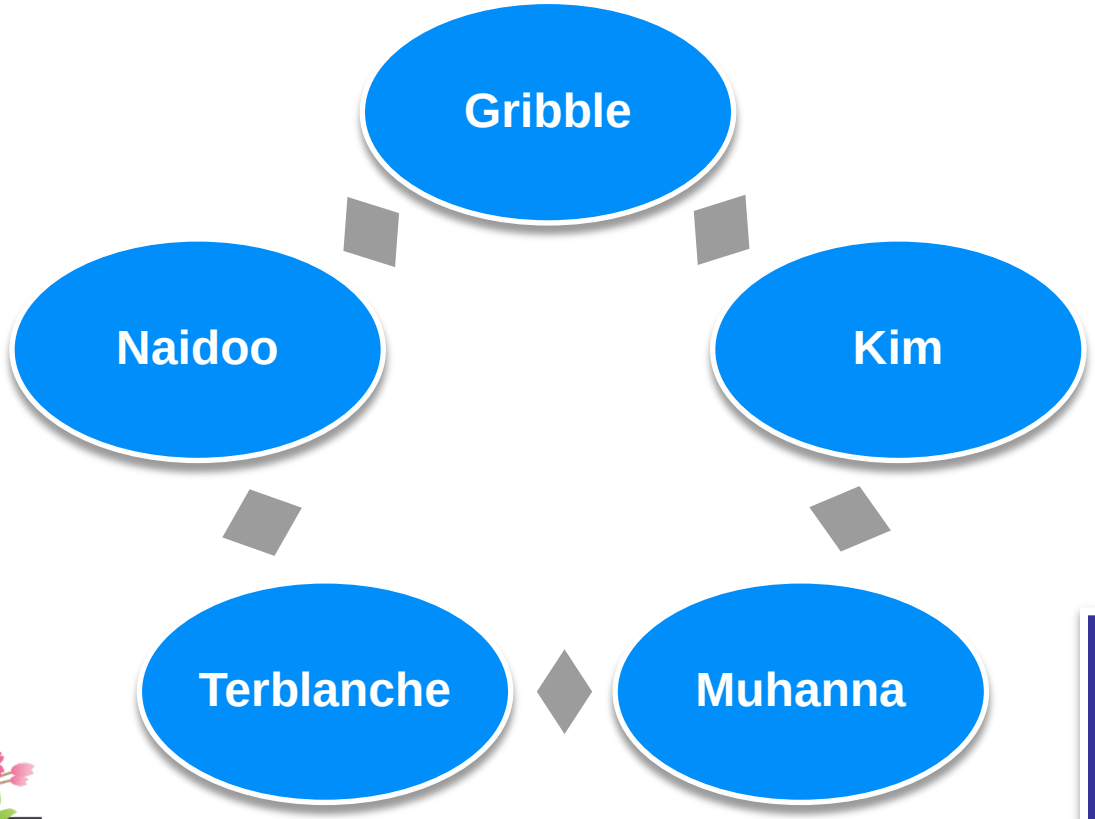
Introduction

Consistency with International Actuarial Association (IAA) slogan:

Moving the Profession Forward Internationally

Background

Other actuaries have considered the same or similar concepts:



We believe that our analysis draws from the work of others but extends the concepts and the interrelationships

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Data

Data elements used:

- Number of FQAs by FMA
- Insurance Premium
- Population
- GDP (US $ and PPP basis in Int $)
- Age of the Associations

Calculations made:

- Insurance Density
- Insurance Penetration
- Actuarial Density
- Actuarial Economic Penetration
- Actuarial Insurance Penetration

Data

FQAs

Number of Fully Qualified Actuaries ("FQAs").

The IAA provided data by Full Member Association ("FMA") regarding the number of FQAs from 2002 to 2011.

We explore a sample of 56 countries.

Data

Special treatment of FQA data by FMA:

More then one FMA, used the number of FQAs in the largest FMA.

Determined USA FQAs by combining CAS and SOA FQAs, then subtracting out FQAs from Canada.

We used the number of FQAs from Canadian Institute of Actuaries (CIA) without adjustment.

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Data

Insurance Premium

Published by Swiss Re in its **Sigma Publication** in US $ from 2002-2011 separately by country and for the life and non-life sectors.

May be understated when government agencies or corporations have significant premium.

Country with the most premium is USA, with nearly $1.1 trillion, followed by Japan with nearly $0.7 trillion.

Country with the least premium is Serbia, with approximately $800 million total premium.

Data

Gross Domestic Product

GDP data published in ***Sigma*** without an adjustment for PPP.

Most GDP is for USA, with more than $13 trillion, followed by China, with more than $7 trillion.

Least GDP in our sample is for Iceland, with approximately $14 billion.

Purchasing Power Parity (PPP)

For 2011, we obtained PPP data for GDP from The World Bank and performed a comparison of the results. We used GDP in international dollars with a PPP adjustment that takes into account differences in costs for products and services across the range of countries.

Data

Population

Data by country from ***Sigma*** for 2002-2011.

China and India have populations greater than 1 billion.

Cyprus and Iceland have populations of approximately 1.1 million and 300,000, respectively.

Age of the Associations

Dates included in a database provided by the IAA are used to calculate age.

Some associations are over one hundred years old while five associations have become FMAs in the last decade.

