```
!pip install -q transformers
!pip install -q torch
!pip install -q sentencepiece
```

```
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━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 56.3/56.3 MB 45.1 MB/s eta 0:00:00
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━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 207.5/207.5 MB 4.2 MB/s eta 0:00:00
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```

```
import pandas as pd
from transformers import AutoTokenizer, AutoModelForSequenceClassification
from scipy.special import softmax
import torch

df = pd.read_csv("/content/CDMX_Answers_real.csv")

# Load Model and tokenizer
MODEL = "cardiffnlp/twitter-roberta-base-sentiment"
tokenizer = AutoTokenizer.from_pretrained(MODEL)
model = AutoModelForSequenceClassification.from_pretrained(MODEL)
```

```
# Function to clasify sentiment
def get_sentiment_score(text):
    try:
        if pd.isna(text) or text.strip() == "":
            return pd.Series([0.0, 1.0, 0.0, 0.0], index=['score_neg', 'score_neu', 'score_pos', 'sentimiento_real'])

        encoded_input = tokenizer(text, return_tensors='pt', truncation=True, max_length=512)
        with torch.no_grad():
            output = model(**encoded_input)
        scores = softmax(output.logits[0].numpy())
        sentiment_score = scores[2] - scores[0]  # positive - negative
        return pd.Series([scores[0], scores[1], scores[2], sentiment_score], index=['score_neg', 'score_neu', 'score_pos', 'sentimiento_real'

    except Exception as e:
        print(f"Error procesando texto: {text[:30]}... — {str(e)}")
        return pd.Series([0.0, 1.0, 0.0, 0.0], index=['score_neg', 'score_neu', 'score_pos', 'sentimiento_real'])
```

```
df[['score_neg', 'score_neu', 'score_pos', 'sentimiento_real']] = df['Answer'].apply(get_sentiment_score)
df.to_csv("/content/CDMX_Answers_real_sentimient.csv", index=False)
```

```
# Load the file with generated answers
df_gen = pd.read_csv("/content/CDMX_Answers_generated.csv", encoding='ISO-8859-1')

# Apply sentiment analysis to the 'Answer_generated' column
df_gen[['score_neg', 'score_neu', 'score_pos', 'sentimiento_generado']] = df_gen['Answer_generated'].apply(get_sentiment_score)

# Save the updated file with sentiment scores
df_gen.to_csv("/content/CDMX_Answers_generated_sentimient.csv", index=False)
```

```
import pandas as pd

# Load real and generated responses (with sentiment scores)
df_real = pd.read_csv("/content/CDMX_Answers_real_sentimient.csv")
df_gen = pd.read_csv("/content/CDMX_Answers_generated_sentimient.csv")

# Group by 'pregunta' and calculate average sentiment
avg_sent_real = df_real.groupby("Number")["sentimiento_real"].mean().reset_index()
avg_sent_real.rename(columns={"sentimiento_real": "avg_sentimiento_real"}, inplace=True)

avg_sent_gen = df_gen.groupby("Number")["sentimiento_generado"].mean().reset_index()
avg_sent_gen.rename(columns={"sentimiento_generado": "avg_sentimiento_generado"}, inplace=True)
```

```
# Merge both results on the question
merged_avg = pd.merge(avg_sent_real, avg_sent_gen, on="Number")

# Display or export results
print(merged_avg)
merged_avg.to_csv("/content/avg_sentimiento_comparado.csv", index=False)
```

```
   Number  avg_sentimiento_real  avg_sentimiento_generado
0     1.0             -0.040012                 -0.118984
1     2.0             -0.110049                 -0.230552
```

```
import pandas as pd

# Load both real and generated datasets
df_real = pd.read_csv("/content/CDMX_Answers_real_sentimient.csv")
df_gen = pd.read_csv("/content/CDMX_Answers_generated_sentimient.csv")

