SHOWING YOU'RE WORKING

A collection of case studies, detailing how former pupils have used Mathematics in their everyday lives

Mr Musto would like to thank former members of Kingswood School for giving up their time to answer his various letters and filling in the case study template so fully. Also, as a direct result of this initiative several members kindly offering to visit Kingswood and talk to the students.

The project has enjoyed the support of several national organisations since its inception; they include MEI and NCETM. In addition The More Maths Grads project have been keen to see this model rolled out on a national basis as well as being the platform to house the case studies on the national maths careers website (www.mathscareers.org.uk). The More Maths Grads Project is keen to promote Maths career case studies to encourage young people to see maths in the real world and Kingswood have been delighted to work in collaboration with them, and the other organisations.

Dear Kingswood Students;

This is a collection of experiences of former students of Kingswood, and hence people who have sat in your seats and studied the same subjects as you in years gone by.

The aim of the project is to give you the current students an insight into who might use Mathematics in their professional lives. If you focus solely on the occupations found in the booklet, they are diverse in nature. This I hope gives an indication that Mathematics is not just a subject needed as a prerequisite for such numerate professions as Accountancy, but is an integral part of some fascinating and (some might say) extremely unlikely careers.

Contents:

Name: Ben Allison
Dates at Kingswood School: 1987-1992

Please describe your current or former career.

Currently I am teaching 'special needs' maths and English in a state integrated secondary school in Northern Ireland.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Apart from the obvious; maths has to be presented to low ability classes in a relevant and accessible way. Most importantly it needs to be appropriate to the ability level that you are dealing with and what they are likely to want to use it for. This will be very different to your experience of maths.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Statistical analysis of results continues to be an important tool even with low ability pupils. We have looked at underachievement of boys and differences in results across the curriculum. As with all schools these days the department is charged with evaluating the school results and achievements when the external exam results are published.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to……develop base line ability to allow individual pupils to acquire much needed life skills through experiencing number related concepts in an appropriate way.

Name: John Botteley
Dates at Kingswood School: 1959 (Prior's Court) -1968

Please describe your current or former career.

I trained as a Junior school teacher, and taught for a year, but then went on to work in theatre. I started as a Stage Carpenter and Assistant Stage Manager, and worked my way up to my current career as a theatre Chief Executive. I have managed the Grand Theatre in Wolverhampton, the Alhambra Theatre in Bradford, and I am now Theatre Director of the 1000 seat Grand Opera House in Belfast.

Please give a short explanation of how you use (have used) mathematics in your professional life.

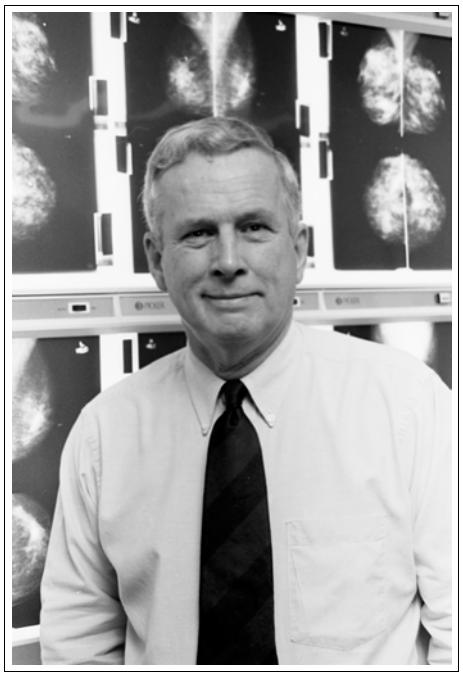
As Theatre Director I am responsible to a Board of Trustees for every part of the Theatre's operation. I use maths to calculate potential income from sales, including detailed calculations of how decreasing / increasing individual seat prices will affect potential earnings. I need to be able to understand complex financial reports produced by my Commercial Director, and present these to our Board. I manage budgets in excess of £5 million annually. However, I think the most benefit from having studied Maths for Science to A level, was that it developed my problem solving skills, and helped develop an analytical way of thinking.

Has mathematics helped you to resolve a problem in your workplace / environment? Please give a brief explanation with an example that you think the students would find thought provoking / interesting.

Shortly after leaving school I was a stage carpenter. We were asked to build a piece of scenery out of plywood which would sit in the centre of the stage. The piece was intended to represent the cowl of an air conditioning shaft in the centre of a factory yard. It was to be the place around which the characters congregated during their breaks. The designer of the play had designed everything on the set in perspective, so that building the cowl in perspective involved very complicated geometry, and the accurate interpretation of plans. Using skills gained from studying Maths for Science I was able to interpret the plans and build the cowl. Later the play was filmed by the BBC and they asked to use our cowl, as the BBC carpenters were unable to recreate it themselves.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to manage and monitor the financial success of the business I run. A good grounding in Mathematics has been of great importance in all stages of my career, and I have regularly used it from my early days in scenery design and construction, to my later career - budget setting and monitoring, doing financial deals with visiting theatre companies, calculation of VAT and Income Tax, statistical analysis of ticket sales.



Name: Norman Boyd
Dates at Kingswood School: 1952-58

Please describe your current or former career.
I work as a physician and research epidemiologist. After leaving Kingswood I graduated in medicine from Guy's Hospital Medical School, University of London, and did post-graduate training in medicine and hematology (blood diseases) in Canada, and research training in epidemiology at Yale University in the USA. I work at the Princess Margaret Hospital in Toronto, which is one of the largest cancer hospitals in North America. For some years I practiced clinical cancer medicine and did research as well. For the past 15 years I have focused entirely on research. I am currently a professor in the Departments of Medicine, Nutritional Sciences and Medical Biophysics at the University of Toronto and a Senior Scientist at the Campbell Family Institute for Breast Cancer Research.

