

What Mathematics Should We Do For Our Project?

The mathematics your group needs to carry out for your project is open-ended. It is up to your group to consider what mathematical calculations would best shed light on the problem on which your group is working. As you work through each stage of your project, consider the following in deciding what mathematics to do. Note: The list of topics below follows (roughly) the order in which topics appear in the course – not (necessarily) the order in which you should apply the topics. You may not have reason to use some of these topics, and you may have reason to use other topics in several different ways and at more than one stage of the project.

NOTE: The Textbook Sections listed below refer to Bennett and Briggs *Mathematics: A Quantitative Reasoning Approach, 3rd ed.*, and the Handout page numbers refer to pages in this manual.

- I. Working with Units and Converting Units (Textbook Sections 2A, 2B)
Would the results found in sources or calculated by your group be put in better perspective in different units? If so, identify more appropriate units, and calculate the unit conversions. (For example, it would be better to report the average speed of Greenland's Jakobshavn Isbrae glacier in miles per year than in miles per hour.)
- II. Uses and Abuses of Percentages (Textbook Section 3A)
 - A. Counts vs. percentages: Will reporting percents, rather than just a count (number of things) be more enlightening? (For example, when comparing auto thefts that occurred on various sized college campuses, it would be more informative to report percentages of cars that were stolen from each of the campuses in a certain year than just the number of car thefts that occurred on each campus.)
 - B. Percentages to describe change: Is there a quantity that has changed over time? Calculate the percent change of this quantity.
 - C. Percentages for comparisons: Are there two quantities that you would like to compare? Calculate the percent that one quantity is *more than* the other quantity, or calculate the percent that one quantity is *of* the other.
 - D. Misuses of percentages: Have you found any misuses of percentages in any of your sources? If so, show where/how the misuse occurs. Calculate the correct percentage.
- III. Putting Numbers in Perspective, Significant Digits (Textbook Sections 3B, 3C)
 - A. Perspective through comparisons: Are there any very large or very small numbers involved that could be better “made sense of” through comparisons? If so, calculate at least one meaningful comparison. (For example, if LMU’s bookstore found next fall, that there would be a \$235,000 increase in the cost of ordering undergraduate textbooks, it would help us to understand the impact of this increase by calculating that this represents an average increase of $\$235,000/5500 \approx 43$ dollars per LMU undergraduate student.)
 - B. Absolute, relative error: Can you calculate the absolute or relative error to any measured quantities involved?

- C. Combining and reporting measured numbers: Are you reporting results of measurements with an appropriate (and not misleading) number of significant digits? When adding, subtracting, multiplying or dividing measured numbers have you reported the results with the appropriate number of significant digits?

IV. Power of Compounding (Textbook Section 4A)

- A. Simple interest: Are there financial accounts involved that earn simple interest? Are there quantities (of any kind) involved that will grow over time at a rate proportional to the *original* quantity? If so, use the simple interest formula to predict account balances or quantities at various (later) times.
- B. Compound growth: Are there financial accounts involved that earn compound interest? Are there quantities (of any kind) involved that will grow over time at a rate proportional to the quantity in the *previous time* period? If so, use the compound interest formula to predict account balances or quantities at various (later) times.
- C. Annual percentage yield: Can you calculate the actual percentage by which a balance (quantity) will increase in one year?

V. Savings Plans and Investments (Textbook Section 4B)

- A. Savings plan formula: Are there any savings plans (annuities, retirement savings plans) involved for which it would be helpful to predict account balances at (various) future times? Or do you want to know what regular savings will yield a desired amount at a future date? If so, use the savings plan formula. You may want to use the formula to predict account balances under various assumptions about interest rates, quantities deposited etc.
- B. Total and annual return: Is there an investment or quantity that has grown from some original quantity to a later quantity? It may be of interest to calculate the relative change in the investment and the annual percentage yield that would give the same overall change in the investment (quantity). That is, calculate the total return and annual return for the investment (quantity).
- C. Liquidity, risk, and return: Are there investments involved? If so, evaluate the investments for their liquidity, risk, and return.

