Notebook 3 - Final Product

Author: Kavan Wills

Computing ID: meu5cg

Course: DS 2023 - Communicating with Data

Purpose

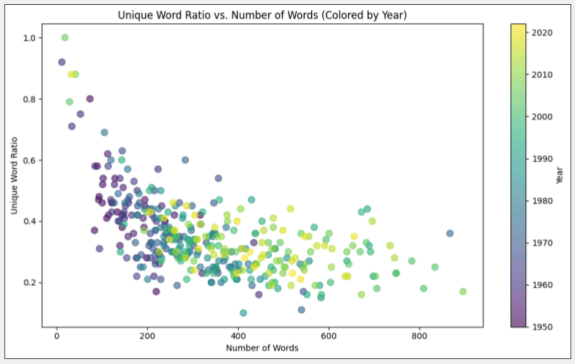
Present the final infographic and document all project resources.

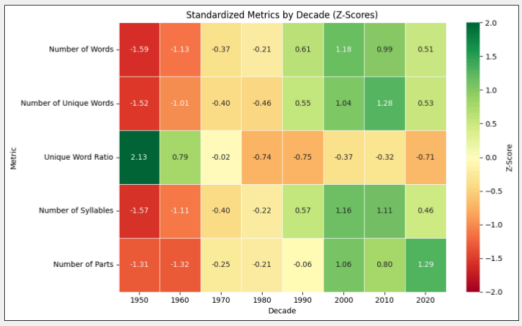
Final Infographic

In [97]:
```
from IPython.display import Image, display
import pandas as pd

# Display the final infographic
display(Image(filename='DSF Infographic (13).png'))
```

Is Our Music Getting Dumber?
An Analysis on Lyrical Complexity





Scatter Plot Interpretation

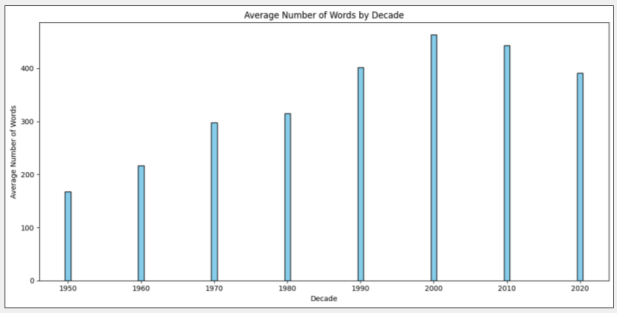
- Each dot represents one song
- Purple (1950s): Short songs with high vocabulary diversity
- Yellow (2020s): Long songs with low vocabulary diversity
- Notice the shift from top-left to bottom-right over time

Heat Map Interpretation

- 🔥 Z-SCORE HEATMAP
- Colors show how each decade compares to the average for that metric.
- Green in 1950s → Yellow in 2020s & Red in 1950s → Green in 2000s

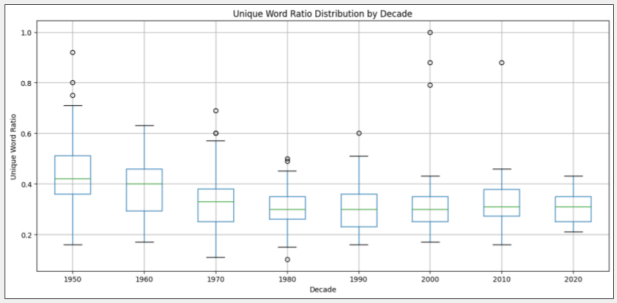
Bar Plot Interpretation

- 📈 WORD COUNT IS INCREASING
- Average word count nearly TRIPLED
- KEY TRENDS:
  - Steady increase from 1950s-2000s
  - Peak in 2000s
  - Slight decline in 2010s-2020s



Box Plot Interpretation

- 📉 VOCABULARY DIVERSITY DECLINING
- The 1950s had the highest median diversity. By 2020s, median dropped to ~0.3 – a large decrease despite using more words.
- KEY TRENDS:
  - Steepest decline: 1950s → 1980s
  - Stabilization: 1980s-2020s hover around ~0.3
- Notice: Box heights shrinking = less variation among songs.



