Cal State East Bay
ILO Quantitative Reasoning Assignment Guide
November, 2019, v1

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Why Faculty Should Use This Guide

This guide has been developed by and for faculty in all Cal State East Bay colleges to support us in our efforts as effective and efficient instructors. Contributions have also been made by faculty and staff in the Office of Faculty Development and Academic Programs and Services. By applying the suggestions contained in this guide, we are more able to craft assignments that allow our students to clearly demonstrate their achievement of the quantitative reasoning Institutional Learning Outcome learning outcome as it applies to the our particular disciplines and programs. Course assignments aligned to the ILO of Quantitative Reasoning by the college will be used as part of the assessment process to improve university-wide student learning,

Examples of assignment instructions/prompts and Tips/Strategies for each criteria in different disciplines and general in nature

Prompts/General Comments (or guiding questions)	Specific Examples from Different Disciplines
Problem Formulation *Translation of the disciplinary/real-world problem into a QR context (e.g., writing a hypothesis, a math model, quantitative instrumentation). Use and interpretation of quantitative data/information to identify or formulate a problem.* • Does the prompt define for students what the problem is or should students define their own problem? • The student should develop and communicate one or more research	Statistics • The student should clearly articulate a specific, testable hypothesis. • The student should clearly identify the population of interest and the sample. • Speech Pathology • Collecting a robust case history (includes patient/client/family interview, reports from other professionals, etc.) • Translating this information into testable clinical hypotheses to set the stage for

questions/problems. • What is the problem to be quantified and reasoned to derive a conclusion? • Where is your starting point (e.g. inductive versus deductive, or abductive reasoning)? • Define the model. What are the variables you will include in your model? (Might other variables have been used? What are the potential effects of missing variables?) • Did students engage in collection of data or was it given to them? Collect relevant data and decide types of data to set boundaries. What data are needed for the problem? Quantitative (ratio or interval) or ordinal or categorical data? • What is the theoretical axiom - seek to explain first - contextualizing the problem	differential diagnosis Social Science • Consider application of quantitative theory (e.g. surplus value) to social justice questions (e.g. sociology: fitting the context to the model to seek explanation: for example applying surplus value to surrogacy, bail, drug legalization, prison labor). • Describe differences in groups. For example, the "achievement gap"- different proportions of students graduate college in 4 years for different races. • Consider geography/sustainability. • Use life cycle analysis to understand the implications of different consumption choices - food, transport, housing, etc. – which requires choosing a reference value, setting boundaries and acknowledging limitations. Computer Science • The inputs, outputs and their desired characteristics, including goal conditions

Representation/Visualization

Depiction of quantitative information such as visual (e.g., figures, charts, tables, equations) and non-visual (e.g., audio, ADA accessible).

- What guidance does the prompt offer in terms of the purposes for presenting quantitative information visually?
- What guidance does the prompt offer in terms of the criteria for selecting an appropriate depiction of that information?
    - Should a student know what graph to use or needs a prompt to select the correct one?
    - Students may think they know how to select methods to best represent data; however, they often use inappropriate methods of data depiction. Important to consider for maps (spatial data representation) and also types of graph (e.g. scatter plot versus line graph - and use of a histogram where a line graph is more appropriate, or a linear instead of log scale, etc.)
- What guidance does the prompt offer in terms of how to display or present the quantitative information within the final product?
    - Visuals can help to draw conclusions. How to depict in a non-biased way to help others interpret, understand, and conclude. It is an important tool to aid in scientific reasoning. What is accurate? What is appropriate?
    - How does selection of visual format affect communication/interpretation of data - e.g. use of format, size, color, shading, scale, interval selection, truncation of upper/lower bounds, elimination of outliers in plots, use of annotation, presentation of missing data series, etc.

Quantitative Analysis *Selection and use of analytical methods (e.g., data analysis, solution technique).* • What guidance does the prompt offer in terms of the kinds of calculations/ analyses students should perform? ○ May be easier for students to go to descriptive procedures rather than inferential models because of anxiety about numbers and methods; • Clarify if the assignment is computational versus methodological. • The student should use the appropriate methodology for the problem and data type. • What guidance does the prompt offer in terms of presenting those calculations/ analyses (e.g. how much of their work they should show, the units involved)? • Development of theories, formalisms, algorithms, tools • Amortization, probabilistic methods, Probabilistic model checking tools and techniques. • Use of methods from combinatorics, complex analysis, and asymptotics in obtaining precise analyses of algorithms. General • What simulation procedure would you use? • What tests, assessments, diagnostic tools would you use and why? • What statistical/analytical methods would you use?	Biology • What statistical test is appropriate to summarize the data? Computer Science • What is the appropriate algorithmic technique to choose? • What data structure would you use? Statistics • Calculate the appropriate statistic(s) for the context of the problem. • Which inferential model would you use, if applicable? • Establish base error rates (before intervention) and use that to establish statistically significant change. • Are there situations wherein "statistical significance" and "clinical significance" ("practical importance") differ? Give an example of the former, not the latter and vice-versa. Speech Pathology • Students may need a direct prompt to survey the evidentiary basis (e.g., Evidence-Based Practice research literature) to determine the appropriate or best methods for analyzing the clinical data. Geography • How to analyze data derived from different population sizes (e.g. census, surveys) to derive averages, etc. • What statistical methods are most appropriate for spatial data (e.g. chi square) versus non-spatial data? • How/if the method of data collection requires validation/calibration and how uncertainties should be handled (e.g. in analysis of remotely sensed data - combine with physical data sampling/ground truthing).

