

# Predicting Tik-Tok User Data Based on Video Data

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## Introduction and data

TikTok now has over 1 billion users globally, making it one of the fastest growing social platforms in the world. As it has risen to prominence, so has its ubiquitous algorithm, which is said to generally account for account factors (likes and comments) and video information (captions, sounds, hashtags). Given, that TikTok has been heavily criticized alongside other platforms for declining youth mental health outcomes and rising hate due to the addictive nature of its explore page, we decided to look at TikTok's data and how follower count (a huge driver of engagement) is impacted by other aspects of a user's account, like average number of videos, average number of likes, and average number of comments.

The dataset comes from the 'top\_users\_vids.csv' file (under folder 'Trending Videos Data Collection') of the Github repository found at: [https://github.com/ivantran96/TikTok\\_famous/tree/main](https://github.com/ivantran96/TikTok_famous/tree/main). The data was originally collected as part of the DataResolutions's Data Blog project exploring Tiktok's demographics and trending video analytics.

The original data curators collected the data using David Teather's open-source Unofficial Tiktok API (found at <https://github.com/davidteather/TikTok-API>), which uses Python to scrape Tiktok data and fetch the most trending videos, specific user information, and much more. Using the list of top Tiktokers, the curators compiled a list of users with the getSuggestedUsersbyIDCrawler api method, which used the top TikTokers and collected the suggested users. Using the byUsername method, they collected video data of the 25 most recent posts of each user from the top TikTokers and the suggested list. The curators also used the API's bySound method to collect videos using some of the most famous songs on TikTok to get an idea of how the choice of music can impact the potential of a video to become a trending video.

## EDA

We begin our EDA process by first examining the dataset.

Currently, our dataset tiktok has 13 columns and 12,559 observations. The columns cover attributes of a tiktok video such as video length, hashtags used, songs/sounds used, and number of likes, shares, comments, plays, and followers (and their total number of likes and videos). Variables `id`, `create_time`, `video_length`, `n_likes`, `n_shares`, `n_comments`, `n_plays`, `n_followers`, `n_total_likes`, and `n_total_vids` are numerical while the others are categorical.

However, from just our initial exploration, it's clear that some of the columns won't be useful for our analysis. It is also apparent that we should find a way to address the potential issue `user_name` might have with the other columns. There's a potential for severe multicollinearity if we choose to just drop `user_name`, since the number of plays or likes a video would have a strong relationship with the user that post it. Therefore, any analysis without user and its related features would have to consider the user's account as confounding variables. In addition, we'll be forced to drop valuable features directly related to a user such as user followers, user total likes and user total videos (`n_followers`, `n_total_likes`, `n_total_vids`).

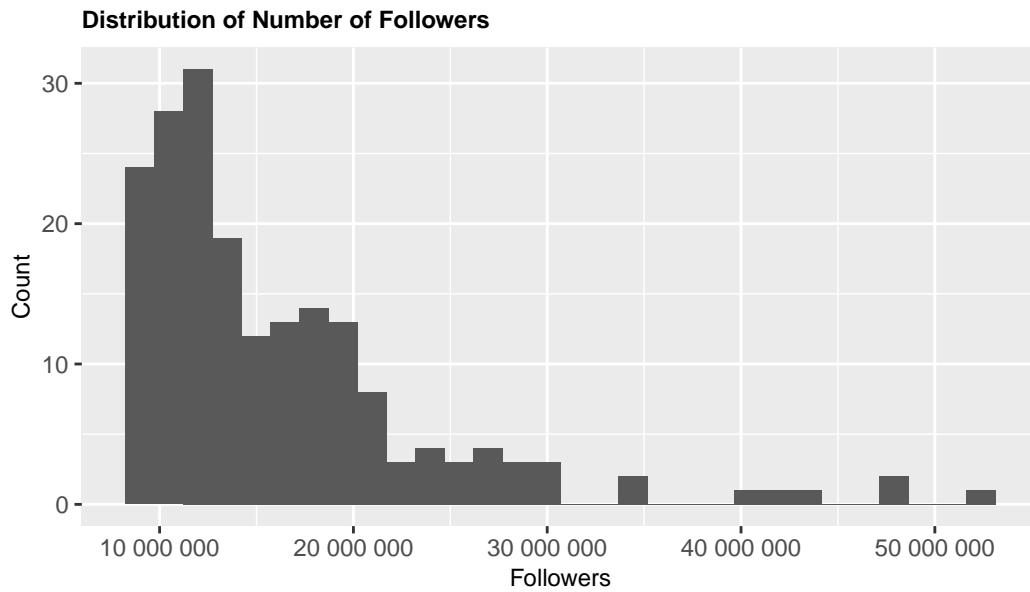
We see that the less relevant variables are create time and video ID. In addition, from looking at our data, hash tags and songs might not be useful. Most videos don't include a hashtag and there are too many unique instances of them for it to be valuable in our analysis. We could consider binning hashtag into none and at least 1 hashtag(s), however that wouldn't be useful for our analysis since its rare for tiktok followers to actually look at the hashtags. The same is true for songs; one could consider grouping original songs into one bin and the rest into others. However, from our domain knowledge, its wouldn't be useful to categorize all original songs as similar since most of them could just be user-edited snippets of actual songs.