# Add a column to indicate source
df_real["tipo"] = "real"
df_gen["tipo"] = "generada"

# Standardize sentiment column names
df_real.rename(columns={"sentimiento_real": "sentimiento"}, inplace=True)
df_gen.rename(columns={"sentimiento_generado": "sentimiento"}, inplace=True)

# Standardize answer column names (optional)
df_real.rename(columns={"Answer": "respuesta"}, inplace=True)
df_gen.rename(columns={"Answer_generated": "respuesta"}, inplace=True)

# Select only relevant columns
cols = ["Number", "respuesta", "sentimiento", "tipo"]
df_combined = pd.concat([df_real[cols], df_gen[cols]], ignore_index=True)

# Compute average sentiment per question and type
avg_by_group = df_combined.groupby(["Number", "tipo"])["sentimiento"].mean().reset_index()
avg_by_group.rename(columns={"sentimiento": "avg_sentimiento"}, inplace=True)

# Merge the average back to each row
df_final = pd.merge(df_combined, avg_by_group, on=["Number", "tipo"], how="left")

# Save the final combined file
df_final.to_csv("/content/CDMX_Sentiment_Comparation.csv", index=False)
```

STADISTICAL TEST

```
import pandas as pd
from scipy.stats import ttest_rel

# Load the CSV file
df = pd.read_csv('/content/CDMX_Sentiment_Comparation.csv')

# Initialize a list to collect results for each question
results = []

# Loop over each unique question number
for q_num in sorted(df['Number'].dropna().unique()):
    # Filter data for the current question
    q_data = df[df['Number'] == q_num]

    # Separate real and generated sentiment values
    real_q = q_data[q_data['tipo'] == 'real']['sentimiento'].reset_index(drop=True)
    gen_q = q_data[q_data['tipo'] == 'generada']['sentimiento'].reset_index(drop=True)

    # Make sure we compare only pairs of responses
    min_len = min(len(real_q), len(gen_q))
    if min_len == 0:
        continue  # Skip questions that don't have both real and generated responses

    real_q = real_q[:min_len]
    gen_q = gen_q[:min_len]

    # Perform paired t-test
    t_stat, p_val = ttest_rel(real_q, gen_q)
```

```
    # Save the results
    results.append({
        "Question (Number)": int(q_num),
        "N pairs": min_len,
        "Mean Real": real_q.mean(),
        "Mean Generated": gen_q.mean(),
        "Mean Difference": gen_q.mean() - real_q.mean(),
        "t-statistic": t_stat,
        "p-value": p_val,
        "Significant (p < 0.05)": p_val < 0.05
    })

# Convert the list of results to a DataFrame
results_df = pd.DataFrame(results)

# Display the result
results_df
```

	Question (Number)	N pairs	Mean Real	Mean Generated	Mean Difference	t-statistic	p-value	Significant (p < 0.05)
0	1	20	-0.040012	-0.118984	-0.078973	4.224362	0.000459	True
1	2	20	-0.110049	-0.230552	-0.120503	2.612867	0.017109	True

Pasos siguientes: Generar código con `results_df` | Ver gráficos recomendados | New interactive sheet

```
from scipy.stats import wilcoxon

# Initialize a list to collect Wilcoxon results
wilcoxon_results = []

# Loop over each unique question number
for q_num in sorted(df['Number'].dropna().unique()):
    # Filter data for the current question
    q_data = df[df['Number'] == q_num]

    # Separate real and generated sentiment values
    real_q = q_data[q_data['tipo'] == 'real']['sentimiento'].reset_index(drop=True)
    gen_q = q_data[q_data['tipo'] == 'generada']['sentimiento'].reset_index(drop=True)

    # Match the length for paired comparison
    min_len = min(len(real_q), len(gen_q))
    if min_len == 0:
        continue  # Skip questions with missing pairs

    real_q = real_q[:min_len]
    gen_q = gen_q[:min_len]

    # Perform Wilcoxon signed-rank test
    try:
        stat, p_val = wilcoxon(real_q, gen_q)
    except ValueError:
        # If all differences are zero or the sample is too small, skip
        continue

