

An investigation into the way Jupyter Notebooks enhance learning and teaching on TM351

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Project proposal

TM351 (Data Management and Analysis) has used Jupyter (2019) notebooks for practical work from its inception in 2016. This web-based tool enables students to embed program code and associated discussion in a notebook in the style of a lab book (Appendix B) so that they can explain what they were doing and why. Teaching materials include notebooks in the same style, to explain a concept and then show its practical application such that the example can be run. In this way students can return to a project at a later stage and if their notes were sufficient, they or another researcher can repeat the work and study how valid their assumptions were as well as whether their conclusions in a report were justified.

The project will investigate how students divide their time between theoretical reading on the TM351 module website and practical work using notebooks, both as a part of their learning, and then practice for their final report. It will explore to what extent their use of the notebooks reinforces their learning or extends their knowledge. It will look at whether there is any relationship between where they are currently studying and what computing devices, they have available when the student works at home, at work or on the go that might affect their ability to undertake practical work using notebooks as opposed to theoretical reading using other provided materials.

The research questions the project will answer are:

- Does the use of notebooks effectively support students in their studies of the module learning outcomes?
- Do notebooks allow the students to integrate theory and practice?
- Do students have technological problems in using notebooks?
- Does the use of notebooks dictate when and where students are able to study?
- Is the use of notebooks restricted by accessibility constraints?

Barber et al (2019) "Teaching and Learning with Jupyter [online] Available from: <https://jupyter4edu.github.io/jupyter-edu-book/> (Accessed: 28 Aug 2019)

Jupyter (2019) "Some information about the Jupyter Project and Community" [online] Available from: <https://jupyter.org/about> (accessed: 28 Aug 2019)



Relationship to other work

This project fits into the eSTEeM theme "innovations in STEM" in that it looks at Jupyter notebooks as a study resource. It is also relevant to "Learning Design" as its outcomes may impact on other modules thinking of incorporating notebooks. The notebooks are most relevant in computing subjects but can also be used with statistical packages so have potential application in maths, science and social science modules.

The project was prompted by the 2021 M269 (Algorithms Data structures and Computability) module rewrite, as the module team are proposing to use Jupyter notebooks. There seem to have been few studies into the pedagogy of the use of notebooks and how students learn using these in correspondence tuition. Whilst we are still reviewing the literature, it is focused on how notebooks can be used, rather than the students' experience of using them. For example a recently published ebook (Barber et al, 2019) focuses on how they can be used with some evidence based on investigations based on other tools and pedagogic principles, but only anecdotal evidence of how Jupyter notebooks specifically fulfil these roles.

The project will inform module teams who might use notebooks in the future on various coding modules either for practical work or for a mix of theory and practical work as to the extent that this might be pedagogically sound.

The impact of the project on students would be that there would be a better understanding of how they need to be supported in their use of notebooks and what could be provided to assist in this. This would be of external value in the use of Jupyter notebooks in data science teaching, which is a growing curricular area.

Code to be executed

```
In [3]: def milkType(code):
-       if code == '0401': # neither concentrated nor sweetened
-           return 'unprocessed'
+       if code == '0402': # concentrated or sweetened
+           return 'processed'
-       return 'unknown'

COMMODITY = 'Milk and cream'
milk[COMMODITY] = milk['Commodity Code'].apply(milkType)
MONTH = 'Period'
PARTNER = 'Partner'
FLOW = 'Trade Flow'
VALUE = 'Trade Value (US$)'
headings = [MONTH, PARTNER, FLOW, COMMODITY, VALUE]
milk = milk[headings]
milk.head()
```

Results

```
Out[3]:
```

	Period	Partner	Trade Flow	Milk and cream	Trade Value (US\$)
0	201501	World	Imports	unprocessed	13934595
1	201501	World	Exports	unprocessed	26259775
2	201501	Australia	Exports	unprocessed	50331
3	201501	Austria	Exports	unprocessed	360
4	201501	Belgium	Imports	unprocessed	1424271

lab notebook style comments

The data contains the total imports and exports per month, under the 'World' partner. Those rows are removed to keep only the per-country data.

This cell could contain some tutor feedback on the work above