

**Bills 1:**

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**Defending Civil Liberties By Predicting Arizona Legislative Outcomes****Executive Summary:**

As state legislatures across the U.S. convene, they introduce numerous new bills on a variety of topics, including some that might affect the rights of marginalized groups. The American Civic Protection Association (ACPA) focuses on protecting these groups from laws that could harm their civil liberties. Currently, ACPA reacts to laws through advocacy and legal action after they are passed. Because this is a more reactive strategy, it creates challenges for protecting vulnerable groups from any negative impacts of these bills and can be highly resource-intensive. ACPA desires to become more proactive by identifying potentially harmful bills earlier in the legislative process. However, they face resource constraints due to the costly nature of their interventions.

Using comprehensive legislative data, our approach sought to improve upon this system and offer a more proactive approach. The primary goal was to improve efficiency so that ACPA could better target their advocacy and legal efforts. We compared the use of machine learning methods to those ACPA could use today on their own. We found that ACPA could do a decent job of identifying the bills that are most likely to pass simply by looking at which bills have the most events. The performance of this baseline was just barely behind our best-performing machine learning model. The baseline offers ACPA an opportunity to improve their advocacy efforts without machine learning, but at the cost of remaining relatively reactive.

Due to Arizona's interesting legislative structure, there is no legislative action after June. This highlights a potential need for prioritizing efforts towards the beginning of the year so that ACPA can achieve its goal of proactive advocacy. Because of time limitations, we were unable to definitively evaluate whether or not a bill is relevant to ACPA. We were able to capture whether a bill mentions relevant terms, but this does not account for the frequency of terms or sentiment of the legislation. This leaves room for further exploration and the use of more advanced natural language processing methods. However, while these methods are explored, ACPA should consider utilizing the baseline method of examining the number of bill events to rank bills and guide their advocacy efforts.

## **Background and Introduction:**

At the start of state legislative sessions throughout the United States, a wide array of new legislation is introduced, covering topics ranging from serious immigration reform to a simple decision such as renaming a street. While the U.S. constitution safeguards specific rights for citizens, legislative actions often take aim at marginalized communities, impinging on their rights and detrimentally affecting their welfare. In 2010, for example, the Arizona state legislature passed the “Support Our Law Enforcement and Safe Neighborhoods Act”, allowing police to investigate an individual’s immigration status on the basis of “reasonable suspicion”<sup>1</sup>. It was one of the broadest and strictest immigration laws of its time, and it faced significant legal challenges from civil rights groups. Furthermore, it led to significant racial profiling and created chaos for immigrant families in Arizona. The American Civic Protection Association (ACPA) is dedicated to safeguarding these vulnerable groups by contesting the approval of such bills that encroach upon individuals’ civil liberties.

ACPA's current approach is mainly reactive: they initiate legal and advocacy efforts once a restrictive bill has been enacted, which may involve legal challenges in court or campaigns addressing pertinent policy concerns. However, ACPA aspires to adopt a more proactive strategy by tackling legislation before it becomes law and before vulnerable groups are impacted. Nevertheless, they encounter limitations in terms of capacity, as comprehensively reviewing each bill to determine its relevance to their mission is time-consuming. Furthermore, they currently lack a method of understanding which bills are most likely to pass. Every state introduces thousands of bills each session, and these bills undergo multiple rounds of voting and amendments before becoming law. As ACPA's state affiliates can only focus their advocacy and legal preparations on roughly 15% of the bills introduced in a legislative session, ACPA aims to pinpoint bills with higher prospects of passage.

This strategy would reduce the likelihood that bills infringing on civil rights are passed into law, harming vulnerable groups. Such an approach is crucial for ACPA as it prevents them from expending effort on bills that are unlikely to pass while enabling them to concentrate their resources on bills that could potentially become law. Ultimately, this would help the ACPA identify and legally contest problematic legislation more effectively.

A primary goal of this work is to effectively avert the approval of bills that could infringe upon the freedom of vulnerable populations and safeguard the civil liberties of these marginalized groups. This goal aligns with ACPA's mission to identify and challenge dangerous legislation. However, due to constraints related to knowledge, data availability, and timing, identifying relevant bills may pose challenges, as the ultimate decision rests with ACPA's legal

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<sup>1</sup> (Newman, P. (2017). Arizona's Anti-Immigration Law and the Pervasiveness of Racial Profiling. *Georgetown Immigration Law Journal*, 31(3).

staff. Another goal pertains to efficiency, specifically supporting ACPA's lobbying and legal endeavors to enhance the likelihood of successful challenges focusing on the relevant bills in their 15 percent. This could streamline ACPA's legal advocacy and deter the passage of troublesome legislation, although the measure of their current efficiency rates is unknown. In pursuit of protecting the rights of vulnerable populations, an equity goal emerges: ensuring equitable protection of civil liberties for different types of vulnerable groups in the U.S.

From these goals, there are policy impacts that may arise. First, by predicting which bills are likely to pass, ACPA can better prepare for and challenge such legislation, potentially leading to more successful advocacy outcomes. In terms of resource allocation, our goals would result in the efficient allocation of ACPA's resources towards bills that pose the greatest threat to civil liberties. Lastly, ensuring broader protection and a more equitable focus by valuing those bills that are civil rights bills allows us to look into how we may be directly impacting individuals' civil rights.

It is important to acknowledge that not all of these goals can be simultaneously achieved, and trade-offs will be inevitable. A focus on identifying bills most likely to pass may lead to the allocation of resources towards bills that pose no real threat, thereby failing to assist the ACPA in effectively distributing their resources or defending citizens' rights. Concentrating solely on efficiency may risk sidelining ACPA's core mission, which is to safeguard civil liberties. However, an emphasis on effectiveness and equity may compromise the performance of the product. At present, ACPA seems to lack a mechanism to bolster its efficiency, effectiveness, or equity in allocating legal resources to challenge problematic legislation, as far as we comprehend. Their advocacy efforts cannot encompass all bills, and they cannot guarantee the success of their endeavors. While ACPA can independently identify bills relevant to their advocacy, predicting which bills are most likely to pass remains beyond their capabilities. Consequently, given the constraints of limited resources and the aspiration for quantifiable outcomes, our group will pursue the efficiency goal by predicting bills with higher chances of passage, acknowledging that identifying relevant bills may pose challenges. By predicting which bills are most likely to pass, ACPA could target a subset of bills to prevent their approval, ultimately preserving citizens' civil liberties.

#### **Related Work:**

There have been several similar organizations to the ACPA, with the goal of protecting civil liberties through working with legislatures and communities. One such organization is the American Civil Liberties Union. It is an organization that works daily in courts, legislatures, and communities to defend and preserve the individual rights and liberties that the Constitution and laws of the United States guarantee to everyone in this country. This organization and those similar are nonprofit, nonpartisan, and appear before the United States Supreme Court more than any other organization except the U.S. Department of Justice. About one hundred ACLU staff

attorneys collaborate with about two thousand volunteer attorneys in handling close to two thousand cases annually.<sup>2</sup> They also communicate with and inform the public about various civil liberties issues, including AIDS, capital punishment, lesbian and gay rights, immigrants' rights, prisoners' rights, reproductive freedom, voting rights, women's rights, and workplace rights. Similar to the ACPA, the ACLU cannot take on every worthy case, and they usually select lawsuits that will have the greatest impact, cases that have the “potential for breaking new ground and establishing new precedents that will strengthen American freedoms.”

In terms of machine learning (ML) work, there does seem to be ML work in the area of civil liberties and human rights. One such work is from Carnegie Mellon University in E-Lamp (Event Labeling and Media Processing), which can help human rights practitioners filter enormous amounts of media in order to find the most relevant images with which to build their case.<sup>3</sup> However, the sheer volume of content being recorded and shared means that the number of videos human rights practitioners are able to gather is outpacing their ability to review them. “One of the key elements of E-LAMP is that it allows you to train classifiers to look for exactly what you want them to look for. You could specify “helicopter in the sky” and “explosion,” and the system will find videos that fit that criteria,” says one of the researchers. Our work compares to these related works in that we will support the ACPA through using ML to identify bills that have a higher likelihood of passing into law, whereas other work has been done by focusing on what has generated the most advocacy, or for slightly different focuses. Our work will be able to prioritize the targeting of advocacy and legal efforts and will focus on action in the state of Arizona. We will be examining several ML models and will make recommendations to help the ACPA re-strategize their efforts.

## **Problem Formulation and Overview of Solution**

The problem we would like to solve is: at the end of every month, for each bill introduced in the state of Arizona within the current session year (that has not yet passed or been vetoed), can we identify the 15% of bills with the highest likelihood of passing into law by the end of the session to prioritize targeting of advocacy and legal efforts? This predictive approach is crucial for focusing efforts on legislative measures that have the most significant potential impact on civil liberties.

In an ideal scenario, the analysis would first filter out bills that infringe on civil liberties before assessing their likelihood of passage. However, current data limitations and the lack of a concrete method to identify such bills makes this approach less feasible. Due to these limitations,

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<sup>2</sup> “ACLU History.” *American Civil Liberties Union*, [www.aclu.org/about/aclu-history#3](http://www.aclu.org/about/aclu-history#3). Accessed 11 Dec. 2023.

<sup>3</sup> “Machine Learning Tool Helps Human Rights Workers Seek Justice.” *Carnegie Mellon University's Heinz College*, [www.heinz.cmu.edu/media/2019/December/machine-learning-tool-helps-human-rights-workers-seek-justice](http://www.heinz.cmu.edu/media/2019/December/machine-learning-tool-helps-human-rights-workers-seek-justice). Accessed 11 Dec. 2023.

the project will concentrate on identifying bills that are most likely to pass. This approach, while not directly identifying bills that infringe on civil liberties, is still a significant step toward optimizing ACPA's resource allocation. When formulating our solution, we will be predicting on bills that have been introduced this session and not yet passed or vetoed. The outcome: whether or not the bill passes by the end of the session is 1 (bill passes) or 0 (bill does not pass). The information we will be working with will be varied across time intervals while we explore bill lifecycle, bill sponsor information, and bill topics. Overall, we want to identify the 15% of bills that are most likely to pass in a particular session, understand what features may make a bill more/less likely to pass, and know what bills infringe on citizens' civil liberties. Our modeling approach and further details of our solution will be discussed later in the report.

