

## Tasks: Machine Learning and Statistics

ian.mcloughlin@atu.ie

Last updated: 13 September 2023

1. Square roots are difficult to calculate. In Python, you typically use the power operator (a double asterisk) or a package such as `math`. In this task,<sup>1</sup> you should write a function `sqrt(x)` to approximate the square root of a floating point number  $x$  without using the power operator or a package.

Rather, you should use the Newton's method.<sup>2</sup> Start with an initial guess for the square root called  $z_0$ . You then repeatedly improve it using the following formula, until the difference between some previous guess  $z_i$  and the next  $z_{i+1}$  is less than some threshold, say 0.01.

$$z_{i+1} = z_i - \frac{z_i \times z_i - x}{2z_i}$$

2. Consider the below contingency table based on a survey asking respondents whether they prefer coffee or tea and whether they prefer plain or chocolate biscuits. Use `scipy.stats` to perform a chi-squared test to see whether there is any evidence of an association between drink preference and biscuit preference in this instance.

		Biscuit	
		Chocolate	Plain
Drink	Coffee	43	57
	Tea	56	45

3. Perform a t-test on the famous penguins data set<sup>3</sup> to investigate whether there is evidence of a significant difference in the body mass of male and female gentoo penguins.
4. Using the famous iris data set,<sup>4</sup> suggest whether the setosa class is easily separable from the other two classes. Provide evidence for your answer.
5. Perform Principal Component Analysis on the iris data set,<sup>5</sup> reducing the number of dimensions to two. Explain the purpose of the analysis and your results.

<sup>1</sup> *A Tour of Go*. Aug. 18, 2023. URL: <https://go.dev/tour/flowcontrol/8> (visited on 08/18/2023).

<sup>2</sup> *Square Roots via Newton's Method*. Feb. 4, 2015. URL: <https://math.mit.edu/~stevenj/18.335/newton-sqrt.pdf> (visited on 08/18/2023).

<sup>3</sup> *mwaskom/seaborn-data: Data repository for seaborn examples*. Aug. 30, 2023. URL: <https://github.com/mwaskom/seaborn-data/blob/master/penguins.csv> (visited on 08/30/2023).

<sup>4</sup> *Iris – UCI Machine Learning Repository*. Aug. 17, 2023. URL: <https://archive.ics.uci.edu/dataset/53/iris> (visited on 08/17/2023).

<sup>5</sup> *Iris – UCI Machine Learning Repository*.