P5

Final Draft – Instructions

Resources to guide you: (1) This **P5 packet** and (2) the ***Internal Assessment Project Writing Guide***.
*Also keep the **IB** Scoring Criteria and the IB formula sheet handy.*

Due Date:

Submit your final draft hardcopy (and to *Turnitin.com*) of your entire project no later than:

Monday, January 13th

Advice: Get some momentum by starting the first few math processes ASAP. Make it a goal to finish before winter break OR by the end of winter break. If you have questions over winter break, you can send me an email and I will answer them. (*cedarlund@4j.lane.edu*)

Format of the Rest of Your Project:

After the "Data Collection" section, you can write the rest of the project in either future or past tense. For example, "I will now carry out a chi-squared test to show...." or "Next I carried out a Chi-Squared test of Independence…". Just be consistent. Carry out your project in a logical order. Revise your introduction if you find the order of your math processes needs to be changed.

How to Write Your Math Processes graphs, calculations, anything mathematical, etc.,

Perform the mathematics (graphs, calculations, etc.) according to your plan, one process at a time. Do all of your writing (explaining and interpreting) of each process before you leap to the next process. You should have a header before each process.

Follow ***pages* 8-19 *of the Writing Guide*** as well as reading below:

General format for each math process or project step:

1. **State** what you are about to do. **Explain** why the process is needed or appropriate in your situation. *Avoid using the word "data". Instead add context of your situation. Use the terminology for your own project. (Costs of cheeseburgers, player heights, number of participants).*

2. **Show your math processes. Demonstrate** that you understand the mathematics you are using as you are using it, regardless of whether it is *simple or further. Let the reader (and*

*evaluator) know what you are doing with <u>your</u> situation by discussing the results using **your** project terminology and units and as your write any sentences.* The Writing Guide indicates the detail needed if you are showing a "further process".

If you copy results from a calculator or other technology tool, be sure to have some explanation of what is being done.

> *<u>From May 2016 IB Moderations</u>: "Candidates often showed insufficient calculations in the simple math processes and did not quote the formula they were using or calculator results appeared without work or an interpretation. This made it difficult to assess the candidate's understanding."*

If your data needs re-organizing for a particular step, then be sure to show this re-organization of data in a new table (*Table B for example*) so the reader of your project does not have to guess what data is being used with your calculations.

3. **<u>Interpret</u> -** Projects read well if partial interpretations are written after <u>each</u> math process. Therefore, after performing each graph, calculation, process, etc., **analyze** and **interpret** what "the math results" have told you ***in terms of <u>your</u> topic and your project*** *specifically*. (in context!)

   *You should not be typing the words "data" or "variables" very much. Instead you should be using the terminology and units unique to your project. Also, follow **page 20 of the Writing Guide**.*

<u>Footnotes</u> - Use formulas as shown in the IB formula packet. If you use formulas from the *HH textbook, or any other source* then you need to footnote <u>on that page</u> and cite a source in the bibliography *(using MLA format)*

<u>Units</u> - Every value shown in your interpretations should also have a unit written next to the number. (except in a few situations). This is especially true in sentences when you interpret or summarize calculations. Units are not needed while you show the process/calculations.

Use technological tools like spreadsheets, other computer software, and graphing calculators. ***However, always make sure you show an understanding of each math process before you start whipping out results from technology.*** *(You are required to show an understanding of at least 2 simple math processes and one further process to have a chance for top scores in criteria C).* At least one of every calculation for further processes must be done by hand. "By hand" means showing each step of the procedure along the way, using appropriate notation. Never use calculator notation.

<u>Repeated Math Processes</u>: If you will be repeating a math process, only show complete steps and explain in detail the first time you use the math process. Too many details for processes that are repeated will cause you to LOSE marks! For repeated occurrences, just use a calculator or computer and report the results. In other words, don't repeat all of the explanations and detailed calculations the second time.

> *However, if you do multiple χ^2 Tests of Independence, you will at least need to show each contingency table of observed values and state a null hypothesis at the very least for repeated tests. But do not show any of the other steps except for the final results.*

Graphs - If you make a graph by hand, graph paper must be used. Be neat. Use a ruler. Graphs made by computer are also good provided they only include information that is relevant. Pay attention to details when labelling graphs and tables. **You are not allowed to use color in your project.**

Borders - You must leave at least a 0.5-inch, or more, border between the edges of EVERY page of your project. This includes pages with data and pages with math notation. Don't write anything outside this border.

Tips About Making Interpretations

You are basically answering the question, "***what does the mathematics I have shown tell me about my situation***?"
Follow page 20 of the Writing Guide.

Make your interpretations bring your results to life in the context of your project: When making interpretations, be sure to convert your math results to clearly show what the result means in terms of your project/context in everyday language.