Interpretation *Description of the meaning of the results in the context of the original problem formulation.* • What guidance does the prompt offer in terms of how students should interpret/explain quantitative information? General • Assign a meaning to the information analyzed and determine its significance. • Interplay between intuitive insights, theoretical modeling, and practical implementations. • Students need to know the directional value of the analysis. That often is not obvious. If data is going in different directions, you may have to infer the numbers. • The student should clearly state the conclusion in language a layman could understand. • Recognizing and understanding the importance of units, unit conversions, etc. and the directional value of data (interpreting the meaning and significance of data magnitude and direction and rate of change).	Biology • Does the data support or refute your hypothesis or research questions and why? Sociology: • How do you fit various sources of data and analysis? What has primacy? • How does contradictory finding *contaminate* the original hypothesis? For instance, one may have a hypothesis that men make more in terms of wages than women for the same job given educational attainment and experience. Black men make more than Black women BUT only in some occupations. Overall, Black women make more than black men once you insert incarceration data. • How does one account for serendipity which may take the study to a whole different outcome? This is often a peculiar dilemma in the social sciences. Computer Science • What is the meaning of Big-O (order of magnitude) in your analysis? • What does it mean once you say your approach is more efficient than the other? • Given your solution, what is the worst-case space complexity? And what does that mean? Statistics • Which of the mean and median is a better indicator in the problem context? • Interpret the appropriate statistic(s) for the context of the problem. • What is the p-value and what does it mean? • Interpret the coefficients in your model? • What is the margin of error (error bars) indicate? • What is the meaning of your 95% confidence? Business • What do the ratios mean? (Finance)

Implications *Extension of potential application to broader contexts (e.g., predictive values, future directions, ramifications, clinical prognosis, professional and/or civic responsibilities).* • What guidance does the prompt offer for extending applications to broader contexts? General • Goal frequently is to lead to binary outcomes - accept or reject, diagnose this/that, etc. Decision-making depends on the QR - how to link the QR, data interpretation, etc. to deciding on an appropriate outcome/conclusion. • Links to limitations - one implication is no action due to limitations in data. • Would it be practically possible to achieve the outcomes? What about real-time scenarios?	Biology • What biological process or phenomenon best explains the pattern in the data? Business • Given your analysis what is your suggested solution for the business case? What are your recommendations? Sociology • How do you generalize given the specific nature of the inquiry? • The implications change with the introduction of new variables. For instance, immigration and legislation. Immigration is the most beleaguered bureaucracy because there is no consensus on legislation. The many interest groups and the need to accommodate their peculiar demographic needs actually makes legislation less effective and efficient. This may then constitute a study by itself.
Limitations *Acknowledgement of and/or reflection on limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., sample size, skewed, obvious bias).* • How does the prompt engage students in establishing or questioning the limits of the quantitative evidence? • What criteria for evaluating reasonableness exist in the situation of the problem? How explicitly are those criteria described (i.e., are they implied by the situation or explicitly described)? General • Quality of data versus quantity of data: Is there the possibility of response bias, or incorrect data recording? (Give the methods, including the exact survey questions or mechanical issues, as appropriate.) • How to question/verify/qualify the data if it is not primary (i.e. collected by the faculty/student) but derived from a secondary source. Are sources verifiable?	General • Important not to make spurious/unfounded conclusions beyond the limitations of the data. • Recognize built-in suspicion, skepticism about science, data - being mindful of audience expectations, need for defensibility. • Inherent assumptions about analysis - need to state assumptions that you used. • The student should clearly state any assumptions about the data (including distribution) and any limitations (such as issues in data collection or points that were eliminated) with the data. • Elaborate on data gaps. • Discuss implications of incomplete data. Social Science • Inaccessible data, for instance data on prisons or even accessing commercial farming. Sketchy data as occasionally revealed by watch-dog groups that are regularly persecuted via legislation. Hence, in the social sciences one has to jump and additional hoop or ignore the issue. The interrelated aspect of phenomenon.

