CHAPTER SIX: NORMAL DISTRIBUTIONS   **Due Monday, May 22**

6-A   The Normal Curve

z score • normal curve

❶ Convert a raw score *x* to a standardized score *z*.
> ❶ Calculate the *z* score of a 25-year-old man weighing 75 kg, given $\mu = 77$ kg and $\sigma = 13$ kg.

❷ Sketch and label a normal curve for a given μ and σ and use it to calculate probabilities or frequencies.
> ❷   Given the mean height of college men is 69″ with standard deviation 3″, estimate the following.
> a) the percentage of college men between 66″ and 75″ tall   b) the probability that a random one will be shorter than 67″

6-B   Normal Probabilities

❶ Find the area under the normal curve above or below a *z* score.
> ❶   Find the area under the normal curve above $z = -0.81$.

❷ Find the area under the normal curve between two *z* scores.
> ❷   Find the area under the normal cuve between -0.81 and 1.06.

❸ Calculate normal probabilities or frequencies from raw scores.
> ❸   On a test with normally distributed scores with $\mu = 139$ and $\sigma = 48$, what percent of scores are between 100 and 190?

6-C   Percentiles and the Normal Curve

❶ Find the *z* score needed to achieve a given percentile.
> ❶   What *z* score is at the 90th percentile?

❷ Find the *z* scores needed to achieve a given range centered about the mean.
> ❷ The middle 80% of the normal curve lies between which *z* scores?

❸ Convert a standardized score *z* to a raw score *x*.
> ❸ Find the height of a college woman with a *z* score of -1.08 given $\mu = 65$″ and $\sigma = 2.5$″.

❹ Calculate the raw score needed to be higher or lower than a specified percentage of the population.
> ❹   How high of a score is needed on an SAT I to be in the top 10%?, given $\mu = 500$ and $\sigma = 100$?

6-D   The Central Limit Theorem
law of large numbers • sampling distribution • standard error • central limit theorem

❶ Use the law of large numbers to determine whether a statistic is more likely to fall within a given range for a small sample or for a large sample.
    ❶ Is Trump more likely to have a favorable approval rating in a random sample of 20 California voters or in a random sample of 200 California voters?

❷ Calculate sampling probabilities or frequencies of sample means, or calculate sample means from percentiles.
    ❷ Four random students take a test that has normally distriubted scores with $\mu = 140$ and $\sigma = 55$. What is the probability that their average will be between 100 and 190?

CHAPTER SEVEN: CONFIDENCE INTERVALS   **Due Wednesday, May 24**

7-A   Confidence Intervals for a Mean
confidence interval • confidence level • critical value • t distribution • t chart • degrees of freedom • margin of error

❶ Find a critical value z_0 or t_0.
    ❶ Find the critical value for the following confidence intervals.
    a) $c = 95\%$, $\sigma = 8.1$, $n = 45$ b) $c = 80\%$, $\sigma = 0.72$, $n = 11$ c) $c = 90\%$, $s = 21$, $n = 8$

❷ Find a confidence interval for a mean and interpret it in words.
    ❷ The heights of 6 random turner trees after one year average 84 cm with standard deviation 10 cm. Use $c = .95$.

7-B   Confidence Intervals for a Proportion

❶ Find a confidence interval for a proportion and interpret it in words.
    ❶ In a Gallup survey in January 2016, 1017 American adults were asked, "Is there any candidate running who you think would make a good president?" 671 said yes. Create a 95% confidence interval.

❷ Interpret a poll result based on its margin of error.
    ❷ In a Gallup survey last year, 13% of Americans said they would like to see gays and lesbians less widely accepted in America. The margin of error was ±4 percentage points.

7-C   Sample Size Needed for a Specified Margin of Error

❶ Estimate the sample size needed to achieve a specified margin of error for a confidence interval for a mean.

    ❶ Tanner wants to find the average speed of drivers of drivers on Navarra Drive. Given $s = 4.5$ mph from a previous survey, how many cars should he record to have a margin of error of 1.5 mph for a 98% confidence interval?

❷ Estimate the sample size needed to achieve a specified margin of error for a confidence interval for a proportion.

    ❷ Sheena wants to find out what percentage of Santa Cruz county adults were born here. How many people should she survey to have an 8% margin of error for a 95% confidence interval?