Data

Algebraic relationships hold:

Actuarial economic penetration	=	**Actuarial insurance penetration**	x	**Insurance penetration**
Actuarial density	=	**Actuarial insurance penetration**	x	**Insurance density**
Actuarial density	=	**Actuarial economic penetration**	x	**GDP per capita**

Data

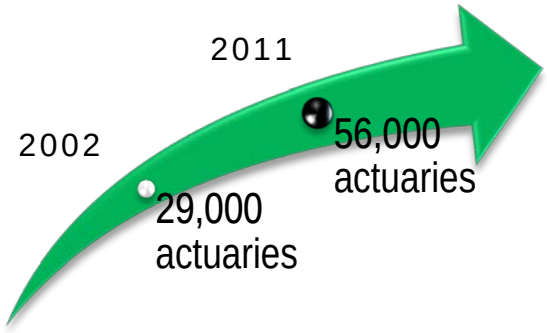
The ranges for the derived variables are as follows:

Actuarial density	from 0.15 per million for Egypt to more than 169 per million for the United Kingdom
Actuarial economic penetration	from approximately 50 FQAs per trillion USD of GDP for China and Egypt to more than 5,000 FQAs per trillion USD for the United Kingdom
Actuarial insurance penetration	from less than 2 FQAs per billion USD of premium for China and Thailand to nearly 40 for Croatia

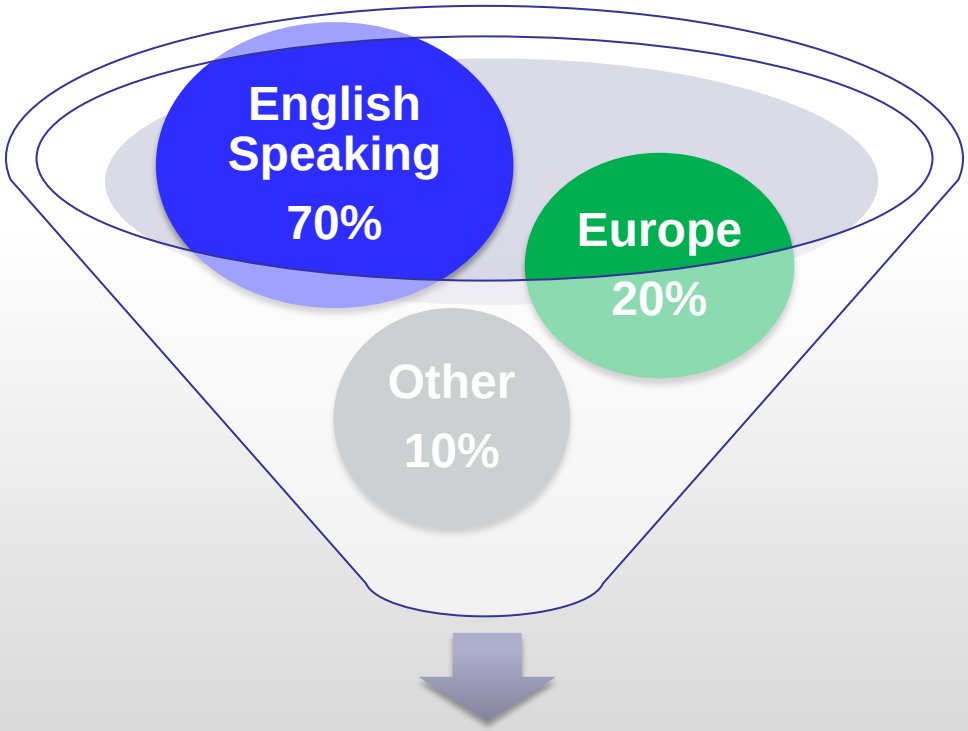
Analysis

Distribution of Actuaries – 2002 and 2011

Countries	Number of FQA's - 2011	Number of FQA's - 2011 (%)	Number of FQA's - 2002	Number of FQA's - 2002 (%)
English Speaking Countries	39,074	70.82%	19,161	66.99%
Euro 1	10,202	18.49%	6,678	23.35%
Euro 2	937	1.69%	402	1.40%
Latin America	1,615	2.93%	766	2.67%
Asia	3,281	5.95%	1,583	5.53%
Africa	61	0.11%	9	0.03%
Total	55,170	100.00%	28,599	100.00%