Please give a short explanation of how you use (have used) mathematics in your professional life.

My research is concerned with the development of methods to prevent breast cancer Breast cancer is the second commonest cause of death from any cancer in women in most of the Western world, and the leading cause of death from all causes among women aged less than 50. Several factors have been identified that influence risk of the disease, including the characteristics of breast tissue on either mammography or histology, the number of pregnancies, alcohol, and body weight. There is also wide variation in the incidence of breast cancer between countries, indicating that environmental factors influence risk of the disease. Diet may be one of the factors in the environment that influences risk.

Our studies are concerned with the development of improved methods of recognizing breast tissue at increased risk of cancer, with understanding the relationship between these changes and other risk factors, including diet, and with exploiting this information in the prevention of breast cancer. This research involves making measurements in individuals, combining results from individuals into groups that can be compared, and making statistical comparisons between them that seek to identify the factors that may cause breast cancer.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

See attached paper (in appendix I) describing a recent application.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

To carry out research in epidemiology, mathematics, which is the basis of statistics, is needed to plan research studies and to determine what studies have found.

Name: Tudor Brown
Dates at Kingswood School: 1971-1976

Please describe your current or former career.

After Kingswood I went to Cambridge to study mainly Physics. But at Cambridge Physics is really Applied Maths and Maths is more like Philosophy (there was even the dreaded department of Applied Maths and Theoretical Physics for the very very bright people!). So after Part 1 (first 2 years) I switched to Electrical Sciences (Cambridge's answer to Electronics). But being Cambridge, Engineering was really Phsyiscs. So I essentially became an analog engineer taught by people who had invented Radar in the War. Not a big market for that in 1979, so I became an electronics engineer in a digital electronics company, knowing almost nothing about computer science or digital electronics. I soon taught myself- and designed lots of interesting bits of control electronics for nuclear reactors and nuclear fusion experiments. My analog training made me rather unusual as a "high speed" digital designer. Through a terrible accident I ended up moving back to Cambridge to design personal computers at Acorn, even though I have always had a serious dislike for computers. Graphics display controllers became my speciality (these are high speed devices) and then I became part of the company that created the ARM microprocessor which now powers virtually every mobile phone and many other consumer devices. I lead the engineering of that company for many years and then became the Chief Operating Officer in 2001, helping to grow the company to the 1700 people in 38 offices worldwide that it is today.

Please give a short explanation of how you use (have used) mathematics in your professional life.

High speed electronics includes solving many different types of equations - simple ones like resistor ratios to more complex ones to do with how much light is lost down a long fibre optic cable or how much peak current will be taken every time a computer switches (which happens hundreds of millions of times second). There is a close linkage between the physics to set up the situation and equation and actually solving the equations - I guess you call that applied maths!
How much does the filament in an electric heater cool down during each cycle of the mains (100 times a second)? If you are transmitting an ethernet signal by infra red LED between two buildings on a misty day, how powerful does the light source need to be? Share options - if you pay income tax now or capital gains tax later, when is the best time to sell your shares? Employment - if it costs a certain amount to fire someone now but if you wait a while you know they will leave, what is the cheapest solution for the company, taking into account all the factors?

To give students an idea of how important Mathematics is/was to your job please complete the sentence below.

I need Mathematics every day to solve fairly simple physics problems in my professional and home life.

Name: Elliott Collins
Dates at Kingswood School: 1999-2004

Please describe your current or former career.

Student at University of Leicester studying Physics with Space Science and Technology.

Please give a short explanation of how you use (have used) mathematics in your professional life.

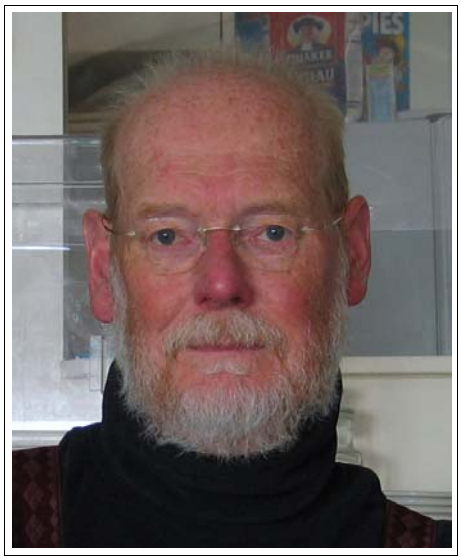
Used all the time in calculations. Specifically for use in space science, maths is essential for calculating spacecraft trajectories, rocket and engine design and efficiency and, for interplanetary spaceflight – in solving Newton's equations to plot a course through the solar system.

Has mathematics helped you to resolve a problem in your workplace/environment?

Physics obviously demands a high degree of maths, however it's very fulfilling, for me at least, in seeing how some of the higher level maths we were taught at Kingswood actually applies to real life situations. While the basic physics of nature is understood to a certain degree, maths is essential to explore more fundamental aspects of reality – from multiple dimension universes to black holes and exploding stars. Investigating the maths behind everyday occurrences can lead to startling results: did you know quantum mechanics suggests that nothing 'exists' for definite until someone looks at it? At a microscopic scale, if you've put something in a box, and close the box, then until you look at it again it could be on the bottom of the box, anywhere inside, or halfway to the moon – all of these things have a probability (however small) and until you open the box, the thing you put in there exists in ALL these places at once!

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day solve physics equations: plot spacecraft courses, design spacecraft, investigate electromagnetic waves, understand quantum mechanics, and about a hundred other things. If you ever wanted to know why the moon doesn't just spin into the Earth, or how likely it is that a black hole will suck us up at any moment – you need maths.



