Don't Disturb The Student

Gray, Cameron

Published: 09/05/2018

PRIFYSGOL BANGOR UNIVERSITY

AdvanceHE

Don't Disturb The Student

CAMERON GRAY, BANGOR UNIVERSITY

ADVANCEHE SURVEYS 2018

Introductions

- Cameron Gray, FHEA
- Teaching Assistant and Ph.D. Candidate in Computer Science at Bangor, studying Learning Analytics.
- Part of the Learning Analytics Initiative at Bangor, in partnership with our Centre for Excellence in Learning and Teaching (CELT)
- Contactable at c.gray@bangor.ac.uk.

How This All Started…

- Doctoral work surrounds using Data Science methods to add an ‘Early Warning System’ to our Learning Analytics platform.
- To assist with the earliest possible identification of students in potential difficulty, we discounted data sets that could not be provided from day one.
- The prime data set we identified is student attendance at scheduled events, such as lectures, tutor meetings, employability sessions, etc.

Why Attendance?

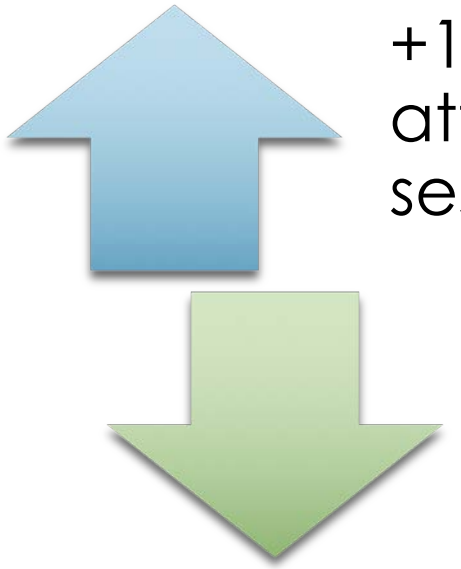
- Anecdotally, teachers and lecturers have correlated attending with academic achievement for years. Usually in the form 'show up and do the work, you pass'.
- Multiple studies have shown this correlation to be correct [1- 3] and visible across institutions and cohorts.
- Institutions start to collect this data from the very first activity/session.

[1] J. R. Rodgers, "A Panel-Data Study of the Effect of Student Attendance on University Performance," *Australian Journal of Education*, vol. 45, no. 3, pp. 284–295, 2001.
[2] D. R. Marburger, "Does Mandatory Attendance Improve Student Performance?," *The Journal of Economic Education*, vol. 37, no. 2, pp. 148–155, 2006.
[3] M. Credé, S. G. Roch, and U. M. Kieszczynka, "Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics," Review of Educational Research, vol. 80, no. 2, pp. 272–295, 2010.

Making Sense of the Data

- We explored various options to summarise all of the attendance information into a single metric.
  - Ratio of Sessions Attended.
  - Raw Counts.
  - Derivatives
  - Etc.

- With help from CELT, we defined a summary metric.



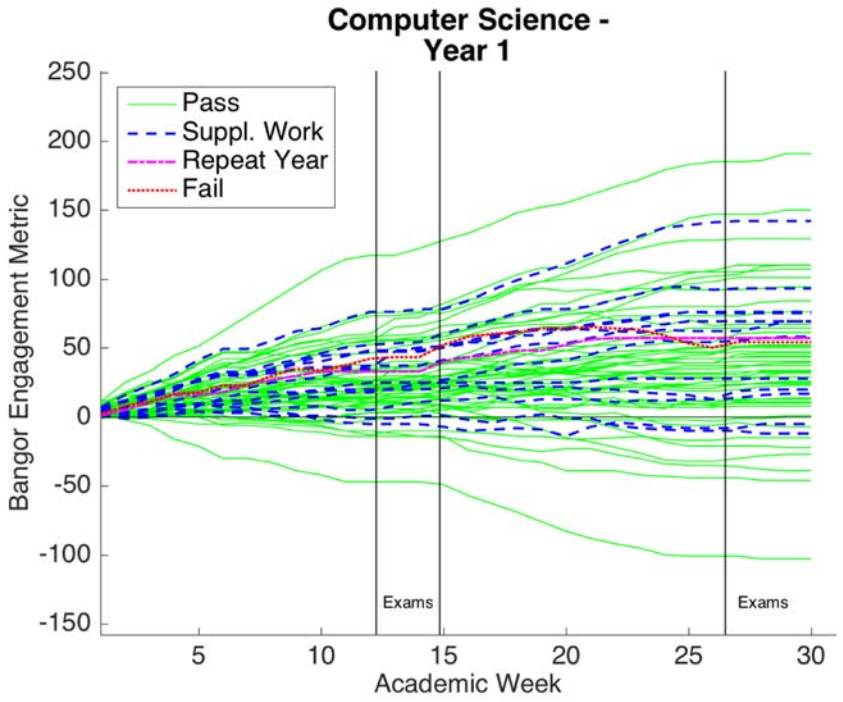
+1 Point for attending a session.

