



Airline Customer Review Analysis

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PROJECT INTRODUCTION



MOTIVATION

Comprehensive Customer Feedback Analysis of Different Airlines By Deploying Topic Modelling

Comparison Over Airlines

- Which European airline do customers like/dislike?
- How does customer feedback change over time by different airlines?
- How are the reviews distributed over route, classes and travel types?

Feedback Sentiment Analysis

- Do consumers of different travel types and classes have different experiences ?
- What do customer like and dislike about different aspects of the flight?

Customer Review Topic Modeling

- What are the most common issues customer complain about?
- Do different airlines have the same issues?
- Compared with competitors, what are their advantages and disadvantages?
- Implications on strategy

DATA AND WORKFLOW



DATA SOURCE

- Skytrax review page: <https://www.airlinequality.com/airline-reviews/>
- Overall ratings
- Travel type, Seat type, date flown, ratings, aircraft, routes, recommended;
- Rating of experience (scale 1 - 5): different aspects including 'Seat Comfort', 'Inflight Entertainment', 'Ground Services', etc.
- Detailed review of the experience.



Lufthansa Customer Reviews

Food & Beverages



Inflight Entertainment



Seat Comfort



Staff Service



Value for Money

Customer rating
from 2400 reviews

5/10

3/10

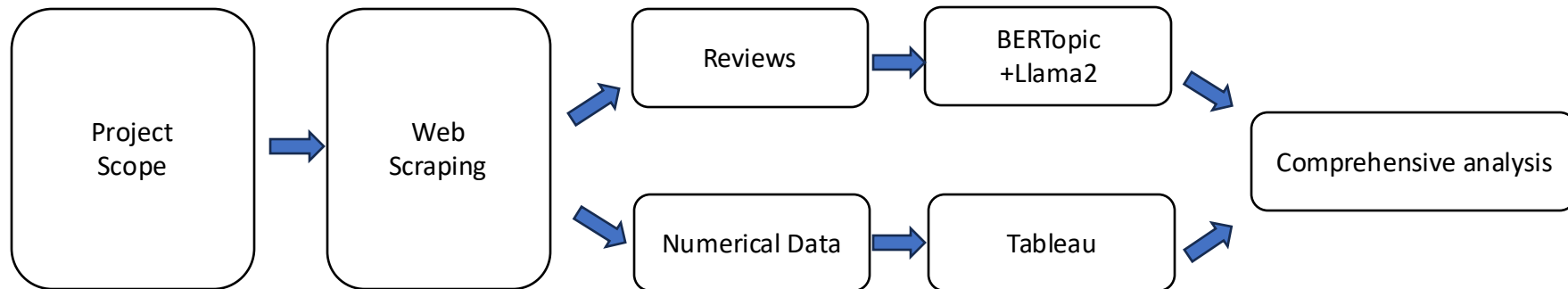
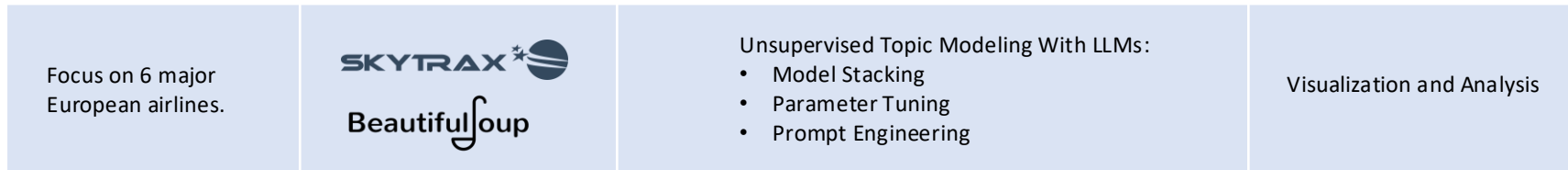
Lufthansa customer review

Mata Karagianni (Greece) 24th December 2023

Trip Verified | The crew was more than willing and kind to help us out through a lot of problems that we dealt in the flight from South Africa to Frankfurt. Firstly, the space between the seats is almost zero, let alone if the person sitting in front of you leans the seat backwards. I was unlucky enough to spend more than 1000€ for an economy seat, having to share my space with the person sitting next to me, because they weighted a few more kilos than a supermodel! After that, the headset wouldn't work, so I had to replace it with another one that also wouldn't work, so to realize that the base of the headset was broken, so I didn't have the chance of enjoying a movie or sth. The crew was kind enough to help me out, offering a headset from business class, but it also didn't work. As a gift, they offered me a voucher for wifi connection, however, the usb charger would not charge my phone enough. I tried to get some sleep, with no result of course, because the seat wouldn't come to a place where I could relax. The meals were about average.

