# AE 05: Mathematical Models

**Songs on Spotify**

Driver: _____, Reporter: _____, Gopher: _____

2024-09-11

> **!** Important
>
> - Open RStudio and create a subfolder in your AE folder called "AE-05"
> - Go to the Canvas and locate your `AE 05` assignment to get started.
> - Upload the `ae-05.qmd` and `spotify-popular.csv` files into the folder you just created. The `.qmd` and PDF responses are due in Canvas no later than Saturday, September 14 at 11:59pm.

```
library(tidyverse)
library(ggformula)
library(broom)
library(knitr)
library(patchwork) #arrange plots in a grid
```

## Data

The data set for this assignment is a subset from the Spotify Songs Tidy Tuesday data set. The data were originally obtained from Spotify using the **spotifyr** R package.

It contains numerous characteristics for each song. You can see the full list of variables and definitions here. This analysis will focus specifically on the following variables:

| variable | class | description |
|---|---|---|
| track_id | character | Song unique ID |
| track_name | character | Song Name |
| track_artist | character | Song Artist |
| track_popularity | double | Song Popularity (0-100) where higher is better |

| variable | class | description |
|---|---|---|
| energy | double | Energy is a measure from 0.0 to 1.0 and represents a perceptual measure of intensity and activity. Typically, energetic tracks feel fast, loud, and noisy. For example, death metal has high energy, while a Bach prelude scores low on the scale. Perceptual features contributing to this attribute include dynamic range, perceived loudness, timbre, onset rate, and general entropy. |
| valence | double | A measure from 0.0 to 1.0 describing the musical positiveness conveyed by a track. Tracks with high valence sound more positive (e.g. happy, cheerful, euphoric), while tracks with low valence sound more negative (e.g. sad, depressed, angry). |

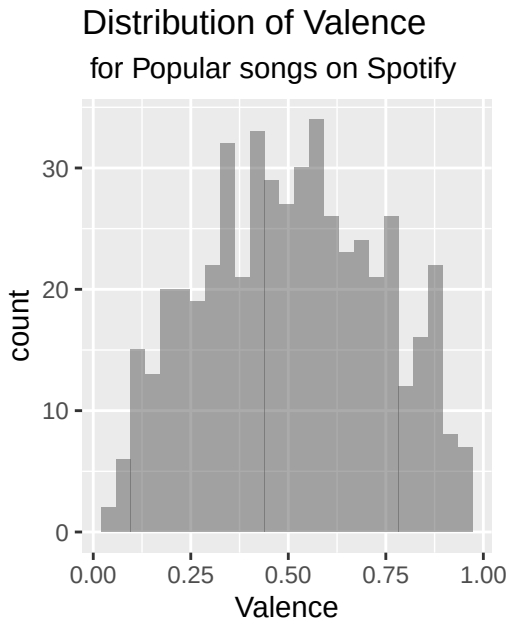
```
spotify <- read_csv("spotify-popular.csv")
```

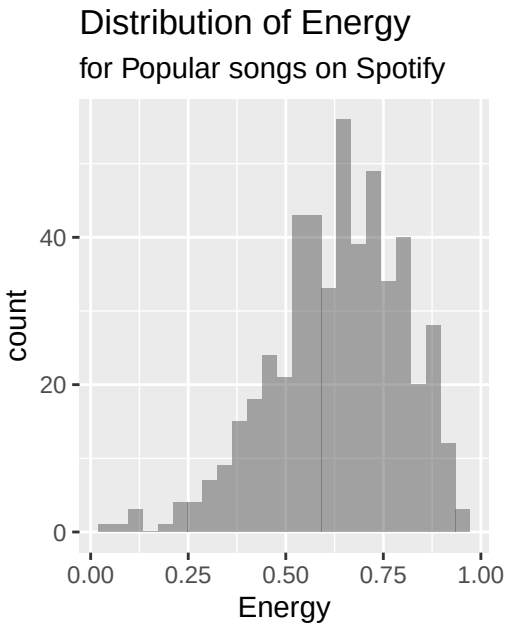
Are high energy songs more positive? To answer this question, we'll analyze data on some of the most popular songs on Spotify, i.e. those with `track_popularity >= 80`. We'll use linear regression to fit a model to predict a song's positiveness (`valence`) based on its energy level (`energy`).

