# Text Mining and Sentiment Analysis

**Prof. Annamaria Bianchi**
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UNIVERSITÀ DEGLI STUDI DI BERGAMO | Dipartimento di Scienze Economiche

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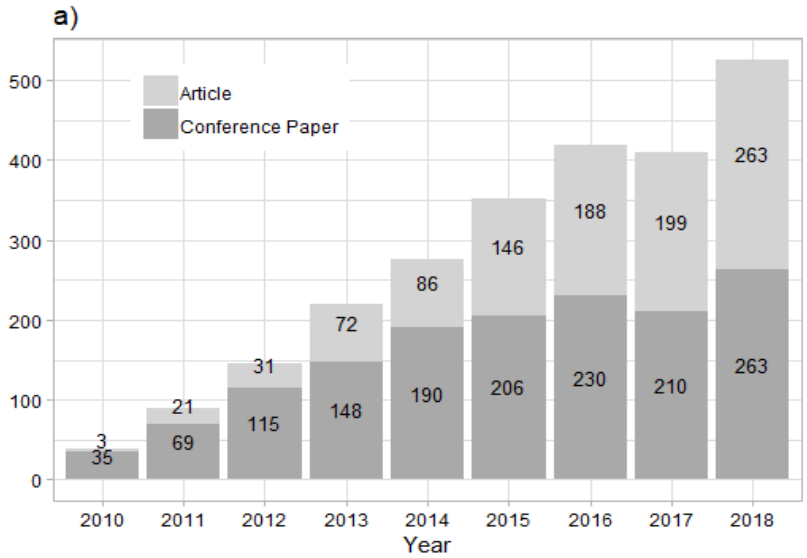
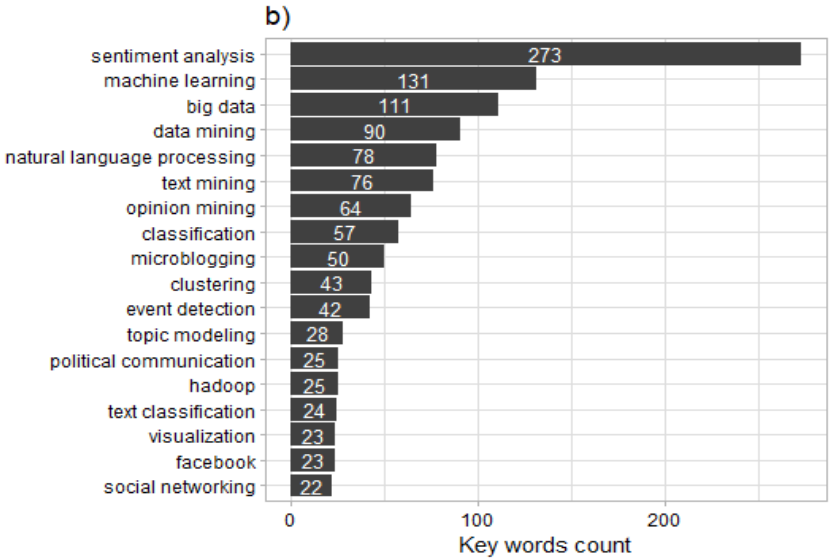
# The need of a Quality Framework for Social Media Data

- Social Media data provide alternative methods to study public opinion/social indicators that overcome some limitations of surveys (timeliness and cost)
- Social Media data are increasingly used by themselves or to complement other data and provide faster estimates to the traditional ones
- It is important to identify and be aware of the errors associated with these data
- So far there is not a shared definition of Social Media data quality, nor indicators for quality

# Increasing use of Twitter data

- Papers that analyse Twitter Data:



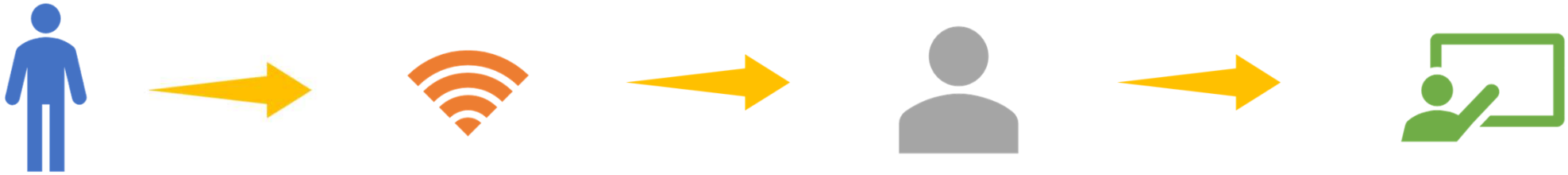




- Research Area: Economics; Politics; Well-Being;

