1. Introduction

Radio, after its “golden age” of network programming in the 1930s and 1940s, almost died in the 1950s. The advent of television led many popular comedy shows, dramas, and serials to make the move to the new technology, leaving network radio with the remaineder offerings. Advertising money migrated to television as well. Between 1945 and 1962, network radio advertising revenues fell from $134 million to $44 million per year (Fatherley and MacFarland 2014). That is not to say that there was no remaining network component after 1962; news was the primary offering of radio networks along with a few entertainment shows. Don McNeill’s “Breakfast Club” did not leave the air until 1968 after 35 years of broadcasts, and remained on Chicago station WLS even after its switch to Top 40 in 1960. It is safe to argue, however, that radio in the 1950s was in trouble; it would take a revolution in local radio to save it.

Broadcaster Todd Storz is widely credited with the development of the Top 40 format. Storz, owner of KOWH in Omaha, Nebraska, is alleged to have observed the music listening habits of patrons in a bar. He and program director Bill Stewart noticed that the same songs received play through the evening. They were most astonished to see, after closing time, the waitress spend her tip money to play the same song that had played all day “three times in a row” (Simpson 2011; Fong-Torres 2001). Interestingly, this same story is also attributed to Storz, but took place when he was stationed in the Army (Fatherley and MacFarland 2014), calling into question the exact creation of the format. The concept to limit the station’s playlist to 40 records — the same quantity as was held in the jukebox — and offer the listening public the same sort of repetition is not in question, as Storz executed this format with dramatic results. Within a year, KOWH had risen to the top of the Omaha ratings, and Storz went on to purchase stations in New Orleans, Kansas City, Minneapolis, and Miami, and change them to similar formats (Simpson 2011).

The advent of Top 40 radio created a new position in the broadcast lexicon: consultant. The execution of Top 40 had become known as “formula radio,” and experts would often be hired by radio station management to assist with the proper execution of the formula. These consultants would work with multiple radio stations across the country, examining playlists and ensuring that stations operated in the same way. By the end of the 1960s, WLAV and WGRD in Grand Rapids, which originally published lists of up to 50 selections, had tightened their lists down to a Top 30 presentation. By lowering the number of available selections to be heard on the station, the consultant narrowed the number of possible songs that could receive airplay on a station. Program directors were limited in terms of whether they could or could not add a song to the station given two factors: (1) the decreased number of opportunities for adding to a playlist, and (2) the fact that, at most stations, the consultant answered only to the station general manager or owner, and any other employees were therefore subject to following the instruction of the consultant. The role of the radio consultant informed the first set of research questions.

How closely do the playlists of Chicago radio stations (WCFL, WJJD, and WLS) match the national Billboard chart, and did this change over time?

How closely do the playlists of Grand Rapids radio stations (WGRD and WLAV) match the national Billboard chart, and did this change over time?
Many stations made the change to Top 40 format in the early 1960s just as racial and gender equity issues began to impact all of society’s institutions. African-Americans and women began to demonstrate for civil rights and equal protection under the law. Radio certainly was not immune to the competing forces in society. Race and gender issues informed the second set of research questions.

Was there evidence that African-American artists were not played as frequently on local stations as their national popularity warranted?

Was there evidence that female artists were not played as frequently on local stations as their national popularity warranted?

Was there evidence that African-American female artists were not played as frequently on local stations as their national popularity warranted?

The dataset described in this article came about as a serendipitous byproduct of the authors meeting in a faculty-to-faculty mentoring group sponsored by the Pew Faculty Teaching and Learning Center at Grand Valley State University during the 2014–2015 academic year. In the next section, we describe the dataset and provide some context for how radio charts were created in the 1960s. A brief explanation of radio charts helps students to understand just how different radio stations were in the 1960s than they are now.

2. Billboard Radio Chart Data

All of the radio chart data were hand-entered by O’Kelly from old radio charts. Figure 1 shows a Top 30 chart (in the late 1960s some radio stations began to produce a Top 30 chart instead of a Top 40 chart) for WGRD in Grand Rapids, Michigan for January 1, 1969.

While there was not a standard format for radio charts in the 1960s, most of them had the information contained in this example chart. The date at the top “PREVIEWED JANUARY 1, 1969” specifies the week to which the chart corresponds. The column at the left labeled “THIS WEEK” shows the songs in descending order of chart position — that is, chart position 1 is the “top of the charts” and the best position. An interesting side note is that just because a song was listed at Number 1 for the radio station is no guarantee that it was the most played song for that week. The data was compiled by hand rather than by computer, and how a station determined the ranking of a song was a bit mysterious and varied from station to station. In the lower right corner of the chart, it states, “The WGRD survey is a true, accurate and unbiased account of record popularity, based, in part, upon local sales reports and listener requests.” The second column labeled “TITLE” is the name of the song. Interestingly, on this chart song number 27 is Hey Jude written by John Lennon and Paul McCartney of The Beatles but done in a remake by Wilson Pickett. The third column labeled “ARTIST” is the performer of the song. The column “LABEL” is the name of the record company that released the song. A feature of 1960s pop music is that there were many small independent labels releasing popular music that got Top 40 airplay. The column labeled “LAST WEEK” is the position of the song on the previous week’s chart, where HB indicates that the song was not on the previous week’s chart.