-1 Point for missing a session.

Definition The Bangor Engagement Metric

Predictive Model

- We conducted a series of Machine Learning experiments to determine the best settings to maximise identification of poor outcomes, at the earliest possible juncture.
- The results prove in both seen and unseen data, that we can predict the outcome of students from the first 3 weeks' attendance values of the BEM.
- 84.79% Identical Match Accuracy
- 97.33% 'On-Mission' Accuracy.



The full paper supporting this effort has been submitted for publication in IEEE Transactions on Learning Technologies.
C. C. Gray and D. Perkins, "Utilizing Machine Learning for Early Indication of Student Outcomes", Transactions on Learning Technologies, submitted, 2018.

‘On Mission’ Accuracy

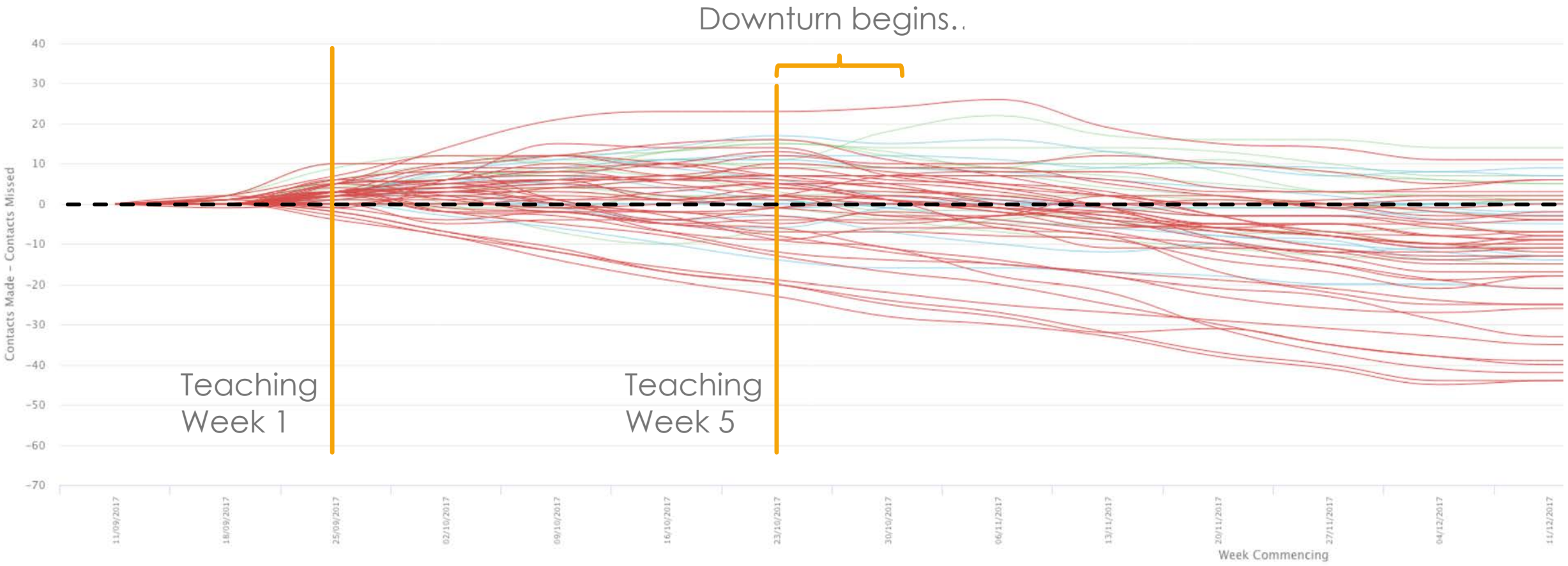
- Our guiding principle is a reworking of Blackstone’s Formulation (applying to Criminal Justice).
- “It is better to intervene with 10 students that would pass unaided, than to miss *one* student that would fail.”
- The model is designed to minimise the number of would-be failing students that get missed.