VI Loans and Credit Cards (Textbook Section 4C)

- A. Loan payment formula: Are there (installment) loans involved? If so, find the required monthly payment using the terms of the loan. Could the terms of the loan vary – such as the interest rate or the life (length) of the loan? If so, recalculate the required monthly payment using the various terms.
- B. Amortization tables: Would it be helpful to be able to track the loan balance and interest paid over the life of a loan? If so, create an amortization table showing the payment date, payment amount, payment amount of interest, payment amount of principal, and account balance for each month of the loan.
- C. Predicting credit card bills: Do credit cards play a role in your project? Can you calculate the amount due at various times for a certain credit card (assuming a certain

previous balance, interest rate, and method of charging interest)? Given a certain credit card balance and desired time-frame to pay off the entire balance, use the loan payment formula to calculate the amount that must be paid each month in order to pay-off the credit card balance.

- D. Loan payment, prepayment strategies: If there are (installment) loans involved, calculate the effect on the loan payment, total interest paid over the life of the loan and the length of the loan by (voluntarily) paying an extra amount each month.

VII. Fundamentals of Statistical Studies (Textbook Section 5A)

Will you be carrying out a statistical study? If so, develop the basic steps for your statistical study: (i) Develop the precise goal and population for your study; (ii) determine how you will choose a representative sample for your study; (iii) determine what raw data will you collect and what sample statistics you will calculate; (iv) determine what inferences you can make about the population parameters from the sample statistics; and (v) look back and evaluate your study and its results.

VIII. Sampling (Textbook Section 5A and Handout from pages 70-72)

Will you be choosing a sample as part of your statistical study? If so, carefully consider possible methods of choosing a (representative) sample and the feasibility of each method. Will you use simple random sampling, systematic sampling, convenience sampling, quota sampling, stratified random sampling etc?

IX. Should You Believe a Statistical Study? (Textbook Section 5B)

Have you evaluated the results of statistical studies you reference by considering the eight guidelines in our text for evaluating a statistical study? Have you evaluated your methods you use in your own survey project against the eight guidelines in our text for evaluating a statistical study?

X. Statistical Tables and Graphs (Textbook Sections 5C, 5D)

Which of the following types of statistical tables and graphs will best summarize the data you have collected - frequency tables, bar graphs, pie charts, histograms, line charts? After deciding on appropriate data categories (or bins), use a spreadsheet program to construct statistical tables and graphs from your results.

XI. Characterizing a Data Distribution (Textbook Section 6A)

- A. Measures of center: Can you summarize your data by calculating a mean, median, and/or mode value? Are there outliers in your data? If so, what effect do the outliers have on the mean, median, mode values?
- B. Shapes of distributions: What features does the distribution of your data have? Is there more than 1 peak to the data distribution? Is the distribution symmetric or skewed? Does it show large or small variation?

XII. Measures of Variation (Textbook Section 6B)

Did you use a median value to describe the center of your data? If so, compute the quartiles and the five number summary as a measure of the variation in your data. Did

you use a mean value to describe the center of your data? If so, compute the standard deviation as a measure of the variation in your data. Give interpretations of what your measures of variation tell about the data.

XIII. Normal Distribution (Textbook Section 6C)

Are there any normal distributions of data involved? If so, is it appropriate to calculate standard scores and percentiles corresponding to certain data values?

XIV. Central Limit Theorem (Handout from page 73)

What does the Central Limit Theorem say about the distribution of sample proportions or sample means taken from many different samples? What does this say about sample proportions or sample means you have calculated?

XV. Statistical Inference (Textbook Section 6D and Handout from pages 73-76)

- A. Statistical significance: Does any of your background research indicate that certain measurements are “statistically significant?” If so, give some interpretation of what it means to say they are statistically significant.
- B. Margin of error, confidence intervals: Have you calculated a mean or percentage (proportion) of data values collected from a sample of a larger population? If so, determine the appropriate confidence level(s), then calculate the associated margin of error and confidence intervals, and finally give an interpretation of the meaning of each confidence interval.

XVI. Income Taxes (Textbook Section 4D)

Are there tax implications involved with the financial aspects of your project? If so, calculate the taxes an individual owes under the (various) financial actions projected.