```
display(med_rect); med_tooth=mean(xtooth); display(med_tooth)
disp('Sequences minimum');
min_sin=min(xsin); display(min_sin); min_rect=min(xrect);
display(min_rect); min_tooth=min(xtooth); display(min_tooth)
disp('Sequences maximum');
max_sin=max(xsin); display(max_sin); max_rect=max(xrect);
display(max_rect); max_tooth=max(xtooth); display(max_tooth)
disp('Sequences standard deviation');
ds_sin=std(xsin); display(ds_sin); ds_rect=std(xrect);
display(ds_rect); ds_tooth=std(xtooth); display(ds_tooth)
```

In the command window:

```
Sequences mean
    med_sin =       0
    med_rect =      0
    med_tooth =    -1.0000e-001
Sequences minimum
    min_sin =      -9.5106e-001
    min_rect =     -1
    min_tooth =    -1
```

```
Sequences maximum
    max_sin =       9.5106e-001
    max_rect =      1
    max_tooth =     8.0000e-001
Sequences standard deviation
    ds_sin =        7.2548e-001
    ds_rect =       1.0260e+000
    ds_tooth =      5.8938e-001
```

2.4 Exercises

1. Generate and graph the ramp sequence, with initial value 0 and final value 100, of length 20: $x(n) = \frac{100}{19}n,\ n = \overline{0,19}$.

2. Plot the discrete sequence, of length 20:
$$x(n) = \begin{cases} \sin(0.2n), & n > 10, \\ 0, & n \le 10. \end{cases}$$

3. Generate the complex sequence, of length 50:
$$x(n) = \exp\left[-0.1n + j\left(2\pi 0.1n + \frac{\pi}{4}\right)\right].$$
Plot the sequence attenuated by sine, respectively by cosine functions:
$$x_1(n) = e^{-0.1n}\sin\left(2\pi 0.1n + \frac{\pi}{4}\right); \qquad x_2(n) = e^{-0.1n}\cos\left(2\pi 0.1n + \frac{\pi}{4}\right).$$

4. Graph the sequence $x(n) = 3\sin(4\pi n) + 2\cos(0.72\pi n),\ n = \overline{0,100}$. Is this sequence periodic? If yes, which is the period?

5. Graph the attenuated sine sequence of length 100, given by:
$$x(n) = \begin{cases} \dfrac{\sin(0.1n)}{0.1n}, & n \ne 0, \\ 1, & n = 0. \end{cases}$$

6. Generate 16 periods of a periodic sequence; every period consists in 5

samples of 1 and 10 samples of 0.

7. Generate three sinusoidal sequences of different amplitude, frequency and phase and plot them simultaneously on the screen (minimum one period).

8. Generate and graph a rectangular sequence and a sawtooth one having 15 samples per period. You have to represent graphically 5 periods.

9. Generate and plot next sequences:

$$x_1(n) = \begin{cases} n(2-n), & n = \overline{-5,10} \\ 10, & \text{otherwise} \end{cases} \quad n = \overline{-10,20};$$

$$x_2(n) = \begin{cases} \sum_{i=0}^{8} a(n-2i), & 0 \le n \le 10 \\ 50, & \text{otherwise} \end{cases} \quad n = \overline{0,15},$$

$$a = \begin{cases} n+3, & n = \overline{0,5} \\ 0.5, & \text{otherwise} \end{cases}$$

10. Generate 101 samples of a ramp sequence with the initial value 0 and the increment equal by 0.01. Plot this sequence between 20 and 30.

    Hint: For plotting this sequence you can use: `stem(20:30, x(21:31))` assuming that the generated sequence was denoted by `x`.

11. Generate an uniformly distributed random sequence, between 0 and 10. Plot this sequence for $n = \overline{0,49}$.

    Hint: To generate an uniform distributed random sequence on a specified interval $[a, b]$, you have to multiply the output of `rand` function by $(b-a)$, and then to add a. In the case of this example $a = 0$ and $b = 10$.