• There are some cases where QR even though complete cannot give you an answer. For example, game theory may be able to tell us how to behave in a probabilistic situation but not the outcome in a particular instance. Or an algorithm designed to solve a problem may be a polynomial-time algorithm under some specific circumstances and not always. Or, the system designed is only secured for Denial of Service attacks, but it's not checked for other possible attacks, etc. • Designed system/solution is secured with respect to some specific factors and not the others. For example, factors could be: confidentiality of information, integrity of data, access to the data when it is required (availability), etc.	

Overall Communication
Following a logical sequence and presenting an explicit chain of reasoning. Use of disciplinary terminology as appropriate.
• How does the prompt provide guidance for overall clarity and organization? How does the prompt encourage the use of appropriate vocabulary and norms of mathematical/statistical arguments?
  ○ They may need a reminder to make explicit their thinking about why they chose a particular method of depiction, and why they made choices on everything from representation type, quantities, scales, units, error bars, etc.
  ○ If there is no guidance from the Evidence-Based Practice literature, we may wish to prompt them to make explicit the chain of reasoning for why they are choosing the analytical method they have chosen, and for how they are using it.
  ○ They should be encouraged to make explicit their reasoning and inferential models - encourage/require students to articulate what, why, how, etc. they picked and executed an analytical method.
  ○ Describe your steps that your took, what you did and why, and what your results mean.	

Designing Quantitative Reasoning assignments

- Quantitative Reasoning (QR) does not necessarily start with numbers. It can start with interesting ways we can use QR or context to help it become less onerous.
- Talking about background and theory can create some anxiety - so reviewing background students need to know with examples and applications can help.
- In the Social Sciences, abstract concepts require clarity while also acknowledging the complexity which encompasses a range on the continuum. In other words, it is not merely a binary dichotomy. So one may delimit the scope of the inquiry even as the limitation is recognized. Numbers capture a slice of the population in a given temporal context hence the data must be specifically tuned to the concept.
- Clarify the idea of objectivity and subjectivity - an absolute truth versus a larger truth. (Related-is empiricism vs. objective. The latter is akin to a mathematical proof, wherein there is an irrefutable argument. The former is where the evidence/data reaches a threshold implying a "likelihood of truth.")
- Ronald Coase once famously stated something like, "if you torture the data long enough, it will confess." There is, especially in fields like social sciences, social psychology, etc., the tendency to use data collection and analysis in a way that confirms the biases of the individual(s) working on the project. We may need a preliminary step (perhaps as part of the Problem Formulation section) that explicitly challenges the students to question what biases they are bringing into the way they have formulated the problem? Perhaps this can be facilitated by requiring students to develop good faith alternate hypotheses that explicitly derive from a contrarian perspective?
- Consider where students are within your course, the program and their student experience e.g. freshman versus senior, whether the concept is being introduced, developed, or mastered. A pre-requisite test can help identify where students skills are.
- Students may have weak analytical and mathematical skills for these assignments along with math anxiety. Reassure students and consider how this will impact how you will prepare them for the assignment. Consider optional "math camps" with extra credit. Provide resources for self-study/remediation/refresh - meaning you don't have to pitch to the lowest common denominator skill-set .
- The ILOs don't sit independently from each other, You can use the discipline as a vehicle to address skills wholistically. QR assignments can also satisfy other ILOs, (also called competencies or skills) such as critical thinking or writing.

CSU East Bay ILO Quantitative Reasoning Rubric: Approved by Academic Senate March 19, 2019

Description: Quantitative Reasoning (QR) is competency and comfort in working with numerical data. It involves understanding and applying mathematics/statistics to analyze and interpret real-world quantitative information in a disciplinary context. Individuals with strong QR skills possess the ability to reason about and solve quantitative problems from a wide array of contexts. They understand and can create sophisticated arguments and conclusions supported by quantitative evidence and can clearly communicate those in a variety of formats (using words, tables, graphs, mathematical equations, etc., as appropriate).

	4	**3**	**2**	**1**
Problem Formulation Translation of the disciplinary/real-world problem into a QR context (e.g., writing a hypothesis, a math model, quantitative instrumentation). Use and interpretation of quantitative data/information to identify or formulate a problem.	Formulation of the problem is comprehensive and placed in an appropriate quantitative context.	Formulation of the problem is adequate and placed in an appropriate quantitative context.	Formulation of the problem is limited; explanation of the context is somewhat incorrect or incomplete.	Formulation of the problem is incorrect or missing; explanation of the context is incorrect or incomplete.
Representation/Visualization Depiction of quantitative information such as visual (e.g., figures, charts, tables, equations) and non-visual (e.g., audio, ADA accessible).	Accurate and appropriate display of quantitative information using academic vocabulary with correct symbols, units, scale, etc.	Mostly accurate and appropriate display of quantitative information. May contain minor errors in academic vocabulary, symbols, units, scale, etc.	Somewhat accurate and/or appropriate display of quantitative information. May contain major errors in academic vocabulary, symbols, units, scale, etc.	Inaccurate, inappropriate, or missing display of quantitative information. May contain major errors in academic vocabulary, symbols, units, scale, etc.
Quantitative Analysis Selection and use of analytical methods (e.g., data analysis, solution technique).	Appropriate and accurate selection and use of analytic methods.	Mostly appropriate and accurate selection and use of analytic methods.	Somewhat appropriate and/or somewhat accurate selection and use of analytic methods.	Inappropriate and inaccurate selection and use of analytic methods.

