In [9]:

```python
import numpy as np
import random
import matplotlib.pyplot as plt
from tqdm import tqdm
from collections import deque

def plot_degree_distribution(graph, scale='linear', color='#D95319', alph
    plt.close()
    num_nodes = len(graph)
    degrees = [len(neighbors) for neighbors in graph.values()]
    max_degree = max(degrees) if degrees else 0

    degree_counts = [0] * (max_degree + 1)
    for degree in degrees:
        degree_counts[degree] += 1

    degree_probabilities = [count / num_nodes for count in degree_counts]

    plt.figure(figsize=(8, 6))
    if scale == 'log':
        plt.xscale('log')
        plt.yscale('log')
        plt.title('Degree Distribution (Log-Log Scale)')
        plt.ylabel('log(P(k))')
        plt.xlabel('log(k)')
    else:
        plt.title('Degree Distribution (Linear Scale)')
        plt.ylabel('P(k)')
        plt.xlabel('k')

    plt.plot(range(max_degree + 1), degree_probabilities, 'o', markersize
    plt.grid(True, which="both", linestyle="--")

    if fit_line and scale == 'log':
        x_vals = list(range(expct_lo, expct_hi))
        y_vals = [(x ** -3) * expct_const for x in x_vals]
        plt.plot(x_vals, y_vals, color='#7f7f7f', linestyle='dashed')

    plt.show()

def select_node_by_probability(graph):
    degrees = {node: len(neighbors) for node, neighbors in graph.items()}
    total_degree = sum(degrees.values())
    probabilities = [deg / total_degree for deg in degrees.values()]
    return np.random.choice(list(degrees.keys()), p=probabilities)

def add_edge_to_graph(graph, new_node):
    existing_node = select_node_by_probability(graph) if graph else 0
    if new_node in graph[existing_node]:
        print("Edge already exists! Retrying...")
        add_edge_to_graph(graph, new_node)
    else:
        graph[new_node].add(existing_node)
        graph[existing_node].add(new_node)

def bfs_shortest_path_length(graph, start_node):
    queue = deque([(start_node, 0)])
    visited = {start_node}
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    path_lengths = []

    while queue:
        node, depth = queue.popleft()
        path_lengths.append(depth)
        for neighbor in graph[node]:
            if neighbor not in visited:
                visited.add(neighbor)
                queue.append((neighbor, depth + 1))

    return sum(path_lengths) / len(path_lengths) if path_lengths else 0

def compute_characteristic_path_length(graph):
    if not graph:
        return 0
    total_length = sum(bfs_shortest_path_length(graph, node) for node in
    return total_length / len(graph)

def assess_topology(graph):
    clustering_coeffs = []
    for node in graph:
        neighbors = graph[node]
        if len(neighbors) < 2:
            clustering_coeffs.append(0)
        else:
            links = sum(1 for neighbor in neighbors for other in neighbor
            clustering_coeffs.append(2 * links / (len(neighbors) * (len(n
    avg_clustering_coeff = sum(clustering_coeffs) / len(graph)
    print(f"Average Clustering Coefficient: {avg_clustering_coeff:.4f}")

    char_path_length = compute_characteristic_path_length(graph)
    print(f"Characteristic Path Length: {char_path_length:.4f}")

def barabasi_albert_simulation():
    init_nodes = int(input("Enter the initial number of nodes (m_0): "))
    final_nodes = int(input("Enter the final number of nodes: "))
    m_parameter = int(input("Enter the value of m parameter (m <= m_0): "

    if m_parameter > init_nodes:
        print("Value of m parameter can't be greater than m0, please retr
    else:
        print("\nCreating initial graph...")
        graph = {i: set(j for j in range(init_nodes) if j != i) for i in
        print(f"Graph initialized with {len(graph)} nodes.")

        new_node = init_nodes
        print("\nAdding nodes...")
        for _ in tqdm(range(final_nodes - init_nodes)):
            graph[new_node] = set()
            for _ in range(m_parameter):
                add_edge_to_graph(graph, new_node)
            new_node += 1

        print(f"\nFinal number of nodes reached: {len(graph)}")

        plot_degree_distribution(graph)
        plot_degree_distribution(graph, scale='log', fit_line=False)
        assess_topology(graph)
```

```python
if __name__ == "__main__":
    barabasi_albert_simulation()
```

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Creating initial graph...
Graph initialized with 12 nodes.

