



Online-Appendix zu

„How Do Companies Communicate Sustainability: A Semantic Analysis of German Automotive Manufacturers“

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A1 LSA-Python code

```
#import modules used for LSA
import os.path
from gensim import corpora
from gensim.models import LsiModel
from nltk.tokenize import RegexpTokenizer
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from gensim.models.coherencemodel import CoherenceModel
from nltk.stem.wordnet import WordNetLemmatizer
import matplotlib.pyplot as plt
import cleantxt as text

# retrieved from:
https://www.datacamp.com/tutorial/discovering-hidden-topics-
python; with some modificatiосn
#Loading data sample into project
def load_data(path, file_name):
    """
    Input : path and file_name
    Purpose: loading text file
    Output : list of paragraphs/documents and
            title(initial 100 words considred as title of
document)
    """
    documents_list = []
    titles=[]
    with open( os.path.join(path, file_name),"r") as fin:      #
insert document path here
        for line in fin.readlines():
            text = line.strip()
            documents_list.append(text)
    print("Total Number of Documents:",len(documents_list))
    titles.append( text[0:min(len(text),100)] )
    return documents_list,titles

#Cleaning data
def preprocess_data(doc_set):
    """
    Input : documnt list
    Purpose: preprocess text (tokenize, removing stopwords,
and stemming)
    Output : preprocessed text
    :type doc_set: object
    """
    # initialize regex tokenizer used for tokenization
(separating each word into its own unit)
    tokenizer = RegexpTokenizer(r'\w+')

    # create English stop words list", downloading words add
```

```
little value to context to eliminate them later
from nltk.corpus import stopwords
stopwords= stopwords.words('english') # traditional word
list
#new stopwords added that are specific to the automotive
industry as well as other words with little value, e.g.,
weekdays
new_stopwords =["mercedes", "benz", "daimler", "january",
"february", "march", "april", "may", "june", "july", "august",
"september", "october", "november", "december", "audi",
"volkswagen", "BMW", "car", "truck", "golf", "again",
"to", "and", "also", "then", "equally", "identically",
"uniquely", "like", "as", "too", "moreover", "well",
"together", "of", "likewise", "comparatively", "similary",
"furthermore", "additionally", "notably", "including", "sure",
"namely", "chiefly", "truly", "indeed", "certainly", "surely",
"clarify", "demonstrate", "especially", "surprisingly",
"specifically", "expressively", "frequently", "significantly",
"henceforth", "generally", "thus", "hence", "because", "of",
"then", "for", "consequently", "therefore", "thereupon",
"forthwith", "accordingly", "after", "but", "still", "unlike",
"or", "yet", "while", "albeit", "besides", "instead", "whereas",
"despite", "conversely", "otherwise", "however", "rather",
"nevertheless", "nonetheless", "regardless",
"notwithstanding", "above", "if", "unless", "whenever",
"since", "while", "that", "lest", "due", "given", "only",
"owing", "middle", "left", "right", "side", "center",
"next", "over", "near", "from", "above", "below", "down",
"Between", "further", "beyond", "nearby", "wherever",
"around", "before", "alongside", "amid", "among", "beneath",
"beside", "behind", "across", "time", "same", "with",
"immediately", "henceforth", "eventually", "til", "once",
"about", "next", "now", "formerly", "suddenly", "shortly",
"meanwhile", "straightaway", "instantly", "presently",
"occasionally", "overall", "ordinarily", "summary",
"altogether", "usually", "either", "rather",
"prior", "neither", "whether", "whatever", "whichever",
"whoever", "whom", "whose", "why", "so", "yes", "no",
"increasing", "make", "Germany", "Wolfsburg", "munich",
"month", "week", "day", "identified", "providing", "current",
"offer", "van", "group", "vehicle", "statement", "generate",
"lease", "right", "one", "million", "note", "non", "combine",
"total", "date", "well", "ment", "ing", "merced", "km",
"million", "b", "p", "meet", "measure", "include", "make",
"consolidate", "bus", "ag", "corporation", "company", "firm",
"discuss", "explain", "inform", "example", "country",
"assess", "international", "declare", "use", "daily", "weekly",
"monthly", "yearly", "annually", "derive", "old", "SUV",
"period", "merced", "board", "ear", "co", "member", "e",
"require", "first", "fleet", "gmbh", "order", "provide",
"generate", "batteries", "declare", "take", "inform", "come",
```

