Predictors of faculty sentiment on their transition to online teaching

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Introduction

- Data collected from national survey of physics faculty – 662 participants, 364 open-ended responses
- Answers to 21 survey questions used as data, covering a range of topics:
  - Participants' position, institution, department, and teaching loads (7)
  - Prior experience with online instruction (1)
  - Preparation and transition to online instruction (7)
  - Comfort in teaching (5)
  - Open-ended response (1)

Research Questions

1. What is the overall sentiment of participants' experiences during their transition to online teaching?
   • Perform sentiment analysis

2. Can participants' answers to survey questions be used to predict the sentiment of their experiences?
   • ~~Train a machine learning model to generate sentiment score predictions using participants' answers to other survey questions~~
   • Using multiple lexicons, use statistics to look for correlations between response sentiment and answers to other survey questions

Sentiment Analysis

Sentiment scores found for four lexicons:

- TextBlob (Python)
- Sentiment Analysis (R)
- Sentimentr (R)
- Afinn (R)

Sentiment scores range from -1 to 1

Each lexicon scores words differently, and finds accuracy by comparing against reviews for products, movies, etc. – no single method

Sentiment means vary:

Textblob: 0.1008746

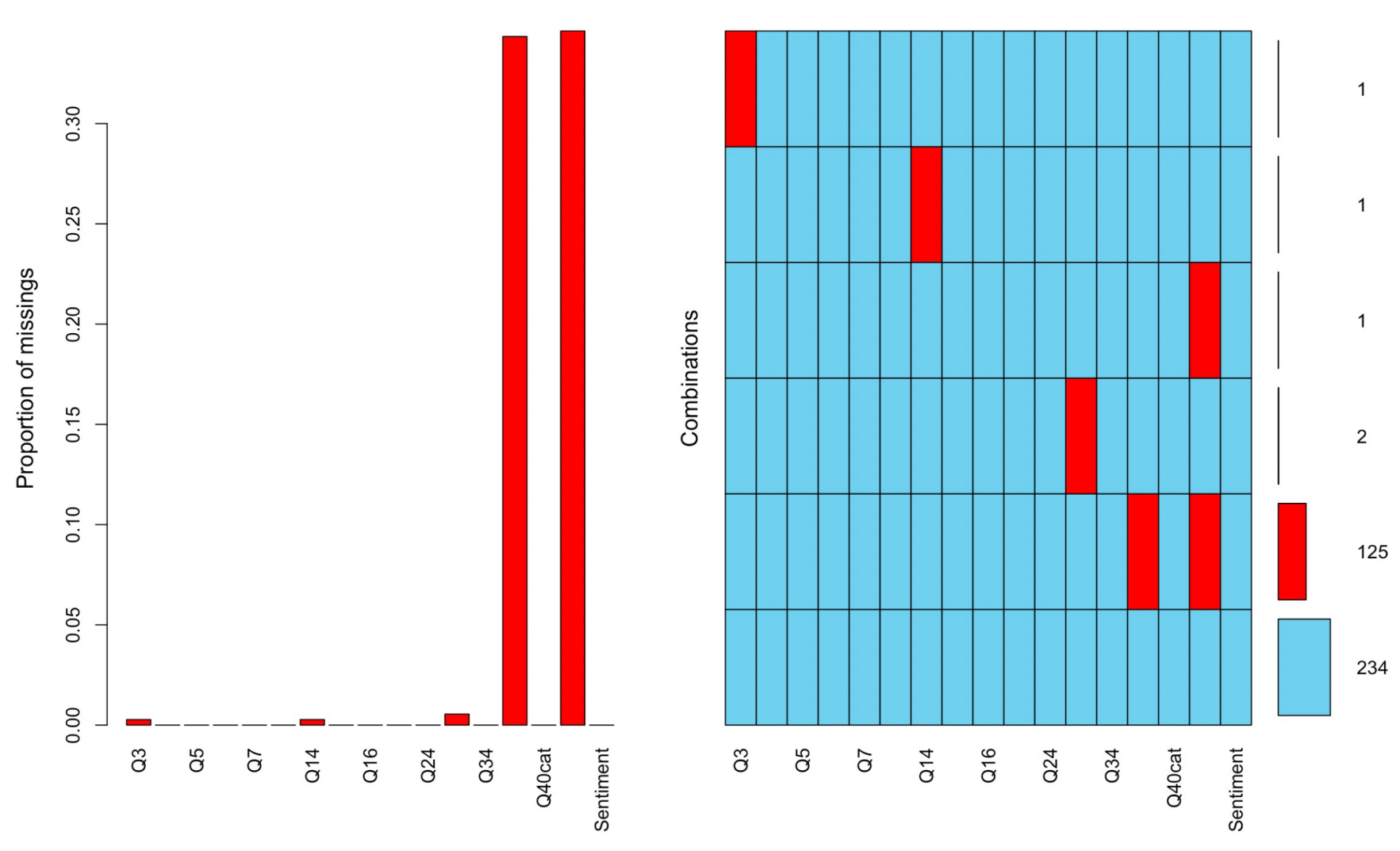
Sentiment Analysis: 0.05100887

Sentimentr: 0.05800111

Afinn: -0.08104395

Sentiment is subjective, and to date there is no lexicon for qualitative work in physics

Visualizing data “missingness”



Missing data

Questions 40 and 41 had the most missing values – random or not?

As it turns out, not random at all!

Missing values for question 40 (job type) imputed with a “random forest” method.

Since the values are categorical, imputed values were rounded.

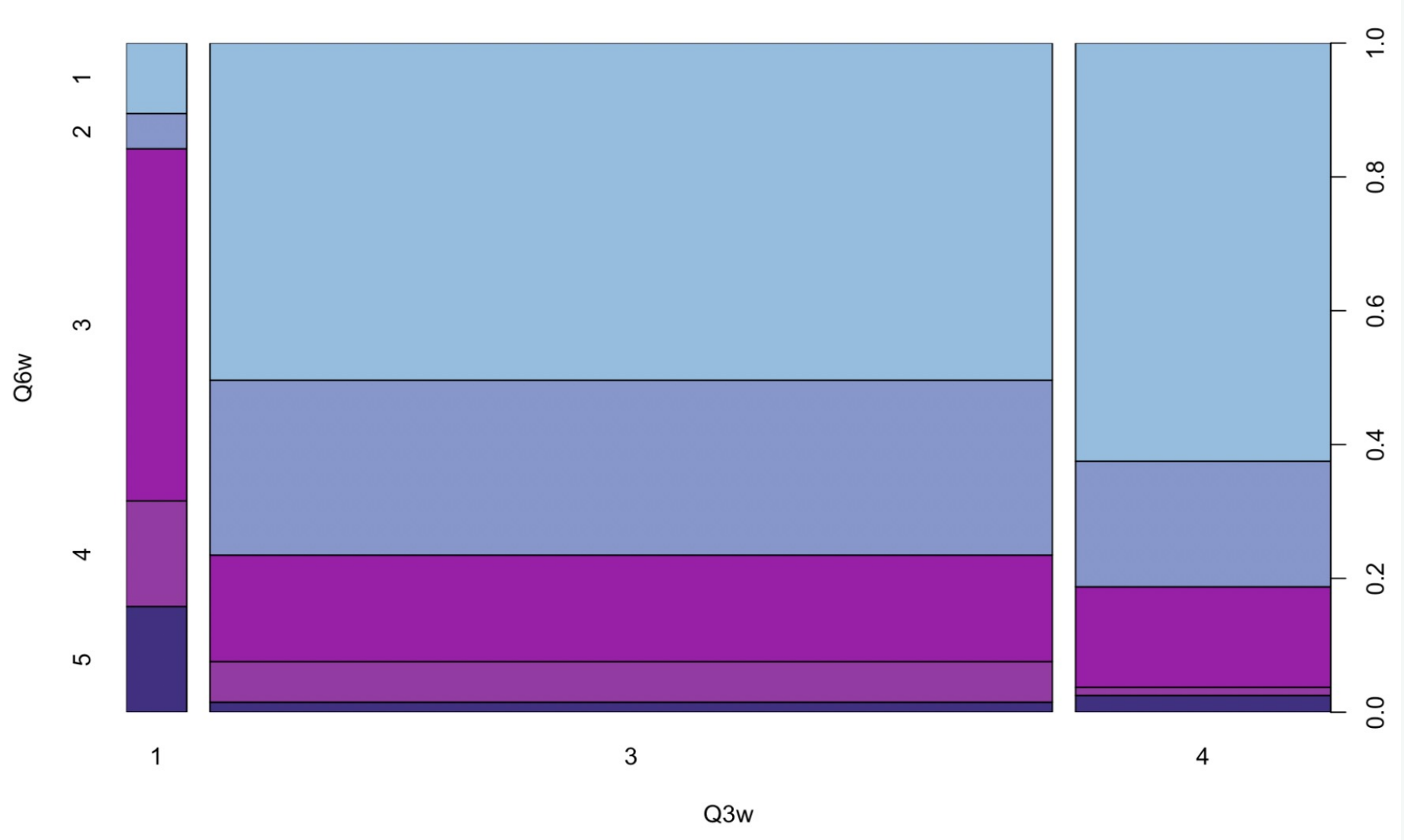
Question 41 (job security) harder to impute, and was excluded from analysis.