To address the issues mentioned above, we grouped the data by users and summarized all relevant predictor variables by taking their mean. Our modified dataset now has 8 columns and 254 observations.

Note that no data leakage is introduced in this process since we are just summarizing by the means of the predictor variable per user. When we split, it'll split based on observations, users. We'll now split our data into testing and training.

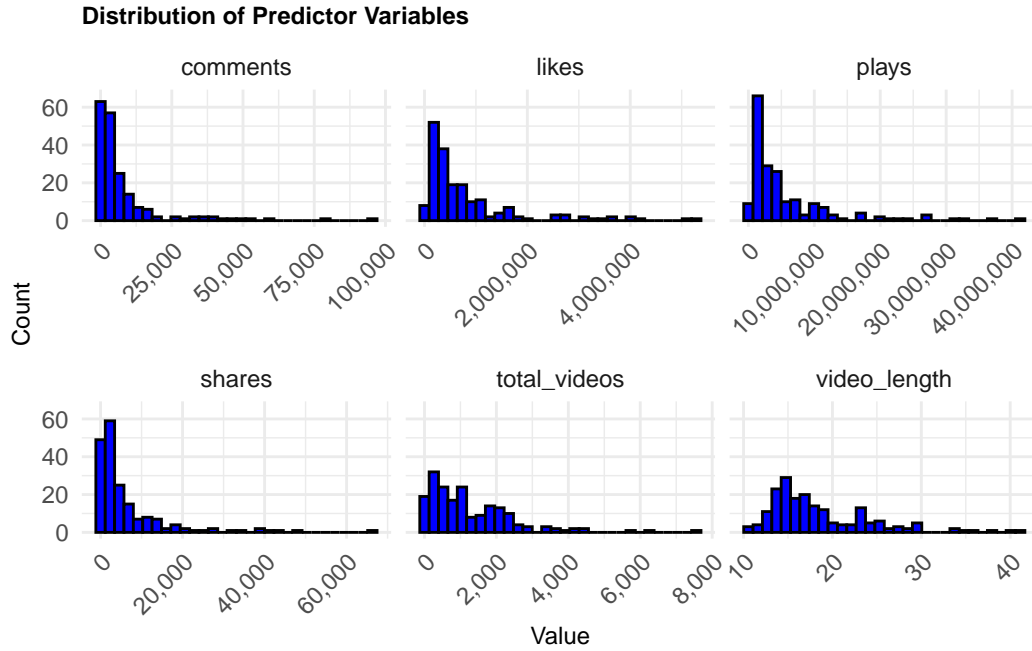
```
<Training/Testing/Total>  
<190/64/254>
```

Here's a distribution of our response variable, user followers, from our training set.