"expect", "achieve", "g", "roup", "assess", "industry",
"define", "ervice", "board", "propose", "basic", "ensure",
"meet", "appoint", "proportion", "train", "road", "remunerate",
"annual", "year", "note", "rate", "new", "use", "system",
"corpor", "f", "ing", "including", "response", "vehicl",
"review", "continue", "issue", "date", "regard", "recognize",
"made", "car", "discuss", "ion", "oblige", "truck", "car",
"proceed", "follow", "significant", "german", "achiev", "m",
"f", "right", "billion", "two", "report", "n", "inform",
"take", "address", "digit", "van", "note", "associate", "per",
"state", "define", "nationa", "worldwide", "local", "kwh",
"china", "fuel", "percent", "free", "see", "mercedesbenz",
"note", "consolidate", "combine", "car", "corpor",
"mobile", "van", "truck", "inform", "meet", "according",
"within", "provide", "end", "start", "assess",
"establish", "part", "possible", "arise", "foreign", "regularly",
"receive", "set", "take", "determine", "derive", "number",
"automotive", "relevant", "drive", "adjust", "recognize",
"key", "follow", "area", "oblige", "net", "expensive",
"paid", "implements", "technical", "generate", "digital",
"recognize", "right", "primarily", "shown", "table",
"european", "europe", "define", "year", "term",
"allow", "manufacturer", "state", "affect", "high", "exist",
"various", "average", "show", "would", "method", "less",
"statement", "use", "relate", "mobil", "remunerated",
"addition", "product", "car", "held", "dealt", "expect",
"whether", "electric", "adopt", "review", "require", "result",
"relate", "effect", "continu", "calculate", "present",
"program", "perform", "participate", "globally", "value",
"carryforward", "demand", "term", "currency", "impair",
"lead", "operate", "diesel", "dispose", "statement", "note",
"report", "mobil", "amount", "flow", "inform", "combine",
"receive", "amount", "achievements", "use", "remuner",
'active', 'result', 'effect', "present", 'increase', 'measure',
'recognize', 'plan', 'active', 'currency', 'committee', 'use',
'company', 'intern', 'interim', 'require', 'corporate',
'response', 'perform', 'supervisory', 'basic', 'extern',
'unit', 'connect', 'adjust', 'accord', 'prepare', 'figure',
'limit', 'application', 'figur', 'limit', 'process',
'calculate', 'proceed', 'consist', 'model', 'approve',
'standard', 'comprehensive', 'define', 'ltd', 'actual', 'bonus',
'review', 'discuss', 'application', 'van', 'share', 'import',
'car', 'time', 'truck', 'item', 'expect', 'institute', 'bus',
'contractures', 'particular', 'meet', "follow", "allocate",
"similar", "decrease", "determine", "adopt", "indicate",
"balance" "exchange", "show", "section", "conduct", "price",
"defer", "case", "situation", "reconciliation", "transform",
"retire", "combine", "unit", "response", "intern", "change",
"amount", "vehicle", "data", "product", "car", "pension",
"work", "external", "issue", "system", "represent",
"appropriate", "establish", "individual", "take", "provision",

```
"component", "model", "use", "assess", "discuss" "truck",
"structure", "continue", "associate", "framework" "approve",
"organize" "official", "right", "function", "decision",
"longterm", "major", "hold", "author", "detail", "region",
"drive", "adjust" "oblige", "intangibl", "value", "member",
"comprise", "range", "describe", "thereof", "impair", "ltd",
"gain", "similar", "item", "plant", "occurance", "offer",
"remain", "refund", "ppsp", "propose", "cooper", "brazil",
"launch", "slightly", "higher", "bmw", "america", "prior",
"consumption", "three", "candid", "chief", "germany", "via"]
stopwords.extend (new_stopwords)

# Create wordnet_lemmatizerto find related forms of a word
wordnet_lemmatizer = WordNetLemmatizer ()
# Create p_stemmer of class PorterStemmer, returning the
term to its root to reduce number of terms in a text
p_stemmer = PorterStemmer()
# list for tokenized documents in loop to repeat the
cleaning process for the entire document
texts = []
# loop through document list
for i in doc_set:
    # clean and tokenize document string
    raw = i.lower()
    tokens = tokenizer.tokenize(raw)
    #remove short words
    tokens= [ i for i in tokens if len(i) >2 ]
    # remove stop words from tokens
    tokens = [i for i in tokens if not i in stopwords]
    # lemmatize tokens
    tokens = [wordnet_lemmatizer.lemmatize(i) for i in
tokens]
    # stem tokens
    tokens = [p_stemmer.stem(i) for i in tokens]
    # add tokens to list
    texts.append(tokens)
return texts
def prepare_corpus(doc_clean):
    """
    Input : clean document
    Purpose: create term dictionary of our corpus and
    Converting list of documents (corpus) into Document Term
    Matrix
    Output : term dictionary and Document Term Matrix
    """
    # Creating the term dictionary of our corpus, where every
    unique term is assigned an index. dictionary =
    corpora.Dictionary(doc_clean)
    dictionary = corpora.Dictionary(doc_clean)
    # Converting list of documents (corpus) into Document Term
    Matrix using dictionary prepared above.
```

```
    doc_term_matrix = [dictionary.doc2bow(doc) for doc in
doc_clean]
    # generate LDA model
    return dictionary,doc_term_matrix

def create_gensim_lsa_model(doc_clean,number_of_topics,words):
    """
    Input : clean document, number of topics and number of
words associated with each topic
    Purpose: create LSA model using gensim
    Output : return LSA model
    """
    dictionary,doc_term_matrix=prepare_corpus(doc_clean)
    # generate LSA model
    lsamodel = LsiModel(doc_term_matrix,
num_topics=number_of_topics, id2word=dictionary) # train
model
    print(lsamodel.print_topics(num_topics=number_of_topics,
num_words=words))
    return lsamodel

def compute_coherence_values(dictionary, doc_term_matrix,
doc_clean, stop, start=2, step=1):
    """
    Input : dictionary : Gensim dictionary
corpus : Gensim corpus
texts : List of input texts
stop : Max num of topics
    purpose : Compute c_v coherence for various number of
topics
    Output : model_list : List of LSA topic models
coherence_values : Coherence values
corresponding to the LDA model with respective number of
topics
    """
    coherence_values = []
    model_list = []
    for num_topics in range(start, stop, step):
        # generate LSA model
        model = LsiModel(doc_term_matrix,
num_topics=number_of_topics, id2word=dictionary) # train
model
        model_list.append(model)
        coherencemodel = CoherenceModel(model=model,
texts=doc_clean, dictionary=dictionary, coherence='c_v')
coherence_values.append(coherencemodel.get_coherence())
    return model_list, coherence_values

def plot_graph(doc_clean,start, stop, step):
    dictionary,doc_term_matrix=prepare_corpus(doc_clean)
```

```
    model_list, coherence_values =
compute_coherence_values(dictionary,
doc_term_matrix, doc_clean,
stop, start, step)
    # Show graph
    x = range(start, stop, step)
    plt.plot(x, coherence_values)
    plt.xlabel("Number of Topics")
    plt.ylabel("Coherence score")
    plt.legend(("coherence_values"), loc='best')
    plt.show()
start, stop, step = 2, 30, 1
document_list, titles = load_data("/Users/fabiennele/PycharmProjects/Bachelor Thesis 2.0/Volkswagen/Legislators
", "VW_legislator_rawdata.txt")
clean_text = preprocess_data(document_list)
plot_graph(clean_text, start, stop, step)

#%%
#from plotted graph the correct number of topics was
identified to model the LSA; insert number in number_of_topics
# create LSA Model
number_of_topics =
words = 50
document_list, titles = load_data("/Users/fabiennele/PycharmProjects/Bachelor Thesis 2.0/Volkswagen/Legislators
", "VW_legislator_rawdata.txt")
clean_text = preprocess_data(document_list)
model = create_gensim_lsa_model(clean_text, number_of_topics, words
)
```

A2 Twitter post scraper code

```
#import scraper modules to extract posts from Twitter
import snsrape.modules.twitter as sntwitter
import pandas as pd
import csv

#Open/ create a file to append data to
csvFile = open("VW_consumers_tweetsUK", 'a')
csvWriter = csv.writer(csvFile)

# Creating list to append tweet data to
tweets_list1 = []

# Using TwitterSearchScraper to scrape data and append tweets
to list
for i, tweet in
enumerate(sntwitter.TwitterSearchScraper('from:UKVolkswagen
```



```

since:2019-01-01 until:2021-12-31').get_items()):#from: to
search specific Twitter account, "since:" and "until" to
define the timeframe for scraped tweets

    if i >100000:
        break
    tweets_list1.append([tweet.date,tweet.content,
tweet.user.username])
    csvWriter.writerow(
[tweet.date,tweet.content,tweet.user.username])
csvFile.close() #saving all posts extracted in a csv file

```

A3 Mercedes-Benz shareholders: topic themes & CV graph

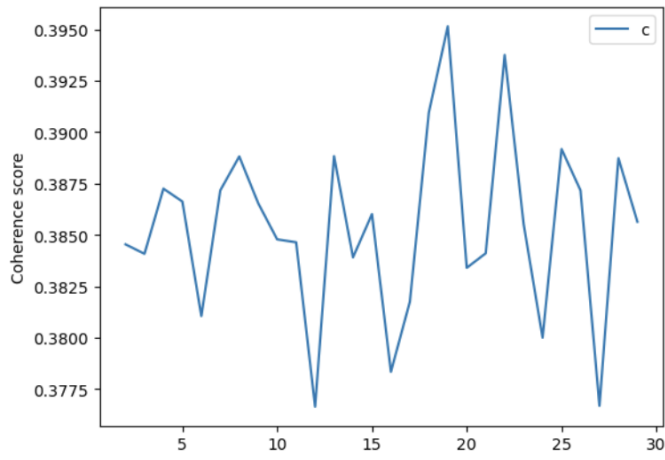
Mercedes-Benz Shareholders: topic themes

Topic number	Terms	Theme	TBL class
1	0, '0.768*"financi" + 0.417*"statement" + 0.414*"consolid" + 0.156*"note" + 0.075*"manag"	Financial performance	Economic
2	0'0.762*"manag" + 0.521*"risk" + 0.129*"combin" + 0.113*"opportun" + - 0.094*"consolid"	Financial performance	Economic
3	'0.724*"risk" + -0.580*"manag" + 0.134*"opportun" + -0.109*"combin" + 0.104*"market"	Financial Performance	Economic
4	'0.327*"busi" + -0.325*"risk" + 0.287*"develop" + 0.280*"servic" + 0.256*"asset"	Sales	Economic
5	'0.471*"asset" + -0.376*"develop" + - 0.292*"consolid" + -0.280*"busi" + - 0.259*"statement"	Sustainable reporting	Environment
6	'0.410*"servic" -0.375*"market" 0.340*"busi -0.323*"asset"	Integration of sustainability for business growth	Environment
7	0.499*"busi" + -0.450*"cash" + 0.360*"servic" + 0.255*"sale" + 0.195*"financi" "	Strategic reorientation/ Product strategy	Economic
8	0.574*"develop" + 0.362*"cash" + 0.249*"sale" + 0.204*"vehicl" + 0.200*"servic"	Sale of products & services (sales)	Economic