📊 2020s vs 1950s Songs:

- **133%** MORE words
- **30%** LESS unique vocabulary

Modern hits: More words but arguably more simple

Data Source:
BiMMuDa Dataset (Hamilton et al., 2024) 371 songs from Billboard Year-End Top 5 (1950-2022) Sample sizes: n=46-53 per full decade; 2020s: n=14 (limited to 2020-2022)

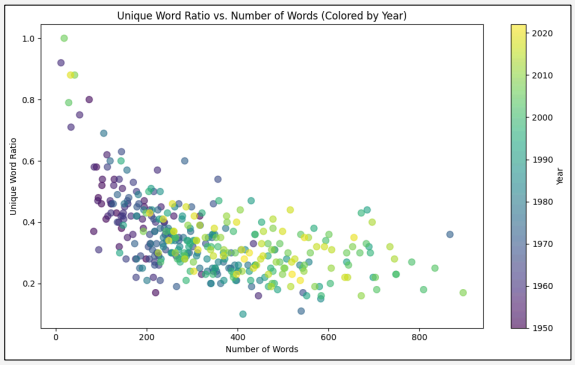
Disclaimer:
• Dataset only includes top 5 songs from each year in Billboard charts, not all music is measured.
• Songs without lyrics are excluded from lyric-based metrics.
• Lyrics and melodies were manually transcribed; small errors are possible.

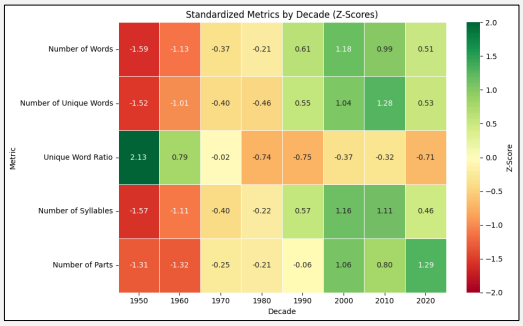
Analysis:
Kavan Wills | DS 2023 | University of Virginia
Computing ID: meu5cg

In [96]:
```
from IPython.display import SVG, display

display(SVG(filename="DSF Infographic (11).svg"))
```

Is Our Music Getting Dumber?
An Analysis on Lyrical Complexity





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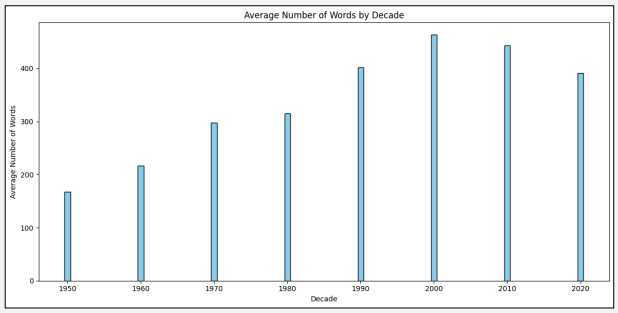

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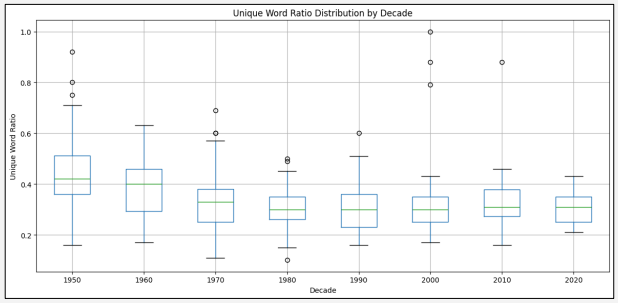

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Analysis:
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Title of Final Product

"Is Our Music Getting Dumber? An Analysis on Lyrical Complexity"

Description of Final Product

This infographic explores the paradox of modern popular music: while songs have gained more words (133% more words than songs from the 1950s), they have simultaneously become more simple, with a 30% decrease in vocabulary diversity. The 1950s averaged 168 words per song with a 0.44 unique word ratio, while the 2020s average 391 words with only a 0.31 ratio.