Name: Leslie Cram
Dates at Kingswood School: 1953-1959?

Please describe your current or former career.

Leslie Cram MA AMA FSA is retired from a career as a museum archaeological curator. His family roots are in England, on his father's side in railway and farming workers; on his mother's side in coalmining with emigrants to New Zealand and missionaries to Africa in the 19th century. His parents went out to work in China in the 1930s, his mother as a surgeon, his father as a missionary. They met and married out there and Leslie was born in Canada when the family's journey back to England was interrupted by the second world war. He studied Old Stone Age archaeology at Cambridge University and subsequently worked in museums as an archaeological curator.
He has published over 30 articles on animal remains.
1975, Osteo-archaeology in Oceania in CLASON A T (ed.) including Dogs Through Time: An Archaeological Perspective, Proceedings of the 1st ICAZ Symposium on the History of the Domestic Dog, Oxford, British Archaeological Reports International Series 889, 171-180, Foot impressed tiles in FULFORD M and J TIMBY, Late Iron Age and Roman Silchester : excavations on the site of the Forum-Basilica, 1977, 1980-86, Proceedings of the 9th International Council of Archaeozoology, Durham, August 2002, Oxford Oxbow Books, 159-166.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Making study of the past available to all by use of statistics which anyone can apply to the material, rather than depending upon the judgement of an expert.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes. How big were Roman dogs. Height at the shoulder can be found by measuring a long bone such as the femur (upper leg bone) and using a formula already in existence, or by measuring the width of the track left by the foot of a dog in the wet bricks and tiles of Roman times before they were fired and then used in buildings. I went to a dog kennels with slabs of wet clay and got the dogs to walk over the clay and leave me their paw prints and then measured the height of the dog at the shoulder. Some Roman dogs were the size of a Pekinese, some approaching wolf size. Of course the largest bones could be of wolf but there is no way that wolves wandered over drying tiles.
Published in Leslie Cram, 2000, Varieties of dog in Roman Britain in S J CROCKFORD (ed.), Dogs Through Time: An Archaeological Perspective

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics when doing research to…make study of the past available to all by use of statistics which anyone can apply to the material, rather than depending upon the judgement of an expert.

Name: Alasdair Dawson
Dates at Kingswood School: 1989ish?-1995

Please describe your current or former career.

I'm currently an Army Officer serving with the Royal Engineers (an odd choice for someone who can barely count). Whilst serving in Germany as a Troop Commander I was responsible for 30 or so soldiers in Barracks and on Operations in Bosnia and Iraq, during which time we helped shut down Basrah for the January 2005 elections; for three blissful days there was no mortaring, suicide vehicle bombs or shooting. It was a thankfully bloodless election.
More recently I have been training to be a Bomb Disposal Operator and serve with 33 Engineer Regiment (Explosive Ordnance Disposal) just to the South of Cambridge where I'm employed to plan and execute Operations on the UK mainland (German World War II bombs) and further a-field in Afghanistan and Iraq.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Everything to do with Military Engineering uses maths, not necessarily exact maths but certainly rule of thumb stuff. For example, to bring down a bridge explosively you need to know how much 'bang' it will take to shatter or cut a steel beam of a certain thickness: a 23g stick of plastic explosive (which detonates to produce 2-3 million psi) will shatter about 4-6mm of steel. You can increase the effect of explosives by using shaped charges (4-5 million psi), these are copper cones which once explosively inverted form a plasma jet cutting far more steel than just explosives alone. Therefore the amount and type of explosive required will depend on the thickness and construction of the bridge. Military Engineering is not just about making things disappear in a puff of smoke, it's about building and providing support to others, civilian and military alike. After the earthquakes in Pakistan last year some of the only people who could get to the remote mountain regions were Army Engineers. There they built basic shelters out of corrugated iron and wood – they would have had to calculate wind loading factors for their shelters to ensure they would withstand the harsh mountain conditions. We can also supply water. The calculations for the water supply equipment are quite mind blowing and are all based on planning assumptions like how much water a pump can suck up, how long it takes special chemicals to purify a tank of water and what the end delivery rate would be. You then need to see if this rate matches with what you have been told to supply and if it does not you then need to rework the process to produce more.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes, although a lot of what we do is planning for a worst case so here's one below:

If a 1000kg bomb detonates in Bath City centre how much damage would it do and where?

A bomb produces three effects, blast (the high explosive detonating) fragmentation (both primary, from the bomb casing and secondary from anything the blast wave picks up) and earth shock (the crater).

The blast wave travels at approximately 5000-9000 meters / second and does slow down over time, it is also reflected just like any other wave, so if it went off in Milsom St, the shops there would be wrecked as would be the ones on George St but the Circus might be OK as would the Pig and Fiddle Pub on Bond St as they are protected by other buildings and the blast wave is channelled away from them.

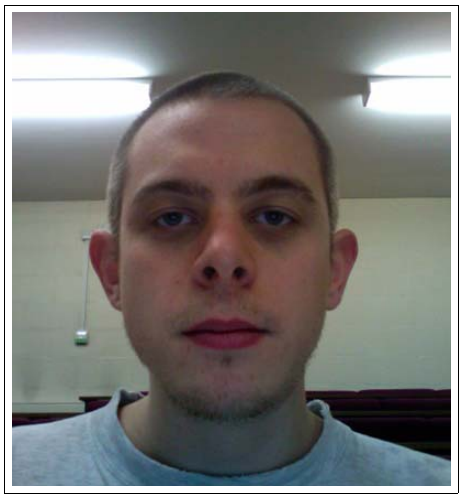
Fragmentation will follow a blast wave and has exactly the same effect as bits of flying debris picked up by tornadoes and violent weather. It pockmarks walls, smashes windows and along with the blast wave helps bring down buildings and punctures gas mains, it also cuts into people. There are some examples of the effects of fragmentation from WWII in Bath just near the Cross Baths and towards the Hob Goblin pub.

