PES UNIVERSITY

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Department of Computer Science & Engineering
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UE24MA242A: Mathematics for Computer Science Engineers

Classwork Problems

<table>
<tr><th>#</th><th>UNIT_1 Questions</th><th>Exercise Number</th></tr>
<tr><td>1.</td><td>The article “Wind-Uplift Capacity of Residential Wood Roof-Sheathing Panels Retrofitted with Insulating Foam Adhesive” (P. Datin, D. Prevatt, and W. Pang, Journal of Architectural Engineering, 2011:144–154) presents tests in which air pressure was applied to roof-sheathing panels until failure. The pressure at failure for each panel was recorded, along with the type of sheathing, sheathing thickness, and wood species. The following table presents the results of four tests.
<table>
<tr><th>Sheathing Type</th><th>Failure Pressure (kPa)</th><th>Thickness (mm)</th><th>Wood Species</th></tr>
<tr><td>5-ply plywood</td><td>2.63</td><td>11.9</td><td>Douglas Fir</td></tr>
<tr><td>Oriented strand board</td><td>3.69</td><td>15.1</td><td>Spruce-Pine-Fir</td></tr>
<tr><td>Cox plywood</td><td>5.26</td><td>12.7</td><td>Southern Yellow Pine</td></tr>
<tr><td>4-ply plywood</td><td>5.03</td><td>15.9</td><td>Douglas Fir</td></tr>
</table>
Which data are numerical and which are categorical?</td><td>Example 1.8</td></tr>
<tr><td>2.</td><td>Each of the following processes involves sampling from a population. Define the population, and state whether it is tangible or conceptual.

a. A chemical process is run 15 times, and the yield is measured each time.
b. A pollster samples 1000 registered voters in a certain state and asks them which
candidate they support for governor.
c. In a clinical trial to test a new drug that is designed to lower cholesterol, 100 people with high cholesterol levels are recruited to try the new drug.
d. Eight concrete specimens are constructed from a new formulation, and the compressive strength of each is measured.
e. Quality engineers need to estimate the percentage of bolts manufactured on a certain day that meet a strength specification. At 3:00 in the afternoon they sample the last 100 bolts to be manufactured.</td><td>Exercise 1.1</td></tr>
<tr><td>3.</td><td>A medical researcher wants to determine whether exercising can lower blood pressure. She recruits 100 people with high blood pressure to participate in the study. She assigns a random sample of 50 of them to pursue an exercise program that includes daily swimming and jogging. She assigns the other 50 to refrain from vigorous activity. She measures the blood pressure of each of the 100 individuals both before and after the study.
a. Is this a controlled experiment or an observational study?</td><td>Exercise 1.1</td></tr>
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4.	In the article "Evaluation of Low-Temperature Properties of HMA Mixtures" (P. Sebaaly, A. Lake, and J. Epps, Journal of Transportation Engineering, 2002: 578– 583), the following values of fracture stress (in megapascals) were measured for a sample of 24 mixtures of hot-mixed asphalt (HMA). 30 75 79 80 80 105 126 138 149 179 179 191 223 232 232 236 240 242 245 247 254 274 384 470 a. Compute the mean, median, and the 5%, 10%, and 20% trimmed means b. Find the mode and range c. Find the first and third quartiles of the asphalt data d. Find the 65th percentile of the asphalt data	Example 1.12
5.	In a sample of 20 men, the mean height was 178 cm. In a sample of 30 women, the mean height was 164 cm. What was the mean height for both groups put together?	Exercise 1.2
6.	Why can't the average of nominal data be computed?	Data types
7.	Is it possible to sort ordinal data meaningfully but not perform arithmetic operations on it? Why or why not?	Data types
8.	Why is temperature in Celsius considered interval data and not ratio data?	Data types
9.	You are asked to analyze customer satisfaction scores on a 5-point scale (1 to 5). Can you treat these scores as interval data? Justify.	Data types
10.	A student records eye color and test scores. Which is qualitative and which is quantitative data? How does this affect analysis?	Data types
11.	A piston is placed inside a cylinder. The clearance is the distance between the edge of the piston and the wall of the cylinder and is equal to one-half the difference between the cylinder diameter and the piston diameter. Assume the piston diameter has a mean of 80.85 cm with a standard deviation of 0.02 cm. Assume the cylinder diameter has a mean of 80.95 cm with a standard deviation of 0.03 cm. Find the mean clearance. Assuming that the piston and cylinder are chosen independently, find the standard deviation of the clearance.	Example 2.50
12.	If X and Y are independent random variables with means $\mu X = 9.5$ and $\mu Y = 6.8$, and standard deviations $\sigma X = 0.4$ and $\sigma Y = 0.1$, find the means and standard deviations of the following: a. 3X b. $Y - X$ c. $X + 4Y$	Execrcise 2.5
13.	A laminated item is composed of five layers. The layers are a simple random sample from a population whose thickness has mean 1.2 mm and standard deviation 0.04 mm. a. Find the mean thickness of an item. b. Find the standard deviation of the thickness of an item.	Execrcise 2.5
14.	Suppose that we extract an individual at random from a population whose members have an average income of \$40,000, with a standard deviation of \$20,000. What is the probability of extracting an individual whose income is either less than \$10,000 or greater than \$70,000?	Chebyshev's inequality

