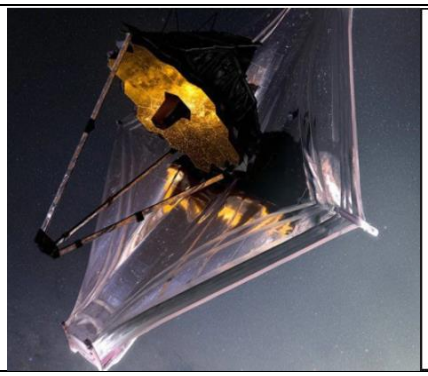
Curtin College

EMTH1019 – Statistics Assignment (20%)



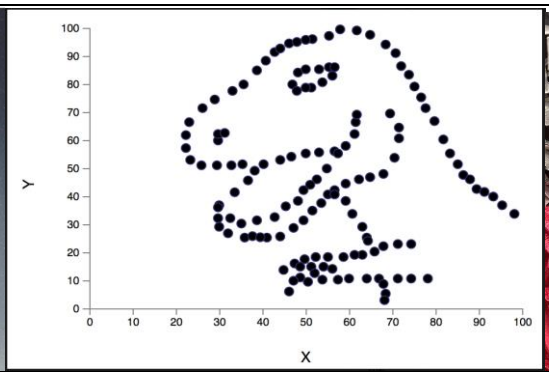


Figure 1 Origami is more than paper cranes. The James Webb Telescope which is now located ~1.6 million kilometres from Earth uses origami in the form of a hyperbolic paraboloid for its sunshield. The British Museum has silk scarves that use the Herringbone and tessellating folds.

Background Information

Origami is more than paper cranes. The James Webb Telescope which is now located ~1.6 million kilometres from Earth uses origami in the form of a hyperbolic paraboloid for its sunshield.

Individual Assessment: This assignment is an individual assessment.

Evidence: In this assignment making your own squares is the way you generate your own unique data set. One of the biggest problems you will face in your careers is the quality and credibility of the data you are analysing. Many sections of this assignment require credible evidence/proof of work done and claims you make; saying you did something is not credible evidence.

> *"I believe in evidence. I believe in observation, measurement, and reasoning, confirmed by independent observers. I'll believe anything, no matter how wild and ridiculous, if there is evidence for it. The wilder and more ridiculous something is, however, the firmer and more solid the evidence will have to be."*
>
> ***Isaac Asimov***

Paper and models that do not comply with the specification may receive *zero* for Make, Collect and Construct.

Sustainable: Using old newspapers, magazines or junk mail means that there is no cost and the origami paper is recycling something that otherwise might go to waste.

Handwritten Calculations: The first time there was an Origami assignment I asked for calculations to be typed as I thought this was a good opportunity to learn how to use the equation editor in WORD. What happened? There was a flood of submissions that were copied and pasted from other sources which I then had to give zero to and report for breaches of academic integrity. The other downside of typed calculations is that they take a lot of time.

Assignment

1. **Make (10 marks)**
   a) Make at least 6 paper squares using recycled magazines, catalogues or junk mail. The side length specification is 190 mm.
   b) Compliance with the specification is clearly demonstrated for every square you make by an image that shows the entire square complies with the specification. 1 image per square * 6 squares = 6 images. Think carefully how you will demonstrate in a single image that a paper square complies with the specification.

2. **Collect Data (10 marks)**

Measure all 4 sides of all your squares in mm to 4 significant figures and provide all data. You need to do this before you make the models. You must watch the video "***Precision, Accuracy Measurement and Significant Figures***" to ensure you know how to measure to 4 significant figures.

WARNING: For your data to be credible you must have provided credible evidence in **Make**. You need to collect data before you construct the models.

2. **Critical Knowledge (10 marks)**

Choosing what data to collect and ***how to measure*** it are the most significant part of any analysis; errors made at the beginning can make your analysis meaningless.

a) A student shows the side length data from 2 of her squares to her teacher. She claims she watched the video "***Precision, Accuracy Measurement and Significant Figures***" and measured the side length to 4 s.f. using the mm side of a ruler. Square 1 $\{190.0, 190.5, 190.5, 190.0\}$ and Square 2 $\{188.5, 191.0, 188.5, 191.0\}$.
Using your knowledge from measuring your own squares and watching the video, explain why the teacher does not believe the student's data is credible nor the claim that they watched the video.

b) Verify that the measuring device you used is accurate.

3. **Construct (20 marks)**

Using **all** the squares from **Make** construct each of the following:

- A Tyrannosaurus https://www.youtube.com/watch?v=6-_CLEAMElc
- 'v' pleats with at least 6 folds https://www.youtube.com/watch?v=jgEOR2YFjxo
- x-form span https://www.youtube.com/watch?v=IWXBPuSZVxo
- Origami star box https://origami.guide/origami-boxes/origami-star-box/
- Herringbone with at least 4 horizontal and 4 vertical folds https://www.youtube.com/watch?v=nw5RLvN7fYA
- Hyperbolic Parabola https://www.youtube.com/watch?v=4g1OcLHp6yI

Option: If you are an accomplished origami artist and want to make something ***more complicated***, I am open to offers 😊 but I still need you to use all your squares to make models.