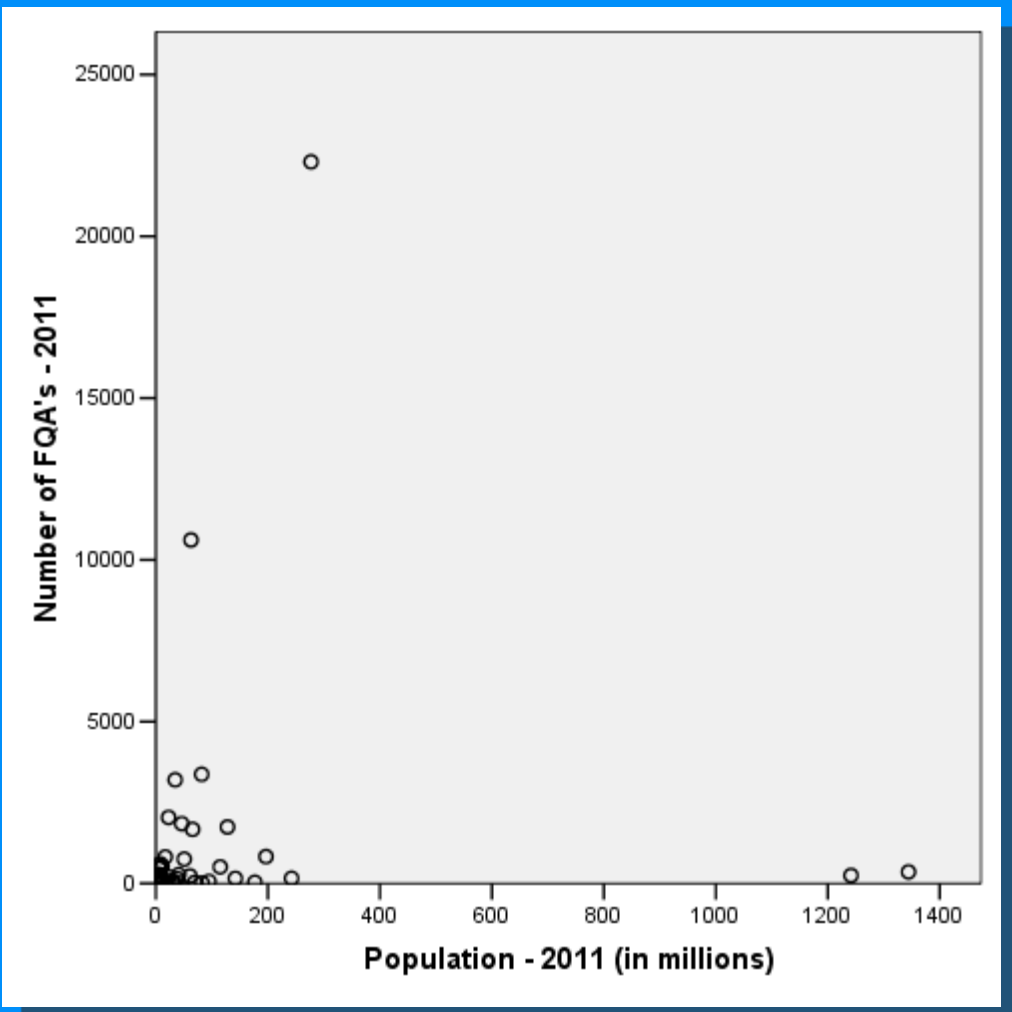
Analysis



Distribution of the number of actuaries

Analysis

FQA´s Number versus Population



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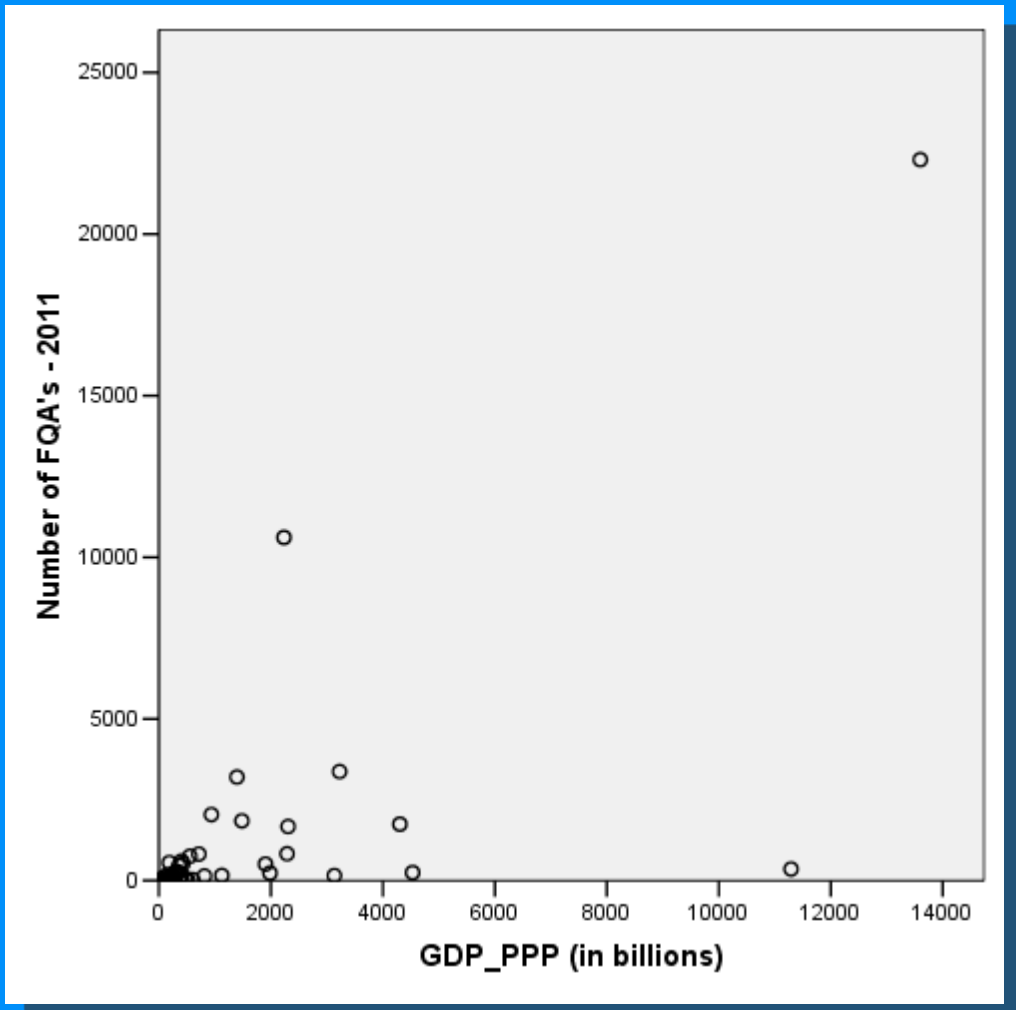
Analysis