- In Official statistics:
  - VM (security) survey + STI (social tension indicator based on social media);
  - CCI (consumer confidence index) survey + SMS (social media sentiment);
  - Istat Experimental statistic: Social mood on economy index

# Statistical Considerations

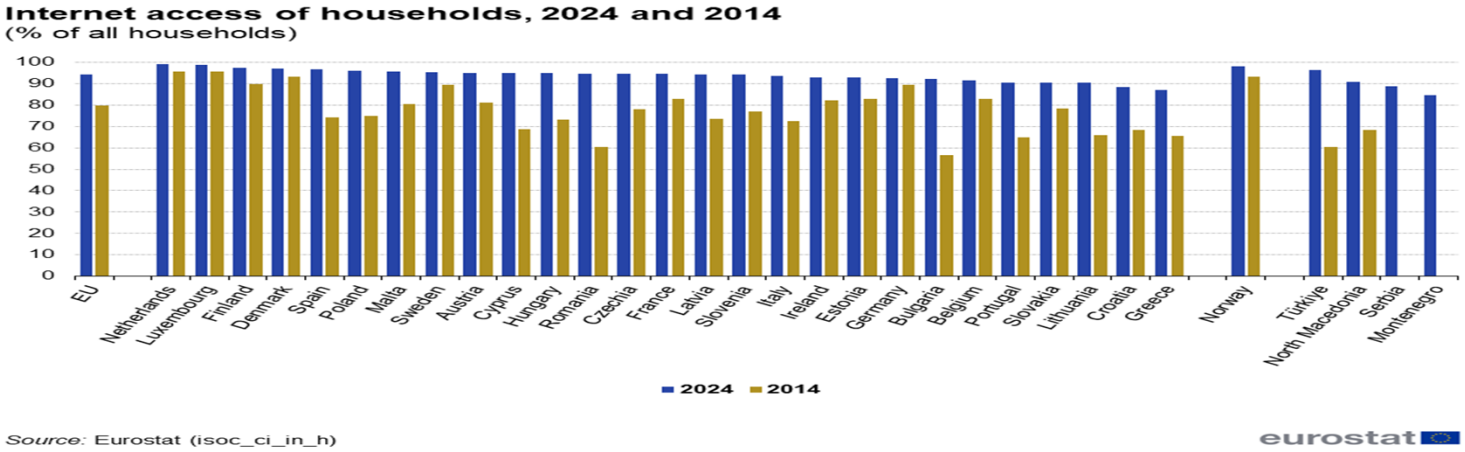
*Self-selection process*



**1**: Have an Internet connection

**2**: Decision to join a specific social-media platform

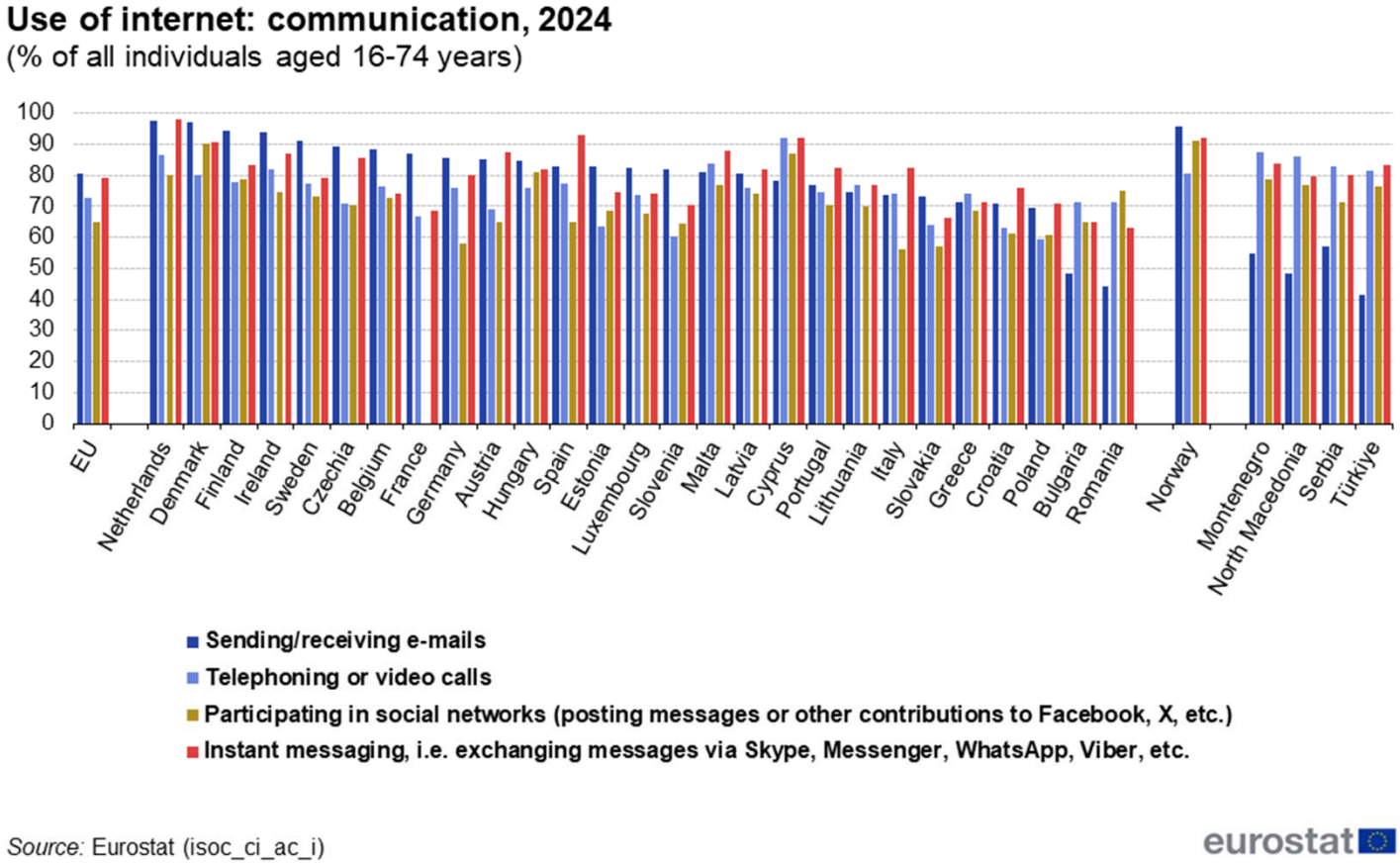
**3**: Decision to publish contents




*Sources:* Eurostat.

