## Summary

The objective of the study was to demonstrate, whether a relation existed between the lexical diversity of patent documents. In principle the supposition was that the richer the lexical diversity the higher the possibilities of the patent being granted.

Four lexical diversity indexes were obtained from the abstracts of 450 patent documents filed by applicant of nine non English speaking European countries. The patents were published by the USPTO between the years 2005 and 2008. The four years average from filing to grant supposed that by the date when the data was obtained (10 November 2017) the vast majority would have seen their patenting processes completed and either issued (granted) or not.

The initial comparisons between the granted and non granted patents didn’t show any difference in lexical diversity. However, when the patents under the 20% lowest percentile in the indexes results were compared with the patents above the 20% highest percentile a surprising result (unless you are a patent examiner, I suspect) appeared.

The surprise came when comparing the four lexical diversity means of the granted patents with the means of the non granted. The patents gathered after reordering the data from lowest index value to highest and after eliminating the 60% closest do the median showed that if a 90% confidence level was used, the difference of means and the association of variables hypothesis (Chi square) would be accepted in two of four indexes what  suggests that the effect of using very complex vocabulary in the patent’s text is negative on the chances of being granted.

There might be a quite logical explanation for that result. Since patent examiners have to  read many applications it is probable that they feel more inclined to give a positive opinion when reading an application written with a very simple language than when reading one with a very complex vocabulary. Imposing patent examiners an unusual effort to read a patent application might not be a good idea, however, the small differences also suggest that it is highly unlikely going to be the main reason why a patent application wasn’t issued/granted.

**The data**

The dataset consist of 9 sets of data that were downloaded from the EPO database, accessed via the patent search engine Global Patent Index (EPO Patent information services for experts) Each original set of data contained 50 patents filed by European applicants from a non English speaking country to the USPTO The patents had been published between 2005 and 2008 in the United States of America, taking into account that the average patent processing time in USPTO is of four years by the day in which the dataset was obtained the vast majority of them will have reached an issued (granted) or non issued decision. The search string for Germany was: ((PRC AND APPC) = DE) AND (PUC = US) AND PUD>20050101 AND PUD<20080101 Where PRC means priority country, APPC means applicant country, PUC publication country and PUD publication date

The dataset and the R codes used do transform and analyze the data are stored in the github platform and can be freely accessed via the link:

https://github.com/WernerDJ/Patents-and-Lexical-diversity

**The lexical diversity distributions**

| Index | Minimum | Median | Mean | Maximum | SD |
|---|---|---|---|---|---|
| TTR | 0.3099 | 0.6290 | 0.6430 | 1.0000 | 0.14032 |
| Herand C | 0.7251 | 0.8890 | 0.8899 | 1.0000 | 0.04747 |
| Guiraud R | 2.611 | 4.953 | 5.003 | 8.393 | 0.95909 |
| Uber Index | 6.735 | 16.490 | 20.502 | 180.905 | 15.2561 |