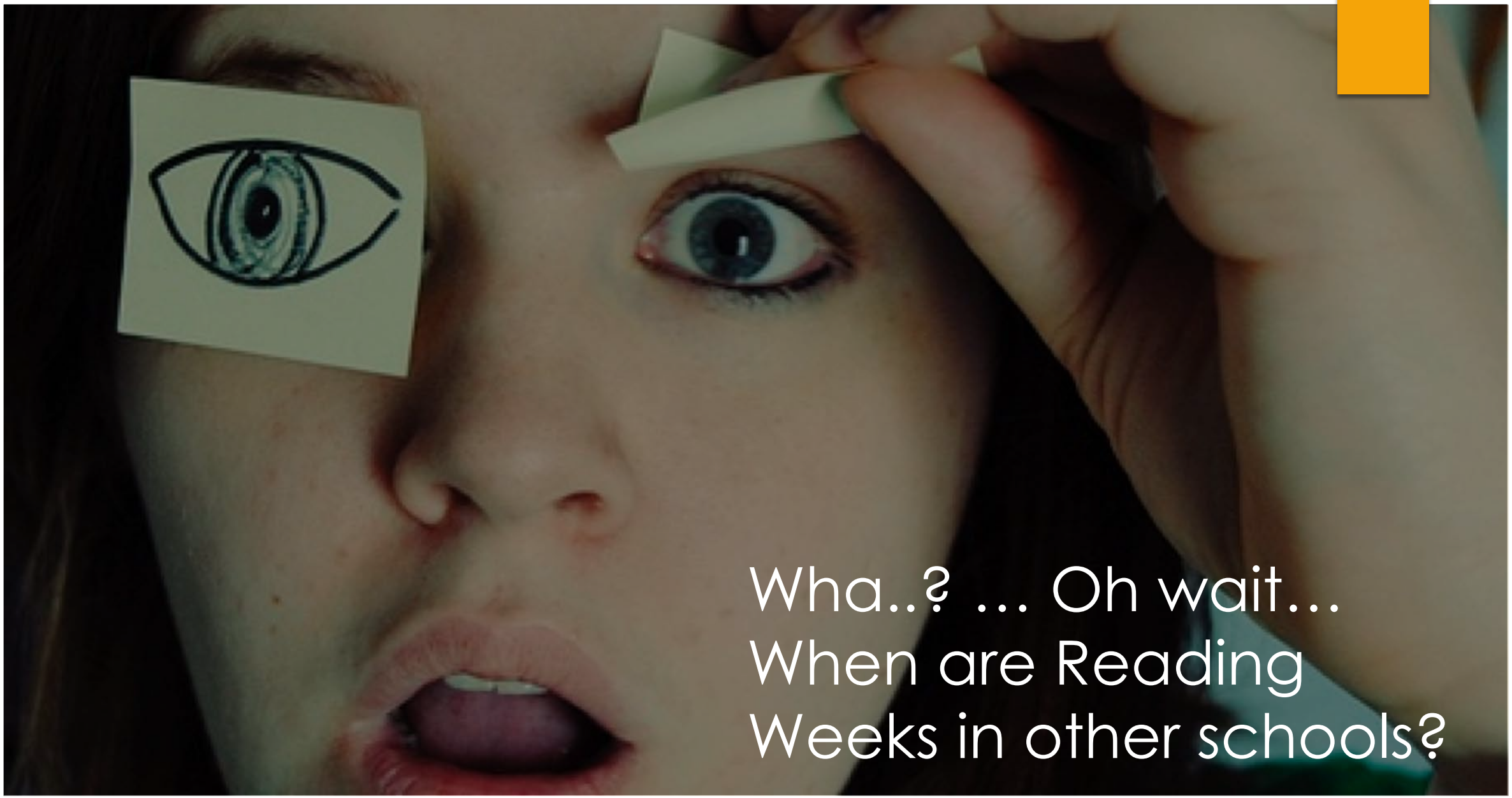
Courtesy NASA, Photo Number: S69-34038 Date: May 18, 1969

‘Real World’ Model Testing

- We conducted a ‘Field Trial’ during semester 1 A/Y 2017/18.
- The predictions from our model were compared against the previous ‘Low Engagement Report’ used at Bangor.
- The report showed an additional 63 students (within the School of Computer Science) with low rankings, that were not identified as ‘at-risk’ by Week 3.