Aircraft	Boeing 747-8
Type Of Traveller	Couple Leisure
Seat Type	Economy Class
Route	Johannesburg to Athens via Frankfurt
Date Flown	December 2023
Seat Comfort	★☆☆☆☆
Cabin Staff Service	★★★★☆
Food & Beverages	★★☆☆☆
Inflight Entertainment	★☆☆☆☆
Ground Service	★☆☆☆☆
Wifi & Connectivity	★★☆☆☆
Value For Money	★☆☆☆☆
Recommended	✗

WORKFLOW



Lufthansa



TECHNIQUES: WEB SCRAPING & BERTOPIC LLAMA2



WEB SCRAPING

Web Scraping all entries of 6 major European Airlines from Skytrax

Sample - web data

10/10

"would like to commend the crew"

C Manning (Germany) 21st December 2023

Not Verified | I would like to commend the crew of the flight from Frankfurt to Denver. The Purser, Mr. Nicolas and his colleague Dangelo. They were, from the moment one stepped onboard the most accommodating, caring, friendliest, warm, and welcoming flight crew I have ever met. Thank you all for making my travels fun, enjoyable, and safe.

Type Of Traveller	Solo Leisure
Seat Type	Economy Class
Route	Frankfurt to Denver
Date Flown	December 2023

Seat Comfort	★★★★★
Cabin Staff Service	★★★★★
Food & Beverages	★★★★☆
Inflight Entertainment	★★★★★
Ground Service	★★★★★
Wifi & Connectivity	★★★★★
Value For Money	★★★★★
Recommended	✓

Sample - extracted data

Text Data Extraction

Airline	Region	Title	Rating	Date Flown	Aircraft	Type of Traveller	Seat Type	Route	Recommended	Review	Verified
Lufthansa	Europe	ysmal exper	5	2024-01	N/A	Solo Leisure	amium Econornich to Bos		no	give me my luggage	No
Lufthansa	Europe	othing short of	1	2023-12	N/A	Couple Leisure	economy Class	geles to Co	no	cy during these	Yes
Lufthansa	Europe	ed to refund	1	2023-07	N/A	Couple Leisure	economy Class	nia to Dusse	no	, that flight hac	Yes
Lufthansa	Europe	ular flight wa	6	2024-01	A320/321	Solo Leisure	economy Class	kfurt to War	no	essenger and h	Yes
Lufthansa	Europe	ur cabin ba	1	2024-01	N/A	Family Leisure	economy Class	urt to Lond	no	irplane was sr	Yes
Lufthansa	Europe	was really g	8	2024-01	A321neo	Family Leisure	economy Class	nkfurt to Ath	yes	ate. Also I boug	Yes
Lufthansa	Europe	l rather ride z	1	2024-01	N/A	Solo Leisure	economy Class	m to Dubai v	no	ldnâ€™t find a	Yes
Lufthansa	Europe	for an avera	4	2023-12	A321-200	Family Leisure	economy Class	ens to Frank	yes	on they only ser	Yes
Lufthansa	Europe	l bottle of wa	4	2023-12	A321	Solo Leisure	economy Class	lin to Frank	yes	angers. Not a si	Yes
Lufthansa	Europe	ed our holid	1	2023-08	N/A	Family Leisure	economy Class	Windhoek vi	no	n. Even at the a	Yes
Lufthansa	Europe	v were very n	10	2023-12	A320-214	Family Leisure	economy Class	blin to Muni	yes	uggage to arri	Yes

Ratings Extraction

Seat Comfort	Cabin Staff Service	Food & Beverages	Inflight Entertainment	Ground Service	Wifi & Connectivity	Value For Money
4	4	4	3	2	1	3
4	1	1	1	1	1	1
N/A	N/A	N/A	N/A	1	N/A	1
4	4	1	N/A	3	N/A	2
3	1	1	1	1	1	1
4	4	4	N/A	4	N/A	3
2	1	2	1	1	1	1