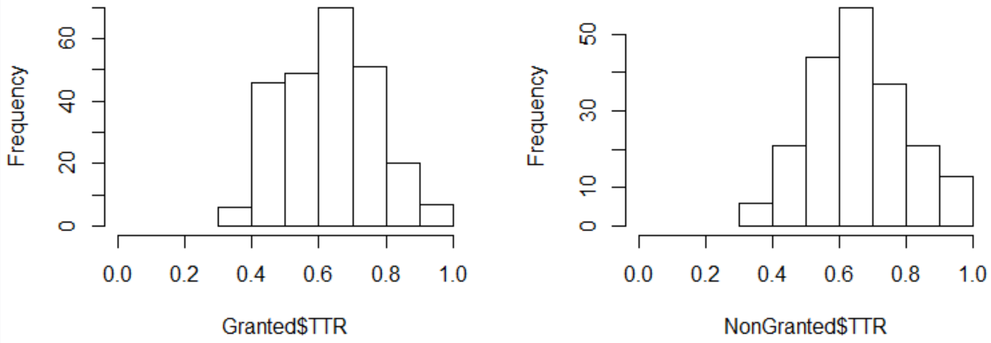
TTR

Shapiro Normality test

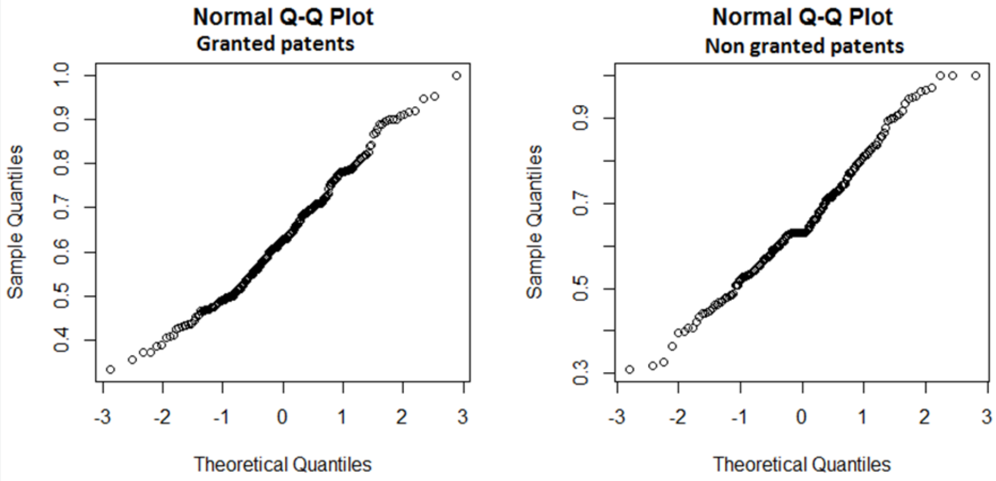
Granted patents p-value: 0.02253

Non Granted patents p-value: 0.05392

The Granted patents do not follow a normal distribution however, the non granted seem to do so, although the p-value is very close to the limit 0.05



The difference in the normality test result is quite strange, especially taking into account that the histogram plots, in both cases look like normal distributions. Another test the Q-Q normal plot, visual as well, plots the distribution of data values against a vertical axis in which the distribution of normal quantiles is represented. If the data follows a normal distribution the points follow a straight diagonal line across the graphic.



In both granted and non granted patents the TTR distribution follows very closely a normal distribution

### Herdan C

Shapiro Normality test

Granted patents p-value: 0.1579

Non Granted patents p-value: 0.07579

In both cases (granted and non granted patents) normality cannot be rejected

### GuiraudR

Shapiro Normality test

Granted patents p-value: 0.4138

Non Granted patents p-value: 0.5529

In both cases (granted and non granted patents) normality cannot be rejected

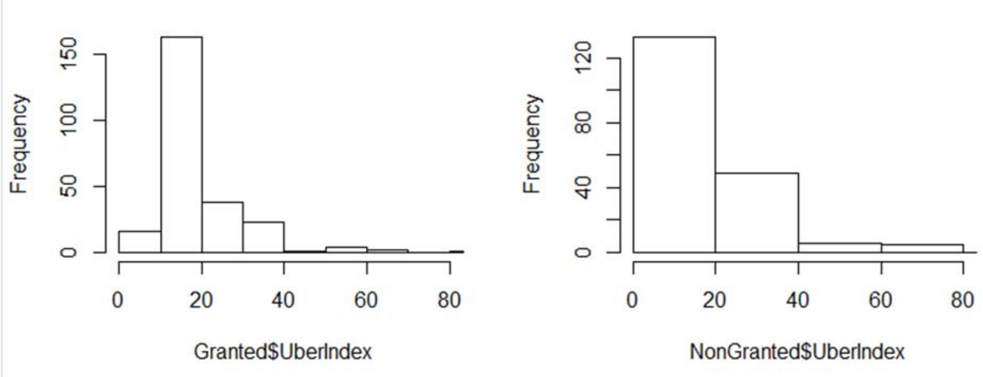
### Dugast's Uber Index

Shapiro Normality test

Granted patents p-value: 2.2e-16

Non Granted patents p-value: 2.2e-16

The distribution of both granted and non granted patents do not follow normal distributions



The histogram graphic of the Dugast's Uber Index (left graphic) show what look like exponential distributions a logarithmic transformation of the frequencies show a linear descending trend (right graphic) as is usual when a power distribution is transformed by logarithms.