Figure 1. Top 30 radio chart for WGRD for week of January 1, 1969.
Table 1. Key variables in the Top 40 radio dataset.

| Name         | Description                                                                 |
|--------------|-----------------------------------------------------------------------------|
| Title        | Name of the song                                                            |
| Artist       | Individual or group who recorded the song                                   |
| RecordLabel  | Record company that released the song                                       |
| BBTop100     | Date the song first debuted in the Billboard Top 100                        |
| BBTop40      | Date the song first debuted in the Billboard Top 40                          |
| BBPeak       | Highest position (closest to 1) the song reached on the Billboard chart      |
| WJJDDec      | Decision on whether to play song where nc = station was not in Top 40 format at time; dnp = station did not play song |
| WJJDebebut   | Date the song first debuted on the WJJD station chart                        |
| WJJDPeak     | Highest position (closest to 1) the song reached on the WJJD station chart   |
| Gender       | Gender of solo artist or lead singer/instrumentalist in group (0 = male, 1 = female) |
| Race         | Race of solo artist or lead singer/instrumentalist (0 = white, 1 = black, 2 = Hispanic) |
| Local        | Indicator of whether the act is local to the radio station (i.e., an act based in Chicago would be local to Chicago radio stations) where 0 = not local, 1 = Chicago based, 2 = Grand Rapids based |
| Motown_Soul  | Indicator of Black artist song type where 0 = not Black artist, 1 = Pop/Motown, 2 = Soul, 3 = Instrumental |

The dataset includes all songs that made the national Billboard charts Top 40 and/or charted at one or more of five different Top 40 radio stations (three in Chicago, Illinois and two in Grand Rapids, Michigan) from April 4, 1960 through December 31, 1970. The dataset includes 5746 observations and 26 variables, one of which is an ID variable. Because the dataset was created by-hand from thousands of hard copy weekly radio charts, there were numerous errors in the original, raw version of the data. In the body of this article, we discuss analysis of the cleaned dataset. In Appendix A, we discuss use of the raw dataset in an R programming class that focused on data management and data cleaning, in addition to data analysis.

The cleaned dataset (radio.xlsx) that is ready for analysis can be found in the online supplements. While we leave an exhaustive description of all variables to the data documentation file (radioDataDoc.txt, see online supplements), we highlight key variables in Table 1. The variables WJJDDec, WJJDebebut, and WJJDPeak have corresponding variables for each of the other four radio stations studied. For example, there are variables named WLSDec, WLSDebebut, and WLSPeak that correspond to each song's airplay on radio station WLS.

Table 2 shows the first observation in the dataset. The song 96 Tears was recorded by ? and the Mysterians (the ? is part of the band’s name) and was released on the Cameo 428 record label. The song debuted in the Billboard Top 100 on September 3, 1966 and in the Billboard Top 40 on September 17, 1966. The song reached #1 on the Billboard chart. WJJD and WGRD were not in Top 40 format at this time; hence, the nc value for WJJDDec and WGRDDec and the missing values for WJJJDebut- but, WJJDPeak, WGRDDebebut, and WGRDPeak. 96 Tears debuted on WLS on September 9, 1966 and on WCFL on September 15, 1966 and reached #1 on both stations. The song debuted on WLAV on August 26, 1966 and reached #2. The lead singer for the group is male (Gender = 0) and Hispanic (Race = 2). ? and the Mysterians are not a Chicago-based or Grand-Rapids-based act (Local = 0) and the song is not by a black artist (Motown_Soul = 0).

O’Kelly’s work is the only known extant dataset of the combined radio charts from the 1960s for the three Chicago radio stations (WJJD, WLS, and WCFL) and the two Grand Rapids radio stations (WGRD and WLAV).

The following files are included with this dataset and story in the online supplements:

1. radio.xlsx — This is the cleaned version of the dataset used in the analysis described in Section 3.
2. radioDataDoc.txt — This file details variable names and values.
3. radio R script.R — This is the complete R code used to do the analyses discussed in Section 3.
4. radioraw.xlsx — The original, raw dataset. This is the dataset used in Appendix A by the students in an introductory R programming course. The dataset requires extensive cleaning.
5. radio R script data cleaning.R — This is the complete R code used to clean the original, raw dataset. The data cleaning is described in Appendix A.