Visual Story:

The infographic uses a 24" × 36" poster format to tell a data-driven story through:

1. **Scatter Plot (Top Left)**
   Shows individual songs plotted by word count vs. unique word ratio
   Color-coded by year (purple = 1950s, yellow = 2020s)
   Reveals the clustering pattern: older songs (short & diverse) vs. modern songs (long & repetitive)

2. **Heatmap (Top Right)**
   Shows all metrics across decades in a color-coded matrix
   Colors show how each decade compares to the average for that metric.
   Demonstrates the inverse relationship: word count rising while diversity declining

3. **Bar Chart (Middle Right)**
   Average word count by decade showing steady increase from 1950s to 2000s
   Peak at 2000s with slight decline in 2020s

4. **Box Plot (Bottom Right)**
   Distribution of lyrical diversity across decades
   Shows declining median from 1950s-1980s, then stabilization at lower levels

Supporting Elements:

- **Key Statistics Callout Box** (center): "2020s songs: 133% MORE words (168→391), 30% LOWER diversity (0.44→0.31)"
- **Annotations** by each plot explaining trends and key insights

Design Approach:

Color Scheme:

- **Temporal gradient (Scatter plot):** Purple (1950s) to yellow (2020s) shows progression over time
- **Intensity heatmap:** Bright green (high values) to dark red (low values) shows metric magnitude
- **Consistent blue:** Bar and box plots use blue for clean, professional appearance
- **Neutral background:** White/light gray for maximum readability

Layout:

- 2×2 grid arrangement with four equal-weight plots
- Key statistic callout centered for emphasis
- Annotations positioned directly below/beside each plot
- Hierarchical flow: title → visuals → interpretation → source

Typography:

- Bold headers for section titles and key statistics
- 14-16pt body text in annotations for readability
- Clear axis labels with appropriate font sizing
- Sans-serif font (Arial/similar) for modern, clean look

Annotations:

- Text boxes with borders for visual separation
- Bullet points for scannability
- Arrows connecting annotations to relevant plot features
- Emoji icons (📈 📉 🔥) to enhance visual interest and guide attention

Target Audience:

Music enthusiasts, data visualization students, cultural historians.

Main Message:

Modern music production prioritizes number of words over unique word ratio, which likely means more repetitive and simple music.

In [88]:
```
# Calculate exact statistics for infographic claims
import pandas as pd

df = pd.read_csv('bimmuda_per_song_full.csv')
df_clean = df[df['Number of Words'] > 0].copy()
df_clean['Decade'] = (df_clean['Year'] // 10) * 10

# Get 1950s and 2020s averages
stats_1950s = df_clean[df_clean['Decade'] == 1950].agg({
    'Number of Words': 'mean',
```

```
    'Unique Word Ratio': 'mean'
})

stats_2020s = df_clean[df_clean['Decade'] == 2020].agg({
    'Number of Words': 'mean',
    'Unique Word Ratio': 'mean'
})

# Calculate percentage changes
word_increase = ((stats_2020s['Number of Words'] - stats_1950s['Number of Wo
                 / stats_1950s['Number of Words'] * 100)

ratio_decrease = ((stats_1950s['Unique Word Ratio'] - stats_2020s['Unique Wo
                  / stats_1950s['Unique Word Ratio'] * 100)

print(f"1950s: {stats_1950s['Number of Words']:.1f} words, {stats_1950s['Uni
print(f"2020s: {stats_2020s['Number of Words']:.1f} words, {stats_2020s['Uni
print(f"\nWord count increase: {word_increase:.1f}%")
print(f"Diversity decrease: {ratio_decrease:.1f}%")
```

```
1950s: 167.9 words, 0.44 ratio
2020s: 391.4 words, 0.31 ratio

Word count increase: 133.0%
Diversity decrease: 29.7%
```

In [89]:

```
df_clean = df[df["Number of Words"] > 0].copy()

df_clean["Decade"] = (df_clean["Year"] // 10) * 10

decade_summary = (
    df_clean
    .groupby("Decade")
    .agg(
        mean_words=("Number of Words", "mean"),
        mean_unique_words=("Number of Unique Words", "mean"),
        mean_unique_ratio=("Unique Word Ratio", "mean"),
        mean_syllables=("Number of Syllables", "mean"),
    )
)

decade_summary = decade_summary.round({
    "mean_words": 1,
    "mean_unique_words": 1,
    "mean_unique_ratio": 2,
    "mean_syllables": 1,
})

decade_summary.loc[[1950, 2020]]
```