How'd That Happen..?




Wha..? … Oh wait…
When are Reading
Weeks in other schools?

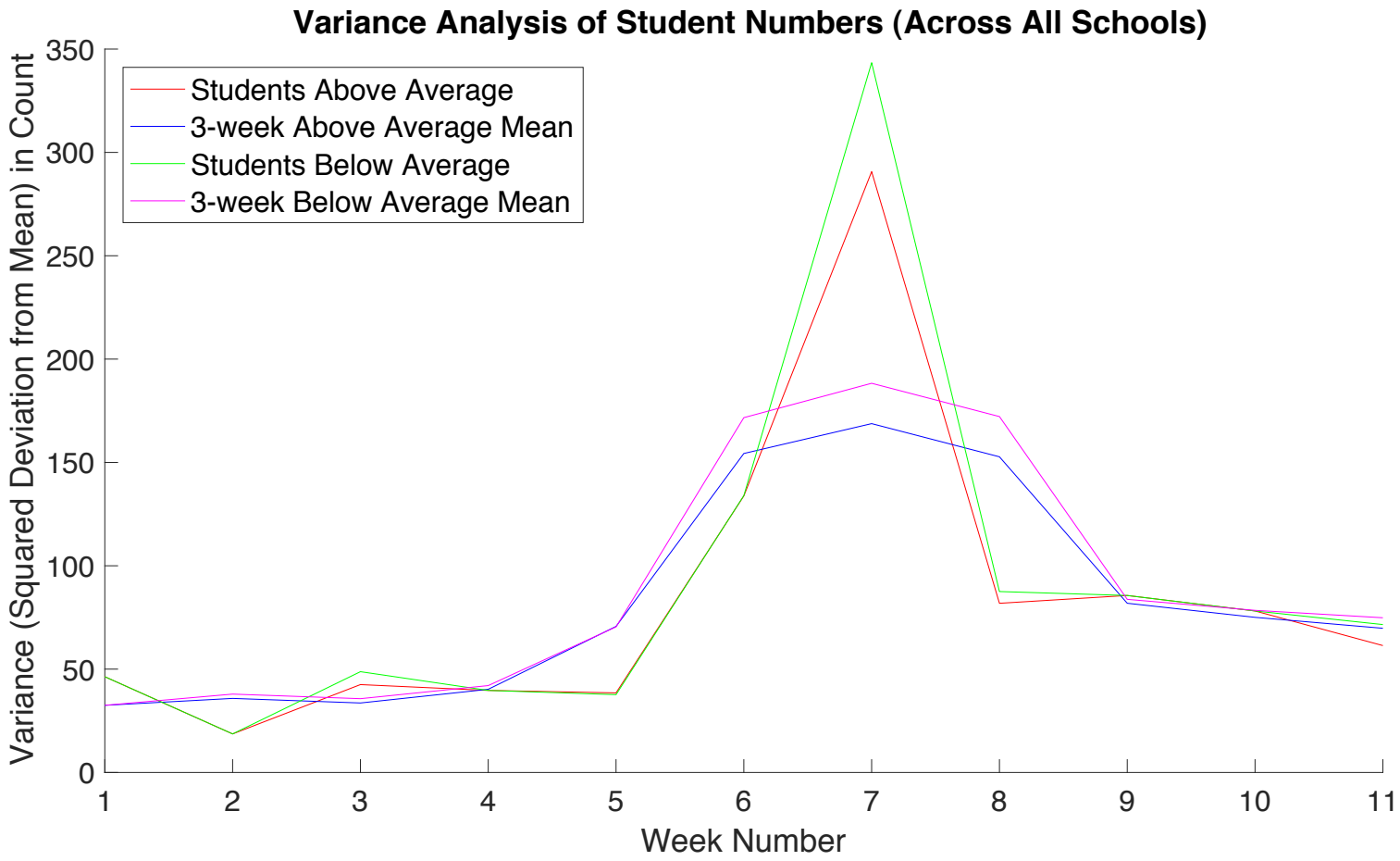
Playing ‘Spot the Reading Week’

- At this point we knew that Reading Weeks occur, but as a School that doesn’t use them we had no idea when they fall in the calendar.
- We set about using the data set we already had to try to find this event prior to obtaining the actual dates.
- As a side benefit, this work provided an answer to ‘can we spot disturbances that may impact student achievement?’

