

Q1 Consider the rolling of a fair dice infinite times, the probability of outcomes is?

Dice rolling is a classical uniform distribution problem, and it has the characteristics of having exact same probability getting each and every possible outcome. For this question, rolling a fair dice no matter how long doesn't change its distribution, which still remains to be uniform for all of its possible outcomes.

Therefore, $P(X) = \frac{1}{n_x}$.

Q2 List some zero-mean signals? What is DC offset?

Zero-mean signals: white noise, pink noise, zero-mean sinusoidal signal

DC offset: It is what zero-mean signals doesn't have, which is making the above and below signal integral not equal to each other. The resulting signal looks like being shifted upward or downward from original zero-mean signal.

Q3 A rand function generated pseudo-random numbers uniformly distributed in the interval [0, 1]

The video in the following answer is created by generating 1 to 1k random values and compute its mean or variance, and repeat this action 1k times, which result in the value distribution graph.

(a) Mean

Video: <https://youtu.be/U1RjWee0A18>

Code: https://github.com/belongtothenight/RTDSP_Code/blob/main/src/w5_code3_1.m

(b) Variance

Video: <https://youtu.be/wcjkwlTRmUg>

Code: https://github.com/belongtothenight/RTDSP_Code/blob/main/src/w5_code3_2.m

(c) How to generate zero-mean random numbers?

Video: <https://youtu.be/HJhx3YpgSrs>

Code: https://github.com/belongtothenight/RTDSP_Code/blob/main/src/w5_code3_3.m

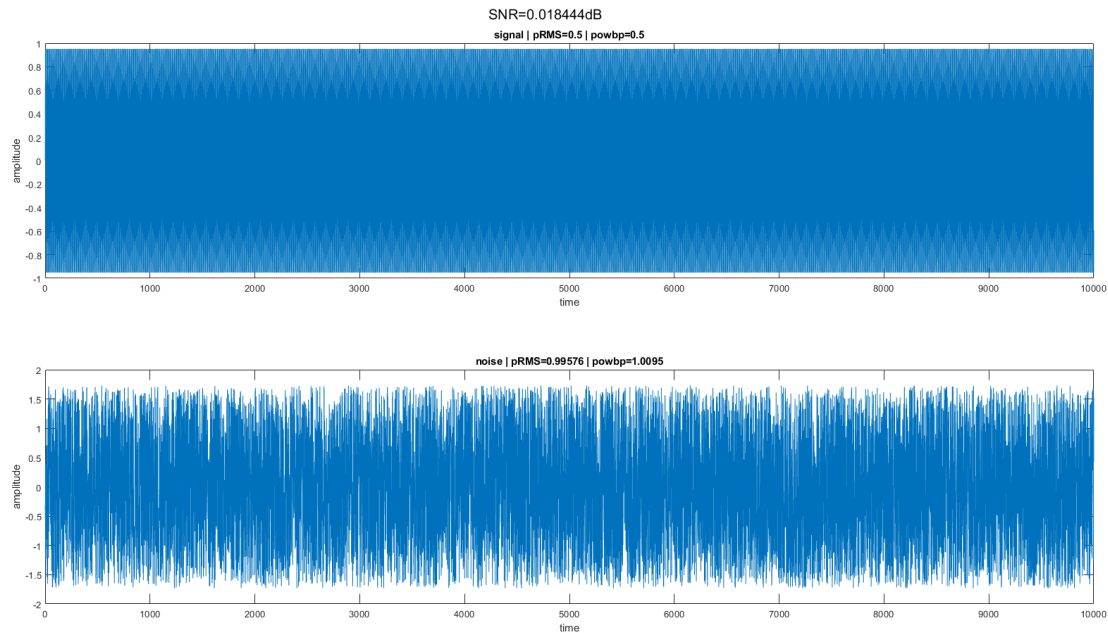
(d) How to generate zero-mean, unit-variance random numbers?

Video: <https://youtu.be/XRjISipjxyg>

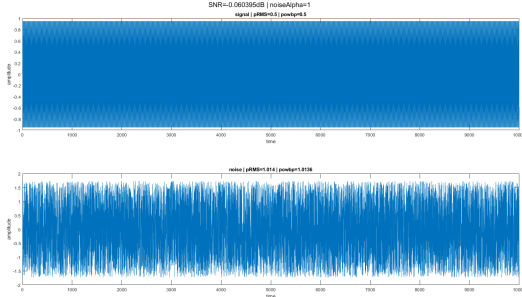
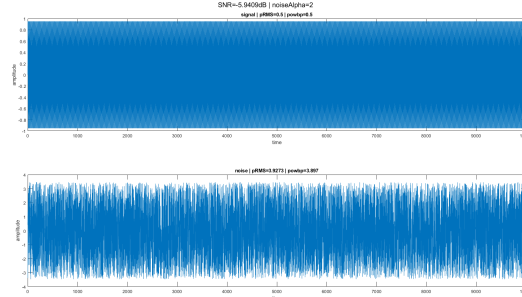
Code: https://github.com/belongtothenight/RTDSP_Code/blob/main/src/w5_code3_4.m

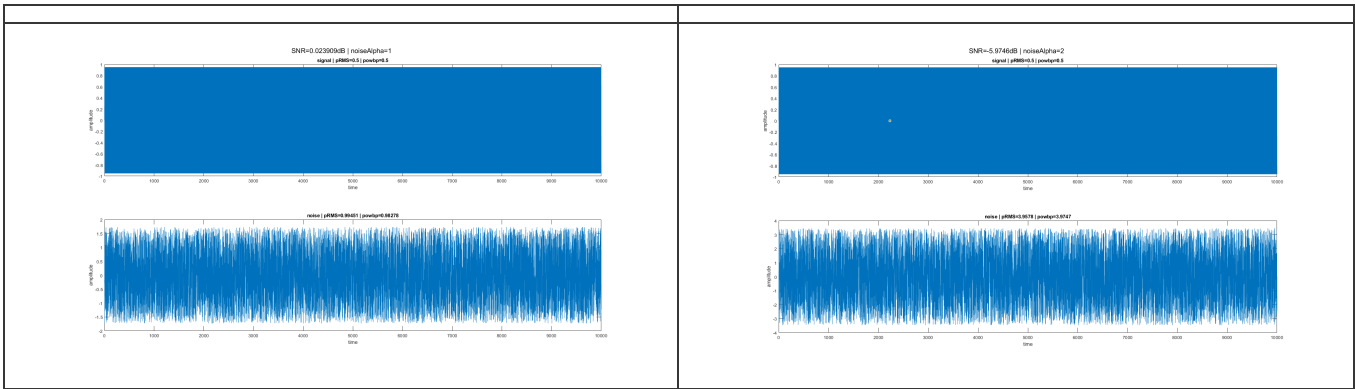
Q4

(a) Generate a sinewave corrupted by the zero-mean, unit-variance white noise with SNR=0 dB



(b) Generate sinewave at different frequency corrupted by white noise with different SNR

1kHz sinewave & 0dB SNR	1kHz sinewave & -6dB SNR
	
2kHz sinewave & 0dB SNR	2kHz sinewave & -6dB SNR



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