### T test (Welch Two Sample t-test) with a 95% significance level

H0 – The means of granted and non granted patents are equal

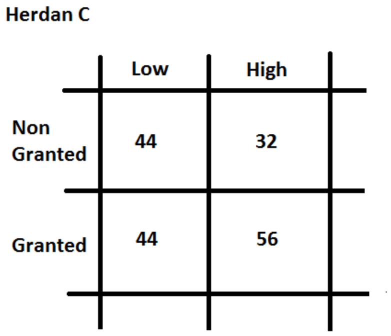
HA – The means are different

| | t-values | Degrees of freedom | p-values |
|---|---|---|---|
| TTR distribution | 1.6442 | 410.45 | 0.1009 |
| Herdan C | 1.6313 | 414.92 | 0.1036 |
| Guiraud Root | 0.75596 | 418.64 | 0.4501 |
| Uber Index Wilcox test (non-parametric) | W = 25926 | | 0.227 |

The next step was to further develop the initial hypothesis of an influence of the vocabulary diversity by comparing the patents with the lowest vocabulary diversity with those with the highest. The cutoff was arbitrarily set in the 20% lowest and highest indexes. Four datasets, one for each variable were constructed.

Since the new data had been divided in four categories of two variables, low vs. high (variable of Lexical index value) and granted vs. non granted (outcome variable of the patenting process) the Chi square test for 2x2 tables was the natural first step to analyze if there was an association between both variables:

#$H_0$ No association between the variables Lexical Index and patenting outcome
#$H_A$ there is association between both variables



Herdan C

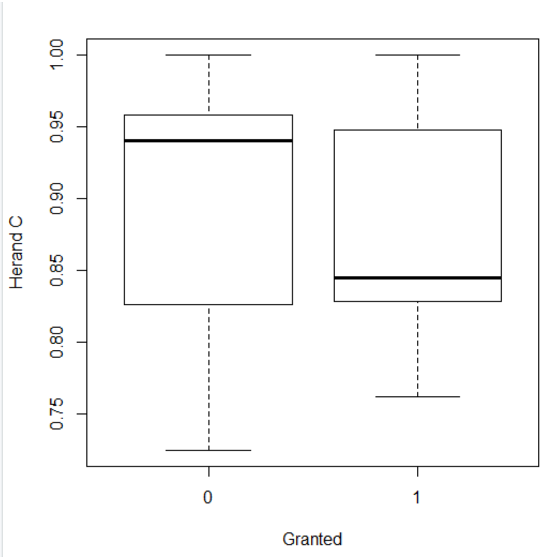
| | Low | High |
|---|---|---|
| Non Granted | 44 | 32 |
| Granted | 44 | 56 |

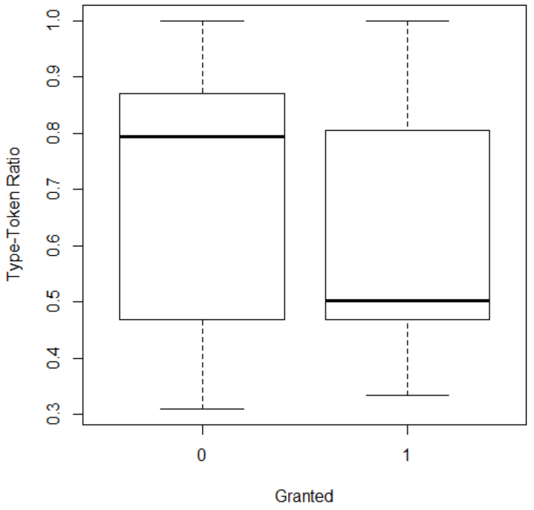
A second test was run on the four to see if there was a difference in the vocabulary index means or distributions of the granted and non granted patents

