Integrating data rescue into the classroom

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1. Introduction

Ambitious research led teaching experiment in which undergraduate students at Maynooth University engaged in a substantial data rescue effort to transcribe more than 1300 years of daily rainfall data and associated metadata across Ireland for the period 1860-1939.

Aims:

i. To examine the potential for students to produce accurate and reliable observational data.
ii. To expose students to the basic processes involved in climate data rescue.
iii. To motivate students by engaging them in a practical exercise whereby their contribution has considerable value to research.

2. Overview

Students were provided with digital images of annual rainfall sheets recovered from Met Éireann's (Ireland's National Meteorological Service) archives, together with templates for transcribing the data. The assessment process was linked to creating a corrected data series whereby differences in double keyed sheets were identified and a master 'correct' series created by teaching staff. Data previously transcribed by Met Éireann were used as a benchmark against which the performance of the students was evaluated. Learning outcomes were formally assessed through an anonymous questionnaire.

Key supports included:

- Video tutorial demonstrating the transcription process
- Online discussion forum (Moodle) where students could post queries
- Automatic QA check built in to transcription template
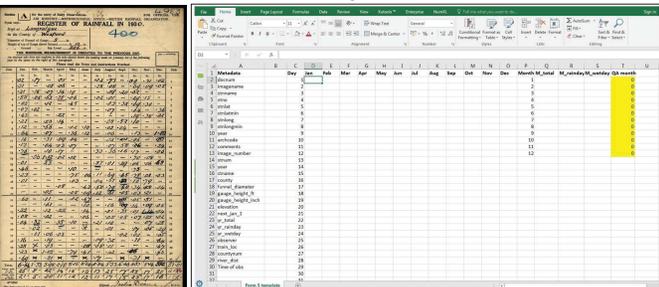- Check-in clinic to address reoccurring issues

Figure 1: Annual rainfall sheets and transcription template provided to the students

3. Methodology

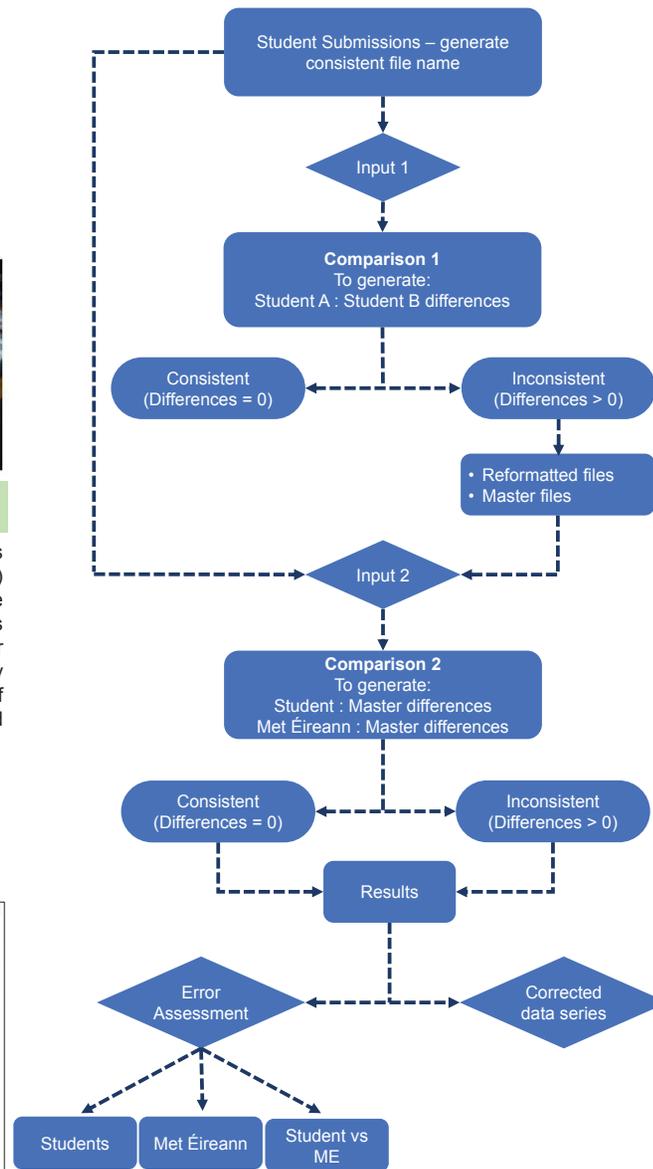**Assessing students performance and creating a master 'corrected' data series**

Figure 2: Flowchart outlining the workflow from receiving student submissions to final output and assessment of errors.

4. Results

An evaluation of student performance revealed that 62% of student transcribed sheets had no errors

In 96% of student sheets < 5% of data entries were incorrect
i.e., 96% of sheets had < 20 errors

A review of all incorrect sheets reveals that 52% of the sheets containing errors had < 5 errors, 90% had < 20 errors and only 3% had > 40 errors

Cumulative error across all 2556 sheets transcribed by students reveals a percentage error of less than 1%
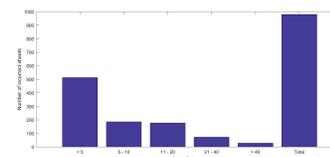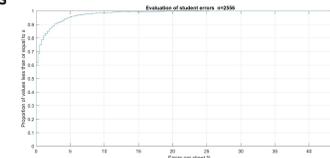
Figure 3: Empirical CDF showing the frequency (%) of student submissions being less than or equal to x, where x is the percentage of errors per sheet (top). Bar graph categorising the total number of incorrect sheets by actual number of errors per sheet (bottom).

An assessment of the 274 sheets transcribed by both Met Éireann and the students revealed that while the students have a smaller number of incorrect sheets overall, 39% compared to 49%, the majority of Met Éireann's incorrect sheets lie in the lowest error category. However, Met Éireann also have a greater number of sheets with > 40 errors
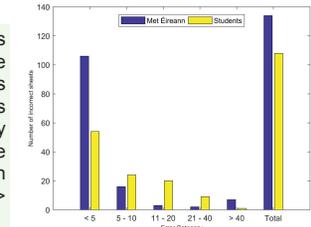
Figure 4: Benchmarking students: Evaluation of errors for common sheets (n = 274). Proportion of incorrect sheets by error category.

5. Summary

- Over 1300 annual rainfall sheets (~ 1 million data points and metadata) double keyed in a period of 64 days
- Performance of the students comparable to the professionals
- Percentage error ~ 1%
- Highlights the importance of historical climatology to students
- Student feedback was notably positive
- Demonstrates the potential to integrate citizen science into the classroom

Future work:

- Develop daily rainfall network for Ireland
- Application of comprehensive QA and homogenisation techniques
- Analysis of the long-term record to assess changes in the characteristics of extreme rainfall events
- Make the data readily updatable and widely available to national and international researchers