    # Store the result
    wilcoxon_results.append({
        "Question (Number)": int(q_num),
        "N pairs": min_len,
        "Mean Real": real_q.mean(),
        "Mean Generated": gen_q.mean(),
        "Mean Difference": gen_q.mean() - real_q.mean(),
        "Wilcoxon statistic": stat,
        "p-value": p_val,
        "Significant (p < 0.05)": p_val < 0.05
    })

# Convert to DataFrame
wilcoxon_df = pd.DataFrame(wilcoxon_results)

# Display the result
wilcoxon_df
```

	Question (Number)	N pairs	Mean Real	Mean Generated	Mean Difference	Wilcoxon statistic	p-value	Significant (p < 0.05)
0	1	20	-0.040012	-0.118984	-0.078973	11.0	0.000105	True
1	2	20	-0.110049	-0.230552	-0.120503	36.0	0.008308	True

Pasos siguientes: Generar código con `wilcoxon_df` | Ver gráficos recomendados | New interactive sheet

```
from scipy.stats import ks_2samp

# Initialize a list to collect KS test results
ks_results = []

# Loop through each unique question
for q_num in sorted(df['Number'].dropna().unique()):
    # Filter data for the current question
    q_data = df[df['Number'] == q_num]

    # Separate sentiment values
    real_q = q_data[q_data['tipo'] == 'real']['sentimiento'].reset_index(drop=True)
    gen_q = q_data[q_data['tipo'] == 'generada']['sentimiento'].reset_index(drop=True)

    # Perform K-S test only if both have values
    if len(real_q) > 0 and len(gen_q) > 0:
        ks_stat, p_val = ks_2samp(real_q, gen_q)
        ks_results.append({
            "Question (Number)": int(q_num),
            "N Real": len(real_q),
            "N Generated": len(gen_q),
            "Mean Real": real_q.mean(),
            "Mean Generated": gen_q.mean(),
            "K-S statistic": ks_stat,
            "p-value": p_val,
            "Significant (p < 0.05)": p_val < 0.05
        })

# Convert results to DataFrame
ks_df = pd.DataFrame(ks_results)

# Display the table
ks_df
```

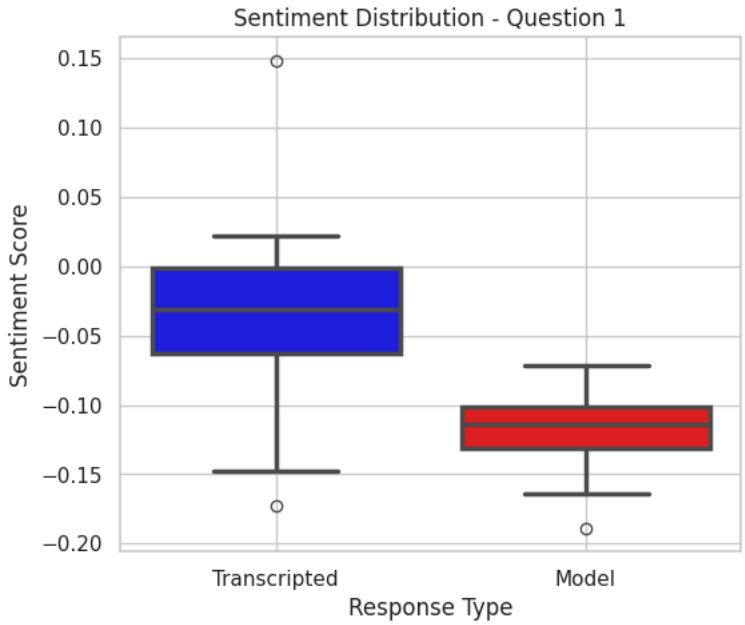
	Question (Number)	N Real	N Generated	Mean Real	Mean Generated	K-S statistic	p-value	Significant (p < 0.05)
0	1	20	20	-0.040012	-0.118984	0.75	0.000010	True
1	2	20	20	-0.110049	-0.230552	0.50	0.012299	True

Pasos siguientes: Generar código con `ks_df` | Ver gráficos recomendados | New interactive sheet

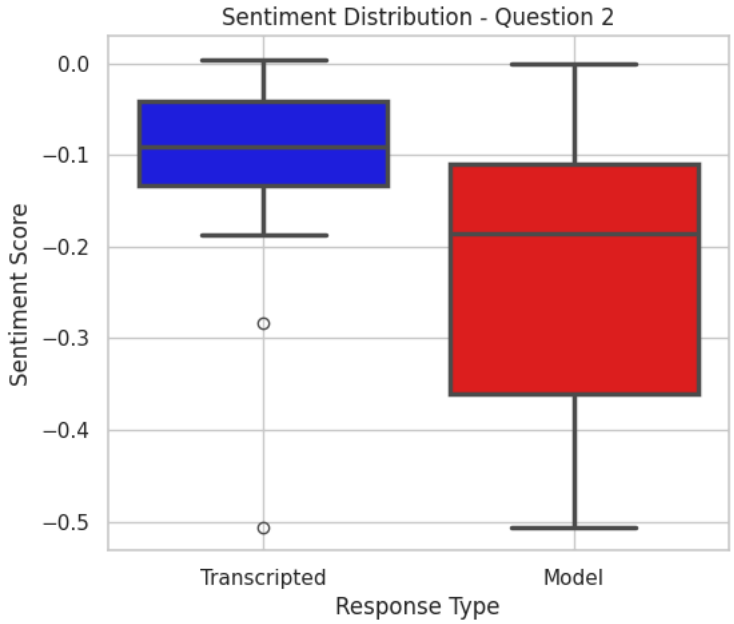
```
import seaborn as sns
import matplotlib.pyplot as plt