Out[89]:

Decade	mean_words	mean_unique_words	mean_unique_ratio	mean_syllables
1950	167.9	65.7	0.44	213.1
2020	391.4	118.3	0.31	473.9

In [90]:
```
w_50 = decade_summary.loc[1950, "mean_words"]
w_20 = decade_summary.loc[2020, "mean_words"]
r_50 = decade_summary.loc[1950, "mean_unique_ratio"]
r_20 = decade_summary.loc[2020, "mean_unique_ratio"]

word_increase_pct = ((w_20 - w_50) / w_50) * 100
ratio_decrease_pct = ((r_50 - r_20) / r_50) * 100

print("Average words per song:")
print(f"  1950s: {w_50:.1f}")
print(f"  2020s: {w_20:.1f}")
print(f"  Percent increase: {word_increase_pct:.1f}%")

print("\nAverage unique-word ratio:")
print(f"  1950s: {r_50:.2f}")
print(f"  2020s: {r_20:.2f}")
print(f"  Percent decrease: {ratio_decrease_pct:.1f}%")
```

```
Average words per song:
  1950s: 167.9
  2020s: 391.4
  Percent increase: 133.1%

Average unique-word ratio:
  1950s: 0.44
  2020s: 0.31
  Percent decrease: 29.5%
```