## **Data Description**

The data for the project is provided by LegiScan, an organization that collects and disseminates data about national and state level legislation and legislative processes that is publicly available. This provided database contains legislative session and bill data for the last 10 years. The nine interconnected datasets are:

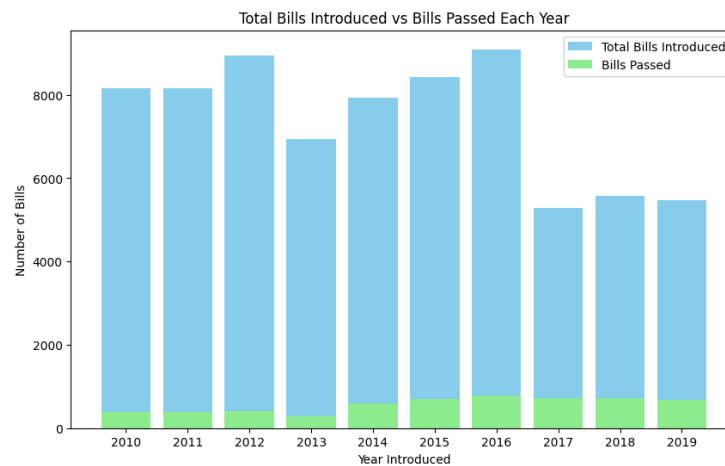
1. bills: This table contains information on bills, including bill\_id, session\_id, bill\_type, and introduced\_body. It records data for bills introduced in a state per session.
2. bill\_votes: This table records the voting process of bills in each legislative chamber. Each bill may undergo multiple votes, possibly due to various reasons, such as proposed amendments.
3. bill\_texts: This table holds descriptive data about the bills themselves.
4. bill\_sponsors: This table contains data on bill sponsorship, including bill\_id, party\_id, and sponsor\_type.
5. bill\_progress: This table records bill\_status on each progress\_date for a bill.
6. bill\_events: This table includes the event\_date and chamber for each bill, as well as whether the event is important or not.
7. bill\_amendments: This table contains information about amendments a bill has been through and whether the bill has adopted the amendment or not.
8. sessions: This table includes session-related data, such as session\_id, year\_start, year\_end, state\_id, and special indicators. Special sessions are noted. Fewer bills are introduced during special sessions, with a higher passage rate.
9. sessions\_people: This table calculates the number of congresspersons from each political party.

### *Initial EDA:*

The bill\_status column in the bill\_progress table has informed us to choose our label of each entity (bill) to be passed or not. While there is a status reflecting that a bill was “reported

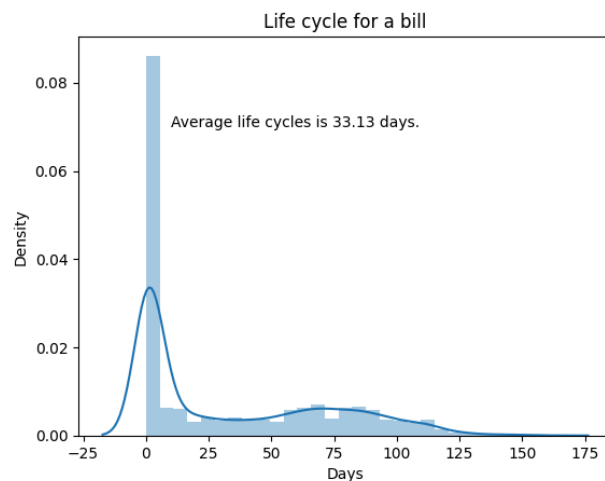
passed," we chose to use the "pass" label (bill status = 4). Even though a bill is reported to pass (bill status = 10), there is still time to prevent its official passage through the governor's veto power. We examined the percentage of a bill's passage of all the bills introduced each year in Arizona to get a general idea of the base rate. Figure 1 highlights the large amount of bills introduced each year and the small proportion of those that pass each year.

**Figure 1:** *Total Bills introduced vs Passes Each Year*



To identify the cohort of our problem, the model training and validation sets, and also the model update frequency in our following steps, we also checked the life cycle distribution of bills to avoid omission of bills; the average life cycle of a bill tends to fall around thirty days (Figure 2).

**Figure 2:** *Life Cycle for a Bill*



## **Baseline Approach**

Prior to delving into a machine learning solution, we considered what the ACPA could do currently to determine which bills might be more likely to pass. Three different approaches emerged: ranking bills based on the number of sponsors, the number of amendments, and the number of events the bill goes through. For the bill sponsor approach, we felt that a larger number of sponsors could indicate the bill has more support and thus would be more likely to pass. A similar approach could be used for the number of bill amendments and bill events; as the bill moves through the legislative process, the more likely it is to pass because it is refined (through amendments) or simply approved by committees and voted on (bill events). However, it is important to note that because the ACPA is committed to safeguarding civil rights, they likely prefer an early indicator; the bill events and bill vote session methods are not early indicators.

## **Machine Learning Approach**

Before deciding which machine learning models to use, we first established how we would evaluate our models. We decided to use precision at fifteen percent. The decision to focus on the top fifteen percent comes from ACPA's capacity constraints: they can only offer advocacy and legal action for fifteen percent of the bills introduced in a session. The two primary evaluation metrics that could have been used were precision and recall. In this scenario, precision refers to the rate of bills we predicted would pass that actually pass by the end of the session. Recall, on the other hand, refers to the rate of bills that we correctly identified as passing within the session. To reduce the rate of false positives, or bills that are falsely identified as passing, precision is the preferred metric. To reduce the rate of false negatives, or bills that are falsely identified as not passing, recall is the preferred metric. As mentioned previously, our primary goal is efficiency; ACPA's legal and advocacy efforts are extremely time consuming. If we falsely identify a bill as passing that is not actually going to pass, those are valuable efforts wasted that could have otherwise gone to a more relevant bill and prevented a dangerous piece of legislation from passing into law. Therefore, the metric of focus in this scenario is precision at fifteen percent.

A core goal of machine learning is to create models that are generalizable to unseen data. To ensure this, we must routinely test the models on information they have not yet seen, in this case, bills and information about those bills. To do this and to ensure that the models do not leverage information from the future to make their current predictions, we used a particular temporal validation method. We specifically allowed our models to leverage all of the information available up until the test date. Because Arizona sessions are on a yearly basis, we needed a full year from the test date to ensure we captured the final label for the bill. Although our formulation reflects monthly predictions, we are only updating and testing our model every three months. This is because there are not dramatic changes to the data on a monthly basis. In

the end, there were a total of about twenty-eight different train/test splits. However, in the structure of our data, there is a lack of legislative action in the latter half of the year (June through December). Because of this, there was only one month in our test sets with positive labels (March). Therefore, we could only look at the test results from March in each of our validation splits.

Before building any models, we first needed to build features. Initially, the features built only captured the movement of bills (total number of events, total number of important events, number of amendments, days since last event, etc.) and bill sponsor information (the total number and number of sponsors from each party). However, we also sought a way to identify whether or not the bill was relevant to ACPA. Therefore, we used a naive approach to determine the topic of the bill and whether or not it was a civil rights bill. The primary focus areas of ACPA are listed on their website, and we created a binary flag for each of these topics. The topics range across domains such as immigration, women's rights, disability rights, LGBT rights, and several other areas. The criteria to determine whether the bill pertained to these topic areas was simply whether the bill mentioned any of ACPA's focus areas at all (or a related word). For example, if a bill mentioned the words "immigrant," "immigration," "immigrants," etc., it was flagged as an immigration bill. The full range of features created can be found [here](#).

In terms of machine learning models, we tested a variety. We investigated the performance of various classification models such as scaled logistic regressions, decision trees (mostly as a sanity check on whether or not our model set-up was functioning properly), random forests, and gradient boosting classifiers. We began with a larger grid of hyperparameters and slowly narrowed down the grid based on which hyperparameter combinations provided the best average performance across validation splits. Figure 3 reflects the performance over time of the top five models (based on average precision across all train/test splits).

## **Model Evaluation**

Generally, for all models we examined, the performance appeared to increase over time; for the majority of models, there was a slight decrease in performance during 2016 (Figure 3). Again, in the context of this problem, we are utilizing precision as our primary evaluation metric, which refers to the proportion of bills we correctly identified as passing by the end of the session. The model with the highest average performance was the scaled logistic regression with the following hyperparameters: {"C": 0.1, "solver": "saga", "penalty": "l1", "random\_state": 4}. Interestingly, the model with the second highest average performance across all splits was the bill events baseline. Finally, the third-best model was the random forest classifier with the following parameters: {"criterion": "gini", "max\_depth": 25, "n\_estimators": 1000, "random\_state": 4, "min\_samples\_split": 25}. Although the logistic regression had the highest

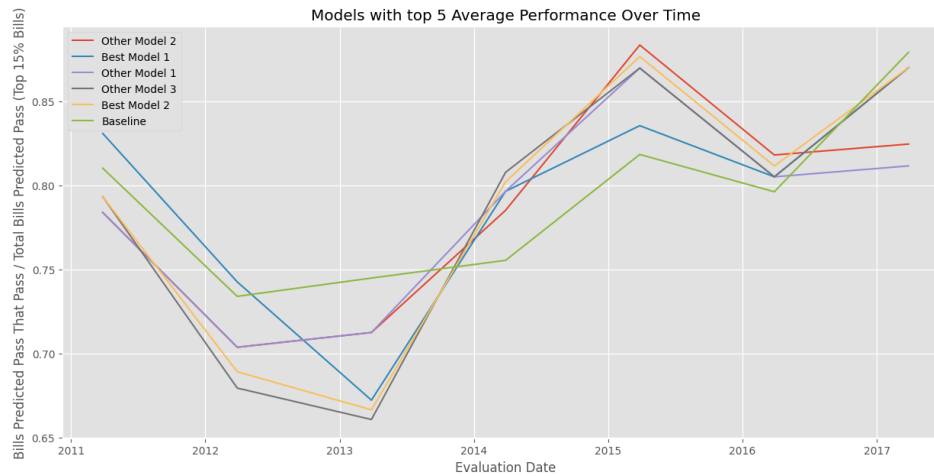


average performance, it was not the highest performing model in the final train/test split (Table 1).

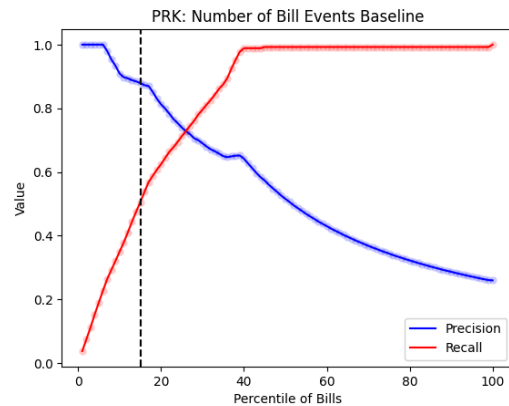
**Table 1: Precision of Best Performing Models**

Model	Average Precision	Precision in Final Train/Test Split
Scaled Logistic Regression	.793	.844
Bill Events Baseline	.791	.871
Random Forest Classifier	.787	.883

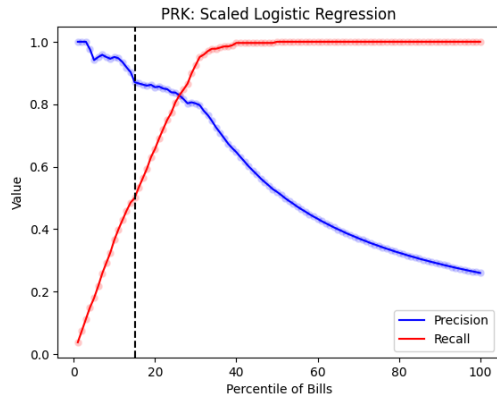
**Figure 3: Model performance over time of top five models (defined by average precision over time).**



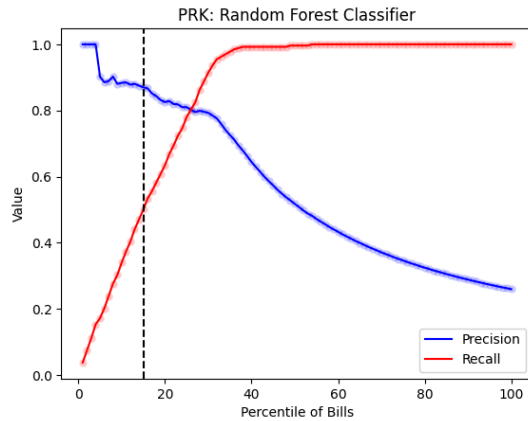
**Figure 4: PRK Graph of bill events baseline, with validation set start time 03-28-2017. The dotted vertical line represents  $k$  of 15%.**



**Figure 5:** PRK Graph of Scaled Logistic Regression with hyperparameters {"C": 0.1, "solver": "saga", "penalty": "l1", "random\_state": 4}, with validation set start time 03-28-2017. The dotted vertical line represents k of 15%.



