import matplotlib.pyplot as plt

import numpy as np

from scipy.ndimage import gaussian\_filter1d

# مقادیر بتا

betas = np.arange(0.1, 1.1, 0.1)

# داده‌های هزینه

cost\_combined = np.array([5.1, 9.7, 15.2, 20.1, 29.7, 39.8, 50.4, 60.3, 74.9, 89.6])

cost\_maintain = np.array([6.0, 12.4, 17.3, 22.5, 31.93, 43.6, 53.7, 64.4, 78.7, 92.1])

cost\_reallocate = np.array([7.2, 13.8, 19.9, 27.3, 30.4, 49.9, 63.8, 77.3, 94.8, 109.3])

# محاسبه درصد افزایش هزینه نسبت به سیاست ترکیبی

increase\_maintain = (cost\_maintain - cost\_combined) / cost\_combined \* 100

increase\_reallocate = (cost\_reallocate - cost\_combined) / cost\_combined \* 100

increase\_maintain\_smooth = gaussian\_filter1d(increase\_maintain, sigma=1)

increase\_reallocate\_smooth = gaussian\_filter1d(increase\_reallocate, sigma=1)

plt.figure(figsize=(12, 5))

# نمودار (a)

plt.subplot(1, 2, 1)

plt.plot(betas, cost\_combined, '-s',color='blue', linewidth=2, label='reallocate-and-maintain policy')

plt.plot(betas, cost\_maintain, '-o', color='red', linewidth=2, label='maintain-only policy')

plt.plot(betas, cost\_reallocate, '-^',color='orange', linewidth=2, label='reallocate-only policy')

plt.xlabel(r'$\beta$', fontsize=12)

plt.ylabel('Minimal expected cost per time unit', fontsize=12)

plt.title('(a) Minimal average cost per unit time', fontsize=13)

plt.legend()

plt.grid(False)

# نمودار (b)

plt.subplot(1, 2, 2)

plt.plot(betas, increase\_maintain\_smooth, 'k-', linewidth=2, label='maintain-only policy')

plt.plot(betas, increase\_reallocate\_smooth, 'k--', linewidth=2, label='reallocate-only policy')

plt.xlabel(r'$\beta$', fontsize=12)

plt.ylabel('Percentage increase in cost', fontsize=12)

plt.title('(b) Cost increase (%)', fontsize=13)

plt.legend()

plt.grid(False)

plt.tight\_layout()

plt.show()