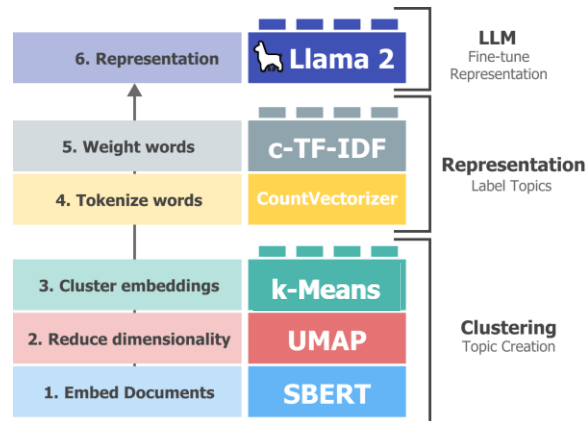
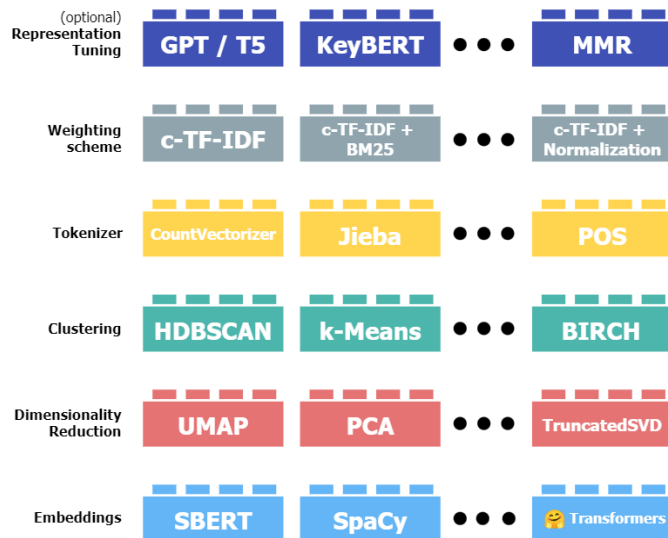
TOPIC MODELLING WITH LLM

BERTopic

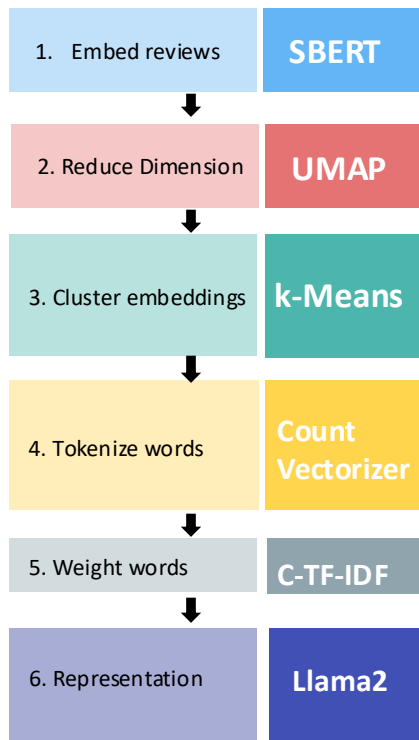
A framework for topic modeling leveraging BERT generated embeddings, dimension reduction, clustering and TF-IDF with customized modules.

Llama2

Generate the topic labels in a more interpretable way than traditional keyword-based algorithms.



MODULES & PARAMETERS



SentenceTransformer ("BAAI/bge-small-en")

Pick suitable model from Massive Text Embedding Benchmark (MTEB) Leaderboard

UMAP (`n_neighbors=15`, `n_components=5`, `min_dist=0.0`, `metric='cosine'`, `random_state=42`)

UMAP balances local versus global structure in the data, and reduce the embedding dimension to 5

k-Means allows to set a fixed number of clusters we would like and forces every single point to be in a cluster. Therefore, no outliers will be created.

Use **5 clusters** to generate yearly most concerned topics. Use **20 clusters** to find more detailed issues.

vectorizer_model = CountVectorizer (`ngram_range=(1, 3)`, `stop_words="english"`)

Tokenize the reviews into 1-3 words and remove the stopwords.

$$w_{c,e} = |tf_{c,e}| \times \log\left(1 + \frac{A}{f_c}\right)$$

$tf_{c,e}$ = frequency of word e in class c
 f_c = frequency of word e across all classes
 A = average number of words per class

TF-IDF was adjusted to work on a cluster level instead of a document level to find the most importance words/gram words

Candidate keywords and documents are passed to the Llama2 and asked to generate output that fits the topic best.

LLAMA2

Llama2 7B version is powerful and smart enough as a topic label generator, and small enough to run with limited computing resource.

