EPSRC
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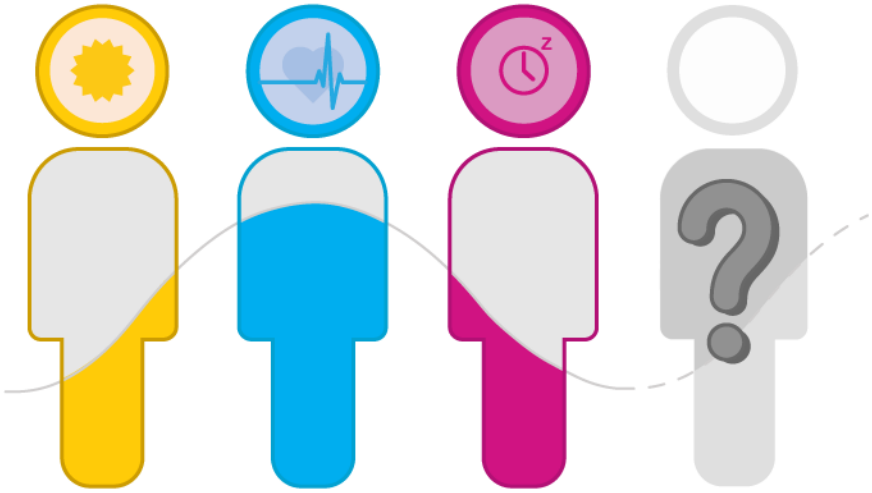
InFoMM
Industrially Focused Mathematical Modelling

EPSRC Centre for Doctoral Training in Industrially Focused Mathematical Modelling



User Cancellation Modelling: on Clustering of Customer Behaviours

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Maths-Whizz by whizz EDUCATION

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1. Introduction

Motivation and goal

Retained customers in general create higher revenues than new customers do, and making a sell to a new customer can cost up to 5 times more depending on the business. Therefore, many companies form the Customer Relationship Management (CRM) team with a focus on customer retention strategies. A crucial step is then to identify high risk customers who are intending to discontinue their usage of the services. This assessment is better known as *churn prediction*.

Our project aims to perform the churn prediction task based on investigation of customers' behavioural clusterings, and formulate the processes into a scalable pipeline which can be easily reused, updated and extended for many applications. In particular, we apply the pipeline to analyse pupil subscribers' data for Whizz Education (referred to as "Whizz"). Whizz provides online virtual tutorial service, Math-Whizz, which pupils can access by purchasing subscriptions.

1. Modelling pipeline

Churn prediction helps the business to detect customers who are likely to cancel a subscription.

We can reference loads of useful stuff like Figures 1 and 2, and also Table 1.

Quantity	Name	Value	Units
Time	Tenure	12	µs
Length	Height	1.82	cm
Planks constant	$\hbar$	$6.62 \cdot 10^{-32}$	$\mathrm{m^2\,kg\,s^{-1}}$

Table 1 – Some useful values.

1. Very specific points

In the margin I can mention something I need to do.

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Incase I need to highlight something I need to do.

It's all about

$$\|I\|_{\infty}^{4} = \frac{\partial^4 f}{\partial g^4} := x^2 + y^2 = z^2. \tag{1}$$

	Value	Units
c	$3 \cdot 10^3$	$\mathrm{m\,s^{-1}}$
$\hbar$	$6.62 \cdot 10^{-32}$	$\mathrm{m^2\,kg\,s^{-1}}$

Table 2 – Some physical constants which frequently come in handy for calculations, (although InFoMM students always non-dimensionalise).

1. Glossary of terms

- **Cartoon:** A brilliant sketch.
- **Lay report:** A smaller version of the technical report without all the maths.
- **InFoMM:** A great way to get a PhD and change the world.
- **Something a bit odd:** Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas.

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1. An odd point

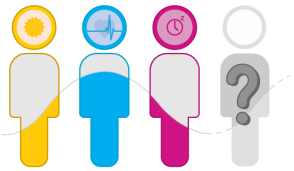

Figure 1 – He is my favourite cartoonist.

