Solution 3.1

- Using the simulated data for $f_m = 5$ Hz, LCR=3 and AFD=0.021 when the rms threshold is set to be $-10$ dB. Based on LCR and AFD equations, we find
\[ N_R = 3.52 \quad \bar{\tau} = 0.0260 \]

- Using the simulated data for $f_m = 5$ Hz, LCR= 9 and AFD= 0.0055 when the rms threshold is set to be $-10$ dB. Based on LCR and AFD equations, we find
\[ N_R = 14 \quad \bar{\tau} = 0.0065 \]
Since the simulated data is relatively short, the simulated results can be somewhat different from the theoretical results. Therefore, more simulated data should be used to match the theoretical results.

**Solution 3.2**

(a) Maximize capacity given by

\[
C = \max_{S(\gamma): \int S(\gamma)p(\gamma)d\gamma = S} \int B \log \left( 1 + \frac{S(\gamma)\gamma}{S} \right) p(\gamma)d\gamma
\]

Construct the Langrangian function

\[
\mathcal{L} = \int B \log \left( 1 + \frac{S(\gamma)\gamma}{S} \right) p(\gamma)d\gamma - \lambda \int \frac{S(\gamma)}{S} p(\gamma)d\gamma
\]