Simple statistics for DH

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CZECH NATIONAL CORPUS

Introduction

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Overview

1. Why quantification matters?
2. Types of frequency measures
3. Why dispersion matters too?
4. How to interpret frequencies properly
5. Comparing frequencies
6. Comparing texts/corpora
    - KWords
    - QuitaUp

Quantification in DH research

Empirical research = quantification

- implicit quantification in qualitative research
  - studies use vague quantifiers like “often”, ”rarely”, “regularly” etc. in order to establish wider relevance of the findings (ten Have 2007: 158)
- evaluating and comparing phenomena
- quantitative analysis is *not* just aggregating single instances (analysis “built on the back of qualitative single case analysis”, Schegloff 1993: 102)
  - quantitative analysis has its own exploratory potential and can uncover hidden phenomena

Frequency

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Type and token

Difference: *token* (instance) and *type* (class)

> *one and one and one is three*

…7 tokens, 4 types

- types have overall characteristics that tokens lack (e.g. frequency)

Frequency in description

- frequency characteristics of phenomena in
  - lexicon (Čermák & Křen 2011)
  - grammar (Cvrček et al. 2010)
  - …
- psycholinguistics
- cognitive lingvistics
- text interpretation (DH)

Frequency and its distribution in texts

Zipf's laws – George Kingsley Zipf (1902–1950)

- statistical properties of texts as a structure (empirical)
- balance between language economy and distinctiveness (unifying and diversifying forces)
- three types of relations (laws):
  1. $f \times r = k$, where r is rank of a word with frequency f
  2. $a_f \times f^2 = k$, where a is number of words with frequency f
  3. $\frac{m}{\sqrt{f}} = k$, where m is number of meanings of a word and f is its frequency

How to measure frequency

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Types of frequencies

- **raw** (absolute) frequency – *poison* in DraCor: 84 hits
  - useless if it is an isolated information
  - something to compare with, e.g. *venom*, the play, the whole corpus
- **relative** frequency (w.r.t. whole)
  - instead of count we get a concentration (chemistry)
  - number of instances per million, thousand, per cent (ipm, wpt, %…)
  - $ipm = fq/N \times 1000000$
  - comparable between texts/corpora
  - which play has the highest *poison* concentration?
- **adjusted** frequency (cf. Gries 2008)
  - frequencies do not take into account dispersion, sometimes words come in bursts
  - *Romeo* vs. *hour* – are they spread evenly?
  - measures of dispersion vs. adjusted frequencies
  - ARF (Savický-Hlaváčová, 2002): average number of corpus parts that contain a word

How to interpret frequency

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How to interpret frequency?

- raw/relative frequency is a *point* estimate
- would the frequency be the same in a similarly compiled corpus of the same size?
- binomial model (coin flipping) – content vs. function words

> *O, teach me how I should forget to think!*

> *C C F F F F C F C …4 content, 5 function*

- *interval* estimate is more adequate ⇒ **binomial confidence intervals**
- korpus.cz/calc (poison: 84 hits in 1M corpus)

What a zero means?

Is there a difference between frequency of 1 (hapax legomenon) and 0?

- 0 = the phenomenon is not attested in the data (we cannot be sure it does not exist!)
- 1 and more = we have a proof that it exists but no generalizations are possible (might not be attested in other corpora)

Line selection in KonText and evaluation of groups in Calc.

Comparing frequencies

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How to compare frequency?

- statistical tests: chi2, log-likelihood, fisher (exact) test
- significance is not relevance (effect size)
- Calc modules:
  - 2 words in 1 corpus
  - 2 words in 2 corpora
- *poison* vs. *venom* in DraCor
- lemmas: *father* vs. *son* in DraCor

Keywords – comparing texts/corpora

Keywords:

- prominent units showing what the text is about (topic, register)
- words with unexpectedly high frequency in a text in comparison to reference corpus
- based on statistical tests
- KWords app: https://kwords.korpus.cz/