> *You may even want to comment on your original raw data after viewing it, before you even start any math processes if it "tells" you something relevant just by observing it.*
>
> *Interpretations are best if sprinkled throughout your project and interwoven with your mathematical processes. If you have set up a robust and sophisticated project, be sure to tie together and compare all of the results from the project. You can use the results obtained to generalize or make conjectures or to draw relevant conclusions. Don't make any unsubstantiated conjectures.*

On robust projects with a lot of depth, include a summary of interpretations or conclusions to piece together smaller conclusions. Comprehensive discussion of your interpretations are possible only if you have set up a project that is large enough or complex enough to do so. If you have a simple project, don't try to force something to be comprehensive when it is not.

On the other hand, you may try to give brief speculations why certain results may have happened. However, avoid giving unsupported conclusions or giving your personal beliefs!

And **never include any comments that are superficial or not genuine.**

Before I forget….. At some point in your project you need to justify that the specific quantity of data you collected was adequate and why.

If you are Calculating the Correlation Coefficient:

Whether you comment on the correlation visually from a scatter plot or actually calculate Pearson's Product Moment Correlation Coefficient (*r)* or both, be sure to show an understanding by explaining what the correlation means in the context of your project and variables. For example:

> *"Since there is a strong positive correlation, it appears safe to conclude that, as the worm count goes up, the height of the flowers seems to increase."*

Just because a strong correlation exists between two variables, it does not mean that one variable causes the other to happen. Be careful how you word your interpretations. For example, it might be an overstatement to say that "*worm count effects flower growth*" just because the correlation is high. Instead, you could perhaps say something like "*since the correlation is strong, it seems like there is a strong association between worm count and how well a flower grows" or "since the correlation is strong, it might be possible that worm count effects flower growth*".

If you calculate Pearson's correlation coefficient by hand,
Use the formula 2012 Haese & Harris textbook, Chapter 11

$$r = \frac{\sum(x-\overline{x})(y-\overline{y})}{\sqrt{\sum(x-\overline{x})^2 \sum(y-\overline{y})^2}}$$

And use the following footnote to reference:
Coad, Mal, et al. Mathematics" Mathematical Studies SL. 3rd ed. Australia: Haese Mathematics, 2012. Print.

If you calculate the Least Squares Regression Line by hand, use the following formulas as shown in the 2004 Haese & Harris textbook:

$$y - \overline{y} = \frac{s_{xy}}{s_x^2}(x-\overline{x})$$ and $$S_{xy} = \frac{\sum(x-\overline{x})(y-\overline{y})}{n}$$

where s_{xy} is the covariance.

And use the following footnote to reference:
Coad, Mal, et al. Mathematics" Mathematical Studies SL. 1st ed. Australia: Haese and Harris Publications, 2004. Print.

If the summary statistics, like mean and standard deviation, are calculated from a GDC and then substituted into the formula, then correlation would only be counted a simple process. One must show the details of all portions of the formula to count as "further". One more thing, correlation is not a "test".

If you are conducting the χ^2 Test of Independence:

Be sure to point out that the test is appropriate for you since at least one of the two variables are categorical. Explain your rationale for how you divided up any quantitative data to make two-way tables.

For a further process, you are expected to write down the null hypotheses, the alternative hypothesis, degree of freedom, show the calculation of at least one expected value, work out the chi-square test statistic using the formula and write down the conclusion. (Follow the guide given in class).

For the critical values, you can use the chart shown in the Haese & Harris textbook, which is shown in the handouts given in class. Be sure to footnote and cite the source:

> *Coad, Mal, et al. Mathematics" Mathematical Studies SL. 1st ed. Australia: Haese and Harris Publications, 2004. Print.*

You can also use $p - values$ instead.

In cases of 1 degree of freedom (in other words, a 2 by 2 table), Yates Continuity Correction must be used. See the Ch. 11 Packet. (Provide a reference).

Note that the χ^2 test does not prove anything. If supplies evidence to support only. Be sure to use the wording as shown in the course handout when we studied the χ^2 test.

Note about Five Number Summary and Box Plots

There are different methods used around the world to calculate quartiles. The method used by Excel is different than the amount used from TI-Calculators. Both can be used but be clear which method you are using.

Validity: follow page 21 of the Writing Guide.

In general, you want to describe what might pollute or discredit your findings and, in doing this, how this affected your mathematical results. I suggest you have a separate section in your project called "Validity" or include these comments in your final Analysis that summarizes your findings. *Note: Validity and Accuracy are not synonyms. Your processes are not valid just because you have checked your answers a few different ways.*

- Discuss whether the mathematics you used is appropriate.
- Discuss the limitations of the processes used and conclusions drawn.
- Reflect critically on the math processes as a whole or on certain ones.

Don't include any comments that are superficial or not genuine. Doing so, will decrease your score.

Structure and Communication.

Follow pages 22-23 of the Writing Guide. In general, record actions at each stage. Express ideas clearly, staying focused on your task. Edit the text so that the project flows smoothly, using accurate terminology.

If attaching work done by hand, make a clean photocopy and place into your project. Taped items are not allowed. Get help from your teacher if you need help with copies or scans.