Adding nodes...
100%|██████████| 188/188 [00:00<00:00, 2307.99it/s]
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Final number of nodes reached: 200
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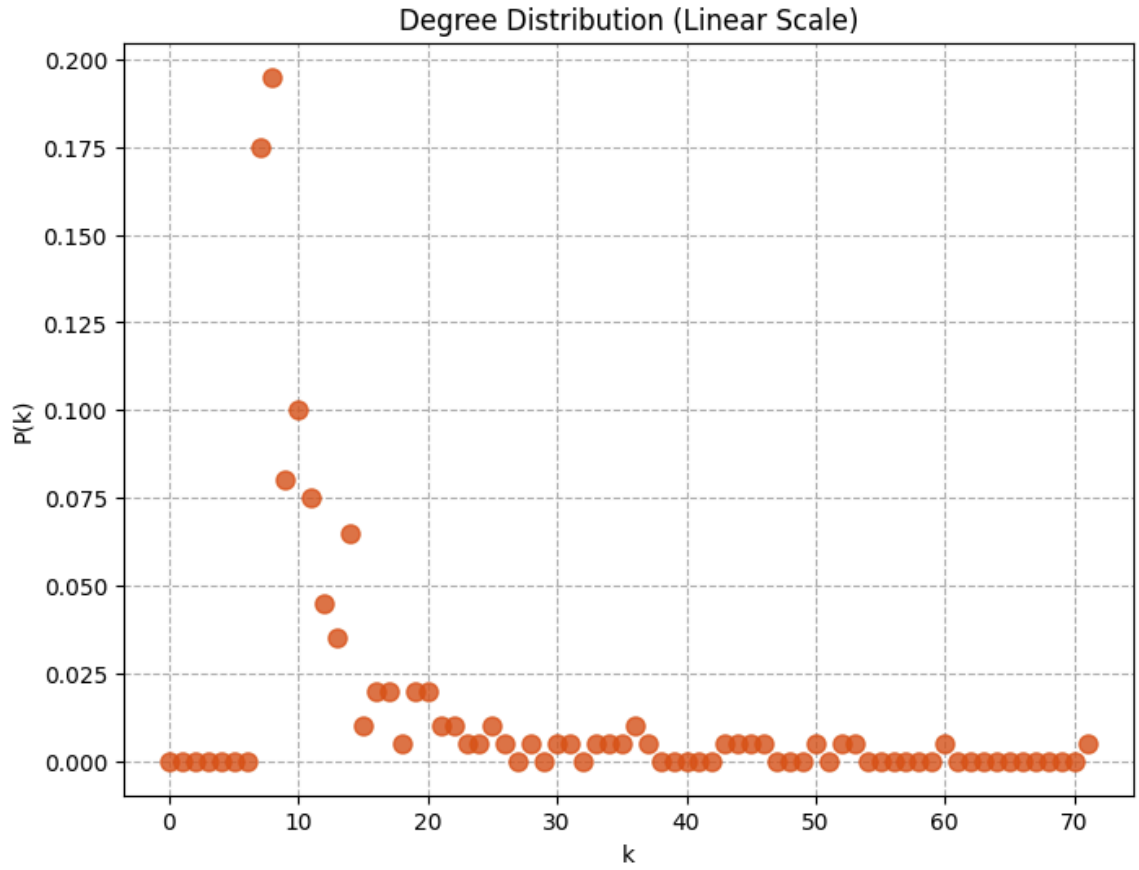

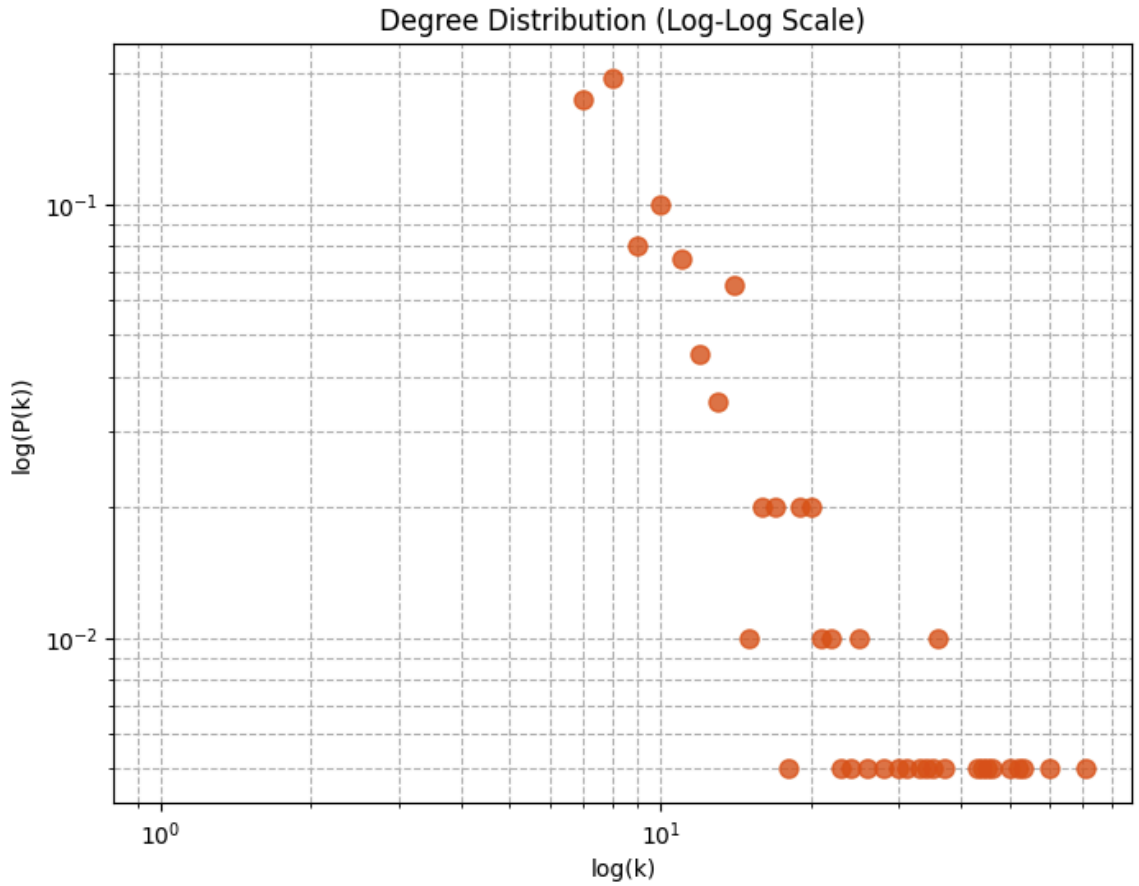

Average Clustering Coefficient: 0.1714
Characteristic Path Length: 2.2439