<table>
<tr><td>15.</td><td>Suppose the average number of requests a web server receives per minute is 100, with a standard deviation of 10. What is the minimum percentage of time the number of requests will be between 80 and 120</td><td>Chebyshev's inequality</td></tr>
<tr><td>16.</td><td>A program has an expected execution time of 10 seconds with a standard deviation of 2 seconds. Using Chebyshev's inequality, what is the probability that the program will take longer than 16 seconds to execute?</td><td>Chebyshev's inequality</td></tr>
<tr><td>17.</td><td>As part of a quality-control study aimed at improving a production line, the weights (in ounces) of 20 bars of soap are measured. The results are as follows, sorted from smallest to largest.
11.6 12.6 12.7 12.8 13.1 13.3 13.6 13.7 13.8 14.1
14.3 14.3 14.6 14.8 15.1 15.2 15.6 15.6 15.7 15.8
Construct a normal probability plot for these data. Do these data appear to come from an approximately normal distribution?</td><td>Exercise 4.10</td></tr>
<tr><td>18.</td><td>Bottles filled by a certain machine are supposed to contain 12 oz of liquid. In fact the fill volume is random with mean 12.01 oz and standard deviation 0.2 oz.
a. What is the probability that the mean volume of a random sample of 144 bottles is less than 12 oz?
b. If the population mean fill volume is increased to 12.03 oz, what is the probability that the mean volume of a sample of size 144 will be less than 12 oz?</td><td>Exercise 4.11</td></tr>
<tr><td>19.</td><td>A 500-page book contains 250 sheets of paper. The thickness of the paper used to manufacture the book has mean 0.08 mm and standard deviation 0.01 mm.
a. What is the probability that a randomly chosen book is more than 20.2 mm thick (not including the covers)?
b. What is the 10th percentile of book thicknesses?
c. Someone wants to know the probability that a randomly chosen page is more than 0.1 mm thick. Is enough information given to compute this probability? If so, compute the probability. If not, explain why not.</td><td>Exercise 4.11</td></tr>
<tr><td>20.</td><td>A commuter encounters four traffic lights each day on the way to work. Let X represent the number of these that are red lights. The probability mass function of X is as follows.
<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$P(X = x)$</td><td>0.1</td><td>0.3</td><td>0.3</td><td>0.2</td><td>0.1</td></tr></table>What is the probability that in a period of 100 days, the average number of red lights encountered is more than 2 per day?</td><td>Exercise 4.11</td></tr>
<tr><td>21.</td><td>The time taken by an automobile mechanic to complete an oil change is random, with
mean 29.5 minutes and standard deviation 3 minutes.
a. What is the probability that 50 oil changes take more than 1500 minutes?
b. What is the probability that a mechanic can complete 80 or more oil changes in 40
hours?</td><td>Exercise 4.11</td></tr>
<tr><td>22.</td><td>There are 100 men on a plane. Let Xi be the weight (in pounds) of the ii-th man, with Xi's being i.i.d., E[Xi]=μ=170, and σXi=30. Find the probability that the total weight exceeds 18,000 pounds</td><td>CLT</td></tr>
<tr><td>23.</td><td>Generating Poisson Variates
Random Numbers: 0.25, 0.70, 0.15, 0.90, 0.40
Goal: Generate 3 Poisson variates (λ = 0.2)</td><td>Random variate generation</td></tr>
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24.	Generating Poisson Variates Random Numbers: 0.81, 0.73, 0.55, 0.21, 0.98 How many Poisson Variates can be generated? List them. ($\lambda = 0.7$)	Random variate generation