**Figure 6:** PRK Graph of Random Forest Classifier with hyperparameters {"criterion": "gini", "max\_depth": 25, "n\_estimators": 1000, "random\_state": 4, "min\_samples\_split": 25}, with validation set start time 03-28-2017. The dotted vertical line represents k of 15%.



Figures 4, 5, and 6 demonstrate the tradeoff in performance between precision and recall. Recall in this scenario refers to how many bills we correctly identified as passing out of all the bills that actually pass within a session, while precision refers to the number of bills that we correctly identified as passing within the session out of the bills we predicted would pass. It is clear that trying to maximize both of these simultaneously does not maximize performance on either metric. Furthermore, as the number of bills increases, the results are less confident, and thus the precision also decreases. This is important for ACPA to recognize because if they seek to expand their efforts beyond just fifteen percent of bills, the predictions may not be as strong/confident as they are with the smaller percentiles. On the other hand, if they perhaps lose staff and can only focus on a smaller percentage of bills, they can be even more confident in those predictions.

Because the baseline model only involves one feature—total bill events in the past year—it was the most important feature for that model. Considering the performance of the baseline model, the feature-importance results for the machine learning models were not surprising. The top machine learning model’s most important feature was the number of important bill events in the past month. The number of important bill events in the past six months followed closely behind (Appendix, Section 3.5). Interestingly, the number of bills previously passed by a sponsor was also an important feature for this model. The random forest had similar results for feature importance. However, the random forest’s most important feature was the number of days since the last event, followed closely by the total number of important bill events in the last three months.

The results of these models and their predictions have real-world implications for Arizona constituents. Because of this, it is important to evaluate whether or not the models are biased in some way. Often, when investigating bias in machine learning models, individuals look at how particular demographics, such as race and gender, may be affected differently. However, the demographics of bills do not fall into these traditional categories. Instead, we examined bills that were considered civil rights bills and those that were not considered civil rights bills because we care about protecting individual’s civil liberties. As mentioned earlier, this definition is relatively broad: if a bill mentions any of the ACPA’s primary focus areas at least once, it is considered a civil rights bill. In alignment with our effectiveness goal, the group we focused on protecting was civil rights bills, and our reference group was non-civil rights bills. We did not find a significant disparity in the models’ performance across these groups. However, we do recognize this might be a result of our broad definition of civil rights bills (Appendix Section 5.5).

## **Discussion of Results**

After looking at the results, we found that the bill events baseline performed similarly to our machine learning models. Furthermore, the number of bill events and the number of important bill events were important features for all three of our highest-performing models. This confirms our hypothesis that the more events a bill has, the more likely it is to pass. This is good news for ACPA because it means that they have a relatively solid method of evaluating bill passage without the use of machine learning models. However, the number of bill events is a late indicator and may not be the best method to use in practice if they are seeking to target their lobbying efforts ahead of time and refrain from the reactive strategy they currently use.

In terms of the problem, we found that the legislative structure in Arizona is quite interesting. Although there is a year-long session, there is almost no legislative action in the second half of the year. Although ACPA is likely aware of this, our analysis confirms this. During our training and validation sets, there were never any bills labeled as passing after June.

This highlights the need to prioritize efforts and model performance in the first half of the year, and maybe even sooner than that.

It was interesting to see the performance of the models change over time. Although the baseline model's performance remained relatively consistent, the machine learning models certainly performed better when they had more information to learn from (their performance tended to be higher in the later train/test splits). This suggests that if there was even more data to work with (information before 2011), the machine learning models might have performed better because they had more information to learn from. Although our machine learning models matched the performance of the baseline quite closely, it is evident that a more in-depth modeling approach is necessary. Leveraging more advanced techniques, such as natural language processing, might be beneficial for ACPA to further meet the effectiveness and equity goals outlined at the beginning of this report.

## **Field Trial Design**

When assessing the efficiency of the models, it is crucial to compare the predictions of the models against real-world data. The models built as part of this study are trained on bills introduced in Arizona from 2011 to 2016 and validated against the bills of 2017. We would expect the models to perform similarly in the years to follow. However, the onset of the Covid-19 pandemic in 2020 brought significant changes to the way the world worked. We are interested in understanding the model's performance in predicting the bills that are most likely to pass in later years and validating its predictions against real-world data. Additionally, since ACPA is an organization that operates at a national level, we need to explore how our models can be adopted and applied to different states and at a federal level. Doing so would help us understand the models' broader utility and applications. Another important objective of designing the field trials is to evaluate the effectiveness of the models through the organization's interventions. In the context of this problem, a model would be considered highly effective if it was successful in protecting the civil liberties of minority groups. However, since quantifying this would be difficult, a proxy for the measure of effectiveness could be to verify if the interventions by ACPA (legal, lobbying, and advocacy efforts) led to tangible outcomes in terms of whether the bill in question did not pass or passed with amendments.

Conducting randomized controlled trials to evaluate the effectiveness of the interventions is strongly recommended. Similar bills introduced in the current legislative session would be randomly distributed into treatment and control groups, ensuring balance between the two groups. The treatment group would be subject to the recommended models from this study, while the control group would be subject to the ACPA's current method for identifying bills. ACPA would intervene in the top 15 percent of bills most likely to pass that are identified from both

groups. The outcomes of the interventions would be compared across the groups towards the end of the session.

While in theory, this comparison design should be a causal effect of the intervention, there are caveats to the inferred causality. Ensuring balance and randomization between the groups based on the type of bill, its descriptions, sponsors, etc. is possible. However, accounting for uncontrollable factors like political dynamics and unexpected external factors can be challenging. Secondly, ACPA isn't the only organization invested in advocacy efforts. Certain bills identified for intervention might garner advocacy efforts by other organizations and the public. Not accounting for these factors would impact the direct causality of the intervention.

### **Limitations, Caveats, and Future Work**

The baselines and the machine learning models trained and tested in this study perform well, with the best models' precision crossing 85%. However, there are limitations to these models. First, these models score the bills based on their likelihood of passing and identify the top 15% for ACPA to intervene, which might not be relevant to ACPA or efficient in terms of advocacy efforts. We use a rather naive approach to indicating bill relevance based on the presence of certain keywords. This might not be sufficient for identifying relevant bills. Also, the data used in this study is limited to that obtained from the Legiscan API. Including ACPA's data on advocacy efforts on past bills would help factor in the advocacy efforts. Generating more features to handle the textual nuances in the data would help in narrowing down the bills of interest and relevance to ACPA. Upon evaluating the feature's importance, we understand that further varying time parameters might also yield better results.

Due to the frequency of prediction being every month, we intended to re-train the model every month in the test period. However, due to the large number of train/test splits and the lack of significant changes to our data on a monthly basis, we decided to set the model update frequency to 3 months. As a result, we have only one month (March) in the test sets with tangible results. Again, this is due to the fact that there is a lack of legislative action in the second half of the year, so there are no bills with positive labels (passing) in these months.

The current bias audit is set to examine the disparity in the model performance concerning civil rights bills and non-civil rights bills. As the work progresses to a more concrete definition of civil rights bills, we hope to see a more in-depth bias audit. We would like to further expand the bias audit to measure disparity in bills that are polarizing and garnering largely the sponsorship of the Republicans (who are the state majority). Doing so will allow us to determine whether the political leaning of the bill's sponsors or the bill's contentious nature has any undue influence on the model's predictions. This audit is crucial considering the current political

landscape, where partisan views can heavily influence the legislative process and the impact our predictions will have on Arizona constituents.

### **Policy recommendations:**

The performance of the baseline model and the best models, random forest and scaled logistic regression, are around the same range. Before making a policy recommendation, we wanted to compare the predictions of the models. We found that among the top 15% of the bills predicted by the baseline model, about 40% of them pass in the next day or two, whereas only 25% of them pass after the next 45 days. We also found a 43% overlap between the predictions of the baseline and the scaled logistic model. Among the overlapping predictions, 50% of the bills pass within the next two days and only 15% pass after 45 days of the prediction date. These results raise an important question as to how early ACPA would like their predictions. This is a crucial aspect, as advocacy and lobbying efforts usually take a good amount of time.

Regarding efficiency, the optimal model selection depends on the specific needs of the ACPA. If ACPA requires early indications of a bill's likelihood to pass, then the scaled logistic regression, calibrated for early predictions, is recommended. When precision is the priority, scaled logistic regression again stands out due to its high average precision. However, the Random Forest model exhibited higher precision in the most recent test period. This suggests that the choice between these models should be based on ACPA's preference for higher precision in specific periods.

Equity considerations bring slightly different recommendations. The random forest model shows the least disparity in predictions at the 15th percentile for civil rights bills, making it a suitable choice if ACPA aims to ensure equitable treatment across different bills. If precision in predicting the outcome of civil rights bills is more important for ACPA, the scaled logistic regression would be a better option. This decision will be based on the organization's prioritization of either general equity across bill types or focused precision for civil rights-related bills.

As for effectiveness, the actual impact of any intervention remains unknown until ACPA implements the recommended field trials. During the initial analysis, we found evidence that about 90% of bills likely to be introduced in a session are done so by March, and 95% of those that pass do so in June. This insight is crucial for the ACPA to restrategize its advocacy efforts. Concentrating resources during these critical months could significantly enhance the effectiveness of their interventions, ensuring that efforts are aligned with the legislative cycle's key stages.

ACPA faces a complex decision where efficiency, equity, and effectiveness must be carefully balanced. While efficiency focuses on precision, equity would be to ensure fair treatment across different types of bills. Effectiveness, on the other hand, is tied to the real-world impact of ACPA's interventions, which is yet to be fully understood. There is further work to be done to improve the effectiveness goal and gain a more concrete understanding of which bills are considered civil rights bills. While this work is in process, ACPA can leverage the bill events baseline model to make progress towards more efficiently allocating their resources; this approach does not pose a serious investment for the organization. Overall, ACPA's problem is highly nuanced, and more advanced methods are necessary to properly handle this nuance, but we can offer them a simple and cost-effective solution in the meantime.