Visualizing data

Interesting to visualize combinations of answers to various questions, such as:

“Did more participants from four year public universities have higher teaching loads than four year private universities?”

Visualizing combinations of answers



Data handling

Random IDs assigned to each participant

Questions with multiple answers per participant separated; each answer given its own column – 66 total variables to analyze against sentiment scores

Variable selection

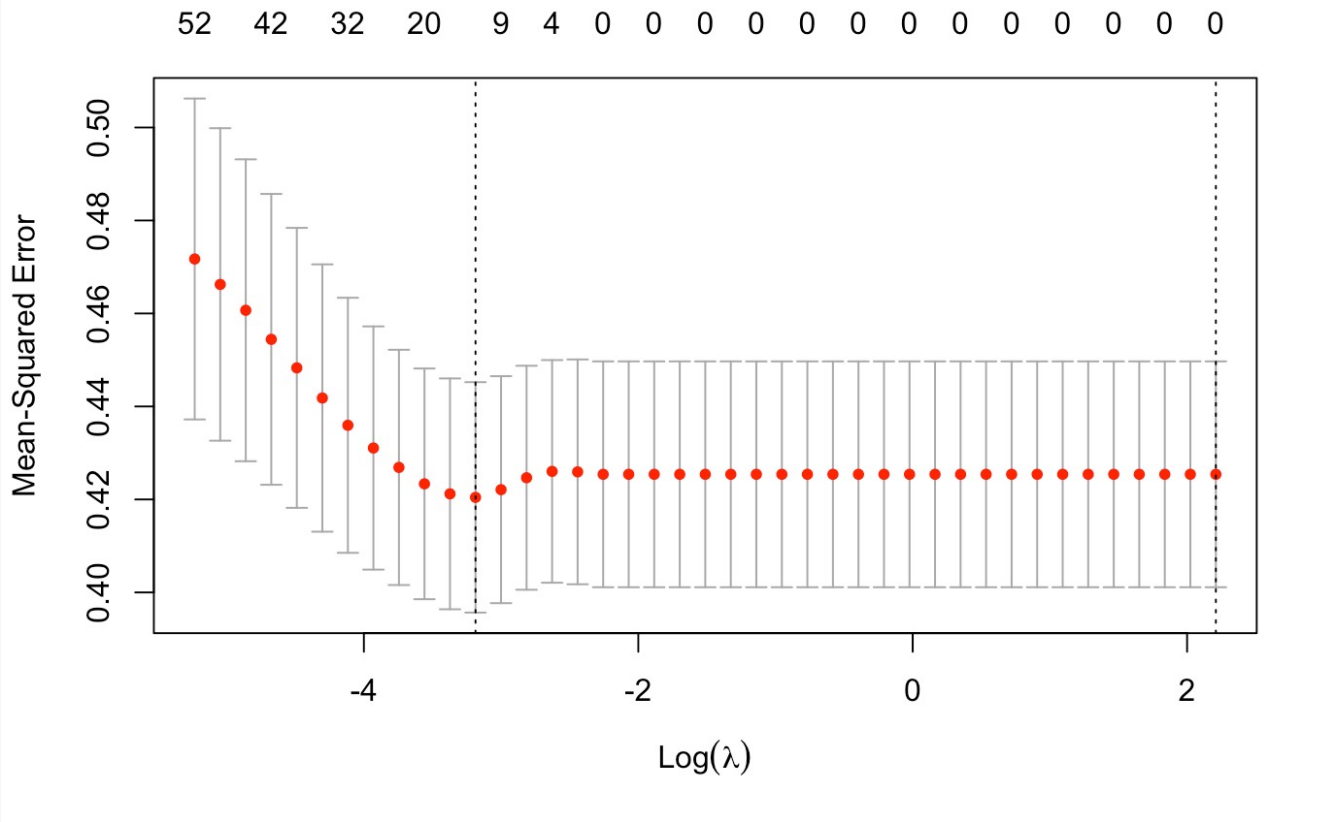
LASSO regularization – how many variables are actually needed

