

A statistician's career in telecoms

Blaise F Egan

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Overview

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I recently retired from BT, where I worked for 47 years, in a career mostly involved with statistics, either doing it or advising others. I saw many changes and learned a few lessons worth passing on.

Education

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- 1974: I went to Queen Mary College, University of London, in 1974 to study Pure Mathematics, but I ended up doing mostly applied maths and avoided statistics completely
- In my second year my flatmate (best friend) was killed in a railway accident and I fell into a deep depression and I failed most of my exams. I had enough course units to make it to the third year.
- I left in 1977 without a degree.

Employment

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- Monday 3rd January 1978. I took a position as a Telecommunications Traffic Officer with Post Office Telecommunications,
- Much competition for the post. Got the job because of a joke.
- Forecasting telephone traffic in the London Telecommunications Region.
- Two forecast horizons: 7 years ahead and 30 years ahead. Both were unachievable.

The need for Statistics

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- I realised statistics would be useful
- I retook my exams and was awarded a pass degree in 1978.
- I started reading up on statistics in my spare time.

The erlang forecasts

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The forecasting/planning process as a whole was a mess and the resulting network was substantially over-engineered.

The erlang forecasts

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- The forecast horizon of 7 years arose from the 7-year time lag it took to commission an extension to a telephone exchange.
- Eventually management realised this and got the lead time down to 18 months, a timescale over which we could forecast with reasonable accuracy.

Moral: don't forecast if you don't have to. It's better to make the resulting response process more robust.

Move to the IT department

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- Promoted in 1980 and trained as a programmer.

Moral: This was important in my career and it's even more important now. Many business processes are implemented through the IT estate and if you can't talk the language of software engineers you won't get a seat at the table. You won't be able change anything.

An example of this is next...

MEMIS

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- In 1981 two statisticians turned up at our offices. Some of my colleagues were working with them on a project to build a marketing system and the statisticians were providing a module to do the sales forecasting.
- I button-holed them and introduced myself and made them explain the novel Bayesian method they were using, in some detail.

A Problem with the MEMIS forecasting algorithm

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- Preliminary tests with it running it with data from just one of our 10 regions took an hour.
- It was supposed to run for all 10 regions in a 2-hour batch slot.
- I knew how to fix it (and I was the only one).

MEMIS

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- I was assigned to the project team, with the brief to rewrite the forecasting program in Fortran and make it run 10 times faster.
- I rewrote it and it ran 60 times faster, to much acclaim.
- The statisticians immediately had me seconded to their Unit for the next two years. I made several friends, and they helped me get a permanent job there, as an Assistant Statistician.

- I worked in the Management Science Consultancy Unit (MSCU) for 9 years, doing a wide variety of short-term consulting jobs. BT was privatised in 1984 and there was a lot of scope for improving that horrendously inefficient organisation.
- I talked my way onto a night-school MSc at the Polytechnic of Central London, in *Statistical Applications in Business and Government* and I graduated in 1993, with a degree from the newly-renamed University of Westminster.

Flat-rate phone call prices

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- I advised the marketing department about the implications of flat-rate tariffs
- No senior engineer would sign it off
- I collected a lot of data to show that the network was substantially over-engineered
- We got flat-rate tariffs across the whole day implemented, despite the engineer's objections.
- It did not cause any capacity problems

The death of MSCU

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- In 1995 the MSCU fell into the domain of a senior director who did not value having a stats and OR function in BT and he just wanted the head count, for his pet project.
- Most of the professional staff, including myself, were up in arms and left.
- The MSCU was abolished a year later.

Moral: The statistics profession was largely invisible, despite making a large contribution. It's on nobody's organisation chart and it was not valued by senior management.

Research department: The Data Mining Group

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- A fashionable buzzword for when computer scientists wanted to get into doing data analysis.
- I joined BT's research department, in the Data Mining Group and learned about the most fashionable area of computer science

Network engineering

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- Eventually, after 5 years the Data Mining Group was formally wound up, but I still had many customers for my data analysis skills.
- My subsequent managers saw the value of this and allowed me to continue doing statistical consulting from inside an engineering unit.

- Signed up for a PhD at Goldsmiths
- I wanted one in Statistics but BT wanted me to do one in Data Mining.
- The maths group moved to QMUL
- The PhD did not go well, but I ended up with an MPhil in 2007 in *Tree Models: a Bayesian Perspective*.
- This enabled me to have Chartered Statistician

The Cumulo Rates Appeal

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- In 1987 MSCU devised a sample-based method to estimate the value of Cu assets for the *BT Report and Accounts*
- In 1997, after MSCU had been wound up, the VOA challenged the estimation method and increased BT's rates from £150M per year to £300M in one go.
- BT took the VOA to the High Court and a high-powered legal team, led by a Law Lord, was assembled to fight the VOA assessment

The Cumulo Rates Appeal

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- I told the rates people the method was sound but they weren't happy about me representing BT in court
- I recommended we hire professor Vic Barnett, who had just retired from Head of Statistics at Nottingham university, to work with me and appear in court.
- Vic satisfied himself that I was correct that the methodology was sound and that the estimates were as accurate as I had stated them to be, and he agreed to appear in court to say so.
- Vic wrote a devastating critique of the VOA intended alternative approach, that was passed to the VOA.

The Cumulo Rates Appeal

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- The VOA gave up at the last minute and the court awarded BT £150M reduction in annual rates plus £250M back pay
- My General Manager emailed me to say that the FT was reporting that BT share price had gone up several points due a favourable court case!

Moral: The sampling fraction is not that important!