## Appendix

### 1. triage configuration file:

[https://github.com/dssg/mlpolicylab\\_fall23\\_Bills1/tree/main/main\\_triage](https://github.com/dssg/mlpolicylab_fall23_Bills1/tree/main/main_triage)

#### 1) temporal\_config:

feature\_start\_time: '2010-01-11' # earliest date included in features  
feature\_end\_time: '2018-12-28' # latest date included in features  
label\_start\_time: '2010-01-11' # earliest date for which labels are available - 2010-01-11  
(from bill progress table)  
label\_end\_time: '2018-12-28' # day AFTER last label date (all dates in any model are < this date) - 2019-06-07 (from bill progress table)  
model\_update\_frequency: '3months' # how frequently to retrain models  
training\_as\_of\_date\_frequencies: ['1month'] # time between as of dates for same entity in train matrix  
test\_as\_of\_date\_frequencies: ['1month'] # time between as of dates for same entity in test matrix  
max\_training\_histories: ['100year'] # length of time included in a train matrix  
test\_durations: ['0day'] # length of time included in a test matrix (0 day will give a single prediction immediately after training end)  
label\_timespans: ['1year'] # time period across which outcomes are labeled in train matrices

#### 2) Cohort:

label\_config:

query: |

```
WITH introduced AS(SELECT DISTINCT bill_id
                    FROM ml_policy_class.bill_progress bp JOIN ml_policy_class.bills b
USING(bill_id)
                    JOIN ml_policy_class.sessions s USING(session_id)
                    WHERE state_id = '3'
                    AND introduced_date >= (EXTRACT('Year' FROM TIMESTAMP
'{as_of_date}'))::text || '-01-01')::date
                    AND introduced_date < '{as_of_date}'
                    AND NOT EXISTS (
                        SELECT bill_id
                        FROM ml_policy_class.bill_progress
                        WHERE bill_id = bp.bill_id
                        AND bill_status IN ('4', '5', '8')
                        AND progress_date < '{as_of_date}')
                    ),
```



# status '4', '5', '8' represents a bill is passed, vetoed, and chaptered and we shall exclude them from our prediction

```
passed_bills AS(
    SELECT DISTINCT bill_id
    FROM ml_policy_class.bill_progress JOIN ml_policy_class.bills
    USING(bill_id) JOIN ml_policy_class.sessions USING(session_id)
    WHERE state_id = '3'
    AND bill_status = '4'
    AND progress_date >= (EXTRACT('Year' FROM TIMESTAMP
'{as_of_date}')::text || '-01-01')::date
    AND progress_date < ((EXTRACT('Year' FROM TIMESTAMP
'{as_of_date}')::text || '-01-01')::date + INTERVAL '{label_timespan}') ::date
)
```

```
SELECT i.bill_id::INT AS entity_id,
    CASE WHEN pb.bill_id IS NOT NULL THEN 1 ELSE 0 END AS outcome
# 1 for a bill labeled as passed, and 0 for not passed
FROM introduced i LEFT JOIN passed_bills pb ON i.bill_id = pb.bill_id
```

name: passed\_label

Definition of the label: Whether a bill has been passed for the current session year.

Source: In the bill\_progress table, there's a bill\_status column. If a bill is marked '4' in the bill\_status column, it means that it is passed for the current session.

### 3) Features:

feature\_aggregations:

-

prefix: 'bill\_sponsors'

# from\_obj is usually a source table but can be an expression, such as

# a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')

from\_obj: |

```
(SELECT bill_id::INT AS entity_id,
    progress_date AS knowledge_date,
    sponsor_id
FROM ml_policy_class.bill_progress JOIN ml_policy_class.bills USING (bill_id)
    JOIN ml_policy_class.sessions USING (session_id)
    LEFT JOIN ml_policy_class.bill_sponsors USING (bill_id)
WHERE state_id = 3) AS bill_sponsors
knowledge_date_column: 'knowledge_date'
```

# top-level imputation rules that will apply to all aggregates functions

```
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
```

```
all:
```

```
  type: 'constant'
```

```
  value: 0
```

```
# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
```

```
aggregates:
```

```
-
```

```
  quantity:
```

```
    total: 'DISTINCT sponsor_id'
```

```
  metrics:
```

```
    - 'count'
```

```
# The time intervals over which to aggregate features
```

```
intervals:
```

```
- '1year'
```

```
-
```

```
  prefix: 'bill_vote_sessions'
```

```
# from_obj is usually a source table but can be an expression, such as
```

```
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
```

```
from_obj: |
```

```
  (SELECT bill_id::INT AS entity_id,
```

```
    vote_date AS knowledge_date
```

```
  FROM ml_policy_class.bill_votes) AS bill_votes
```

```
knowledge_date_column: 'knowledge_date'
```

```
# top-level imputation rules that will apply to all aggregates functions
```

```
# can also specify categoricals_imputation or array_categoricals_imputation
```

```
aggregates_imputation:
```

```
all:
```

```
  type: 'constant'
```

```
  value: 0
```

```
# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
```

```
aggregates:
```

```
-
```

```
  quantity:
```

```

    total: '*'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'
-
  prefix: 'tot_bill_events'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (select bill_id as entity_id, event_date as knowledge_date
     FROM ml_policy_class.bill_events JOIN ml_policy_class.bills USING(bill_id)
     JOIN ml_policy_class.sessions USING(session_id)
     WHERE state_id = '3') AS bill_events
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: '*'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'

```

- '1year'
- - prefix: 'tot\_important\_events'
  - # from\_obj is usually a source table but can be an expression, such as
  - # a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')
  - from\_obj: |
    - (SELECT bill\_id as entity\_id, event\_date as knowledge\_date, important
    - FROM ml\_policy\_class.bill\_events JOIN ml\_policy\_class.bills USING(bill\_id)
    - JOIN ml\_policy\_class.sessions USING(session\_id)
    - WHERE state\_id = '3') AS bill\_events
    - knowledge\_date\_column: 'knowledge\_date'
  - # top-level imputation rules that will apply to all aggregates functions
  - # can also specify categoricals\_imputation or array\_categoricals\_imputation
  - aggregates\_imputation:
    - all:
      - type: 'constant'
      - value: 0
    - # Aggregates of numerical columns. Each quantity is a number of some
    - # sort, and the list of metrics are applied to each quantity
    - aggregates:
      - - quantity:
          - total: 'important'
        - metrics:
          - 'sum'
      - # The time intervals over which to aggregate features
      - intervals:
        - '1month'
        - '3months'
        - '6months'
        - '1year'
  - - prefix: 'bill\_sponsors\_dem'
    - # from\_obj is usually a source table but can be an expression, such as
    - # a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')
    - from\_obj: |

```

(SELECT bill_id::INT AS entity_id,
      progress_date AS knowledge_date,
      sponsor_id
FROM ml_policy_class.bill_progress JOIN ml_policy_class.bills USING (bill_id)
      JOIN ml_policy_class.sessions USING (session_id)
      LEFT JOIN ml_policy_class.bill_sponsors USING (bill_id)
WHERE state_id = 3 AND party_id = 1) AS bill_sponsors
knowledge_date_column: 'knowledge_date'

```

```

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

```

```

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:

```

```

-
  quantity:
    total: 'DISTINCT sponsor_id'
  metrics:
    - 'count'

```

```

# The time intervals over which to aggregate features
intervals:
  - '1year'

```

```

-
  prefix: 'bill_sponsors_repub'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
          progress_date AS knowledge_date,
          sponsor_id
    FROM ml_policy_class.bill_progress JOIN ml_policy_class.bills USING (bill_id)
          JOIN ml_policy_class.sessions USING (session_id)
          LEFT JOIN ml_policy_class.bill_sponsors USING (bill_id)
    WHERE state_id = 3 AND party_id = 2) AS bill_sponsors

```

```

knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT sponsor_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1year'

-
  prefix: 'tot_bill_events_senate'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (select bill_id as entity_id, event_date as knowledge_date
     FROM ml_policy_class.bill_events JOIN ml_policy_class.bills USING(bill_id)
     JOIN ml_policy_class.sessions USING(session_id)
     WHERE state_id = '3' AND chamber = 'S') AS senate_events
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some

```

```

# sort, and the list of metrics are applied to each quantity
aggregates:
-
  quantity:
    total: '*'
  metrics:
    - 'count'
# The time intervals over which to aggregate features
intervals:
- '1month'
- '3months'
- '6months'
- '1year'

-
  prefix: 'tot_bill_events_house'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (select bill_id as entity_id, event_date as knowledge_date
     FROM ml_policy_class.bill_events JOIN ml_policy_class.bills USING(bill_id)
     JOIN ml_policy_class.sessions USING(session_id)
     WHERE state_id = '3' AND chamber = 'H') AS house_events
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
-
  quantity:
    total: '*'
  metrics:
    - 'count'

```

```

# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'

-
prefix: 'tot_important_events_house'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (select bill_id as entity_id, event_date as knowledge_date, important
   FROM ml_policy_class.bill_events JOIN ml_policy_class.bills USING(bill_id)
  JOIN ml_policy_class.sessions USING(session_id)
   WHERE state_id = '3' AND chamber = 'H') AS house_events
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'important'
    metrics:
      - 'sum'
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'

```



```

-
prefix: 'tot_important_events_senate'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
    (select bill_id as entity_id, event_date as knowledge_date, important
      FROM ml_policy_class.bill_events JOIN ml_policy_class.bills USING(bill_id)
 JOIN ml_policy_class.sessions USING(session_id)
    WHERE state_id = '3' AND chamber = 'S') AS house_events
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'important'
    metrics:
      - 'sum'
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'

-
prefix: 'bill_vote_sessions_house'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
    (SELECT bill_id::INT AS entity_id,
      vote_id,

```

```
    vote_date AS knowledge_date
FROM ml_policy_class.bill_votes
WHERE chamber = 'H') AS bill_votes_house
knowledge_date_column: 'knowledge_date'
```

```
# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
```

```
  all:
    type: 'constant'
    value: 0
```

```
# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
```

```
-
  quantity:
    total: 'DISTINCT vote_id'
  metrics:
    - 'count'
```

```
# The time intervals over which to aggregate features
intervals:
```

```
- '7days'
- '14days'
- '1month'
- '3months'
- '6months'
- '1year'
```

```
-
prefix: 'bill_vote_sessions_senate'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
```

```
from_obj: |
  (SELECT bill_id::INT AS entity_id,
        vote_id,
        vote_date AS knowledge_date
  FROM ml_policy_class.bill_votes
  WHERE chamber = 'S') AS bill_votes_senate
knowledge_date_column: 'knowledge_date'
```

```

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT vote_id'
    metrics:
      - 'count'
    # The time intervals over which to aggregate features
    intervals:
      - '7days'
      - '14days'
      - '1month'
      - '3months'
      - '6months'
      - '1year'

  -
    prefix: 'bill_passed_votes_passed_total'
    # from_obj is usually a source table but can be an expression, such as
    # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
    from_obj: |
      (SELECT bill_id::INT AS entity_id,
        vote_id,
        vote_date AS knowledge_date
      FROM ml_policy_class.bill_votes
      where passed = True) AS bill_votes_passed_total
    knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:

```

```

all:
  type: 'constant'
  value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT vote_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '7days'
  - '15days'
  - '1month'
  - '3months'
  - '6months'
  - '1year'

-
  prefix: 'bill_passed_votes_passed_house'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
      vote_id,
      vote_date AS knowledge_date
    FROM ml_policy_class.bill_votes
    where chamber = 'H' and passed = True) AS bill_votes_passed_house
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

```

```

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
-
  quantity:
    total: 'DISTINCT vote_id'
  metrics:
    - 'count'
# The time intervals over which to aggregate features
intervals:
- '7days'
- '15days'
- '1month'
- '3months'
- '6months'
- '1year'

-
  prefix: 'bill_passed_votes_passed_senate'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
      vote_id,
      vote_date AS knowledge_date
    FROM ml_policy_class.bill_votes
    where chamber = 'S' and passed = True) AS bill_votes_passed_senate
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:

```

```

-
  quantity:
    total: 'DISTINCT vote_id'
  metrics:
    - 'count'
# The time intervals over which to aggregate features
intervals:
  - '7days'
  - '15days'
  - '1month'
  - '3months'
  - '6months'
  - '1year'

-
  prefix: 'num_total_ammendments'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
    amendment_date AS knowledge_date
  FROM ml_policy_class.bill_amendments) AS bill_amendments_process
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      number: '*'
    metrics:
      - 'count'
# The time intervals over which to aggregate features

```

intervals:

- '1month'
- '3months'
- '6months'
- '1year'

-

prefix: 'num\_total\_ammendments\_in\_house'

# from\_obj is usually a source table but can be an expression, such as

# a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')

from\_obj: |

```
(SELECT bill_id::INT AS entity_id,
       amendment_date AS knowledge_date
FROM ml_policy_class.bill_amendments
WHERE chamber = 'H') AS bill_amendments_process
```

knowledge\_date\_column: 'knowledge\_date'

# top-level imputation rules that will apply to all aggregates functions

# can also specify categoricals\_imputation or array\_categoricals\_imputation

aggregates\_imputation:

all:

type: 'constant'

value: 0

# Aggregates of numerical columns. Each quantity is a number of some

# sort, and the list of metrics are applied to each quantity

aggregates:

-

quantity:

number: '\*'

metrics:

- 'count'

# The time intervals over which to aggregate features

intervals:

- '1month'
- '3months'
- '6months'
- '1year'

-

```

prefix: 'num_total_ammendments_in_senate'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
         amendment_date AS knowledge_date
   FROM ml_policy_class.bill_amendments
   WHERE chamber = 'S') AS bill_amendments_process
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      number: '*'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'
-
prefix: 'num_adopted_ammendments'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
         amendment_date AS knowledge_date
   FROM ml_policy_class.bill_amendments

```



```
WHERE adopted = '1' ) AS bill_amendments_adopted
knowledge_date_column: 'knowledge_date'
```

```
# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0
```

```
# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
```

```
-
  quantity:
    total: '*'
  metrics:
    - 'count'
```

```
# The time intervals over which to aggregate features
intervals:
```

```
- '1month'
- '3months'
- '6months'
- '1year'
```

```
-
  prefix: 'num_adopted_ammendments_in_senate'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
      amendment_date AS knowledge_date
    FROM ml_policy_class.bill_amendments
    WHERE adopted = '1' and chamber = 'S') AS bill_amendments_adopted_s
  knowledge_date_column: 'knowledge_date'
```

```
# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
```

```

    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
-
  quantity:
    total: '*'
  metrics:
    - 'count'
# The time intervals over which to aggregate features
intervals:
- '1month'
- '3months'
- '6months'
- '1year'

-
  prefix: 'num_days_since_last_event'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id AS entity_id,event_date as knowledge_date,* FROM
ml_policy_class.bill_events) AS events
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
-
  quantity:
    last_event: "{collate_date} '::DATE - knowledge_date"
```

```

    metrics: ['min']
# The time intervals over which to aggregate features
intervals:
  - '1month'
  - '3months'
  - '6months'
  - '1year'

-
prefix: 'bill_session'
from_obj: |
  (SELECT bill_id::INT AS entity_id,
    introduced_date AS knowledge_date,
    CASE WHEN special THEN 1 ELSE 0 END AS special_num
  FROM ml_policy_class.bills
    JOIN ml_policy_class.sessions USING (session_id)) AS bill_session
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      special_session: 'special_num'
    metrics:
      - 'max'
# The time intervals over which to aggregate features
intervals:
  - '1year'

-
prefix: 'session_house_people'
# from_obj is usually a source table but can be an expression, such as

```

```

# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
    introduced_date AS knowledge_date,
    person_id
  FROM ml_policy_class.bills
    JOIN ml_policy_class.sessions_people USING (session_id)
  WHERE role_name = 'Rep' and state_id = 3) AS session_house_people
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT person_id'
    metrics:
      - 'count'

# The time intervals over which to aggregate features
intervals:
  - '1year'

-
  prefix: 'session_senate_people'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
      introduced_date AS knowledge_date,
      person_id
    FROM ml_policy_class.bills
      JOIN ml_policy_class.sessions_people USING (session_id)
    WHERE role_name = 'Sen' and state_id = 3) AS session_senate_people

```

```

knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT person_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1year'

-
  prefix: 'session_senate_people_dem'
  # from_obj is usually a source table but can be an expression, such as
  # a join (ie 'cool_stuff join other_stuff using (stuff_id)')
  from_obj: |
    (SELECT bill_id::INT AS entity_id,
      introduced_date AS knowledge_date,
      person_id
    FROM ml_policy_class.bills
      JOIN ml_policy_class.sessions_people USING (session_id)
      WHERE role_name = 'Sen' and party_id = 1 and state_id = 3) AS
session_senate_people_dem
  knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'

```

value: 0

# Aggregates of numerical columns. Each quantity is a number of some

# sort, and the list of metrics are applied to each quantity

aggregates:

-

quantity:

total: 'DISTINCT person\_id'

metrics:

- 'count'

# The time intervals over which to aggregate features

intervals:

- '1year'

-

prefix: 'session\_senate\_people\_rep'

# from\_obj is usually a source table but can be an expression, such as

# a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')

from\_obj: |

(SELECT bill\_id::INT AS entity\_id,  
introduced\_date AS knowledge\_date,  
person\_id

FROM ml\_policy\_class.bills

JOIN ml\_policy\_class.sessions\_people USING (session\_id)

WHERE role\_name = 'Sen' and party\_id = 2 and state\_id = 3) AS

session\_senate\_people\_rep

knowledge\_date\_column: 'knowledge\_date'

# top-level imputation rules that will apply to all aggregates functions

# can also specify categoricals\_imputation or array\_categoricals\_imputation

aggregates\_imputation:

all:

type: 'constant'

value: 0

# Aggregates of numerical columns. Each quantity is a number of some

# sort, and the list of metrics are applied to each quantity

aggregates:

-

quantity:

```

    total: 'DISTINCT person_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1year'

-
prefix: 'session_house_people_dem'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
    introduced_date AS knowledge_date,
    person_id
  FROM ml_policy_class.bills
    JOIN ml_policy_class.sessions_people USING (session_id)
    WHERE role_name = 'Rep' and party_id = 1 and state_id = 3) AS
session_house_people_dem
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT person_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1year'

```

```

-
prefix: 'session_house_people_rep'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT bill_id::INT AS entity_id,
    introduced_date AS knowledge_date,
    person_id
  FROM ml_policy_class.bills
    JOIN ml_policy_class.sessions_people USING (session_id)
    WHERE role_name = 'Rep' and party_id = 2 and state_id = 3) AS
session_house_people_rep
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
  all:
    type: 'constant'
    value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:
  -
    quantity:
      total: 'DISTINCT person_id'
    metrics:
      - 'count'
# The time intervals over which to aggregate features
intervals:
  - '1year'

```

```

-
prefix: 'bill_description'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
  (SELECT
    b.bill_id::INT AS entity_id,

```



introduced\_date AS knowledge\_date,

CASE WHEN doc ILIKE '%%disability%%' OR doc LIKE '%%ADA%%' OR doc ILIKE '%%accessibility%%' THEN 1 ELSE 0 END AS mention\_disability,

CASE WHEN doc ILIKE '%%free speech%%' OR doc ILIKE '%%freedom of expression%%' OR doc ILIKE '%%first amendment%%' THEN 1 ELSE 0 END AS mention\_free\_speech,

CASE WHEN doc LIKE '%%HIV%%' OR doc ILIKE '%%AIDS%%' OR doc ILIKE '%%health%%' THEN 1 ELSE 0 END AS mention\_hiv,

CASE WHEN doc ILIKE '%%immigrant%%' OR doc ILIKE '%%migration%%' OR doc ILIKE '%%naturalization%%' OR doc ILIKE '%%asylum%%' THEN 1 ELSE 0 END AS mention\_immigrants,

CASE WHEN doc ILIKE '%%juvenile%%' OR doc ILIKE '%%youth offender%%' OR doc ILIKE '%%minor%%' THEN 1 ELSE 0 END AS mention\_juvenile,

CASE WHEN doc ILIKE '%%prisoner%%' OR doc ILIKE '%%inmate%%' OR doc ILIKE '%%correctional facility%%' OR doc ILIKE '%%detainee%%' THEN 1 ELSE 0 END AS mention\_prisoners,

CASE WHEN doc ILIKE '%%privacy%%' OR doc ILIKE '%%data protection%%' OR doc ILIKE '%%surveillance%%' THEN 1 ELSE 0 END AS mention\_privacy,

CASE WHEN doc ILIKE '%%technology%%' OR doc ILIKE '%%information technology%%' OR doc ILIKE '%%IT%%' OR doc ILIKE '%%cybersecurity%%' THEN 1 ELSE 0 END AS mention\_technology,

CASE WHEN doc ILIKE '%%abortion%%' OR doc ILIKE '%%reproductive rights%%' OR doc ILIKE '%%family planning%%' THEN 1 ELSE 0 END AS mention\_reproductive\_freedom,

CASE WHEN doc ILIKE '%%religion%%' OR doc ILIKE '%%faith%%' OR doc ILIKE '%%religious freedom%%' THEN 1 ELSE 0 END AS mention\_religion,

CASE WHEN doc ILIKE '%%voting rights%%' OR doc ILIKE '%%electoral law%%' OR doc ILIKE '%%suffrage%%' OR doc ILIKE '%%ballot access%%' THEN 1 ELSE 0 END AS mention\_voting\_rights,

CASE WHEN doc ILIKE '%%women%%' OR doc ILIKE '%%female%%' OR doc ILIKE '%%gender equality%%' OR doc ILIKE '%%women%%' THEN 1 ELSE 0 END AS mention\_women,

CASE WHEN doc ILIKE '%%same-sex%%' OR doc ILIKE '%%LGBTQ%%' OR doc ILIKE '%%gender identity%%' OR doc ILIKE '%%transgender%%' THEN 1 ELSE 0 END AS mention\_lgbtq,

CASE WHEN doc ILIKE '%%human rights%%' OR doc ILIKE '%%civil liberties%%' OR doc ILIKE '%%equal rights%%' THEN 1 ELSE 0 END AS mention\_human\_rights,

```

CASE WHEN doc ILIKE '%%death penalty%%' OR doc ILIKE '%%capital
punishment%%' OR doc ILIKE '%%lethal injection%%' THEN 1 ELSE 0 END AS
mention_capitol_punishment,
CASE WHEN doc ILIKE '%%racial justice%%' OR doc ILIKE '%%racial
equality%%' OR doc ILIKE '%%civil rights%%' OR doc ILIKE
'%%anti-discrimination%%' THEN 1 ELSE 0 END AS mention_racial_justice,
CASE WHEN doc ILIKE '%%smart justice%%' OR doc ILIKE '%%criminal
justice innovation%%' OR doc ILIKE '%%justice reform%%' OR doc ILIKE
'%%alternative sentencing%%' THEN 1 ELSE 0 END AS mention_smart_justice,
CASE WHEN doc ILIKE '%%criminal justice%%' OR doc ILIKE
'%%sentencing%%' OR doc ILIKE '%%incarceration%%'
OR doc ILIKE '%%prison%%' OR doc ILIKE '%%rehabilitation%%' OR doc
ILIKE '%%restorative justice%%'
OR doc ILIKE '%%bail%%' OR doc ILIKE '%%drug policy%%' OR doc ILIKE
'%%recidivism%%'
OR doc ILIKE '%%juvenile%%' OR doc ILIKE '%%fair trial%%' OR doc
ILIKE '%%legal representation%%'
OR doc ILIKE '%%decriminalization%%' OR doc ILIKE '%%parole%%' OR
doc ILIKE '%%expungement%%' OR doc ILIKE '%%penal code%%'
OR doc ILIKE '%%correctional%%' OR doc ILIKE '%%inmate%%' OR doc
ILIKE '%%public defender%%'
OR doc ILIKE '%%law enforcement%%' THEN 1 ELSE 0 END AS
mention_criminal_law_reform
FROM ml_policy_class.bill_texts bt
JOIN ml_policy_class.bills b USING (bill_id)
JOIN ml_policy_class.sessions USING (session_id)
WHERE state_id = 3) AS bill_description
knowledge_date_column: 'knowledge_date'

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:
all:
type: 'constant'
value: 0

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:

```

quantity:  
  mention\_free\_speech: 'mention\_free\_speech'  
metrics:  
  - 'max'

-

quantity:  
  mention\_hiv: 'mention\_hiv'  
metrics:  
  - 'max'

-

quantity:  
  mention\_immigrants: 'mention\_immigrants'  
metrics:  
  - 'max'

-

quantity:  
  mention\_juvenile: 'mention\_juvenile'  
metrics:  
  - 'max'

-

quantity:  
  mention\_prisoners: 'mention\_prisoners'  
metrics:  
  - 'max'

-

quantity:  
  mention\_privacy: 'mention\_privacy'  
metrics:  
  - 'max'

-

quantity:  
  mention\_technology: 'mention\_technology'  
metrics:  
  - 'max'

- quantity:  
  mention\_rep\_freedom: 'mention\_reproductive\_freedom'  
metrics:  
  - 'max'

- quantity:  
  mention\_disability: 'mention\_disability'  
metrics:  
  - 'max'

- quantity:  
  mention\_religion: 'mention\_religion'  
metrics:  
  - 'max'

- quantity:  
  mention\_voting\_rights: 'mention\_voting\_rights'  
metrics:  
  - 'max'

- quantity:  
  mention\_women: 'mention\_women'  
metrics:  
  - 'max'

- quantity:  
  mention\_lgbtq: 'mention\_lgbtq'  
metrics:  
  - 'max'

- quantity:  
  mention\_human\_rights: 'mention\_human\_rights'

```

metrics:
  - 'max'

-
quantity:
  mention_capitol_punishment: 'mention_capitol_punishment'
metrics:
  - 'max'

-
quantity:
  mention_racial_justice: 'mention_racial_justice'
metrics:
  - 'max'

-
quantity:
  mention_smart_justice: 'mention_smart_justice'
metrics:
  - 'max'

-
quantity:
  mention_crml_law_rfm: 'mention_criminal_law_reform'
metrics:
  - 'max'

# The time intervals over which to aggregate features
intervals:
  - '1year'

-
prefix: 'num_prev_sponsor'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: (SELECT bp.bill_id::INT AS entity_id,
           bs.sponsor_id,
           bp.progress_date as knowledge_date,
           (
             SELECT COUNT(DISTINCT bp_inner.bill_id)
             FROM ml_policy_class.bill_progress bp_inner

```

```

        JOIN ml_policy_class.bill_sponsors bs_inner ON bp_inner.bill_id =
bs_inner.bill_id
        WHERE bs_inner.sponsor_id = bs.sponsor_id
        AND bp_inner.progress_date < bp.progress_date
    ) AS previously_sponsored_bills_count
FROM
    ml_policy_class.bill_progress bp
JOIN
    ml_policy_class.bill_sponsors bs ON bp.bill_id = bs.bill_id JOIN
ml_policy_class.bills b ON bp.bill_id = b.bill_id
JOIN ml_policy_class.sessions s ON b.session_id = s.session_id
WHERE
    s.state_id = 3 and bp.bill_status = 1 ) AS sponsor_bills_prev_introduced

```

knowledge\_date\_column: 'knowledge\_date'

# top-level imputation rules that will apply to all aggregates functions  
# can also specify categoricals\_imputation or array\_categoricals\_imputation  
aggregates\_imputation:

```

all:
    type: 'constant'
    value: 0

```

# Aggregates of numerical columns. Each quantity is a number of some  
# sort, and the list of metrics are applied to each quantity  
aggregates:

```

-
    quantity:
        total: 'previously_sponsored_bills_count'
    metrics:
        - 'avg'

```

# The time intervals over which to aggregate features  
intervals:

```

- '3months'
- '6months'
- '1year'
- '2years'

```

```

-
    prefix: 'num_passed_sponsor'

```

# from\_obj is usually a source table but can be an expression, such as

```

# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: (SELECT
    bp.bill_id::INT AS entity_id,
    bs.sponsor_id,
    bp.progress_date as knowledge_date,
    (
        SELECT COUNT(DISTINCT bp_inner.bill_id)
        FROM ml_policy_class.bill_progress bp_inner
        JOIN ml_policy_class.bill_sponsors bs_inner ON bp_inner.bill_id =
bs_inner.bill_id
        WHERE bs_inner.sponsor_id = bs.sponsor_id
        AND bp_inner.bill_status = 4
        AND bp_inner.progress_date < bp.progress_date
    ) AS previously_passed_bills_count
FROM
    ml_policy_class.bill_progress bp
JOIN
    ml_policy_class.bill_sponsors bs ON bp.bill_id = bs.bill_id JOIN
ml_policy_class.bills b ON bp.bill_id = b.bill_id
    JOIN ml_policy_class.sessions s ON b.session_id = s.session_id
WHERE
    s.state_id = 3 and bp.bill_status = 1 ) AS sponsor_num_bills_passed

```

knowledge\_date\_column: 'knowledge\_date'

```

# top-level imputation rules that will apply to all aggregates functions
# can also specify categoricals_imputation or array_categoricals_imputation
aggregates_imputation:

```

```

all:
    type: 'constant'
    value: 0

```

```

# Aggregates of numerical columns. Each quantity is a number of some
# sort, and the list of metrics are applied to each quantity
aggregates:

```

```

-
    quantity:
        total: 'previously_passed_bills_count'
    metrics:
        - 'avg'

```

# The time intervals over which to aggregate features  
intervals:

- '1year'
- '2years'
- '3years'

-

prefix: 'bill\_status\_max'

# from\_obj is usually a source table but can be an expression, such as

# a join (ie 'cool\_stuff join other\_stuff using (stuff\_id)')

from\_obj: |

```
(SELECT bill_id::INT as entity_id ,  
       progress_date as knowledge_date,  
       bill_status  
FROM ml_policy_class.bill_progress  
  JOIN ml_policy_class.bills USING (bill_id)  
  JOIN ml_policy_class.sessions USING (session_id)  
WHERE state_id = 3) as bill_status
```

knowledge\_date\_column: 'knowledge\_date'

# top-level imputation rules that will apply to all aggregates functions

# can also specify categoricals\_imputation or array\_categoricals\_imputation

categoricals\_imputation:

all:

type: 'null\_category'

# Aggregates of numerical columns. Each quantity is a number of some

# sort, and the list of metrics are applied to each quantity

categoricals:

- column: 'bill\_status'

choice\_query: |

```
SELECT DISTINCT bill_status  
FROM ml_policy_class.bill_progress
```

metrics:

- 'max'

# The time intervals over which to aggregate features

intervals:

- '1day'
- '3days'
- '7days'



- '15days'
- '1month'
- '3months'
- '6months'
- '1year'

-

```

prefix: 'civil_rights_bills'
# from_obj is usually a source table but can be an expression, such as
# a join (ie 'cool_stuff join other_stuff using (stuff_id)')
from_obj: |
    (SELECT
      b.bill_id::INT AS entity_id,
      introduced_date AS knowledge_date,
      CASE WHEN doc ILIKE '%%disability%%' OR doc LIKE '%%ADA%%' OR
doc ILIKE '%%accessibility%%'
      OR doc ILIKE '%%free speech%%' OR doc ILIKE '%%freedom of
expression%%'
      OR doc LIKE '%%HIV%%' OR doc ILIKE '%%AIDS%%'
      OR doc ILIKE '%%immigrant%%' OR doc ILIKE '%%naturalization%%' OR
doc ILIKE '%%asylum%%'
      OR doc ILIKE '%%youth offender%%'
      OR doc ILIKE '%%prisoner%%' OR doc ILIKE '%%inmate%%' OR doc
ILIKE '%%correctional facility%%' OR doc ILIKE '%%detainee%%'
      OR doc ILIKE '%%privacy%%' OR doc ILIKE '%%data protection%%' OR
doc ILIKE '%%surveillance%%'
      OR doc ILIKE '%%cybersecurity%%'
      OR doc ILIKE '%%abortion%%' OR doc ILIKE '%%reproductive rights%%'
      OR doc ILIKE '%%religion%%' OR doc ILIKE '%%religious freedom%%'
      OR doc ILIKE '%%voting rights%%' OR doc ILIKE '%%suffrage%%' OR
doc ILIKE '%%ballot access%%'
      OR doc ILIKE '%%women%%' OR doc ILIKE '%%female%%' OR doc
ILIKE '%%gender equality%%' OR doc ILIKE '%%women%%'
      OR doc LIKE '%%LGBTQ%%' OR doc ILIKE '%%gender identity%%' OR
doc ILIKE '%%transgender%%'
      OR doc ILIKE '%%human rights%%' OR doc ILIKE '%%civil liberties%%'
OR doc ILIKE '%%equal rights%%'
      OR doc ILIKE '%%death penalty%%' OR doc ILIKE '%%capital
punishment%%' OR doc ILIKE '%%lethal injection%%'

```

```
OR doc ILIKE '%%racial justice%%' OR doc ILIKE '%%racial equality%%'
OR doc ILIKE '%%civil rights%%' OR doc ILIKE '%%anti-discrimination%%'
```

```
OR doc ILIKE '%%smart justice%%' OR doc ILIKE '%%criminal justice
innovation%%' OR doc ILIKE '%%justice reform%%' OR doc ILIKE '%%alternative
sentencing%%'
```

```
OR doc ILIKE '%%criminal justice%%' OR doc ILIKE '%%sentencing%%'
OR doc ILIKE '%%incarceration%%'
```

```
OR doc ILIKE '%%prison%%' OR doc ILIKE '%%rehabilitation%%' OR doc
ILIKE '%%restorative justice%%'
```

```
OR doc ILIKE '%%bail%%' OR doc ILIKE '%%drug policy%%' OR doc
ILIKE '%%recidivism%%'
```

```
OR doc ILIKE '%%juvenile%%' OR doc ILIKE '%%legal representation%%'
```

```
OR doc ILIKE '%%decriminalization%%' OR doc ILIKE '%%parole%%' OR
doc ILIKE '%%expungement%%' OR doc ILIKE '%%penal code%%'
```

```
OR doc ILIKE '%%correctional%%' OR doc ILIKE '%%inmate%%' OR doc
ILIKE '%%public defender%%'
```

```
OR doc ILIKE '%%law enforcement%%' THEN 1 ELSE 0 END AS
civil_rights_bill
```

```
FROM ml_policy_class.bill_texts bt
```

```
JOIN ml_policy_class.bills b USING (bill_id)
```

```
JOIN ml_policy_class.sessions USING (session_id)
```

```
WHERE state_id = 3) AS civil_rights_bills
```

```
knowledge_date_column: 'knowledge_date'
```

```
# top-level imputation rules that will apply to all aggregates functions
```

```
# can also specify categoricals_imputation or array_categoricals_imputation
```

```
aggregates_imputation:
```

```
all:
```

```
type: 'constant'
```

```
value: 0
```

```
aggregates:
```

```
-
```

```
quantity:
```

```
civil_rights_bill: 'civil_rights_bill'
```

```
metrics:
```

```
- 'max'
```

```
intervals:
```

```
- '1year'
```