Run for all four sentiment lexicons, 10-fold lasso cross validation

Only Sentiment Analysis and Afinn sentiments appear to have a mean squared error minimum, none for TextBlob or sentimentr

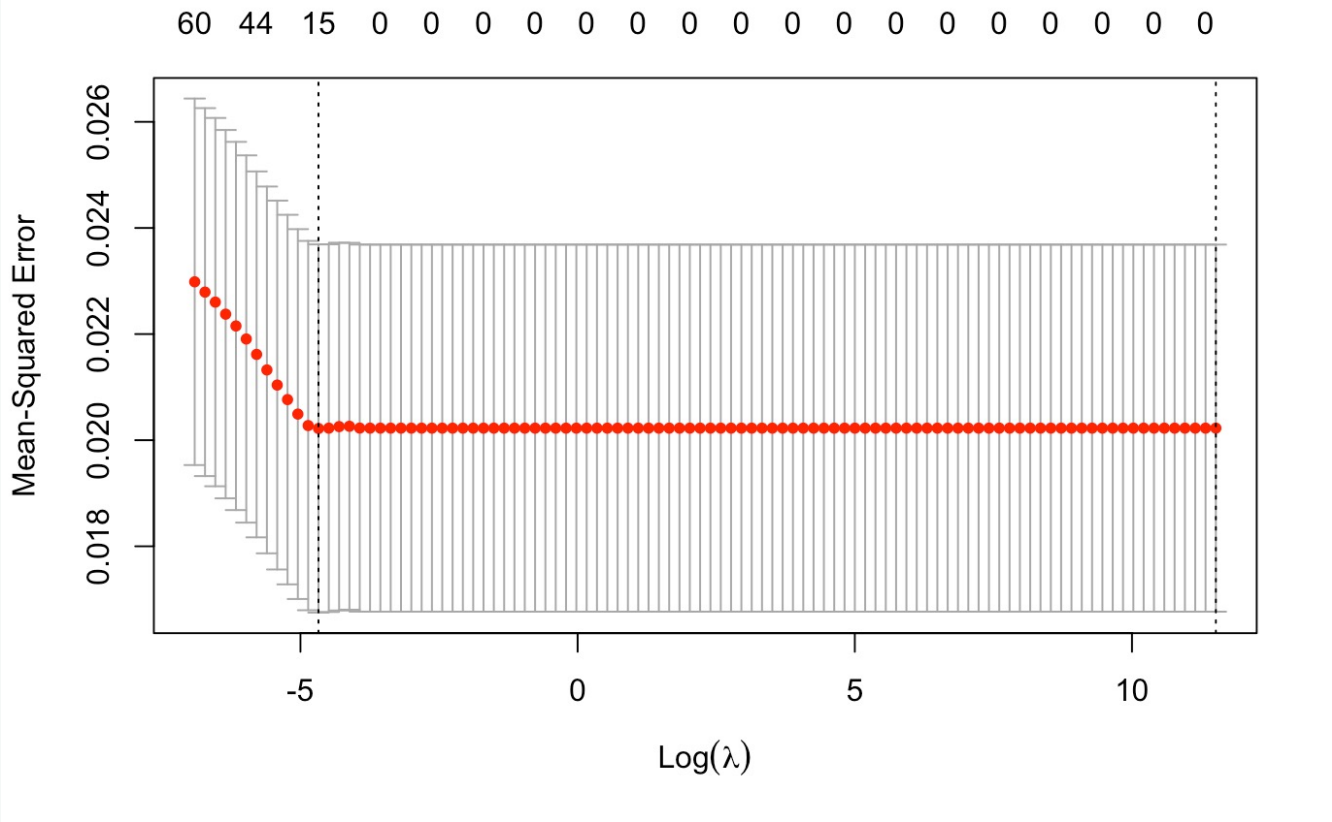
Variable selection

Afinn lexicon



Variable selection

Sentiment Analysis lexicon



Variable selection

Afinn lexicon

lambda	s0	s1	s2	s3	s4	s5	s6	s7	s8	s9	s10
intercept	-9.11E-17	-0.003485282	-0.02819502	-0.05964359	-0.08788799	-0.1050855	-0.1099608	-0.1135272	-0.1144874	-0.1157896	-0.1222801
Q5.1	0	0.02079742	0.04075765	0.05965782	0.0768857	0.09136173	0.1020355	0.1121599	0.1222627	0.1315073	0.1402971
Q5.2	0	0	0	0	0	0	0	0.01517272	0.06024262	0.1014108	0.1398752
Q16	0	0	0.006245848	0.01268871	0.0184534	0.02335023	0.02763322	0.03149389	0.03475492	0.03771531	0.04035684
q17_1	0	0	0	0	0	0	0	0	0	0.000639838	0.008433493
q17_3	0	0	0	0	0	0	0	0.00451268	0.01023969	0.01522941	0.01853525
q17_6	0	0	0	0	0	0	0.0130765	0.02722022	0.04067007	0.053045	0.06585819
q17_7	0	0	0	0	0.007510585	0.03777449	0.06489466	0.0910229	0.1166844	0.1398142	0.1591142
q17_10	0	0	0.01341676	0.03958822	0.06345462	0.08589155	0.106485	0.1238979	0.1403861	0.1554149	0.1691186
Q24.2	0	0	0	0	0	-0.002300569	-0.01502681	-0.02583362	-0.03469025	-0.0427886	-0.05016441
Q24.4	0	0	0	0.01307364	0.02598344	0.04182023	0.05659937	0.0693548	0.08080366	0.09122427	0.09993491
Q24.9	0	0	0	0	-0.00455696	-0.02447612	-0.04391146	-0.0612655	-0.07701026	-0.09118303	-0.1023471
q25_3	0	0	0	0	0	0	0	0	0	-0.003375581	-0.03590584
q26_3	0	0	0	0	0	0	0	0	0.02778694	0.05539439	0.09199913
Q30_3	0	0	0	0	0	-0.002798655	-0.006638355	-0.009928124	-0.01279464	-0.01543362	-0.01798818
Q34	0	0	0	0	0	0	0	-0.001218457	-0.004065323	-0.006632211	-0.008736766

Variable selection

Sentiment Analysis lexicon