The maximum word count for the entire project is roughly 2000 words. *Words on graphs and headings and next to calculations do not count in the maximum*. If you go over the limit by just a little, you may still be ok. If you are too wordy or include any fluff or meaningless phrases in the project, there could likely be a deduction regardless of the length.

Notation and Terminology Requirement: follow page 24 of the Writing Guide

Math Notation - You will be evaluated on your use of good math notation. Don't force math notation using word processing software. Instead……

Type out all math notation and calculations using some type of an Equation Editor software. If this is your first time, it will take some getting used to. On Google Docs there is now an equation editor. You can type out fairly detailed mathematical expressions directly into documents. Some versions of Microsoft Word include built-in Equation editor software.

- ✓ Candidates should avoid using their cameras to take pictures of calculator screens.
- ✓ Isolated typographical errors are condoned, however if the candidate uses x^2 or X^2 instead of χ^2, for example, this is poor notation and the maximum that can be awarded is level 1 for Criteria G.
- ✓ Examples of notation:

Correct notation	Incorrect notation
x^2	x^2 **or** $x2$
$x \times 2$ **or** $2x$	x*2
1.2×10^{-3}	1.2 E-03
χ^2	X^2 **or** x^2
r^2 :Coefficient of determination	r^2 :Correlation coefficient
$\sqrt{\frac{2402}{16}}$ **or** $\sqrt{(2402/16)}$	$\sqrt{}$ 2402/16 **or** sqrt.

- ✓ Use r for the correlation coefficient

Biggest Causes of Lower Scores:

Most projects require you to do calculations with LARGE amounts of data. I have seen quite a few *excellent* projects turn to *average* after silly computation errors. *Silly* because the student knew the

math, *but did not double-check their calculations*. Remember, this is a math project and you "*gotta*" get the math correct!

Start early. Don't wait till the last second and force yourself to rush! Come by to get help if you need it.

Lastly. At some point in your project you need to justify the quantity of data you collected was adequate for the specific math processes you used. It probably makes sense to do so after your last math process or the final summary.

Did you have at least 30 points or more points on every scatter plot? Did you have enough data for each display (histogram, bar graph, etc) to accurately portray the patterns or conclusions? If using the Chi-Square Test of Independence, were all of your expected values greater than 5?

References and bibliography

Be aware that direct or indirect use of the words of another person (in written, oral or electronic formats) must be acknowledged appropriately, as must any visual material used in the project that has been derived from another source. Failure to comply with this requirement will be viewed as plagiarism, and, as such, may be treated as a case of malpractice.

The bibliography, or list of references, should include only those works (for example, books and journals) that you have consulted while working on the project. An accepted form of quoting and documenting sources should be applied consistently. The major documentation systems are divided into two groups: parenthetical in-text name–date systems and numbered systems. Either may be used, provided this is done consistently and clearly.

Each work consulted, regardless of whether or not it has already been cited in the text as a reference, must be listed in the bibliography. The bibliography should specify: author(s), title, date and place of publication, and the name of the publisher, and should follow consistently one standard method of listing sources (for example, the Harvard author–date system or the Vancouver author–number system).

Possible examples are:

Peterson, A.D.C. (2003). *Schools Across Frontiers: The Story of the International Baccalaureate and the United World Colleges*. 2nd ed. Chicago: Open Court Publishing Company.

Zieger, H.E. (1992). "Aldehyde" in *The Software Toolworks Multimedia Encyclopedia 1.5* [CD-ROM] Software Toolworks. Boston: Grolier.

Bruckman, A.S. (1994). "MOOSE Crossing Proposal" [Online]. Available from: http://www.cs.uml.edu/~fredm/cher/people/asb/papers/moose-crossing-proposal.rtf [Accessed 29 July 2011].

MLA format is acceptable.

When you are 100% finished, add page numbers to every page including your data.

Final Submittal Checklist

Complete the checklist below before you hand in your project.

1. *Make sure your introduction is up to date and accurately describes your project.*

2. If you used a survey, you are required to imbed one copy of a participant's completed survey. This can be taped and then scanned into your project as part of your "Data Collect" section or in an appendix.

3. Your title page should look like:

   - **Your Full Name and IB Number**
   - **Eugene IHS**
   - **IB Math Studies SL**
   - **Exam Date - May 2020**
   - **Your specific project title**

4. Include a bibliography and footnotes (where appropriate).

5. Be sure to include page numbers on each and every page including the front title page and all pages with data.

6. There should be no loose items or taped-on items on any page. If you need help scanning any page to a single page, then I can help you with that.

7. On the bottom of the title page, include your signature to acknowledge that this is ***your*** project and that you have done all the work and that all words, data, or visuals of others have been appropriately cited.

8. **Proofread** your project carefully. Remember there is no color allowed. **Re-read** this packet, P5, one more time.

9. **Submit 1, single-sided, hard copy**

   - ✓ **Paperclip your project. Don't staple.**
   - ✓ **Place your project inside a simple folder.**
   - ✓ **Do not use bindings.**
   - ✓ **All sheets should be the same size with nothing taped.**

10. **Submit** to **Turnitin.com,** 2nd edit.