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9	'0.424*"market" + -0.322*"servic" + - 0.294*"tax" + 0.288*"instrument" + 0.276*"hedg"	Financial performance, disclosure to stakeholders	Economic
10	0.422*"busi" + 0.340*"develop" + - 0.322*"asset" + -0.318*"sale" + 0.280*"cash"	Financial Performace	Economic
11	'0.371*"tax" + -0.302*"cash" + 0.296*"loss" + 0.251*"interest" + -0.233*"sharehold"	Reporting/ Auditing/ Compliance	Economic
12	, '0.314*"complianc" + -0.289*"cash" + - 0.283*"develop" + 0.283*"legal" + 0.234*"measur"	Labor practices	Social
13	0.807*"target" + -0.324*"achiev" + 0.220*"market" + 0.141*"audit" + - 0.140*"remuner"	Benchmarking	Economic
14	.648*"interest" + -0.303*"loss" + 0.223*"incom" + 0.219*"expens" + - 0.183*"complianc"	Shareholder / market value growth	Economic
15	-0.558*"tax" + 0.307*"interest" + - 0.297*"market" + -0.253*"sharehold" + - 0.216*"audit"	Compliance/ Auditing	Economic
16	'0.415*"market" + -0.358*"sharehold" + 0.309*"complianc" + -0.260*"sale" + - 0.255*"meet"	Business compliance	Economic
17	'0.649*"truck" + 0.305*"bu" + -0.270*"sale" + -0.248*"loss" + 0.199*"liabil"	Product sales	Economic
18	0.555*"liabil" + -0.390*"mobil" + 0.229*"complianc" + 0.215*"tax" + - 0.199*"remuner"	Regulations of business operations	Economic

Mercedes-Benz shareholder CV:

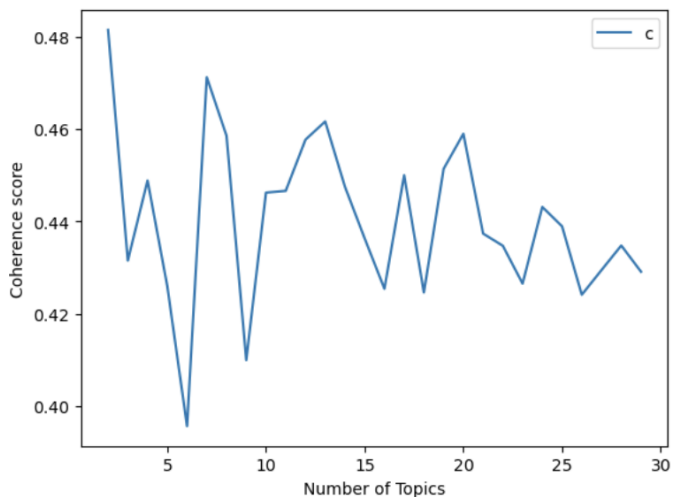


A4 Audi shareholders: topic themes & CV graph

Audi Shareholders: topic themes

Topic number	Terms	Theme	TBL class
1	-0.911*"product" + -0.177*"servic" + -0.172*"sustain" + - 0.164*"employe" + -0.090*"emiss"	Financial performance	Economic
2	0.708*"vote" 0.680*"right" 0.071*"amount" 0.057*"attribut" 0.054*"law"	Policies/ Integeration of stakeholders	Social

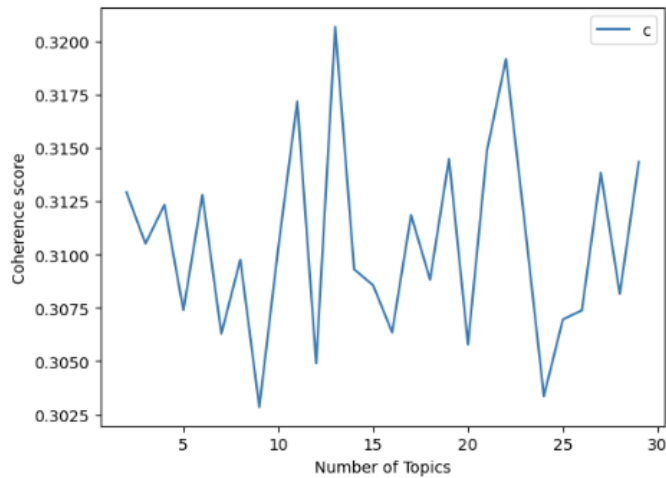
Audi shareholders CV:



A5 Volkswagen shareholders: topic themes & CV graph

Volkswagen Shareholders: topic list			
Topic number	Terms	Theme	TBL class
1	0.767*"financi" +0.378*"statement" +0.378*"consolid" +0.156*"asset" +0.142*"note"	Financial performance/ Balance sheet evaluation	Economic
2	'0.644*"manag" +0.541*"risk"+ 0.162*"hedg" + - 0.155* "consolid",0.149*"statement"	Financial performance	Economic
3	0.627*"manag" +0.306*"asset" +0.192*"market" +0.186*"hedg" +0.173*"tax"	Financial performance	Economic
4	0.691*"risk" +0.314*"manag" + - 0.252*"hedg" +0.220*"asset" +0.194*"sale"	Sales	Economic
5	-0.453*"asset" +0.436*"market" +0.390*"vehicl" + -0.178*"loss" +0.178*"commerci"	Market & brand value	Economic
6	'0.469*"hedg"+-0.395*"asset" +0.339*"tax" + 0.251*"cash" + -0.247*"risk" +0.237*"consolid"	Financial performane	Economic
7	0.481*"vehicl" + -0.463*"market" + - 0.283*"develop" + -0.283*"cost" +0.225*"commerci"	Car/ product development	Economic
8	'0.614*"tax" + -0.436*"hedg" +0.231*"risk" + -0.178*"fair" + -0.158*"cost"	Accounting	Economic
9	0.523*"sale" + -0.353*"cash" + -0.315*"tax" +0.253*"revenu" + -0.211*"servic"	Sales/ revenue	Economic
10	-0.435*"cash" + -0.381*"asset" +0.346*"loss"+0.250*"servic" + -0.222 *"oper"	Financial performance	Economic
11	-0.420*"develop" + 0.412*"sale" +0.280*"market" + -0.239*"cost" + - 0.231*"vehicl"	Market strategy/ brand development	Economic
12	'0.555*"loss" + -0.388*"liabil" + - 0.349*"hedg" + 0.226*"oper" + 0.217*"profit"	Financial Performance	Economic
13	-0.592* "liabil" + 0.363*"brand" + -0.232 *"vehicl" +0.228*"passeng" + 0.224*"tax"	Relation between car brand and firm value	Economic

Volkswagen shareholders CV:



A6 BMW shareholders: topic themes & CV graph

BMW Shareholders: topic list

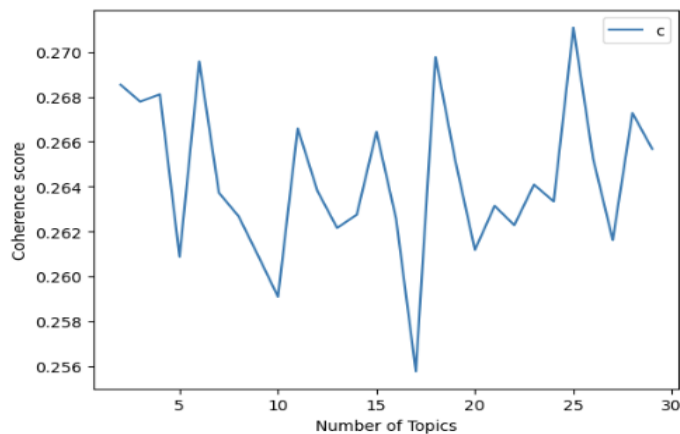
Topic number	Term	Theme	TBL class
1	'0.701*"financi" + 0.385*"manag" + 0.259*"risk" + 0.243*"statement" + 0.182*"remuner"	Financial reporting	Economic
2	'0.720*"manag" + -0.536*"financi" + 0.249*"risk" + 0.188*"combin" + 0.138*"remuner" +	Outlook of financial/business strategy concerning resources and materials	Economic
3	'0.674*"risk" + -0.416*"remuner" + -0.267*"statement" + -0.225*"govern" + -0.207*"nformat"	Outlook of financial/business strategy concerning resources and materials	Economic/ Environment
4	-0.481*"manag" + 0.478*"risk" + 0.461*"remuner" + 0.233*"govern" + -0.216*"financi"	Impact investing	Environment/ Economic
5	-0.315*"risk" +0.305*"cash" +0.240*"asset" + -0.235*"financi" +0.213*"invest"	Sales	Economic
6	-0.560*"cash" +0.361*"product" +0.273*"servic" + -0.222*"invest" +0.182*"develop"	Environmental-friendly products	Economic