# Set style for consistency
sns.set(style="whitegrid")

# Loop through each question
question_numbers = sorted(df['Number'].dropna().unique())

for q_num in question_numbers:
    q_data = df[df['Number'] == q_num].copy()

    if q_data['tipo'].nunique() < 2:
        continue

    # Rename labels for clarity
    q_data['tipo'] = q_data['tipo'].replace({'real': 'Transcripted', 'generada': 'Model'})

    plt.figure(figsize=(6, 5))
    sns.boxplot(
        data=q_data,
        x='tipo',
```

```
        y='sentimiento',
        palette={'Transcripted': 'blue', 'Model': 'red'},
        linewidth=2.5
    )

    plt.title(f'Sentiment Distribution - Question {int(q_num)}')
    plt.xlabel('Response Type')
    plt.ylabel('Sentiment Score')
    plt.grid(True)
    plt.show()
```

```
/tmp/ipython-input-20-3022093883.py:20: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend

  sns.boxplot(
```




```
/tmp/ipython-input-20-3022093883.py:20: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend

  sns.boxplot(
```



COMPARATION VS FULL CORPUS

```
import pandas as pd
```

```
import torch
from transformers import AutoTokenizer, AutoModelForSequenceClassification
from torch.nn.functional import softmax
from tqdm import tqdm

# Load corpus file
df_corpus = pd.read_csv("/content/base_CDMX_C-D+_18-25.csv", encoding='ISO-8859-1')

# Load model and tokenizer
model_name = "cardiffnlp/twitter-roberta-base-sentiment"
tokenizer = AutoTokenizer.from_pretrained(model_name)
model = AutoModelForSequenceClassification.from_pretrained(model_name)

# Function to get sentiment score from text using same logic as your image
def get_sentiment_score(text):
    try:
        if pd.isna(text) or text.strip() == "":
            return pd.Series([0.0, 1.0, 0.0, 0.0], index=['score_neg', 'score_neu', 'score_pos', 'sentiment_score'])

        encoded_input = tokenizer(text, return_tensors='pt', truncation=True, max_length=512)
        with torch.no_grad():
            output = model(**encoded_input)
        scores = softmax(output.logits[0], dim=0).numpy()
        sentiment_score = scores[2] - scores[0]  # positive - negative
        return pd.Series([scores[0], scores[1], scores[2], sentiment_score], index=['score_neg', 'score_neu', 'score_pos', 'sentiment_score'])
    except:
        return pd.Series([None, None, None, None], index=['score_neg', 'score_neu', 'score_pos', 'sentiment_score'])
```