3. Results from the Analyses

Most of the five radio stations were not in Top 40 format for the entire time of the dataset from 4-4-1960 to 12-31-1970. Figure 2 shows when each of the five stations was in Top 40 format. WCFL was in Top 40 format from 12-16-1965 through 12-31-1970. WGRD was in Top 40 format from 1-14-1960 through 11-20-1964 and then again from 4-14-1967 through 12-31-1970. WJJD was in Top 40 format from 2-29-1960 through 3-7-1966. WLAV was in Top 40 format from 12-71962 through 12-31-1970. WLS was in Top 40 format from 1014-1960 through 12-31-1970. When making comparisons between radio stations and the Billboard Top 40 or between two radio stations, subsets were created to match the time the stations were in Top 40 format. (Note: Some songs that charted on Billboard after 4-4-1960 charted on the radio station before 4-4-1960 and some songs that charted on Billboard late in 1970 did not chart on the radio station until 1971. Because we are interested in how closely each station’s chart matches the national chart, we kept these songs in the dataset for each station.)
Students were tasked with using the data to investigate several research questions. In the next section, we begin with an investigation of the discrepancy between each radio station’s Top 40 chart and the national Billboard Top 40 chart.

### 3.1. Station Comparisons to the Billboard Charts

The first two research questions investigated were:

- **How closely do the playlists of Chicago radio stations (WCFL, WJJD, and WLS) match the national Billboard chart, and did this change over time?**
- **How closely do the playlists of Grand Rapids radio stations (WGRD and WLAV) match the national Billboard chart, and did this change over time?**

The goal is to find a measure of discrepancy between each station and Billboard. Students created three different measures of discrepancy.

#### R Code: Create a dataframe for WJJD40

```r
WJJD40 = radio %>% filter(((BBT>= 1960-02-25) & (BBT<= 1966-03-07)) | ((WJJDDebut >= 1960 - 02 - 25) & (WJJDDebut <= 1966 - 03 - 07))) %>%
select(ID, Title, Artist, RecordLabel, BBT40, BBP, WJJDDebut, WJJDPeak, Gender, Race, Local, Motown, Soul)
```

#### Figure 2. Time in Top 40 format and songs played compared to Billboard Top 40.

![Figure 2](image)

Billboard Top 40 (solid violet line in Figure 2). While there is no indication on the graph that the same songs were played by WCFL as charted nationally, it is informative that the number of songs charting on WCFL approximates the number of songs on the Billboard national charts. (In Figure 2, the data points are counts of songs for each year. For example, WCFL had 346 songs that charted in 1966. The use of a line graph is helpful for showing yearly trends in the data.)

#### R Code: Create Figure 2

```r
R Code: The R code to create Figure 2 requires students to (1) filter songs by radio station by year to match when each station was in Top 40 format, (2) find the number of songs that charted on each station and Billboard each year the station was in Top 40 format, and (3) create a data frame from which to make the graphic. The code is included in the radio R script file on lines 57-565.
```

Other radio stations show more discrepancy for the number of songs that charted on the Billboard Top 40 and the number of songs that charted on the station than does WCFL. The Chicago station WJJD played more songs each full year it was in Top 40 format (1961 through 1965) than charted in the Top 40 on Billboard. The discrepancy is fairly large with WJJD averaging 437 songs per year during the five-year time period while 299 songs charted per year on Billboard. The third Chicago station WLS is particularly interesting because it was in Top 40 format for the entire time period of the dataset. For the full years from 1961–1965, WLS averaged 427 songs per year (compared to 299 for Billboard). However, beginning in 1966 through 1970, the discrepancy between WLS and Billboard drastically decreased with WLS averaging 302 songs per year compared to 290 for Billboard.

The first measure of discrepancy compared the number of songs that charted on a station to the number of songs that charted on Billboard for each year that the station was in Top 40 format. Figure 2 shows the number of songs that charted on each station compared to the numbers of songs that charted on the Billboard Top 40. Recall that except for WLS the other four stations were not in Top 40 format the entire time period represented in the dataset. In Figure 2, the light-gray-shaded regions correspond to when each station was in Top 40 format. For example, WCFL was in Top 40 format from 12-16-1965 to the end of the data collection time period 12-31-1970. Comparing each station’s line graph to the Billboard line graph is a measure of discrepancy. The number of songs played by WCFL (dashed blue line in Figure 2) closely matches the number of songs in the
Grand Rapids stations WGRD and WLAV exhibit the same behavior as the Chicago stations with more discrepancy from the Billboard chart from 1961–1965 and less discrepancy from 1966–1970. WGRD averaged 356 songs charted per year from 1961–1963 and 297 songs from 1968–1970 while the matching years numbers for Billboard were 292 (1961–1963) and 267 (1968–1970). WLAV averaged 422 songs charted per year from 1963–1965 and 289 songs from 1966–1970 while the matching years for Billboard were 302 songs (1963–1965) and 290 songs (1966–1970).

The less discrepancy between radio station airplay and the Billboard charts in the latter half of the 1960s is commensurate with the advent of radio consultants as discussed in Section 1.

A second measure of discrepancy used was to find the number of songs that charted on both the station and Billboard (i.e., the number of “matches”), on the station only, and on Billboard only. Figure 3 shows the results by year for each radio station. In each panel of Figure 3, the dashed black line corresponds to songs that charted on both Billboard and the radio station; the solid violet line corresponds to songs that charted on Billboard but did not chart on the radio station; and, the dashed light blue line corresponds to songs that charted on the radio station but not on Billboard.

