lab07

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```r
spotify <- read_csv("spotify.csv")
```

```
## New names:
## * `` -> ...1
```

```
## Rows: 2017 Columns: 17
```

```
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (2): song_title, artist
## dbl (15): ...1, acousticness, danceability, duration_ms, energy, instrumenta...
```

```
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```r
glimpse(spotify)
```

```
## Rows: 2,017
## Columns: 17
## $ ...1             <dbl> 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,~
## $ acousticness     <dbl> 0.010200, 0.199000, 0.034400, 0.604000, 0.180000, 0.0~
## $ danceability     <dbl> 0.833, 0.743, 0.838, 0.494, 0.678, 0.804, 0.739, 0.26~
## $ duration_ms      <dbl> 204600, 326933, 185707, 199413, 392893, 251333, 24140~
## $ energy           <dbl> 0.434, 0.359, 0.412, 0.338, 0.561, 0.560, 0.472, 0.34~
## $ instrumentalness <dbl> 2.19e-02, 6.11e-03, 2.34e-04, 5.10e-01, 5.12e-01, 0.0~
## $ key              <dbl> 2, 1, 2, 5, 5, 8, 1, 10, 11, 7, 5, 10, 0, 0, 9, 6, 1,~
## $ liveness         <dbl> 0.1650, 0.1370, 0.1590, 0.0922, 0.4390, 0.1640, 0.207~
## $ loudness         <dbl> -8.795, -10.401, -7.148, -15.236, -11.648, -6.682, -1~
## $ mode             <dbl> 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0,~
## $ speechiness      <dbl> 0.4310, 0.0794, 0.2890, 0.0261, 0.0694, 0.1850, 0.156~
## $ tempo            <dbl> 150.062, 160.083, 75.044, 86.468, 174.004, 85.023, 80~
## $ time_signature   <dbl> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 3, 4, 4, 4, 4, 4, 4, 4,~
## $ valence          <dbl> 0.286, 0.588, 0.173, 0.230, 0.904, 0.264, 0.308, 0.39~
## $ target           <dbl> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ song_title       <chr> "Mask Off", "Redbone", "Xanny Family", "Master Of Non~
## $ artist           <chr> "Future", "Childish Gambino", "Future", "Beach House"~
```

Part 1: Data Prep & Modeling

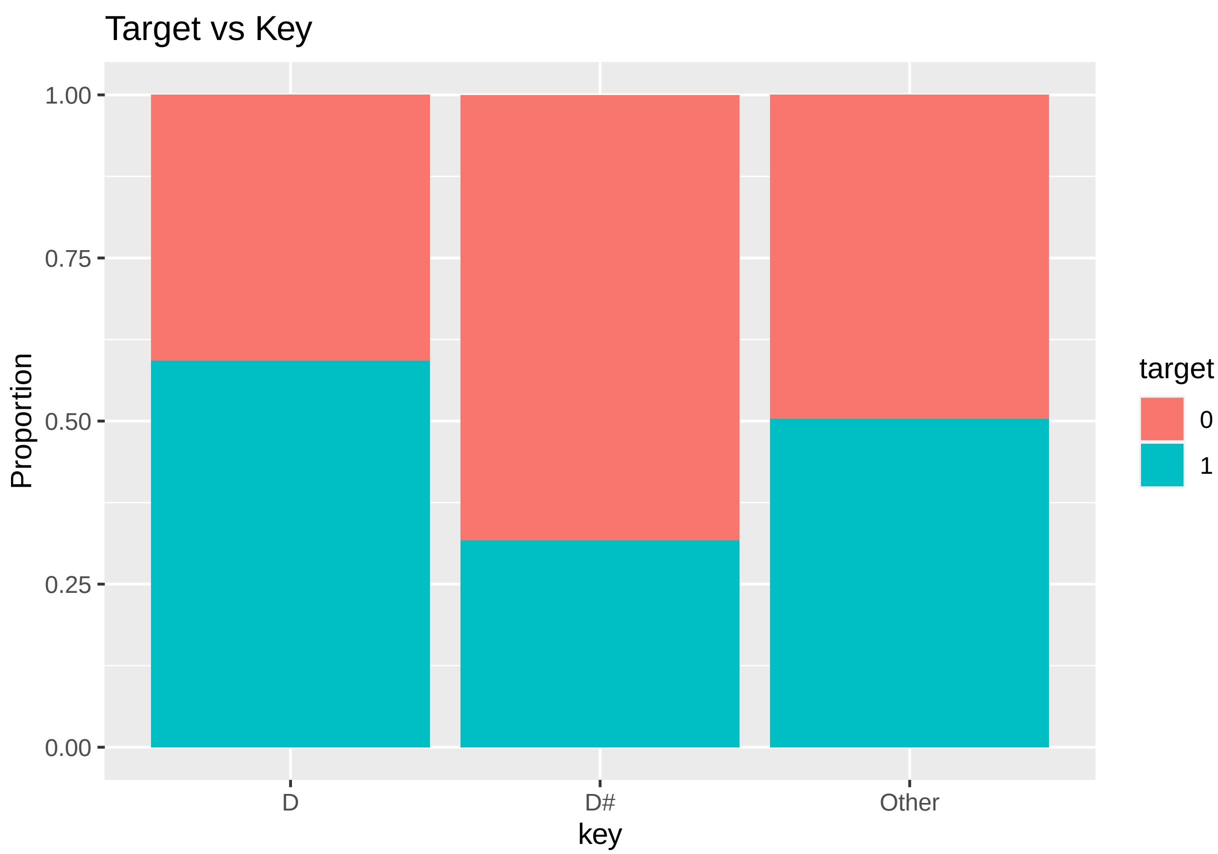
Exercise 1