Complete Feature List:

Feature Name (prefix)	Type (categorical, continuous, binary, etc.)
bill_type	categorical
introduced_body	categorical
num_bill_vote_sessions	continuous
bill_votes_passed	continuous
bill_votes_session_house	continuous
bill_votes_session_senate	continuous
bill_passed_in_house	continuous
bill_passed_in_senate	continuous
num_adopted_ammendments	continuous
num_adopted_ammendments_in_house	continuous
num_adopted_ammendments_in_senate	continuous
num_total_ammendments	continuous
num_total_ammendments_in_house	continuous
num_total_ammendments_in_senate	continuous
num_sponsors	continuous
num_sponsors_dem	continuous
num_sponsors_repub	continuous
num_prev_sponsor	continuous
num_passed_sponsor	continuous
num_days_since_last_event	continuous
most_recent_num_days_since_introduction	continuous
bill_status	categorical
current_total_bills_passed_this_session	continuous
multiple_activity_past_month	boolean
tot_bill_events	continuous
tot_important_events	continuous
tot_bill_events_house	continuous
tot_bill_events_senate	continuous

tot_important_events_senate	continuous
tot_important_events_house	continuous
special_session	boolean
num_house_representatives_total	continuous
num_house_representatives_party	continuous
num_senators_total	continuous
num_senators_party	continuous
mention_capitol_punishment	boolean
mention_criminal_law_reform	boolean
mention_disability_rights	boolean
mention_free_speech	boolean
mention_HIV	boolean
mention_Human_rights	boolean
mention_immigrants_rights	boolean
mention_juvenile_justice	boolean
mention_lgbtq_rights	boolean
mention_national_security	boolean
mention_prisoners_rights	boolean
mention_privacy	boolean
mention_technology	boolean
mention_racial_justice	boolean
mention_religious_liberty	boolean
mention_reproductive_freedom	boolean
mention_smart_justice	boolean
mention_voting_rights	boolean
mention_women_rights	boolean
similar_bill_prev_intr	categorical/text
similar_bill_prev_passed	boolean
num_text_words	continuous
bill_category	categorical

#### 4) Model Grid

#logistic regression

'triage.component.catwalk.estimators.classifiers.ScaledLogisticRegression':

```

penalty: ['l1']
solver: ['saga']
C: [0.1]
random_state: [4]

```

```

#decision tree classifier
'sklearn.tree.DecisionTreeClassifier':
max_depth: [4, 5]
min_samples_split: [4, 5]
random_state: [4]
criterion: ["gini"]
splitter: ["best"]

```

```

#additional models for planned model grid:
'sklearn.ensemble.RandomForestClassifier':
n_estimators: [100, 500, 1000]
max_depth: [2, 5, 10, 25]
min_samples_split: [2, 5, 10, 25]
criterion: ["gini"]
n_jobs: [4]
random_state: [4]

```

```

'sklearn.ensemble.GradientBoostingClassifier':
n_estimators: [100, 200, 300, 500]
random_state: [4]
criterion: ["friedman_mse"]
min_samples_split: [2, 3, 5, 10]
max_depth: [2, 3, 5, 10]

```

## 2. Table of train and validation sets

	Train Set				Validation Set			
Train-Vali dation Pair ID	Earliest row as of date	Latest row as of date	Start date for labels	End date for labels	Earliest row as of date	Latest row as of date	Start date for labels	End date for labels
1	2011-01-28	2011-03-28	2011-01-28	2012-03-28	2012-03-28	2012-03-28	2012-03-28	2013-03-28
2	2011-01	2011-06	2011-01	2012-06	2012-06	2012-06	2012-06	2013-06

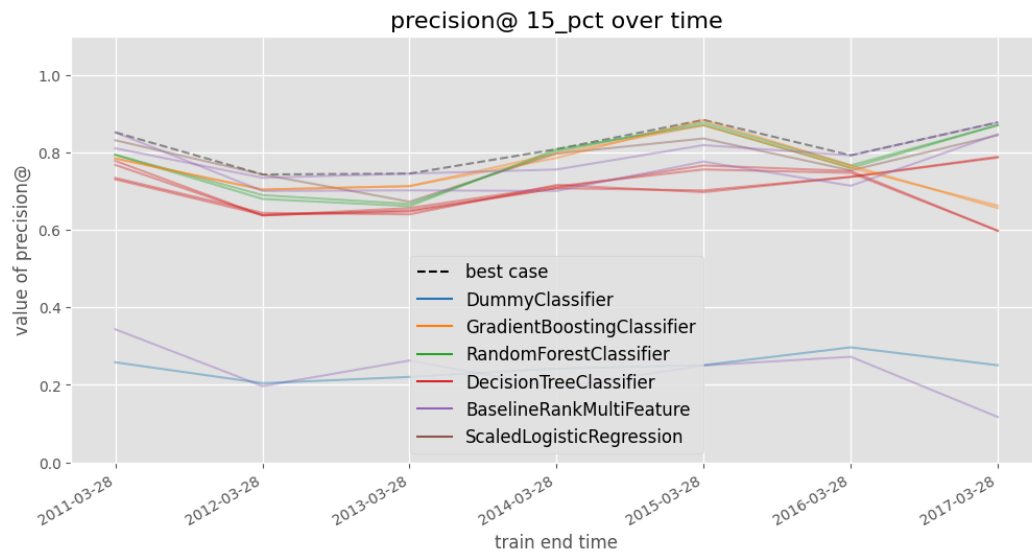
	-28	-28	-28	-28	-28	-28	-28	-28
3	2011-01 -28	2011-09 -28	2011-01 -28	2012-09 -28	2012-09 -28	2012-09 -28	2012-09 -28	2013-09 -28
4	2011-01 -28	2011-12 -28	2011-01 -28	2012-12 -28	2012-12 -28	2012-12 -28	2012-12 -28	2013-12 -28
5	2011-01 -28	2012-03 -28	2011-01 -28	2013-03 -28	2013-03 -28	2013-03 -28	2013-03 -28	2014-03 -28
6	2011-01 -28	2012-06 -28	2011-01 -28	2013-06 -28	2013-06 -28	2013-06 -28	2013-06 -28	2014-06 -28
7	2011-01 -28	2012-09 -28	2011-01 -28	2013-09 -28	2013-09 -28	2013-09 -28	2013-09 -28	2014-09 -28
8	2011-01 -28	2012-12 -28	2011-01 -28	2013-12 -28	2013-12 -28	2013-12 -28	2013-12 -28	2014-12 -28
9	2011-01 -28	2013-03 -28	2011-01 -28	2014-03 -28	2014-03 -28	2014-03 -28	2014-03 -28	2015-03 -28
10	2011-01 -28	2013-06 -28	2011-01 -28	2014-06 -28	2014-06 -28	2014-06 -28	2014-06 -28	2015-06 -28
11	2011-01 -28	2013-09 -28	2011-01 -28	2014-09 -28	2014-09 -28	2014-09 -28	2014-09 -28	2015-09 -28
12	2011-01 -28	2013-12 -28	2011-01 -28	2014-12 -28	2014-12 -28	2014-12 -28	2014-12 -28	2015-12 -28
13	2011-01 -28	2014-03 -28	2011-01 -28	2015-03 -28	2015-03 -28	2015-03 -28	2015-03 -28	2016-03 -28
14	2011-01 -28	2014-06 28	2011-01 -28	2015-06 28	2015-06 28	2015-06 28	2015-06 28	2016-06 28
15	2011-01 -28	2014-09 -28	2011-01 -28	2015-09 -28	2015-09 -28	2015-09 -28	2015-09 -28	2016-09 -28
16	2011-01 -28	2014-12 -28	2011-01 -28	2015-12 -28	2015-12 -28	2015-12 -28	2015-12 -28	2016-12 -28
17	2011-01 -28	2015-03 -28	2011-01 -28	2016-03 -28	2016-03 -28	2016-03 -28	2016-03 -28	2017-03 -28
18	2011-01 -28	2015-06 -28	2011-01 -28	2016-06 -28	2016-06 -28	2016-06 -28	2016-06 -28	2017-06 -28

19	2011-01-28	2015-09-28	2011-01-28	2016-09-28	2016-09-28	2016-09-28	2016-09-28	2017-09-28
20	2011-01-28	2015-12-28	2011-01-28	2016-12-28	2016-12-28	2016-12-28	2016-12-28	2017-12-28
21	2011-01-28	2016-03-28	2011-01-28	2017-03-28	2017-03-28	2017-03-28	2017-03-28	2018-03-28
22	2011-01-28	2016-06-28	2011-01-28	2017-06-28	2017-06-28	2017-06-28	2017-06-28	2018-06-28
23	2011-01-28	2016-09-28	2011-01-28	2017-09-28	2017-09-28	2017-09-28	2017-09-28	2018-09-28
24	2011-01-28	2016-12-28	2011-01-28	2017-12-28	2017-12-28	2017-12-28	2017-12-28	2018-12-28

### 3. Criteria used to select top models

We use average model precision over time at top 15% to identify the top performance models.