For WCFL, most songs charted on both WCFL and Billboard (1145 songs) with about equal numbers charting on Billboard only (339) and WCFL only (307). This is not surprising as Figure 2 showed that WCFL had the closest adherence to the national charts for the total number of songs played. In contrast, each of the other stations displayed greater discrepancy from the national charts with the distinguishing feature being that many more songs charted on the station than did nationally. For example, WJJD had 1506 songs that charted on the station and Billboard, 253 songs that charted only on Billboard, and 1026 songs that charted only on WJJD. The graphs for WLS, WLAV, and WGRD all show that beginning in 1965 the discrepancy between each station and the Billboard charts decreased dramatically as the light blue dashed lines are closer to the solid violet line.

The third approach that students used to measure discrepancy from the national charts was to correlate the station peak chart position for the song to the Billboard peak for the song. Only songs that charted on both the station and in the Billboard Top 40 were used in the analysis. Figure 4 shows the peak for each song that charted on both Billboard and a station for each of the five stations. Consider the plot of BBPeak against WCFLPeak. This plot includes all songs that charted in the Top 40 on Billboard and on WCFL. Similarly, for the other four stations.

We draw the following conclusions from Figure 4:

- All five stations have a cluster of points in the lower left corner. This equates to songs that charted in the Top 10 on Billboard and on the radio station.
- All stations show only moderate correlation in station chart position to Billboard chart position. The correlations range from 0.35 (for both Grand Rapids stations WGRD and WLAV) to 0.53 for WCFL. The correlation values for the three Chicago stations WCFL, WJJD, and WLS are closer to 1 than the two Grand Rapids stations WGRD and WLAV. Coupled with the scatterplots, these values suggest that the two Grand Rapids stations had greater discrepancy from the Billboard charts than did the three Chicago stations.
- WCFL has relatively few songs with WCFL Peak between 30 and 40. This is because often WCFL only reported a Top 30 chart.
- There is some clustering of points with WGRD Peak between 20 and 30 and with WLAV peak between 25 and 35. These points include numerous songs where the station peak was much further from the top chart position than the Billboard Peak. Interestingly, these are the two Grand Rapids stations.

### 3.2. Black Artists’ Airplay

Throughout the 1960s, African-Americans demonstrated for equal protection under the law in response to racial bias. The third research question investigates whether bias against African-Americans was present in local radio airplay in the 1960s.

**Was there evidence that African-American artists were not played as frequently on local stations as their national popularity warranted?**

Table 3 shows the number of songs by black artists that charted on Billboard and/or a radio station. For example, there

---

**R Code:** The code to find the correlation between WCFLPeak and BBPeak is:

```r
cor(WCFLPeak ~ BBPeak, data = scratch)
```

**WCFL:60**

```r
ggplot(data = scratch) + geom.point(size = 1.5, shape = 1, color = "blue", position = "jitter") + geom.abline(intercept = 0, slope = 1, color = "blue", size = 1.5) + theme(panel.background = element_rect(fill = "white", colour = "red")
```
were 643 songs that charted on Billboard and/or WJJD. Of these songs, 289 charted on both Billboard and WJJD, 290 charted on only Billboard, and 64 charted on only WJJD. Considering that Figure 3 shows that WJJD had more songs chart overall than did Billboard, the large difference in the number of songs by black artists that charted nationally compared to WJJD suggests that black artists were not played as often as their national popularity warranted.

WLS played the same number of records by black artists as charted nationally with 1000 records by black artists charting on WLS and nationally (748 songs charted on both WLS and Billboard, 252 songs charted on only WLS, and 252 songs charted on only Billboard). The number of songs by black artists that charted nationally but not on WLS is balanced by the number of songs by black artists that WLS played that did not chart nationally. WCFL had a profile much closer to WJJD than WLS when it came to playing black artists. There were 204 songs that charted nationally that WCFL did not play, while there were only 22 songs that WCFL played that did not chart nationally.

The two Grand Rapids stations WGRD and WLAV behaved similarly to each other in the play of songs by black artists. Both stations had many more songs that charted on Billboard but not on the station (376 for WGRD and 321 for WLAV) than they had songs that charted on the station but not on Billboard (138 for WGRD and 114 for WLAV).

Interestingly, the Grand Rapids station WGRD did not play 17 songs by black artists that peaked at #1 nationally. Those songs include Hit the Road Jack by Ray Charles, Pony Time and The Twist by Chubby Checker, Save The Last Dance For Me by The Drifters, and one of the most recognizable songs from the 1960s Respect by Aretha Franklin. Respect was not played by WLAV either.

After viewing these results O’Kelly theorized that more “black” sounding soul songs may have fared poorer than more mainstream (i.e., largely white radio acceptable) “pop” songs. This led to a related question:

Did the songs by African-American artists with more of a “soul” feel fare poorer relative to the Billboard chart on local radio station charts than songs with a “pop” feel?