		and their market performance	
7	-0.497*"asset" +-0.325*"tax" +0.305*"cash" +0.295*"servic" +-0.211*"incom"	Financial performance	Economic
8	-0.481*"segment" +-0.481*"servic" +0.267*"emiss" +-0.194*"tax" +0.182*"statement"	Compliance to environmental regulations	Environmental
9	'0.583*"asset" +-0.337*"tax" +0.336*"product" +-0.231*"incom" +0.199*"cash"	Financial performance	Economic
10	-0.439*"product" +0.402*"segment" +0.296*"emiss" +0.278*"target" +0.238*"inform"	Financial performance disclosure	Economic
11	-0.435*"remuner" +0.322*"cash. +0.313*"asset" +0.261*"statement" ++0.258*"invest"	Carbon emission footprint of product	Environment
12	0.466*"unit" +-0.403*"tax" +0.318*"emiss" +-0.287*"product" +0.203*"market"	Reporting of sustainable supply chain/ product	Environment
13	-0.681*"unit" +-0.346*"tax"+ 0.299*"cost" + 0.279*"develop" +- 0.173* "joint"	Reporting of sustainable supply chain/ product / alliances	Environment
14	-0.581*"inform" + -0.347*"report" + 0.334*"target" + 0.223*"unit" + 0.218*"develop"	Meeting target/ reporting	Economic
15	0.581*"develop" + -0.344*"capit" + - 0.255*"product" + 0.232*"inform" + - 0.222*"market"	Developments of environmental-friendly cars for market value increase	Economic/ Environmental
16	-0.476*"emiss" + -0.276*"cost" + 0.267*"target" + 0.265*"product" + - 0.256*"carbon"	Compliance to meet target of carbon emission reduction	Environmental
17	'0.449*"market" + 0.357*"develop" + - 0.249*"target" + 0.244*"capit" + 0.215*"inform"	Conforming and reporting of policies	Economic
18	-0.461*"inform" + 0.335*"invest" + 0.321*"account" + 0.248*"servic" + 0.243*"report"	Compliance to regulations	Economic

B.Sc. Thesis – How do companies communicate sustainability: a semantic analysis of German automotive manufacturers

19	$-0.344 \cdot \text{"loss"} + -0.308 \cdot \text{"report"} + 0.241 \cdot \text{"invest"} + -0.212 \cdot \text{"segment"} + -0.210 \cdot \text{"perform"}$	Market value and performance	Economic
20	$-0.307 \cdot \text{"tax"} + 0.304 \cdot \text{"loss"} + 0.303 \cdot \text{"incom"} + 0.284 \cdot \text{"invest"} + -0.239 \cdot \text{"perform"}$	Market performance	Economic
21	$0.371 \cdot \text{"market"} + -0.312 \cdot \text{"employe"} + 0.306 \cdot \text{"target"} + -0.257 \cdot \text{"emiss"} + 0.235 \cdot \text{"combin"}$	Environmental measures and its implication for stakeholders	Economic & Environmental
22	$-0.351 \cdot \text{"sale"} + -0.310 \cdot \text{"financ"} + 0.309 \cdot \text{"hedg"} + 0.283 \cdot \text{"cost"} + 0.260 \cdot \text{"capit"}$	Supply chain of raw materials / sustainable supply chain	Environment
23	$-0.318 \cdot \text{"report"} + -0.281 \cdot \text{"target"} + 0.237 \cdot \text{"vehicl"} + -0.229 \cdot \text{"account"} + 0.209 \cdot \text{"materi"}$	Reporting/ auditing/ accounting	Economic
24	$0.495 \cdot \text{"vehicl"} + -0.292 \cdot \text{"market"} + 0.189 \cdot \text{"electr"} + 0.188 \cdot \text{"loss"} + 0.184 \cdot \text{"cost"}$	Market performance due to corona virus external factors	Environmental

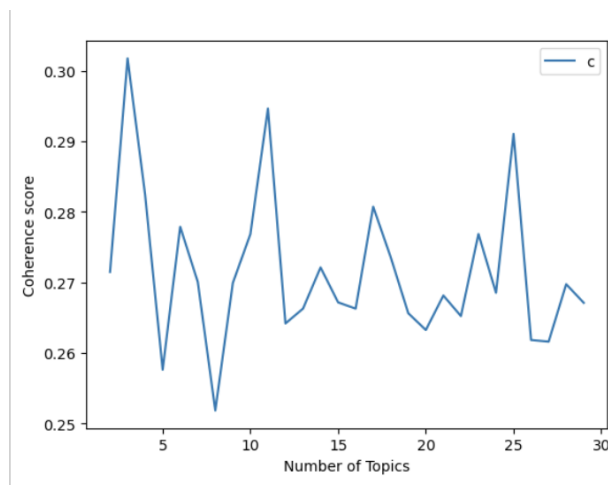
BMW shareholders CV:



A7 Mercedes-Benz legislation: topic themes

Mercedes Legislation: topic themes			
Number of topics	Term	Theme	TBL class
1	0.696*"sustain" + - 0.360*"manag" + - 0.197*"develop" + - 0.148*"busi" + - 0.144*"risk"	Sustainable supply chain addressing environment and climate change in production & business operation	Environmental
2	-0.628*"sustain" + 0.536*"manag" + 0.319*"employe" + 0.210*"complianc" + 0.194*"risk"	Employee protection and work environment	Social
3	0.608*"manag" + 0.329*"employe" + 0.258*"emiss" + 0.244*"product" + 0.203*"develop"	Sustainable product development	Environmental

Mercedes-Benz legislation CV:



A8 Audi legislation: topic themes & CV graph

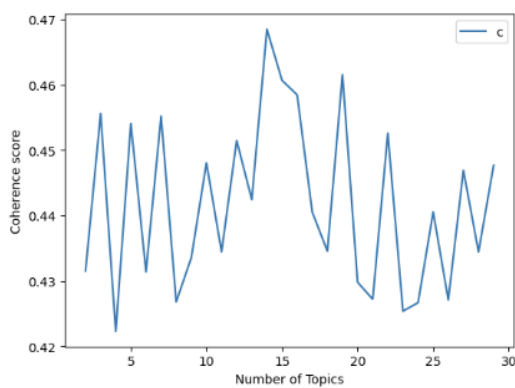
Audi legislation: topic themes			
Number of topics	Terms	Theme	TBL class
1	-0.911*"product" + - 0.177*"servic" + - 0.172*"sustain" + - 0.164*"employe" + - 0.090*"emiss"	Carbon emission reduction, sustainable/ fair operating practices	Environmental
2	-0.589*"employe" + - 0.455*"sustain" + - 0.403*"manag" +	Labor practices	Social