FQA´s Number versus GDP



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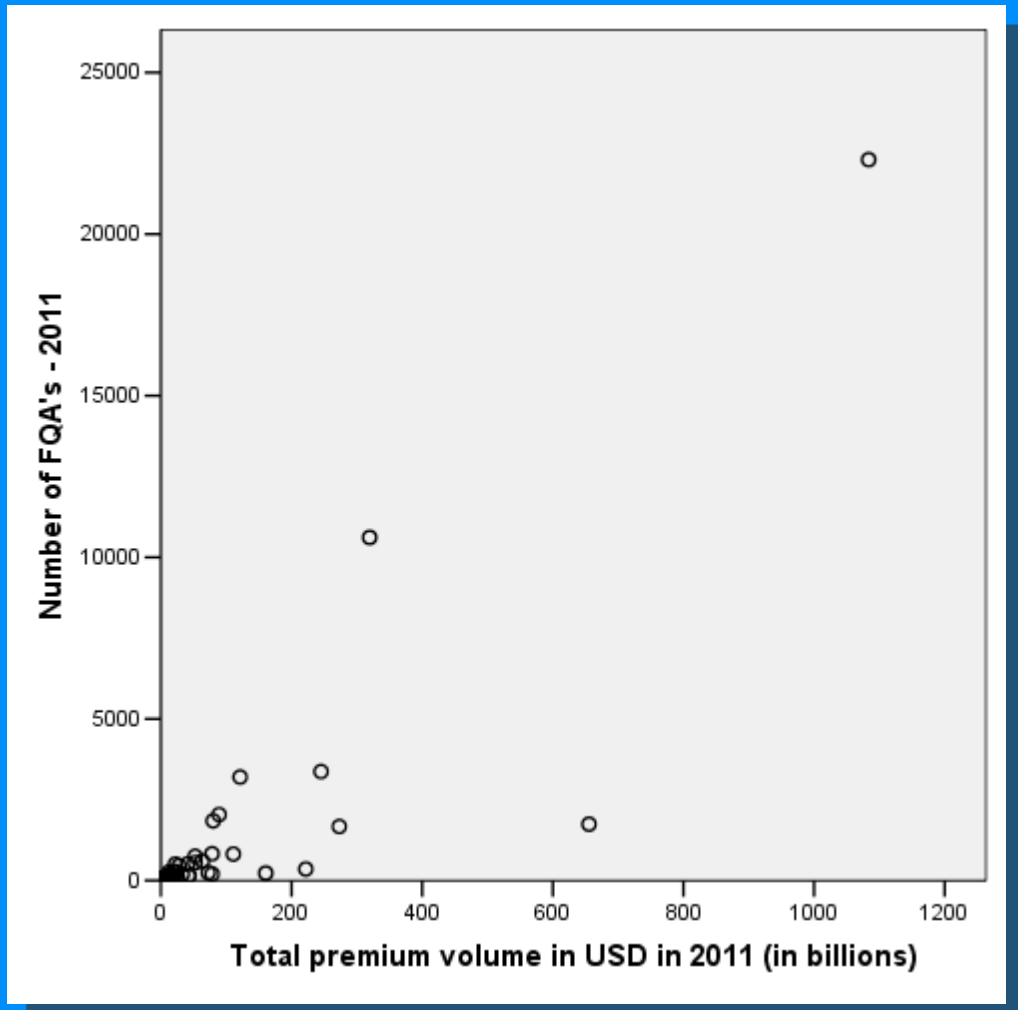
Analysis