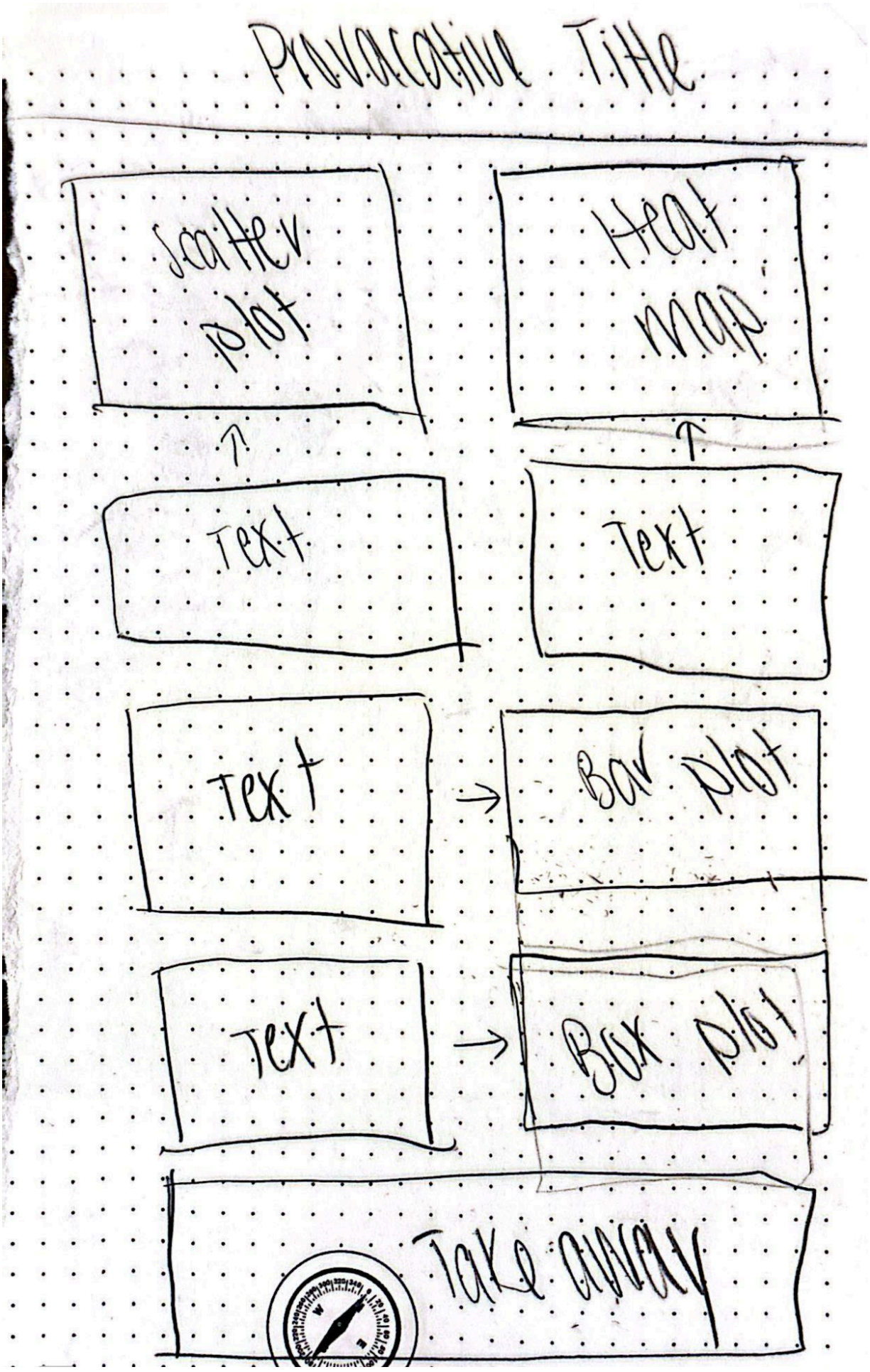
Design Process Documentation

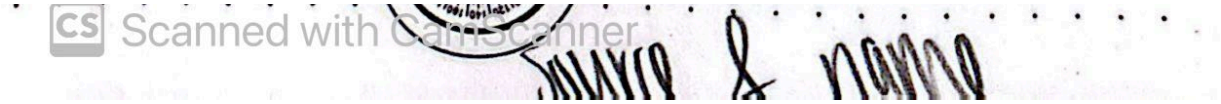
Paper Storyboard

Before creating the infographic digitally, I sketched the layout on paper to plan composition, plot arrangement, and visual hierarchy.

In [99]:
```
from IPython.display import Image, display

# Display storyboard sketch
display(Image(filename='Infographic_rough_sketch.JPG'))
```


Provocative Title
Scatter plot
Heat map
Text
Text
Text
Bar plot
Text
Box plot
Take away



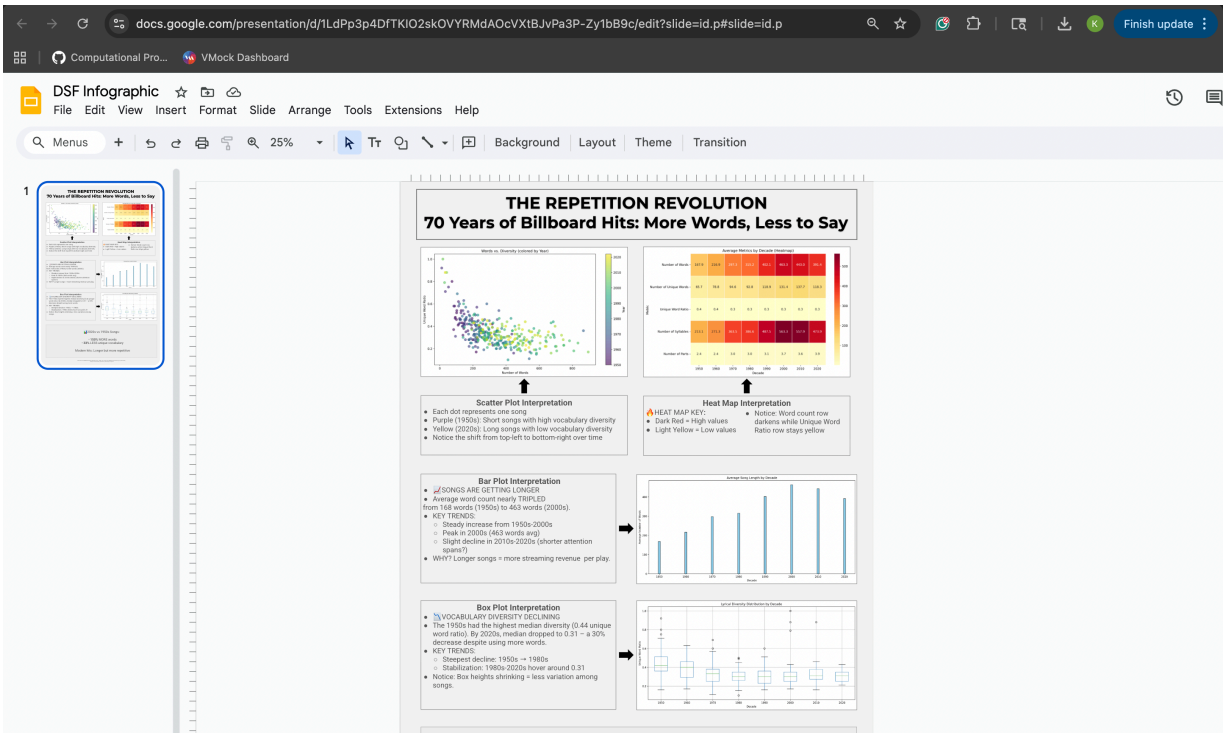
Storyboard decisions:

- Positioned scatter plot top-left as primary focal point
- Placed heatmap top-right to show comprehensive metrics
- Bar and box plots middle-right and bottom-right to support main narrative
- Central key statistic box for immediate impact

Design Tool: Google Slides

The infographic was created in Google Slides with custom dimensions (24" × 36").

In [92]:
```
display(Image(filename='DSF_googledriveediting.png'))
```



Project Manifest

In [100…
```
import pandas as pd

manifest_data = [
    # --- Core notebooks (source of analysis) ---
    {
        "Resource Name": "DFP_Notebook1.ipynb",
        "Type": "Jupyter Notebook",
        "Description": "Notebook 1 — project framing, BiMMuDa data descripti
        "Link": "./DFP_Notebook1.ipynb"
```

```
    },
    {
        "Resource Name": "DFP_Notebook2.ipynb",
        "Type": "Jupyter Notebook",
        "Description": "Notebook 2 — exploratory data analysis and visualiza
        "Link": "./DFP_Notebook2.ipynb"
    },
    {
        "Resource Name": "DFP_Notebook3.ipynb",
        "Type": "Jupyter Notebook",
        "Description": "Notebook 3 — final infographic, supporting statistic
        "Link": "./DFP_Notebook3.ipynb"
    },

    # --- PDF exports (for easy viewing) ---
    {
        "Resource Name": "DFP_Notebook1.pdf",
        "Type": "PDF Export",
        "Description": "PDF export of Notebook 1 for easier viewing/printing
        "Link": "./DFP_Notebook1.pdf"
    },
    {
        "Resource Name": "DFP_Notebook2.pdf",
        "Type": "PDF Export",
        "Description": "PDF export of Notebook 2 for easier viewing/printing
        "Link": "./DFP_Notebook2.pdf"
    },
    {
        "Resource Name": "DFP_Notebook3.pdf",
        "Type": "PDF Export",
        "Description": "PDF export of Notebook 3 for easier viewing/printing
        "Link": "./DFP_Notebook3.pdf"
    },

    # --- Data file ---
    {
        "Resource Name": "bimmuda_per_song_full.csv",
        "Type": "CSV Data File",
        "Description": "Per-song BiMMuDa dataset used in the project (379 ro
        "Link": "./bimmuda_per_song_full.csv"
    },

    # --- Final infographic & design artifacts ---
    {
        "Resource Name": "DSF Infographic (12).png",
        "Type": "Image (PNG)",
        "Description": "Final infographic poster (PNG, 24\"×36\" canvas) for
        "Link": "./DSF Infographic (12).png"
    },
    {
        "Resource Name": "DSF Infographic (10).svg",
        "Type": "Image (SVG)",
        "Description": "Final infographic poster (SVG, vector format) suitab
        "Link": "./DSF Infographic (10).svg"
    },
    {
```

```
        "Resource Name": "Infographic_rough_sketch.JPG",
        "Type": "Image (JPG)",
        "Description": "Hand-drawn rough sketch of the infographic layout cr
        "Link": "./Infographic_rough_sketch.JPG"
    },
    {
        "Resource Name": "DSF_googledriveediting.png",
        "Type": "Image (PNG)",
        "Description": "Screenshot of editing the infographic in Google Slic
        "Link": "./DSF_googledriveediting.png"
    },

    # --- External resources ---
    {
        "Resource Name": "Project GitHub Repository",
        "Type": "External Resource",
        "Description": "Public GitHub repository containing all project file
        "Link": "https://github.com/kavanwills/ds2023-final-bimmuda"
    },
    {
        "Resource Name": "Infographic Google Slides",
        "Type": "External Resource",
        "Description": "Google Slides file used to design and export the fir
        "Link": "https://docs.google.com/presentation/d/1LdPp3p4DfTKIO2skOVY
    },
    {
        "Resource Name": "BiMMuDa Paper (Hamilton et al., 2024)",
        "Type": "External Resource",
        "Description": "Research paper describing the construction of the Bi
        "Link": "https://transactions.ismir.net/articles/10.5334/tismir.168"
    },
    {
        "Resource Name": "BiMMuDa GitHub Repository",
        "Type": "External Resource",
        "Description": "GitHub repository containing BiMMuDa data and code r
        "Link": "https://github.com/madelinehamilton/BiMMuDa"
    },
    {
        "Resource Name": "BiMMuDa Documentation",
        "Type": "External Resource",
        "Description": "Online documentation / Google Doc describing the per
        "Link": "https://docs.google.com/document/d/17EyW-bA8oppRZ_3KloYB5Z-
    }
]

manifest_df = pd.DataFrame(manifest_data)
manifest_df
```

