Test Your Understanding 0

The following table shows counts of vehicles passing a particular point on a road, grouped by day (columns) and hour (rows). There is something wrong with the table. Can you tell what it is?

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<th>Day</th>
<th>Hours</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
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Test Your Understanding 1

A process that produces audiotapes is monitored for the thickness of magnetic coating on the tapes. In Figure 1, the thicknesses of 150 thickness measurements (in microns) are plotted versus the order in which they were taken. Your boss asks you how the process is performing. What do you say?

Figure 1: One-hundred fifty consecutive measurements of the thickness of magnetic coating on audio tape
Test Your Understanding 2

Figure 2 shows a time series plot. What is the simplest moving average that will remove the cycles in the plot? Apply the moving average to the first 5 data values: $-0.95, 0.79, -0.99, 1.20, -1.03$. Plot the moving average values on the graph to demonstrate the cycles have been removed.

![Figure 2: Time series plot](image-url)
Test Your Understanding 3

A microhardness tester is a machine designed to test the hardness of material. In order to test the repeatability and reproducibility of the measuring process using a particular microhardness tester, four operators each took 20 measurements of the hardness of the same metal piece. Time series plots showed that the measuring process was stationary for each of them. Summarize what the stratified plot in Figure 3 tells about the R&R of the measuring process.

Figure 3: Force measurements from a microhardness tester
Test Your Understanding 4

Figure 3 shows four frequency histograms.

Figure 4: Four frequency histograms

Briefly describe the main features of each histogram.
Test Your Understanding 5

Figure 3 shows four frequency histograms.

![Four Frequency Histograms](image)

Figure 5: *Four frequency histograms*

For each histogram, describe the summary measures you would use to back up your description.
Test Your Understanding 6

The lengths of seven telephone calls, in minutes, are 17, 7, 1, 4, 39, 2, 11. Generate a boxplot for these data. Does the boxplot identify any outliers?
Test Your Understanding 7

Compute a 1-time trimmed mean and a 1-time Winsorized mean for the data from the last TYU: 17, 7, 1, 4, 39, 2, 11
Test Your Understanding 8

Suppose you want to estimate the average amount spent by first term sophomores at WPI for textbooks, and that you can interview 10 students for your study.

(a) If you believe the distribution of the amounts spent for textbooks is pretty consistent across all students, how might you choose the 10 students? Why?

(b) If you believe that textbook expenses for engineering students are substantially higher than for other majors, how might you choose the 10 students? Why?

(c) If you want to be certain to obtain an estimate for humanities majors, as well as other majors, how might you choose the 10 students? Why?
Test Your Understanding 9

To compare the efficacy of mosquito repellent, volunteers have an arm coated with a prescribed amount of the product. The arm is then inserted into a chamber filled with mosquitoes for a fixed amount of time and the number of bites counted (YUCK!). To compare the efficacies of two different repellants, volunteers are randomly divided into two groups. One group is given repellant 1 and the other repellant 2 and the test described above is conducted for each.

1. Is this a controlled experiment? Why?

2. If it is a controlled experiment, describe the
   
   (a) Experimental units
   
   (b) Response
   
   (c) Experimental factor(s)

   (d) Possible nuisance factors

   (e) Factor levels

   (f) Treatments

   (g) Effect
Recall the experiment described in TYU 9:

To compare the efficacy of mosquito repellant, volunteers have an arm coated with a prescribed amount of the product. The arm is then inserted into a chamber filled with mosquitoes for a fixed amount of time and the number of bites counted (YUCK!). To compare the efficacies of two different repellants, volunteers are randomly divided into two groups. One group is given repellant 1 and the other repellant 2 and the test described above is conducted for each.

How could blocking be used to improve the design?
Test Your Understanding 11

In order to identify risk factors for juvenile criminal behavior, researchers compared a large group of juvenile offenders with a group of their peers who were not offenders. These groups were compared with respect to a large number of factors.

1. What kind of a study is this? Be as specific as you can.

2. Suppose the researchers find a number of factors that are quite different for the two groups. Do you think the researchers can conclude these factors cause juvenile crime? Explain.
Test Your Understanding 12

Graph the dynamic modulus (stress/strain, measured in mega-pascals) of a set of asphalt samples using a density histogram, with the intervals indicated.

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>[48, 54)</td>
<td>36</td>
</tr>
<tr>
<td>[54, 57)</td>
<td>51</td>
</tr>
<tr>
<td>[57, 67)</td>
<td>30</td>
</tr>
</tbody>
</table>
A population histogram has four bars. The first corresponds to measurement value 1 and has area 0.40, the second corresponds to measurement value 3 and has area 0.25, the third corresponds to measurement value 8 and has area 0.30, and the fourth corresponds to measurement value 12.

(a) What is the area of the fourth bar?

(b) 1000 measurements are sampled randomly from the population. How many do you expect will have the value 1? 3? 8? 12? Why?
Test Your Understanding 14

Experience has shown that the width, in mm, of the flange on a plastic connector has the following distribution:

\[ p_Y(y) = \begin{cases} 
50y, & 0.48 < y < 0.52, \\
0, & \text{otherwise} 
\end{cases} \]

1. Of the next 1000 connectors produced, how many do you estimate will have widths between 0.50 and 0.51 mm? Show how you arrived at your estimate.

2. How many times as likely is it to produce connectors with flange width close to 0.51 mm as it is to produce connectors with flange width close to 0.49 mm? Justify your answer.
Test Your Understanding 15

A department at a college has 10 professors whose ages in years are 28, 44, 51, 32, 39, 48, 61, 55, 64, and 30. A random sample of size 4 is taken from this population, and the ages of those selected are 28, 48, 64, and 30. Compute the population mean $\mu$, and the sample mean $\bar{y}$. 
Test Your Understanding 16

Suppose we sample 4 OJ containers from the production lot having population proportion \( p \) of acceptable containers. Calculate \( p_Y(3) = P(Y = 3) \), the probability of obtaining exactly 3 acceptable containers in the sample.
A system consists of three identical components. The system can operate successfully only if at least two components are operating. The probability any one component lasts less than 100 hours is 0.06, and whether that component fails before 100 hours is independent of the performance of the other two components. If \( Y \) is the number of components in the system that fail before 100 hours,

(a) Obtain the distribution model of \( Y \).

(b) What is the probability the system fails before 100 hours?
Test Your Understanding 18

Suppose the population of math SAT scores follows a normal distribution with mean 500 and standard deviation 80. What proportion of students get between 600 and 700 on the exam?
Test Your Understanding 19

In Example 4.5, if 100 cereal boxes are used to compute the mean find the probability the estimate is within 0.1 ounces of the true mean weight.
Test Your Understanding 20

The state bar exam is designed so that 30% of prospective lawyers pass it each year, and over time, this passing percentage has held true, on average. From one year to the next, however, the percentage can vary. If 1000 prospective lawyers take the exam this year, and assuming each lawyer has a 0.30 probability of passing, approximately what is the probability that 320 or more pass?