FQA´s Number versus Total Insurance Premium



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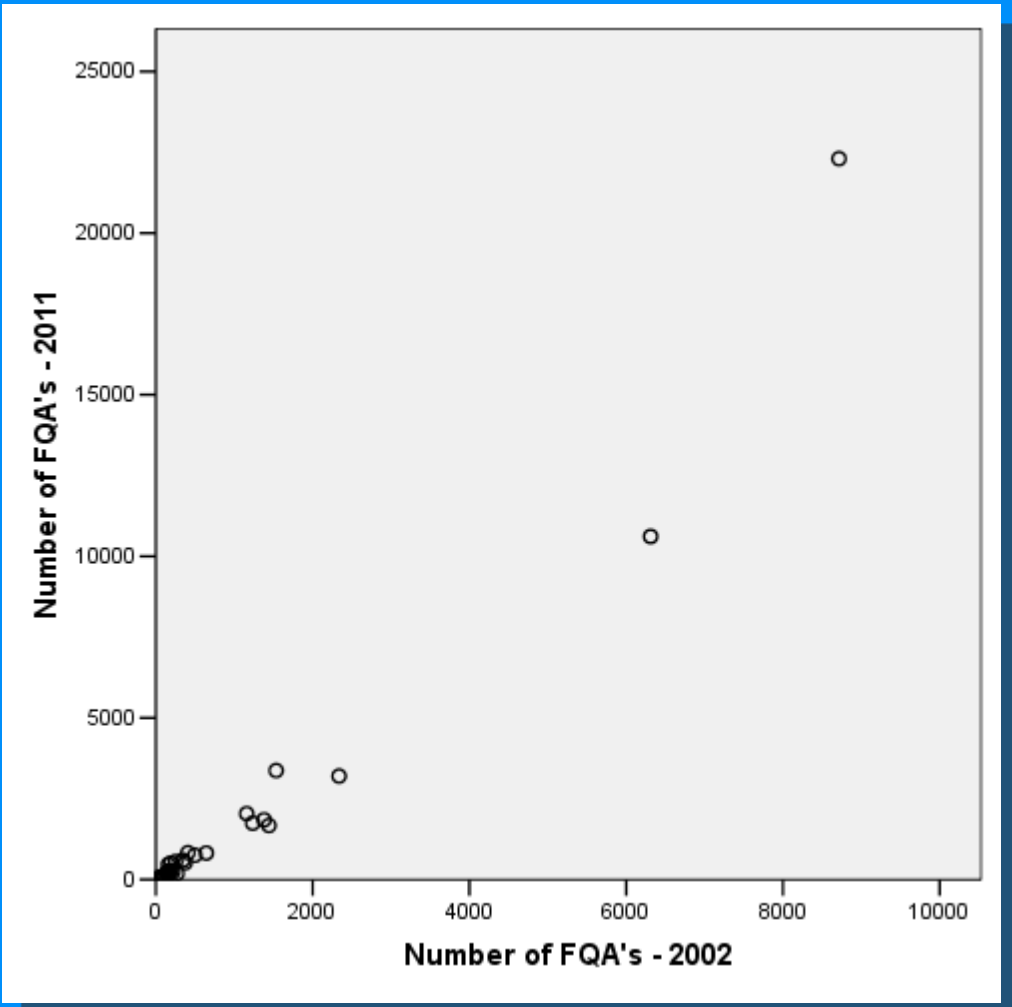
Analysis

2011 FQA´s Number versus 2002 FQA`s Number



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Analysis

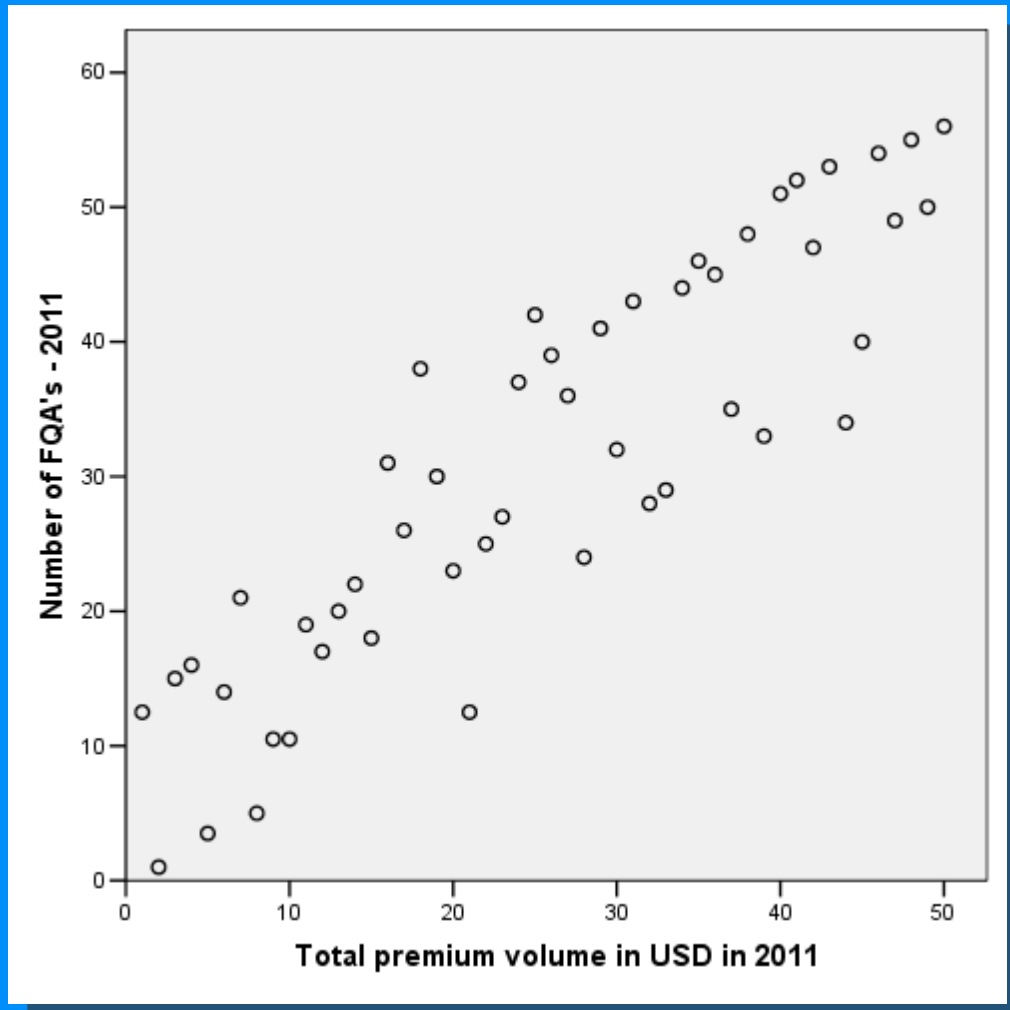
Graphs show clustering near the origin with the extreme values almost appearing as outliers.