Interpretation Description of the meaning of the results in the context of the original problem formulation.	Appropriate and comprehensive explanation of the results obtained from the quantitative analysis in the context of the original problem.	Mostly appropriate explanation of the results obtained from the quantitative analysis in the context of the original problem.	Somewhat appropriate explanation of the results obtained from the quantitative analysis. Explanation of the context is somewhat incorrect or incomplete.	Inappropriate, inadequate, or missing explanation of the results obtained from the quantitative analysis. Explanation of the context is incorrect or incomplete.
Implications Extension of potential application to broader contexts (e.g., predictive values, future directions, ramifications, clinical prognosis, professional and/or civic responsibilities).	Clearly identifies and explains substantive potential applications of the results and their broader impacts.	Adequately identifies and explains substantive potential applications of the results and their broader impacts.	Unclear or limited explanation of substantive potential applications of the results and their broader impacts.	Inappropriate or missing explanation of substantive potential applications of the results and their broader impacts.
Limitations Acknowledgement of and/or reflection on limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., sample size, skewed, obvious bias).	Accurate and thorough articulation of deficiencies with the underlying data, analyses or conclusions.	Mostly accurate and/or mostly thorough articulation of deficiencies with the underlying data, analyses or conclusions.	Somewhat inaccurate and/or limited articulation of deficiencies with the underlying data, analyses or conclusions.	Inaccurate or missing articulation of deficiencies with the underlying data, analyses or conclusions.
Overall Communication Following a logical sequence and presenting an explicit chain of reasoning. Use of disciplinary terminology as appropriate.	Consistently clear and logical presentation throughout, using appropriate academic language.	Mostly clear and logical presentation; generally uses appropriate academic language.	Somewhat unclear or illogical presentation; may fail to use appropriate academic language.	Unclear or illogical presentation; fails to use appropriate academic language.

Assignment Essentials Relevant to All Assignments

Developing assignments and assessments can take a lot of time. A well-written assignment provides students a clearer roadmap to demonstrate their competence, their knowledge acquisition and mastery. It enhances understanding of expectations (clarity) and can improve student evaluations. The instructor should also keep in mind how long it will take to grade assignments and incorporate appropriate assessments to make the grading more efficient.

Students complete assignments to:

- Practice applying skills, content, and concepts learned to demonstrate what they have learned.
- To be assessed and receive feedback on the achievement of assignment, course, and program learning outcomes.

- ❑ How will my assignment prompt students to show what content they have learned and/or demonstrate their skills?
- ❑ Does the array of assignments in this class address students with varied learning preferences multiple means of demonstrating knowledge and skill acquisition?

Students need *clear and transparent expectations* and instructions documented *in writing*. Assignment instructions should:

- Help students clearly understand the main purpose, clearly identify tasks, provide the required format elements, and describe the final product. When designing an assignment, also consider how the requirements such as page limit, number of words, etc. relates to the expectations embedded in the assignment. Is what we ask realistic both in terms of student and faculty time to effectively address the expectations?
- Demonstrate the connections to how their work meets learning outcomes, builds on their knowledge and skills for future assignments, relates to graduation, and has professional relevance.
- Let students know when how long the assignment will take and how feedback will be provided.
- Include links or references to material needed to complete the assignment
- Provide clear assessment guidelines for students. For example, a grading rubric that expresses expectations and aligns with the outcomes will assist students as they complete the assignment.

- ❑ How will assignment instructions clarify what tasks to do, how they are connected, how to get started, and how to complete the tasks?
- ❑ How will you know if students met the assignment expectations; how will students be assessed?

Chunk and scaffold assignments: Students perform better on assignments when instructors break them into manageable chunks. Presenting students with smaller assignments that build into a larger one creates the opportunity for early feedback and improvement.

Example of smaller assignments that build toward a research essay that meets expectations:

Course timing	Week 6	Week 8	Week 10	Week 12	Week 14
Developmental Assignment Due	Thesis statement	Annotated Bibliography	Outline	Essay Draft	Final essay

Reflection Aids Retention: Students' learning improves and sticks when they *reflect* on their process and their completed assignment:

- Ask students to report what they learned from the assignment or what they would do differently in a future assignment.
- Student reflection on assignment process and performance may also help you shape the next version of the assignment.

