Example Summative Assessment Elements and Accompanying Rubric

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There is no single summative assessment for this module. This is because kinematic and static GNSS require different equipment and different interpretative tools. Instead, we offer a suite of questions that can added into the summative exercise of different units. Alternatively, these questions may be asked as part of a final exam.

Grading rubrics are provided as an outline for knowledge-based assessments, but instructors are encouraged to heavily weight student progress and active participation in field-based activities. Remember that the key goal for these modules is to teach students the skill of designing and executing a survey with the given technique.

Here are examples of questions provided in the material, their location, and a detailed rubric.

# Example Questions

## Unit 1:

1. After stating the accuracy and precision possible with each grade of device, explain which types of surveys or research applications are appropriate for each? What would happen if you tried to measure changes that are smaller than the device’s error? Name at least two applications for each: consumer, mapping, and survey/geodetic.
2. Concept Sketch Assignment

## Unit 2: Kinematic Survey Assignment

1. Answer the following questions regarding your survey in a short essay (1–2 paragraphs):
* What was the intention of your survey? What did you hope to resolve/measure/map? Justify your survey design.
* How well did the resulting positions describe the object(s) you were trying to measure?
* What issues or troubleshooting occurred in the field and how were they resolved?
* How did the point density and sampling design affect the results of your study?
* How could you modify this design in the future to more effectively capture the object(s) of interest and/or mitigate various sources of error, uncertainty, or hazards?

## Unit 2.1 Summative Assignment

1. Discuss the societal relevance of high-resolution topography generated through a survey like yours. How can this data benefit the general public? Give two specific examples.

## Unit 2.2 Summative Assignment

1. Evaluate how well your selected survey design was able to answer your question of interest. Given unlimited resources, how could you modify this survey design to improve the results?
2. Change detection is often used to assess hazards. If we detect change, how might we communicate this to the public without causing unnecessary concern?
3. What are the societal benefits of this research? Write three sentences in plain English that would communicate this benefit in some public medium like a newspaper.

## Unit 3.0 Summative Assignment

1. Is a static GNSS system appropriate for this survey given the results and your experience? Why or why not? Your claims must be justified by your evidence and measurements of accuracy, precision, and uncertainty of the technique.

# Rubric

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| **Component** | **Exemplary** | **Basic** | **Nonperformance** |
| **General Considerations** | Exemplary work will not just include all components requested above but also answer correctly, completely, and thoughtfully. Attention to detail—as well as answers that are logical and make sense—is an important piece of this. Sketch is neat, organized, and readable. | Basic work may answer all components of the given question, but some answers are incorrect, ill-considered, or difficult to interpret given the context of the question. Basic work may also be missing components of a given question.  | Nonperformance occurs when students are missing large portions of the assignment or when the answers simply do not make sense and are incorrect.  |
| **3 pts****Question 3** | 3 points:For each grade of GNSS device, correctly gave the accuracy, precision, and two uses.Identified that change cannot be detected if the reported error or uncertainty is greater than the amount of change measured.  | 1–2 points:Answered the questions correctly but failed to either correctly attribute error to the correct source or didn’t discuss the differences in consumer versus commercial grade equipment And/OrFailed to identify change couldn’t be detected. | 0–1 points:Failed to correctly attribute error to the correct source or didn’t discuss the differences in consumer versus commercial grade equipment AndFailed to identify change couldn’t be detected.  |
| **10 pts****2: Concept Sketch****\*See example sketch provided** | **9–10** points:Sketch includes all parts of the GNSS station including antenna, receiver, tripod, and radio or external batteries (as discussed in the demo)Sketch includes concise descriptions of each component and its functionSketch includes directional elements (arrows) showing data-communication paths from satellite to receiverSketch includes at least one source of error, such as multi-pathing Good articulation of GNSS applications to science and society. | **5–8** points:Missing 1–2 of the listed characteristics for an exemplary sketch.AND/ORAll characteristics are present but lack detail or are incorrect, showing a lack of comprehension. | **0–4** points:Missing 2–4 of the sketch components.AND/ORMost characteristics are present (1–2 missing) but are incorrect, showing a lack of comprehension. |
| **10 pts****3: Write-Up or Discussion** | **9–10** points:The discussion is well written and includes all of the following components:* Justification of survey design
* Challenges and solutions
* Discussion of the results

Answers all of the reflection questions. Thoughtful discussion of how to improve on survey design. | **5–8** points:The discussion is moderately well written and includes all of the componentsORThe discussion is well written but weak in 1–2 components or fails to answer some of the questions.Discussion on future improvements is sparse. Improvement is always possible! | **0–4** points:The discussion is poorly written and missing several componentsAND/ORThe discussion fails to address more than 2 critical components or fails to answer questions completely. |
| **10 pts****4: Write-Up or Discussion** | **9–10** points:The discussion is well written and includes all of the following components:Justification of survey designChallenges and future solutionsDiscussion of future map and discernable changes is correctTwo good examples of societal benefits of GPS-derived topographyShould answer all of the questions. | **5–8** points:The discussion is moderately well written and includes all of the componentsORThe discussion is well written but missing 1–2 components or fails to answer some of the questions. | **0–4** points:The discussion is poorly written and missing several componentsAND/ORThe discussion fails to discuss more than 2 critical components or fails to answer questions. |
| **10 pts****5–6: Figures and Final Report** | **9–10** points:A well-written summary that accurately assesses the survey design, potential errors, interpretation of results, and discussion of broader impact of technique.Societal benefit is clearly articulated using nontechnical language.Figures and/or map is well designed and contains all requested components. It illustrates the change detected and associated uncertainty. A map should minimally include station locations, base station, and some indicator of the change detected.Student identifies that reporting potential error and impact of your statement must be stated clearly to reduce unnecessary concern.  | **5–8** points:Missing 1–2 of the listed characteristics for an exemplary report and may be poorly written/unclear.Societal benefit is listed but not clearly justified.AND/OR All characteristics are present but lack detail or are incorrect, showing a lack of comprehension. | **0–4** points:Missing 2–4 of the characteristics, may be poorly written and unclear; AND/ORMost characteristics are present (1–2 missing) but are incorrect, showing a lack of comprehension. |
| **10 pts****7: Figures and Final Report** | **9–10** points:A well-written summary that accurately assesses the survey design, potential errors, interpretation of results, and discussion of broader impact of technique.Societal benefit is clearly articulated using nontechnical language.Plots are well designed and contains all requested components. It illustrates the change detected and associated error. Should minimally include station locations and error bars. | **5–8** points:Missing 1–2 of the listed characteristics for an exemplary report and may be poorly written/unclear.Societal benefit is listed but not clearly justified.AND/OR All characteristics are present but lack detail or are incorrect, showing a lack of comprehension. | **0–4** points:Missing 2–4 of the characteristics, may be poorly written and unclear; AND/ORMost characteristics are present (1–2 missing) but are incorrect, showing a lack of comprehension. |

\*For an example concept sketches, see the References and Resources section of the Unit 1 GETSI website.