Earth shock is the most localised effect, bearing in mind that a small anti-tank mine weighing 8kg will produce a crater of about 2m wide and 1m deep, how big could a 1000kg bomb crater be and what damage would it do to underground services and any tunnels or foundations?

With the three effects taken into account and with planning data we can work out the actual distance to which people should be evacuated to and it's always HUGE! This causes a large headache for the emergency services who actually have to carry out the evacuation. None of this planning data would be available to us if it was not for maths.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to work out how to protect people from the effects of explosions. Although we rather the thing didn't go bang in the first place…



Name: James Drake
Dates at Kingswood School: 2002-2004

Please describe your current or former career.

I'm at university but currently on my placement year, working for a location recording company, but not news or sport, we record music. If you watch something like Reading festival on TV then we balance the sound of the music so it's nice (like the band's album).

Please give a short explanation of how you use (have used) mathematics in your professional life.

Well, the theory side of how gear works is of course highly mathematical, Bessel is the man to quote, and the theory of how digital audio works is similarly complex (literally),. Fourier is the man. However, when it comes to actually working, it's sort of up to you how much you really think about how and why the gear is working. To get the job done on a daily basis is more about work related things like client relations, it's a service industry. But then again the theory is sort of implied so maybe you wouldn't be able to get everything working without knowing how it works, even though you don't sit there doing sums before plugging everything up. There's a lot of logic type thinking that has to happen, we have this amount of gear, this amount of time, we have to be in these different towns on the right day and deliver the final product at the end of gig. How are we going to make this happen? I guess that's more like decision maths…

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes. Again, it's all sort of implied. Each action taken to solve a given problem may not involve any direct sums or calculations, but it will use assumptions that you take as being certain due to experience of an earlier, similar problem. The earlier problem may have been solved, again, using assumptions derived from pervious experiences. And those previous experiences may have actually been you sitting down doing a calculation when you were bored. Our job is problem solving. Once the problem is solved then the gig will happen. I'm sure the students will find that interesting. Did they go to a gig at the weekend, see their favourite indie band in a smelly club or their super-star heros at Wembley? Do they realise how many man-hours and brain-hours went into making that happen? Then think about the thought involved in getting that gig from the venue and into your living room on the telly.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to work because otherwise there would be no mains electricity and batteries can only work for so long.

Name: Guy Dunscombe
Dates at Kingswood School: 1995-2000

Please describe your current or former career.

I currently work for Mott MacDonald, a multidisciplinary design consultancy, as a bridge engineer. My job primarily consists of the assessment and design of rail, road and pedestrian bridges.

Please give a short explanation of how you use (have used) mathematics in your professional life.

To say mathematics is key as an engineer in an understatement! The complete deign process is underpinned by maths of all different levels from the calculation of dead loads to the Finite Element Analysis of complete bridge structures. As well as this project programming, accounts and project management all involve mathematics.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes…… Every day!!!!!!!!!!!!

In appendix II is a very simple example of the calculation of the dead weight of a bridge deck to enable a crane to lift it into place to be specified.

Note that the factors of safety provide a degree of flexibility to account for problems and variation in the design and lifting process.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to..... plan, manage and undertake the design and assessment of a wide range of structures.

Name: Louise Forbes
Dates at Kingswood School: 1990-95

Please describe your current or former career.

I am a solicitor. I work for a large international practice and I specialise in insurance and reinsurance law. Historically I have worked in litigation and arbitration (basically I represent clients who wish to sue other companies/individuals and defend clients who have been sued). My current practice is however commercial contract work (reviewing and negotiating various commercial contracts). I am involved in insurance issues which emanate from corporate deals. I trained (degree, post-graduate year and training contract) and then qualified straight into insurance and reinsurance

Please give a short explanation of how you use (have used) mathematics in your professional life.

Insurance and reinsurance is placed with insurers and reinsurers in a number of ways (on a quota share or straight percentage basis, on an excess basis – for example an insurer may agree to provide 15% of cover of £40million pounds for losses over £10million and the appropriate remuneration will usually be expressed as a percentage of the cover) and there are a huge number of variations involved. We may have to examine arrangements retrospectively or in advance of a contract to determine how a contract should have worked or does work.. We also deal with maths when working out bills, court costs, settlement agreements and when working out payment mechanisms in contracts. Also maths is important so that you can request expenses accurately!

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes. I use maths constantly on settlements. A client and the party that they are in dispute with may not be able to agree a settlement because of a difference of 250,000 pounds. Sometimes in the overall scheme this amount is small when looked at as a percentage. Generally the professionals I serve are very clued up on figures so it is more often the case that they come to me with figures.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to understand the contracts I review and investigate my clients' disputes. I also need maths every day to ensure that time sheets, invoices and expenses are kept up to date.

Name: Dominic Fielden [dominic@rockymountainflatbread.ca]

http://www.rockymountainflatbread.ca/revolutionize/founders.html

Please describe your current or former career.

I'm the co-owner of a restaurant and manufacturing company. So far we have two organic pizza restaurants and are franchising next year. Previously I was a partner in a change management consultancy company.

Please give a short explanation of how you use (have used) mathematics in your professional life.

