Set #2

Due Date Monday September 27, 2021

Problems

1. Z&T 6.27.
2. Z&T 6.46.
3. Z&T 7.3.
4. Z&T 7.5.
5. Z&T 7.10.
6. Z&T 7.13.

Computer Exercises

1. Z&T 7.1. I recommend working using Python. Increase the ensemble size from 20 to 100 or even 1000. You will need to pick a time interval for $X(t)$. I suggest that you choose one period. So if you let $f_0 = 1$ Hz, then generate sample functions on $0 \le t \le 1$. Since Python/MATLAB makes this easy to do, go ahead and let the number of sample per period be 100. This is a huge amount of oversampling, but it will be convenient for measurements you may want to take in working 7.1 and also in working 7.2. Once you have your 1000×100 data array the numpy function `mean()` makes it very easy to average each column (ensemble average) or each row (time average). This is done by setting the optional argument `axis` to either `0` for column average or `1` for row average. Use `shape` on the output array from `mean()` to confirm you have the proper average.
   For part (c) plot the ensemble averages $E[X(t)]$ and $E[X^2(t)]$ versus time and compare the answers with your theoretical expectations. For more theory see Z&T Example 7.1 pp. 313–314.
2. Z&T 7.2. Note this problem is identical to 7.1, but now the phase is uniform on only $[-\pi/4, \pi/4]$. Text Example 7.1 will help you with the theory side of this experiment.
   For part (c) plot the ensemble averages $E[X(t)]$ and $E[X^2(t)]$ versus time and compare the answers with your theoretical expectations.