Considering the rank of the variables, the pattern is clearer. We have removed the effects of a large range between the lower and the higher values of each variable.

Look at the graphs on the next two slides.

Analysis

FQA´s Number Rank versus Total Premium Volume Rank



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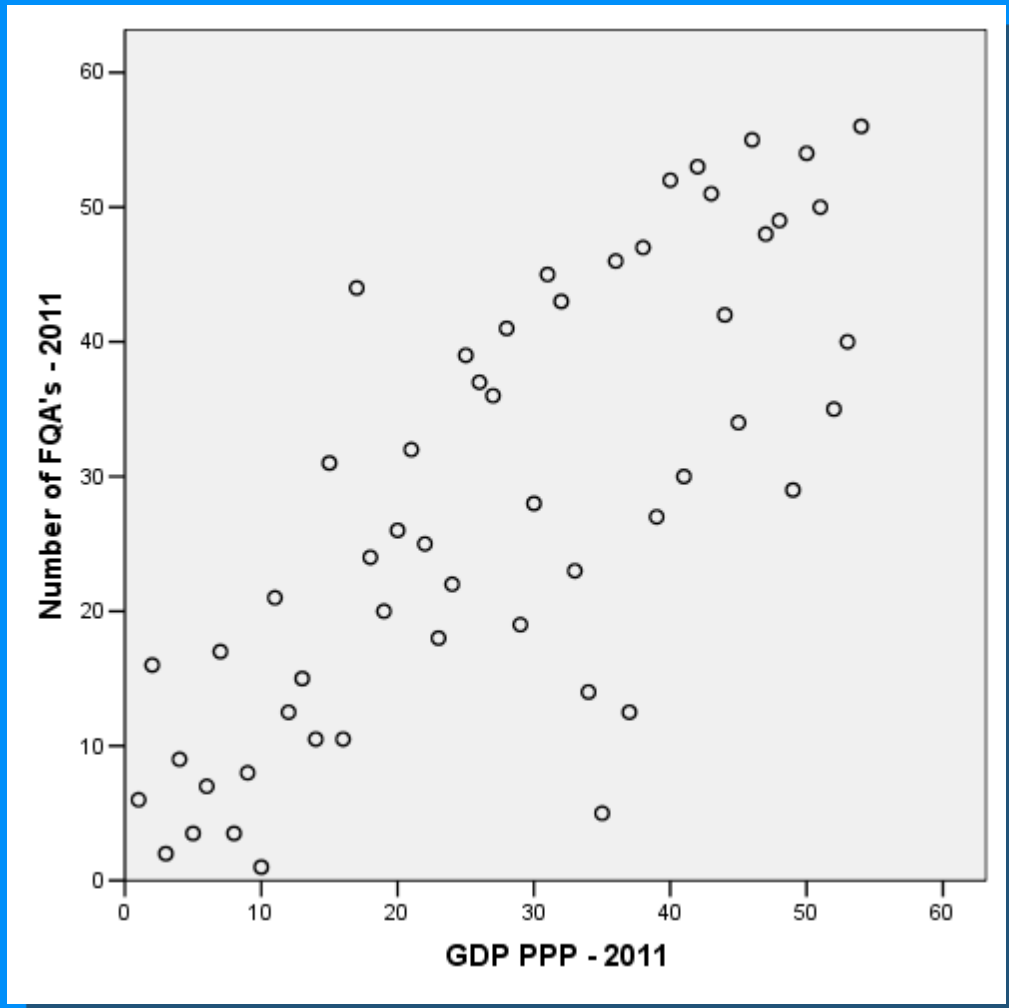
Analysis

FQA`s Number Rank versus GDP



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Analysis

All graphs show a generally increasing relationship between number of actuaries and the other variables considered.

We also performed pair wise correlation analysis using both absolute numerical (parametric correlation of Pearson) and rank data (non-parametric correlation of Spearman).

Use of non-parametric correlation can lessen potential distortions caused by the extreme numerical values of some variables.

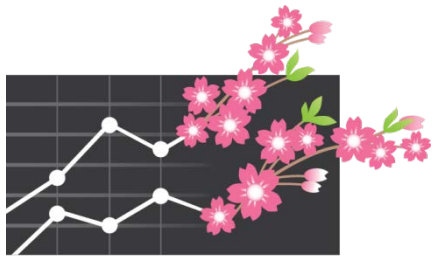
With data roughly elliptically distributed and without prominent outliers, the Spearman correlation and Pearson correlation give similar values. But Spearman is less sensitive than Pearson correlation to strong outliers.

Results and Discussion

Results with 2011 data, summarizing correlation analysis in the charts below, highlighting correlations significant at 0.01 levels.