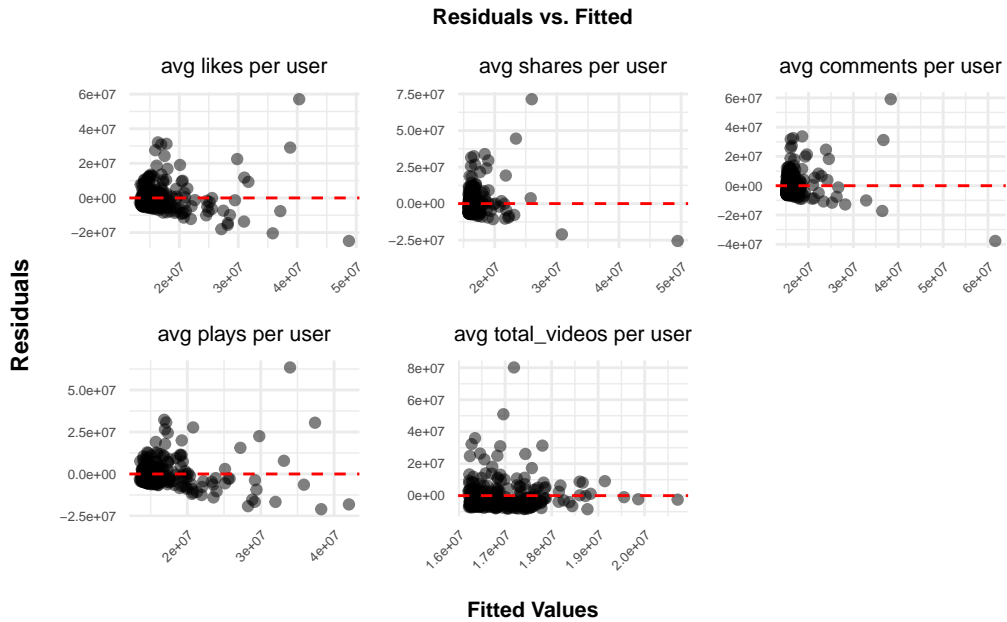


The distribution of our response variable follows, is unimodal and heavily right skewed. The mean is 16,220,526.3 and the standard deviation is 7,710,869.8. The minimum is 8,900,000 and the maximum is 52,300,000. Based on our standard deviation, there seems to be a lot of variation in our dataset; and from our plot, there are major outliers.

Here are the distributions for the predictor variables we are interested in:



judging by the number of outliers in our dataset, we are interesting in knowing how this might influence our model conditions. Hence, we have the following residual plots for each of them.

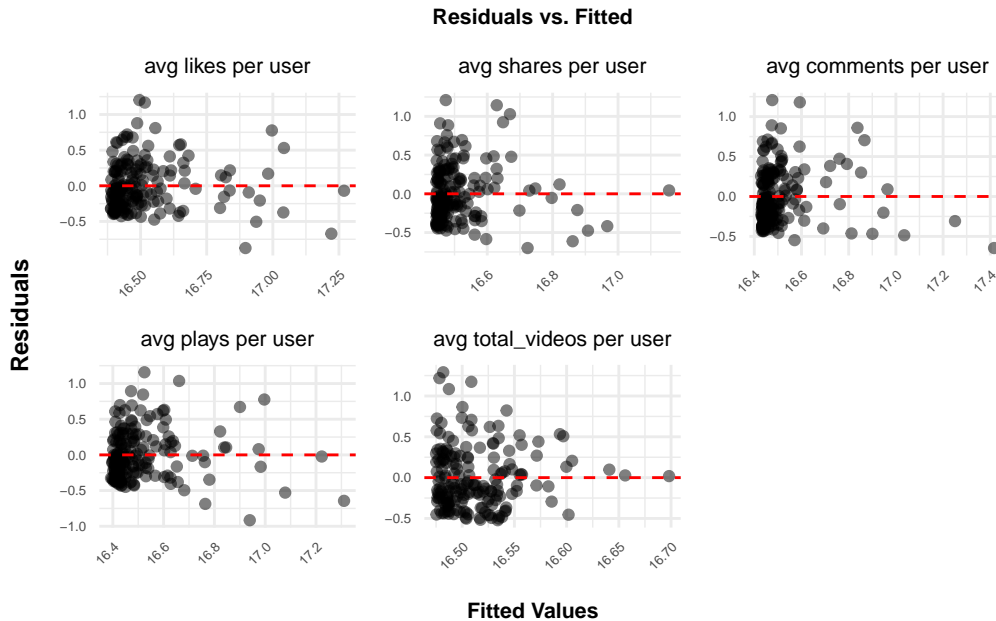


It's clear that all our predictors variables violates constant variance. There's a clear out-

ward spread for likes, shares, comments, plays and video\_length, while an inward spread for total\_videos.