lambda	s0	s1	s2	s3	s4	s5	s6	s7	s8
intercept	-8.40E-18	-0.000307661	0.002074333	0.007556904	0.0119974	0.01724123	0.02155867	0.0207927	0.01902927
Q5.0	0	0	0	-0.002282609	-0.004098775	-0.005580135	-0.006509172	-0.007231049	-0.007385571
Q5.1	0	0	0	0	0.001274713	0.002887337	0.004553336	0.00604295	0.007761133
Q5.5	0	0	0	0	0	0	0	0	0.00137487
q8_2	0	0	0	-0.006036962	-0.01209546	-0.01766113	-0.02254458	-0.02710897	-0.03143964
Q16	0	0	0	0	0	0	0	0.000587265	0.001307588
q17_5	0	0.009332387	0.01769853	0.02545601	0.03256718	0.03892337	0.04482097	0.04985744	0.05428014
q17_7	0	0	0	0.004442248	0.01266468	0.01998524	0.02610387	0.03121788	0.03606552
q17_10	0	0	0	0	0	0	0	0.002479577	0.006197088
Q24.2	0	0	-0.000887244	-0.004298779	-0.007297072	-0.0101464	-0.01293049	-0.01536684	-0.01757331
Q24.4	0	0	0	0	0	0	0.002451194	0.004990475	0.007301695
Q24.7	0	0	0	0	-0.000328501	-0.004935311	-0.009558928	-0.01381861	-0.01753196
q25_2	0	0	0	0	0	-0.001655736	-0.006292815	-0.01065686	-0.01455297
Q30_3	0	0	-0.001020441	-0.002066727	-0.002957189	-0.003546192	-0.004153942	-0.004774188	-0.005410001
Q31_3	0	0	0	0	0	-0.000605856	-0.001320856	-0.002032923	-0.00262848
Q32_4	0	0	0	0	0	0	0	0.000805803	0.001506787

Variables in common

Q5.1: Minority-serving institution

Q16: Preparation time before transition to online

Q17.7: Institution's own school of education

Q17.10: Social media use for guidance (Twitter)

Q24.2: Grading changes - pass/fail options

Q24.4: Grading changes – reducing/eliminating penalties for late work

Q30.3: Anxiety

What's next?

Look at how the selected variables for the two lexicons affect prediction of sentiment

Thank you!

References

J. M. Aiken, R. D. Bin, H. J. Lewandowski, and M. D. Caballero, *A framework for evaluating statistical models in physics education research* (2021), 2106.11038