Worksheet for faculty to fill-in their own questions

	Questions that best bring out the criteria in student responses
Problem Formulation Translation of the disciplinary/real-world problem into a QR context (e.g., writing a hypothesis, a math model, quantitative instrumentation). Use and interpretation of quantitative data/information to identify or formulate a problem.	
Representation/Visualization Depiction of quantitative information such as visual (e.g., figures, charts, tables, equations) and non-visual (e.g., audio, ADA accessible).	
Quantitative Analysis Selection and use of analytical methods (e.g., data analysis, solution technique).	
Interpretation Description of the meaning of the results in the context of the original problem formulation.	
Implications Extension of potential application to broader contexts (e.g., predictive values, future directions, ramifications, clinical prognosis, professional and/or civic responsibilities).	
Limitations Acknowledgement of and/or reflection on limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., sample size, skewed, obvious bias).	
Overall Communication Following a logical sequence and presenting an explicit chain of reasoning. Use of disciplinary terminology as appropriate.	

For QR Assignments Aligned to QR ILO for Assessment

- Not all criteria may be applicable for an ILO aligned QR assignment. But note that at least 5 of the 7 criteria should be aligned to be included for university-level assessments.
- As a general tip, fill the rubric criteria with your own specific requirements and examples. If you can't easily fill in the majority of the criteria, your assignment probably requires more thought and explicit components/elements.
- Each criterion should be articulated for your assignment with an activity (what they are doing) and a value (what they will deliver to demonstrate the criterion).
- If you intend the assignment to be included in ILO assessment, student work needs to be completed individually rather than a group project.

SPPA 6010 – Advanced Speech Science
Dr. Ramanathan

Final Clinical Case Analysis Project
Instructions

The purpose of this final Advanced Speech Science project is to help you to integrate all that you have learned about quantifying and measuring aspects of respiration, phonation, articulation, and resonance, and to apply that to a clinical case.

Central to this project is reasoning: both critical thinking and quantitative reasoning. As a general rule, simply throwing everything (including the kitchen sink) at a case is not the answer (i.e., don't include a particular measure just because you can). It is necessary to apply critical thinking to decide what to measure and why. Then, based on the quantitative results, it is necessary to reason through what the results mean. For the purposes of this project, however, you will be expected to carry out all of the quantitative measures listed in the Appendix below, even though some of them would not be necessary for this particular patient. This is to give you practice in applying what you have learned.

For this project, you may help each other, discuss ideas together, and analyze data in conjunction with classmates. This does **not** mean that you can divide up the work, with each person carrying out only a portion of the measurements, and then pooling your data; **this is not permitted**. Remember, the purpose here is for each person to get practice in carrying out each and every one of the analytical methods. That said, you may *average* data across multiple students in the class if it makes sense to do so. For example, let's say four of you work together and each person carries out his/her own CAPE-V, then yes you may take the average values of each rating across all four of you to use in your individual reports. If you do this, however, your data table in the appendix must contain the name of each student/rater, the raw ratings for each rater, and the average values. In summary, you may collaborate to *facilitate your understanding* of the case and the project, and you may collaborate in averaging data across raters. However, each student must carry out each and every analysis him-/her- self, and submit his/her own final product (you may **not** create a joint final product). You must not submit work that contains the same, or very similar, wording as any of your classmates – that would be an example of plagiarism.

For the final clinical case, you will analyze various speech, voice, respiration, and resonance characteristics, and write a Diagnostic (Dx) report. The organization and structure of the Dx report should follow the following template.

I. STATEMENT OF PROBLEM

State the full name of client, age, remarkable pertinent background history or diagnosis. Include the name of the individual or agency making referral. Provide a statement of the problem in the words of the client or informant and note purpose of evaluation.

II. HISTORY *(past tense)*

Unless case is extremely complex, simply paragraph history, covering the following areas without using sub-headings, ending with purpose of assessment. Paragraphing history requires writer to be succinct and construct meaningful transitions, focusing on relevant and remarkable information.

Commented [A1]: These provide additional guidance on Problem Formulation. Additional instructions are also given in the Appendix.

III. GENERAL IMPRESSIONS / BEHAVIORAL OBSERVATIONS ***(past tense)***

Provide general impressions of the client. This paragraph may include a description of the behavior during an initial observation period with the parent, separation from the parent for testing (only appropriate for a young or significantly impaired child), and other impressions (cooperation, attention span, engagement, etc.), client's primary means of communication. Include speech and non-speech behaviors noted outside of standardized testing that will not be highlighted later in Evaluation Results.

IV. EVALUATION RESULTS *(past tense)*

Use a sub-heading for each area assessed. Begin with the primary problem area and list other areas in decreasing order of severity. Group together any areas which are within normal limits in a concluding statement. When reporting results of a formal test, state and underline the full name of the test and compare client's performance to norms in test manual. Raw scores are not reported. If testing was invalidated, state why, providing a more qualitative description of test performance. Utilize a file to summarize assessments with multiple sections and then in your analysis don't repeat the same info, but instead comment on remarkable subtests, doing an item analysis and comparing info to other measures or observations.