For interpretability, it makes sense to process average bin video length into levels, corresponding to “short”, “medium” and “long.” This also allows us to search for interesting interactions effects video\_length might have with other predictors such as likes. Therefore, we’ll add `step_discretize()` into the recipe for video\_length.

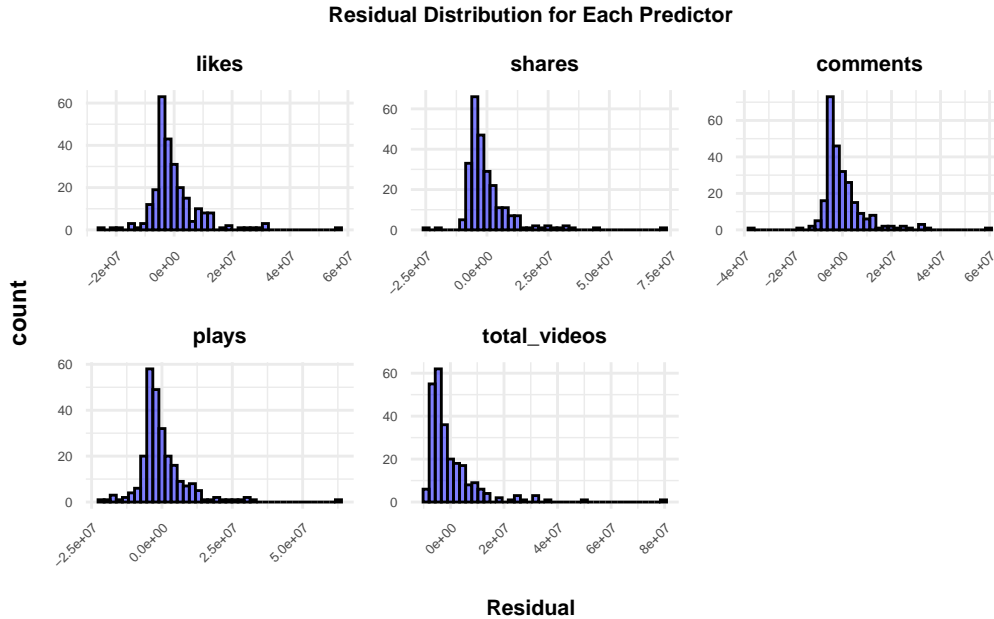
In order to deal with constant variance for the other terms, we log transformed the rest of the predictor variables.



Fanning is a lot less noticeable now. The residual plots don’t seem to suggest any underlying patterns. As such, we conclude the predictors satisfy linearity and constant variance.

We can also assume independence is met. Each of the videos are by individual creators, therefore the videos are independent of each other.

We continue with normality.



Normality seems to be satisfied for each of the predictors except total\_videos and possibly shares. However, even though total\_videos and shares do not have completely normal distributions, because we have more than 30 observations in the dataset, we can conclude that normality is satisfied regardless of the distribution.

## Methodology

We chose the model without plays, m2, because it had a lower AIC and BIC value, indicating that it was a better fit. Therefore, we choose to remove plays from the model and leave likes in the model to deal with the multicollinearity.

In our recipe, we fit the dataset 'tiktok\_user,' after which we added steps omitting all NA values from our predictors and log-transforming all our predictor variables and followers. We then conducted a cross-validation test on tiktok\_train.