CHAPTER EIGHT: HYPOTHESIS TESTING WITH *Z* AND *T*   **Due Monday, May 29**

8-A   Introduction to Hypothesis Testing

inferential statistics • hypothesis testing • null hypothesis • alternate hypothesis • left-tailed test • right-tailed test • two-tailed test • reject the null • statistically significant • type I error • type II error • power

❶ State the null and alternate hypothesis for a test of a single mean or proportion.

    ❶ The average birthweight of a certain breed of cattle is known to be 29 kg. Ryan is testing whether feeding the mother a protein-rich diet before birth causes increased birth weights.

❷ Identify factors leading to uncertainties about conclusions from statistical inference.

    ❷ Ryan finds the weights (in kg) of six newborn calves with mothers fed protein-rich diets: 32.5, 30.1, 28.1, 27.4, 29.9, 29.6. The average weight is more than 29 kg. Why should he be cautious in concluding that protein-rich diets increase birthweight?

❸ State the meaning of a type I error and a type II error for a test.

    ❸ State possible statistical conclusion errors for Ryan's cows.

8-B   *P* Values

p value • level of significance • alpha

❶ Calculate *z* or *t* for a sample mean or proportion.

    ❶ The average weight of a Johnston cat is 4.13 kg. In a sample of 20 Johnston cats, $\bar{x} = 3.81$ kg and $s = 0.52$ kg.

    ❶ 65% of Johnston cats are black. Of the 20 cats in the sample, 14 were black.

❷ Explain the logic of a *p* value in a simple probability situation.

> ❷ Jianna pulls a card from a deck. Nathan guesses that it is the nine of diamonds, and he is correct.

❸ Calculate the *p* value of a *z* test of a single mean or proportion, and interpret its meaning.

> ❸ IQ scores are normally distributed with $\mu = 100$ and $\sigma = 15$. Emma hypothesizes that children living within 2000 meters of a coal power plant have lower IQ's. In her sample of 120 such children, the mean is 97.6.

> ❸ Molly hypothesizes that people prefer Big Macs over Whoppers. (That is, she wants to find out if the proportion of people who prefer Big Macs over Whoppers is more than ½.) In a survey of 80 people, 38 say they prefer Big Macs and 42 say they prefer Whoppers.

❹ Use a *p* value to make a statistical conclusion about a test.

> ❹ Make a conclusion from Molly's data on Big Macs and Whoppers.

8-C   Critical Values

critical value • critical region

❶ Find a critical value for a *z* test.

❷ Find a critical value for a *t* test.

> ❷ $n = 20$, two-tailed

❸ Use a critical value to make a statistical conclusion about a test.

> ❸ Make a conclusion about Emma's sample of IQ's of children living near the coal plant.

❹ Report the results of a study using a *p* value range.

> ❹ Melina tests 25 200mg Advil tablets in a two-tailed test to see if μ is not in fact equal to 200. She calculates $t(24) = 2.96$.

8-D   Within-Participants Designs

within-participants design

❶ Do a statistical test for a within-participants design.

> ❶ Julissa is testing to see if people can balance better with their eyes open than closed. She has seven participants each see how long they can balance on a balance board with eyes open and also with eyes closed.

Participant #:	1	2	3	4	5	6	7
Eyes open (seconds):	24	50	18	29	24	36	40
Eyes closed (seconds):	13	38	25	19	24	21	31

8-E   Between-Participants Designs
between-participants design • sequence effects • counterbalancing

❶ Use a `Test` function on the calculator to do a statistical test of two means using a between-participants design.

   ❶ Julissa is testing to see if people can balance better with their eyes open. Use the same data as in the previous section.

❷ Identify possible sequence effects with a given within-participants design.

   ❷ Alondra is testing if eating a PowerBar 15 minutes before a run increases speed.

❸ State how a given within-participants design could make use of counterbalancing, and discuss how effective this would be.

   ❸ Alondra uses counterbalancing in her PowerBar study.

❹ Determine whether or not a within-participants design is appropriate for a test of two means.

   ❹ Is Julissa's balance study better off done with a within-participants design or a between-participants design?

❺ Use a `Test` function on the calculator to do a statistical test of two proportions.

   ❺ Mueller & Dweck (1998) had fifth-graders do puzzles. They told all of them that they did well, and they told some of them that they must be smart. Then they gave all of them more difficult puzzles and told them that they did not do well. When asked later about how well they had done, 11 of the 30 who had been told they were smart and 8 of the 58 of the others lied about their score.