MODEL SIZE (PARAMETERS)	PRETRAINED	FINE-TUNED FOR CHAT USE CASES
7B	Model architecture:	Data collection for helpfulness and safety:
13B	Pretraining Tokens: 2 Trillion	Supervised fine-tuning: Over 100,000
70B	Context Length: 4096	Human Preferences: Over 1,000,000

Test prompt

```
prompt = "Could you give me some typical issues that customers
complain about airlines?"
res = generator(prompt)
print(res[0]["generated_text"])
```

Answer from Llama2

- 1. Overbooking:** When an airline sells more tickets than it has available seats on a flight, it's called overbooking. This can lead to passengers being bumped from flights, which is frustrating and inconvenient.
- 2. Lack of legroom:** Tight spaces and cramped quarters can make long flights uncomfortable, especially if you're sitting in economy class.
- 3. Poor customer service:** From rude attendants to slow check-in processes, many passengers cite poor customer service as a major issue with flying.
- 4. Delays and cancellations:** Flight delays and cancellations are never fun, but they happen frequently enough to warrant complaint.
- 5. Baggage fees:** Many airlines charge extra for checked bags, leading to added costs for travelers.
- 6. Inflight entertainment:** Some planes don't offer adequate entertainment options, leaving passengers bored and restless during long flights.
- 7. Food quality:** The food served on flights often receives negative reviews, with passengers citing bland or unappetizing meals as a problem.
- 8. Layovers:** Long layovers between flights can cause stress and disrupt travel plans, particularly if you're trying to connect to another flight.
- 9. Security lines:** Wait times at security checkpoints can be lengthy, causing frustration among travelers.
- 10. Lack of amenities:** Some airlines don't provide basic amenities like blankets or pillows, making long flights even less comfortable. These are just a few examples of common complaints people have when flying. While airlines may not always be able to completely address these issues, listening to passenger feedback can help improve the overall flying experience.

PROMPT OF LLAMA2

Prompt : system_prompt + example_prompt + main_prompt

System prompt describes information given to all conversations

```
system_prompt = """
<s>[INST] <<SYS>>
You are a helpful, respectful and honest assistant for labeling topics for airline customer reviews.
<</SYS>>"""
```

Example prompt demonstrating the output we are looking for

```
example_prompt = """
I have a topic that contains the following documents which are airline customer reviews:
- Worst customer service of all Airlines. I have never seen employees so rude that can't help resolve simple issues. Everytime there was an issue to arise they always say there is nothing they can do about it. I have booked with them twice and both times have been awful experiences.
- Worst, the customer Service, cabin crew, specially main desk & boarding desk staffs at the airport are rude and unhelpful.
- Customer service is really bad! Takes 40 to 45 minutes to talk to the agent.
The topic is described by the following keywords: 'customer service, Worst, cabin crew, rude, unhelpful, hard'.
Based on the information about the topic above, please create a short label of this topic about airline customer reviews. Make sure you only return the label and nothing more.
[/INST] Bad customer service with rude attitude.
"""
```

#Main prompt with documents ([DOCUMENTS]) and keywords ([KEYWORDS]) tags

```
main_prompt = """

[INST]
I have a topic that contains the following documents which are airline customer reviews:
[DOCUMENTS]

The topic is described by the following keywords: '[KEYWORDS]'.

Based on the information about the topic above, please create a short label of this topic about airline customer reviews. Make sure you to only return the label and nothing more.

But do not just give a general label such as poor or bad service, but be more specific and give the subtheme.

[/INST]
"""
```

OUTPUT SAMPLE

Topic	Count	Top 10 keywords	Llama2 Topic Labels
0	71	customer service connecting flight flight cancelled flight delayed flight munich customer care flight frankfurt singapore airlines half hour return flight	Lost Luggage and Unhelpful Customer Service
1	36	lost luggage customer service flight attendant received email lufthansa flight lost bag montreal airport delayed baggage reference number luggage lost	Flight Cancellation and Rebooking Difficulties with Poor Customer Service
2	35	cabin crew flight time air france hour flight business class 11 hours food good seats comfortable 20 minutes boarding time	Cabin Comfort and Crew Service

A young man with short brown hair, wearing a light blue button-down shirt and a silver watch, is reaching up to a high shelf in a library. He is looking up at the shelf with a focused expression. The shelves are filled with books, and the background is slightly blurred. The entire image has a blue tint.

— RESULTS



Executive Summary

Competitive Advantages



Consider all 10 years:

- **Crew service:**
 - In person service remains positive
- **Inflight entertainment** and **seat comfort** are the **highest** among all airlines compared
- Good first class experience
- **No significant disadvantages** in all 7 metrics compared

Competitive Disadvantages



- **Economy class experiences**
 - Given major consumers are taking economy class, need to improve experiences
- **Luggage losing, poor issue solving services and communication**
- **Bad dining experience**
- **General declining brand image**

General Consumer Perception

Mixture of positive and negatives

- **Decreasing rating from 2016 -2024:** however still ranked 2nd out of 6 airlines chosen.
- **Outstanding experience in First class, and premium economy class.**
- **Generally ranked high in all metrics except WiFi connectivity**
 - cabin services remain positive to consumers