Figure 5 shows radio airplay for black artists’ soul records and black artists’ pop records. The bottom green portion of each bar corresponds to songs that charted on both the station and

| Station | Charted both | Billboard only | Station only | Station and/or Billboard |
|---------|--------------|----------------|--------------|--------------------------|
| WJJD    | 289 (45%)    | 290 (45%)      | 64 (10%)     | 643                      |
| WLS     | 748 (60%)    | 252 (20%)      | 252 (20%)    | 1252                     |
| WCFL    | 278 (55%)    | 204 (40%)      | 22 (4%)      | 504                      |
| WGRD    | 467 (48%)    | 376 (38%)      | 138 (14%)    | 981                      |
| WLAV    | 455 (51%)    | 321 (36%)      | 114 (13%)    | 890                      |

*Percentages are taken out of the Station and/or Billboard count.
Figure 5. Black artist airplay soul and pop records.

Billboard; the middle orange-yellow colored portion of each bar corresponds to songs that charted on Billboard but not on the station; and, the upper blue portion of each bar corresponds to songs that charted on the station but not on Billboard. It should be no surprise that many more pop records charted nationally and at most local radio stations than did soul records. The Motown pop sound was ubiquitous in the 1960s with groups such as The Temptations and The Supremes scoring many hit songs.

Figure 5 shows the conditional distribution of where a song charted (both Billboard and Station, Billboard only, Station only) by Black Record Type (Pop or Soul). For example, the two bars to the far left correspond to all songs by black artists that charted during the time that WCFL was in Top 40 format. The first bar represents pop songs; the second bar represents soul songs.

We draw the following conclusions from Table 3 and Figure 5:

- There is a large disparity from station to station in the number and type of black records that charted. Some of this can be traced to when a station was in Top 40 format. WCFL was in Top 40 format during the latter half of the 1960s when soul records gained more popularity. WJJD was in Top 40 format in the first half of the 1960s when pop records dominated.

- Chicago station WLS was in Top 40 format the entire time period so the large discrepancy between soul and pop records cannot be explained by the popularity of the Motown sound in the early to mid-60s alone. During the entire time frame, 27.4% of the black artists’ songs that charted nationally and/or on WLS were soul songs, and 72.6% were pop songs. By comparing songs that charted on Billboard only (orange-yellow portion of bar) to songs that charted on WLS only (blue portion of bar), we see that slightly more pop songs charted on WLS only compared to Billboard only, but many more soul songs charted on Billboard only compared to WLS only. In fact, there were 19 soul songs that charted in the Billboard Top 10 that did not chart on WLS.

- The two Grand Rapids stations WGRD and WLAV have somewhat similar profiles. About half of all black artists’ songs charted on both Billboard and the station whether the songs were pop or soul. The ratio of Billboard only to station only did vary by station and song type. For WGRD, the ratio is three Billboard only to one WGRD only for pop records and 2.5 to 1 for soul records. For WLAV, the ratio is 2.1 to 1 for pop records and 4.5 to 1 for soul records. Interestingly, neither station played Respect by Aretha Franklin which charted at #1 nationally. WLAV also did not play When A Man Loves A Woman by Percy Sledge that charted at #1 nationally. In total, WGRD did not play 26 soul songs that charted in the Top 10 nationally while WLAV did not play 32 such songs. WLAV appears to have had a particular aversion to playing James Brown’s songs having chosen not to play nine songs that reached the Top 10 nationally.

Teacher Tip: To create Figure 5 students need to filter observations by station by year to find the number of black soul records and the number of black pop records that charted. Next, it is helpful to create a data frame with columns Station, Type (song charted on both Station and Billboard, Billboard only, or Station only), Proportion, and SoulPop (indicates if song is soul or pop). Once the data frame (named Black in the code below) is created, the R code below can be used to make the graph.

R Code:
```r
colPalette = c("#563D40", "#009873", "#0072B2")
ggplot(Black, aes(x = SoulPop, y = Proportion, fill = Type)) +
  geom_bar(stat = 'identity', position = 'stack') +
  facet_grid(~ Station) +
  xlab("Black Record Type") +
  ylab("Number of Records Charted") +
  scale_fill_manual(values = colPalette)
```
3.3. Female Artists’ Airplay

As the Civil Rights movement gained traction in the 1960s, women also began demonstrating for equal rights under the law. The fourth research question investigates whether female artists received less local airplay than warranted based on their national popularity.

Was there evidence that female artists were not played as frequently on local stations as their national popularity warranted?

It was quite common in the 1960s for radio stations not to play similar types of music — including female vocals — back to back in order to achieve the appearance of variety. Disc jockey John Landecker attributed the practice to attempts to avoid listener tune-out. "(It was done) ... at least as far as I was concerned, as a music balance ... So that you wouldn't tune in and hear ... if somebody was only going to tune in for two records and hear two slow females back to back, and perhaps they didn't like that, they were gone" (J. Landecker, personal communication, March 9, 2016).

Table 4 shows the number (and percentage of the Station and/or Billboard total) of songs by female artists that charted on Billboard and/or a radio station. For example, there were 453 songs that charted on Billboard and/or WJJD during the time that WJJD was in Top 40 format. Of these songs, 264 (58%) charted on both Billboard and WJJD, 125 (28%) charted on only Billboard, and 64 (14%) charted on only WJJD. Considering that Figure 3 shows that WJJD had more songs chart overall than did Billboard, the difference in the number of songs by female artists that charted nationally compared to WJJD suggests that female artists were not played as often as their national popularity warranted.