I use maths everyday. as a business owner I have to do everything from daily sales/cost evaluation to business strategy. The restaurant and food manufacturing business is high volume low sales and therefore margins are fine. What's important is managing your gross profit (sales-cost of sale). Cost of sale is food, drink and cleaning supplies and packaging. A good business will have a gross profit of between 60-65%. From that you take off rent, operating expenses, labour and depreciation and eventually end up with your pre-tax profit. It's all about managing clear and defined ratios. Although our micros point of sale computer works out most of this for me, without maths you have no way of interpreting the data and making good business decisions from it.

Has mathematics helped you to resolve a problem in your workplace/environment?

Again, everyday we have forty staff and one or more will make a mistake at some time during the day and that will need to be resolved. Normally around inputing information into the pos system.

If Yes please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Here's a simple one. There is a table of 6 people and they want the bill split 6 ways but each of them want to put a separate tip on. the first wants to put 10%, second 11%, third 12% and so on until the last one puts 16%. The bill is $187 + vat of 6%. What does each person put on their credit card.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need (or needed) Mathematics every day to…make sure we are making money from every transaction we do. And if we are not making money, work out how to correct that for the next transactions.

Name: Guy Hinchley
Dates at Kingswood School: 1971-1978

Please describe your current or former career.

I studied law at University College London and qualified as a solicitor. I have worked for most of my career at Mills & Reeve, which is a 78 partner 700 employee UK top 50 law firm in Birmingham, Cambridge, Norwich, and London. I was a commercial property partner from 1990 to 2001, have been managing partner of our Birmingham office since 2001 and will be national managing partner from 1 March 2007.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Solicitors have to pass an accounts exam as part of the qualification process. The course and exam is straightforward for those who have studied maths to A level. As a commercial property lawyer I worked on complex documents relating to development projects. Deals are often done to share future development value, or "uplift" or "overage". The sharing of this profit is contingent and is usually best expressed in mathematical formula, rather than words. Those lawyers who can only express themselves in words struggle to elegantly and effectively express the overage arrangements, or even to understand them. As a manager of a business I need to set and approve budgets, deal with capitalisation and cash flow and analyse performance against benchmarks. We use statistics, percentages, and maths in this process. Our performance as a business is usually measured numerically.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes. Many drafting issues in property development and letting documents

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to measure our business, understand how it is working, monitor trends and under or exceptional performance……

Name: Professor Chris Lawn
Dates at Kingswood School: 1957-1963

Please describe your current or former career.

I spent nearly 30 years in industrial research, mostly with the Central Electricity Generating Board, originally at their Berkeley Nuclear Labs in Gloucestershire, and then at Marchwood on Southampton Water. When Mrs Thatcher decided to smash up that organisation, I became the Research Manager for PowerGen for three years and then Head of Advanced Engineering for Rolls-Royce Aerospace for four. At that point I decided I wanted to get back to my own research and took up my current position, nearly 12 years ago, as Professor of Thermofluids Engineering at Queen Mary, University of London.

Please give a short explanation of how you use (have used) mathematics in your professional life.

The theoretical core of engineering research is, of course, mathematical. In particular, the solution of differential equations is part of constructing a 'mathematical model'. Therefore, I have used maths fairly intensively throughout my career, apart from a middle period when the tasks were primarily managerial. I now struggle to teach Dynamics to first-year students, who don't appear to start from where I think they should! (I should be interested to have the perspective of another high-grade school.)

Has mathematics helped you to resolve a problem in your workplace/environment?

Many problems. One of my current interests relates to the large 'industrial' gas turbines that are being used increasingly to generate power. A persistent problem has been the generation of high intensities of sound by the flames in the combustion chamber. These can resonate in the system and produce vibrations of the turbine blades that are potentially damaging. By solving the equations describing the propagation of acoustic waves, together with ones describing the processes of interaction with the flames, we are able to predict the frequencies of excitation, and suggest remedial measures.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to.....describe the engineering processes that I am researching, so that improved designs of equipment can be suggested. (And to teach the next generation of engineers!)

Name: Tony Law
Dates at Kingswood School: 1960-65

Please describe your current or former career.

A period in earth science research including learning the principles and practice of regression analysis to fit Gaussian or Lorentzian curves to spectra, and some statistics to handle the likelihood of a converged fit being the correct model.
Seven years starting in IT in one of the London University computer services, mainly running short courses but also programming computer graphics and other packages, and learning a variety of programming languages.
Eleven years in IT at BP Exploration, the last several in the Research Centre working collaboratively with other companies and Imperial College.
Finally over 14 years at GlaxoSmithKline (formerly SmithKline Beecham) managing external information services and emerging technology awareness.

Please give a short explanation of how you use (have used) mathematics in your professional life.

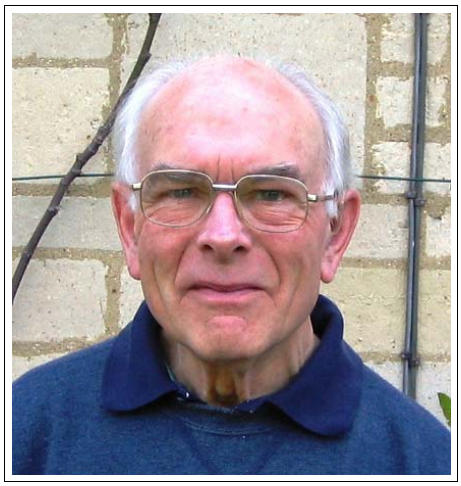
1 - over many years, using curve-fitting regression analysts and statistics (as above).
2 - over the last five years, since GSK was formed at merger, the IT department has progressively developed its use of Six Sigma methodologies for process analysis and improvement. These are statistically based although some liberties are taken with normal distribution and some other concepts to create practical tools. Originally a technique for reducing defects in manufacturing, it is gaining a lot of ground in services particularly IT.
There's lots of information at http://www.isixsigma.com/

Has mathematics helped you to resolve a problem in your workplace/environment? If Yes please give a brief explanation with an example that you think the students would find thought provoking/interesting.