12. Generate a normally distributed random sequence (Gaussian), between 0 and 10. Graph this sequence for $n = \overline{0,49}$.

    Hint: This sequence has a specific mean equal by 5 and a variance equal by 5. To generate a Gaussian sequence with these parameters multiply the output of `randn` function by the value of the standard deviation ($\sqrt{5}$) and then add the desired mean (5).

13. Plot using `stem` function, the sequence obtained by summing a sinusoid with an uniform noise with the amplitude 10 times lower.

14. Create a MATLAB function to generate the values corresponding to a finite length sinusoidal sequence. The function must have 5 input arguments: 3 for the sinusoid's parameters and 2 to specify the first and the last index of the finite sequence.

Hint: `function seq = gensin(ampl, freq, phase, ninit, nfin)`

Use the created function in a script to evaluate the minimum, the maximum, the mean and the standard deviation of a sinusoidal sequence with next parameters: `ampl = 1.5` , `freq = 1/15` , `phase = pi/6` , $n = \overline{0, 50}$.

15. Modify the previously generated function, to return 2 output arguments: a vector that contains the sequence's values and a vector with the sequence's indices.

    Hint: `function [seq, n] = gensin1(ampl, freq, phase, ninit, nfin)`

16. Generate and plot the next sequences (abscissa n must include only the indicated range):

$$x_1(n) = 0.5\delta(n),\ n = \overline{-5, 10}; \qquad x_2(n) = 0.8\delta(n-5),\ n = \overline{-5, 10};$$
$$x_3(n) = 2u(n),\ n = \overline{-20, 20}; \qquad x_4(n) = 1.5\delta(n+80),\ n = \overline{-90, 0};$$

$$\begin{aligned} x_5(n) &= 1.5u(n-9),\ n = \overline{-9, 20}; \\ x_6(n) &= 2.5u(n+6),\ n = \overline{-15, 9}; \\ x_7(n) &= 2.2\sin\left(2\pi 0.1n + \frac{\pi}{4}\right),\ n = \overline{0, 49}; \\ x_8(n) &= 1.5\sin\left(\frac{\pi}{4}n + \frac{\pi}{3}\right),\ n = \overline{0, 20}; \\ x_9(n) &= 2\cos\left(\frac{\pi}{\sqrt{5}}n + \frac{\pi}{6}\right),\ n = \overline{-20, 20}; \end{aligned}$$

$$x_{10}(n) = \exp(3n),\ n = \overline{0, 9}; \qquad x_{11}(n) = (-3)^n \sin\left(\frac{\pi}{8}n\right),\ n = \overline{0, 20};$$

$$\begin{aligned} x_{12}(n) &= 10\sin\left(2\pi 0.1n + \frac{\pi}{6}\right),\ n = \overline{0, 20}; \\ x_{13}(n) &= 1.2\delta(n+5) + 1.3\left[u(n) - u(n-20)\right], \quad n = \overline{-15, 25}; \\ x_{14}(n) &= \ln\left|\sin\left(\frac{\pi}{10}n\right) - \cos\left(\frac{\pi}{10}n\right)\right|, \quad n = \overline{-20, 20}. \end{aligned}$$

17. Generate and plot the sequences of length 100:

$$x_1(n) = \delta(n) - \delta(n-5); \qquad x_2(n) = u(n-5);$$
$$x_3(n) = n\left[u(n) - u(n-10)\right]; \qquad x_4(n) = \exp\left[(-0.2 + j0.3)\,n\right];$$

$$\begin{aligned} x_5(n) &= n\left[u(n) - u(n-10)\right] + \exp\left[(-0.2 + j0.3)\,n\right]; \\ x_6(n) &= n\left[u(n) - u(n-10)\right] + \exp(0.3n)\left[u(n-10) - u(n-20)\right]. \end{aligned}$$

18. Add an uniformly distributed random sequence of mean 0 and maximum amplitude 0.2, to the 100 length sequences, generated at exercise 17.

19. Repeat exercise 18, for a Gaussian sequence of mean 0 and variance 0.1.