LO 1. Explain how the hypothesis testing framework resembles a court trial.

LO 2. Recognize that in hypothesis testing we evaluate two competing claims:

- the null hypothesis, which represents a skeptical perspective or the status quo, and
- the alternative hypothesis, which represents an alternative under consideration and is often represented by a range of possible parameter values.

LO 3. Construction of hypotheses:

- Always construct hypotheses about population parameters (e.g. population mean, μ) and not the sample statistics (e.g. sample mean, $\bar{x}$). Note that the population parameter is unknown while the sample statistic is measured using the observed data and hence there is no point in hypothesizing about it.
- Define the null value as the value the parameter is set to equal in the null hypothesis.
- Note that the alternative hypothesis might be one-sided (μ < or > the null value) or two-sided (μ≠ the null value), and the choice depends on the research question.

LO 4. Define a p-value as the conditional probability of obtaining a sample statistic at least as extreme as the one observed given that the null hypothesis is true.

- p−value=P(observed or more extreme sample statistic | H0 true)

LO 5. Calculate a p-value as the area under the normal curve beyond the observed sample mean (either in one tail or both, depending on the alternative hypothesis). Note that in doing so you can use a Z score, where

$$p - value = P(\text{observed or more extreme sample statistic} \mid H_0 \; true)$$

- Always sketch the normal curve when calculating the p-value, and shade the appropriate area(s) depending on whether the alternative hypothesis is one- or two-sided.

LO 6. Infer that if a confidence interval does not contain the null value the null hypothesis should be rejected in favor of the alternative.

LO 7. Compare the p-value to the significance level to make a decision between the hypotheses:

- If the p-value < the significance level, reject the null hypothesis since this means that obtaining a sample statistic at least as extreme as the observed data is extremely unlikely to happen just by chance, and conclude that the data provides evidence for the alternative hypothesis.
- If the p-value > the significance level, fail to reject the null hypothesis since this means that obtaining a sample statistic at least as extreme as the observed data is quite likely to happen by chance, and conclude that the data does not provide evidence for the alternative hypothesis.
- Note that we can never “accept” the null hypothesis since the hypothesis testing framework does not allow us to

confirm it.

LO 8. Note that the conclusion of a hypothesis test might be erroneous regardless of the decision we make.

- Define a Type 1 error as rejecting the null hypothesis when the null hypothesis is actually true.
- Define a Type 2 error as failing to reject the null hypothesis when the alternative hypothesis is actually true.

LO 9. Note that the probability of making a Type 1 error is equivalent to the significance level, and hoose a significance level depending on the risks associated with Type 1 and Type 2 errors.

- Use a smaller α if Type 1 error is relatively riskier.
- Use a larger α if Type 2 error is relatively riskier.