CHAPTER NINE: HYPOTHESIS TESTING WITH *R*, χ^2, and *F*   **Due Wednesday, May 31**

9-A   Relationships Between Two Continuous Variables: Linear Correlation
positive correlation • negative correlation • correlation coefficient • rho • test of a correlation • line of best fit • interpolation • extrapolation

❶ Estimate *r* for a correlation.

   ❶ *x* = daily high temperature, *y* = heating bill

❷ Calculate *r* by hand.

❸ Do an *r* test of a correlation.

   ❸ Is there a correlation between average monthly temperature and Makaila's monthly heating bill?

Month:	October	November	December	January	February	March
	77°	67°	60°	61°	64°	67°
	$11	$20	$45	$49	$43	$30

❹ Find the equation of a line of best fit.
    ❹ Find the equation of the line of best fit for Makaila's data.

❺ Use a line of best fit to predict a value of the dependent variable, and consider the accuracy of the estimate.
    ❺ Predict Makaila's heating bill for a month averaging 84°, and discuss the accuracy of the prediction.

9-B   Relationships Between Two Discrete Variables: Independence
chi-square statistic • test of independence • cell • observed value • expected value
❶ Find a critical value of χ^2 for a test of independence.
    ❶ Emma is testing to see if there is a relationship between type of cell phone and gender. She asks 80 boys and 90 girls whether they use an iPhone, an Android, or other.

❷ Sketch a χ^2 distribution.
    ❷ Sketch a χ^2 distribution for grade level (freshman, sophomore, junior, senior) versus gender (male, female).

❸ Calculate χ^2 by hand for a test of independence.
❹ Do a χ^2 test of independence.
    ❹ 43 boys had iPhones, 21 had Androids, and 16 had neither. 67 girls had iPhones, 11 had Androids, and 12 had neither.

9-C   Distributions: Goodness of Fit
goodness of fit test
❶ Calculate χ^2 by hand for a goodness of fit test.
    ❶ The distribution of highest education level of Californians over 25 is 19.6% with no diploma, 53.3% with a high school diploma, 22.9% with a bachelor's degree, and 4.2% with a graduate degree. In a random sample of 180 Santa Cruz County residents over 25, 26 have no diploma, 81 have a high school diploma only, 53 have a bachelor's degree only, and 11 have a graduate degree.

❷ Do a χ^2 goodness of fit test.
    ❷ Is the distribution of education level in Santa Cruz County different from that of California overall?

❸ Test to see if a sample does not come from a normal distribution.

9-D   Standard Deviations: Single Variance

test of a single variance

❶ Find critical values of χ^2 for a test of a single variance.

  ❶ Nathan times the life of 25 AA batteries in a motor and finds $\bar{x} = 445$ minutes and $s = 42$ minutes. Find the critical values for a two-tailed test.

❷ Do a χ^2 test of a single variance.

  ❷ Can Nathan conclude that the standard deviation of AA batteries is different from 60 minutes?

9-E   Differences Between Standard Deviations: Two Variances

F statistic • test of two variances

❶ Calculate F for a test of two variances.

  ❶ Noah has two different routes he can take to school. He times Route A 10 times and finds a standard deviation of $s = 99$ seconds. He times Route B 13 times and finds a standard deviation of $s = 132$ seconds.

❷ Find a critical value of F.

  ❷ Find the critical value for a two-tailed test of Noah's data in ❶.

❸ Do an F test of two variances.

  ❸ Can Noah conclude that one route has a smaller standard deviation than the other?

9-F   Differences Between Means: ANOVA

analysis of variance (ANOVA) • means square

❶ Calculate the sum of squares within samples.
❷ Calculate the sum of squares between samples.
❸ Calculate the variance between samples.
❹ Calculate the variance within samples.
❺ Calculate F for an ANOVA.
❻ Do an ANOVA.

  ❶ Sarah plants eight trees throughout Santa Cruz, seven throughout San Jose, and five throughout San Diego. After one year their heights (in cm) are: SC 43, 48, 51, 47, 41, 44, 52, 50; SJ 45, 51, 55, 50, 48, 49, 45; SD 49, 56, 55, 53, 57. Find SS_W.

9-G   Selecting a Statistical Test

❶ Select an appropriate statistical test for a study.

  ❶ Is there a relationship between gender and political affiliation (Republican, Democrat, or independent)?

  ❶ Are there not equal numbers of Republicans, Democrats, and independents in Oregon?

  ❶ Do pulse rates increase within 30 minutes of drinking a cup of coffee?