statsHW11Q1b

January 20, 2025

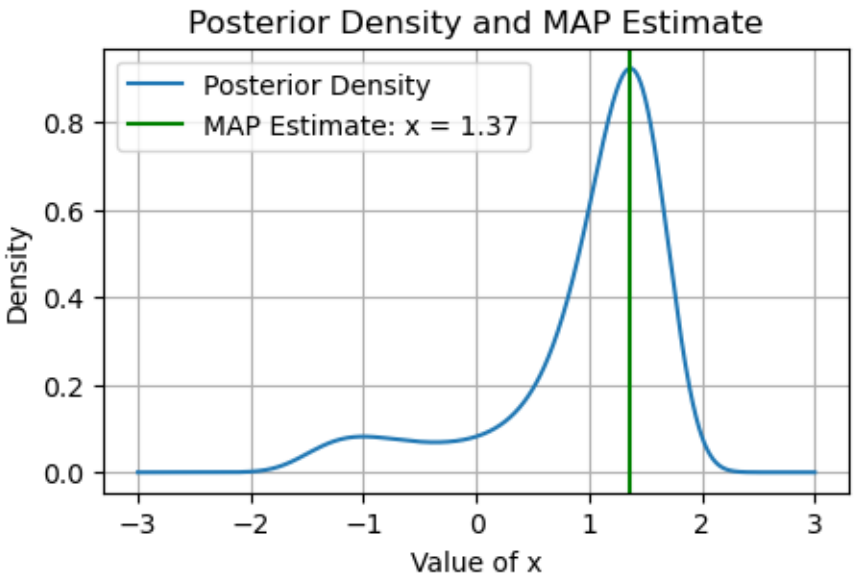
[1]:
```
import numpy as np
import matplotlib.pyplot as plt

def posterior_density(x, y):
    return np.exp(-0.5 * ((y - x**2)**2 + (x - 1)**2))

y_obs = 2
x_vals = np.linspace(-3, 3, 1000)
posterior_vals = posterior_density(x_vals, y_obs)
posterior_vals /= np.trapz(posterior_vals, x_vals)
map_index = np.argmax(posterior_vals)
map_estimate = x_vals[map_index]

plt.figure(figsize=(5, 3))
plt.plot(x_vals, posterior_vals, label="Posterior Density")
plt.axvline(map_estimate, color='g', linestyle='-', label=f"MAP Estimate: x =␣
 ↪{map_estimate:.2f}")
plt.title("Posterior Density and MAP Estimate")
plt.xlabel("Value of x")
plt.ylabel("Density")
plt.legend()
plt.grid()
plt.show()

print(f"The MAP estimate of x given y = 2 is approximately: x_MAP =␣
 ↪{map_estimate:.3f}")
```




```
The MAP estimate of x given y = 2 is approximately: x_MAP = 1.366
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