Methodology for Detecting Disturbances

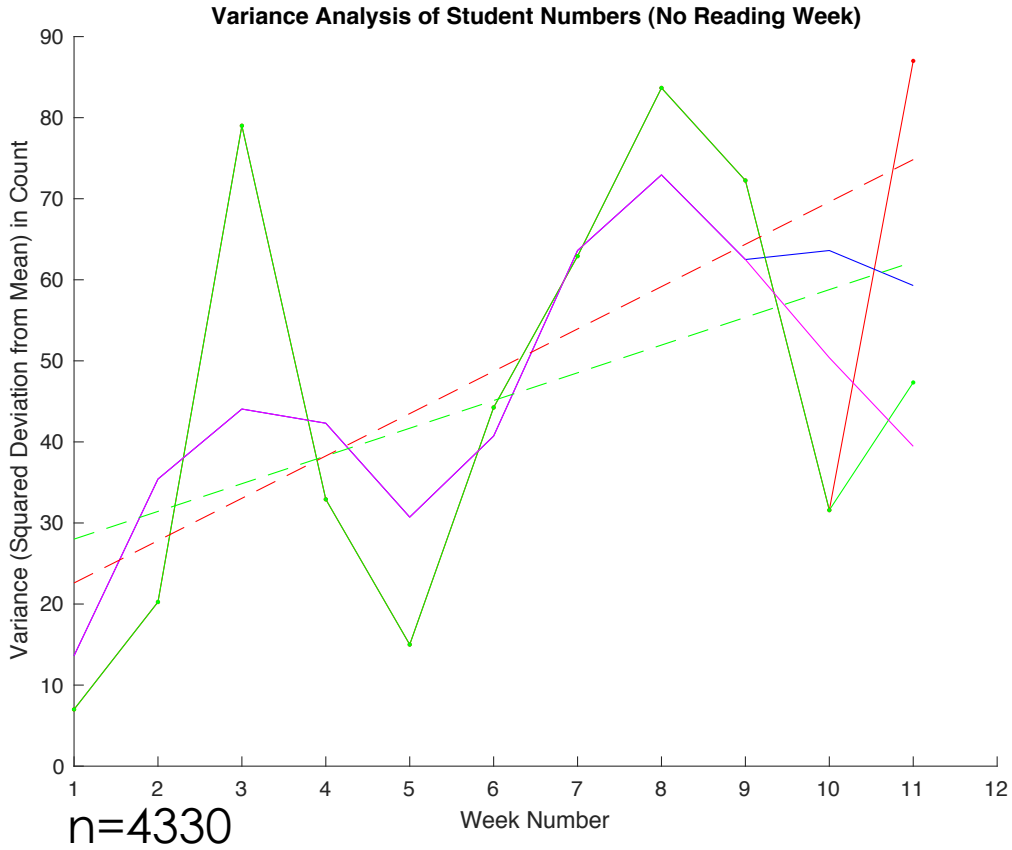
- We examined all students as a whole population and school by school.
- First, we calculated the number of students above and below the average BEM measure for each population (at that week).
- Next, we calculated the variance of those counts between adjacent weeks.
- We then included a 3-value rolling average, to deal with any extreme outliers.

Detecting Disturbances Results (1)