WLS was much more open to playing records by female artists than WJJD. Female artists charted on WLS at a higher rate than nationally with 291 songs charting nationally and 302 songs charting on WLS. There were only four songs by black female artists that charted in the Top 10 nationally that did not chart on WLS.

WCFL showed less willingness to play black female artists with 128 songs charting nationally and only 86 charting on WCFL. Six songs by black female artists that charted in the Top 10 nationally did not chart on WCFL. It appears that WCFL was willing to play songs by black female artists that did exceptionally well nationally, but WCFL was not inclined to play songs that did less well nationally.

Grand Rapids station WGRD played fewer songs by black female artists than charted nationally (241 nationally and 186 on WGRD). WGRD did not play 17 songs by black female artists that charted in the Top 10 nationally. Grand Rapids station WLAV was similar to WGRD with 234 songs charting nationally and 205 charting on WLAV. WLAV did not play 14 Top 10 Billboard songs by black female artists.

Neither WGRD nor WLAV played Respect by Aretha Franklin. The only Grand Rapids area station that reported frequently playing Respect by Aretha Franklin was WERX, a small-wattage station in Wyoming, Michigan, a Grand Rapids suburb. One Grand Rapids program director at the time rejected the record on the basis that it was “uppity” (B. Stickroe, personal communication, March 8, 2016).

3.4. Black Female Artists’ Airplay

Comparing black artists’ airplay and comparing female artists’ airplay led students to compare national and radio station airplay for both race and gender at the same time. In other words, students naturally did a multivariable investigation of station, gender, and race. The following research question was generated:

Was there evidence that African-American female artists were not played as frequently on local stations as their national popularity warranted?

Table 5 shows the number (and percentage of the Station and/or Billboard total) of songs that charted by black female artists on Billboard and/or a radio station. For example, there were 186 songs by black female artists that charted on Billboard and/or WJJD during the time WJJD was in Top 40 format. Of these songs, 102 (55%) charted on both Billboard and WJJD, 74 (40%) charted on only Billboard, and 10 (5%) charted on only WJJD. Interestingly, 16 songs by black female artists that charted in the Top 10 nationally did not chart on WJJD.

WLS was much more open to playing records by black female artists than WJJD. Black female artists charted on WLS at a higher rate than nationally with 291 songs charting nationally and 302 songs charting on WLS. There were only four songs by black female artists that charted in the Top 10 nationally that did not chart on WLS.

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4. Conclusion

The radio chart data collected by O’Kelly is an ideal dataset for use in an introductory statistics course, especially for investigating multivariable relationships. The subject matter is of interest
to students because it deals with popular music. The subject matter is also complicated enough that students need to engage with the subject matter to gain true insight into the data. It is valuable for students to become familiar with the racial and gender climate of the 1960s and how racial and gender bias was exhibited in Top 40 radio airplay during a time when the Civil Rights movement was beginning to impact systemic change in the United States.

The analysis discussed in Section 3 is suitable for an introductory course provided that students are fluent enough in a software package to create the necessary subsets from the data. Of course, the instructor could create the necessary subsets ahead of time to do an analysis such as comparing WJJD play of female artists’ songs to the Billboard charts during the time when WJJD was in Top 40 format.

There are many additional questions that would be suitable for investigation in an introductory statistics course. A few examples of univariate analyses are:

- Create a difference in Debut Date variable between each pair of stations in a market to determine which radio station in a given market (Chicago or Grand Rapids) tended to play songs first. For example, to compare Grand Rapids stations’ WGRD and WLAV students could create the variable: Diff = WGRD Debut — WLAV Debut. A simple count of the number of positive and negatives differences would indicate if one station tended to lead on introducing new songs to their playlist. Numerical and graphical summaries of the actual difference in days would provide information on the scope of the difference in debut dates. This analysis is meaningful because in communication studies there is a theory of diffusion of innovation that seeks to explain how rapidly innovation spreads (Rogers 1995).

- Determine which market (Chicago or Grand Rapids) tended to play more local artists’ songs.

As mentioned in Section 1, the advent of the radio consultant led to a decrease in diversity of songs played from station to station. This phenomenon did not begin until the late 1960s; thus, disc jockeys had more freedom to play local artists and lesser known national acts prior to the late 1960s. Is this freedom reflected in airplay with more songs by local artists than by nonlocal artists?

- A more complicated question would be to add in external information on whether the artist is British. Students could then look to see when the so-called British invasion began, when it peaked, and when it began to wane by tracking the number and peak of songs by British performers over time.

A. Appendix: Using the Raw Data in an R Programming Class

In the next two sections, we describe how the raw data set (radioraw.xlsx, see online supplements) was used in a cross-listed undergraduate/graduate course in R programming to engage students in data cleaning and data entry error detection prior to data analysis. Students in the class had no or very little prior exposure to the R programming language. All students in the class had substantial prior experience with SAS programming. The data cleaning models the work of professional statisticians and data scientists. A 2016 survey by CrowdFlower of 80 data scientists found that 60% of their work involves cleaning and organizing data (GilPress 2016). While this task is highly relevant in an R programming course, it is probably not suitable for an introductory statistics course taught to a general education audience.