Correlations between the number of actuaries and the indicated Variable:

Variable	Sample size	Pearson Correlation	Spearman Correlation
Population (in millions)	56	0.090	0.434
GDP (in milions)	56	0.786	0.856
GDP_PPP (in millions)	54	0.688	0.762
Life premium volume in USD (in millions)	50	0.695	0.865
Non-life premium volume in USD (in millions)	50	0.929	0.882
Total premium volume in USD (in millions)	50	0.845	0.894
Insurance Penetration	50	0.200	0.617
Insurance Density	50	0.220	0.641
Population Variation 2011 - 2002	56	(0.053)	0.094
Total Premium Volume Variation 2011 - 2002	50	(0.305)	(0.354)
Life Premium Volume Variation 2011-2002	50	(0.136)	(0.470)
Non-life Premium Volume Variation 2011-2002	50	(0.225)	(0.262)
GDP Variation 2011 - 2002	56	(0.079)	(0.258)
Association Age	55	0.280	0.694



Results and Discussion

Correlations between Actuarial Density with the indicated Variable

Variable	Sample size	Pearson Correlation	Spearman Correlation
GDP (in milions)	56	0.215	0.201
GDP_PPP (in millions)	54	0.119	0.021
Total premium volume in USD (in millions)	50	0.323	0.464
Life premium volume in USD (in millions)	50	0.282	0.459
Non-life premium volume in USD (in millions)	50	0.336	0.431
Insurance Penetration	50	0.620	0.722
Insurance Density	50	0.734	0.867
Association Age	55	0.521	0.526

Results and Discussion

Correlation with Actuarial Insurance Penetration results:

Variable	Sample size	Pearson Correlation	Spearman Correlation
GDP (in milions)	50	(0.068)	(0.260)
GDP_PPP (in millions)	48	(0.112)	(0.233)
Population (in millions)	50	(0.223)	(0.213)
Insurance Density	50	(0.135)	(0.092)
Association Age	49	(0.109)	(0.106)
Insurance Penetration	50	(0.189)	(0.223)

None of the variables tested show significant correlations with Actuarial Insurance penetration

Results and Discussion

Correlation with Actuarial Economic Penetration results:

Variable	Sample size	Pearson Correlation	Spearman Correlation
Population (in millions)	56	(0.187)	(0.439)
Insurance Density	50	0.512	0.575
Insurance Penetration	50	0.578	0.540
Association Age	55	0.333	0.241

Actuarial economic penetration provides a measure of economic scale and growth, and by implication, the need or opportunity for Actuaries.

Results and Discussion

Comparison of the results of the correlation with GDP adjusted for PPP for both parametric and non-parametric correlation.

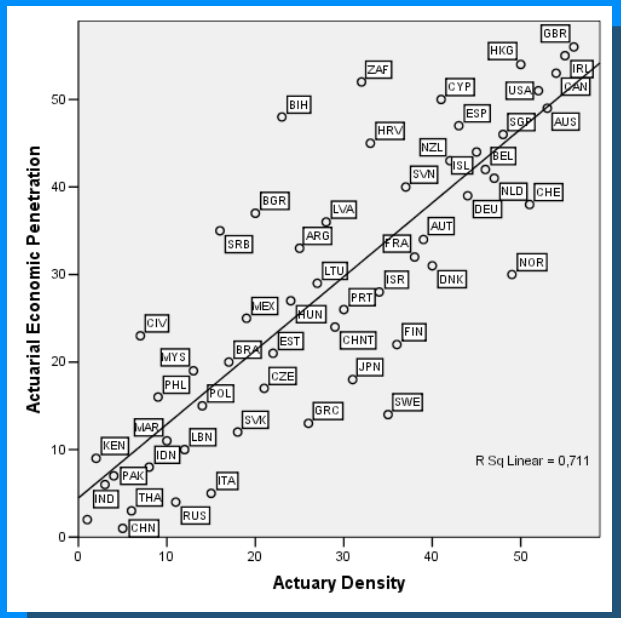
Variable	Variable	Sample size	Pearson Correlation	Spearman Correlation
Actuarial Economic Penetration	Insurance Density	50	0.512	0.575
Actuarial Economic Penetration _PPP	Insurance Density	48	0.634	0.756
Actuarial Economic Penetration	Insurance Penetration	50	0.578	0.540
Actuarial Economic Penetration _PPP	Insurance Penetration	48	0.669	0.701

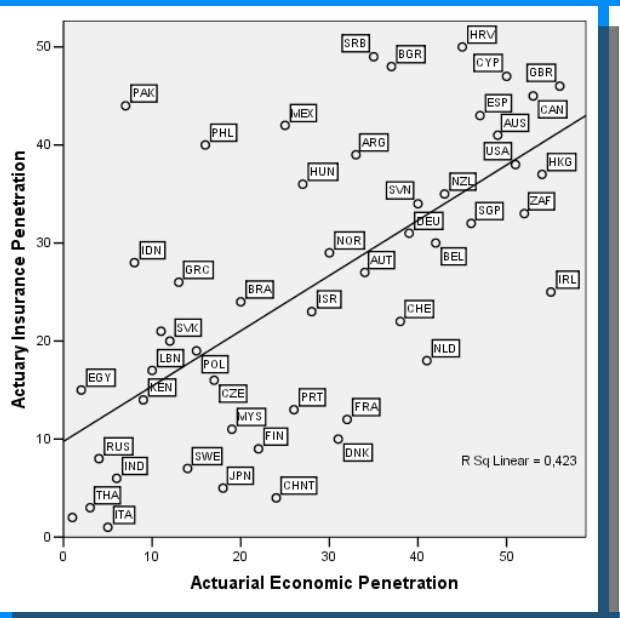
Correlation between actuarial economic penetration, actuarial density and actuarial insurance penetration.