## Detecting Multicollinearity & Model Comparison

In our model selection process, we are interested in detecting any multicollinearity. We found that likes and plays had the highest vif values in our VIF test (11.614 and 9.82 respectively).

likes	shares	comments	plays
11.613679	3.536988	2.681733	9.820479
video_length_bin2	video_length_bin3	total_videos	
1.394816	1.367240	1.181881	

Therefore, we constructed two linear regression model fitting variable ‘followers’ with predictor variables ‘likes’, ‘shares’, ‘comments’, ‘plays’, ‘video\_length\_bin’, and ‘total\_videos.’ Our first model m1 had all the previously indicated predictor variables excluding variable ‘likes’ while our second model m2 had those predictor variables excluding variable ‘plays.’ We compared these two models because meaning they have the highest likelihood for multicollinearity.

term	estimate	std.error	statistic	p.value
(Intercept)	16.512	0.024	675.614	0.000
shares	-0.119	0.046	-2.582	0.011
comments	0.105	0.035	2.982	0.003
plays	0.224	0.046	4.885	0.000
total_videos	0.113	0.027	4.243	0.000
video_length_bin2	0.001	0.029	0.027	0.979
video_length_bin3	0.028	0.029	0.973	0.332

term	estimate	std.error	statistic	p.value
(Intercept)	16.512	0.025	673.395	0.000
likes	0.238	0.050	4.753	0.000
shares	-0.098	0.044	-2.247	0.026
comments	0.060	0.039	1.533	0.127
total_videos	0.110	0.027	4.142	0.000
video_length_bin2	-0.001	0.029	-0.043	0.966
video_length_bin3	0.024	0.029	0.831	0.407

### Model Comparison with 5-fold CV

To determine which between m1 and m2, we perform 5-fold cross validation and extract the resulting BIC and AIC scores along with additional evaluations.

Model 1: (without likes):

RMSE:

```
# A tibble: 1 x 4
  mean_rmse mean_adj_rsqr mean_aic mean_bic
    <dbl>      <dbl>      <dbl>    <dbl>
1    0.340      0.266      90.7     114.
```

Model 2 (without plays):

RMSE:

```
# A tibble: 1 x 4
  mean_rmse mean_adj_rsq mean_aic mean_bic
    <dbl>      <dbl>      <dbl>    <dbl>
1    0.333      0.259      92.1     116.
```

The difference between the model's evaluations aren't large. Model 1 has a slightly higher RMSE, but it has a lower AIC and BIC, and a higher adjusted r-squared. In this case, we would consider model 1 (the model without likes) to be a better model since it's able to explain more of the variance while also maintaining lower AIC and BIC scores. Therefore, we choose to remove likes from the model and leave plays in the model to deal with the multicollinearity.

### Determining whether video\_length\_bin are necessary

We can see from our previous tidy table that the p-values associated with the video length bins are high, indicating that the variables aren't significant. Because of this, we can do once again do cross validation to test to see how a model without video\_length and likes performs against m1 (our chosen model without likes but contains video length).

Model 3 (without video length and likes):

```
# A tibble: 1 x 4
  mean_rmse mean_adj_rsq mean_aic mean_bic
    <dbl>      <dbl>      <dbl>    <dbl>
1    0.339      0.269      88.2     106.
```

We can see that when we remove video\_length, it makes sense that AIC and BIC both decrease. However, we also see that adjusted r-squared only slightly increased. We wish to further evaluate video\_length and potentially tease out some of its importance for our model. Therefore, we explore its role as an interaction term.

### Determining whether interaction terms are needed

To do this, we can start by adding all of the interaction terms associated with video\_length bins and observing our tidy table for significant coefficients. We will be incorporating both likes and plays into this model for a fuller evaluation of video\_length as an interaction term. The end goal is to determine whether the parsimonious model of not including likes and video\_length bin (model 3) is a better predictor than a model could potentially fully incorporate video\_length into itself.

