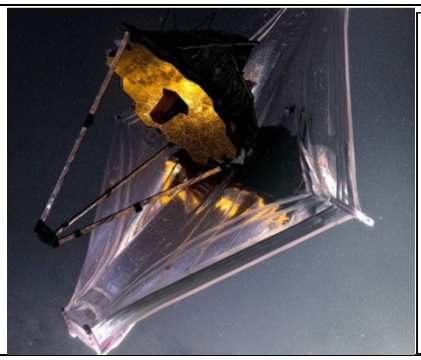
Curtin College

EMTH1019 – Statistics Assignment (20%)



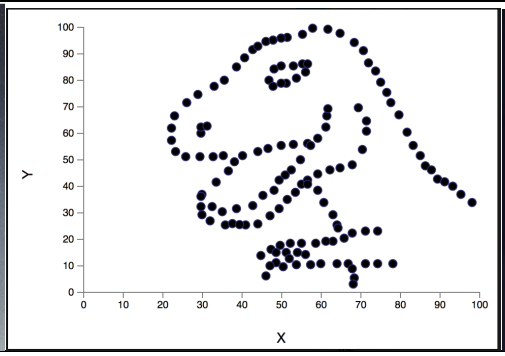


Figure 1 Origami is more than paper cranes. The James Webb Telescope which is now located ~1.6 million kilometres from Earth uses origami in the form of a hyperbolic paraboloid for its sunshield.

Important Information

Handwritten: 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. All calculations are to be handwritten.

Sustainable: Origami paper and models are to be made from recycled paper as specified in Make. Paper and models that do not comply with the specification may receive *zero* for Make, Collect and Construct.

Evidence: 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***

Assignment

1. **Make (10 marks)**
   a) Make at least 9 paper squares only using recycled material such as newspapers, magazines, old school notes or junk mail. The side length specification is 210 mm.
   b) Compliance with the specification is clearly demonstrated with informative images and labelling that proves all paper is square and has a side length that complies with the side length specification.

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.

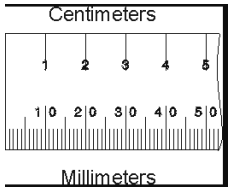


Figure 2 Ruler

a) A student shows some of their side length data to the teacher. They claim that they watched the video Precision, Accuracy Measurement and Significant Figures video link and measured the side length to 4 significant figures using the mm side of a ruler like the one in (*Figure 2*). The data $\{210.0, 210.5, 210.5, 209.5, 210.5, 210.0, 209.0, 211.0\}$. Discuss why the teacher does not believe the student's claims that they watched the video and measured the squares as directed.
b) Discuss why you cannot use average side lengths to calculate the standard deviation.
c) Prove that the measuring device you used is accurate.

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

   Measure all 4 sides of all your squares in mm to 4 significant figures and provide all data. WARNING: You need to collect data before you construct the models.

4. **Construct (20 marks)**

   Use all the squares you have made in **Make** to make a polyhedra (3D object) using unit origami with at least 3 units and at least 2 of the following pleat models, but no repeats.

   - 'v' pleats with at least 8 folds https://www.youtube.com/watch?v=jgEOR2YFjxo
   - Herringbone with at least 4 horizontal and 4 vertical folds https://www.youtube.com/watch?v=nw5RLvN7fYA
   - x-form span https://www.youtube.com/watch?v=IWXBPuSZVxo
   - Hyperbolic Parabola https://www.youtube.com/watch?v=4g1OcLHp6yI

   Provide quality images of all models as evidence of construction using the paper you made in **Make**.

   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.

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

   Using all the side length data collected in **Collect Data** create the following data visualizations.

   a) A single informative histogram.
   b) A single informative box-plot.

   You must provide all working to support the design of your histogram and box plot. Excel outputs or graphs without logical working are not credible evidence. Refer to week 1 slides.

6. **Datasaurus (5 marks)**

   a) Use http://www.robertgrantstats.co.uk/drawmydata.html to create a graph of a bird that has ***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 graph and summary statistics from the website.
   c) Discuss the following "graphs of data sets with similar summary statistics look the same". (<200 words)

7. **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.
   b) Take a random sample of 7 side lengths. Prove with evidence how you ensured it was a random sample.
   c) Calculate the mean and standard deviation of the sample.
   d) Determine the 90% confidence interval of an SRS of size n=7 if:
      - σ is known and it is assumed that the population is normally distributed.
      - σ is not known but if it is assumed that the population is normally distributed.
   e) Create and test an appropriate hypothesis that evaluates whether the origami paper meets the side length specification in **Make** at a 1% level of significance when σ is unknown for an SRS of size n=7.
      - Write a technical conclusion that summarises the findings of your analysis.
      - Re-write the conclusion so that someone unfamiliar with statistics can understand what it means There should be no mention of significance, z, t or even standard deviation. (<200 words)

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; 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 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.

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.