```
spotify <- spotify %>%
  drop_na() %>%
  mutate(target = as.factor(target),
         key = case_when(
           key == 2 ~ "D",
           key == 3 ~ "D#",
           TRUE ~ "Other"
         ))

glimpse(spotify)
```

```
## Rows: 2,017
## Columns: 17
## $ ...1             <dbl> 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,~
## $ acousticness     <dbl> 0.010200, 0.199000, 0.034400, 0.604000, 0.180000, 0.0~
## $ danceability     <dbl> 0.833, 0.743, 0.838, 0.494, 0.678, 0.804, 0.739, 0.26~
## $ duration_ms      <dbl> 204600, 326933, 185707, 199413, 392893, 251333, 24140~
## $ energy           <dbl> 0.434, 0.359, 0.412, 0.338, 0.561, 0.560, 0.472, 0.34~
## $ instrumentalness <dbl> 2.19e-02, 6.11e-03, 2.34e-04, 5.10e-01, 5.12e-01, 0.0~
## $ key              <chr> "D", "Other", "D", "Other", "Other", "Other", "Other"~
## $ liveness         <dbl> 0.1650, 0.1370, 0.1590, 0.0922, 0.4390, 0.1640, 0.207~
## $ loudness         <dbl> -8.795, -10.401, -7.148, -15.236, -11.648, -6.682, -1~
## $ mode             <dbl> 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0,~
## $ speechiness      <dbl> 0.4310, 0.0794, 0.2890, 0.0261, 0.0694, 0.1850, 0.156~
## $ tempo            <dbl> 150.062, 160.083, 75.044, 86.468, 174.004, 85.023, 80~
## $ time_signature   <dbl> 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 3, 4, 4, 4, 4, 4, 4, 4,~
## $ valence          <dbl> 0.286, 0.588, 0.173, 0.230, 0.904, 0.264, 0.308, 0.39~
## $ target           <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
## $ song_title       <chr> "Mask Off", "Redbone", "Xanny Family", "Master Of Non~
## $ artist           <chr> "Future", "Childish Gambino", "Future", "Beach House"~
```