This is a table with all of our interaction terms:



term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	16.509	0.025	671.654	0.000	16.460	16.557
likes	0.162	0.085	1.914	0.057	-0.005	0.329
plays	0.095	0.078	1.221	0.224	-0.059	0.249
shares	-0.118	0.050	-2.376	0.019	-0.216	-0.020
comments	0.069	0.043	1.603	0.111	-0.016	0.154
total_videos	0.129	0.029	4.458	0.000	0.072	0.186
video_length_bin2	0.005	0.029	0.160	0.873	-0.052	0.061
video_length_bin3	0.022	0.029	0.755	0.451	-0.035	0.078
likes:video_length_bin2	-0.028	0.055	-0.510	0.611	-0.137	0.081
shares:video_length_bin2	-0.002	0.056	-0.040	0.968	-0.113	0.108
total_videos:video_length_bin2	-0.009	0.036	-0.235	0.814	-0.081	0.063
likes:video_length_bin3	-0.158	0.062	-2.529	0.012	-0.281	-0.035
shares:video_length_bin3	0.132	0.060	2.202	0.029	0.014	0.250
total_videos:video_length_bin3	-0.041	0.028	-1.473	0.143	-0.095	0.014

We can see from the p-values in the table that likes:video\_length\_bin3 and shares:video\_length\_bin3 seem to be the only statistically significant interaction terms. Therefore, those terms should certainly be in our model. All three of the interaction terms associated with video\_length\_bin2 have extremely high p-values and low coefficients, meaning that video\_length\_bin2 is insignificant. The p-value for total\_videos:video\_length\_bin3 is not less than our significance level of 0.05, but it is still low. We can preform CV on a model with likes:video\_length\_bin and shares:video\_length\_bin.

Model 4 (with plays:video\_length and likes:video\_length interaction terms):

```
# A tibble: 1 x 4
  mean_rmse mean_adj_rsq mean_aic mean_bic
    <dbl>      <dbl>      <dbl>    <dbl>
1   0.338      0.284      91.9     130.
```

The mean RMSE (0.3378707) is barely smaller than model3, one without likes and video\_length\_bin (0.3389576). However given we are have included more terms, our adj r-square shows a slight increase (0.2839 vs. 0.26883, the latter is the parsimonious model), and BIC shows a noticeable decrease (130.3332 vs 105.9608). There's also a difference in AIC (91.944 vs 88.243). Becuase of the noticeable decrease in AIC and BIC going from model 4 to model 3 and because our the increase in our adj r-square isn't significant enough to consider, we choose the more parsimonious model, model 3.

## Results

Model 3 performance on test:

```
# A tibble: 2 x 3
  .metric .estimator .estimate
  <chr>   <chr>         <dbl>
1 rmse    standard        0.407
2 rsq     standard        0.362
```

Note that we log transformed our response variable. In order to evaluate the meaning of our RMSE of 0.4067, we take  $\exp(0.4067) \sim 1.502$ . This value is the multiplicative square difference. For example, if have log followers of 16.04552, our model will be more or less off by  $16.04552 \pm .4067^2 \Rightarrow \exp(16.04552 \pm 0.1654) \Rightarrow 7882219 < 9,299,954 < 10,972,689$ . This means our model does a fairly poor at predicting a tiktok user's followers. We also have an RSQ of 0.3615, indicating only 36.2% of the variability in followers can be explained by our predictor variables.

Interpreting useful coefficients:

- we were confused about how to write a meaning interpretation out since the scale of our data is so large. We could use “for every additional likes”, however a video could have millions of likes.

Interpreting intercept (since we mean centered all predictors):

## Conclusion

We originally decided to look at TikTok's data and how follower count (a huge driver of engagement) is impacted by other aspects of a user's account. We learned that it is extremely difficult to correctly predict follower count, given our model only captures 36.2% of the variability in the dataset. More complex models seemed to only worsen performance, and we chose to prioritize parsimony for this reason - however, even the simple models did not predict well.

Our dataset was extremely difficult to work with, given that it did not meet the conditions for linear regression (linearity and constant variance), and contained multicollinearity. The variables were also extremely large, and needed to be scaled down to have meaningful coefficients - which made late interpretation significantly more difficult. A more complex model was likely needed, that was beyond the scope of our knowledge, given how poorly our model performed at the end. There also may be underlying relationships between follower count, and other portions of the TikTok algorithm that are not contained in the dataset, which our model might have also failed to capture. In order to improve our analysis, it would be helpful to comb TikTok for a dataset that potentially contains more variables.

! Important

Before you submit, make sure your code chunks are turned off with `echo: false` and there are no warnings or messages with `warning: false` and `message: false` in the YAML.