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	0.314*"product" + - 0.195*"gri"		
3	'0.737*"employe" + - 0.581*"sustain" + - 0.180*"manag" + - 0.120*"develop" + - 0.116*"gri"	Labor practices	Social
4	-0.643*"manag" + 0.497*"sustain" + - 0.461*"gri" + - 0.212*"approach" + 0.175*"employe"	Fair operating practices	Social
5	'0.528*"electr" + 0.458*"emiss" + 0.410*"combin" + 0.255*"power" + 0.252*"etron"	Car production/ innovation (climate-friendly)	Environmental
6	-0.837*"gri" + 0.484*"manag" + - 0.102*"standard" + 0.091*"integr" + 0.085*"risk" + 0.084*"approach"	Operating practices/ compliance	Social
7	'0.925*"develop" + - 0.255*"sustain" + - 0.078*"combin" + - 0.076*"manag" + - 0.073*"employe"	Car production/ innovation (Climate-friendly)	Environmental
8	-0.689*"integr" + - 0.673*"oper" + 0.141*"manag" + - 0.121*"complianc" + 0.067*"sustain"	Alliances, organizational government	Social
9	'0.643*"electr" + - 0.581*"emiss" + - 0.203*"gkm" + - 0.171*"nedc" + 0.170*"mobil"	Car production	Economic
10	'0.426*"strategi" + 0.357*"vehicl" + 0.289*"chain" + 0.277*"busi" + 0.248*"suppli"	Supply chain	Economic
11	'0.650*"oper" + - 0.600*"integr" + - 0.257*"strategi" + - 0.203*"complianc" + 0.148*"vehicl"	Sales operation/management	Economic

12	-0.754*"strategi" + 0.280*"busi" + - 0.234*"oper" + 0.191*"partner" + 0.183*"vehicl"	Product brand	Economic
13	'0.571*"busi" + 0.390*"partner" + - 0.343*"vehicl" + 0.223*"strategi" + - 0.216*"chain"	Production/ supply chain operation	Economic

Audi legislation CV:



A9 Volkswagen legislation: topic themes & CV graph

Volkswagen legislation: topic themes

Number of topics	Terms	Themes	TBL class
1	'0.835*"manag" + 0.292*"sustain" + 0.260*"risk" + 0.122*"complianc" + 0.100*"busi"	Compliance to environmental targets in business operation	Environmental
2	'0.747*"sustain" + - 0.460*"manag" + 0.176*"suppli" + 0.174*"chain" + 0.163*"busi"	Environmental action in supply chain management	Environmental
3	'0.538*"risk" + -0.503 *"sustain" + 0.304 *"busi" + -0.214* "manag" + 0.209*"human"	Environmental action in business operation	Environmental
4	'0.488*"vehicl" + - 0.339*"risk" + 0.320*" emiss" + 0.256*"car" + 0.242*"commerci"	Car production/ development (climate- friendly)	Environmental

5	0.511*"busi" + -0.401*"risk" + 0.339*"employe" + 0.267*"right" + 0.258*"human"	Integration of stakeholders in environmental actions	Environmental & social
6	-0.512*"suppli" + -0.497*"chain" + 0.471*"car" + 0.199*"vehicl" + -0.156*"respons"+ 0.125*"car"	Environmental action in supply chain management	Environmental
7	'0.358*"inform" + 0.296*"public" + 0.277*"contain" + 0.275*"unit" + 0.269*"directli"	Communication & integration of stakeholders and public	Social
8	'0.756*"green" + 0.268*"financ" + 0.239*"framework" + 0.223*"bond" + 0.179*"elig"	Financial performance	Economic
9	'0.758*"materi" + 0.452*"raw" + -0.212*"suppli" + -0.203*"chain" + 0.173*"employe"	Raw materials/ Car production/ development (climate-friendly)	Environmental

A10 BMW legislators: topic themes & CV graph

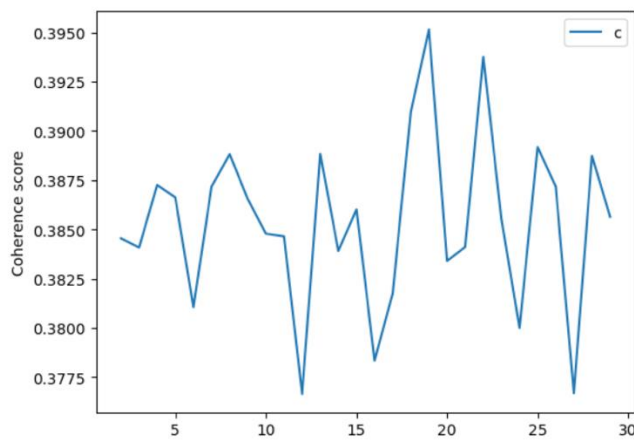
BMW legislators: topic themes			
	Terms	Theme	TBL class
1	0.748*"emiss" + 0.271*"co2" + 0.228*"product" + 0.213*"scope" +0.143*"climat" +0.100*"reduc"	Emission reduction 3in production& supply chain	Environmental
2	0.381*"climat" + 0.325*"cdp" + 0.308*"questionnair" + 0.305*"wednesday" + -0.266*"emiss" + -0.089*"co2"	Carbon reduction in production	Environmental
3	0.651*"manag" + 0.343*"risk" + 0.340*"product" + -0.289*"emiss" + 0.189*"sustain"	Employee care and stakeholder integration / relationship maintenance	Social

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4	-0.795*"product" + 0.442*"manag" + - 0.195*"servic" + 0.189*"emiss" + 0.183*"risk"	Renewable resources/ carbon reduction/ conserving of resources/ environment	Environmental
5	0.665*"employe" + - 0.288*"risk" + 0.278*"develop" + 0.272*"sustain" + - 0.222*"product"	Employee conditions / people & society	Social
6	-0.532*"employe" + 0.366*"sustain" + 0.299*"chain" + 0.282*"suppli" + - 0.245*"manag"	Sustainable supply chain strategy	Environmental
7	-0.546*"risk" + 0.365*"sustain" + 0.360*"manag" + - 0.308*"employe" + - 0.284*"chain"	Sustainable supply chain	Environmental
8	-0.579*"energi" + 0.447*"sustain" + - 0.253*"electr" + 0.223*"develop" + - 0.210*"vehicl"	Renewable energy, electric cars,	Environmental
9	0.451*"chain" + 0.427*"suppli" + - 0.370*"risk" + - 0.278*"vehicl" +	Emission reductions in production & supply chain	Environmental
10	0.531*"energi" + -0.295*"vehicl" + 0.202*"sustain" + 0.175*"effici" + 0.164*"renew"	Electric cars/ energy efficient cars → sales	Environmental
11	0.620*"2020" + - 0.451*"vehicl" + - 0.258*"electr" + 0.240*"supplier" + 0.216*"gri"	Supply chain of electric. Cars	Economic
12	0.627*"co2" + 0.555*"scope" + - 0.300*"target" + 0.166*"energi" + - 0.114*"reduc"	CO2 reduction, hitting target for renewable energy,	Environmental
13	-0.581*"gri" + - 0.417*"supplier" + - 0.193*"brilliant" + 0.152*"target" + - 0.135*"vehicl"	Conforming to GRI regulations and meeting climate targets	Economic/ Environmental

14	0.535*"und" + - 0.491*"target" + - 0.449*"der" + - 0.218*"gri" + 0.194*"supplier" +	Reporting and disclosing environmental actions	Environmental
15	0.535*"und" + - 0.491*"target" + - 0.449*"der" + - 0.218*"gri" + 0.137*"brilliant"	Conforming to GRI regulations and meeting climate targets	Economic/ Environmental
16	-0.466*"target" + - 0.419*"supplier" + 0.373*"gri" + - 0.253*"brilliant" + - 0.245*"scope"	Targets for supply chain concerning carbon emission and energy	Environmental
17	0.671*"die" + - 0.497*"der" + - 0.430*"brilliant" + - 0.187*"und" + 0.080*"supplier"	Compliance to environmental actions/ regulations	Environmental

BMW legislation CV:



A11 Mercedes-Benz consumers: topic themes

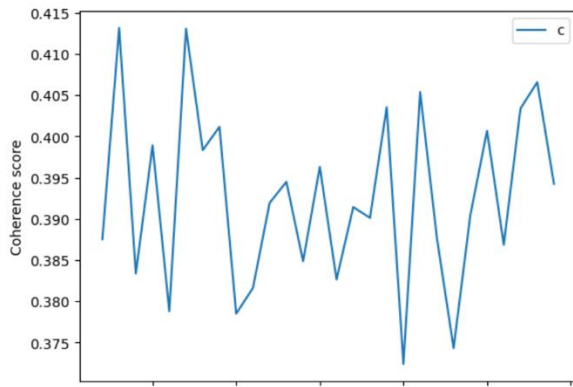
Mercedes-Benz consumers: topic themes

Number of topics	US consumers			UK consumers		
	Terms	Themes	TBL class	Term	Themes	TBL class
1	0.954*"http" + 0.155*"mbphotopass" + 0.060*"gle" +	Promotion/ advertisement	Economic	0.371*"team" + 0.337* "servic" + 0.308* "custom"	Customer service	Social

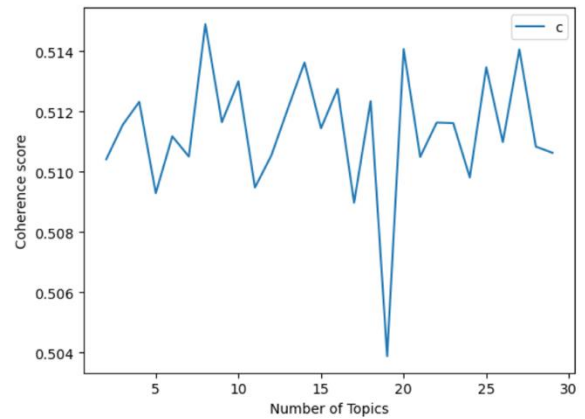
B.Sc. Thesis – How do companies communicate sustainability: a semantic analysis of German automotive manufacturers

	0.058*"sclass" + 0.051*"glc"			+ 0.289*"sorri" + 0.272*"pleas"		
2	0.592*"mbphotopass" + -0.569*"eq" + - 0.351*"mercedeseq" + -0.177*"allelectr" + -0.136*"allnew"	Customer service	Social	-0.798*"http" + -0.253* "retail" + 0.195*"team" + 0.193*"servic" + 0.183* "custom"	Customer service	Social
3	0.592*"mbphotopass" + -0.569*"eq" + - 0.351*"mercedeseq" + -0.177*"allelectr" + -0.136*"allnew"	Promotion/New mode introduction		'0.419*"http" + -0.390*" pleas" + -0.344*"send" + 0.298*"team" + -0.285* "contact"	Customer service	Social
4				'0.632*"thank" + -0.460 *"sorri" + -0.383*"hear" + 0.265*"youmercedesbenzuk" + -0.146*"contact"	Customer service	Social
5				'0.460*"sorri" + 0.383 *"thank" + 0.351*"hear" + - 0.265*"custom" - 0.264 *"servic	Customer service	Social
6				'0.548*"retail" + -0.329 *"http" + 0.326*"contact" + -0.267*"send" + -0.211*. "email"	Customer service	Social
7				'0.453*"team" + -0.410 *"servic" + -0.349* "custom" + -0.270*" thank" + 0.240*"email"	Customer service	Social
8				-0.380*"retail" + 0.359*"team" + - 0.343*"email" + 0.252*"pleas" + - 0.239*"reach"	Customer service	Social

Mercedes-Benz US consumers:



Mercedes-Benz UK consumers:

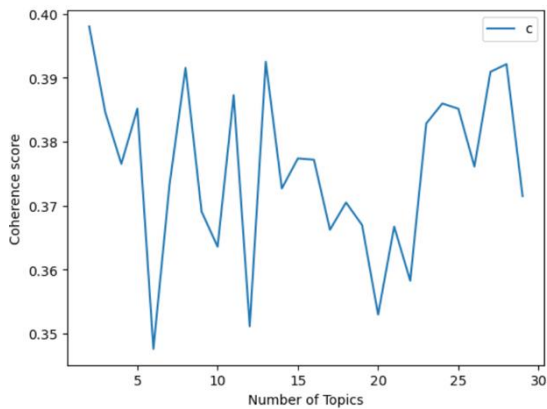


A12 Audi consumers: topic themes & CV graph

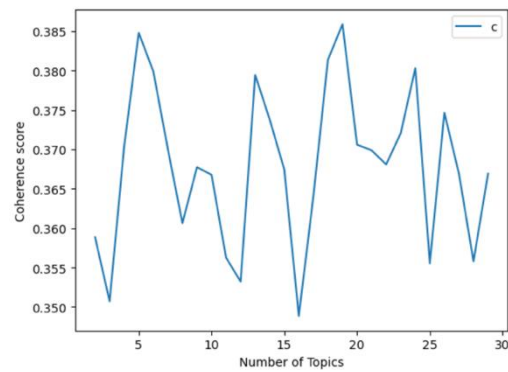
Audi consumers: topic themes

Number of topics	US consumers			UK consumers		
	Terms	Theme	TBL class	Terms	Theme	TBL class
1	0, '0.411*"pleas" + 0.323 *"detail" + 0.304*"experi" + 0.298*"conveni" + 0.292 *"inform"	Customer service	Social	0, '0.405*"hear" + 0.393*"look" + 0.340*"pleas" + 0.321*"detail" + 0.296*"sorri"	Customer service	Social
2	'0.728*"http" + 0.358 *"tcowtwucmwaudi" + -0.206*"could" + 0.178*"thank" + 0.177 *"assist"	Customer service	Social	'0.653*"http" + 0.241*"good" + 0.240*"pleas" + 0.219*"thank" + -0.193*"look"	Customer service	Social
3				'0.607*"http" + -0.431*"thank" + -0.288*"pleas" + 0.162*"look" + -0.157*"assist"	Customer service	Social
4				0.233*"assist" + 0.201*"good" + -0.181*"disappoint" + 0.175*"vin" + 0.174*"happi"	Customer service	Social
5				'0.502*"good" + 0.284*"look" + -0.257*"happi" + -0.227*"team" + -0.220*"centr"	Customer service	Social

Audi US consumers:



Audi UK consumers:



A13 Volkswagen consumers: topic themes & CV graph

Volkswagen consumers: topic themes

Number of topics	US consumers			UK consumers		
	Terms	Theme	TBL class	Terms	Theme	TBL class
1	0.953*"http" + - 0.100*"sale" + - 0.091*"vwoa" + - 0.077*"suv" + - 0.060*"unit" +	Promotion	Economic	'0.367*"pleas" + 0.361 *"hear" + 0.315*"http" + 0.309 *"thank" + 0.283 *"disappoint"	Customer service	Social
2	0.715*"sale" + - 0.383*"unit" + - 0.321*"suv" + - 0.315*"vwoa" + - 0.193*"brand"	Business performance	Economic	.513*"http" + 0.439*"thank" + - 0.340*"hear" + -0.313 *"disappoint" + -0.211 *"thanksukvolkswagen"	Customer service	Social
3	0.507*"amp" + 0.267*"vwoa" + 0.239*"mobil" + 0.196*"fatur" + 0.192*"electr"	Environmental innovations to car model	Environmental	-0.407*"retail" + - 0.343* "team" + 0.312*"look" + 0.277*"detail" + -0.217 *"advis"	Customer service	Social
4	0.399*"amp" + - 0.362*"electr" + 0.310*"jetta" + - 0.290*"mobil" + - 0.241*"fatur"	Environmental innovations to car model	Environmental	-0.518*"pleas" + 0.355* "retail" + -0.304*"team" + 0.279*"hear" + 0.262* "disappoint"	Customer service	Social
5	0.421*"concept" + 0.334*"tao" + - 0.331*"amp" + 0.315*"suv" +	Product promotion	Economic	'0.502*"good" + 0.284* "look" + -0.257*"happi" + -0.227* "team" + - 0.220* "centr"	Customer service	Social

