GENG-8030 Computational Methods and Modeling for Engineering Applications

Summer 2023

Tutorial 6

All questions were taken from the course textbook:

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Chapter 7: Statistics, Probability, and Interpolation

2. Thirty pieces of structural timber of the same dimensions were subjected to an increasing lateral force until they broke. The measured force in pounds required to break them is given in the following list. Plot the absolute frequency histogram. Try bin widths of 50, 100, and 200 lb. Which gives the most meaningful histogram? Try to find a better value for the bin width.

243	236	389	628	143	417	205
404	464	605	137	123	372	439
497	500	535	577	441	231	675
132	196	217	660	569	865	725
457	347					

5. Create some data by evaluating the function $x = \sin 0.5t$ for integer values of t over the range 0, 10. Then, by plotting the data and the moving means, investigate the accuracy of the moving average using (a) three points and (b) five points.

7. For the data given in **Problem 2**:

a. Plot the scaled frequency histogram.

b. Compute the mean and standard deviation and use them to estimate the lower and upper limits of strength corresponding to 68 and 96 percent of such timber pieces. Compare these limits with those of the data.

12. A certain product requires that a shaft be inserted into a bearing. Measurements show that the diameter d_1 of the cylindrical hole in the bearing is normally distributed with a mean of 4 cm and a variance of 0.0064. The diameter d_2 of the shaft is normally distributed with a mean of 3.96 cm and a variance of 0.0036.

a. Compute the mean and the variance of the clearance $c = d_1 - d_2$.

b. Find the probability that a given shaft will not fit into the bearing. (*Hint:* Find the probability that the clearance is negative.)

15. Use a random number generator to produce 1000 uniformly distributed numbers with a mean of 10, a minimum of 2, and a maximum of 18. Obtain the mean and the histogram of these numbers, and discuss whether they appear uniformly distributed with the desired mean.

19. Suppose that $y = x^2$, where x is a normally distributed random variable with a mean and variance of $\mu_x = 0$ and $\sigma_x^2 = 5$. Find the mean and variance of y by simulation. Does $\mu_y = \mu_x^2$? Does $\sigma_y = \sigma_y^2$? Do this for 100, 1000, and 5000 trials.

27. The following table gives temperature data in °C as a function of time of day and day of the week at a specific location. Data are missing for the entries marked with a question mark (?). Use linear interpolation with MATLAB to estimate the temperature at the missing points.

	Day				
Hour	**Mon**	**Tues**	**Wed**	**Thurs**	**Fri**
1	16	15	12	17	16
2	13	?	8	11	12
3	14	15	9	?	15
4	17	15	14	17	19
5	21	18	19	20	24

29. The following data are the measured temperature T of water flowing from a hot water faucet after it is turned on at time $t = 0$.

t (sec)	T (°F)	t (sec)	T (°F)
0	72.5	6	109.3
1	78.1	7	110.2
2	86.4	8	110.5
3	92.3	9	109.9
4	110.6	10	110.2
5	111.5		

a. Plot the data, connecting them first with straight lines and then with a cubic spline.

b. Estimate the temperature values at the following times, using linear interpolation and then cubic spline interpolation: $t = 0.6, 2.5, 4.7, 8.9$

c. Use both the linear and cubic spline interpolations to estimate the time it will take for the temperature to equal the following values: $T = 75, 85, 90, 105$.