See (2) above; there are many quotable examples of analysing the natural variability of processes, criteria for determining if the process has changed, and demonstrating improvements.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to manage and improve the services I deliver to my customers in the business.



Name: Professor Ian Maxwell Leck
Dates at Kingswood School: 1941-1949 (including 2 years at Prior's Court)

Please describe your current or former career.

MB ChB, PhD, DSc Birmingham; MSc (ex officio) Manchester; FRCP; FFPH
Academic epidemiologist (at medical schools of Birmingham University, University College Hospital (London), and Manchester University); retired as Professor of Epidemiology and appointed Professor Emeritus at Manchester in 1991. Main achievement since then was co-editing and contributing to the second edition of "Antenatal and Neonatal Screening" (OUP 2000) which won first prize in Public Health Section of BMA Medical Book Competition, 2001.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Used statistical methods to analyse data (including assessment of significance/confidence intervals) throughout academic career, mainly in studies of the distribution and determinants of birth defects and some cancers. Taught statistical methods to medical students for a few years in the 1960s, and epidemiological methods to postgraduate public health students from about 1970 to 1990.

Has mathematics helped you to resolve a problem in your workplace/environment? If Yes please give a brief explanation with an example that you think the students would find thought provoking/interesting.

One example of the many problems that I approached using maths or statistics was the relative importance of genetic differences and differences in the environment before birth in causing birth defects (e.g. neural tube defects such as anencephaly and spina bifida). Many defects are much commoner in some ethnic groups than in others, so one of the approaches I used was to look at the frequency of these defects in children whose parents were of different ethnic groups. If the frequency of such a defect in children of mixed parentage is about half way between its frequency in the mother's ethnic group and in the father's, this suggests a genetic explanation for the difference between the two parental frequencies. If on the other hand the frequency of a defect in children of mixed parentage is much more like its frequency in the mother's ethnic group than in the father's, it suggests that differences in prenatal environment between the two groups may account for them differing in frequency.

I therefore calculated the frequency of different defects in children of various ethnic groups and in the offspring of matings between these groups during a 25-year period in Birmingham, and used tests of statistical significance in assessing which differences between ethnic groups appeared more likely to be of genetic and which of environmental origin. The results suggested that, for example, genetic factors were mainly responsible for neural tube defects being several times as common in white infants as in Afro-Caribbeans. On the other hand, within the white group these defects were over 50% more common in infants with Irish parents than in those of British parentage; and the figures for those of mixed parentage suggested that *this* difference was more likely to be due to environmental factors (e.g. mother's diet during pregnancy).
Reference: Birth prevalence of malformations in the members of different ethnic groups and in the offspring of matings between them, in Birmingham, England (Leck I, Lancashire R J). **Journal of Epidemiology and Community Health** 1995; **49:** 171-179.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.
I need Mathematics every day to use statistical methods throughout my epidemiological research work, which I found the most satisfying part of my career and without which I could not have progressed in that career.

Name: John Marsham
Dates at Kingswood School: 1993-2000

Please describe your current or former career.

Research meteorologist/cloud physicist (university based).

Please give a short explanation of how you use (have used) mathematics in your professional life.

There are many unanswered questions about clouds, which are important for our predictions of both weather and climate change – we don't even understand how rain forms yet! Answering such questions makes use of computer simulations, field observations and laboratory experiments. Maths is essential for designing/running the models, processing data, interpreting the results and understanding how (in)accurate you expect your answers to be!

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Recently, climate change has pushed atmospheric science onto the front pages of newspapers on a regular basis. The models used for climate prediction are essentially the same as those used predicting the weather – using large computers these models solve the equations which control the flow of air within the atmosphere. Solving these equations and finding ways to calculate the effects of solar heating, clouds, mountains, turbulence etc requires a lot of maths (the effects of clouds is now the largest uncertainty in climate change). I really enjoy applying mathematics to these processes that you see every day out of the window.

I am currently working on why summertime storms happen when and where they do – we are currently not very good at predicting them! There was an international field campaign in England in 2005 (a similar one took place in the USA in 2002 and another will take place in Germany in 2007). These results show, for example, that on one day one storm created waves that propagated through the atmosphere – and that these waves initiated further storms downwind of the original one. We found this using both computer models and observations from radars, satellites, balloons and surface instruments. We now know that it can be important for weather forecasting models to represent these waves. Other experiments have shown that the dramatic Boscastle flood in Cornwall in 2004 was actually (using modern computers) relatively predictable!

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to analyse data from field campaigns and computer models, and understand how the atmosphere works. Most atmospheric scientists did maths, physics or chemistry degrees at university. It is increasingly hard to find graduates with the fundamental mathematical skills – especially as people are tending to do more applied degree subjects. If you do a maths degree you are very valuable to many employers – they will be happy to train you in the details of whatever they want you to do. It's much easier for you to learn those details than it is for a non-mathematician to learn the maths!

Name: Nicholas Mills
Dates at Kingswood School: 1979-84

Please describe your current or former career.

Specialist Charge Nurse on the Children's Intensive Care Unit in Europe's largest Hospital. 19 years of nursing in various forms of Intensive Care.

Please give a short explanation of how you use (have used) mathematics in your professional life.