# Statistical Considerations

*Self-selection process*

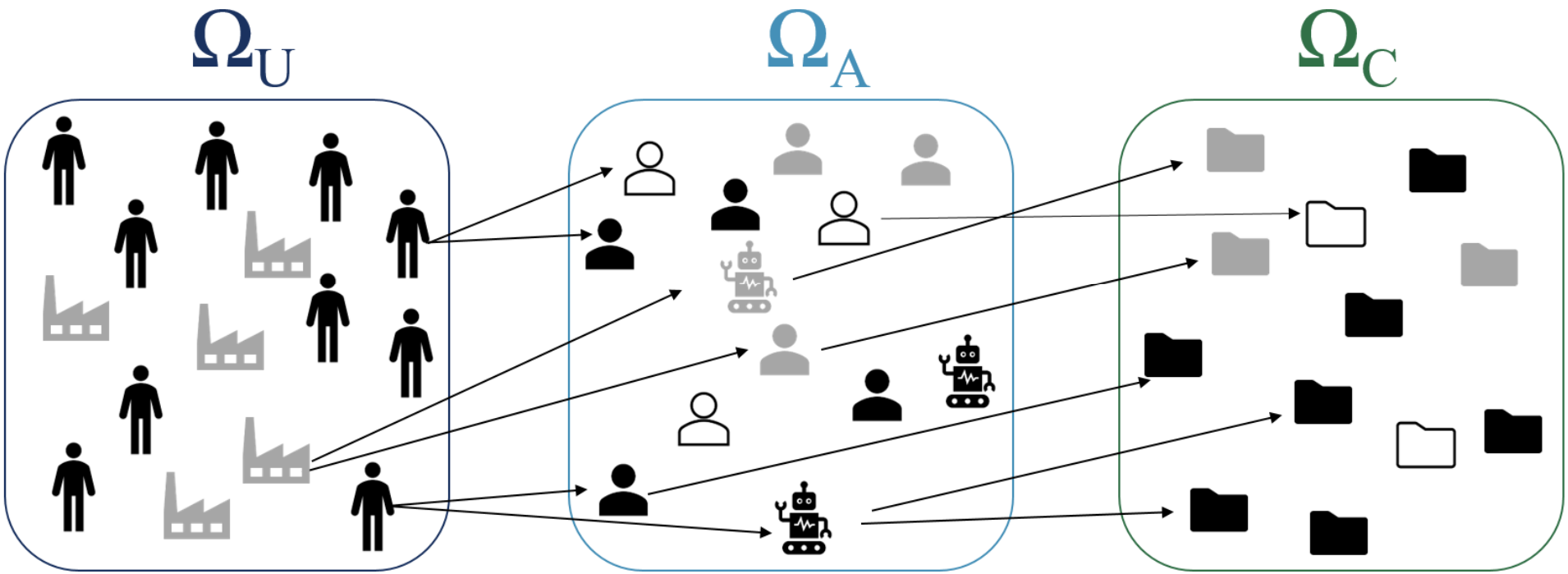



*Source*: Eurostat (isoc_ci_ac_i)

eurostat

# Statistical Considerations

*Populations in social media*



# Statistical Considerations

*Summary*

We do not observe directly the characteristics of $\Omega_U$.

$\Omega_A$ includes also malicious accounts.

The link between the statistical phenomena of interest and the data collected is indirect.

Nature of the data: Twitter message ≠ survey answer.

Other considerations related to Big Data in general:

- Data deluge;
- Methodological issues
- Volatility
- Consent to the use of data;
- Privacy and other issues.

# Total Survey Quality

A quality framework has been developed for surveys.

**Can this be applied to the analysis of Social Media data?**

The evaluation of quality for surveys is a very large research area, which was developed in the early 90's and includes the definition of quality in the different phases of the process.

# Total Survey Quality

Most quality frameworks contain a subset of the following dimensions:

**Accuracy** – Total survey error is minimized
**Credibility** – credible methodologies; trustworthy data
**Punctuality** – data deliveries adhere to schedules
**Timeliness** – period between the availability of the information and the event or phenomenon it describes
**Relevance** – data satisfy user needs
**Accessibility** – access to data is user friendly
**Usability/Interpretability** – documentation is clear; meta-data are well-managed
**Comparability** – demographic, spatial and temporal comparisons are valid
**Coherence** – estimates from different sources can be reliably combined
**Completeness** – data are rich enough to satisfy the analysis objectives without undue burden on respondents