Out[100...

	Resource Name	Type	Description	
0	DFP_Notebook1.ipynb	Jupyter Notebook	Notebook 1 – project framing, BiMMuDa data des...	./DF
1	DFP_Notebook2.ipynb	Jupyter Notebook	Notebook 2 – exploratory data analysis and vis...	./DF
2	DFP_Notebook3.ipynb	Jupyter Notebook	Notebook 3 – final infographic, supporting sta...	./DF
3	DFP_Notebook1.pdf	PDF Export	PDF export of Notebook 1 for easier viewing/pr...	./
4	DFP_Notebook2.pdf	PDF Export	PDF export of Notebook 2 for easier viewing/pr...	./I
5	DFP_Notebook3.pdf	PDF Export	PDF export of Notebook 3 for easier viewing/pr...	./I
6	bimmuda_per_song_full.csv	CSV Data File	Per-song BiMMuDa dataset used in the project (...	./bimmuda
7	DSF Infographic (12).png	Image (PNG)	Final infographic poster (PNG, 24"×36" canvas)...	./DSF I
8	DSF Infographic (10).svg	Image (SVG)	Final infographic poster (SVG, vector format) ...	./DSF
9	Infographic_rough_sketch.JPG	Image (JPG)	Hand-drawn rough sketch of the infographic lay...	./Infographic
10	DSF_googledriveediting.png	Image (PNG)	Screenshot of editing the	./DSF_goo

	Resource Name	Type	Description	
			infographic in Googl...	
11	Project GitHub Repository	External Resource	Public GitHub repository containing all projec...	https://github.com/kavanwills/
12	Infographic Google Slides	External Resource	Google Slides file used to design and export t...	https://docs.google.com/preser
13	BiMMuDa Paper (Hamilton et al., 2024)	External Resource	Research paper describing the construction of ...	https://transactions.ismir.r
14	BiMMuDa GitHub Repository	External Resource	GitHub repository containing BiMMuDa data and ...	https://github.com/madelin
15	BiMMuDa Documentation	External Resource	Online documentation / Google Doc describing t...	https://docs.google.com/d

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Project Summary

Dataset

- **Name:** BiMMuDa (Billboard Melodic Music Dataset)
- **Songs:** 371 from Billboard year-end top 5 (1950-2022)
- **Focus:** Lyrical complexity trends

Key Finding

Modern Billboard hits use 133% more words than 1950s songs but have 30% less vocabulary diversity.

Methodology

1. Data establishment (Notebook 1)
2. Exploratory analysis with 17+ visualizations (Notebook 2)
3. Selection of best plots for infographic
4. Storyboard design on paper

5. Infographic in Google Slides (24×36 format)
6. Final export as PNG and PDF

Tools Used

- **Analysis:** Python (pandas, matplotlib, seaborn)
- **Design:** Google Slides
- **Documentation:** Jupyter Notebooks

AI Usage Acknowledgement

Per course policy, I used **Claude (Anthropic)** and **ChatGPT (OpenAI)** as a learning aid for code examples, debugging, and conceptual clarification. All submitted work reflects my own understanding and reasoning. I can explain all aspects of this work without external assistance.

Kavan Wills (meu5cg)