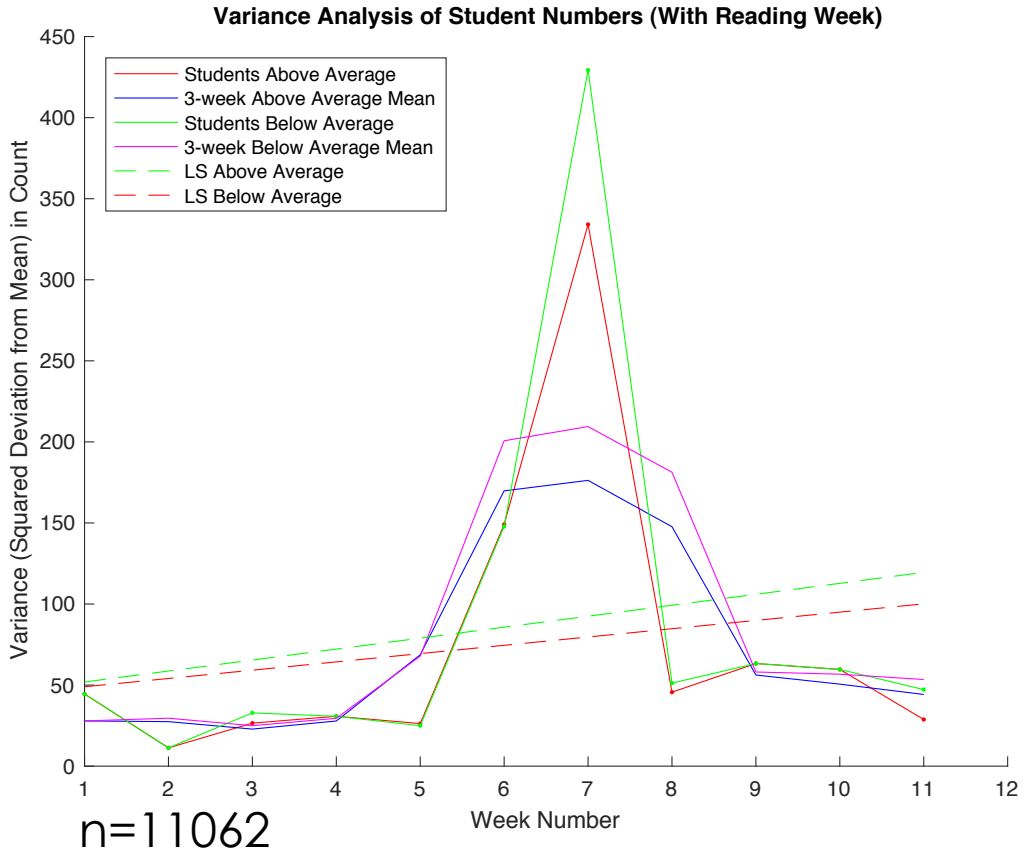


n=15392

Detecting Disturbances Results (2)



n=4330



n=11062

Observations

Overall Observations

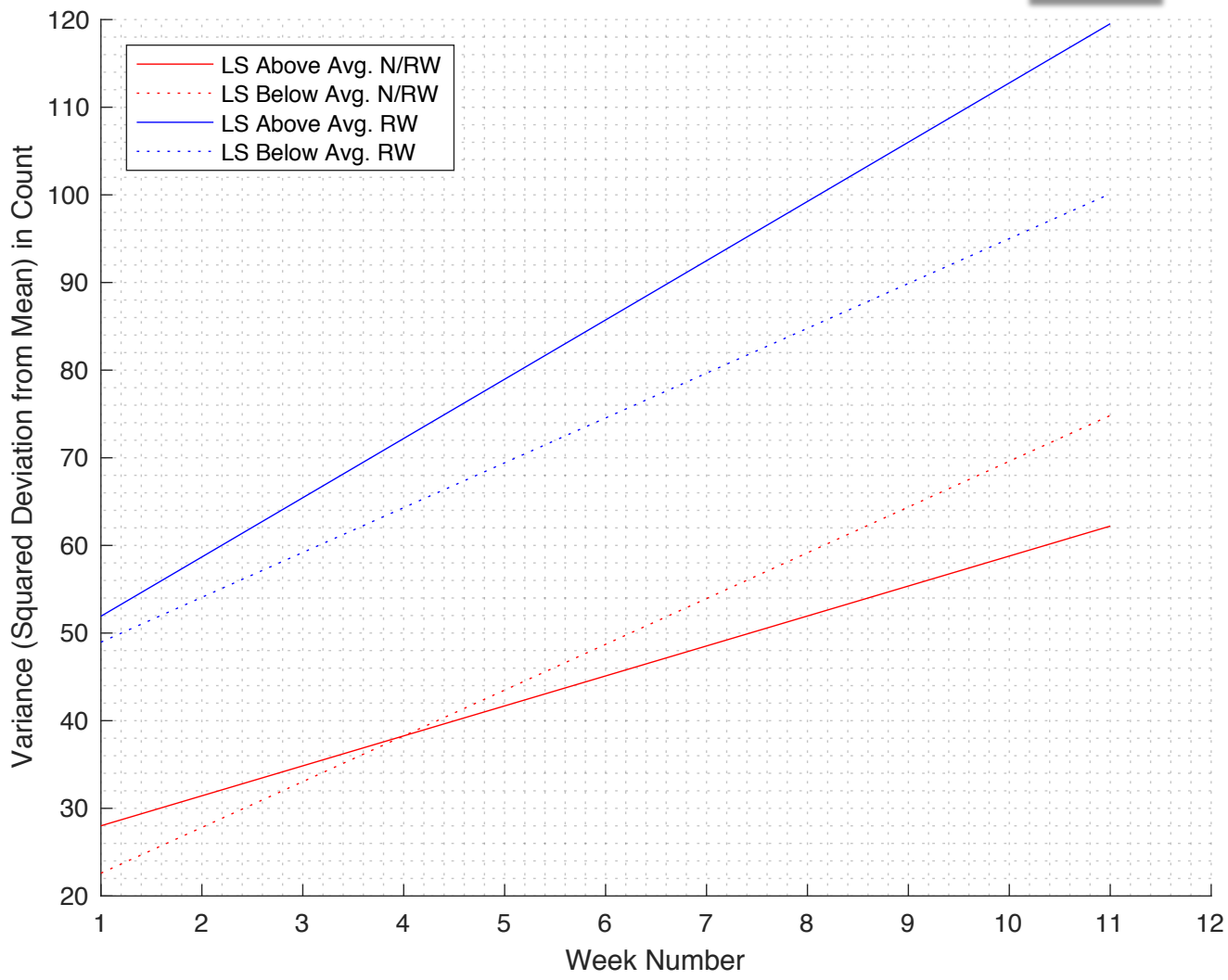
- Attendance patterns stabilise at teaching week 3 and 4.
- Once that pattern is interrupted, the same level of variance never returns, implying that the interruption has introduced change.