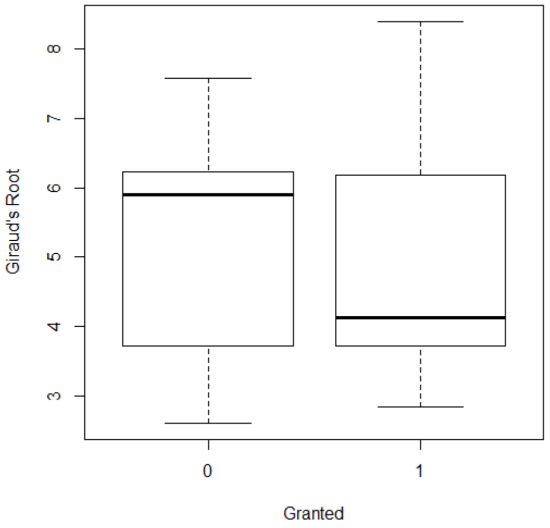
| Dataset | test | p-value | Refute $H_0$ with 95% confidence | Refute $H_0$ with 90% confidence |
|---|---|---|---|---|
| Herdan C | Chi square | 0.06783 | NO | YES |
| | t-test | 0.08382 | NO | YES |
| Type-Token Ratio | Chi square | 0.0658 | NO | YES |
| | t-test | 0.05667 | NO | YES |
| Giraud's Root | Chi square | 0.8792 | NO | NO |
| | t-test | 0.7856 | NO | NO |
| Dugast's Uber | Chi square | 0.1292 | NO | NO |
| | wilcox.test | 0.2622 | NO | NO |

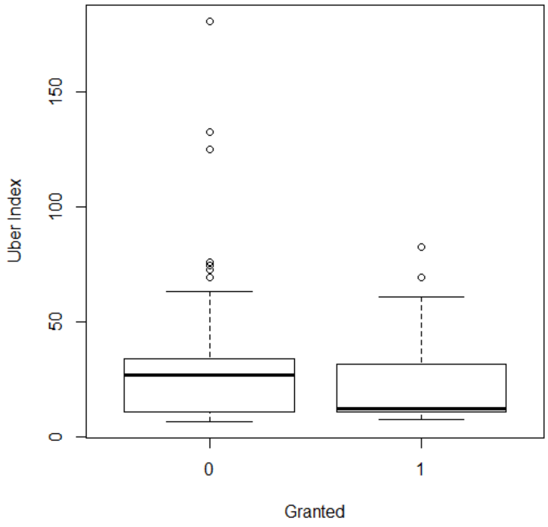
Finally a summary of the means in granted and non granted patents of the four used indexes showed that in all cases the lexical diversity mean of granted patents was lower than in non granted patents.

| Index ordered data | Mean of the non granted patents | Mean of the granted patents |
|---|---|---|
| Herdan C Index | 0.8995965 | 0.8806790 |
| Type-Token Ratio | 0.6899532 | 0.6278951 |
| Giraud's Root Index | 5.049695 | 4.990261 |
| Dugast's Uber Index | 30.09606 | 22.32343 |









## Conclusion

It has to be taken into account that the data analyzed was the 20% lower and higher index results. The t-tests and the means differences suggest that a highly complex vocabulary has an effect on the chances of a patent being granted, however the effect is slight. If a patent in which a complex vocabulary was used is not granted most of the blame will be due to the causes pointed out by the examiner and at the same time writing a very easy to read patent will not constitute a guarantee for the issuing / granting of the patent application. There is however one clear advice that should be taken into account in view of this study: Keep it simple. Writing a patent application that is as easy to read as the technical matter makes possible might help not only the patent examiner but even yourself.