During the course of our work we observe and record many data. These then need analysing and presenting. This can involve anything from simple plotting of graphs to complex calculations.
For instance, drug doses in particular need careful calculation to take account of body weight, surface area, rates of uptake and/ or elimination. This helps ensure effective dosage without undue side-effects or toxicity.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Drugs used in resuscitation need doses specific to a child's weight. These need calculating quickly yet accurately. This is a potential source of stress and delay at any resuscitation. I designed and introduced a simple spreadsheet that calculates resuscitation drug doses for all drugs concerned by doing nothing more than entering the child's weight. I'm glad to say now in frequent use and on its fourth edition.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to observe, assess, process and analyse biochemical data. This is a vital part of intensive care.

Name: Mark Alan Nelson
Dates at Kingswood School: 1995-1997

Please describe your current or former career.

I am working as a contract geologist in a small consulting firm.

Please give a short explanation of how you use (have used) mathematics in your professional life.

I have used simple statistics and trigonometry. Trig is used to plot diamond drill holes in 3D space and determine the true thickness of lithological units.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Stats are used to find anomalies in gridded data – we collect 200 soil samples in a grid and analyse each sample for 10 elements of interest and then use percentiles and standard deviation to determine which samples have anomalous elemental abundances.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every week/month to calculate budgets for drill projects worth C$ 3,000,000 and to determine where the next mine might be in British Columbia.

Name: Alastair Page
Dates at Kingswood School: 1987-1996

Please describe your current or former career.

My job title is operations analysis: I work for National rail enquires which is government regulated information service for the national rail network. My role incorporates 3 main responsibilities within a team of 20 people. The first is manage the operations side of the contact we have with 2 companies to supply 4 call centre's to answer calls from the famous number 08457484950.
The 2nd role is to manage the Call routing platform to deliver the calls to the right place at the right time. And the 3rd is analyse statistics both from the call centres and our other information channels like the website in order to increase productivity, forecast future volumes and improve our service through trends in the user's activities.

Please give a short explanation of how you use (have used) mathematics in your professional life.

I could not do my job without the use of excel. I use complex formulas to work out trends within data, work out forecasts and variances and use percentages, benchmarks to measure performance and service level agreements.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Statistics are very important. In meetings where we are debating the best course of action, the data presented often shows you the right path to take.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to…… show me how my suppliers are performing. As in most industries business is driven by money. And we have service level agreements in place to make sure they perform to the standard expected, if they don't then they don't get paid. So these levels are PCA, AHT and ASA. PCA is the percentage of calls answered (calls offered to the call centres / calls answered) there target is 95%. AHT is Average handle time and ASA is there average speed to answer.

Name: Ben Raskin
Dates at Kingswood School: 1982-1987

Please describe your current or former career.

I have a degree in Ancient History and qualifications in horticulture. I have worked among other things in catering and horticulture. I was previously commercial manager at Welsh College of Horticulture, an organic agricultural advisor for the Soil Association, and I am now Horticultural Development Manager, and self employed trainer/consultant.

Please give a short explanation of how you use (have used) mathematics in your professional life.

I have used it in many aspects of practical horticulture, including measuring areas and right angles, rates of seed / fertiliser application.

Also have used arithmetic in account management, as well as mental arithmetic on market stall.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes I use maths to resolve problems on a regular if not daily basis.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

Mathematics makes all things possible, without it nothing adds up and you will never achieve what you want to achieve.

Name: Paul Roebuck (Dr)
Dates at Kingswood School: 1949-57 (first 2 years at Priors Court)

Please describe your current or former career.

Started life as an assistant Chemistry master at Nottingham High School (roughly equivalent to a day school version of KS, even down to the 1850s buildings) and ended up as Nottingham Trent University as HoD i/c Timetabling and Space Management. (Also sat as one of the 6 permanent members of the HEFCE's standing committee on Space Management in HE.) I did 5 years in Secondary Education before going to Nottingham College of Education as a chemistry tutor. By staying at the one place and going though a merger and three name changes, I did a complete career change (slowly) in house.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Apart from the day-to-day use of mathematics in chemistry I also used it extensively in timetabling, and especially in Space Norms to control Space Management in HE.

Has mathematics helped you to resolve a problem in your workplace/environment?

Yes ~ see above.

Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

Probably the work I was involved in HE had an indirect impact on students rather than ensuring that student's directly learnt anything. For instance we (HEFCE committee) devised an allocation norm of
5 m2 per student in science and engineering, graded down through Art & Design, Geography, etc., to 1 m2 for traditional arts subjects. Back in one's own institution it was a highly political rôle and did not make many friends (But the KS tradition of being even-handed did win respect.)

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I needed Mathematics every day to function at all. Any reputable scientist needs maths all the time; my brain works firstly as a chemist, even if I'm in church! But maths underpins it all.
I retired in 1994 and am now largely out of touch with school and student life and needs.

Name: Philip Sweetenham
Dates at Kingswood School: 1973-1980

Please describe your current or former career.

My current job is as a programme director, overseeing the installing and running of computer systems to calculate banks' credit exposure. A typical system calculates a bank's exposure to each counterparty, in the event that the counterparty is unable to fulfil its obligations. The exposure is updated in real time for 300 000 trading positions, with several thousand new trades each day.

Please give a short explanation of how you use (have used) mathematics in your professional life.

Quite advanced mathematics (probability distributions and calculus) is fundamental to working out the value of each trade and how that value may change as the market (currency exchange rates, interest rates and share prices) changes in the future.

Has mathematics helped you to resolve a problem in your workplace/environment? Please give a brief explanation with an example that you think the students would find thought provoking/interesting.