Commented [A2]: This section pertains to the use of analytical methods, interpretation of results and assessment of limitations.

A. Receptive Language

(In the event that assessment included a mixed language assessment, combine Sections A & B, into Language.)

Analyze results of testing for all receptive language tests, such as PPVT, etc., (e.g., child demonstrated difficulty following complex and lengthy directions, etc). Report results of informal testing for receptive skills when appropriate. If possible, include a general summary statement concerning child's level or receptive functioning. If normal, state (e.g., receptive language performance revealed adequate single word and syntactic comprehension).

B. Expressive Language

Analyze results from all expressive language tests. Describe language performance in terms of semantics, syntax and pragmatics. If the major area of concern is social language or pragmatics, then that should be a separate sub-heading. Analyze child's spontaneous language using structured analysis or informal measure. An analysis and interpretation of tests may include: description of child's syntactic and morphological errors, level of complexity of grammatically correct sentences, use of child's utterances to illustrate errors, child's response to clinician model, etc. If possible, make a general statement about child's communicative behavior (e.g. rarely initiated conversation, poor eye contact, behavior, etc.) With a nonverbal child, describe all attempts at communication, (e.g., gestures, facial expressions, laughing, crying, etc.). Describe play behavior, but consider if this should be a separate sub-heading if significantly impaired or if client is very young or non-verbal. If normal, indicate that expressive language performance appeared appropriate, with brief remarkable observations, if appropriate. .

C. Articulation / Phonology*

(As appropriate; if unremarkable utilize heading Speech Parameter to capture Articulation, Voice and Fluency)

Report results of phonological/articulation testing. An analysis and interpretation of tests should include: description of error patterns (with examples), developmental levels, response to stimulation (stimulability), facilitating phonetic contexts, consistency of errors, level of intelligibility. Otherwise report as adequate or WNL.

D. Oral Mechanism Screening*

(*Can be combined with Hearing Screening under a single sub-heading.)

Describe structure, symmetry, functioning of facial, lip and tongue musculature. Describe structure of hard and soft palate, efficiency of velopharyngeal closure. Describe dental occlusion, appearance of tonsils. Report diadochokinetic rates, and describe motor sequencing and pattering skills. Describe

structural deviations, strength, force, range of motion, and consistency where appropriate. If normal indicate that an examination of the oral mechanism revealed adequate physiologic support for speech.

E. Hearing Screening*

State results of audiometric screening, (e.g., a pure tone, air conduction audiometric screening for the frequencies 500 to 8000 Hz administered at 25 db (ISO) indicated that hearing sensitivity was within normal limits bilaterally. Screenings are pass/no pass. Do not report a specific frequency and/or side in which client did not respond. Report tympanometric screening results as appropriate. Do not administer an audiometric screening to a client who has hearing aids or a documented hearing loss.

V. DIAGNOSTIC IMPRESSIONS *(present tense)*

Reiterate client's name, age, and state the client's speech and language diagnosis, including severity. Describe in general (summarize) the reason for evaluation, the significant aspects of the problem(s) identified during the evaluation. In separate paragraphs, present each area of significance in order of severity as it relates to the diagnoses provided. Discuss possible contributing and maintaining factors, e.g., poor oral motor functioning, foreign language influences in the home, low intellectual functioning, etc.

This portion of the report should provide the reader with an overall picture of the client, even if the rest of the report has not been read. This section should serve as a summary that includes client's skills as well as potential problem (e.g., inattention, medical fragility, limited response to treatment, fatigue, poor responsiveness, etc.) In this section the clinician attempts to integrate and synthesize the findings of the evaluation. It is not sufficient to merely restate test scores or re-present information. In fact, test scores should rarely be included. It is in this section that the clinician's hypotheses, impressions, and predictions are noted.

Commented [A3]: This section deals with interpretation and some implications.

VI. RECOMMENDATIONS *(present tense)*

Based on the results of the evaluation, state whether therapy is recommended and if not, why. If therapy is recommended, discuss frequency and type of therapy (group, individual, intensive), and suggest initial therapy goals, that may address as appropriate caregiver involvement, inclusion of literacy and/or multi-modalities, etc. List and discuss other recommendations (e.g., psychological evaluation, family counseling, implementation of a home program). Discuss prognosis in terms of the recommendations made and your knowledge of the client's behavior, e.g., based on the child's inconsistent attention during the evaluation, it is expected that progress in therapy will be slow initially. Where relevant, make a statement concerning the client's or family's acceptance of the recommendations.

Commented [A4]: This section deals with implications.