Split RW/NRW Observations

- In schools without a reading week, there is natural tendency toward non-attendance by the end of a semester.
- The cross over point between the two trends for NRW schools is week 4. This week seems to be significant in student attendance patterns.

Analysing the Trend

- By adding a Least Squares Trend Line over both populations, we arrive at these trends.
- This graph reveals:
  - Students that are below average attendance do not seem affected (roughly the same gradient).
  - Above Average gradients diverge significantly.



What the Trend Tells Us

Student Type	Effect
High Flyers	Always attend irrespective of outside influences.
Volatile	Highly susceptible to outside influences, only requires a nudge to fall either way.
Average	*Generally keeps up, may benefit from occasional interventions.*
Below Average	Likely immune to interventions unless very specific.

- The difference in gradients allow us to infer structure in student achievement groups.
- The lower end appears to be largely immune to retention efforts, but cannot be ignored.
- The higher end are also likely to perform no matter what efforts or disturbances occur.
- The important group is the one just above average, but below the high flyers. These students are the ones most affected by changes.

Behavioural Economics and ‘Nudging’

- Nudge Theory [1] holds that reinforcement and indirect suggestion can vastly alter the decision making processes of groups or individuals.

- Students without reading weeks are affected disproportionately than students that do. We hypothesise that this is a nudge effect of students not keeping to their pattern.

- The observation that following a reading week student attendance doesn’t immediately return to pre-break levels, would also imply there is a nudge effect present.

[1] R. H. Thaler and C. R. Sunstein, “Libertarian paternalism,” American economic review, vol. 93, no. 2, pp. 175–179, 2003.

Escaping Negative Nudges

- We observed that there are three Schools at Bangor that have been affected far less significantly.
- Those schools either have a very structured set of reading week activities (just not normal lectures), or a very insular community.
- Negative nudges, such as peer pressure, changing patterns of classes, etc. need to be considered when designing any 'non-standard' or pattern-breaking element of a course.

Decisions, decisions…

- In order to confirm our observations, a longitudinal study is required.
- In the mean time, our data provides a wealth of insight in order to make better decisions; Data Driven Decisions (D3) [1].
- We're not proposing scrapping reading weeks, but we as educators need to determine if the break in routine serves our students best.
- Potentially, different forms of activity could enhance the experience without the negative nudging effect.

[1] M. Fickes, "Data-Driven Decision Making.," School Planning and Management, vol. 37, no. 4, 1998.

If you would like to know more… Contact Us

Learning Analytics Initiative,
School of Computer Science, Bangor University

PRIFYSGOL BANGOR UNIVERSITY

Cameron Gray	Dave Perkins
c.gray@bangor.ac.uk	d.perkins@bangor.ac.uk