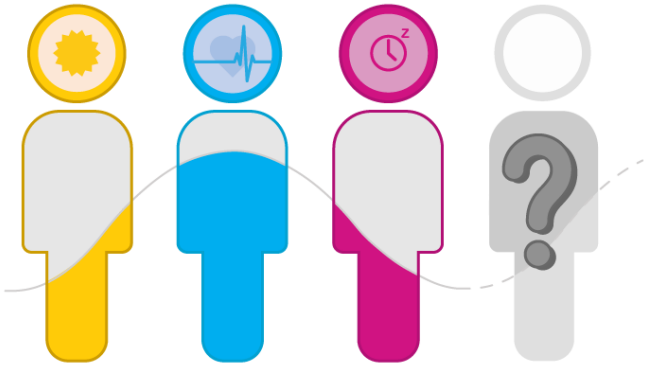

Figure 2 – A hilarious S. Harris cartoon. Here $e = mc^2$ or $e = mc^2$.

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I love these side bubbles! They're awesome and very helpful.

$$\int_{\mathbb{R}}^{\infty^+} f(z)\,\mathrm{d}(z) = 0$$

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2. Some crazy maths

Code 1 is a nice example of using Python rather than Matlab.

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```python
def prime_numbers():
    """
    A prime number generator.
    :return: Int, prime number.
    """
    x = 2
    primes = [x]
    yield x  # We the first prime number.
    while True:
        if x in primes:
            x += 1
        else:
            is_prime = True
            for p in primes:
                if x % p == 0:
                    is_prime = False  # The number is not prime.
                    x += 1
                    break  # We do not need further checks.
            if is_prime:
                primes.append(x)
                yield x
```

Code 1 – Some example python code, incase we wanted to show the company some awesome programming idea.

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$$\bar{x} = \frac{1}{n}\sum_{i=1}^{i=n} x_i = \frac{x_1 + x_2 + \ldots + x_n}{n}$$

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$$\int_0^\infty e^{-\alpha x^2}\mathrm{d}x = \frac{1}{2}\sqrt{\int_{-\infty}^{\infty} e^{-\alpha x^2}\mathrm{d}x \int_{-\infty}^{\infty} e^{-\alpha y^2}\mathrm{d}y} = \frac{1}{2}\sqrt{\frac{\pi}{\alpha}}$$

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$$\sum_{k=0}^{\infty} a_0 q^k = \lim_{n\to\infty}\sum_{k=0}^{n} a_0 q^k = \lim_{n\to\infty} a_0\frac{1-q^{n+1}}{1-q} = \frac{a_0}{1-q}$$

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$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-p \pm \sqrt{p^2 - 4q}}{2}$$

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$$\frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} + \frac{\partial^2 \Phi}{\partial z^2} = \frac{1}{c^2} \frac{\partial^2 \Phi}{\partial t^2}$$

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3. Discussion, conclusions & recommendations

Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas. Sator Arepo tenet opera rotas.

Dr. Junaid Mubeen, Director of Education at Whizz Education said: *"We are very pleased with Victor's contribution. He has addressed our key requirement of developing a model that allows us to predict the likelihood of home users cancelling their subscription from one month to the next. Discussions are already underway with our Development and Marketing teams to understand how we can make use of Victor's model on a continual basis to turn around customers "at risk" of cancelling. Victor has also illuminated a number of Machine Learning strategies that we can see having applications in other business problems."*

[1]

References

[1] Thomas Bradley, Jacques du Toit, Robert Tong, Mike Giles, and Paul Woodhams. Parallelization techniques for random number generations. *GPU Computing Gems Emerald Edition*, 16:231–246, 2011.

4. COMMENTS ON THE REPORT

For the **final** editing:

- Ensure the side bubbles are correctly centred and don't spill over any pages.
- Ensure there are no dangling headers (This might require inserting a `\clearpage` command.)