### 4. Model Performance Graph



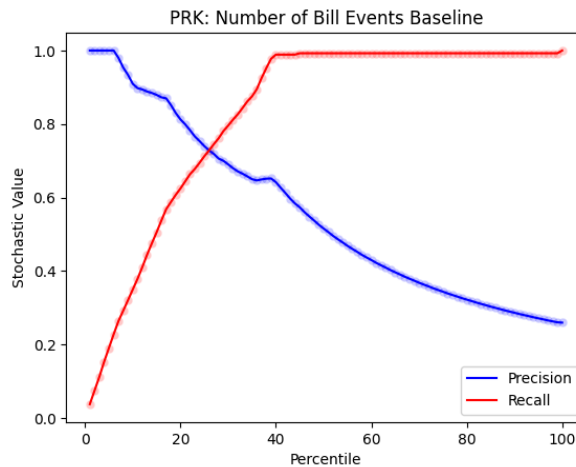
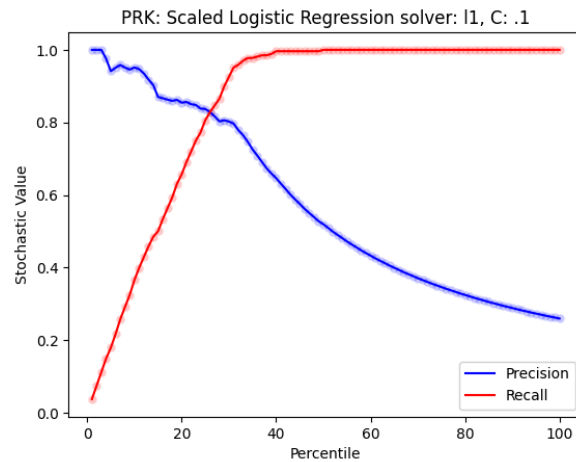
### 5. top 5 models + commonsense baseline

1) Our top 5 models with the commonsense baseline are (average precision value from highest to lowest):

i. Scaled Logistic Regression: {"C": 0.1, "solver": "saga", "penalty": "l1", "random\_state": 4}

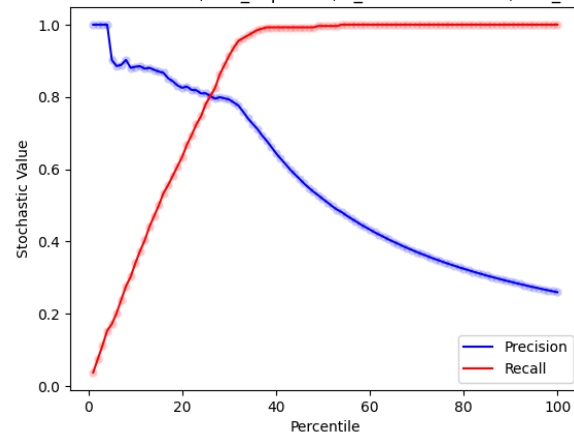
- ii. Baseline: the bills with the most number of events will be passed
- iii. Random Forest Classifier: {"criterion": "gini", "max\_depth": 25, "n\_estimators": 1000, "random\_state": 4, "min\_samples\_split": 25}
- iv. Gradient Boosting Classifier: {"criterion": "friedman\_mse", "max\_depth": 10, "n\_estimators": 500, "random\_state": 4, "min\_samples\_split": 10}
- v. Gradient Boosting Classifier: {"criterion": "friedman\_mse", "max\_depth": 10, "n\_estimators": 300, "random\_state": 4, "min\_samples\_split": 10}
- vi. Random Forest Classifier: {"criterion": "gini", "max\_depth": 25, "n\_estimators": 500, "random\_state": 4, "min\_samples\_split": 25}

## 2) PR\_k graphs

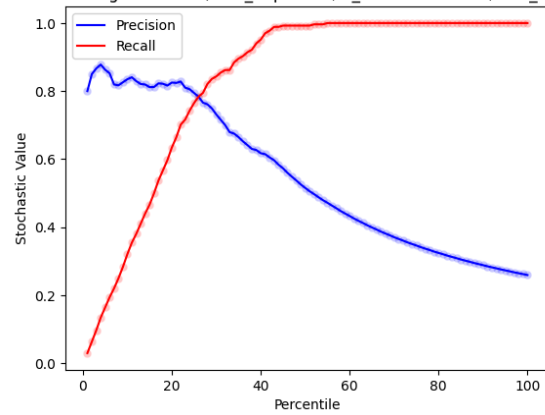




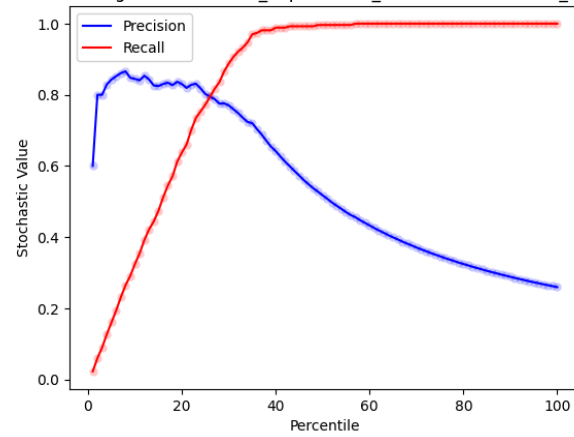
PRK: Random Forest Classifier (max\_depth: 25, n\_estimators: 1000, min\_samples\_split: 25)



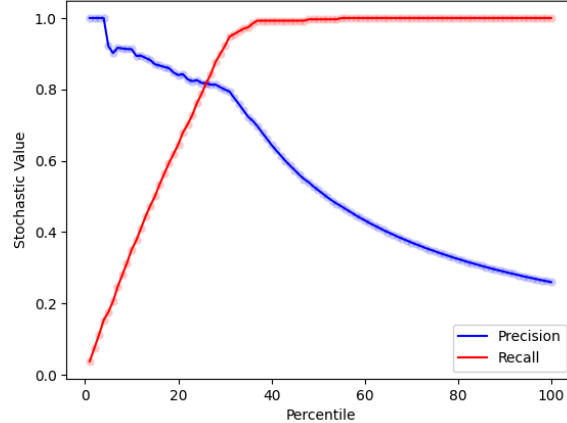
PRK: Gradient Boosting Classifier (max\_depth: 10, n\_estimators: 500, min\_samples\_split: 10)



PRK: Gradient Boosting Classifier (max\_depth: 10, n\_estimators: 300, min\_samples\_split: 10)



PRK: Random Forest Classifier (max\_depth: 25, n\_estimators: 500, min\_samples\_split: 25)



### 3) Feature Importance

i. Scaled Logistic Regression: {"C": 0.1, "solver": "saga", "penalty": "l1", "random\_state": 4}

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#### 4) Cross-tabs for 10 most different features

i. Scaled Logistic Regression: {"C": 0.1, "solver": "saga", "penalty": "l1", "random\_state": 4}

	top_values	bottom_values	difference	
num_passed_sponsor_entity_id_3years_total_avg	176.753	122.667	54.0861	
num_passed_sponsor_entity_id_2years_total_avg	176.753	122.667	54.0861	
num_passed_sponsor_entity_id_1year_total_avg	176.753	122.667	54.0861	
num_prev_sponsor_entity_id_6months_total_avg	422.377	369.037	53.3399	
num_prev_sponsor_entity_id_3months_total_avg	422.377	369.037	53.3399	
num_prev_sponsor_entity_id_2years_total_avg	422.377	369.037	53.3399	
num_prev_sponsor_entity_id_1year_total_avg	422.377	369.037	53.3399	
num_days_since_last_event_entity_id_1year_last_event_min	7.06494	42.7986	35.7337	
num_days_since_last_event_entity_id_6months_last_event_min	7.06494	42.7986	35.7337	
num_days_since_last_event_entity_id_3months_last_event_min	7.06494	42.7986	35.7337	

ii. Random Forest Classifier: {"criterion": "gini", "max\_depth": 25, "n\_estimators": 1000, "random\_state": 4, "min\_samples\_split": 25}

	top_values	bottom_values	difference	
num_passed_sponsor_entity_id_3years_total_avg	167.673	124.258	43.4153	
num_passed_sponsor_entity_id_2years_total_avg	167.673	124.258	43.4153	
num_passed_sponsor_entity_id_1year_total_avg	167.673	124.258	43.4153	
num_days_since_last_event_entity_id_1year_last_event_min	2.74675	43.5552	40.8084	
num_days_since_last_event_entity_id_6months_last_event_min	2.74675	43.5552	40.8084	
num_days_since_last_event_entity_id_3months_last_event_min	2.74675	43.5552	40.8084	
num_prev_sponsor_entity_id_2years_total_avg	400.445	372.879	27.5651	
num_prev_sponsor_entity_id_6months_total_avg	400.445	372.879	27.5651	
num_prev_sponsor_entity_id_1year_total_avg	400.445	372.879	27.5651	
num_prev_sponsor_entity_id_3months_total_avg	400.445	372.879	27.5651	

iii. Gradient Boosting Classifier: {"criterion": "friedman\_mse", "max\_depth": 10, "n\_estimators": 500, "random\_state": 4, "min\_samples\_split": 10}

	top_values	bottom_values	difference	
num_days_since_last_event_entity_id_1year_last_event_min	2.9863	35.2392	32.2529	
num_days_since_last_event_entity_id_6months_last_event_min	2.9863	35.2392	32.2529	
num_days_since_last_event_entity_id_3months_last_event_min	2.9863	35.2392	32.2529	
num_passed_sponsor_entity_id_3years_total_avg	107.803	83.8473	23.9553	
num_passed_sponsor_entity_id_2years_total_avg	107.803	83.8473	23.9553	
num_passed_sponsor_entity_id_1year_total_avg	107.803	83.8473	23.9553	
num_prev_sponsor_entity_id_1year_total_avg	290.374	270.455	19.9191	
num_prev_sponsor_entity_id_2years_total_avg	290.374	270.455	19.9191	
num_prev_sponsor_entity_id_3months_total_avg	290.374	270.455	19.9191	
num_prev_sponsor_entity_id_6months_total_avg	290.374	270.455	19.9191	

iv. Gradient Boosting Classifier: {"criterion": "friedman\_mse", "max\_depth": 10, "n\_estimators": 300, "random\_state": 4, "min\_samples\_split": 10}

	top_values	bottom_values	difference	
num_days_since_last_event_entity_id_1year_last_event_min	3.00685	35.2356	32.2287	
num_days_since_last_event_entity_id_6months_last_event_min	3.00685	35.2356	32.2287	
num_days_since_last_event_entity_id_3months_last_event_min	3.00685	35.2356	32.2287	
num_prev_sponsor_entity_id_3months_total_avg	300.381	268.699	31.6828	
num_prev_sponsor_entity_id_2years_total_avg	300.381	268.699	31.6828	
num_prev_sponsor_entity_id_6months_total_avg	300.381	268.699	31.6828	
num_prev_sponsor_entity_id_1year_total_avg	300.381	268.699	31.6828	
num_passed_sponsor_entity_id_3years_total_avg	111.505	83.1975	28.3076	

num_passed_sponsor_entity_id_2years_total_avg	111.505	83.1975	28.3076
num_passed_sponsor_entity_id_1year_total_avg	111.505	83.1975	28.3076

v. Random Forest Classifier: {"criterion": "gini", "max\_depth": 25, "n\_estimators": 500, "random\_state": 4, "min\_samples\_split": 25}

	top_values	bottom_values	difference
:----- :----- :----- :-----			
num_passed_sponsor_entity_id_3years_total_avg	166.611	124.444	42.1668
num_passed_sponsor_entity_id_2years_total_avg	166.611	124.444	42.1668
num_passed_sponsor_entity_id_1year_total_avg	166.611	124.444	42.1668
num_days_since_last_event_entity_id_1year_last_event_min	2.93506	43.5222	40.5871
num_days_since_last_event_entity_id_6months_last_event_min	2.93506	43.5222	40.5871
num_days_since_last_event_entity_id_3months_last_event_min	2.93506	43.5222	40.5871
num_prev_sponsor_entity_id_6months_total_avg	398.234	373.267	24.9675
num_prev_sponsor_entity_id_3months_total_avg	398.234	373.267	24.9675
num_prev_sponsor_entity_id_2years_total_avg	398.234	373.267	24.9675
num_prev_sponsor_entity_id_1year_total_avg	398.234	373.267	24.9675

5) Bias Metrics : We tested whether our prediction had bias among civil rights bills group versus non civil-rights bills group. If the disparity of true positive rate and false discovery rate fall into [0.8, 1.25], we can conclude that the bias is not that significant, and that's what we got from our examination. In our case, the true positive rate is the number of bills we predicted to pass and do pass divided by the total number of bills that pass in session, and the false discovery rate is the number of bills we predicted to pass but did not pass divided by total number of bills we predicted will pass. These two metrics reflect the accuracy and completeness of our prediction, and we don't want to see a significant disparity between the two groups.