In 1987 there was a serious fire at the Kings Cross underground station in London. Following the fire, investigators were unable to explain why the fire had changed so rapidly from a very minor fire (on an escalator) which people walked past with little worry, to a major problem that shot up the escalator faster than someone could run away from and then killed several people in the booking hall above. My colleagues and I (at Harwell Laboratory) ran a computer simulation of the fire and showed, to the fire brigade's surprise, that as a fire in a sloping tunnel grows, at some point the tunnel starts to act like a chimney and the fire then sucks in air from below and suddenly rushes up the tunnel. These results were initially doubted by the experts in fire safety, but were later confirmed by experiments run by the UK Health and Safety Executive.

To give students an idea of how important Mathematics is/was to your job please complete the sentences below.

I need Mathematics every day to work out my customers' risks and hence keep them trading; without such mathematics, the current banking system would not work. A failure of banking system would, amongst many other problems, make it far harder for people to buy houses.

Name: Keith M. Treves-Brown
Dates at Kingswood School: 1947-1953

Please describe your current or former career.

Graduated VetMB (Cantab), MRCVS in 1961. Spent just over a year in agricultural veterinary practice in East Anglia. 23 years in the veterinary division of The Wellcome Foundation Ltd., during which I travelled abroad frequently, visiting a total of 22 different countries. In 1985 entered the Civil Service in that section of MAFF which licensed the sale of animal medicines under the Medicines Act 1968. In 1991 given specific responsibility for medicines for (farmed) fish. Retired at the end of 1994 and wrote a book, Applied Fish Pharmacology, publ. Kluwer Academic Publishers 2000. Still a member of the Council of the British Veterinary Association, and involved in policy on animal medicines.

Please give a short explanation of how you use (have used) mathematics in your professional life.

For a medicine to be licensed the applicant pharmaceutical company has to provide scientific data on Quality, Safety and Efficacy. Safety includes safety to the animal treated, safety to the person administering the medicine, safety to the environment and, in the case of food-producing animals, safety to the consumer.

Efficacy is normally shown by a statistical comparison of a group ('cohort') of animals given the new medicine and a cohort of animals either untreated, given a placebo or given the currently accepted treatment. Applicant companies would normally have employed a professional statistician to help design their trials.

Safety to the consumer is more complicated (for me!). The first (non-mathematical) stage is to establish the maximum residue level (MRL) in food acceptable for human consumption. This parameter is determined on toxicological grounds and may be different not only for each (pharmacologically) active ingredient but for each edible tissue. You then give the recommended course of treatment to a large number of animals, slaughter cohorts at intervals afterwards, and analyse the edible tissues for active ingredient. The aim is to establish the time after treatment (the "withdrawal period") at which all edible tissues are below the MRL. Here maths is important.

For small food-producing animals, e.g. poultry and fish, the cohort is normally ten animals, and they produce widely varying results. A mean and standard deviation (n-1) is calculated for the residue concentration in each edible tissue at each time point. On grounds of biochemical theory it is assumed that the rate of residue depletion in any one tissue is proportional to concentration; $-d[R]/dt = k[R]$, if that doesn't make a mathematician cringe. It means that a plot of log residue concentration against time ought to be a straight line. It is not actually a line at all so regression has to be applied. If you apply this procedure to the means the line cuts the MRL axis at the time when the concentrations in the tissues of only half the animals are below the MRL. If the plot is actually made of 2 SDs above the mean at each time point, the withdrawal period so calculated ensures that the tissues of 95% of animals are below the MRL, and those of the remaining 5% are only just above the MRL.

Appendix I

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original article

Mammographic Density and the Risk and Detection of Breast Cancer

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Abstr act

Background

Extensive mammographic density is associated with an increased risk of breast cancer and makes the detection of cancer by mammography difficult, but the influence of density on risk according to method of cancer detection is unknown.

Methods

We carried out three nested case–control studies in screened populations with 1112 matched case–control pairs. We examined the association of the measured percentage of density in the baseline mammogram with risk of breast cancer, according to method of cancer detection, time since the initiation of screening, and age.

Results

As compared with women with density in less than 10% of the mammogram, women with density in 75% or more had an increased risk of breast cancer (odds ratio, 4.7; 95% confidence interval [CI], 3.0 to 7.4), whether detected by screening (odds ratio, 3.5; 95% CI, 2.0 to 6.2) or less than 12 months after a negative screening examination (odds ratio, 17.8; 95% CI, 4.8 to 65.9). Increased risk of breast cancer, whether detected by screening or other means, persisted for at least 8 years after study entry and was greater in younger than in older women. For women younger than the median age of 56 years, 26% of all breast cancers and 50% of cancers detected less than 12 months after a negative screening test were attributable to density in 50% or more of the mammogram.

Conclusions

Extensive mammographic density is strongly associated with the risk of breast cancer detected by screening or between screening tests. A substantial fraction of breast cancers can be attributed to this risk factor.

Appendix II

Project		
Maths in Engineering		Mott MacDonald
Calculations for: Kingswood School Bath	Drw/Dept: BRG	Job No/File No:
	Calculated by: G.C.D	Date: Feb 2007
	Checked by:	Date:
		Sheet No: 2 of 3

X Sectional Area of Deck;

1× Bottom Flange = 3000mm × 125mm
= 375,000mm²

2× Web = 2(1385mm × 25mm)
= 69,250mm²

2× Top Flange = 2(730mm × 80mm)
= 36,800mm²

∴ Total deck X-Sectional Area
= 375,000mm² + 69,250mm² + 36,800mm²
= 481,050mm²

And based on a Deck Length of 19,570mm

Total Volume of Steel = 481,050mm² × 19,570mm
≃ 9,414,000,000 mm³
= 9.414 m³

Multiply this by 1.1 (10%) to account for welds, stiffeners etc

∴ 9.414m³ × 1.1 = 10.34m³