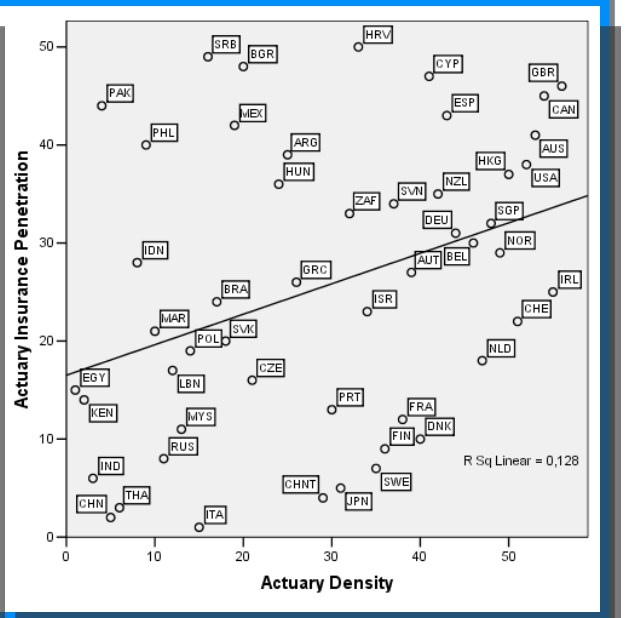
Variable	Variable	Sample size	Pearson Correlation	Spearman Correlation
Actuarial Economic Penetration	Actuarial Density	56	0.880	0.838
Actuarial Economic Penetration _PPP	Actuarial Density	54	0.959	0.950
Actuarial Economic Penetration	Actuarial Insurance Penetration	50	0.516	0.652
Actuarial Economic Penetration _PPP	Actuarial Insurance Penetration	48	0.428	0.520

Results and Discussion

Actuarial density vs Actuarial penetration







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Results and Discussion

- Number of actuaries, #48 of 56
- Population, #52 of 56
- GDP, #51 of 56
- Insurance Premium, #38 of 50
- Insurance Density, #18 of 50
- Insurance Penetration, #18 of 50
- Actuarial Density, #17 of 56
- Actuarial Economic Penetration, #20 of 56
- Actuarial Insurance Penetration, #24 of 50

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Results and Discussion

- Number of actuaries, #40 of 56
- Population, #56 of 56
- GDP, #55 of 56
- Insurance Premium, #45 of 50
- Insurance Density, #10 of 50
- Insurance Penetration, #15 of 50
- Actuarial Density, #5 of 56
- Actuarial Economic Penetration, #1 of 56
- Actuarial Insurance Penetration, #2 of 50

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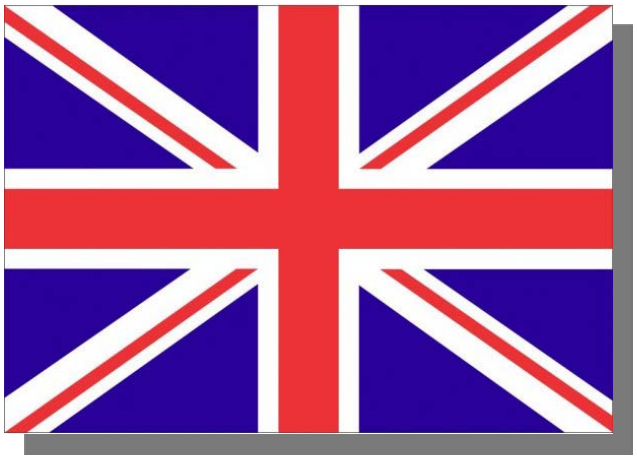
Results and Discussion



- Number of actuaries, #55 of 56
- Population, #42 of 56
- GDP, #50 of 56
- Insurance Premium, #48 of 50
- Insurance Density, #45 of 50
- Insurance Penetration, #47 of 50
- Actuarial Density, #56 of 56
- Actuarial Economic Penetration, #56 of 56
- Actuarial Insurance Penetration, #46 of 50

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Results and Discussion

- Number of actuaries, #44 of 56
- Population, #11 of 56
- GDP, #20 of 56
- Insurance Premium, #34 of 50
- Insurance Density, #50 of 50
- Insurance Penetration, #50 of 50
- Actuarial Density, #55 of 56
- Actuarial Economic Penetration, #55 of 56
- Actuarial Insurance Penetration, #25 of 50

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Conclusion

Measures of actuarial density and actuarial penetration add to the description of the actuarial profession.

There are unexpected results in which countries with a low to medium number of FQAs have high actuarial density (Croatia, Cyprus) or actuarial penetration (Croatia, Bulgaria, Cyprus). Other countries like Brazil and India have a much larger number of FQAS but lower actuarial density and actuarial penetration.

The measures have value in documenting the current situation, comparing countries, and planning for the future of the profession.

Further, the differentiation between actuarial economic and insurance penetration gives further insight.

Conclusion

It is premature to posit a conclusive model for the number of actuaries, the growth in the number of actuaries or the derived concepts of density and penetration based on the variables that we have studied.

Clearly, there will be other important factors, such as regulation, structure of pension systems, cultural, social and so on, which will impact specific countries in different ways and will influence the future number of actuaries. In addition, in a globalizing world, there may also be significant supra national influences to consider.

However, we believe that further study of the actuarial profession both on the comparative regional or global basis and locally for a particular association will yield results and insights beneficial for our future professional success.

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