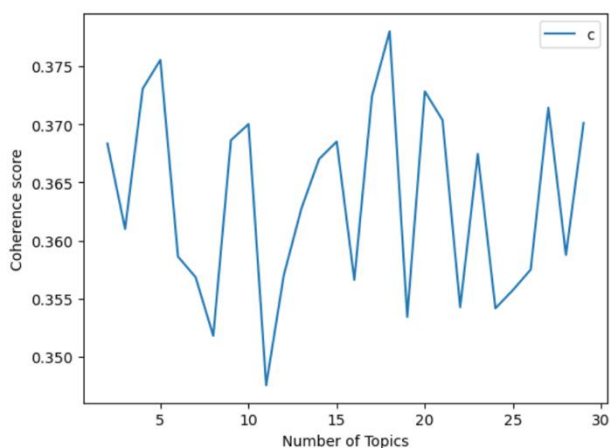
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	0.276*"atla" + 0.191*"basecamp"					
6	-0.297*"concept" + + 0.274*"name" + -0.270*"vwoa" + 0.264*"jetta" + 0.242*"best"	Brand promotion	Economic	'0.375*"retail" + - 0.315*"hope" + 0.289*"http" + 0.288 *"thanksukvolkswagen" + -0.288*"get"	Customer service	Social
7	-0.576*"design" + -0.213*"product" + + 0.186*"futur" + -0.182*"tao" + 0.179*"atla" +	Product promotion	Economic	-0.412*"hope" + - 0.373* "look" + - 0.249*"detail" + 0.245*"thank" + - 0.222* "helpsukvolkswagen"	Customer service	Social
8	'0.400*"name" + - 0.320*"jetta" + - 0.235*"gli" + 0.228*"best" + - 0.210*"look"	Product promotion	Economic	-0.440*"thank" + 0.420*"hope" + 0.223* "helpsukvolkswagen" + 0.217*"thanksukvolksw agen" + -0.197*"team"	Customer service	Social
9	-0.353*"vwoa" + 0.313*"amp" + - 0.294*"golf" + 0.204*"suv" + - 0.165*"technolog"	Product promotion	Economic	-0.436*"assist" + 0.258*" ukvolkswagen" + -0.220 *"contact" + 0.201*"team" + 0.197*"concern"	Customer service	Social
10	'0.298*"dustin" + -0.298*"concept" + + 0.281*"tod" + 0.273*"journey" + 0.238*"cross" + - 0.221*"golf"	Product promotion	Economic	-0.432*"pleas" + 0.330* "team" + 0.312* "thanksukvolkswagen" + -0.311*"retail" + 0.227* "updat"	Customer service	Social
11	'0.407*"world" + - 0.268*"vwoa" + - 0.257*"jetta" + - 0.254*"technolog" + 0.175*"golf"	Product promotion	Economic	0.401*"contact" + 0.355* "detail" + 0.350*"servic" + - 0.287*"advic" + 0.253* "custom"	Customer service	Social
12	-0.321*"product" + + -0.279*"test" + - 0.226*"safeti" + - 0.186*"golf" + - 0.185*"atla"	Product promotion	Economic	'0.583*"contact" + - 0.270* "thanksukvolkswagen" + 0.225* "hear" + - 0.187*"rais" + - 0.185*"get"	Customer service	Social
13	'0.391*"world" + - 0.356*"golf" + - 0.219*"design" + 0.183*"celebr" + 0.182*"vwgoa"	Workshops, educational training programs	Social	-0.512*"assist" + 0.340*"get" + - 0.249*"updat" + - 0.249* "ukvolkswagen" + 0.220* "touch"	Customer service	Social
14	-0.344*"electr" + 0.260*"design" + 0.249*"futur" + 0.227*"atla" + - 0.194*"suv"	Product promotion	Economic	'0.352*"thank" + - 0.341* "ukvolkswagen" + -0.298* "get" + 0.256*	Customer service	Social

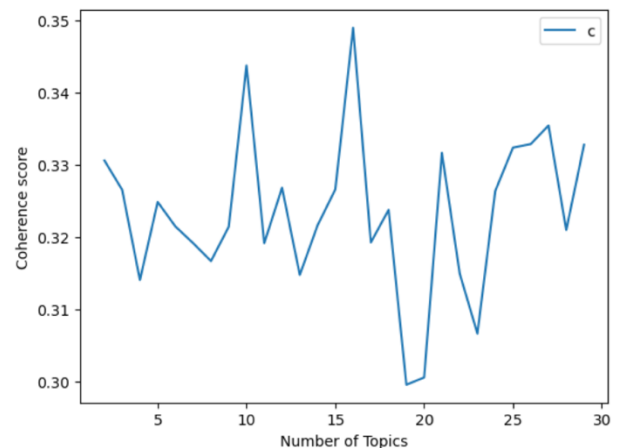
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				"helpsukvolkswagen" + -0.253*"http"		
15	-0.310*"join" + - 0.306*"design" + 0.266*"read" + 0.234*"product" + 0.210*"engin"	Alliances and integration of different actors in research & development	Social	-0.383*"detail" + 0.329* "help" + 0.285*"great" + - 0.252*"get" + 0.249 *"thanksukvolkswagen"	Customer service	Social
16	-0.301*"drive" + 0.239*"read" + - 0.188*"product" + 0.179*"futur" + 0.177*"engin" + -	Product promotion	Economic	-0.486*"detail" + - 0.410* "great" + 0.346*"inform" + - 0.202*"welcom"+ 0.188* "contact"	Customer service	Social
17	0.330*"read" + 0.273*"concept" + -0.255*"suv" + 0.176*"safeti" + - 0.174*"atla"	Product promotion	Economic			
18	-0.280*" technolog" + 0.239*"jetta" + 0.236*"product" + 0.188*"vwoa" + - 0.188*"suv"	Environmental innovations to car model	Environmental			

Volkswagen US consumers:



Volkswagen UK consumers:



A14 BMW consumers: topic themes & CV graph

BMW consumers: topic themes						
US consumers				UK consumers		
Number of topics	Terms	Theme	TBL class	Terms	Theme	TBL class
1	'0.551*"pleas" + 0.426*"http" + 0.301*"vin" + 0.284*"phone" + 0.264*"learn"	Customer service	Social	'0.464*"thanksbmw_uk" + 0.367*"pleas" + 0.342*"sorri" + 0.301*"hear" + 0.277*"vin"	Customer service	Social
2	-0.863*"http" + 0.291*"pleas" + 0.144*"vin" + 0.141*"phone" + 0.111*"amp"	Customer service	Social	-0.734*"http" + -0.266*"find" + 0.220*"vin" + 0.205*"pleas" + 0.164*"sorri"	Customer service	Social
3	0.458*"team" + 0.390*"custom" + -0.336*"vin" + 0.331*"call" + -0.317*"phone"	Customer service	Social	0.466*"http" + -0.316*"happi" + -0.315*"team" + -0.294*"thanksbmw_uk" + 0.275*"pleas"	Customer service	Social
4	0.458*"team" + 0.390*"custom" + -0.336*"vin" + 0.331*"call" + -0.317*"phone"	Customer service	Social	-0.464*"thanksbmw_uk" + 0.325*"look" + -0.317*"pleas" + 0.298*"happi" + 0.285*"hear"	Customer service	Social
5	-0.606*"sorri" + -0.318*"hear" + -0.282*"learn" + -0.242*"enjoy" + -0.241*"frustrat"	Customer service	Social	0.709*"centr" + -0.360*"look" + -0.214*"thank" + 0.193*"help" + 0.154*"involv"	Customer service	Social
6	-0.484*"enjoy" + -0.402*"look" + 0.282*"servic" + -0.248*"great" + -0.241*"thank"	Brand promotion	Economic	-0.476*"look" + 0.432*"help" + -0.373*"centr" + 0.312*"hear" + 0.298*"sorri"	Customer service	Social
7	'0.452*"servic" + -0.373*"pleas" + 0.283*"enjoy" + 0.268*"amp" + -0.255*"look"	Product promotion	Economic	0.473*"help" + 0.415*"happi" + -0.328*"sorri" + -0.286*"thanksbmw_uk" + 0.262*"info" +	Customer service	Social
8	'0.587*"look" + -0.296*"call" + -0.279*"enjoy" + 0.259*"team" + 0.249*"sorri"	Customer service	Social	-0.436*"thanksbmw_uk" + 0.377*"pleas" + -0.306*"happi" + 0.293*"hear" + 0.266*"team"	Customer service	Social
9	-0.315*"look" + -0.268*"call" + -	Customer service	Social	-0.420*"get" + -0.357*"thank" + 0.318*"pleas"	Customer service	Social