```
ggplot(data = spotify, aes(x = key, fill = target)) +
  geom_bar(position = "fill") +
  labs(title="Target vs Key",
       y="Proportion")
```



The plot above describes the relationship between Key and Target. For all songs in the key of D, about 60% of them have a target value of 1. For all songs in the key of D#, about 30% of them have a target value of 1. For all other songs, about half of them have a target value of 1.

Exercise 2

```
model <- glm(target ~ acousticness + danceability + duration_ms + instrumentalness + loudness + speechi

tidy(model, conf.int = TRUE, exponentiate = FALSE) %>%
  kable(format="markdown", digits = 5)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	-2.95548	0.27640	-10.69288	0.00000	-3.50377	-2.41978
acousticness	-1.72231	0.23982	-7.18155	0.00000	-2.19743	-1.25678
danceability	1.63040	0.34421	4.73664	0.00000	0.95847	2.30841
duration_ms	0.00000	0.00000	4.22500	0.00002	0.00000	0.00000
instrumentalness	1.35291	0.20659	6.54883	0.00000	0.95236	1.76298
loudness	-0.08744	0.01727	-5.06219	0.00000	-0.12160	-0.05383
speechiness	4.07238	0.58302	6.98493	0.00000	2.94695	5.23420
valence	0.85638	0.22326	3.83573	0.00013	0.41997	1.29551

Exercise 3

```
model_with_key <- glm(target ~ acousticness + danceability + duration_ms + instrumentalness + loudness +

summary(model)$aic
```

```
## [1] 2534.517
```

```
summary(model_with_key)$aic
```

```
## [1] 2525.16
```

Adding key to the model lowers the model's AIC, making it better at predicting target. Therefore, we will continue to use the model with key.

Exercise 4

```
tidy(model_with_key, conf.int = TRUE, exponentiate = FALSE) %>%
  kable(format="markdown", digits = 5)
```

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	-2.50934	0.31102	-8.06817	0.00000	-3.12416	-1.90422
acousticness	-1.70210	0.24091	-7.06521	0.00000	-2.17930	-1.23436
danceability	1.64880	0.34536	4.77417	0.00000	0.97468	2.32911
duration_ms	0.00000	0.00000	4.18744	0.00003	0.00000	0.00000
instrumentalness	1.38316	0.20745	6.66741	0.00000	0.98104	1.79505
loudness	-0.08662	0.01726	-5.01848	0.00000	-0.12075	-0.05301
speechiness	4.03380	0.58491	6.89650	0.00000	2.90456	5.19917
valence	0.88094	0.22434	3.92682	0.00009	0.44248	1.32224
keyD#	-1.07319	0.33497	-3.20385	0.00136	-1.74517	-0.42805
keyOther	-0.49390	0.16898	-2.92288	0.00347	-0.82793	-0.16468

If the key of the observation is D#, the target value's prediction will increase, by a value of exp(-1.07319).