For subsections that are irrelevant to this class (e.g., physical development, evaluation results for expressive and receptive language, etc.), you may either write N/A if they are not applicable (e.g., for developmental issues), or if an area might be relevant *to the client's case* but is beyond the scope of this class (e.g., her cognitive impairments), then clearly specify these areas and explain that they should be evaluated in a follow up session due to time limitations during this initial evaluation. Also, add in subsections that are relevant to this case project (e.g., for phonation, resonance, etc.). In addition, you will have an appendix; this will include all of the data, as well as a "Problem Formulation" section that is not in a typical Dx report. This Problem Formulation section is so that you can explain your critical thinking. Your clinical report will be graded using CSUEB's Quantitative Reasoning ILO rubric.

Commented [A5]: Note that the tail should not wag the dog - this QR rubric should not dictate the assignment, but rather the converse. The way I dealt with this was to add in an appendix section to the standard clinical Diagnostic Report template that our department uses. This way, since the students are used to the DR format, this appendix just serves to better connect what they already are familiar with to the concepts of QR.

Once you have completed your final project, you will submit it via SafeAssign on Blackboard, so that it can be checked for plagiarism against the writings of your classmates.

Disclosure Statement

From the Institutional Learning Objectives Committee:
"As part of the ongoing commitment to continually improve our instructional programs, CSUEB periodically conducts secondary reviews of randomly selected student work on key assignments. This is only to help faculty improve the curriculum and will not affect your grades. To preserve your privacy, you are invited (but not required) to submit your assignments without your name. Omitting your name ensures that, while your instructor will be able to identify the work in this course as yours through the Blackboard submission process, any additional faculty reviewers will see your work as an anonymous submission."

Appendix

Part A – Problem Formulation

The first part of your Appendix should be a "Problem Formulation" section. The key question to ask yourself here is, "How do I translate a real-world human being's disorder into a quantitative problem?"

The CSUEB Quantitative Reasoning ILO rubric provides the following description for this item:

> *Translation of the disciplinary/real-world problem into a QR context (e.g., writing a hypothesis, a math model, quantitative instrumentation). Use and interpretation of quantitative data/information to identify or formulate a problem.*

What does that mean? It means that in this section, you will explain how a clinician decides what needs to be quantified, and explain how best to quantify those things (for each aspect of respiration, phonation, articulation, and resonance as relevant to this client). In explaining how best to quantify those things, cite research as relevant. We discussed the logic behind these choices for this specific case in class and you were given explicit instructions on what to measure; now your job in this section is to explain those choices and logic for each subsystem.

Please note that "Problem Formulation" is not the same as interpreting the results of your analysis. Also, do not simply list what you measured and what each measurement assesses.

Commented [A6]: This assignment explicitly adopts some of the actual language used in the QR rubric to point the student towards effective problem formulation. In doing so, it highlights in the italicized portion the exact explanation of what "problem formulation" is.
Note that the instructions also clearly communicate to the student what problem formulation is not. It also thereby sets the stage for a separate place for interpretation, which is a distinct element of the QR rubric and skill set.
Finally, by emphasizing that the student needs to explain the **how** of their thinking process, this makes explicit the act of problem **formulation**.

Commented [A7]: This pertains to QR Rubric section on Quantitative Analysis (selection of data analysis methods)

Part B – Data

The next part of your Appendix depicts all of your quantitative information. That is, here is where you present your graphs, charts, and data tables. Please note that numerical data should be presented in tables where the first column lists the variable measured, the next column depicts the client's data and the last column contains normative values). Place the variable name and units in the column header, not in each cell of data. Please list any formulas that you used to compute any quantity.

Commented [A8]: Here is where students are explicitly instructed on representation/visualization - presenting graphs, charts, data tables, etc.
Here is also where the students show their actual **use** of the analytical methods.

Include measures of the items below (with comparisons to norms where available) – note: for *questions* that appear below, just type out your comments/answers in the appropriate section of your Dx report.

- Articulation:
  - Vowels
    - For the vowels /i/, /ɑ/, and /u/ – measure the F1 and F2 formants for 5 different exemplars of each vowel and then take the average of the 5 samples for each vowel.
    - Carry out the following calculation and graph:
      - A quantitative measure of the Vowel Space (e.g., Vowel Articulation Index or Formant Centralization Ratio)
      - F1/F2 plot – be sure to label the axes with the variable name and units
  - Consonants
    - Strident fricatives – compare the F_{peak} values from samples from the client that represent distorted /s/ vs. her normal productions of /s/. Be sure you explain *how* you decided what the peak frequency was.
    - Approximants
      - Through the recording you can hear occasional articulatory errors of approximants.
      - What percent of her /r/ and /l/ productions are distorted? That should also be included in your report.
      - Investigate the average F3 slope index of several exemplars of /l/ that are produced incorrectly, and calculate the average F3 slope index value. Repeat this for several exemplars of /r/ that are produced incorrectly.
  - Suprasegmentals
      - How can you quantify prosody? Measure the following and explain how you quantified them
        - Linguistic stress
        - Pitch contour
        - Speech rate
      - Auditory-perceptual ratings of naturalness of prosody (can be simply a description of the way in which it is not natural and then rated as normal/mild/moderate/severe).
  - Overall intelligibility
    - Include an auditory-perceptual measure of articulatory intelligibility

- Respiration
  - Since we have no way to measure this aerodynamically, is there still any aspect of her breathing that you can and should quantify/describe? Explain. And if there is, then carry out that analysis.