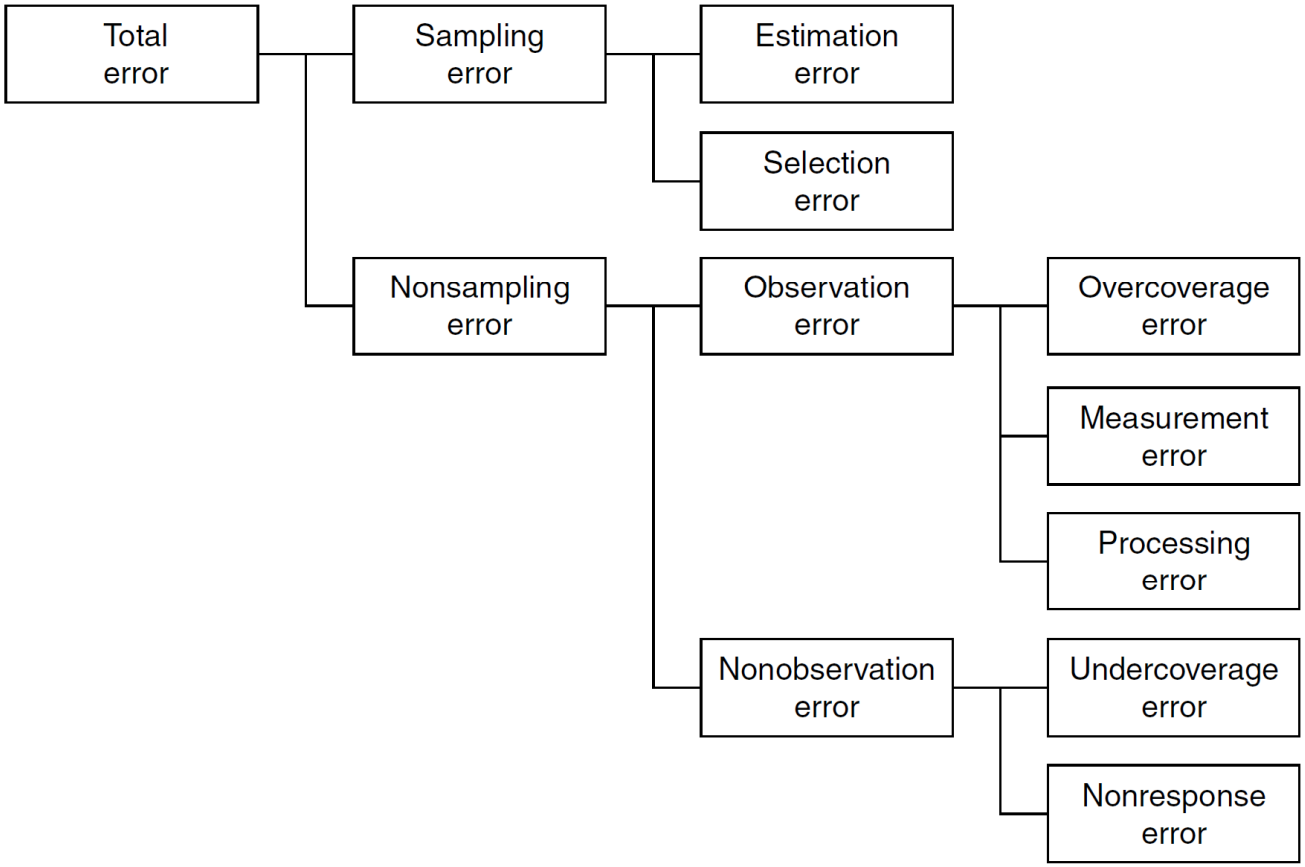
# Total Survey Error

An important step toward a general framework to measure errors has been made with the definition of the **Total Survey Error** (TSE) paradigm.

In the framework of this paradigm errors are linked to the accuracy dimension and the major sources of error to minimise TSE are identified and allocated.

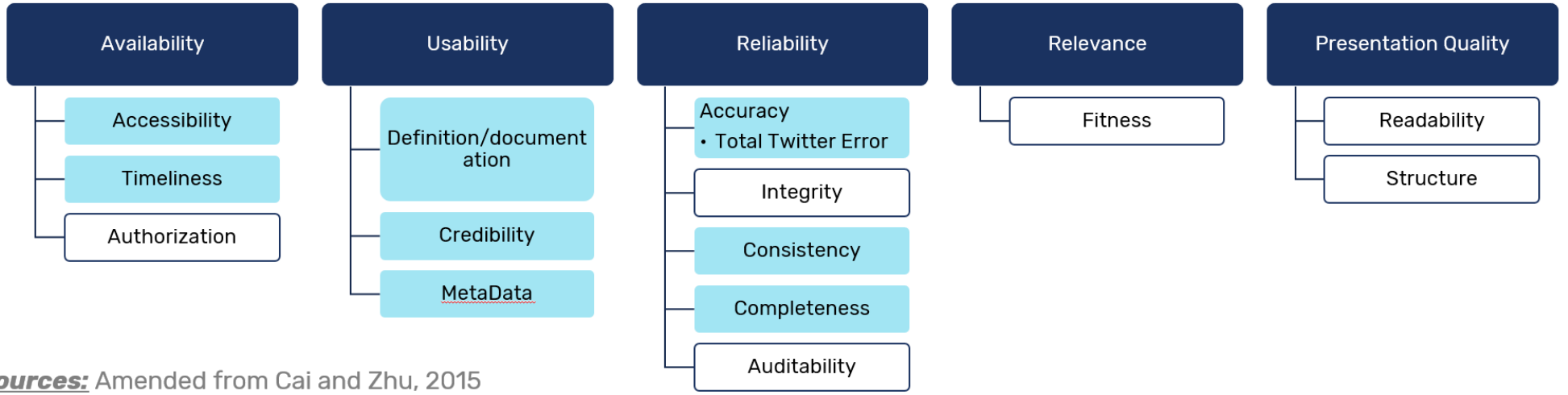
The framework categorizes errors into sampling errors (due to sampling scheme, sample size, and estimator choice) and non-sampling errors (due to specification, non-response, frame, measurement, and data processing).

# Total Survey Error



# Total Quality Twitter Framework

- Quality is a multidimensional concept;
- The dimensions of quality developed for surveys are general enough to be adapted also to big data with some adjustment;
- Cai and Zhu (2015) proposed a hierarchical definition of quality and its indicators considering similar dimensions:




***Sources:*** Amended from Cai and Zhu, 2015

# Total Quality Twitter Framework

## Availability

It refers to the ease and the conditions under which the data and the related information can be obtained. We can consider two sub-dimensions, the *accessibility* and the *timeliness*.