Part 2: Checking Assumptions

Exercise 5

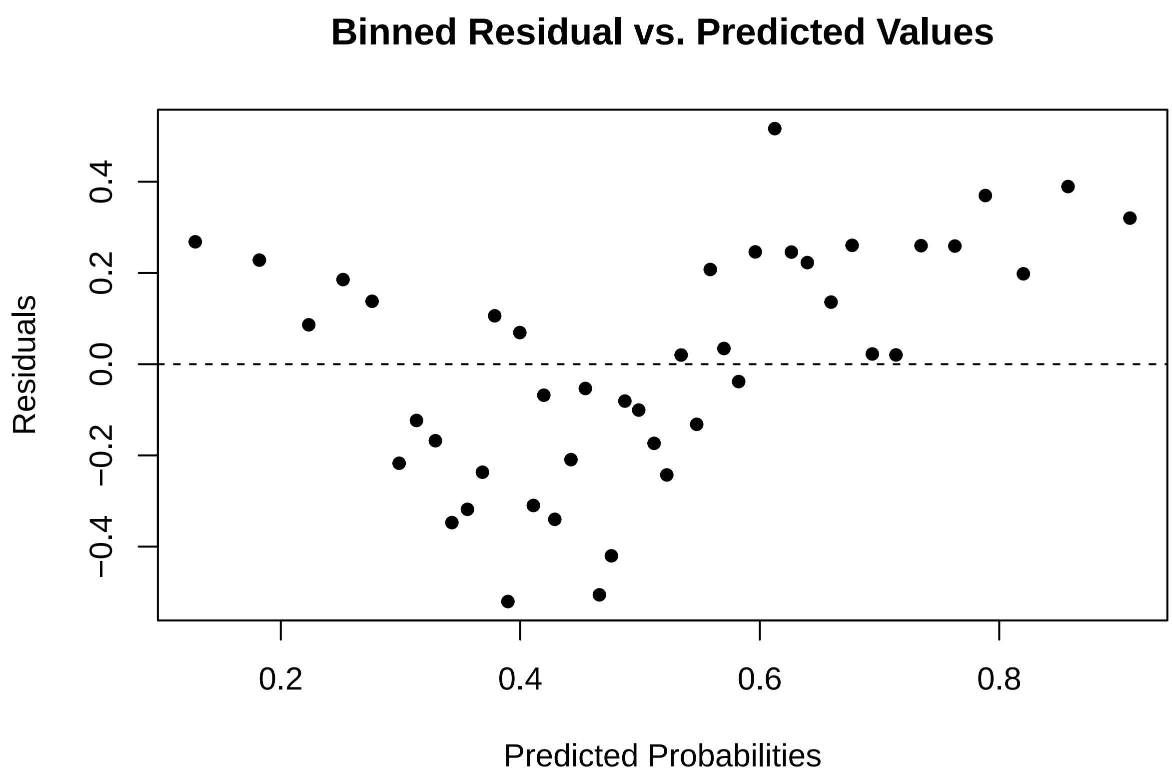
```
df <- augment(model_with_key, type.predict = "response",type.residuals = "deviance")
glimpse(df)
```

```
## Rows: 2,017
## Columns: 15
## $ target           <fct> 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,~
```

```
## $ acousticness     <dbl> 0.010200, 0.199000, 0.034400, 0.604000, 0.180000, 0.0~
## $ danceability     <dbl> 0.833, 0.743, 0.838, 0.494, 0.678, 0.804, 0.739, 0.26~
## $ duration_ms      <dbl> 204600, 326933, 185707, 199413, 392893, 251333, 24140~
## $ instrumentalness <dbl> 2.19e-02, 6.11e-03, 2.34e-04, 5.10e-01, 5.12e-01, 0.0~
## $ loudness         <dbl> -8.795, -10.401, -7.148, -15.236, -11.648, -6.682, -1~
## $ speechiness      <dbl> 0.4310, 0.0794, 0.2890, 0.0261, 0.0694, 0.1850, 0.156~
## $ valence          <dbl> 0.286, 0.588, 0.173, 0.230, 0.904, 0.264, 0.308, 0.39~
## $ key              <chr> "D", "Other", "D", "Other", "Other", "Other", "Other"~
## $ .fitted          <dbl> 0.9015924, 0.6379788, 0.7829667, 0.4223972, 0.8489462~
## $ .resid           <dbl> 0.4551764, 0.9481036, 0.6995214, 1.3128664, 0.5722926~
## $ .std.resid       <dbl> 0.4567745, 0.9493120, 0.7028629, 1.3163187, 0.5733889~
## $ .hat             <dbl> 0.006985200, 0.002544191, 0.009485687, 0.005238444, 0~
## $ .sigma           <dbl> 1.117466, 1.117311, 1.117402, 1.117126, 1.117439, 1.1~
## $ .cooksd          <dbl> 7.731894e-05, 1.451076e-04, 2.679972e-04, 7.238900e-0~
```