There were numerous issues encountered by students during data cleaning. As students discovered data issues, Gabrosek contacted O’Kelly who resolved the issue by looking at original source material. We begin with a discussion of univariate errors or questions in the data.

A.1. Univariate Data Cleaning

There were no errors detected in the variables ID, Artist, RecordLabel, or BBTop100. There were two songs with incorrect BBTop40 dates; ID 5207 You Can Never Stop Me Loving You by Johnny Tillotson had BBTop40 date 01/17/1900 and ID 5497 Trains And Boats And Planes by Dionne Warwick had BBTop40 date 07/16/2022. These values were corrected to 08/24/1963 for the Tillotson song and 07/16/1966 for the Warwick song.

Table A1 shows songs that had individual radio station peaks above 40. While this is possible since stations occasionally created a Top 50 chart or added on a couple songs after the Top 40 list, we chose to change the peak value for each song to NA to make the data consistent to Top 40 songs.

| Song Title           |Artist Name  | Radio Station | Peak |
|----------------------|-------------|---------------|------|
| You Can Never Stop Me Loving You | Johnny Tillotson | WGRD          | 40   |
| Trains And Boats And Planes       | Dionne Warwick    | WLAV         | 40   |

Table A2 shows seven songs that had missing values for the gender of the artist. (Recall that 0 = male and 1 = female.)
Table A1. Data cleaning issues: station peaks above 40.

| Song                          | Resolution                          |
|-------------------------------|-------------------------------------|
| ID 2585 Lovesick Blues by Iffeld, Frank | WGRDPeak 41 is correct but changed to NA |
| ID 4459 Hey There Lonely Boy by Ruby & the Romantics | WGRDPeak 49 is correct but changed to NA |
| ID 4878 You Wanna Be Happy by Soul, Jimmy | WLAVPeak 47 is correct but changed to NA |
| ID 5011 Second Hand Rose by Streisand, Barbra | WJJDPeak 66 corrected to 16 |

Table A2. Data cleaning issues: gender of artist.

| Song                          | Resolution                          |
|-------------------------------|-------------------------------------|
| ID 2855 Long Tall Texan by Kellum, Murry | changed to 0 |
| ID 2856 Red Ryder by Kellum, Murry | changed to 0 |
| ID 2857 I Like It Like That, Part 1 by Kenner, Chris | changed to 1 |
| ID 2858 Land Of 1000 Dances by Kenner, Chris | changed to 1 |
| ID 2859 You've Got To Pay The Price by Kent, Al | changed to 0 |
| ID 2860 Mama Sang A Song by Kenton, Stan | changed to 0 |
| ID 2861 Boy, You Ought To See Her Now by Kevin & Greg | changed to 0 |
| ID 2862 Inky Dinky Spider by Kids Next Door | changed to 0 |
| ID 2863 Love Of My Man, The by Kilgore, Theola | changed to 1 |
| ID 2864 This Is My Prayer by Kilgore, Theola | changed to 1 |
| ID 2893 Hide Away by King, Freddy | changed to 1 |
| ID 2896 It's In His Kiss by King, Ramona | changed to 1 |
| ID 4564 Lavender Sax by Scott, Clifford | changed to 1 |
| ID 4993 Voodoo Woman by Stokes, Simon & the Nighthawks | changed to 0 |
| ID 4998 James Bond Theme, The by Strange, Billy | changed to 0 |

Table A3. Data cleaning issues: race of artist.

| Song                          | Resolution                          |
|-------------------------------|-------------------------------------|
| ID 2585 Long Tall Texan by Kellum, Murry | changed to 0 |
| ID 2856 Red Ryder by Kellum, Murry | changed to 0 |
| ID 2857 I Like It Like That, Part 1 by Kenner, Chris | changed to 1 |
| ID 2858 Land Of 1000 Dances by Kenner, Chris | changed to 1 |
| ID 2859 You've Got To Pay The Price by Kent, Al | changed to 0 |
| ID 2860 Mama Sang A Song by Kenton, Stan | changed to 0 |
| ID 2861 Boy, You Ought To See Her Now by Kevin & Greg | changed to 0 |
| ID 2862 Inky Dinky Spider by Kids Next Door | changed to 0 |
| ID 2863 Love Of My Man, The by Kilgore, Theola | changed to 1 |
| ID 2864 This Is My Prayer by Kilgore, Theola | changed to 1 |
| ID 2893 Hide Away by King, Freddy | changed to 1 |
| ID 2896 It's In His Kiss by King, Ramona | changed to 1 |
| ID 4564 Lavender Sax by Scott, Clifford | changed to 1 |
| ID 4993 Voodoo Woman by Stokes, Simon & the Nighthawks | changed to 0 |
| ID 4998 James Bond Theme, The by Strange, Billy | changed to 0 |

Table A4. Data cleaning issues: BBTop100 after BBTop40.

