EXPERIMENT 7: Formant Estimation

```matlab
clc; clear; close all;

%% Step 1: Load Speech Signal
[y, fs] = audioread('Jingle.wav'); % Load speech file
y = y / max(abs(y)); % Normalize amplitude

%% Step 2: Preprocess Speech Signal
y = y - mean(y); % Remove DC offset
y = filter([1 -0.97], 1, y); % Pre-emphasis filter

% Voice Activity Detection (VAD) - Simple Energy-Based Silence Removal
threshold = 0.02; % Adjust based on noise level
y_active = y(abs(y) > threshold); % Remove silent segments

%% Step 3: LPC Analysis - Estimate Vocal Tract Filter Coefficients
frame_length = round(0.025 * fs); % 25 ms frame
frame = y_active(1:min(frame_length, length(y_active))) .* hamming(frame_length); %
Apply window
p = 12; % LPC order
a = lpc(frame, p); % Compute LPC coefficients

%% Step 4: Compute Frequency Response & Identify Formants
[H, w] = freqz(1, a, 512, fs); % Compute vocal tract frequency response

figure;
plot(w, 20*log10(abs(H)), 'b', 'LineWidth', 1.5);
xlabel('Frequency (Hz)');
ylabel('Magnitude (dB)');
title('Estimated Vocal Tract Frequency Response');
grid on;

% Find Formants (Peaks in LPC Spectrum)
roots_a = roots(a); % Find LPC polynomial roots
formants = sort(angle(roots_a(imag(roots_a) > 0)) * (fs / (2 * pi))); % Convert to Hz

disp('Estimated Formant Frequencies (Hz):');
disp(formants(1:3)); % Display first three formants
```