Below are plots as part of the exploratory data analysis.

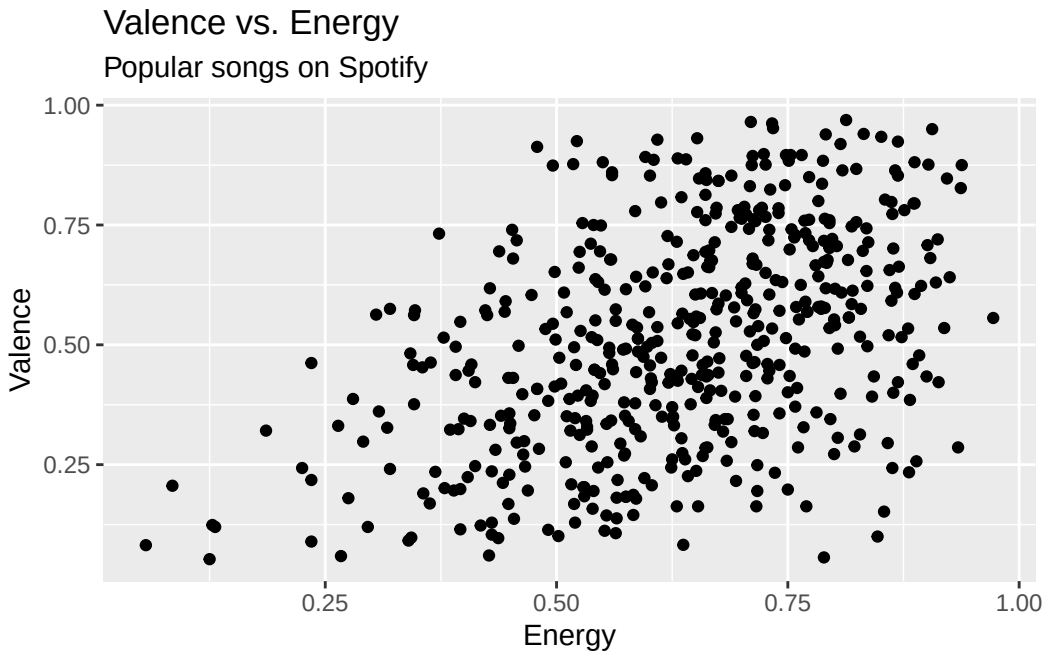
```
p1 <- gf_histogram(~valence, data = spotify) |>
  gf_labs(title = "Distribution of Valence",
       subtitle = " for Popular songs on Spotify",
       x = "Valence")

p2 <- gf_histogram(~energy, data = spotify) |>
  gf_labs(title = "Distribution of Energy",
       subtitle = "for Popular songs on Spotify",
       x = "Energy")
p1 + p2 # The patchwork package will arrange your plots for you
```




```
gf_point(valence ~ energy, data = spotify) |>
  gf_labs(title = "Valence vs. Energy",
       subtitle = "Popular songs on Spotify",
       x = "Energy",
       y = "Valence")
```



### Exercise 1

Fit a model using the `energy` of a song to predict its `valence`, i.e. positiveness. Include the 90% confidence interval for the coefficients, and display the output using 3 digits.

```
## add code
```

### Exercise 2

In words interpret the estimate and confidence interval for the slope in the previous exercise.

### Exercise 3

Interpret the p-value from Exercise 1.

### Exericse 4

Predict what the average valence for a song with an energy score 0.5 is. Report and interpret a 90% confidence interval for the average valence.

### Exericse 5

Report and interpret a 90% confidence interval for a single song with energy score 0.8.

> **!** Important
>
> To submit the AE:
>
> - Render the document to produce the PDF with all of your work from today's class.
> - Upload your qmd and pdf files to the Canvas assignment.