| Song                          | BBTop100 | BBTop40 | Resolution* |
|-------------------------------|----------|---------|-------------|
| ID 343 | I Saw Her Standing There by Beatles | 02/08/64 | 01/25/64 | 01/25/64 |
| ID 2839 | My Coloring Book by Kallen, Kitty | 12/22/63 | 01/12/63 | 12/22/62 |
| ID 2849 | Mother-In-Law by K-Doee, Ernie | 05/01/61 | 04/03/61 | 03/27/61 |
| ID 3297 | Heartaches by Marcella | 11/20/61 | 10/30/61 | 10/09/61 |
| ID 3911 | Stewball by Peter, Paul & Mary | 11/30/63 | 02/28/63 | 12/28/63* |
| ID 4183 | Just Like Romeo & Juliet by Reflections | 05/22/64 | 06/02/64 | 06/11/64* |
| ID 4260 | No Milk Today by Herman's Hermits | 06/11/65 | 06/28/66 | 12/02/66 |
| ID 4355 | Child Of Clay by Rodgers, Jimmie | 11/03/67 | 10/14/67 | 09/23/67 |
| ID 4376 | Dandelion by Rolling Stones | 09/28/67 | 09/23/67 | 09/09/67 |
| ID 4445 | Baby Let's Wait by Royal Guardsmen | 02/03/69 | 01/04/69 | 11/16/68 |
| ID 4734 | Foolish Little Girl by Shirelles | 03/23/64 | 04/20/63 | 03/22/63 |
| ID 4857 | Johnny Get Angry by Sommers, Joanie | 07/23/62 | 06/16/62 | 05/26/62 |
| ID 4935 | Dirty Water by Standells | 06/11/66 | 04/23/66 | 04/23/66 |
| ID 5022 | Talk To Me by Sunny & the Sunglows | 10/21/63 | 09/28/63 | 09/07/63 |
| ID 5546 | You Turn Me On (Turn On Song) by Whitcomb, Ian & Bluesville | 07/05/65 | 06/19/65 | 05/22/65 |

*Change made to BBTop40 otherwise change made to BBTop100.

Table A5 shows 15 songs that had missing values for the race of the artist. (Recall that 0 = white, 1 = black, and 2 = Hispanic.)

A.2. Bivariate Data Cleaning

A challenging task for the students was to determine if any observations had variable values that were not possible when comparing two variables. For example, a song should not have a BBTop100 date that is after the song’s BBTop40 date because BBTop100 is the first date the song is in the Billboard Top 100 while BBTop40 is the first date the song is in the Billboard Top 40. Table A4 lists 19 songs where the BBTop100 date was after the BBTop40 date.

There were two songs that had a BBTop100 date but did not have a BBPeak value; ID 334 For You Blue by The Beatles and ID 2450 No Milk Today by Herman’s Hermits. After discussion with O’Kelly, it was determined that For You Blue was actually a “B side” of another song that charted. The song itself did not chart and thus the BBTop100 date was changed to NA. No Milk Today had BBPeak changed to 35.

Table A5 lists eight songs where there is a BBPeak value less than or equal to 40 but no BBTop40 date. Some of the issues were resolved by correcting the BBTop40 date and some of the issues were resolved by correcting the BBPeak to a number greater than 40.

There were numerous songs that had debut dates for individual stations but did not make the station’s official Top 40 chart (and, thus, did not have a station peak value). This can occur because occasionally stations would play an “up and coming hit”
Table A5. Data cleaning issues: BBPeak but no BBTop40 date.

| Song                                      | BBPeak | Resolution                      |
|-------------------------------------------|--------|---------------------------------|
| ID 984 Let's Twist Again by Checker, Chubby | 22     | BBTop40 corrected to 07/11/64   |
| ID 2872 Graduation Song...Pomp And Circumstance by Kimberly, Adrian | 34     | BBTop40 corrected to 07/10/61   |
| ID 2975 Ain't It A Shame by Lance, Major   | 2      | BBPeak corrected to NA          |
| ID 3065 Pretty Ballerina by Left Banke     | 4      | BBTop40 corrected to 02/04/67   |
| ID 3402 Steel Guitar Rag by Matthews, Tobin & Co. | 2      | BBPeak corrected to NA          |
| ID 4354 Jack And Jill by Roe, Tommy        | 5      | BBPeak corrected to NA          |
| ID 4575 Patsy by Scott, Jack               | 2      | BBPeak corrected to 65          |
| ID 4714 Crazy Downtown by Sherman, Allan    | 40     | BBTop40 corrected to 05/08/65   |

that would flame out and never reach the station’s Top 40. For example, WJJD had 804 songs that were mentioned on a chart but never made the station’s Top 40. Through conversations with station disc jockeys, O’Kelly discovered that mentioning a song on a chart was often done to appease record company executives. For the purposes of the data analysis, the station debut dates were left as is so that differences in debut dates among stations could be calculated for these songs.

After completing this fairly exhaustive list of data cleaning activities, students were ready to analyze the data set radio.xlsx as discussed in the body of the article.

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