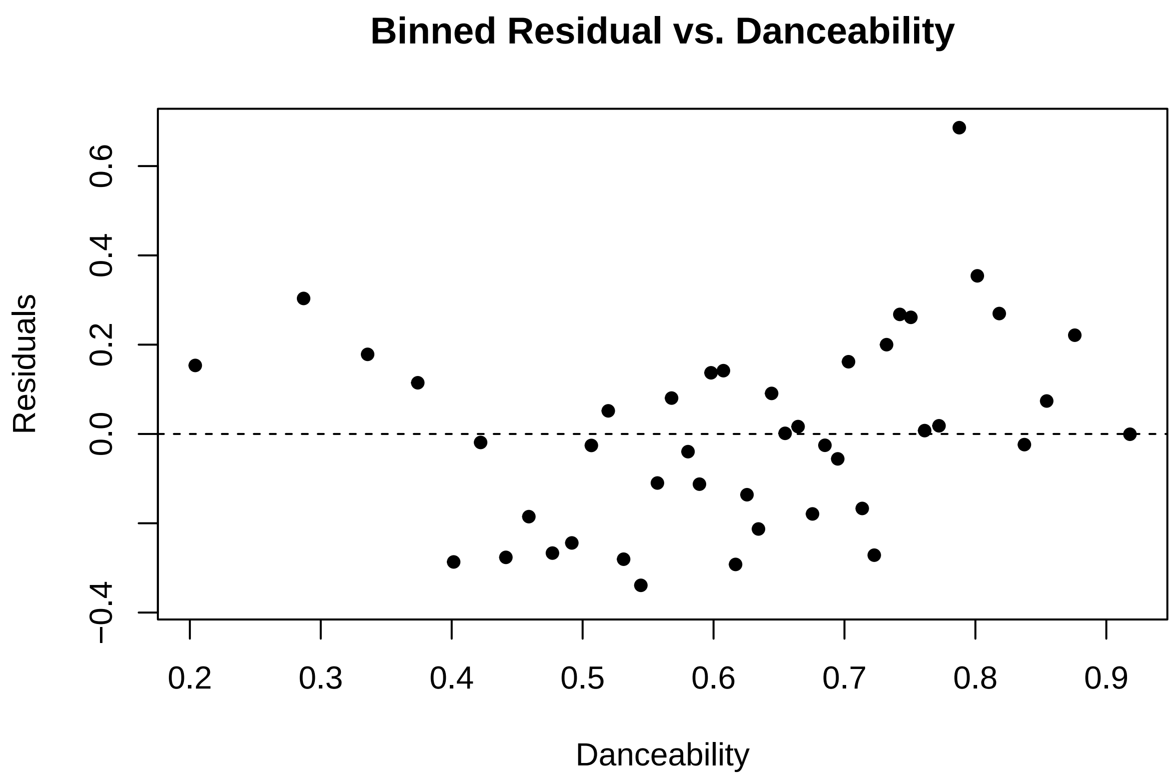
Exercise 6

```r
arm::binnedplot(x = df$.fitted, y = df$.resid,
                xlab = "Predicted Probabilities",
                ylab = "Residuals",
                main = "Binned Residual vs. Predicted Values",
                col.int = FALSE)
```



Exercise 7

```
arm::binnedplot(x = df$danceability, y = df$.resid,
                xlab = "Danceability",
                ylab = "Residuals",
                main = "Binned Residual vs. Danceability",
                col.int = FALSE)
```



Exercise 8

```
df %>%
  mutate(key_resid = if_else(.resid > 1 | .resid < -1, "High Residual", "Low Residual")) %>%
  group_by(key, key_resid) %>%
  summarise(n = n()) %>%
  kable(format="markdown")
```

```
## `summarise()` has grouped output by 'key'. You can override using the `.groups` argument.
```

key	key_resid	n
D	High Residual	98

key	key_resid	n
D	Low Residual	86
D#	High Residual	21
D#	Low Residual	42
Other	High Residual	1039
Other	Low Residual	731

Exercise 9

The linearity assumption is not satisfied because there is no clear linear relationship between our fitted values and our predictors, as shown by the plot in exercise 6.