- Phonation/Voice
  - Carry out an auditory-perceptual measure of voice (e.g., CAPE-V)

- Conduct an acoustic analysis of the voice, either using MDVP in the lab, or using Praat as you learned in the homework assignments. Then compare values against norms where available. It is especially important that you include the CPPS measure.
- Pitch variations (mean, std dev., and min/max F0 over a lengthy portion of the audio)

- Resonance
  - Since we have no nasometer readings, how would you quantify her VP function/resonance?
  - Obtain auditory-perceptual measure of resonance (hypo/hyper nasality, cul de sac, etc.)

Part C – Limitations

Here you will discuss limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., problems obtaining a good sample, biases, etc.).

Commented [A9]: Here is where the students are instructed on the 6th section of the QR rubric - to acknowledge and reflect on all of the limitations pertaining to the assignment.

Worksheet for faculty to fill-in their own questions

	Questions that best bring out the criteria in student responses
Problem Formulation Translation of the disciplinary/real-world problem into a QR context (e.g., writing a hypothesis, a math model, quantitative instrumentation). Use and interpretation of quantitative data/information to identify or formulate a problem.	The first part of your Appendix should be a "Problem Formulation" section. Here you will clarify the translation of the clinical case into a quantitative reasoning context. That is, *explain how you use and interpret the quantitative data/information to identify and quantify the speech/voice impairments*. Please note that this is not the same as interpreting the results of your analysis. Rather, in this section you should explain how a clinician (e.g., you) should decide how to quantify speech and voice impairments for a particular client (e.g., Jennifer Field in this case). That is, explain how a clinician decides what needs quantifying, and how best to quantify those things – do this for each aspect of speech and voice relevant to this client. Cite research as relevant.
Representation/Visualization Depiction of quantitative information such as visual (e.g., figures, charts, tables, equations) and non-visual (e.g., audio, ADA accessible).	The next part of your Appendix depicts all of your quantitative information. That is, here is where you present your graphs, charts, and data tables. Please note that numerical data should be presented in tables where the first column lists the variable measured, the next column depicts the client's data and the last column contains normative values). Place the variable name and units in the column header, not in each cell of data. Please list any formulas that you used to compute any quantity.
Quantitative Analysis Selection and use of analytical methods (e.g., data analysis, solution technique).	Explain how a clinician decides what needs to be quantified, and explain how best to quantify those things (for each aspect of respiration, phonation, articulation, and resonance as relevant to this client).

Interpretation Description of the meaning of the results in the context of the original problem formulation.	This portion of the report should provide the reader with an overall picture of the client, even if the rest of the report has not been read. This section should serve as a summary that includes client's skills as well as potential problem (e.g., inattention, medical fragility, limited response to treatment, fatigue, poor responsiveness, etc.) In this section the clinician attempts to integrate and synthesize the findings of the evaluation. It is not sufficient to merely restate test scores or re-present information. In fact, test scores should rarely be included. It is in this section that the clinician's hypotheses, impressions, and predictions are noted.
Implications Extension of potential application to broader contexts (e.g., predictive values, future directions, ramifications, clinical prognosis, professional and/or civic responsibilities).	Based on the results of the evaluation, state whether therapy is recommended and if not, why. If therapy is recommended, discuss frequency and type of therapy (group, individual, intensive), and suggest initial therapy goals, that may address as appropriate caregiver involvement, inclusion of literacy and/or multi-modalities, etc. List and discuss other recommendations (e.g., psychological evaluation, family counseling, implementation of a home program). Discuss prognosis in terms of the recommendations made and your knowledge of the client's behavior, e.g., based on the child's inconsistent attention during the evaluation, it is expected that progress in therapy will be slow initially. Where relevant, make a statement concerning the client's or family's acceptance of the recommendations.
Limitations Acknowledgement of and/or reflection on limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., sample size, skewed, obvious bias).	Here you will discuss limitations in interpretation and implication that stem from underlying assumptions, data analysis procedures, methods used, and/or characteristics of the data itself (e.g., problems obtaining a good sample, biases, etc.).
Overall Communication Following a logical sequence and presenting an explicit chain of reasoning. Use of disciplinary terminology as appropriate.	You should explain how a clinician (e.g., you) should decide how to quantify speech and voice impairments for a particular client (e.g., Jennifer Field in this case). That is, explain <u>how a clinician decides</u> what needs quantifying, and how best to quantify those things – do this for each aspect of speech and voice relevant to this client. Cite research as relevant.