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- I suspect the perceived problem with BT's sampling approach was the fact that only 300 or so of BT's 5500 exchanges were sampled.
- This whole expensive process could have been nipped in the bud if the engineers had known more about stats.

Forecasting elements of the core network

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After the Cumulo court case in 2000 I was, in effect, 'Mr Statistics' in BT and was given wide latitude to do what I wanted for the rest of my career.

Forecasting traffic on the core network cable elements

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It was easy to see what going wrong with the forecasting.

- They were using 10 weeks' of data to forecast 26 weeks ahead,
- the data was pretty variable,
- the forecasting was done inside a spreadsheet, using the Excel TREND function.

Forecasting traffic on the core network cable elements

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- TREND() uses linear regression, which is very sensitive to outliers.
- Management thought the poor accuracy was caused by not including seasonality into the forecasts.
- I specified a new forecasting function as a plug-in replacement for TREND. A colleague programmed it in VBA as an Excel User Defined Function. Instead of using linear regression it used Holt's method and it worked very well.
- It saved BT £4M per year

Forecasting traffic on the core network cable elements

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Moral: Being able to plug the new forecasting technique into their spreadsheet as a plug-in replacement for TREND() made a big difference. No change to the workflow was needed.

Estimating cabinet to CPE distances

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- Broadband (BB) was provided by ADSL technology (i.e. copper lines), where bandwidth (speed) declines with cable length.
- To know which homes can have what BB speeds you need to know exchange-to-home distances

Estimating cabinet to CPE distances

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- BT's early record-keeping was not good and they don't know the exact path taken by each customer's line!
- A specific BB speed is now mentioned in the customer's contract and the line length should be known as accurately as possible.
- A low estimate will result in BB speed that does not meet the contract, and penalty charges.
- An estimate that is too high will result in unnecessary expenditure on cabinets, ducts and digging up roads.

Estimating cabinet to CPE distances

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- The PIPeR computer system looked at the nearby streets and constructs a hypothetical reasonable path and estimates the line length from that.
- Using recent survey data, I improved these estimates, and I showed that the distances are systematically shorter than had been assumed, so fewer cabinets were needed than had been assumed, with a saving of £20M.

Group HR and EDI

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- The Group HR director wanted to be sure that BT was being fair to our people of all sexes, ages, ethnicities, and part-timers and full timers, job-sharers, and which division of BT they were in.
- I was given anonymised data on all employees, along with their characteristics and their annual appraisal grade. I concentrated on the Very Good (VG) grade. .

Group HR and EDI

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- I produced a number of visualisations to illustrate the findings of my exploratory data analysis (EDA)
- I also did a logistic regression to predict the probability of an employee obtaining a VG grade, conditional on their individual characteristics: age, sex, ethnicity, full-time or part-time and which division of BT they were in. .

Group HR and EDI

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- A significant coefficient would indicate that some employees had better outcomes (positive coefficient) or worse (negative coefficient) associated with that attribute.
- Some statistically significant coefficients were found and guidance for managers was produced as a result.

The CFO and the Well Known Firm of Management Consultants

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- It was discovered that in one BT division some orders were being processed incorrectly and there was an accounting liability of unknown size.
- The CFO of the division commissioned work from a well-known firm of management consultants to estimate the liability.
- They chose to take a random sample of orders and use it to estimate the proportion of incorrectly-processed orders (and hence the liability) to an accuracy of ± 2 percentage points.
- Months afterwards the sample details were made available to the head of data science in BT's Research department, who is a friend of mine.

Group Finance and sampling

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- He contacted me and asked me to look it over.
- I told him that the sample size had been calculated wrongly and that the estimates were far less precise than they claimed to be.
- The sample size would have been correct if the sample had been a Simple Random Sample, but it was clear from the documentation that they took a random sample of *customers* and looked at all the orders made by the sample customers.
- This makes it a cluster sample, and the results will be less accurate, possibly much less. It was.

The future of the statistical profession

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- I have dealt with management consultants in the past and most of their consultants have an MBA and some basic knowledge of statistics.
- More importantly, they know how to recognise a problem beyond their knowledge and pass it on to their Chief Statistician.

The future of the statistical profession

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- These days the statistics profession seems to be invisible and something else has replaced it, called Data Analysis or Data Science.
- In this case the Chief of Data Analysis was an economist, but often it is someone with a background primarily in some aspect of computer science, such as Machine Learning.

Final comments

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- There are now many people with job titles to do with 'data analysis' or 'data science' who have a poor knowledge of statistics. Senior management are largely unaware of this issue and assume 'data science' covers all necessary skill sets and that they are recruiting the right people
- From the statisticians' point of view the new profession of Data Science has a few blind spots.
- A lot of people think forecasting is now just a question of plugging a well-respected forecasting algorithm, such as Microsoft's PROPHET, into the IT stack.
- There is widespread ignorance about certain specific topics, such as Design of Experiments and the theory around samples and surveys

The education of engineers

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- BT (and no doubt other companies) employ large numbers of 'engineers', who are either engineering graduates or computer science graduates. These engineers are then assumed to be fungible.
- These engineers, of both types, are now routinely presented with data, usually large quantities, that they are not trained to deal with in their degree courses
- They are intelligent people and they usually do sensible things but at best they have a very limited statistical toolset.
- Their knowledge of mathematics limits their ability to learn the details of stats/data analysis.
- Engineering grads can do algebra and calculus

The education of engineers

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- Computing grads are more limited, and both usually lack linear algebra
- Links between the engineering and statistics professions need to be strengthened

Shameless plug!

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- I will be continuing to do some stats consultancy
- Contact me at BFE Associates
- blaise@BFE-Associates.co.uk
- The website is currently under development
- 079 186 100 18