Texts: lines by Romeo and Juliet from R&J

workshop cloud > Vaclav Cvrcek > `romeo.txt` and `juliet.txt`

Comparing texts

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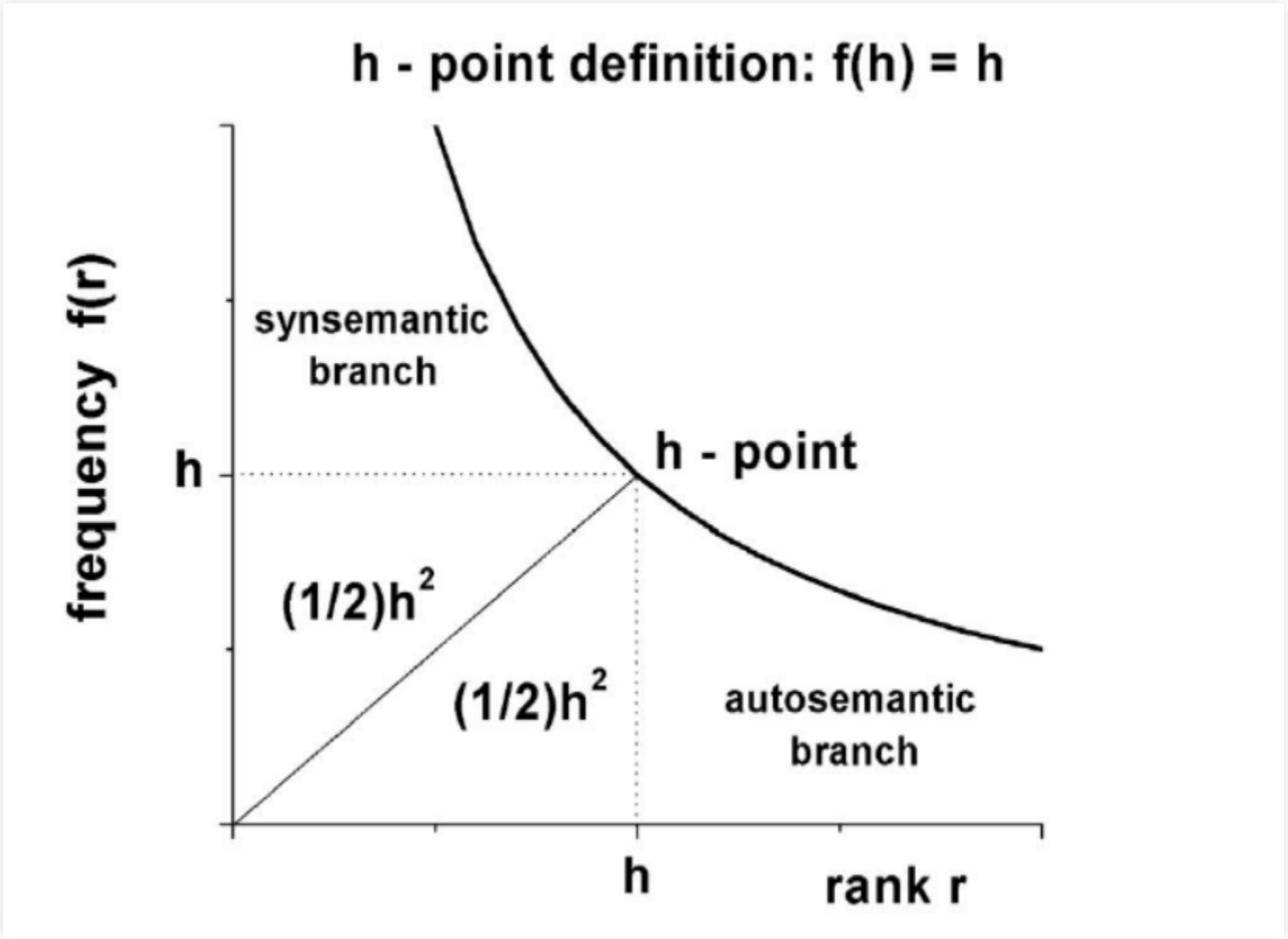
Thematic concentration

Different approach to prominent units (without a reference corpus)



h-point is sensitive to text length (Popescu et al. 2009)

Frequency-based indices

- TTR = type-token ration – sensitive to text length $TTR = \frac{V(N)}{N}$
- better alternatives:
  - Moving Average TTR: $MATTR = \frac{\sum_{i=1}^{N-L} V_i}{L(N-L+1)}$
  - Normalized TTR: $zTTR = \frac{TTR - Med_{TTR}}{IQR_{TTR}}$
- Entropy (H) – vocabulary diversity measure

$$H = \log_2 N - \frac{1}{N} \sum_{r=1}^{V} f_r \log_2 f_r$$

  - Activity (Q) – degree of action of a text $Q = \frac{V}{V+A}$
  - Descriptivity (D) – degree of description in a text $D = 1 - Q$

Application: QuitaUp

Texts: workshop cloud > Vaclav Cvrcek > `romeo.txt` and `juliet.txt`

References

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