### Accessibility

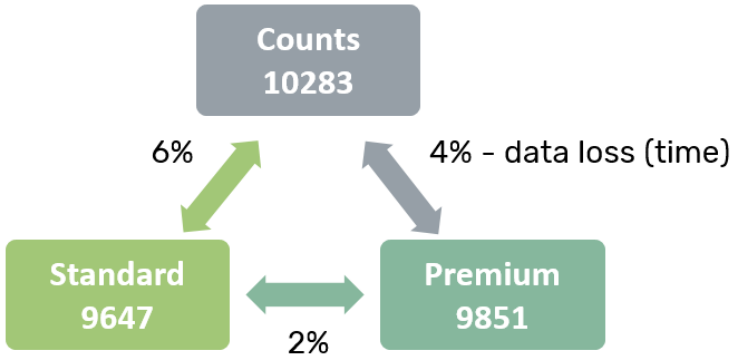
Currently Twitter data are not easily accessible. Twitter provides several APIs to access data according to the different use cases for a fee.

# Total Quality Twitter Framework

Accessibility

The type of access affects the analysis results:

- Real-time Streaming (free) vs Firehose (paid) APIs (Morstatter et al.,2013):
  - They found that that the results of using the Streaming API depend strongly on the coverage and the type of analysis that the researcher wishes to perform;
  - They used Firehose data to get additional samples to better understand the results from the Streaming API and they found that the Streaming API performs worse than randomly sampled data, especially at low coverage.
- Standard (free) vs Premium (paid) Search APIs:
  - We retrieved tweets with query "#BrexitShambles" the 16th of January relative to the 15th January. The results of counts and data endpoints are:



# Total Quality Twitter Framework

Timeliness

There are different time-dimensions to consider:

- The first one is the time between the data request and the data delivery which varies according to the access type.
- Tweets of non-protected accounts are available 30 seconds after the publication but they are not stored forever.
- An indicator of the data loss due to the time lag between the data generation and the retrieval can be the difference between the estimates obtained through the counts endpoint and the quantity of data retrieved through the data endpoint.

# Total Quality Twitter Framework

**Usability**

It refers to the ease with which data can be used.

- Twitter is committed in providing documentation, in enriching and regularly updating Metadata.
- With upgraded access the usability is improved since premium search operator and extra support services are provided and Metadata are enriched.
- Data are provided in JSON format (JavaScript Object Notation) – semi structured form.

# Total Quality Twitter Framework

**Reliability**

The key issue is whether we can trust data. We analyse the following sub-dimensions: accuracy, consistency and completeness.

Accuracy

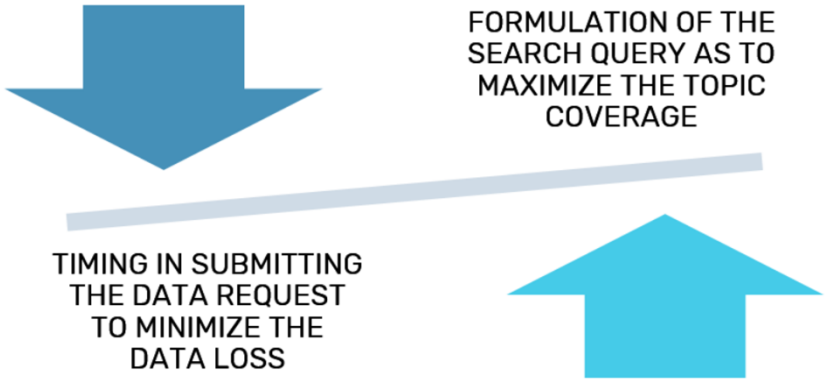
It is linked to the concept of "errors"

- *Textual errors:*
  - Typos: Misspelled words cannot be recognized and elaborated by algorithms and this affects the results of the analysis.
  - We can consider the percentage of misspelled words as an indicator of the accuracy of tweets at the origin.
  - Also abbreviations and *slang* are difficult to evaluate by machines. In this context, text mining techniques represent a fundamental tool to identify and correct errors before the implementation of any analysis.
- *Total Twitter Error Framework (TTE)*. Hsieh and Murphy (2017) adapted the TSE paradigm to Twitter and developed the Total Twitter Error framework. They identify three exhaustive and mutually exclusive sources of errors:
  - query error
  - coverage error
  - interpretation error.