```
# Apply to the "Participación" column with progress bar
tqdm.pandas()
scores_df = df_corpus['Participación'].astype(str).progress_apply(get_sentiment_score)

# Combine with original DataFrame
df_corpus_sentiment = pd.concat([df_corpus.reset_index(drop=True), scores_df], axis=1)

# Drop rows with errors
df_corpus_sentiment = df_corpus_sentiment.dropna(subset=['sentiment_score'])

# Save to file if needed
# df_corpus_sentiment.to_csv("/content/base_CDMX_C-D+_18-25_sentiment.csv", index=False)

# Quick check
df_corpus_sentiment[['Participación', 'sentiment_score']].head()
```

```
100%|██████████| 4376/4376 [06:28<00:00, 11.26it/s]
```

	Participación	sentiment_score
0	sí	-0.065402
1	Muy buenas tardes me escucha bien.	-0.044646
2	Bien, estoy bien.	0.030563
3	Disculpense disculpa si me si me retrasé es qu...	-0.143344
4	Se escucha perfecto todo.	0.095202

```
# Calculate and print the average sentiment score of the corpus
avg_sentiment = df_corpus_sentiment["sentiment_score"].mean()
print(f"Average Sentiment Score (Corpus - Recalculated): {avg_sentiment:.3f}")
```

```
Average Sentiment Score (Corpus - Recalculated): -0.042
```

```
from scipy.stats import ttest_ind, ks_2samp

# Load generated sentiment scores
df_generated = pd.read_csv("/content/CDMX_Sentiment_Comparation.csv", encoding='ISO-8859-1')
sent_gen = df_generated[df_generated["tipo"] == "generada"]["sentimiento"].dropna()

# Load recalculated corpus sentiment scores
# (assuming you already have df_corpus_sentiment from the previous step)
sent_corpus = df_corpus_sentiment["sentiment_score"].dropna()

# Perform t-test
t_stat, p_val_t = ttest_ind(sent_gen, sent_corpus)
```

```
# Perform K-S test
ks_stat, p_val_ks = ks_2samp(sent_gen, sent_corpus)

# Print results
print(f"Average Sentiment - Corpus (Recalculated): {sent_corpus.mean():.3f}")
print(f"Average Sentiment - Generated: {sent_gen.mean():.3f}")
print(f"\nT-test p-value: {p_val_t:.5f}")
print(f"K-S test p-value: {p_val_ks:.5f}")
```

```
Average Sentiment - Corpus (Recalculated): -0.042
Average Sentiment - Generated: -0.140

T-test p-value: 0.00000
K-S test p-value: 0.00000
```

```
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd

# Combine the two series into a single DataFrame for plotting
df_plot = pd.DataFrame({
    "Sentiment": pd.concat([sent_corpus, sent_gen], ignore_index=True),
    "Source": ["Full Corpus"] * len(sent_corpus) + ["Model"] * len(sent_gen)
})

# Set style
sns.set(style="whitegrid")

# Plot boxplot
plt.figure(figsize=(6, 5))
sns.boxplot(data=df_plot, x="Source", y="Sentiment", palette={"Full Corpus": "blue", "Model": "red"}, linewidth=2.5)

plt.title("Boxplot of Sentiment: Corpus vs Generated")
plt.xlabel("Response Source")
plt.ylabel("Sentiment Score (-1 to 1)")
plt.grid(True)
plt.show()
```

```
/tmp/ipython-input-26-2181211753.py:16: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `x` variable to `hue` and set `legend

  sns.boxplot(data=df_plot, x="Source", y="Sentiment", palette={"Full Corpus": "blue", "Model": "red"}, linewidth=2.5)
```