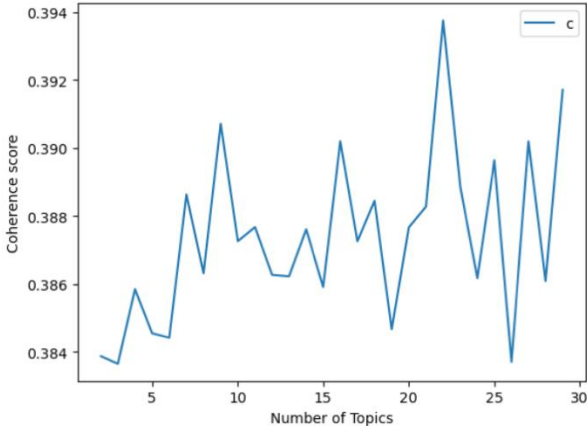
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	0.255*"relat" + 0.250*"enjoy" + 0.244*"pleas"			+ -0.309*"touch" + 0.211*"detail"		
10	'0.417*"team" + 0.328*"hear" + - 0.323*"call" + - 0.314*"thank" + - 0.312*"learn"	Customer service	Social	0.455*"hear" + 0.430* "happi" + -0.213*"team" + 0.203*"receiv" + 0.193* "great"	Customer service	Social
11	-0.396*"avail" + - 0.331*"thank" + 0.302*"look" + - 0.241*"vehicl" + 0.227*"learn"	Customer service	Social	-0.398*"get" + 0.300* "help" + 0.296*"look" + - 0.256*"happi" + 0.242* "find"	Customer service	Social
12	0.507*"thank" + 0.324*"learn" + - 0.269*"sorri" + - 0.253*"enjoy" + 0.233*"experi"	Customer service	Social	-0.381*"servic" + -0.303* "detail" + -0.281*"contact" + 0.256*"centr" + 0.241* "receiv"	Customer service	Social
13	'0.404*"avail" + - 0.360*"thank" + 0.289*"learn" + - 0.265*"hear" + 0.236*" vehicl"	Customer service	Social	'0.678*"info" + -0.504* "inform" + -0.220*"happi" + -0.176*"help" + 0.149* "detail"	Customer service	Social
14	0.437*"bmwmoto rsport" + 0.397* "bmwgroup" + 0.288*"great" + - 0.287*"enjoy" + - 0.202*"thank"	Customer service	Social	'0.598*"servic" + 0.277* "thank" + 0.256*"vin" + 0.233*"receiv" + -0.222* "pleas"	Customer service	Social
15	0.579*"drive" + 0.466*"ultim" + 0.219*"experi" + -0.172*"relat" + - 0.160*"bmwmoto rsport"	Promotion	Economic	-0.439*"find" + -0.400* "detail" + -0.245*"sorri" + 0.231*"team" + -0.215* "get"	Customer service	Social
16	0.408*"brake" + - 0.356*"hear" + 0.266*"thank" + - 0.194*"care" + 0.171*"build"	Customer service	Social	-0.486*"detail" + -0.410* "great" + 0.346*"inform" + -0.202*"welcom" + 0.188 * "contact"	Customer service	Social
17	-0.301* "bmwgroup" + - 0.275* "bmwmotorsport" + 0.255*"call" + - 0.251*"experi" + 0.230*"hear"	Customer service	Social	-0.416*"thank" + -0.385* "sorri" + 0.220*"vin" + 0.212*"get" + 0.204* "disappoint"	Customer service	Social
18	-0.371*"brake" + -0.244*"great" + 0.207*"call" + -	Customer service	Social	-0.316*"recommend" + 0.291*"vin" + 0.253*	Customer service	Social

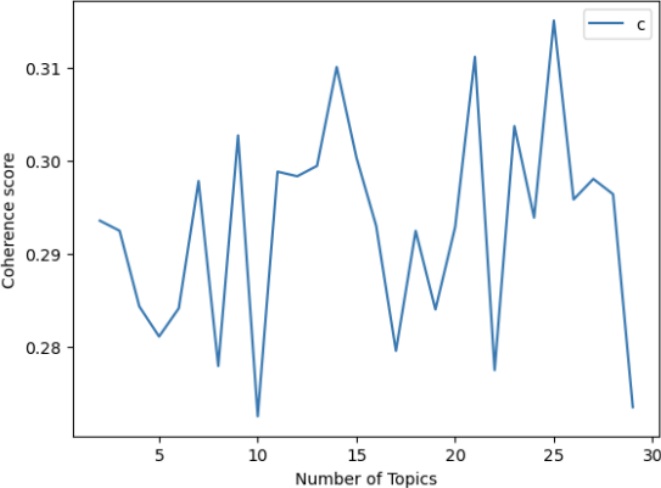
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	0.185*"hear" + - 0.184*"directli"			"team" + 0.246*"find" + - 0.237*"stay"		
19	-0.493*"assist" + -0.362*"great" + - 0.267*"contact" + 0.164*"detail" + 0.156*"care"	Customer service	Social	'0.405*"contact" + 0.357 *"best" + -0.325*"anyth" + 0.260*"look" + 0.250* "help"	Customer service	Social
20	-0.354*"send" + - 0.342*" great" + - 0.256*"detail" + - 0.219* "bmwusacaresbm wusacom" + - 0.218*"custom"	Customer service	Social	'0.549*"best" + 0.297* "seri" + -0.273* "recommend" + - 0.219*"contact" + 0.187*"servic"	Customer service	Social
21	-0.479*"great" + 0.263*"assist" + 0.257*"brake" + 0.204*"learn" + 0.202*"experi"	Promotion	Economic	'0.323*"contact" + 0.313* "find" + -0.261* "best" + - 0.233*"hear" + 0.228* "stay"	Customer service	Social
22	'-0.526*"love" + - 0.281*"get" + - 0.249*"itbmwusa " + 0.228*"experi" + -0.228*"go"	Promotion	Economic	-0.344*"anyth" + -0.338 *"contact" + 0.290*"hope" + -0.226*"know" + -0.212 *"let"	Customer service	Social
23	'0.304*"coup" + 0.289*"seri" + 0.211*"assist" + 0.206*"love" + - 0.190*"avail"	Promotion	Economic	-0.390*"seri" + 0.388* happen" + 0.263*"inform" + -0.258*"recommend" + - 0.245*"vin"	Customer service	Social
24				'0.588*"seri" + 0.285* "inform" + -0.247*"vin" + -0.178*"stay" + 0.173 *"littl"	Customer service	Social
25				'0.314*"recommend" + - 0.254 * "team" + 0.220 *"happen" + -0.215 *"know" + 0.204*"thank" -0.563*"know" + -0.436* "let" + 0.309*"anyth" + 0.228*"feel" + 0.204* "way"	Customer service	Social
26				-0.563*"know" + 0.436* "let" + 0.309* "anyth" + 0.228* "feel" + 0.204* "way"	Customer service	Social

BMW US consumers:



BMW UK consumers:



A15 Digital appendix

Link to digital appendix:

<https://syncandshare.lrz.de/getlink/fiLfGnuX5RLbbrCwxEkCeJ/>