# Total Quality Twitter Framework

***Total Twitter Error : Query Error***

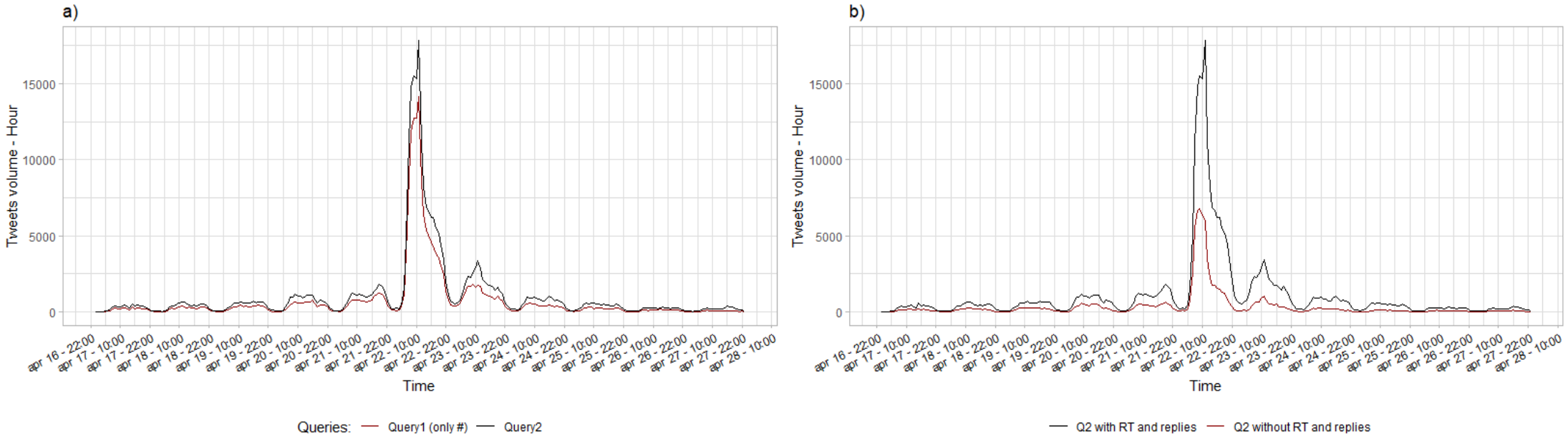
- Researchers formulate the query as to maximize the topic coverage.
- Sources of error:
  - Misspecification of the search string.
  - Inclusion or exclusion of retweets and replies.
  - To other search constraints (ex. Geolocalization).
- TRADE-OFF between:



# Total Quality Twitter Framework

## *Total Twitter Error : Query Error*

- Example:
  - Query 1: "`#londonmarathon OR #londonmarathon18 OR #londonmarathon2018`"
  - Query 2: "`#londonmarathonOR #londonmarathon18 OR #londonmarathon2018 OR (london +marathon)`"

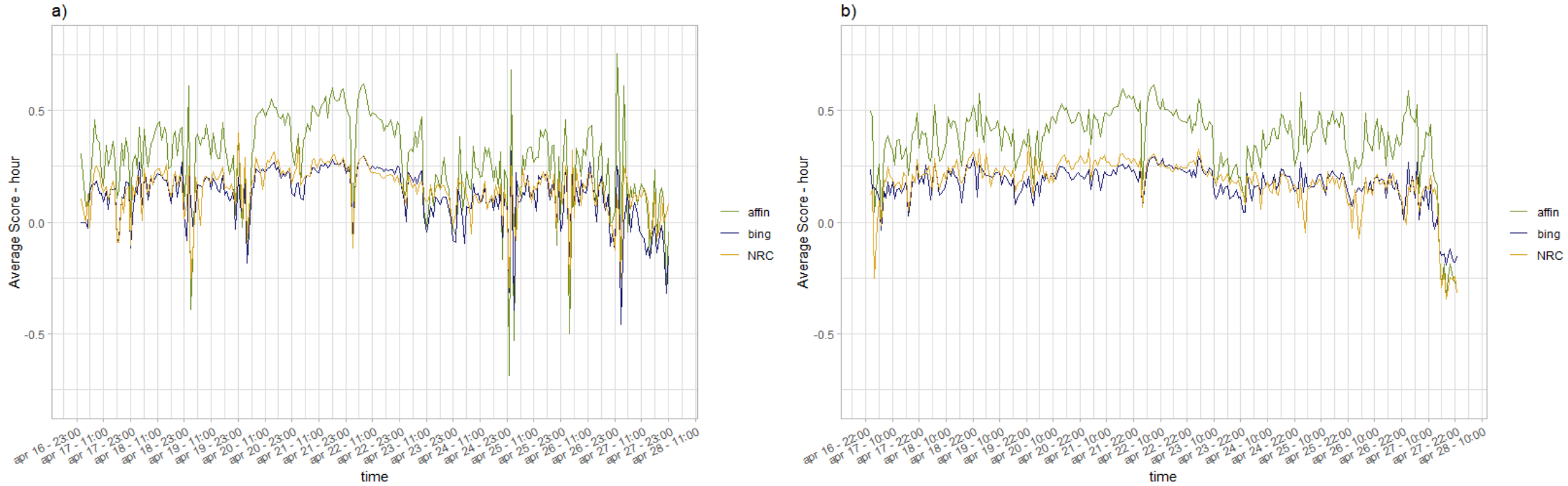



*Sources:* Author's own elaboration

# Total Quality Twitter Framework

## *Total Twitter Error : Query Error*

- How the query formulation affects the analysis:




*Sources:* Author's own elaboration

# Total Quality Twitter Framework

## *Total Twitter Error : Interpretation Error*

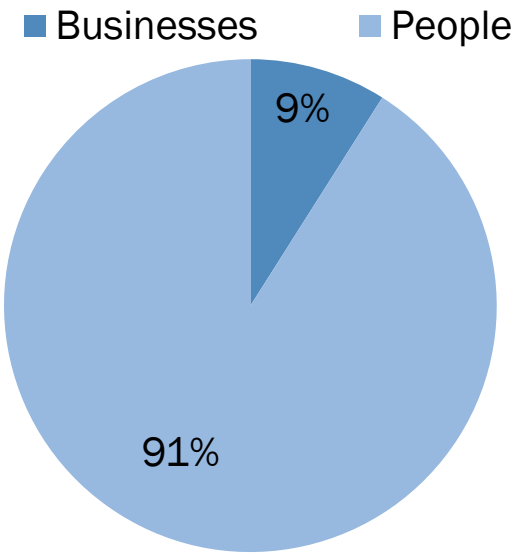
- It is due to the process of extracting insight from the text or to the process of inferring users missing characteristics.
- Kiefer suggests that for automatically sentiment classifier an indicator of the similarity between the input data and the training data can be measured using the Cosine Similarity or the Greedy String Tiling (Kiefer, 2016).
- For dictionary-based approaches, we should consider the characteristics of the lexicons:
  - Lexicons that accounts for the “shade” of the opinion words can give more accurate results;
  - Useful to evaluate the ratio between positive and negative words for each lexicon to obtain an indicator of the negative or positive propensity of the lexicon;
  - Context-specific lexicons should be preferred.

# Total Quality Twitter Framework

## *Total Twitter Error : Coverage Error*

Sources of error:

- Under-coverage: the observed sample is not representative of the target population.
- Over-coverage: the observed sample is composed by accounts that are associated to people, businesses as well as BOT.




*Sources:* Author's own elaboration

# Total Quality Twitter Framework

Consistency

It refers whether the data remain consistent and verifiable over time. To show the data loss over time, we decided to investigate whether London Marathon's tweets are still available after one year.

| Day | No. Tweets (count endpoint) | LM tweets Apr 2018 | Available Apr. 2019 | Loss | % of data loss |
|---|---|---|---|---|---|
| April 17th | 3,803 | 3,731 | 2,342 | 1,389 | 37.22% |
| April 18th | 5,055 | 4,814 | 2,940 | 1,874 | 38.92% |
| April 19th | 6,236 | 6,153 | 3,782 | 2,371 | 38.53% |
| April 20th | 9,833 | 9,645 | 5,999 | 3,646 | 37.80% |
| April 21st | 14,968 | 14,854 | 9,068 | 5,786 | 38.95% |
| April 22nd | 116,185 | 115,494 | 72,580 | 42,914 | 37.15% |
| April 23rd | 24,954 | 24,176 | 14,777 | 9,399 | 38.87% |
| April 24th | 8,257 | 7,870 | 4,845 | 3,025 | 38.43% |
| April 25th | 4,443 | 4,428 | 2,494 | 1,934 | 43.67% |
| April 26th | 2,309 | 2,307 | 1,438 | 869 | 37.66% |
| Total | 196,043 | 193,457 | 120,265 | 73,207 | 38% |

*Sources:* Author's own elaboration

# Total Quality Twitter Framework

Completeness

- The completeness of data and Metadata depends on the data access.
- An indicator of the completeness can be the percentage of missing values.

# Conclusions

- Big Data does not mean Big Information → "imperfect, yet timely, indicator of phenomena in society" (Braaksma and Zeelenberg, 2015).

- To trust data we must assess the Quality and reduce the Error.

- some experimental analysis to build up quality indicators on Twitter data and a framework for the Total Twitter error.

- It is fundamental to use a mixed method based on quantitative as well as on qualitative analysis to built quality and errors indicators.