

**Suggested Answers for WarmUps for Lesson 22**

1.	A manufacturer of salad dressings uses machines to dispense liquid ingredients into bottles that move along a filling line. The machine that dispenses dressing is working properly when 8 ounces are dispensed. Suppose that the mean amount dispensed in a particular sample of 48 bottles is 7.983 ounces. Set up the null and alternative hypotheses to test the filling process.
Answer	Ho: $\mu$ (mean amount of salad dressing fill) = 8 oz. H1: $\mu$ is not equal to 8 oz.
2.	A company I know was accused of shipping underweight boxes of breakfast cereal. The manager of the line, a friend of mine, brought me his hypothesis test, frantic because he did not know what to tell the legal department. The hypotheses he had used were these: Null: $\mu \leq 32$ ounces vs. Alternative: $\mu > 32$ ounces. He was unable to reject the null and he was scared! What do you think he should do?
Answer	He should turn the inequalities in the null and alternative around. Only if the boxes contained significantly more cereal would he be able to reject the null. By assuming that the fill is at least 32 ounces, the company is spared the stress of thinking they are cheating their customers, and should the filling process begin filling boxes with too little cereal, the test will alert the company to that so that it can be adjusted.
3.	Why does every hypothesis test begin with stating the hypotheses and a level of significance?
Answer	Hypothesis tests begin with decisions for these two items because they distinguish the test. The tester should be clear about what is being tested and what the potential results of the test would mean. The tester should also have already conducted cost-benefit analysis to determine the appropriate level of significance, alpha. Waiting to do either of these things until after a sample has been drawn and sample outcomes are known introduces a serious bias into the testing process. It is essentially impossible to establish a legitimate test if sample results are known ahead of time. The sample results are quite likely to cause the direction of tests to change, and the number of tails for a test to change. Likewise, not establishing alpha at once leaves the possibility open that a rejection or failure to reject could be "created" by adjusting alpha to fit the circumstances rather than considerations of the costs of error.
4.	A p-value is sometimes referred to as the "observed level of significance" while alpha is the "chosen level of significance." Explain this difference.
Answer	The p-value is calculated from the test statistic, the evidence from the sample. Since p-values are probabilities in tails as are alphas and the sample mean or proportion is what is "observed," the p-value has been called the observed level of significance. Contrast that to alpha, which is a choice made by the researcher before sampling has begun.
5.	Explain the following phrase: The p-value is to the test statistic as alpha is to the critical value.
Answer	The p-value is the area under the curve from the test statistic out into the tail(s) of the distribution of the random variable ( $\bar{X}$ or $p$ ) used in the test. The location of the test statistic defines where the area begins. Alpha, on the other hand, is the area under the curve from the critical value(s) into the tail(s) of the distribution. In

	fact, alpha is used to calculate the location of the critical value(s). Thus the test statistic and the p-value are a set of location on the number line and area beyond the location as are alpha and the critical value(s).
6.	A decision rule for a p-value test is always the same. What is the decision rule? Why is it the same for all tests?
Answer	If the p-value is less than alpha, reject the null and conclude the alternative; otherwise, fail to reject the null. Because both the p-value and alpha are probabilities, all that is important is their relative size, unlike test statistics and critical values, for which direction as well as magnitude of difference is important. Thus, this decision rule is one size fits all.
7.	Albert Einstein said, "A thousand experiments cannot prove me right, but a single experiment can prove me wrong." With respect to hypothesis testing, what did he mean?
Answer	Einstein was referring to the particular property of hypothesis tests that a thousand hypothesis tests which result in a failure to reject the null do not mean that the null is proved correct. He also realized that his theory was in the precarious position of being completely discounted should some compelling evidence against it come along.
8.	In general, how do we calculate p-values? What is this calculation similar to? (Check back to Lesson Thirteen if you are stumped.)
Answer	P-values are calculated as any area under a curve in the tail of a distribution is calculated. Questions such as "What is the likelihood that a catfish will weigh no more than 2.5 pounds?" is a calculation virtually identical to a p-value. A p-value is nothing more than a tail-area which can be calculated using NORMDIST, NORMSDIST or TDIST. (Technically, BINOMDIST would also calculate such an area.)