Strategy Suggestions

- Improve luggage losing issues, improve flight coordination to prevent flight connection issues
- Attentive in person customer services. Improve communication and more responsive to consumer requests instead of using Auto reply machines.
- Improve dining experiences
- Learning from Air France's Cabin comfort



LEARNINGS AND CHALLENGES

FINDINGS & CHALLENGES

Findings



- **Overall** sentiment scores have been on a **downward decline** from 2016 to 2021.
- **Lufthansa** had been doing well among all until Covid-19 started:
 - **Customer service** (especially from counter, ground, and call center staff) dropped sharply;
 - **Food and beverage**, as well as **luggage transportation** has always been a serious problem identified by customers. Especially under **the cost-saving strategy** after Covid-19.
 - It remain some advantages in terms of **first-class experience** and **cabin crew services**
- **Consumer:**
 - First Class and solo leisure consumer generally had a more positive feedback.
 - Consumer turned not to leave a review when they experienced good service. Conversely, they made an effort to review when experiencing bad service which they were not bother to go through.

Challenges

Limitation of Topic modeling

- BERTopic generally works well for semantic centralized documents such as **academic papers or research papers**.
- In terms of customer reviews complaining about multiple issues, it is **hard to distill only one topic**.

Number of Clusters of BERTOPICS

- This parameter may **largely impact the results** of the topics, it is hard to find the perfect number of clusters.
- However, in practice, it is more straightforward to just decide by your needs.

Output of LLM can be unstable

- The output of the Llama2 does not stay same every time. Sometimes **it is vague** (neutral statements which tells little about the fact 'Lufthansa Business Class Experience').
- And results vary a lot by **different prompt**

Limited GPU

- Using LLM requires GPU support. Due to the limitation of this, we cannot generate a detailed issue detection.

EXTENSIONS & LEARNINGS

Extension (Use Generator from Llama2)

```
main_prompt = """
[INST]
I have this review:

{text}

Return should be in following format, \
if there is no related content, write N/A\
Make sure the labels are not too general, \
also not too specific:

Seat Comfort:
Negative Labels:
Neutral Labels:
Positive Labels:

Cabin Staff Service:
Negative Labels:
Neutral Labels:
Positive Labels:

Inflight Entertainment:
Negative Labels:
Neutral Labels:
Positive Labels:

Food & Beverages:
Negative Labels:
Neutral Labels:
Positive Labels:

Ground Service:
Negative Labels:
Neutral Labels:
Positive Labels:

Wifi & Connectivity:
Negative Labels:
Neutral Labels:
Positive Labels:

Delay & Cancellation:
Negative Labels:
Neutral Labels:
Positive Labels:

```

```
# output[0]['generated_text'] =
"""
Seat Comfort:
Negative Labels: None
Neutral Labels: Small washroom
Positive Labels: Good order & comfortable seats

Cabin Staff Service:
Negative Labels: None
Neutral Labels: Friendly & professional
Positive Labels: None

Inflight Entertainment:
Negative Labels: None
Neutral Labels: IFE screen off
Positive Labels: None

Food & Beverages:
Negative Labels: Limited menu options
Neutral Labels: None
Positive Labels: None

Ground Service:
Negative Labels: None
Neutral Labels: None
Positive Labels: Helpful ground staff member

Wifi & Connectivity:
Negative Labels: None
Neutral Labels: None
Positive Labels: None

Delay & Cancellation:
Negative Labels: Flight delay due to staffing issue at LHR
Neutral Labels: Frequent updates from flight manager & flight d
Positive Labels: None

```

Learnings



- We learned **web-scraping(beautiful soup)** to retrieve json data. Successfully extracted 13,726 reviews within **5 mins**.
- We learned **advanced topic modelling** with BERTopic + GenAI. Successfully developed a pipeline capable of processing each airline reviews in under **3 mins**.
- We learned **basic prompt engineering knowledge**. Successfully make the generated result as clear as possible.
- We learned **tableau dashboard** to create interactive graphs including basic ones like heatmap, pie chart, bar chart, line chart, advanced ones like **map visualization, Gannt chart, and custom multi-layer filters, etc.**
- We learned the overview of **performance of European airlines** in recent years and have a deeper understanding of Lufthansa airline.
- We learned **TEAMWORK**, logical **MINDSET**, and efficient **COMMUNICATION!** Thanks Mussie!



APPENDIX

Github

https://github.com/yanghang0918/Customer_Review_Analysis.git

Dashboard

[One drive](#)



THANK YOU FOR LISTENING!