4. **Data Visualisation (20 marks)**

Using **all** the measured side length data collected in **Collect Data** to create the following data visualizations; there should be at least 24 bits of data.

a) A single informative histogram. (10 marks)
b) A single informative box-plot. (10 marks)

WARNING: Your graphs must be informative and have working that supports their design. This means that if all you do is put your data in Excel to create a graph then you will receive zero marks. Refer to week 1 slides to see what working you need to support the design of your histogram and box plot.

5. **Datasaurus (5 marks)**

   a) Use http://www.robertgrantstats.co.uk/drawmydata.html to create a plot of a humanoid. ("datarobot" or "databot"? 😊) The databot plot will have ***similar*** summary statistics to the Datasaurus in the week 1 slides. It doesn't have to be pretty!
   b) Provide a single image (snip) that shows your "databot" plot and the summary statistics.
   c) Discuss the following "graphs of data sets with similar summary statistics look the same" Ensure that you use your "databot" as evidence in your discussion. (<200 words)

6. **Analyse (25 marks)** Using the data set from **Collect Data** undertake the tasks below. Logical and comprehensive working must be provided so that someone unfamiliar with this document can follow your working. Assumptions are justified, formula are provided, notation is correct and consistent.

   a) Calculate the mean and standard deviation of the population data from **Collect Data**. (2 marks)
   b) Take a random sample of 8 side lengths. **Prove with evidence** how you ensured that each element of the sample was chosen randomly. (4 marks)
   c) Calculate the mean and standard deviation of the sample you obtained in (b). (2 marks)
   d) Determine the 90% confidence interval of an SRS of size n=8 if:
      - σ is known and it is assumed that the population is normally distributed. (2 marks)
      - σ is not known but if it is assumed that the population is normally distributed. (3 marks)
   e) Origami artists want their squares to have side lengths that are almost exactly the same. If an Origami artist took a sample of 8 side lengths from a pack of origami paper, discuss if they would prefer a pack labelled as having a 99% confidence interval, a 90% confidence interval or something else? (<200 words). (2 marks)
   f) Create and test an appropriate hypothesis that evaluates whether the origami paper meets the side length specification in **Make** at a 5% significance when σ is unknown for an SRS of size n=8. (8 marks)
      - Write a technical conclusion that summarises the findings of your analysis. (1 mark)
      - Re-write the conclusion so that someone who is interested in recycled origami paper but who is unfamiliar with statistics can understand what the hypothesis was evaluating. There should be no mention of significance, z, t or even standard deviation. (<200 words). (1 mark)

Submission Guidance

1. Short answer questions can be typed but calculations are to be handwritten, logical and legible.
2. Graphs must be correctly labelled and have linear scales so use a ruler; hand drawn is fine.
3. Word guides <200 means do not write an essay.
4. Images are to be legible, upright and only 1 image across. Images should use most of the page width.
5. Images that are not upright or not legible will not be marked.
6. Do not use pencil for your calculations; it does not photograph or scan well.
7. Save your file as a single PDF. Other file types do not present well in Moodle or Turnitin. If you have a WORD file you can just SAVE AS a pdf.
8. Document orientation is PORTRAIT and background is white. Lined paper is fine.
9. **WARNING**: Assignment answers generated using AI have a particular flavour to them.

Resources

Basic search terms: Unit origami, modular origami, folding pleating, dynamic origami, …

Brigham Young University (2017). *Bullet-proof origami: Folding Kevlar shield designed by BYU mechanical engineers.* Retrieved July 22, 2109 from https://www.youtube.com/watch?v=P_ezsOeX5mQ

Cairo, A., (N.D) *The Functional Art*, retrieved June 9, 2022, from http://www.thefunctionalart.com/

Grant, R., (2022) *Robert Grant Stats*, retrieved June 9, 2022, from http://www.robertgrantstats.co.uk/publications.html

Jackson, P., (2017) *Folding Techniques*, retrieved July 22, 2019, from http://foldingtechniques.com/folding-techniques

Metzger, J., (2017). *The Origami revolution* Retrieved July 22, 2019 from https://www.youtube.com/watch?v=YDBWLKwIAgE

Nakashima, J., (2019), Origami Fireworks, retrieved 25 July 2019 from https://www.youtube.com/watch?v=z0-mlZvJD-E

Origami Instructions. (2005). *Modular Origami folding instructions - how to make a modular Origami.* Retrieved July 22, 2019, from Origami-instructions.com, http://www.origami-instructions.com/modular-origami-instructions.html

Origami Resource Center. *Modular: Free diagrams instructing you how to fold unit origami models.* Retrieved July 22, 2019, from Origami Resource Center, http://www.origami-resource-center.com/modular.html

Tomoko Fuse. (1990). *Unit origami: Multidimensional transformations*. Japan Publications.